Reef

Report to Governments on actions necessary for dugong conservation in the Great Barrier Reef and Hervey Bay/Great Sandy Strait

Great Barrier Reef Marine Park Authority

(7 March 1997)

** This report has been prepared in cooperation with other Commonwealth and Queensland government agencies but does not necessarily represent their views. Extensive consultation with non-government stakeholders and interest groups has also occurred.

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EXECUTIVE SUMMARY

Surveys indicate that, while dugong populations appear to be stable in the Far Northern Great Barrier Reef (GBR), the populations have declined in the southern Great Barrier Reef and the adjacent Hervey Bay by over 50% in the period between 1986-87 and 1994. The maximum loss from unnatural causes that could be sustained by the dugong population in the southern GBR and still allow the population to recover could be as few as 3.3 dugongs per annum, and in Hervey Bay 1.6 dugongs per annum (H. Marsh, personal communication). The corresponding figure for the Far Northern Section of the Great Barrier Reef is between 105 and 162 dugongs per annum. Carcass reports during 1996 indicate that human related deaths are continuing at unsustainable levels in the southern Great Barrier Reef and Hervey Bay.

The Great Barrier Reef Ministerial Council has directed the Great Barrier Reef Marine Park Authority (GBRMPA) to report on actions necessary for dugong conservation in the Great Barrier Reef and Hervey Bay/Great Sandy Strait.

In particular, the Ministerial Council asked that the report address actions *'necessary to ensure no further dugong mortality occurs as a result of commercial and recreational fishing practices '* in Interim Dugong Protection Areas (DPAs), with the objective *'that fishing practices that may result in dugong mortality will not be permitted in those areas.* Council also asked that the report address other activities that adversely affect dugong populations in the GBR and Hervey Bay/Great Sandy Strait region, as well as the appropriateness of the Interim DPA boundaries and any requirement for additional DPAs.

In the area under review, the three significant human activities that directly contribute to the reduction in dugong numbers are commercial fishing with mesh nets, indigenous hunting, and illegal take. Practical steps can be taken for each in the short-to-medium term to reduce their risk to dugongs. Widespread seagrass loss is a fourth issue of major concern in the Hervey Bay region. Within the GBR it is not an issue to the same extent. Impacts on seagrasses appear to be localised, although land-use practices and coastal management require careful attention to minimise adverse impacts (see report # 24).

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Mesh netting : By their design and method of setting, four major categories of mesh nets represent a risk to dugongs : offshore set, foreshore set, river set and drift nets (see report #19). However, in its report on measures to address the risk of nets to dugongs, the Queensland Commercial Fishermen's Organisation (QCFO) proposes changes only to offshore and limited foreshore net operations in the Interim DPAs (see report #1). Changes to river set and drift nets are not proposed as fishers do not consider them a risk to dugongs. Carcass records and other opinion is contrary to that view. Whilst GBRMPA supports a number of the QCFO proposals, the Authority believes that the proposals are insufficient to

achieve the Ministerial Council objective of no further dugong mortality from fishing practices. Accordingly, the Authority recommends as follows :

1. Legislate to remove mesh nets and set mesh nets from all DPAs, subject to such removal in Hervey Bay and Great Sandy Strait applying only to methods of fishing which target shark, mackerel and barramundi.

2. Assess the risk to dugongs of seine, tunnel, ring and set pocket nets for each DPA and fisher, and regulate use accordingly;

3. Permit the use of cast nets under the current *Fisheries Regulation 1995* (Qld);

4. As proposed by most stakeholders and interest groups, develop an Industry Adjustment Scheme in consultation with the Queensland Government and commercial fishing industry (Table 3 provides an appraisal of fishing in each DPA and for proposed additional areas, see below);

   Alternatively, further negotiate and agree with commercial fishers on much stronger dugong protective proposals in DPAs than they have submitted for this report. These measures may include : a limit of one set net per person requiring 'at the net' attendance, limits on net size and breaking strain, tight specifications on method of deployment, careful selection and monitoring of approved fishers in DPAs, and enhanced enforcement. Such measures may reduce the risk of nets to dugongs in DPAs, however they are unlikely to meet the Ministerial Council objective of eliminating the risk; and

5. Implement training, education and compliance strategies in line with the QCFO submission.

Indigenous hunting : There are some 50 different groups (incorporated bodies) representing indigenous peoples in the southern GBR area. To GBRMPA's knowledge, seven of these, representing some significant areas, have agreed to suspend, or have voluntarily ceased, hunting. GBRMPA has a policy against the issue of hunting permits in the southern GBR. It is reported that some (unquantified) hunting is continuing in the Yarrabah, Palm Island and Mackay regions.The cessation of hunting is culturally and politically sensitive. GBRMPA believes that, for cessation of indigenous hunting to be successful, indigenous people need to be more involved in the management of dugongs. In addition, ATSIC have stated that if a fishing industry adjustment scheme is developed to reduce commercial fishing effort for the benefit of dugongs, equal consideration needs to be given to indigenous peoples (see submission #5). The Authority recommends as follows :

1. Do not permit indigenous hunting in the southern GBR whilst dugong populations remain threatened and support the continuation of GBRMPA's work with staff of the Queensland Department of Environment (QDoE) and the Aboriginal and Torres Strait Islander Council (ATSIC) which aims to inform indigenous groups of the urgent need to protect dugongs; and

2. Develop, in conjunction with ATSIC and representative bodies, arrangements for joint management with indigenous peoples of dugongs in DPA's for implementation as a part of management planning for the areas.

Illegal take : Illegal fish netting and hunting activities are a significant component of unnatural dugong mortality in the GBR region. However, the extent of such activities is difficult to quantify and assess. Illegal activities may be contributing to a coastal trade in dugong meat amongst indigenous communities. Current enforcement resources are insufficient to adequately address the matter. Accordingly, the Authority recommends as follows :

- Establish a task force of professional enforcement personnel and representatives of indigenous peoples, together with other interests as necessary, to urgently review and implement actions necessary to successfully counter illegal take of dugongs and other endangered marine animals on the GBR and in the Hervey Bay/Great Sandy Strait region. This will require additional funding in the order of $0.5 million per year over at least two years.

Additional DPA areas : In addition to the above three significant issues, the Ministerial Council directed that this report review, amongst other things, the adequacy of the Interim DPAs and the need for additional areas. The biological basis for the boundaries was reviewed by James Cook University scientists (refer report #18 and its supplementary report). Table 1 summarises biogeographic information contained in report #18. For example, the Interim DPAs agreed by the GBRMC would encompass 40% of dugongs sighted in the southern GBR in the 1986-87 surveys and 66% of coastal seagrasses, whilst the additional areas proposed by report #18 would encompass respectively, 74% of dugongs and 79% of seagrasses. In view of the critical nature of the dugong decline in the southern GBR and Hervey Bay/ Great Sandy Strait, GBRMPA believes that the sanctuary system will need to incorporate as high a proportion of dugongs and their habitats as possible to benefit dugongs. DPAs should also be about 200 km apart for biological reasons and to conform with the Ministerial Council direction. GBRMPA recognises that there has been no opportunity for stakeholders to consider the additional areas. GBRMPA recommends as follows :

1. Confirm the Interim and proposed additional DPA areas but, subject to other decisions arising from this report, seek further consultation with

stakeholders regarding appropriate strategies for the conservation of dugong within the additional DPA areas; and

2. Combine southern Hervey Bay and the Great Sandy Strait as a single DPA; and

3. Do not include Princess Charlotte Bay and Bathurst Bay in the northern GBR as DPAs at this time, noting that management regimes for conservation of dugongs in these Bays are being developed under the GBRMP Far Northern Section Zoning Review.

4. Define the coastal boundary of the DPAs as including all tidal areas.

Vessel and aircraft activity : For reasons related to the water conditions, dugong behaviour, and increasing vessel use, the Authority believes that dugongs in the Hinchinbrook Region DPA are at greater risk from vessel strike than in other DPAs. Accordingly, GBRMPA recommends as follows :

- Apply speed limits and restrictions on boat, helicopter and float plane activity in areas of the Hinchinbrook Region DPA.

Shark netting for bather safety : Twelve shark nets are set for bather safety in the GBR World Heritage Area (GBRWHA), two being in the Cleveland Bay Interim DPA. The Queensland Government recently announced that one of these two is to be replaced with drumlines. The Queensland Department of Primary Industries is reviewing the remaining nets on the Queensland coast. The Chairperson of the Authority has submitted to the review that all nets in the GBRWHA should be replaced unless the nets can be shown to be preferable to drumlines for reasons of human safety. The review is expected to be completed by mid-1997. It is recommended that :

- Shark nets for bather safety in the GBR and Hervey Bay/ Great Sandy region be replaced by drumlines unless the nets can be shown to be preferable to drumlines for reasons of human safety

BACKGROUND

Although dugongs are distributed throughout the Indo-pacific region, they are now either extinct or rare over most of their original range. They are listed by the World Conservation Union as 'vulnerable to extinction'. A decade ago Australia was believed to have the largest, most stable population left in the world. Recent surveys however, indicate that, while dugong populations in the Far North of the Great Barrier Reef appear to be stable, in the southern half of the Great Barrier Reef and Hervey Bay dugong numbers have declined by 50-to-80% in most areas over the last eight years. The causes of this decline are not certain but acknowledged threats include habitat loss, mesh netting, Indigenous hunting, shark netting for bather protection, vessel collision, pollution, and explosions for purposes such as Defence training or marina construction.

Recent reports of dead animals suggest that, at least in the southern Great Barrier Reef, the annual human-related mortality is continuing at between 6% and 10% per year. The maximum loss from unnatural causes that could be sustained by the dugong population in the southern GBR and still allow the population to recover could be as few as 3.3 dugongs per annum, and in Hervey Bay 1.6 dugongs per annum (H. Marsh, personal communication).

The current evidence therefore suggests that dugong are in immediate danger of being lost from a significant proportion of their Australian range if effective and immediate action is not taken to reverse the decline.

On 30 November 1996, the Great Barrier Reef Ministerial Council (GBRMC) considered a program of emergency measures for dugongs and recorded the decisions at **Attachment A**.

Among other things, Commonwealth and Queensland Government Ministers agreed to list 9 Interim Dugong Protection Areas (DPAs) and to consider listing a further 2 areas as the basis of a sanctuary system.

At **Attachment B** is a brief report on action to implement the decisions of Ministerial Council since it met. The remainder of this paper addresses the requirement to report on actions necessary for dugong conservation and management.

In this report, *critical recommendations* for the survival of dugongs in the southern GBR and Hervey Bay/Great Sandy Region are indented and preceded by the letter 'C'.

1. Terms of Reference

- Ministers directed that this report be prepared by the Great Barrier Reef Marine Park Authority (GBRMPA) in cooperation with other agencies and in consultation with the fishing industry.

- Ministers requested that the report address :
  what action is necessary to ensure no further dugong mortality occurs as a result of commercial and recreational fishing practices in each DPA. The objective is to ensure that fishing practices that may result in dugong mortality will not be permitted in those areas.

- Other issues to be included are : the identification of additional DPAs, illegal take, shark netting, use of explosives, indigenous take (including the effectiveness of voluntary moratoria), habitat loss (especially regarding seagrass distribution and health).

- Ministers also recognised the principle of locating dugong protected areas at approximately 200 km intervals.

2. CONSULTATION AND RESEARCH REGARDING THE REPORT

This report has been prepared in cooperation with an inter-agency Dugong Working Group comprising representatives of the Queensland Department of Environment (QDoE), Queensland Department of Primary Industries (QDPI), Queensland Fisheries Management Authority (QFMA), Aboriginal and Torres Strait Islander Commission (ATSIC), and Environment Australia - Biodiversity Group. However, it does not necessarily represent the views of those other agencies.

At **Attachment C** is a list of submissions and reports by government and non-government individuals and organisations in relation to the preparation of this report. The submissions and reports are numbered sequentially for reference purposes and are included in the **Appendix**.

Summaries of biological and user information about the Interim DPAs and additional sanctuaries proposed in this report (see section 3 below) are at **Attachments D** and are mapped at **Attachment E**.

3. APPRAISAL OF DUGONG PROTECTION AREA BOUNDARIES

The GBR Ministerial Council directed that this report review the adequacy of the Interim DPAs and the need for additional areas. The biological basis for the boundaries was reviewed by T. Preen and N. Morissette of James Cook University (refer report #18 and its supplementary report). Their review assessed all available sources of data on dugongs and seagrass distribution including :

- the three reef-wide aerial surveys of dugongs conducted in 1986-87, 1992 and 1994;
- surveys of seagrass distribution by the Queensland Department of Primary Industries (QDPI);
- dugong carcass reports collected by James Cook University since the 1970s, the QDPI shark control program, and other sources;
- shoreline aerial surveys by researchers in 1970s and 1990s;
- incidental dugong information collected during whale surveys of Hervey Bay by the Queensland Department of Environment (QDoE);
- satellite tracking studies of 17 dugongs;
- incidental sightings by Coastwatch, Marine Parks surveillance patrols, the general public and scientists; and
- information from indigenous peoples.

In assessing areas that would form a reliable basis for a network of dugong sanctuaries, Preen and Morissette (report #18) recommend that, because dugongs are relatively mobile and utilise large home ranges, dugong sanctuaries must be relatively large if they are to be effective. They considered that the sanctuaries also need to extend to high water as much favoured seagrass occurs in the inter-tidal region, and into estuaries and streams. Estuaries and streams are outside the GBRMP. In addition, the sanctuaries must form a network that facilitates movement of dugongs between populations. The report states that DNA analysis indicates that interbreeding is restricted to neighbouring populations, so the distance between populations must be small enough to allow for adequate mixing. On these bases, Preen and Morissette propose a number of amendments to the boundaries of the Interim DPAs, and suggest three additional sanctuaries south of Cooktown. In all, they propose a network of 10 sanctuaries. Their proposals are mapped at Attachment E.

Table 1 provides biogeographic information comparing the proportion of dugongs and seagrass habitat in each of the Interim DPAs and the additional areas proposed by Preen and Morissette. Information on the extent of the areas is also provided. Generally, the more coastal waters or mainland coastline occupied by sanctuaries, the more dugongs would be included.

The system of sanctuaries accepted as Interim DPAs by the GBRMC incorporate in the southern GBR (Cape Bedford to Bundaberg) at least 40% of the 1986-87 estimated dugong population and 79% of the 1994 estimated population. For the same southern GBR region, they encompass 66% of coastal seagrasses, 13% of nearshore coastal waters and 23% of the mainland coastline.

In comparison, the extended and new areas proposed by Preen and Morissette would incorporate at least 74% of the 1986-87 estimated dugong population and 89% of the 1994 estimated population. They encompass 79% of coastal seagrasses, 34% of nearshore coastal waters and 44% of the mainland coastline.

The sanctuaries proposed by Preen and Morissette range in size from 193 km^2 to 1268 km^2 and are separated by distances of between 65 km and 240 km (an average of 132 km).

In the short time frame available, the Preen and Morissette review did not give detailed consideration to proposals for a sanctuary system in the northern GBR (north of Cape Bedford near Cooktown). However, a review of Marine Park zoning for this area is nearing completion, and the current proposals for that review would provide a sound basis for a dugong protection in a more broadly based protected area system (see report #35).

In order to reverse the decline in southern GBR dugong numbers, the GBRMPA believes that the sanctuary system will need to incorporate as high a proportion of dugongs and their habitats as possible. DPAs should also be no more than about 200 km apart to conform with knowledge of their movements, based upon satellite tracking and as accepted in principle by Ministerial Council. Although the Preen and Morissette report has been circulated to stakeholders and interest groups, detailed consultation with those groups has not been possible regarding the implications for them of the additional DPAs and the proposed boundary alterations. Accordingly, the GBRMPA recommends as follows :

Recommendations :

C. 1. Confirm the Interim and proposed additional DPA areas but, subject to other decisions arising from this report, seek further consultation with stakeholders regarding appropriate strategies for the conservation of dugong within the additional DPA areas.

C. 2. Combine southern Hervey Bay and the Great Sandy Strait as a single DPA.

C. 3. Do not include Princess Charlotte Bay and Bathurst Bay in the northern GBR as DPAs at this time, noting however that management regimes for conservation of dugongs in the Bays are being developed under the GBRMP Far Northern Section Zoning Review.

C. 4. Define the coastal boundary of the DPAs as including all tidal areas.

4. APPRAISAL OF ISSUES ABOUT IMPACTS

1. Commercial Fishing Activities

The DPAs support varied fisheries using a number of fishing methods, including trawling, potting, line fishing and netting. More than 50 species of fin fish, sharks and crustacea are commonly caught in a variety of habitats including estuaries, foreshores, reefs and bays. The most significant and direct impacts on dugongs from commercial fishing activities are from netting. Other indirect and direct effects may result from damage to seagrass habitat from trawling; vessel strike and displacement of animals through vessel noise and activity.

i) Commercial Netting: Considerable spatial and temporal overlap exists between commercial netting activities and areas favoured by dugong. Although inadequate reporting practices make it impossible to gain a reliable estimate of the number of dugong deaths that are attributable to commercial netting activities, a number of authors have provided information that suggests that significant numbers of dugong deaths are attributed to gill netting activity. For example, Preen and Morissette (report # 18) state that of the 35 stranded dugong carcasses reported in the southern Great Barrier Reef during 1996, 16 were found to have clear signs of having been entangled in nets.

In Queensland waters, the net design and the locations and methods of setting are regulated under the *Queensland Fisheries Act 1994* and by the *Queensland Fisheries Regulations 1995*. There are seven basic net designs identified in the *Queensland Fisheries Regulations 1995* for commercial use in Queensland waters, referred to as: mesh nets, set mesh nets, seine nets, tunnel nets, set pocket nets, ring nets and cast nets. Each design can have many different specifications depending on the target species and the area of use.

The review of nets used in DPAs by Russell in report #19 indicates that dugongs appear to have difficulty in detecting nets because of relatively poor eyesight. Death occurs by drowning within approximately eight minutes (H. Marsh, personal communication) once the animal becomes entangled by their appendages such as tail and flippers. Russell (report #19) suggests that certain net designs have a much higher propensity to capture dugong. He concludes that:

- meshnets and set mesh nets used in an area inhabited by dugong pose a threat of capture to those animals;
- seine, tunnel or set pocket nets used in an area inhabited by dugong may pose a threat of capture to those animals depending on the method and location of use; and
- a cast net, due to the small size and minimal soak time, poses little or no threat of capture to dugong.

The Queensland Commercial Fishermen's Organisation has submitted a proposal on netting strategies in DPA's based on their stated *'obligation to mitigate and wherever possible, eliminate impact on dugongs'* (submission #1). The submission addresses a wide range of proposals, including:

- an education and awareness strategy for commercial fishers;
- legislative changes, enforcement and compliance;
- incident reporting;
- modification of netting practices; and
- research.

The QCFO proposals aim to achieve 'best practice' by commercial netters and, if implemented may have potential to reduce the mortality of dugong from commercial netting.

Table 2 lists netted catch weights of different fish species for the Interim DPAs and proposed additional areas. Note should be taken of the preponderance in areas north of Hervey Bay and the Great Sandy Strait of large species, such as shark, mackerel and barramundi, which require stronger nets which represent a greater entanglement risk for dugongs.

GBRMPA concludes that many of the aspects of the QCFO submission (for example, training and reporting programs) may appreciably reduce dugong mortality in commercial fishing nets in the medium-to-long term . However, the extent of netting that is proposed by QCFO to continue in DPAs would not deliver changes or practices that are likely to ensure the Ministerial Council direction *"that fishing practices that may result in dugong mortality will not be permitted in those areas"*. A more detailed assessment of the QCFO submission by GBRMPA is included in Attachment F together with comments by the Board of the Queensland Fisheries Management Authority (QFMA) and a letter from the interagency Dugong Working Party (through QFMA) seeking clarification of the QCFO proposals. QCFO clarified some proposals in two faxes subsequent to their report (see submission #1, supplementary).

Hervey Bay and Great Sandy Strait support varied fisheries using a number of fishing methods. In 1988, use of a lighter breaking strain net (0.65 mm ply diameter) was made mandatory between Elliott River and Urangan in an attempt to reduce dugong deaths. However, information collected from strandings indicate that dugong are still being killed in fishing nets in Hervey Bay and Great Sandy Strait. The nets are implicated in dugong mortality are mesh nets and set mesh nets involved in the shark, barramundi and mackerel fisheries. Nets used in the whiting and mullet fisheries in Hervey Bay and Great Sandy Strait do not appear to cause mortality.

GBRMPA notes that most stakeholders and interest groups have strongly stated that any netting prohibition needs to be accompanied by an Industry Adjustment Scheme (see Table 3 for estimates of numbers of net fishers in DPAs). Stakeholders believe that this is necessary to ensure that displacement of fishing effort , with its attendant problems, does not occur into other critical dugong areas (e.g. the Far Northern Section which supports about 86% of the remaining dugong population in the GBR). Other relevant factors include the concern that fishers are more likely to comply if they have been compensated for their lost opportunities to fish in DPAs, or that those who hold licence endorsements for more than one fishery may switch to other forms of fishing and place more effort or pressure on those fisheries leading to problems of over-fishing.

The Authority believes that the submission by QCFO is insufficient to achieve the Ministerial Council requirement of ensuring *'that fishing practices that may result in dugong mortality will not be permitted in those areas* (DPAs). Given the limitations on the information that can be readily obtained on dugong movements and interaction with nets, in order to confidently attempt to achieve this objective the Authority recommends as follows :

Recommendations

C. 1. Legislate to remove mesh nets and set mesh nets from all DPAs, subject to such removal in Hervey Bay and Great Sandy Strait applying only to methods of fishing which target shark, mackerel and barramundi.

C. 2. Assess the risk to dugongs of seine, tunnel, ring and set pocket nets for each DPA and fisher, and regulate use accordingly;

C 3. Permit the use of cast nets under the current *Fisheries Regulation 1995* (Qld);

C 4. As proposed by most stakeholders and interest groups, develop an Industry Adjustment Scheme in consultation with the Queensland Government and commercial fishing industry (An appraisal of fishing in each DPA and possible additional areas is in Tables 2 and 3).

- Alternatively, further negotiate and agree with commercial fishers on much stronger dugong protective proposals in DPAs than they have submitted for this report. These measures may include : a limit of one set net per person requiring 'at the net' attendance, limits on net size and breaking strain, tight specifications on method of deployment, careful selection and monitoring of approved fishers in DPAs, and enhanced enforcement. Such measures may reduce the risk of nets to dugongs in DPAs, however they are unlikely to meet the Ministerial Council objective of eliminating the risk; and

C 5. Implement training, education and compliance strategies in line with the QCFO submission.

ii) Trawler impact on seagrass habitat : Under current marine park zoning in the southern GBR, trawling is generally not permitted over seagrass beds, although the there are some, generally small areas of seagrass habitat, that may not have been covered in current zoning. Although this is an important issue, an immediate need is for more detailed surveys to define and appraise seagrass beds, and is most appropriately addressed in longer term planning for each DPA.

An issue which needs further examination in Hervey Bay is the relative absence of dugong in what appears to be suitable habitat between Elliott River and Theodolite Creek. There is a major increase in the density of dugong populations immediately south of the 'offshore trawl' boundary.

iii) Vessel strike, noise and general disturbance of dugongs : This matter is appraised under Issue 5 below.

2. Recreational Fishing Activities

The most likely impacts on dugongs from recreational fishing activities are: vessel strike, noise and disturbance of dugongs; these matters are appraised under Issue 5 below. There may also be some, very limited, potential for dugong interaction with seine nets as they are currently defined by the *Fisheries Regulations 1995 (Qld)*.

3. Indigenous Hunting

The decline of dugongs is a serious cultural issue for indigenous peoples. The animal is associated with "dreaming" stories in many areas and the act of hunting is seen as a continuance of cultural practices in the marine environment. Many indigenous people have expressed concern at the decline in dugong numbers and have voluntarily suspended hunting. Concern has been expressed by others that stopping hunting may potentially result in extinguishment of residual native title rights (see submission #5, and report #21).

There are some 50 different groups (incorporated bodies) representing indigenous peoples in the southern GBR area. Of these, seven to GBRMPA's knowledge have agreed to suspend, or have voluntarily ceased, hunting (see map, report #21).

In general those people/groups who have decided, or agreed, to voluntarily suspend hunting have complied with the suspension. The voluntary agreements are not comprehensive in geographic or group coverage consequently some people are continuing to hunt in the southern Great Barrier Reef region. There are also reports of illegal hunting activities and commercial trading of dugong meat in some areas, but this is not condoned by the wider indigenous community (see discussion under next Issue).

According to the evidence provided by researchers hunting is not ecologically sustainable in the southern GBR region. The Authority has a policy that dugong hunting in the southern GBR is not sustainable, and that permits for dugong hunting cannot be granted on environmental grounds (see report #31).

Cessation of hunting is a culturally and politically sensitive issue. Indigenous people require involvement in management of proposed Dugong Protected Areas and the species in recognition of their cultural associations and responsibilities. ATSIC state in their submission (#5) that if compensation for loss of access to an activity is considered for other sectors such as the commercial fishing industry, then indigenous people require similar consideration.

Recommendations

C. 1. Do not permit indigenous hunting in the southern GBR whilst dugong populations remain threatened, and support the continuation of the GBRMPA's work with Queensland D of E and ATSIC staff which aims to inform indigenous groups of the urgent need to protect dugongs.

C. 2. Develop, in conjunction with ATSIC and representative bodies, arrangements for joint management with indigenous peoples of dugongs in DPA's for implementation as a part of management planning for the areas.

4. Illegal take

Dugong deaths appear to occur illegally as a result of two main activities - illegal fish netting, and illegal hunting. The extent to which they have, and are, adversely affecting dugong populations is difficult to estimate because of socio-cultural and political problems with intelligence, surveillance and enforcement. Reports that are mainly unsubstantiated indicate that significant illegal indigenous hunting is occurring in some coastal areas. In some areas a trade has apparently developed in dugong meat derived from both or either illegal fish netting and illegal indigenous hunting.

The apparent extent of illegal take of dugongs is of considerable concern to the GBRMPA. Current enforcement resources are insufficient to adequately address the matter. The legislation is also complex in the area and may require amendment to improve enforcement.

Recommendations

C Establish a task force of professional enforcement personnel and representatives of indigenous peoples, together with other interests as necessary, to urgently review and implement actions necessary to successfully counter illegal take of dugongs and other endangered marine animals on the GBR and in the Hervey Bay/Great Sandy Strait region. This will require additional funding in the order of $0.5 million per year over at least two years. The Task Force would :

- review legislation (eg. moratorium to hand in illegal nets, review protection of dugongs;
- undertake intelligence work;
- undertake special enforcement activities; and
- assess the ongoing role of the Force (subject to review at end of first two years).

5. Vessel and aircraft activity

The main vessel and aircraft activities which may adversely affect dugong are vessel strike, noise and general disturbance of dugongs.

Unlike the related manatee in Florida, there are comparatively few recorded instances of dugongs being struck by vessels in coastal Queensland. Research on factors affecting vessel strike of dugongs is inadequate and would be very difficult to acquire. However, the risk of striking a dugong appears to be greater where there are frequent and/or high speed craft traversing shallow waters (especially in confined areas such as bays, tidal estuaries and creeks) and when weather is rough. In these circumstances the animal has little time or place to dive to avoid being struck. Propeller guards probably have little effect in minimising injury to dugongs in a high speed collision. It is also estimated that 40% of boat strikes on manatees do not involve propeller injuries (H. Marsh personal communication).

From discussion with people who have struck dugongs with vessels, the GBRMPA suggests that a threshold speed of no more 10 knots apply in depths at low water of less than 5 metres. These guidelines should be applied to defined parts of DPAs as necessary and after appropriate consultation where use patterns, geographic parameters and dugong biology suggest that they are appropriate to minimise risk to dugongs. Dependent upon circumstances, their application could be either voluntary or by legislation. On present appraisal, vessel constraints are necessary in the Hinchinbrook Region DPA, and for activities such as boat racing, water skiing and jet skiing in all DPAs .

Noise disturbance from vessels and aircraft, especially helicopters and float planes, can adversely affect dugongs. Sound is possibly important for dugong communication as they live in turbid waters. Sound is an efficient form of communication as it disseminates well in water. High levels of unnatural background noise may interfere with dugong communication and cause hearing difficulty or damage and social disruption. In general, the larger and faster the engine, the greater the sound. Accordingly, the GBRMPA recommends as follows :

Recommendations

C 1. Apply vessel speed limits and restrictions on helicopter and float plane activity in areas of the Hinchinbrook Region DPA; and

2. Adopt a policy prohibiting boat racing, water skiing and jet skiing in areas where dugongs may be at risk from vessel strike and noise effects in DPAs such as the Hinchinbrook Region, Cleveland Bay, Upstart Bay, and Newry Region DPAs. The areas are to be defined in consultation with stakeholders, local users and the general public and implemented as appropriate under marine park permitting and other legislative frameworks.

6. Shark netting for bather safety

Twelve shark nets for bather safety are currently deployed in the GBR World Heritage Area (GBRWHA). Two of the nets are in the Cleveland Bay DPA. The remainder are outside DPAs. The nets constitute a significant threat to dugongs. A number of nets have been replaced on the GBR over the years; for example in 1992, they were replaced by drumlines in the Rockhampton region and at one beach on Magnetic Island near Townsville with a resultant reduction in the take of non-target species, including dugong, and without apparent loss of efficiency in capture of sharks.

The Queensland Department of Primary Industries is reviewing the shark control program under which the nets are operated. Submissions #4 and 6 relate to that Review. On current advice, the Review is expected to be completed by mid-1997 in time for the proposed June meeting of the GBRMC. The GBRMPA Chairperson has submitted to the Review that all nets in the GBRWHA should be replaced by drumlines unless the nets can be shown to be preferable to drumlines for reasons of human safety. Submission #4 states that the Queensland Minister for Primary Industries recently decided to remove one of the two remaining nets from Magnetic Island, within the Cleveland Bay DPA. The Authority recommends as follows :

Recommendation

C Replace shark nets for bather safety in the GBRWHA and in Hervey Bay and the Great Sandy region by drumlines unless the nets can be shown to be preferable to drumlines for reasons of human safety.

7. Use of explosives,

Explosives are used rarely in waters of the GBR and Hervey Bay/Great Sandy region and only after careful assessment. They are not recorded as having adversely affected dugongs in the GBR and Hervey Bay/Great Sandy Strait but if inappropriately used, have the potential to do so (there are records of the use of explosives to hunt dugongs in Sri Lanka and Palau). As endorsed by the GBRMC on 30/11/96, the Department of Defence has instituted a moratorium during 1997 on the Department's use of explosives in Interim DPAs except in the Shoalwater Bay Military Training Area where specific guidelines have been agreed with the Royal Australian Navy for their explosives training exercises at Triangular Island. GBRMPA will conclude discussions with Defence this year seeking a long-term prohibition on the Department's use of explosives in DPAs as an inappropriate activity unless for exceptional reasons of human safety eg discovery of unexploded World War 2 ordnance. The use of explosives for commercial or other purposes in DPAs should be considered during the environmental impact assessment of proposals with due recognition being given to the status of the areas.

Recommendation
C. Endorse GBRMPA negotiations with Defence during the existing moratorium period, with a view to securing a long-term prohibition on the Department's use of explosives in DPAs as an inappropriate activity unless for exceptional reasons of human safety : for example, discovery of unexploded World War 2 ordnance.

8. Habitat loss, especially seagrasses

The issue of the actual or potential loss of the dugong's seagrass feeding habitat is potentially the most significant in terms of the long-term survival prospects of dugongs in the southern GBR region. However, there is little information available that can be applied to an analysis of the matter in the region (see report # 23).

Dugong feeding scars have been seen in seagrass meadows at water depths of 33 metres and feeding may occur in greater depths. There are anecdotal reports of local losses of seagrass in areas of the GBRWHA, for example, Upstart Bay (see submission #1), The last widespread scientific survey of coastal seagrasses in the southern GBR was in the 1980s. Whilst localised surveys have occurred since in some areas, resources are not available currently for detailed fine-scale surveys of each DPA. Nevertheless, in the event of a significant seagrass die-off event on the GBR, whether from disease or any other factor, it is not readily apparent that a rapid or appropriate management action could be taken to redress the situation. It is therefore appropriate to minimise the risks to seagrass habitat through the application of *best management practice* to the possible contributory activities.

Hervey Bay is identified as having the second largest area of deep water seagrass habitat on the east coast of Queensland. In 1992, the loss of the majority of this habitat (over 100 $km^{2)}$ had a significant effect on dugong populations. The habitat loss has been attributed to an extended period of reduced light conditions caused by a persistent plume of turbid water that resulted from the floods and the resuspension of sediments caused by the cyclonic seas. Recent studies have also identified a pathogen which is documented as causing declines in seagrass communities worldwide. In the system of DPA's, Hervey Bay and Great Sandy Strait is a major stronghold for dugong and dugong habitat. It is essential that any conservation measures for this DPA include a programme of research and monitoring aimed at providing a better understanding of the complex issues affecting seagrass and the health of dugong.

Recommendation
1. Support further appropriate management-related research into seagrass habitat issues, particularly in Hervey Bay/ Great Sandy Strait; and

2. Support the furtherance of best management practices focussing on activities that may impact on seagrass habitats in DPAs.

Attachment A

Record of Decisions : 22nd Meeting of the Great Barrier Reef Ministerial Council, Brisbane, 30 November 1996.

Agenda 2
EMERGENCY MEASURES FOR GREAT BARRIER REEF AND ADJACENT AREA DUGONG RECOVERY AND CONSERVATION

Council:

a) **confirmed** that urgent action is required to ensure recovery of dugong populations in the Great Barrier Reef and adjacent waters;

b) **noted** the material assembled by the Working Party of the Great Barrier Reef Dugong Review Group and comments by all members of the Group on a Draft Program of Emergency Measures;

c) **agreed** to the list of 9 Interim Dugong Protection Areas (DPAS) and to consider listing a further 2 Areas on the basis of a sanctuary system; and recognised the principle of having dugong protected areas at approximately 200 km intervals;

d) **specifically endorsed** the following measures for dugong recovery and conservation :

- the Queensland Government will legislate as soon as possible under the Fisheries Management Act 1994 to require fisher attendance at offshore set mesh nets;

- the Commonwealth Government through GBRMPA will finalise the Shoalwater B ay (Dugong) Plan of Management as soon as possible including a provision prohibiting mesh nets for fishing in the Bay;

- the Commonwealth and Queensland Governments will realign and enhance surveillance and enforcement patrols to focus on areas of high dugong risk;

- the Department of Defence will institute a moratorium during 1997 on the use of explosives in the DPAs except in the Shoalwater Bay Military Training Area and under existing terms agreed with the Royal Australian Navy for Triangular Island in the Shoalwater Bay Military Training Area;

- GBRMPA in cooperation with QDoE, QFMA and QDPI to report to Governments by 28/2/97 on what action is necessary to ensure no further dugong mortality occurs as a result of commercial and recreational fishing practices in each of the Interim Dugong Protected Areas. The objective is to ensure that fishing practices

that may result in dugong mortality will not be permitted in those areas. The report is to be prepared in consultation with the fishing industry.

- Other issues to be addressed by agencies and to be reported to Governments by February include identification of additional DPAs, illegal take, shark netting, use of explosives, indigenous take and habitat loss;

- Ministers will also address the effectiveness of voluntary moratoria in relation to indigenous take of dugongs within the GBRMP.

(e) The Council also had brought to its attention major loss of dugong in the Torres Strait and whilst beyond the jurisdiction of GBRMPA the Commonwealth Minister for the Environment undertook to investigate such losses and review appropriate strategies to advance conservation.

(f) The Council heard concerns in relation to the health and distribution of seagrasses and required GBRMPA to review the status of research and to report back to the next Council meeting on whether further action should be taken.

Attachment B

MEASURES ENDORSED BY GBRMC 22 AND SUBSEQUENT ACTION

Measure	Subsequent Action
1. Legislate to require fisher attendance at offshore set nets;	Mid-February submission by Queensland Commercial Fishermen's Organisation is being appraised by the Queensland Fisheries Management Authority. Recommendation to Queensland Minister for Primary Industries expected shortly, with legislation enacted March-April.
2. Finalise the *Shoalwater Bay (Dugong) Plan of Management*; with a provision prohibiting mesh nets for fishing in the Bay (except cast nets & crab dilly pots);	Finalised. Public notification to bring the plan into force will occur by mid-March 1997. Enforcement provisions require Governor-General's approval and subsequent gazettal.
3. Realign and enhance patrols in areas of high risk to dugongs;	• Actioned to the extent possible under current funding and other management imperatives. • Additional funding required each Financial Year for long-term action.
4. Institute a one-year moratorium on the use of explosives in DPAs by Defence except in the Shoalwater Bay Military Training Area and under existing terms agreed with the Royal Australian Navy for Triangular Island;	• In-place. Discussions to be held ASAP with Defence regarding long-term management arrangements for dugong on the matter.
5. Report by 28/2/97 on, - what action is necessary to ensure no further dugong mortality occurs as a result of commercial and recreational fishing practices in each DPA, - other issues including identification of additional DPAs, illegal take, shark netting, use of explosives, indigenous take and habitat loss, - the effectiveness of voluntary moratoria, - the health and distribution of seagrasses and whether action should be taken.	• Subject of this Report. As requested, the Report has been prepared by GBRMPA in cooperation with other government agencies and in consultation with the fishing industry.
6. Review appropriate conservation strategies for Torres Strait dugongs.	• Environment Australia - Biodiversity Group have prepared a preliminary report (see report #30). Further action to be developed in consultation with Torres Strait and Queensland management agencies.

Attachment C

List of Submissions and Reports

(numbered for reference purposes in this report)

Submissions

1. *Industry proposal for implementation of the QCFO Dugong Conservation Strategy;* plus supplementary fax of 26/2/97 on *'clarification of areas in QCFO Strategy'*.
   (by the Queensland Commercial Fishermen's Organisation)
2. *Dugong mortality from the perspective of recreational anglers in Queensland* (by Sunfish Queensland Incorporated)
3. *Dugong Shoalwater Bay* (by Sunfish Queensland Incorporated)
4. *Latest situation - nets - shark control program* (by QDPI)
5. Letter of 19/2/97 from Commissioner I Delaney, ATSIC Commissioner, Queensland Metropolitan Zone
6. Letter of 24/1/97 from Dr P Corkeron, James Cook University, to the Queensland Minister for Primary Industries (copied to GBRMPA) regarding shark nets at Magnetic Island.
7. Letters of 19/2/97 and 21/2/97 from Humane Society International
8. *Dugong Conservation Policy* (by Australian Marine Conservation Society, 20/2/97)
9. Letter of 21/2/97 from the Queensland Conservation Council
10. Letter of 21/2/97 from the Australian Marine Conservation Society
11. Letter of 21/2/97 from the Wildlife Preservation Society of Queensland (Proserpine/Whitsunday Branch Inc.)
12. Letter of 22/2/97 from the Wildlife Preservation Society of Queensland (Townsville Branch Inc.)
13. Letter of 23/2/97 from the Friends of Hinchinbrook Society Inc.
14. Letter of 23/2/97 from the North Queensland Conservation Council
15. Letter of 24/2/97 from Dr T. Preen, James Cook University, enclosing *'Comments on the Dugong Conservation Policy of the Australian Marine Conservation Society'*.
16. Letter of 24/2/97 from the Wildlife Preservation Society of Queensland (Tully & District Branch)
17. Letters of 17/2/97 and 25/2/97 from Professor H. Marsh, James Cook University, including the draft report, *'Attempts at minimising the bycatch of endangered species in commercial fishing operations in the United States: lessons for the Great Barrier Reef region'* .

Reports

18. *A system of dugong sanctuaries for the recovery and conservation of dugong populations in the Great Barrier Reef World Heritage Area and adjacent southern waters* ; plus supplementary report and comparative Table, received 26/2/97 [attached to main report are overheads and notes for verbal presentation to MPA 165, 20/2/97]
    (by Tony Preen and Nina Morissette, James Cook University)
19. *Mesh nets used in waters of Queensland's East Coast : The risk to dugongs in proposed Interim Dugong Protection Areas*
    (by Martin Russell, GBRMPA)

20. *Report on vessel use in the Interim Dugong Protection Areas* (by M. Gilbert and D Benzaken, GBRMPA)
21. *Report on effectiveness of voluntary cessation of dugong hunting* (by Greg Smith, GBRMPA, in consultation with Rick Hill and Bill White of ATSIC)
22. *Coastal development and pollution in Dugong Protection Areas* (by J. Brodie and D. Haynes, GBRMPA; J Cavanagh, AIMS; D. Pitts, Environment Science and Services)
23. *Dugong Protected Areas - Seagrass Issues* (by W. Lee Long, L. McKenzie, R. Coles, Queensland Dept of Primary Industries)
24. *Impacts on and responses of seagrasses in the Great Barrier Reef - issues for management* (by W. Lee Long and R. Coles, QDPI)
25. *The effects of trawl fisheries on Great Barrier Reef seabed habitat* (by C R Pitcher et. al., CSIRO Division of Marine Research)
26. *Large scale seagrass dieback* (by J. McLeod, Cooloola Seafood Festival)
27. *A part resurvey of long-term seagrass monitoring sites within the Great Sandy Strait and Tin Can Inlet* (by FRC Coastal Resource and Environmental; submitted by J McLeod)
28. *The Influence of water quality on the virulence of the seagrass pathogen, Labyrinthula* (by M Wnuczynski; submitted by J McLeod)
29. *Report on illegal take of dugong in the Great Barrier Reef region and in the proposed dugong sanctuary areas* (by T. Christensen, Queensland Department of Environment)
30. *Information on the conservation status of dugong in the Torres Strait Area* (Preliminary report; by G Anderson, Environment Australia - Biodiversity Group)
31. *Interim Policy - Traditional Hunting Dugong* (by Great Barrier Reef Marine Park Authority)

Further Additions

32 Letter of 25/2/97 from Mackay Conservation Group
33 Letter of 27/2/97 from Wildlife Preservation Society of Queensland (Proserpine/ Whitsunday Branch)
34 Letter of 25/2/97 from Cairns and Far North Environment Centre Inc.
35. *Dugong Management in the Northern Great Barrier Reef* (by J. Phillips, GBRMPA)
36. *Notes on seagrasses and seagrass-dugong interactions in the Hinchinbrook Region* (by W. Lee Long and R. Coles, QDPI)

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ATTACHMENT D

Summaries of Biological and User Information About Interim and Proposed Dugong Protection Areas

Low Isles

1. Dugong numbers and distribution

No dugong population estimates exist for this region because of the relative rarity of dugongs between Dunk Island and Cape Bedford since the mid-1980s. However, herds of 27 and 19 dugongs (possibly the same herd) were recorded just west of Port Douglas in 1994 and 20 dugongs at Agincourt Reef in 1996 demonstrate that significant numbers can occur in the area.

The area was historically important for dugongs as indicated by the high number caught in shark nets at Cairns from the early 1960s . The establishment of a DPA in this region should encourage the recovery of this dugong population and ensure genetic continuity between important dugong populations at Hinchinbrook and the Starcke River.

2. Dugong habitat

The major reefs in this proposed DPA (Batt and Tongue Reefs) are believed to be important nursery areas for dugongs. Dugongs are also commonly seen in the area between White Cliffs and Rocky Point. Seagrass meadows have not been surveyed.

3. Fisheries

Low Isles supports a commercial net fishery which in absolute value comprises 1 tonne or 0.4% of the total catch for the proposed DPA's in the southern GBR.

Netting effort:

Netting effort in the area is very low relative to the total effort in the proposed DPA's in the southern GBR with 15km of net length used in 1995 compared to a total of 1955km set in all proposed DPA's in the southern GBR.

Netting activity

Of the 900 licensed net fishers in Qld:

- 500 reported activity in 1995
- 250 of those operated in the Marine Park
- 150 of those operated in the DPA's, and
- Three of those reported catches in Low Isles of which two reported significant catches (>3tonnes).

4. Strandings

There are no dugong carcass records for the area.

5. Traditional hunting

The Kuku Yalandji Marine Resource Management Committee has, since 1994, declared a moratorium on dugong hunting in this area.

6. Recreational boating

No information available.

Hinchinbrook

1. Dugong numbers and distribution

• In 1994, 24% of the southern GBR dugong population was located in both the interim and proposed Hinchinbrook DPA's. The area has the most stable dugong population remaining in the southern GBR and the second largest area of seagrass meadows.

• Transect aerial surveys indicate that the number of dugongs increased between 1987 and 1994: up from 284 (+/-131) to 484 (+/-170). This increase is due, in part, to movement of dugong into this area.

• Missionary Bay is the most important dugong habitat in this region .

• Hinchinbrook Channel, Cardwell coast, Lucinda coast, and the east coast of Hinchinbrook Island are also used by dugongs.

2. Status of seagrass meadows

• Fine scale (detailed) surveys were undertaken in 1996.

• Seagrass meadows comprise 18.6% of coastal seagrass in all interim and proposed DPA's in the southern GBR, and cover 10, 773 hectares;

• They are extensive and healthy (W. Lee Long, QDPI pers.comm.) and composed of species favoured by dugongs;

• Meadows occur around the island, providing a range of feeding opportunities for dugongs .

In order of importance (based on size), extensive meadows are located in:
• Missionary Bay to Goold Island;
• Shepherds Bay (Northeast coast of the island);
• vicinity of Meunga Creek (north of Cardwell);
• the entire western side of Hinchinbrook Channel to the mouth;
• Lucinda Point to Forrest Beach and Lady Elliot Reef;
• the eastern side and central section of the Channel;
• the east coast of the Island which contains a chain of patchy meadows.

Rivers and creeks with meadows are:

• Deluge Inlet on the eastern side of channel (1.8km inside creek)
• Conn River mouth (western side of channel)
• Seymour River mouth (western side of channel)
• the most northern (unnamed creek) on eastern side of the channel (a 600m meadow, 1km inside creek)

Protection of seagrass under current Marine Park Zoning is satisfactory but not adequately cover the range of significant meadows.
• Meadows protected from trawling under Marine Park zoning are in Missionary Bay and the Channel;

•Important meadows within Marine Park zones that allow trawling are located at Shepherds Bay and Meunga creek. Their protection should be reviewed.

• Important meadows south of Lucinda Point are currently outside the Great Barrier Reef and State Marine Parks and habitat is not protected.

The interim DPA would include 694km2 of seagrass and exclude major meadows north of Cardwell (Meunga Creek).

3. Fisheries

The Hinchinbrook area supports a commercial net fishery which in absolute value comprises 30 tonnes or 28.6 % of the total catch for the interim DPA's, and 35 tons or 13.9 % for the proposed DPA's in the southern GBR..

The main target species are: barramundi; shark; mackeral; mullet and salmon along with trevally, whiting, flathead and mixed fish

Netting effort:
• Effort in the interim DPA is low-medium, with 210 km of net length used in 1995 compared to 250 km used in the proposed DPA in the same period.

• Overall netting effort is the highest for all interim and proposed DPA's in the southern GBR (excluding Hervey Bay).

Highest netting effort occurs in the DPA:

- Off Cardwell (25.2 km/yr)
- Mid-Channel: between Conn creek and Neams inlet: (23.9km/yr)
- In Missionary and Shepherds Bay: (19.2 - 13.7 km/yr), and
- These areas are coincident with key dugong habitat.

Netting activity
- Of the 900 licensed net fishers in Queensland, 150 operate in the DPA's.

- Eighteen (18) fishers reported catches in the interim and proposed Hinchinbrook DPA's; six of those reported significant catches (>3 tonnes). Netting occurs day and night throughout the area, and is concentrated in the intertidal areas, rivers and creeks.

4. Strandings

- Ten dugong carcasses were recorded in 1996. Cause of death was established for 7. River set mesh nets; unidentified nets and vessel strike are implicated.

- The Hinchinbrook area is characterised by shallow waters where areas of seagrass meadows occur in sheltered bays; rivers and on intertidal banks. These areas overlap with some of the main mesh netting locations, bringing the animals into a high risk of incidental capture. The area of subtidal seagrass is small, which reduces the amount of alternative low-conflict feeding areas. Some major rivers also contain seagrasses to which dugongs may travel and become entangled in set nets. It is also possible that additional day-time boat traffic is increasing the likelihood of vessel strike and may cause dugongs to retreat to offshore areas during the day and concentrate inshore feeding activity at night. This would increase likelihood of capture in nets set at night.

5. Traditional hunting

The Girrgun people are traditionally associated with the Hinchinbrook region. They have elected not to hunt dugongs out of concern for the species. There have been reports of hunting by people from the Palm Island area in the southern Hinchinbrook area.

6. Recreational boating

The total number of boats registered in the Ingham area for 1995 was 1604. The Hinchinbrook area has a high recreational boating value as well

as boating from fishing activity. The channel has particularly high use due to its all weather boating environment. Missionary Bay is also intensively used because it is the main access to the start of the island's Thorsborne bush-walking track. Recreational events such as water skiing races are held in the channel, in which vessels reach speeds of up to 70 knots across shallow waters. The level of boat use and high speed boating events are of concern in the area.

Cleveland Bay /Cape Bowling Green

1. Dugong population

The interim DPA would include 18% of the 1994 dugong population recorded in the southern GBR and 21% in the proposed DPA's.

The population of dugongs in the Cleveland/Bowling Green Bay region has declined by 52% between 1987 and 1994 (down from 496 +/-151 to 237 +/-48).

The Cleveland Bay region provides very important dugong habitat.

2. Seagrass

- The interim DPA would include 19.3% of coastal seagrasses DPA's in the southern GBR and 20.9% of the proposed DPA's.

- Cleveland Bay has extensive and healthy meadows covering 121km2 (W.Lee Long QDPI pers.comm.) which were surveyed in detail in 1996. They are both intertidal and sub-tidal, extending to 7km from the coast.

3. Fisheries

- Cleveland Bay supports a commercial net fishery which in absolute value comprises 35 tonnes or 26.1 % of the total catch for the interim DPA's in the southern GBR and 75 tonnes or 29.9 % of the extended DPA's.

- The main target species are shark; mackerel; barramundi; mullet; salmon and trevally.

- Netting effort is low in relation to the total effort for all DPA's but the highest of each interim or proposed DPA, excluding Hervey Bay.

- Highest effort occurs around Halifax Bay and lowest in Bowling Green Bay.

Netting activity

Of the 900 licensed net fishers in Qld:

- 500 reported activity in 1995
- 250 of those operated in the Marine Park
- 150 of those operated in the DPA's, and
- Ten (10) of those fishers reported catches in the interim DPA and 18 in the proposed.

4. Strandings

- 289 dugongs died in shark nets since 1960; and

• 6 carcasses resulting from other causes were recorded in 1996 ; one a confirmed fishing net entanglement; one from vessel strike.

5. Traditional hunting

No agreements are in place with any indigenous groups in the area.

6. Recreational boating

• Boat registrations from 1995 were 6336.
• Cleveland Bay is an area of high recreational use. No information for Bowling Green Bay.
• Of concern are high speed vessels; power boat races and jet ski operations.

Upstart Bay

1. Dugong numbers and distribution

In 1986-7 four (4) percent of the southern GBR dugong population was located in Upstart Bay and two (2) percent in 1994. Dugong density ranking for the area is medium with an estimated .0235 animals per kilometre (Marsh *et al* 1996).

Records show that Dugongs use all of the Bay with heaviest concentrations associated with seagrass meadows.

Transect aerial surveys indicate that the number of dugongs in Upstart Bay has declined by some 89% between 1987 and 1994 (171+/-87 to 19+/-19; Marsh et al., 1996). Despite this, a herd of up to 30 dugongs was seen there by Artie Jackobson as recently as 1993 (John Locke, pers. comm.). The movements of a dugong tagged in Cleveland Bay, which spent most of its time in Upstart Bay (Fig. 5G; Marsh and Rathbun, 1990), demonstrated a link between the dugongs in these two areas.

2. Status of seagrass meadows

Upstart Bay occurs in the Burdekin region where seagrass meadows receive the lowest protection under Marine Park Zoning than elsewhere in the GBR (Morissette 1992).

Upstart Bay has extensive and ecologically significant seagrass for dugongs and prawns (Morissette, 1992; Marsh et al 1996) because:

- It contains 15 meadows (Morissette 1992) comprising 1.5% (an area of 193 km2) of the coastal seagrass meadows of the southern GBR .
- It is one of 3 areas in the region with the most extensive meadows (the others are: Cleveland and Edgecumbe Bay)
- It is one of only 2 areas in the Central Section of the GBRMP that are remote from development and sewage.

The area's urban population is developing rapidly, increasing the threat of degradation; sewage and waste disposal in the meadows.

According to QCFO sources, fishers have noted a deterioration of seagrass meadows in the southern pocket of the Bay (between Molongol creek and Oyster Point) and attribute this to increased land use for agriculture (QCFO submission on netting to GBRMPA, 1997).

3. Fisheries

Upstart Bay supports a commercial net fishery which in absolute value comprises 5 tonnes or 4.8 % of the total catch for the original DPA's and

5 tonnes or 2% of the proposed DPA's. The main target species are shark; blue salmon; king salmon; mullet and barramundi along with queenfish; yellow finned bream; grunter; flathead garfish and mixed fish.

Netting effort:
Effort in Upstart Bay is low relative to the total effort in the original and proposed DPA's with 30km of net length used in 1995 in the original Upstart Bay DPA (compared to 870km for all DPA's in the southern GBR), and, 30 km of net used in the extended DPA compared to 1,955km for all proposed southern GBR/ DPA's.
Netting effort is highest in the western side of the Bay.

Netting activity
Of the 900 licensed net fishers in Qld:
- 500 reported activity in 1995
- 250 of those operated in the Marine Park
- 150 of those operated in the DPA's, and
- Two of those fishers reported catches in Upstart Bay.

The only access to a large number (about 100) of houses on the western shore of Cape Upstart is by boat, and it appears that they are used primarily as fishing retreats by people from the Burdekin delta. As a result, Illegal gill netting may be a potential management problem in this sanctuary. These houses appear to be within the boundary of the Cape Upstart National Park .

4. Strandings
There are no records of dugong carcasses for the Bay.

5. Traditional hunting
The Giru Dala are the traditional owners of the Bay . They have agreed not to hunt dugongs in the area.

6. Recreational boating
The total number of registered vessels for 1995 in the Ayr/Home Hill and Bowen area is 3656. Commercial fishers report that up to 700 boats travel over the eastern side of the Bay on weekends and constitute significant vessel strike threat. Other reports suggest up to 50 boats use access facilities on long weekends.

There is a proposal to dredge an access channel through Molongol Creek for an all tide boat channel, and this would be through prime seagrass meadows.

Edgecumbe Bay

1. Dugong numbers and distribution

• In 1986-7, 8% percent of the southern GBR dugong population was located in the proposed Edgecumbe Bay DPA, and 1% in 1994.

• Transect aerial surveys indicate that the number of dugongs dropped from 173 +/- (77) to 20 (+/- 17) in 1994.

• Historically, Edgecumbe Bay has been important dugong habitat, supporting large herds of up to 30 as recently as 15-20 years ago. Anecdotal information from local people suggests that the decline has been associated with increased trawling and netting activity, especially in the unprotected Sinclair Bay area. Today there are few dugong in the area although regular sightings are made by Aborigines hunting turtle in the southern half of the Bay.

The location of a sanctuary at Edgecumbe Bay should facilitate the recovery of this dugong population. The available data indicates that all of Edgecumbe Bay should be included. The recovery of dugong populations at Repulse Bay and Edgecumbe Bay should eventually result in an increase in the number of dugongs residing around the Whitsunday Islands.

2. Status of seagrass meadows

2.4 % of coastal seagrasses in the southern GBR occur in the proposed DPA.

Edgecumbe Bay is identified as one of 5 significant seagrass habitats in the Central section of the Marine Park, and supports commercially important prawn nurseries as well as turtle and dugong populations.

•Extent and status

Approximately 16 seagrass meadows occur in the intertidal area of the Bay and on the western side of Gloucester Island.

•Protection

Protection of meadows in the proposed DPA under Marine Park Zoning is unsatisfactory, with a significant portion outside the Marine Park and unprotected (includes 7 major meadows from Bowen to Adelaide Point as

well as Sinclair Bay), and the remainder not protected from trawling Marine Park Zone, General Use A.

3. Fisheries

Edgecumbe Bay supports a commercial net fishery which in absolute value comprises 5 tonnes or 2 % of the total catch for all proposed DPA's. The main target species are mackerel, salmon, mixed fish, shark; and barramundi .

Netting effort:
Effort is low with 10 km of net length set in the Bay in 1995 compared to 1955 km of net set for all proposed DPA's in the southern GBR.

•Netting activity
Of the 900 licensed net fishers in Qld:

- 500 reported activity in 1995
- 250 of those operated in the Marine Park
- 150 of those operated in the DPA's, and
- Four (4) of those fishers reported catches in 1995 in the proposed DPA.

Three out of those 4 reported significant catches (>3 tonnes).

4. Strandings

Six carcasses have been recorded in the proposed DPA in recent years. Netting is implied in two (1996).

5. Traditional hunting

The Giru Dala are the traditional owners of the Bay . They have agreed not to hunt dugongs in the area and there has been very little dugong hunting there since the early 1950s .

6. Recreational boating

The total number of registered vessels for 1995 in the Bowen area is 1381. Edgecumbe Bay is within the Whitsunday region where 97% of meadows are within 30km of a boating facility. Whilst Edgecumbe Bay is still relatively remote from mainstream tourist operations there is concern about potential boating impact from future tourist developments.
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Newry / Repulse Bay

1. Dugong numbers and distribution

• Both the interim and proposed DPA's would protect 2% of the estimated 1994 southern GBR dugong population.

• The proposed DPA supported 11% of the population in 1986-7, indicating the importance of the area. Historically, the proposed DPA region supported two dugong fisheries; one at Newry Island and one at nearby Repulse Bay.

• Transect aerial surveys indicate that the dugong population in the Newry area has declined by about 84% between 1986 and 1994 (240+/-104 to 38+/-37). In Repulse Bay it appears that the decline may have occurred well before the start of systematic aerial surveys as the population estimate from the first aerial survey in 1986-7 was only 31 (+/-35). During 1992 the estimate was 70 (+/-59), but in 1994 no dugongs were seen.

• It is likely that the population could recover if it was afforded adequate protection.

• Most dugong records occur in the vicinity of the Newry Islands and in the north of Repulse Bay.

2. Status of seagrass meadows

The interim DPA would include 0.8 % of coastal seagrasses in the southern GBR and 2.1% in the proposed DPA's.

•Extent and status

There are six large meadows in the DPA.

• Protection

The level of protection is unsatisfactory because both the interim and most of the proposed DPA are outside the Marine Park. Concern about the low level of seagrass protection in Repulse Bay is often expressed by members of that local community , along with concerns about the level of trawling and netting and decline of dugongs.

3. Fisheries

The interim DPA supports a commercial net fishery which in absolute value comprises 10 tonnes or 9.5% of the total catch for the original DPA's in the southern GBR and 45 tonnes or 17.9% of the proposed DPA's. The main target species are shark; barramundi and salmon.

Netting effort:

Effort is low (11.5%) in the interim DPA with 100km of net length set in 1995 compared to 870km for all interim DPA's in the SGBR. In the proposed DPA, effort is low, with 18.4% or 360km of net set compared to 1,955km for all proposed DPA's in the SGBR.

Netting activity

Of the 900 licensed net fishers in Qld:

- 500 reported activity in 1995
- 250 of those operated in the Marine Park
- 150 of those operated in the DPA's, and
- Six (6) of those fishers reported catches in the interim DPA and ten (10) for the proposed DPA. Less than half the fishers in both DPA's recorded significant catches (>3 tonnes).

4. Strandings

Eight carcasses have been recorded in recent years. Netting is implicated in several.

5. Traditional hunting

The Giru Dala people are traditionally associated with the area . They have agreed not to hunt dugongs in the interim and proposed DPA's. There are reports that illegal Aboriginal hunting is conducted out of Midge Point (southwest corner of Repulse Bay) indicating the continued presence of dugongs.

6. Recreational boating

The total number of registered vessels for 1995 in the Newry region is 6635. It is a busy recreational area with up to 100 boats a day launched from Seaforth. There is a resort on Newry island.

Ince Bay/ Cape Palmerston

1. Dugong numbers and distribution

• The Interim and proposed DPA would include 1% of the 1994 population, however it is important to note that historically, the proposed DPA included 5% of the southern GBR population.

• Dugong numbers have declined by 85%, from 542 (+/-293) in 1987 to 82 (+/-60) in 1994. This decline may be due to a combination of netting and hunting.(There have been recent reports of gill-net deaths in the Cape Palmerston-Sarina Beach area, and of Indigenous groups hunt out of Clairview and Sarina Beach).

• Distribution of dugongs in this region includes two main areas: between Sarina Beach and Cape Palmerston (including Sarina Inlet, Llewellyn Bay and Ince Bay) and between West Hill Island and Clairview Creek.

• The interim Ince Bay sanctuary does not encapsulate most of the important dugong habitat in the region and, as initially draw, is too small, relative to the scale of dugong movements.

2. Seagrass

• The interim DPA includes 2.5% coastal seagrass in the southern GBR; the proposed DPA, 6.7%.

• The area contains the next most important meadows north of Shoalwater Bay. Two large meadows are located in Ince and 11 south to Clairview. A large and important meadow occurs off the coast of the town of Clairview.

• Protection of these meadows for the proposed DPA could be improved. In the Marine Park, Ince Bay is zoned to exclude trawling and the remaining Marine Park portion of the proposed DPA is zoned to allow trawling. Protection of the intertidal area would be required under State legislation.

3. Fisheries

• The absolute value of the commercial net catch in 1995 was a low 10 tonnes (9.5%) for the interim DPA and 25 tonnes (10%) for the proposed DPA.

• Main target species are shark, salmon and barramundi.

• Netting effort is low in the interim and proposed DPA's (110km and 230 km of net was set respectively compared to total net length set of 870km and 1955km for the interim and proposed SGBR/DPA's).

4. Strandings

8 carcasses have been recorded in recent years. Nets are implicated for some.

5. Traditional hunting

The Djupera Dili people of Mackay have declared a moratorium on the hunting of dugongs in the area.
Other Aboriginal /Torres Straight Islanders may still be hunting as there are reports of Aboriginal hunting in the area.

6. Recreational boating

•6635 boats are registered for the Mackay region. The interim Ince Bay DPA is relatively remote, with access limitations. Boats are launched from the Cape Palmerston National Park.

• Of concern is that the important meadows off Clairview are within <1km from boat ramps. The average range of recreational fishing trips in the area is 30km return. Therefore, all meadows have a potential to be influenced by boating.

Shoalwater Bay/Port Clinton

1. Dugong numbers and distribution

• Both the interim (Shoalwater Bay) and proposed (Port Clinton area) DPA's would include 31% of the 1994 southern GBR dugong population.

• The combined area supports the largest dugong population between Hinchinbrook and Hervey Bay/Great Sandy Strait.

• Both the seagrasses communities of the area and the dugong population have been well researched.

• Satellite tracking of ten dugongs show that dugongs move regularly between the two DPA areas, establishing their habitat importance in the home ranges of the regional dugong population .

• The current boundaries of the interim Shoalwater DPA are appropriate except for a need to include the Island Head Creek area in the Port Clinton interim DPA, to provide a protected swimway around the top of the Peninsula Range and incorporate all critical habitat.

2. Seagrass

•Both the interim and proposed DPA would include 21.4% (13,076 +/- 800 ha) of coastal seagrasses for all DPA's in the southern GBR .

• Fine scale surveys of these meadows were undertaken in 1996, building on broad scale surveys conducted in 1987.

• Meadows in the proposed and interim DPA were extensive and healthy.

• Meadows in both DPA's occur mostly on intertidal banks, extending into many rivers and creeks and around some islands (Akens; Triangular; Leicester; Townshend). There are few sub-tidal meadows (important feeding options for dugongs during low tide). They occur in Shoalwater Bay off the southwest corner of Townshend island and in Canoe Passage.

• The nearest other large seagrass meadows are 150km south at Gladstone (see Rodd's Bay DPA) ; meadows 50km north at Clairview (see Ince/Cape Palmerston) and 300km north in the Whitsunday region (see Edgecumbe).

• Protection of meadows in the interim Shoalwater Bay DPA is adequate. Most of the Bay is zoned to prohibit trawling. Protection for the Port Clinton DPA is unsatisfactory as the entire area is outside the Marine Park.

3. Fisheries

• The commercial net fishery has a low absolute value of 15 tonnes for both the interim and proposed DPA, which contributes 14.3% and 6% of the catch respectively in the southern GBR for all interim and proposed DPA's.

• Fish netting has been implicated as the major cause of dugong mortality in the area.

• Netting effort in the interim DPA is low, with 13.8% (120km net length set) of all netting effort in southern GBR and 6.1% of effort for all proposed DPA's in the southern GBR. The amount of net length reported set in 1995 (120km) did not vary between the interim and proposed DPA's.

• The main target species are: shark; mackerel; salmon and barramundi.

• Mesh nets are used in rivers and creeks; intertidal foreshore areas and offshore areas of both DPA's.

• Netting in Shoalwater Bay will be prohibited under a management plan recently completed by the Great Barrier Reef Marine Park Authority

4. Strandings

Between 1995-1996, 15 carcasses were recorded in the interim and proposed DPA's. Netting was implicated for 13.

5. Traditional hunting

The Darumbal-Noolar Corporation, which represent the traditional Aboriginal users of the area, have agreed not to hunt dugongs in the area whilst the population remains endangered.

6. Recreational boating

- 5583 boats were registered in the Rockhampton district in 1995.
- Motorised vessels are of most concern in the interim and proposed DPA's.
- The main recreational use group for Shoalwater Bay/Prot Clinton have been identified as residents from Yeppoon and Rockhampton.
- Motorised vessels are the most common in Shoalwater Bay with sailing vessels used on outer coastal areas.
- From 1988-1995; 493 commercial and recreational boats were recorded in Shoalwater Bay and 694 in the Island Head Creek/Port Clinton area.

Rodd's Bay (Gladstone Area)

1. Dugong numbers and distribution

• In 1986-7, four (4) percent of the southern GBR dugong population was located in the proposed Rodd's Bay DPA, increasing to seven (7) percent in 1994.

• Transect aerial surveys record that between 1986-7 and 1994 the regional population fell by 65% (from 301 +/-95 to 104 +/-56).

• Dugongs were once abundant in this area. By the 1970's, shoreline aerial surveys indicated that dugongs were common. Carcass data suggests that this decline was buffered, to some extent by immigration of dugongs from Hervey Bay, following the loss of seagrass there in 1992.

• Dugongs seem to be distributed in two areas in this region: from the southern end of The Narrows through to the southern end of Facing Island (including the Gladstone shoreline) and Rodd's Bay. Local Aborigines are concerned that the reclamation of dugong feeding areas at Gladstone is jeopardising the declining dugong population.

• The role of this proposed DPA in dugong recovery is in maintaining the interchange of dugongs between central and south-east Queensland, as the habitat occurs mid-way between the important dugong populations at Shoalwater Bay and Hervey Bay which are approximately 400 km apart. Much of the habitat is also relatively remote with a low level of human use.

2. Status of seagrass meadows

3.6 % of coastal seagrasses in the southern GBR occurs in the proposed DPA.Land reclamation at Port Curtis is regarded as a major threat to 35% of the meadows in the area.

• Protection

• Protection for the area could be improved.

• A large area of Gladstone Harbour, including the Port Curtis meadows are outside the Marine Park. The portion of the DPA in the Marine Park is mostly zoned to allow trawling. There is a narrow Marine Park zone of

General Use B and Marine National Park A around Rodd's Peninsula where trawling and mesh netting are exluded.

3. Fisheries

Rodd's Bay supports a commercial net fishery which in absolute value comprises 45 tonnes or 17.9% of the total catch for the proposed DPA's in the southern GBR. The main target species are shark; mullet; mackerel; salmon; bream; barramundi and mixed fish.

Netting effort:
Effort is low-medium (22%), with 430 km net length set compared to 1,955 km for all proposed DPA's in the southern GBR.

Netting activity
Of the 900 licensed net fishers in Qld:

- 500 reported activity in 1995
- 250 of those operated in the Marine Park
- 150 of those operated in the DPA's, and
- Fifteen (15) of those fishers reported catches in the Rodd's bay DPA.

Nine of those recorded significant catches (>3 tonnes)

4. Strandings

One carcass has been recorded in the Gladstone area in recent times.

5. Traditional hunting

No information on level of hunting in this area.

6. Recreational boating

Over half the meadows in the area (in the south near Rodd's Peninsula) are remote from boating facilities. Areas of concern are in the Gladstone/ Curtis Island area.

Hervey Bay / Great Sandy Strait

1. Dugong numbers and distribution

Hervey Bay / Great Sandy Strait support an important number of dugong. In 1988, the estimated population size was 2,206 dugong equivalent to *ca.* 20% of the total Great Barrier Reef population. In 1992 there was a drastic decline and movement of the population due to an extensive loss of habitat. Dugong numbers declined by approximately 50% and had moved into the southern Great Sandy Strait area. In 1993 the population estimate was only 600 dugong. It is estimated that it will take 25 years for the dugong population to recover to the 1988 population estimates. Calculations by Prof. Helene Marsh of the number of dugong that can be sustainably removed from Hervey Bay is only 1.6 dugong.

Concentrations of dugong are found in south west Hervey Bay and southern Great Sandy Strait. The proposed boundaries reflect the distribution and movement of high density dugong in Hervey Bay / Great Sandy Strait.

2. Impacts

2.1 Habitat

Hervey Bay is identified as having the second largest area of deep water seagrass habitat on the east coast of Queensland. In 1992, the loss of the majority (over 1000 km^2) of this habitat had a significant effect on dugong populations. The habitat loss has been attributed to an extended period of reduced light conditions caused by a persistent plume of turbid water that resulted from the floods and the resuspension of sediments caused by the cyclonic seas. Recent studies have also identified a pathogen which is documented as causing declines in seagrass communities worldwide.

Hervey Bay / Great Sandy Strait is a major stronghold for dugong and dugong habitat. An assessment of the complex issues affecting seagrass in Hervey Bay / Great Sandy Strait concerning the quality of dugong habitat must be a priority. Consequently, it is essential that any conservation measures for this area include a programme of research and monitoring.

2.2 Fisheries

Hervey Bay and Great Sandy Strait support a wide variety of fisheries using a number of fishing methods. The main fisheries using mesh netting are:

Target Species	Product (kilograms)
Mullet	68, 000
Whiting	46, 000
Mackerel	26, 000
Shark	18, 000
Barramundi	1, 000

In the high density seagrass habitat between Elliott River and Point Vernon, there are some discrepancies in the dugong distribution. Dugong herds are localised to the southern part of this seagrass habitat. The seagrass habitat does not appear to differ significantly throughout its distribution but the north / south boundary of high to low density dugong coincides with the offshore trawling boundary. Further work should be undertaken to establish whether this anomaly in dugong distribution is related to trawling.

Between Theodolite Creek and Point Vernon there is a coincidence of high density dugong and mesh net fisheries. In the early 1980's eight dugong drowned in mesh nets in the Burrum River. A seasonal night closure and restrictions on gear type were implemented as a result. The measures implemented have not eliminated dugong mortality. Owing to a limited regrowth of shallow water seagrass since the 1992 floods both dugong and mesh net fishers may be concentrated over a smaller area of seagrass habitat. Numbers of dugong have stranded in this area during recent winter and spring periods.

2.3 Traditional Hunting

There are six clans of indigenous people in the area collectively known as the Butchulla people. The level of take by traditional hunting in this area is minimal. Although no formal agreement exists, a voluntary cessation of traditional hunting is currently in effect.

2.4 Recreational Boating

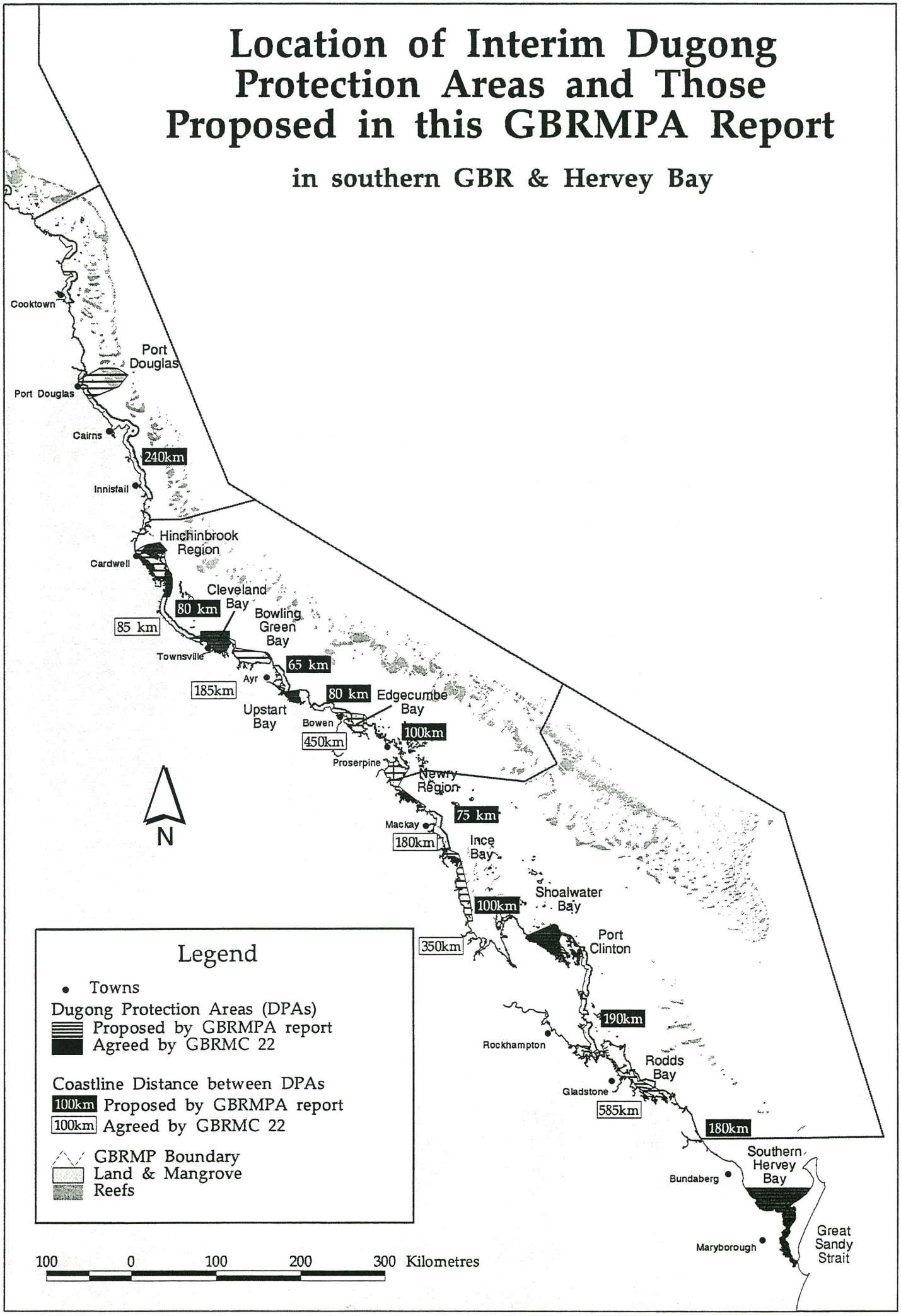
Strategies are required to minimise movement of high speed boats into and over seagrass areas. Coastal management plans should seek to limit development and population growth adjacent to seagrass concentrations between the Elliott River and Point Vernon. Development of boating facilitates in this area and from the Mary River Heads to Tin Can Bay should be discouraged. High speed vessel traffic in the Great Sandy Strait should be restricted to marked channels. There should be no provision to allow high speed boat races in this area.

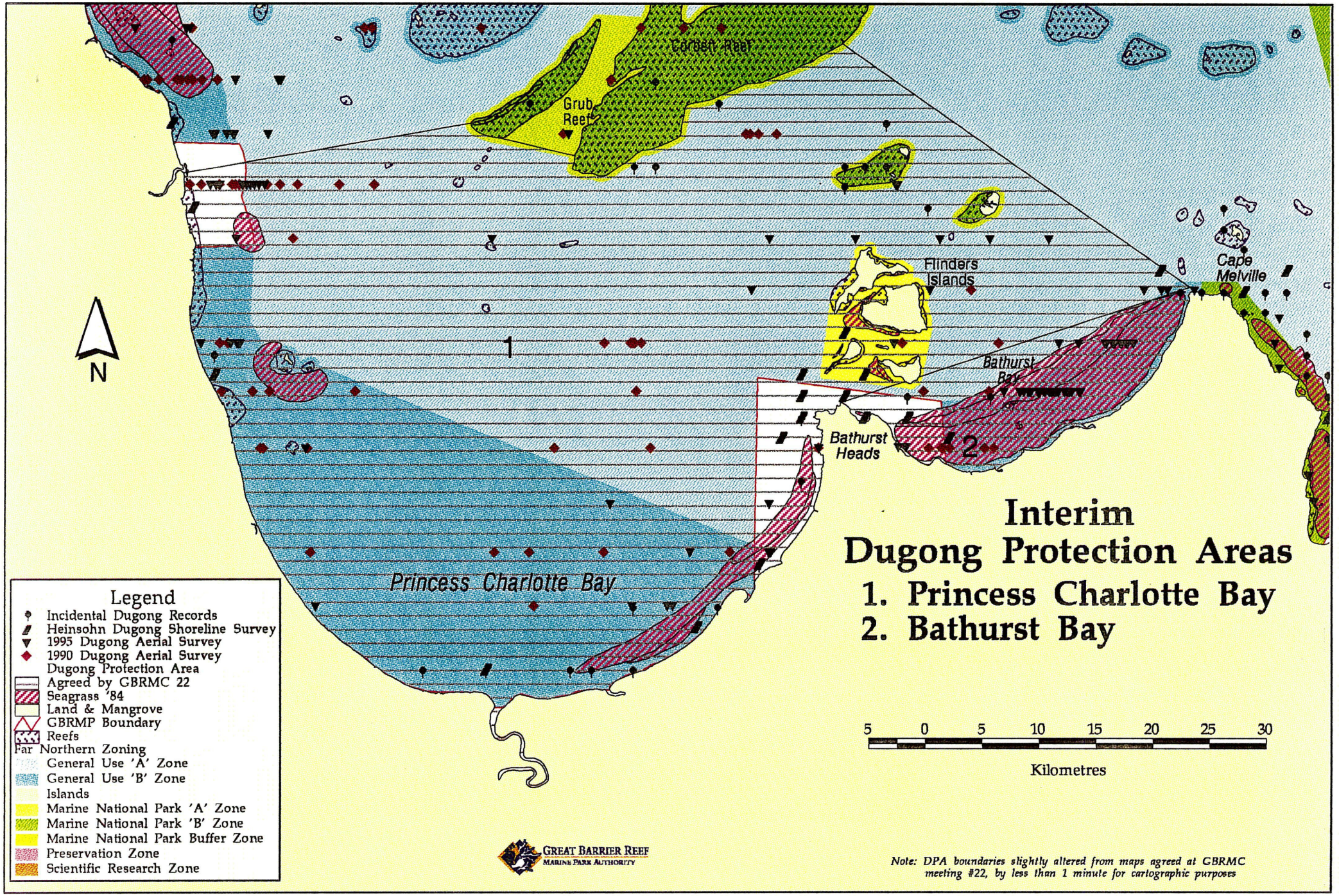
Attachment E

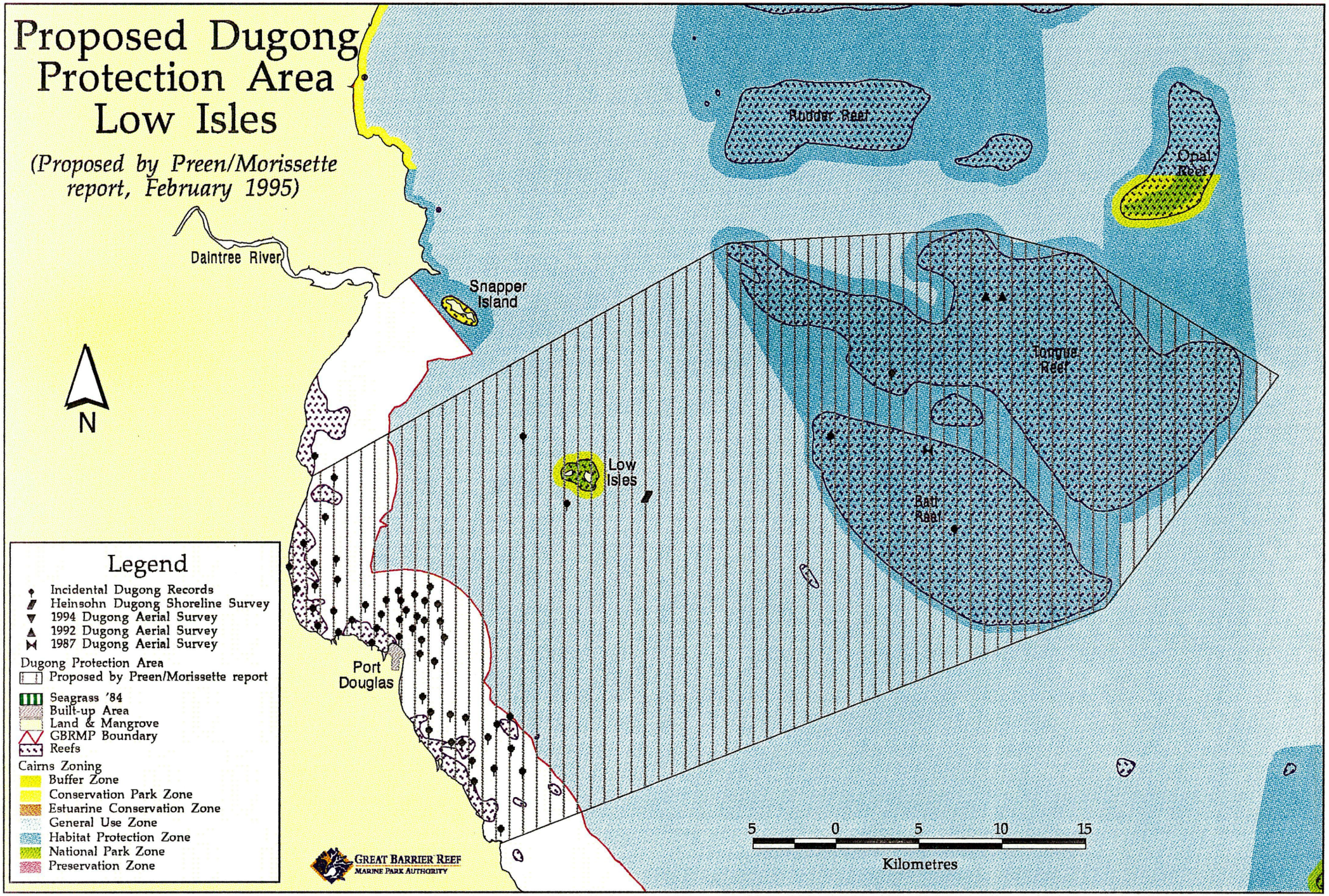
Maps of Dugong Protection Areas (Interim and proposed in this Report, as per Preen and Morissette report #18).

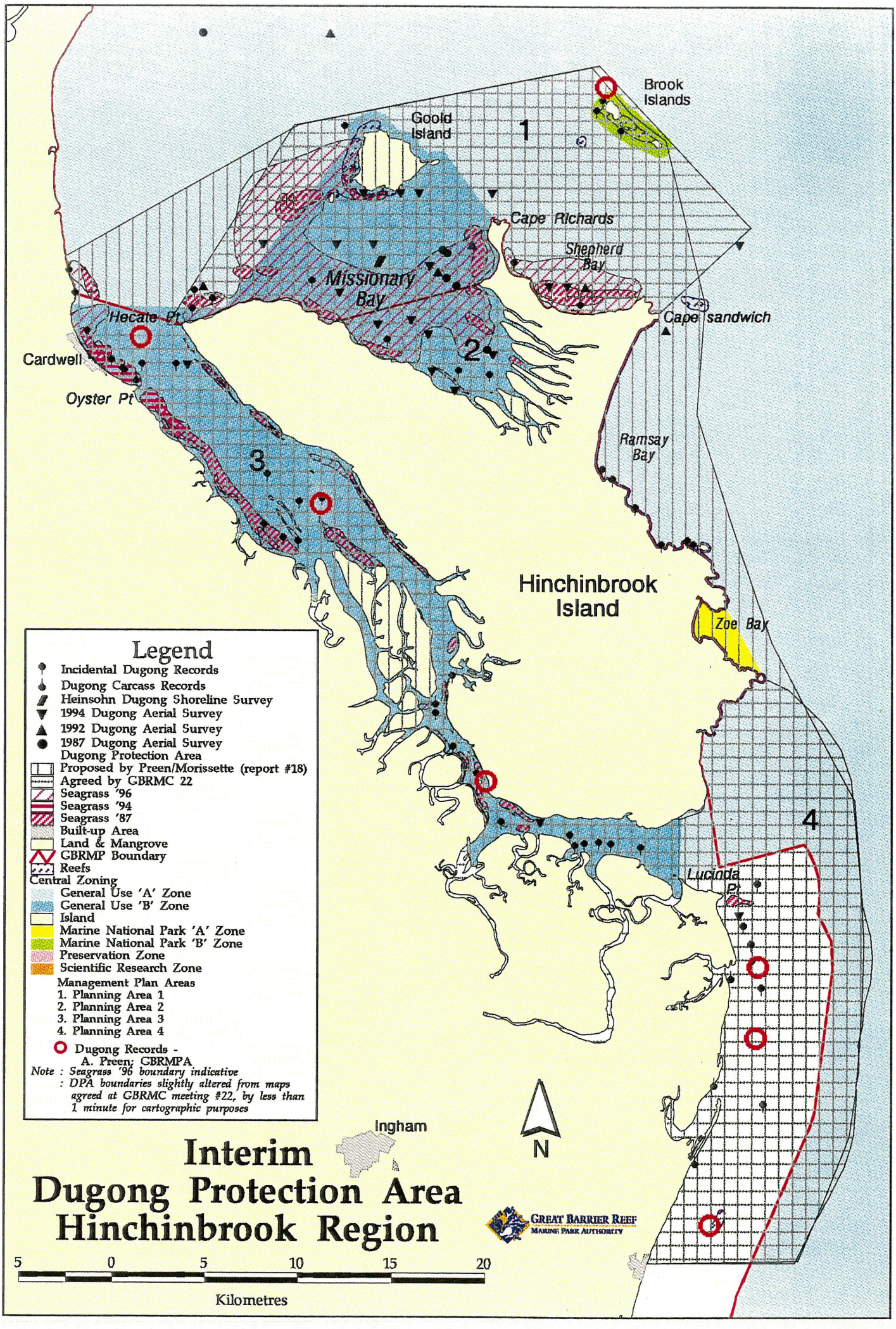
Location of Interim Dugong Protection Areas and Those Proposed in this GBRMPA Report

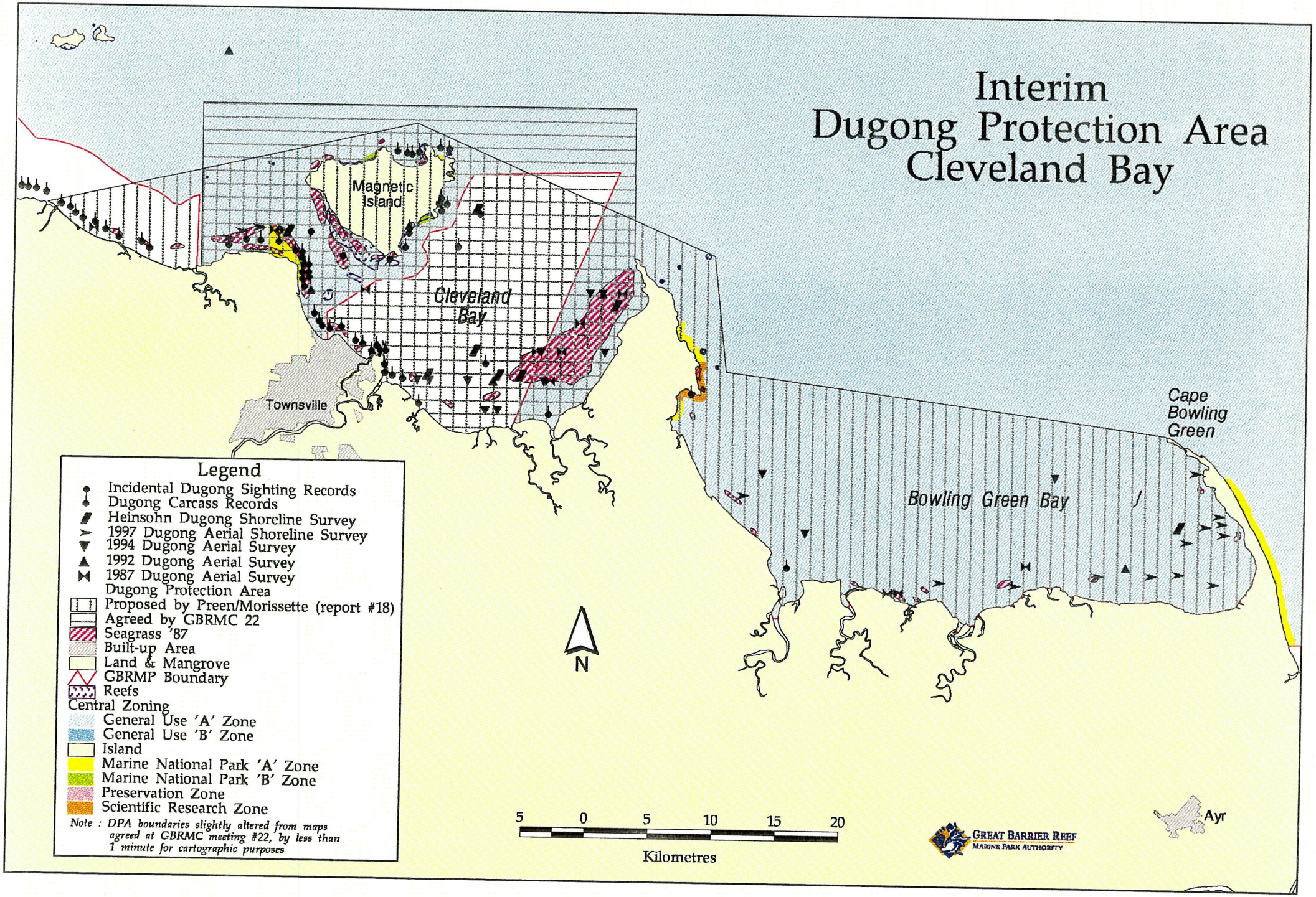
in southern GBR & Hervey Bay

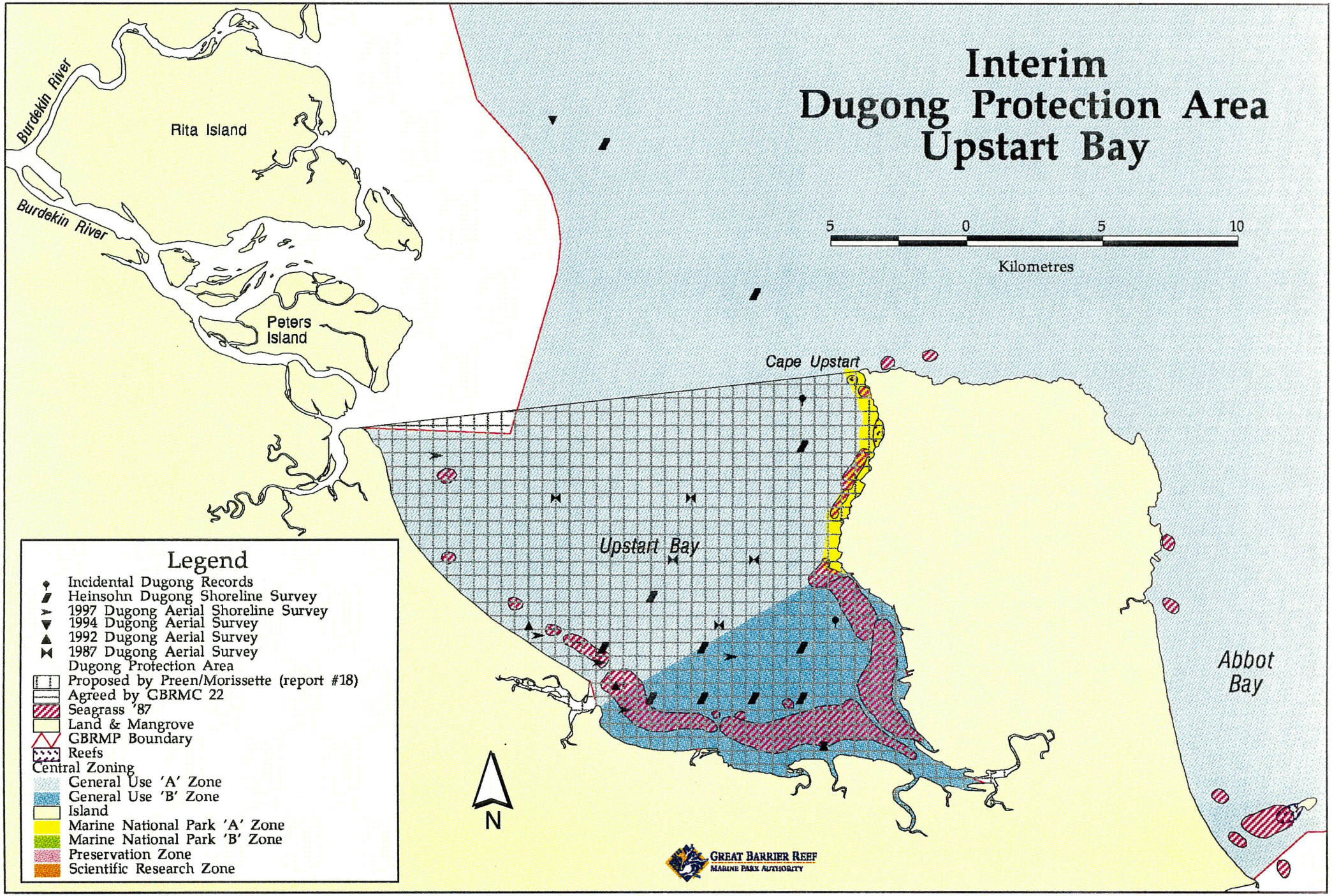


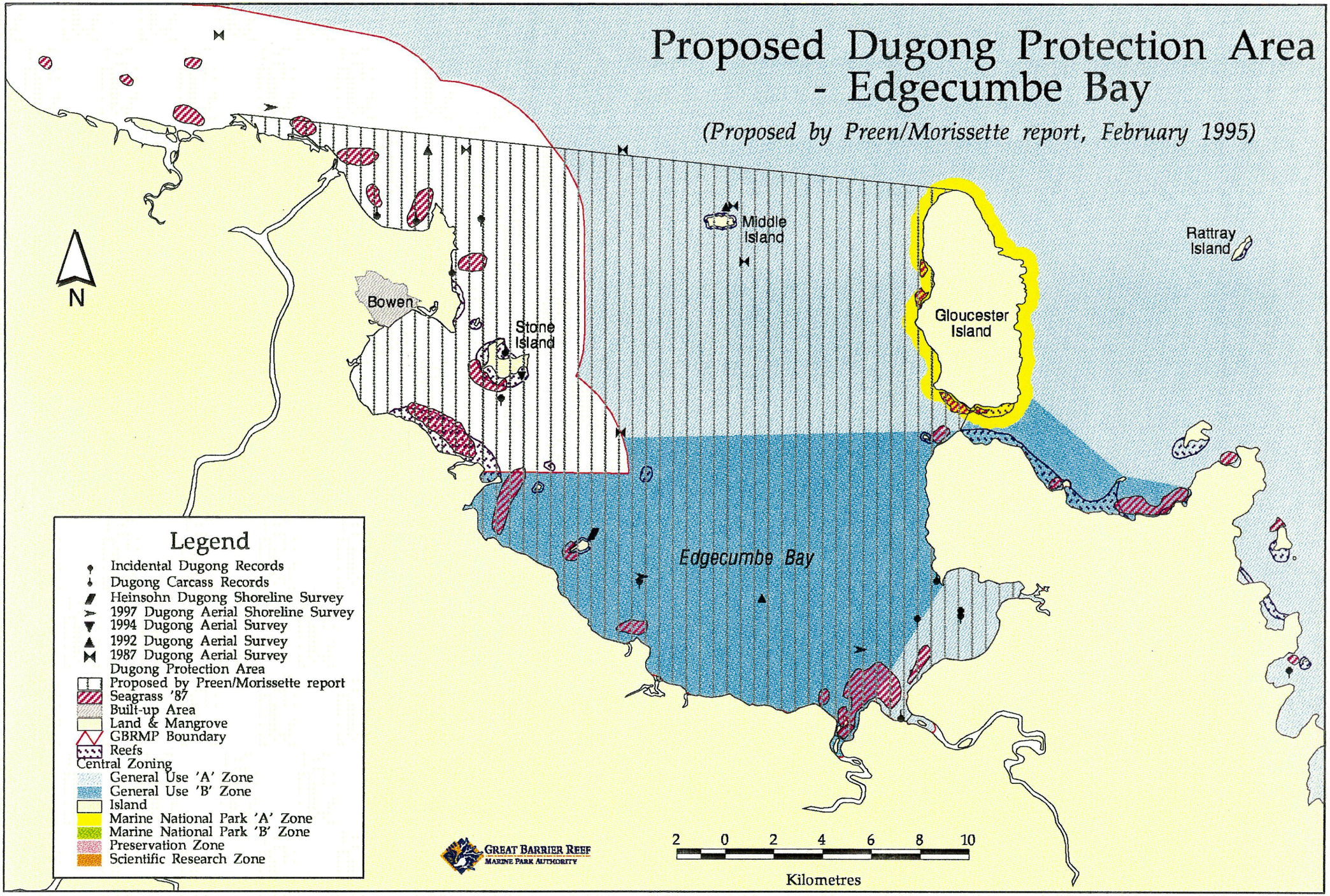

Grub Reef
Flinders Islands
Cape Melville
Bathurst Bay
Bathurst Heads
1
2
N
Princess Charlotte Bay
Legend
Incidental Dugong Records
Heinsohn Dugong Shoreline Survey
1995 Dugong Aerial Survey
1990 Dugong Aerial Survey
Dugong Protection Area
Agreed by GBRMC 22
Seagrass '84
Land & Mangrove
GBRMP Boundary
Reefs
Far Northern Zoning
General Use 'A' Zone
General Use 'B' Zone
Islands
Marine National Park 'A' Zone
Marine National Park 'B' Zone
Marine National Park Buffer Zone
Preservation Zone
Scientific Research Zone
Interim
Dugong Protection Areas
1. Princess Charlotte Bay
2. Bathurst Bay
5 0 5 10 15 20 25 30
Kilometres
GREAT BARRIER REEF
MARINE PARK AUTHORITY
Note: DPA boundaries slightly altered from maps agreed at GBRMC meeting #22, by less than 1 minute for cartographic purposes

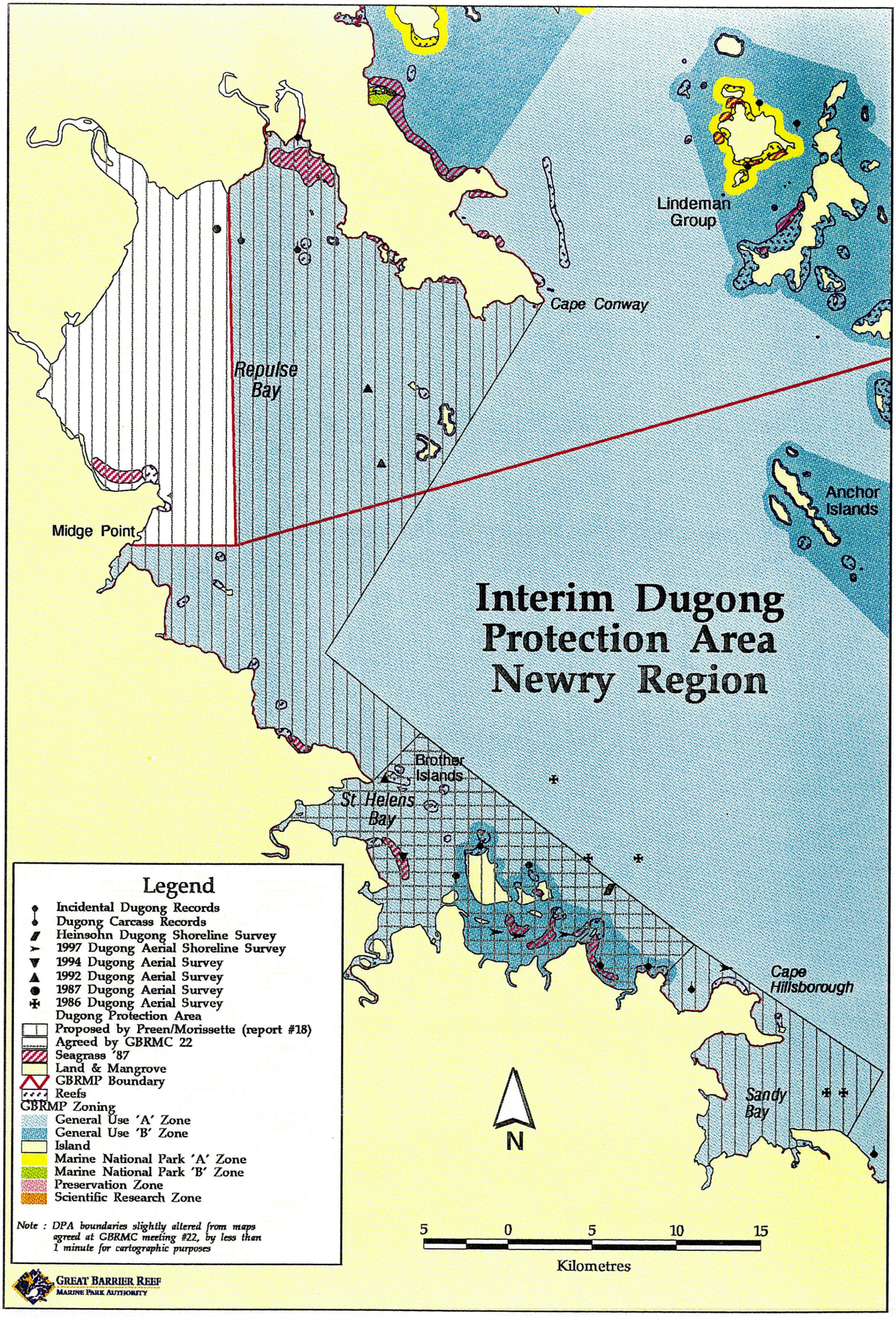

Proposed Dugong Protection Area Low Isles
(Proposed by Preen/Morissette report, February 1995)
Daintree River
Snapper Island
Rudder Reef
Opal Reef
Tongue Reef
Low Isles
Batt Reef
Port Douglas
N
Legend
Incidental Dugong Records
Heinsohn Dugong Shoreline Survey
1994 Dugong Aerial Survey
1992 Dugong Aerial Survey
1987 Dugong Aerial Survey
Dugong Protection Area
Proposed by Preen/Morissette report
Seagrass '84
Built-up Area
Land & Mangrove
GBRMP Boundary
Reefs
Cairns Zoning
Buffer Zone
Conservation Park Zone
Estuarine Conservation Zone
General Use Zone
Habitat Protection Zone
National Park Zone
Preservation Zone
5 0 5 10 15
Kilometres
GREAT BARRIER REEF
MARINE PARK AUTHORITY

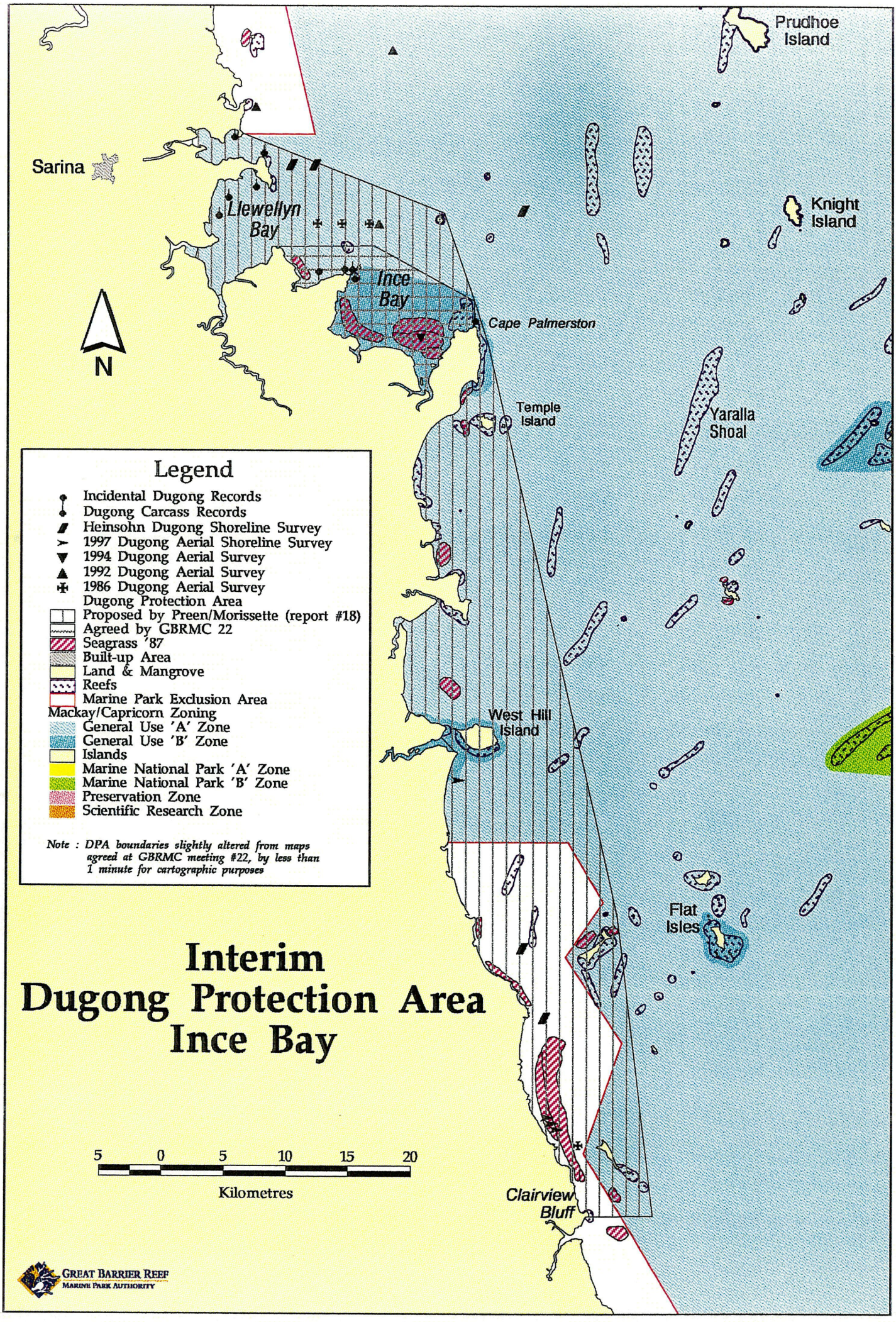

Brook Islands
Goold Island
1
Cape Richards
Shepherd Bay
Missionary Bay
Hecate Pt
Cardwell
Oyster Pt
2
3
Cape Sandwich
Ramsay Bay
Hinchinbrook Island
Zoe Bay
4
Lucinda Pt
Legend
Incidental Dugong Records
Dugong Carcass Records
Heinsohn Dugong Shoreline Survey
1994 Dugong Aerial Survey
1992 Dugong Aerial Survey
1987 Dugong Aerial Survey
Dugong Protection Area
Proposed by Preen/Morissette (report #18)
Agreed by GBRMC 22
Seagrass '96
Seagrass '94
Seagrass '87
Built-up Area
Land & Mangrove
GBRMP Boundary
Reefs
Central Zoning
General Use 'A' Zone
General Use 'B' Zone
Island
Marine National Park 'A' Zone
Marine National Park 'B' Zone
Preservation Zone
Scientific Research Zone
Management Plan Areas
1. Planning Area 1
2. Planning Area 2
3. Planning Area 3
4. Planning Area 4
Dugong Records - A. Preen; GBRMPA
Note : Seagrass '96 boundary indicative
: DPA boundaries slightly altered from maps agreed at GBRMC meeting #22, by less than 1 minute for cartographic purposes
Ingham
N
Interim
Dugong Protection Area
Hinchinbrook Region
Great Barrier Reef Marine Park Authority
5 0 5 10 15 20
Kilometres

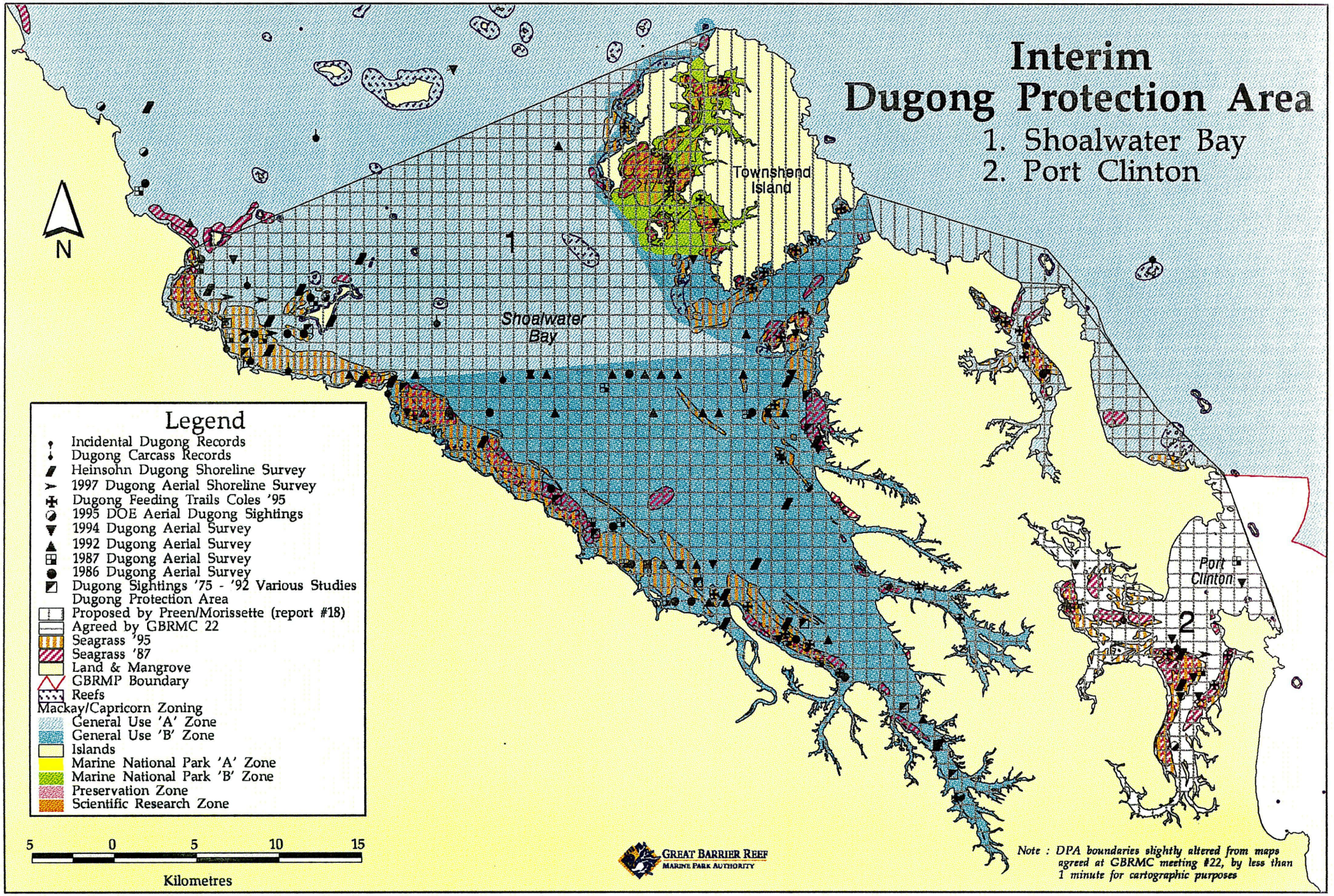

Interim
Dugong Protection Area
Cleveland Bay
Magnetic Island
Cleveland Bay
Townsville
Bowling Green Bay
Cape Bowling Green
Ayr
N
Legend
Incidental Dugong Sighting Records
Dugong Carcass Records
Heinsohn Dugong Shoreline Survey
1997 Dugong Aerial Shoreline Survey
1994 Dugong Aerial Survey
1992 Dugong Aerial Survey
1987 Dugong Aerial Survey
Dugong Protection Area
Proposed by Preen/Morissette (report #18)
Agreed by GBRMC 22
Seagrass '87
Built-up Area
Land & Mangrove
GBRMP Boundary
Reefs
Central Zoning
General Use 'A' Zone
General Use 'B' Zone
Island
Marine National Park 'A' Zone
Marine National Park 'B' Zone
Preservation Zone
Scientific Research Zone
Note : DPA boundaries slightly altered from maps agreed at GBRMC meeting #22, by less than 1 minute for cartographic purposes
5 0 5 10 15 20
Kilometres
Great Barrier Reef
Marine Park Authority

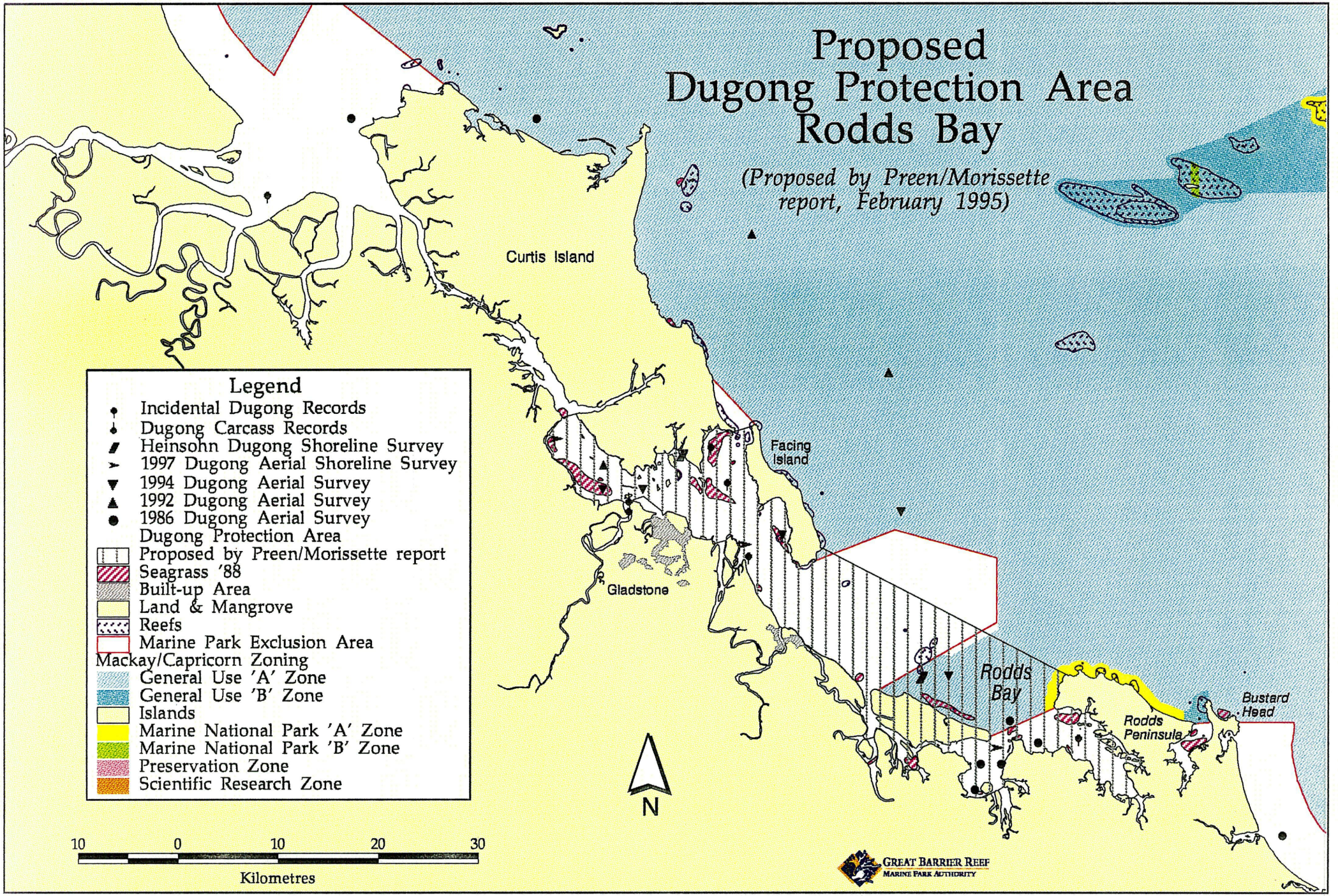

Interim
Dugong Protection Area
Upstart Bay
Burdekin River
Burdekin River
Rita Island
Peters Island
Cape Upstart
Upstart Bay
Abbot Bay
5 0 5 10
Kilometres
N
Legend
Incidental Dugong Records
Heinsohn Dugong Shoreline Survey
1997 Dugong Aerial Shoreline Survey
1994 Dugong Aerial Survey
1992 Dugong Aerial Survey
1987 Dugong Aerial Survey
Dugong Protection Area
Proposed by Preen/Morissette (report #18)
Agreed by GBRMC 22
Seagrass '87
Land & Mangrove
GBRMP Boundary
Reefs
Central Zoning
General Use 'A' Zone
General Use 'B' Zone
Island
Marine National Park 'A' Zone
Marine National Park 'B' Zone
Preservation Zone
Scientific Research Zone
GREAT BARRIER REEF
MARINE PARK AUTHORITY


Proposed Dugong Protection Area
- Edgecumbe Bay
(Proposed by Preen/Morissette report, February 1995)
N
Middle Island
Rattray Island
Bowen
Stone Island
Gloucester Island
Edgecumbe Bay
Legend
Incidental Dugong Records
Dugong Carcass Records
Heinsohn Dugong Shoreline Survey
1997 Dugong Aerial Shoreline Survey
1994 Dugong Aerial Survey
1992 Dugong Aerial Survey
1987 Dugong Aerial Survey
Dugong Protection Area
Proposed by Preen/Morissette report
Seagrass '87
Built-up Area
Land & Mangrove
GBRMP Boundary
Reefs
Central Zoning
General Use 'A' Zone
General Use 'B' Zone
Island
Marine National Park 'A' Zone
Marine National Park 'B' Zone
Preservation Zone
Scientific Research Zone
GREAT BARRIER REEF
MARINE PARK AUTHORITY
2 0 2 4 6 8 10
Kilometres


Lindeman Group
Cape Conway
Repulse Bay
Midge Point
Anchor Islands
Interim Dugong Protection Area Newry Region
Brother Islands
St Helens Bay
Cape Hillsborough
Sandy Bay
N
Legend
Incidental Dugong Records
Dugong Carcass Records
Heinsohn Dugong Shoreline Survey
1997 Dugong Aerial Shoreline Survey
1994 Dugong Aerial Survey
1992 Dugong Aerial Survey
1987 Dugong Aerial Survey
1986 Dugong Aerial Survey
Dugong Protection Area
Proposed by Preen/Morissette (report #18)
Agreed by GBRMC 22
Seagrass '87
Land & Mangrove
GBRMP Boundary
Reefs
GBRMP Zoning
General Use 'A' Zone
General Use 'B' Zone
Island
Marine National Park 'A' Zone
Marine National Park 'B' Zone
Preservation Zone
Scientific Research Zone
Note : DPA boundaries slightly altered from maps agreed at GBRMC meeting #22, by less than 1 minute for cartographic purposes
5 0 5 10 15
Kilometres
GREAT BARRIER REEF MARINE PARK AUTHORITY

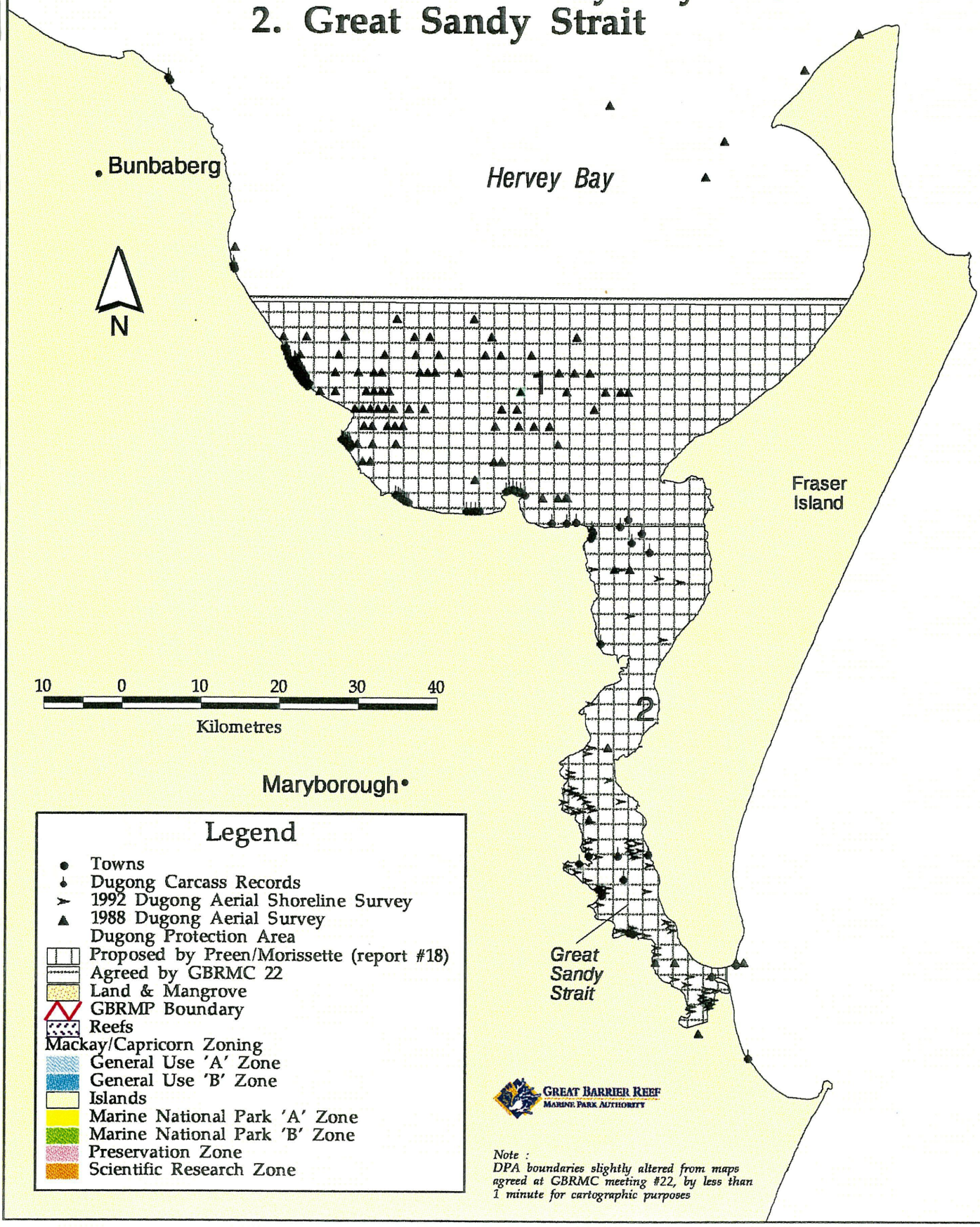

Prudhoe Island
Sarina
Llewellyn Bay
Ince Bay
Knight Island
Cape Palmerston
N
Temple Island
Yaralla Shoal
West Hill Island
Flat Isles
Clairview Bluff
Legend
Incidental Dugong Records
Dugong Carcass Records
Heinsohn Dugong Shoreline Survey
1997 Dugong Aerial Shoreline Survey
1994 Dugong Aerial Survey
1992 Dugong Aerial Survey
1986 Dugong Aerial Survey
Dugong Protection Area
Proposed by Preen/Morissette (report #18)
Agreed by GBRMC 22
Seagrass '87
Built-up Area
Land & Mangrove
Reefs
Marine Park Exclusion Area
Mackay/Capricorn Zoning
General Use 'A' Zone
General Use 'B' Zone
Islands
Marine National Park 'A' Zone
Marine National Park 'B' Zone
Preservation Zone
Scientific Research Zone
Note : DPA boundaries slightly altered from maps agreed at GBRMC meeting #22, by less than 1 minute for cartographic purposes
Interim
Dugong Protection Area
Ince Bay
5 0 5 10 15 20
Kilometres
Great Barrier Reef
Marine Park Authority


Interim
Dugong Protection Area
1. Shoalwater Bay
2. Port Clinton
N
Townshend Island
Shoalwater Bay
Port Clinton
1
2
Legend
Incidental Dugong Records
Dugong Carcass Records
Heinsohn Dugong Shoreline Survey
1997 Dugong Aerial Shoreline Survey
Dugong Feeding Trails Coles '95
1995 DOE Aerial Dugong Sightings
1994 Dugong Aerial Survey
1992 Dugong Aerial Survey
1987 Dugong Aerial Survey
1986 Dugong Aerial Survey
Dugong Sightings '75 - '92 Various Studies
Dugong Protection Area
Proposed by Preen/Morissette (report #18)
Agreed by GBRMC 22
Seagrass '95
Seagrass '87
Land & Mangrove
GBRMP Boundary
Reefs
Mackay/Capricorn Zoning
General Use 'A' Zone
General Use 'B' Zone
Islands
Marine National Park 'A' Zone
Marine National Park 'B' Zone
Preservation Zone
Scientific Research Zone
5 0 5 10 15
Kilometres
GREAT BARRIER REEF
MARINE PARK AUTHORITY
Note : DPA boundaries slightly altered from maps agreed at GBRMC meeting #22, by less than 1 minute for cartographic purposes


Proposed
Dugong Protection Area
Rodds Bay
(Proposed by Preen/Morissette report, February 1995)
Curtis Island
Facing Island
Gladstone
Rodds Bay
Rodds Peninsula
Bustard Head
Legend
Incidental Dugong Records
Dugong Carcass Records
Heinsohn Dugong Shoreline Survey
1997 Dugong Aerial Shoreline Survey
1994 Dugong Aerial Survey
1992 Dugong Aerial Survey
1986 Dugong Aerial Survey
Dugong Protection Area
Proposed by Preen/Morissette report
Seagrass '88
Built-up Area
Land & Mangrove
Reefs
Marine Park Exclusion Area
Mackay/Capricorn Zoning
General Use 'A' Zone
General Use 'B' Zone
Islands
Marine National Park 'A' Zone
Marine National Park 'B' Zone
Preservation Zone
Scientific Research Zone
N
10 0 10 20 30
Kilometres
Great Barrier Reef
Marine Park Authority

Interim
Dugong Protection Areas

1. Southern Hervey Bay
2. Great Sandy Strait



Note :
DPA boundaries slightly altered from maps agreed at GBRMC meeting #22, by less than 1 minute for cartographic purposes

ATTACHMENT F

Comment on QCFO Proposals by GBRMPA, the Interagency Dugong Working Party and the Board of the Queensland Fisheries Management Authority

ATTACHMENT F: GBRMPA Comments on QCFO Proposals

QCFO PROPOSAL	COMMENT BY GBRMPA
Education and Awareness Strategy Implement an endangered species awareness course for commercial fishers with local modules where appropriate.	Supported. This strategy applies to activities within and outside DPAs.
Legislation Any changes to fishing practices should be introduced through Queensland. fisheries legislation.	The most appropriate legislation should be determined on a case by case basis. In particular, comments on inflexibility of Marine Park zoning are not correct and in any case do not reflect regulations and other avenues available under that legislation.
Compliance Impose severe penalties for dugong deaths caused by intentional actions or gross neglect.	Supported in principle, but may need modification to address legislative requirements and practical implementation.
Incident Reporting An incident reporting program has been proposed by QCFO, includes proposal to receive feed back from autopsies and development of carcass handling guidelines.	Supported. Will complement action underway by management agencies.
Research Proposes priorities for research should include: • seagrass assessment; and • migration patterns and paths.	Support priority for research that will clearly assist management to address threats to dugong and enable recovery of populations.

Offshore Nets - Attendance

propose

- at the net attendance be introduced, except in specific areas;
- attendance by trainee or assistant master fishers

Support at the net (within 100 metres) attendance.
Do not support exceptions proposed for Halifax and Repulse Bays, as they would maintain high risk to dugong in those areas.
Do not support attendance by trainee or assistant fishers as it is desirable to have the most experienced fisher in attendance with one other person to assist if a dugong has to be released.

Identification of Nets

Propose registration system for nets to enable identification of illegal nets.

Support the development of better systems for addressing illegal netting.

Reporting of Illegal Netting

Protection for persons reporting illegal netting

Supported if a practical solution can be found.

Displacement of Effort and Compensation

Propose:

- compensation to displaced fishers for loss of income; and
- funds to buy out rather than displace effort.

Displacement of effort may have significant flow -on effects and must be addressed.
Compensation is a matter that concerns legislative provisions and government policy.

Region Specific Measures

There is insufficient basis for accepting that the region-specific measures proposed by QCFO will be adequate to ensure that nets do not cause dugong mortality in DPAs. In particular, the following issues would need to be addressed in each situation:

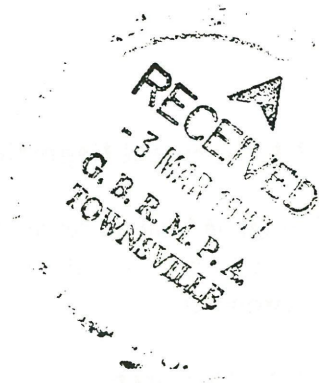
- Netters have previously stated that foreshore set nets have been responsible for dugong deaths yet under the QCFO submission they would only be restricted in some DPAs, and then only to a very limited extent. With the exception of the proposal for "at the net" attendance at the northern end of Hinchinbrook island and maintenance of the existing requirement that foreshore nets are not permitted in Hervey Bay, QCFO propose that netters should continue to be able to set 3 of these nets (and 6 nets in Princess Charlotte and Bathurst Bays) in areas that are known to contain significant number of dugong and be up to 2.6 kilometres from the furthest net;

- River set nets have reportedly been implicated in some dugong deaths and yet no actions are proposed to restrict their use outside of Hervey Bay. Netters would continue to be permitted to use up to 3 nets (6 nets in Princess Charlotte and Bathurst bays) and be up to 2.6 kilometres from the furthest net;

- Drift nets have some potential to catch dugong but the QCFO does not propose to limit their use in DPAs; and

- The proposal to remove offshore set nets in specific instances should indicate a clear intention to remove any possibility that that particular type of net could catch a dugong in that location. However, discussions with QCFO officials suggest that it has been proposed to replace offshore nets with shorter, rocky headland foreshore nets in a number of instances. Such foreshore nets will remain a risk to dugongs, albeit perhaps to a lesser extent when shortened. The use of foreshore nets may also increase the risk to dugongs, as current legislation restricts the use of offshore nets to one per fisher, and the QCFO proposed "at the net" attendance. However, in contrast, up to 3 foreshore nets can be set, and fishers can be up to 2.6km from the furthest net.

QFMA
Queensland Fisheries
Management Authority



Our Ref: th:pa:appleton:ltrs:stokes

28 February 1997

Mr A Stokes
Senior Planning Officer
Great Barrier Reef Marine Park Authority
PO Box 1379
TOWNSVILLE Q 4810

Dear Tony

The following report is provided to give the Working Group members an indication as to how the Board of the QFMA views the current situation with dugong, particularly in the southern Great Barrier Reef region.

The report will follow the sequence of the recommendations in the Commercial Industry Proposal for the implementation of the QCFO Dugong Conservation Strategy.

2.1 Education and Awareness Strategy

The QFMA supports the implementation of the Endangered Species Awareness Course as a medium to long-term measure but recognises that it will not meet the objective set by Ministerial Council.

2.2.1 Legislation

The QFMA does not unconditionally support the industry recommendation as the Commonwealth has similar, if not greater, powers than the *Fisheries Act 1994* and there may be instances where it may be more appropriate for Commonwealth legislation to be used. In terms of assisting commercial fishers, any appropriate Commonwealth legislative measures, which affect commercial netting, may be placed in "Queensland fisheries legislation as well.

2.2.2 Compliance

The QFMA notes that penalties are set by Government and the QFMA has a policy of licence suspension/cancellation for serious fisheries offences.

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Queensland Fisheries Management Authority
PO Box 344 Fortitude Valley Qld 4006

2.3.1 Incident Reporting

The QFMA supports an open and transparent process, which would include clear guidelines in dealing with these issues and currently being developed by the Department of Environment.

2.3.2 Research

The QFMA supports research into priority dugong matters which clearly assist management in protecting dugong from any potential hazardous source.

3.1.1 Offshore Set Net Attendance Rules

(a) The QFMA does not support the proposal that trainee master fishers can fulfill any attendance rule. There has not been any time to examine the ramifications of this proposal to other aspects of fishing. There is a need for experienced people to be in charge of the fishing operation at all times and it would be desirable to have not only the master fisher in attendance but at least one other person as well.

(b) The QFMA supports an attendance "at the net" rule for offshore netting ie. within 100 metres of the net or nets. The arguments used by industry for Halifax and Repulse Bays for the 800m attendance rule appear inappropriate for dugong protection as it may be too rough to see the net, take too long to reach the net if a dugong is entangled, if the weather is that rough not to have an "at the net" rule how can fishers be clearing their nets of fish at appropriate times and it may be that a net should not be set if the conditions at those times are too rough or dangerous.

3.1.2 Identification of Nets

The QFMA would support any investigation or analysis of existing net identification (current regulations require nets to be identified) particularly if a more effective system can be found.

3.1.3 Reporting Illegal Netting

The QFMA would support in principle any method which would eliminate illegal netting practices. QFMA also noted that many commercial netters working in an area can have a limiting effect on the number of illegally set nets.

3.1.4 Displacement of Effort

The QFMA is very concerned that any closures to commercial netting will have a displacement effect if licences are not removed. This displacement effect will not only affect other fisheries management regimes but would also exacerbate the dugong problem when dugong migrate from one DPA to another. The question of compensation is a matter concerning possible legislative provisions and Government policy at both Commonwealth and State levels.

4.1.1 Introduction to Region Specific Measures

Any changes to Queensland fisheries legislation would be dependent on divisions of Ministerial Council and the relevant power of specific pieces of legislation on which they are basing those decisions.

4.1.2 Conditions on Use of Foreshore Set Nets

The QFMA does not support this proposal at this time as there appears to be questionable linkages to dugong mortalities. There would need to be further analysis of the proposal before QFMA could support it.

4.2-4.7 Specific Measures in DPA's

There has been insufficient time to evaluate some of the specific measures advocated by industry.

4.8 Shoalwater Bay

The QFMA understands that the closure of Shoalwater Bay was agreed to in principle at Ministerial Council and that a Management Plan would be the vehicle by which this would occur.

4.9-4.11 Specific Measures in DPA's

There has been insufficient time to evaluate some of the specific measures advocated by industry.

In conclusion the Board of the QFMA has the following general comments to make on the issue of dugong -

- the dugong issue is a high priority as identified by Ministerial Council;
- the QFMA recognises that dugong populations have undergone severe decline in abundance in some areas (eg. Hervey Bay and southern Great Barrier Reef);
- the QFMA recognises there are a number of reasons for the decline including loss of seagrass habitat, shark nets for bather protection, pollution, commercial netting, boat strikes, traditional hunting. The QFMA believes that all of these reasons need to be addressed, not just the commercial netting industry;
- the QFMA supports the need to mitigate dugong captures in commercial nets through a number of approaches including:-
  - seasonal and/or area closures to netting operations;
  - requirements for offshore net attendance by commercial operators;
  - education and training of fishers in release of protected marine animals;
  - redesign, where appropriate, commercial netting apparatus to mitigate against capture; and
  - research to more reliably assess dugong status.

- the QFMA supports a cooperative, collaborative approach to resolution of this issue with the fishing industry and other agencies as the best approach and not by introducing regulations without sufficient consultation; and
- there is a management planning process in fisheries legislation, with MACs and ZACs in existence and this process should be adhered to for consideration of any detailed proposals before they are implemented. For example, if significant areas are closed this may displace effort in the other regions or fisheries which needs to be taken into account.

Yours sincerely

PL Appleton
EXECUTIVE OFFICER



QFMA
Queensland Fisheries
Management Authority

Our Ref:kh:pa:dugong:ltrs:greenhalgh

6 March 1997

Mr C Greenhalgh
QCFO
Clayfield Court
PO Box 392
CLAYFIELD Q 4011

Dear Cliff

I refer to discussions held on the Industry's Proposal for the Implementation of the QCFO Dugong Conservation Strategy at QFMA on Tuesday 4 March 1997.

On behalf of the Dugong Working Party I would like to thank you and Stephen Tapsall for attending the meeting at relatively short notice, and assisting the Working Party members in clarifying some of the proposed measures in the Strategy.

As indicated at the meeting there are some matters which remain outstanding in terms of their impact on dugong and I advised you that I would write to you seeking further information on them.

I propose to do that by seeking a clarification on a number of general points and then proceed to some points concerning specific Dugong Priority Areas.

The initial point which is essentially an observation is that from our discussions on Tuesday it would appear that the industry has the view that when considering the relative potential dangers posed by nets to dugong it ranks the offshore set mesh net the highest risk, the foreshore set mesh net a marginal risk and the river set mesh net of minimal risk. This assessment has been derived at by the high degree of attention paid to the offshore set mesh net and the relatively low amount of discussion on the other two forms of nets in the industry report.

Another general observation by the members of the Working Party is that a lot of the proposed measures have been advocated to protect dugong from the "travelling fisher" who either does not know the local conditions in terms of dugong behaviour or activity or simply just doesn't care about the consequences of unwise netting practices.

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Queensland Fisheries Management Authority
PO Box 344 Fortitude Valley Qld 4006

A general point raised is the general attendance rule at foreshore set mesh nets. The understanding of the Working Party members is that existing foreshore set mesh net attendance rule would mean that it is possible for a fisher to be anywhere from "at the net" to a maximum of 2.6km from the furtherest net. This distance of 2.6kms is brought about by the rule that the distance between the first and last net can be 1 nautical mile (approximately 1.8km) and the general 800m rule for attendance.

The Working Party members are concerned that given these potentially long distances involved with foreshore mesh net attendance, it poses a significant threat to dugong because the time taken to get to a net where a dugong maybe accidently entangled would be greater than the time it takes for a dugong to drown (eight minutes).

The non-recognition of the potential effects of the general attendance rule on foreshore set mesh nets contrasts with the degree of effort put by fishers into the measures designed to mitigate the effects of the offshore set mesh net on dugong.

The Working Party members acknowledge this as being a result of the relative ranking of the dangers posed by the different nets but would appreciate any further comments from industry on the potential dangers posed by the general attendance rule on foreshore set mesh nets.

In relation to the proposed "at the net" attendance rule being advocated by industry for offshore set mesh nets the Working Party acknowledges it as a significant step in attaining the goals of no further deaths of dugong caused through commercial netting.

The exemption for Halifax Bay and Repulse Bay to "at the net" attendance requirements however was of considerable concern because the proposed 800m attendance rule, associated with the exposed waters, and the sea conditions associated with it, would not enhance the survival of a dugong if caught in a net. It was not known what is meant by "to remain in sight of the net" when the reason for the exemption to the "at the net" rule was for the purpose of rough sea conditions which would tend to make any reasonable sighting of the net very difficult. It was indicated at our meeting that there are plenty of examples in Queensland waters where nets are taken out of the water when sea conditions are such that working the net is dangerous or the risk of catching a dugong is unacceptable.

It is therefore requested that the industry reconsider the exemptions for Halifax and Repulse Bay in light of the unacceptable risk that this measure could pose to dugong in these areas.

The Working Party members acknowledge that the industry views the use of river set mesh nets as being of minimal risk but there is a lot of evidence that dugong do travel and feed in a number of rivers and creeks within the Dugong Priority Areas. It will be appreciated if comments would be obtained from commercial fishers fishing in the rivers and creeks in the Dugong Priority Areas as to any measure which could be introduced to achieve the objective of the Great Barrier Reef Ministerial Council of no further dugong mortality as a result of commercial or recreational fishing practices.

The last general point concerns the proposal to go to 50m length of foreshore net for use around rocky headlands. The Working Party understands that the effects of this measure to mitigate against deaths of dugong include the following in areas below Cape Flattery -

- 3 x 50m nets will decrease the amount of net in the water below low water mark provided current use of 200m nets are used (⅓ = 66m). However if only 3 x 100m nets are used the use of 50m nets will increase the amount of net below low water mark;

- the 50m net size will greatly convenience the fisher with the use of nets for rocky headlands; and

- if the 50m maximum net length can be used off rocky headlands it will take the place of offshore set mesh nets.

The decrease in use of offshore set mesh nets will be removing a danger to dugong in these areas. Your confirmation on clarification of these effects would be appreciated.

In terms of the more specific points relating to specific Dugong Priority Areas, I will pose the concerns/questions following the sequence of Dugong Priority Areas in the Report.

PCB/Bathurst/Nearby areas.

- There is no mention of the possible effects of river set mesh nets;
- attendance rules for use of foreshore set mesh nets, particularly around rocky headlands and or islands.

Hinchinbrook

It is assumed that the offshore drift net is not being included within the attendance rules of the offshore set mesh net in this region and in all other regions.

- It would be appreciated if it could be confirmed if any offshore set mesh nets are used in Hinchinbrook Channel and if so what are the industry's views on their conditions of use;
- What is the industry's view on the "at the net" attendance proposal for areas between Hecate Point to Cape Sandwich to be extended to include Hinchinbrook Channel as well?

Cleveland Bay

In the Report it states that there is minimal (if any) dugong interaction with netting operations north of etc. Could it please be confirmed that the "at the net" attendance is being proposed for this area?

Upstart Bay

- Is there any foreshore netting from [illegible]water Creek to Oyster Point? And if there is industry's views on the dugong interaction and possible measures would be appreciated.

Based on further evidence of many sightings of dugong in the north-western part of the Bay, the QCFO agreed to re-examine the proposed measures.

Newry Bay

- The major difficulty with this area was the statement by industry that whilst the major dugong area within this region is around the seagrass at the mouth of Black Rock Creek as well as close to the rocky headlands around St Helens Bay, they appear to be advocating the use of foreshore set mesh nets back into the critical, high density dugong areas. Some clarification would be appreciated to ensure that the members of the Working Party are using the correct interpretation.

- The other point of clarification was the actual line of low water as there was some uncertainty as to whether the line on the map was correct or should it have been drawn between Jewers Point and Finlaysons Point.

Ince Bay

- General question of attendance rule of foreshore set mesh nets and the use of river set mesh nets.

Shoalwater Bay

All participants agreed that the negotiation on this Bay would be undertaken under the Shoalwater Bay Management Plan process being carried by GBRMPA. This was not to downgrade the measures being proposed for the Shoalwater Bay area but to acknowledge that another process had been commenced and negotiation and consultation would be effected under that process.

Port Clinton

- Can views be obtained on the proposition to reduce the ply strength on river set mesh nets in this area to match the reduction in ply strength for the foreshore set mesh nets.
- It is noted that the "at the net" attendance rule is proposed for foreshore set mesh nets in Port Clinton.

Hervey Bay and Great Sandy Straits

No points of clarification were needed.

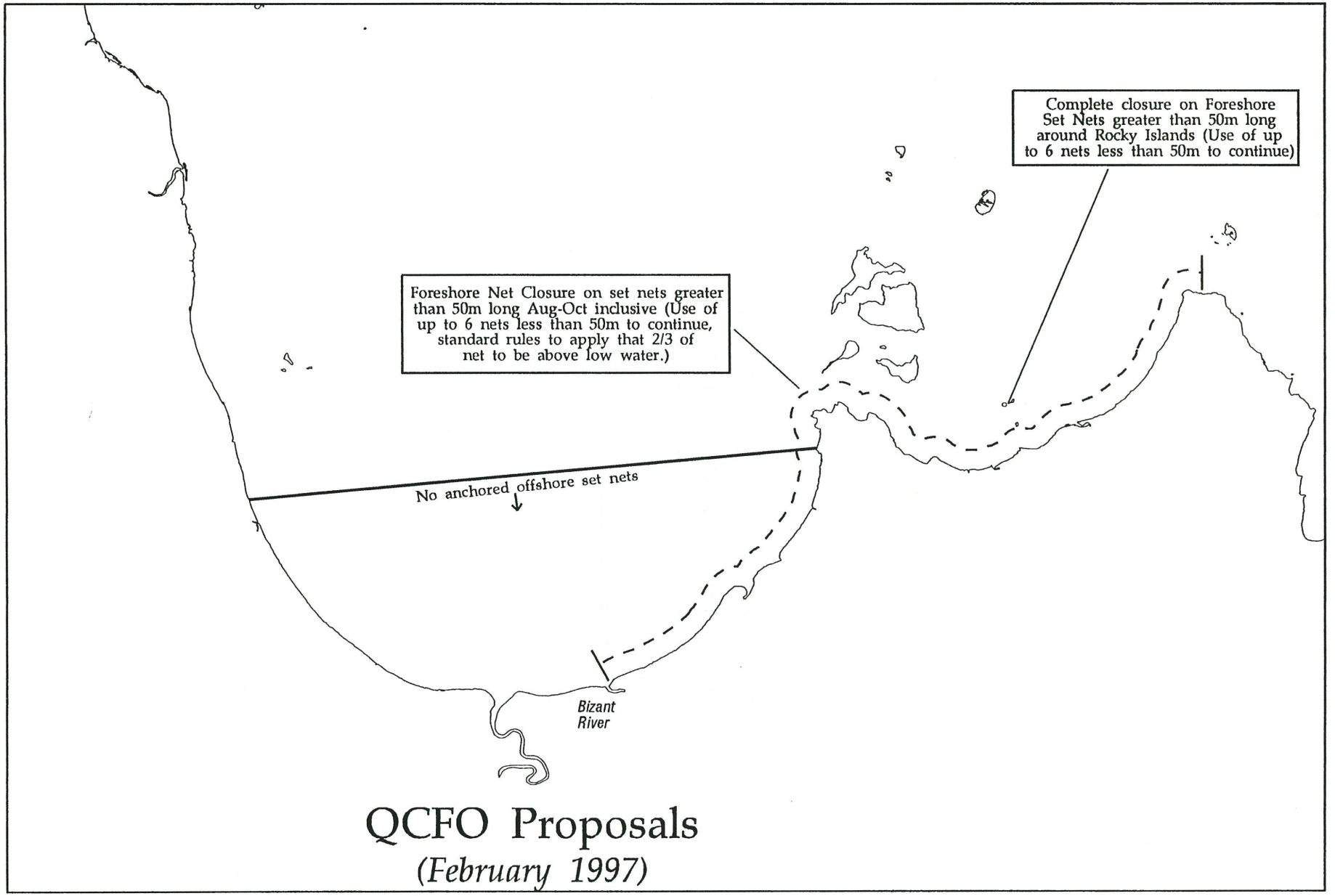
The amount of effort and time being attached to this important dugong issue by the commercial industry and the ongoing consultation and commitment to finding an effective solution to the problem is acknowledged and greatly appreciated.

Yours sincerely

PL Appleton
EXECUTIVE OFFICER

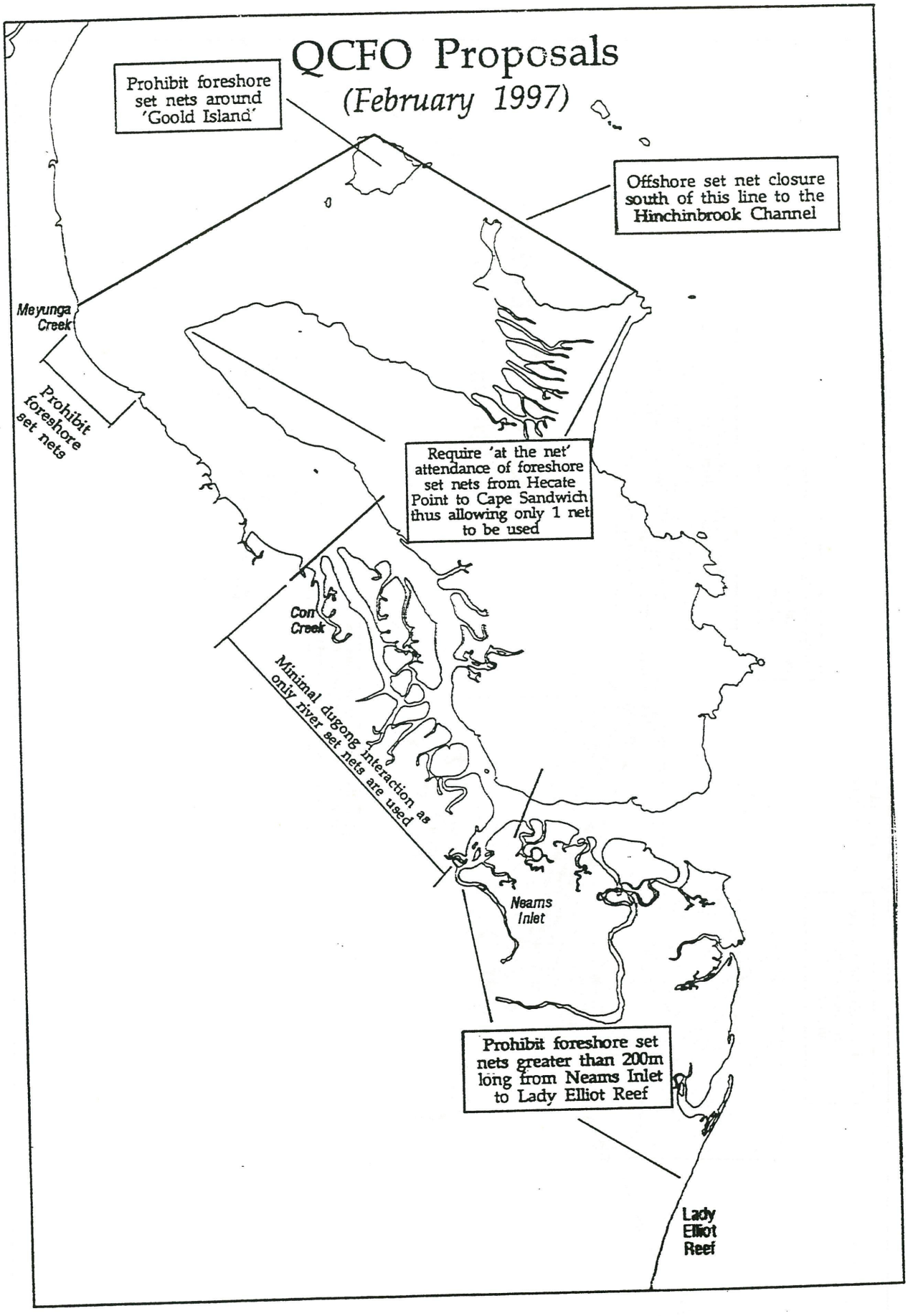
Attachment G

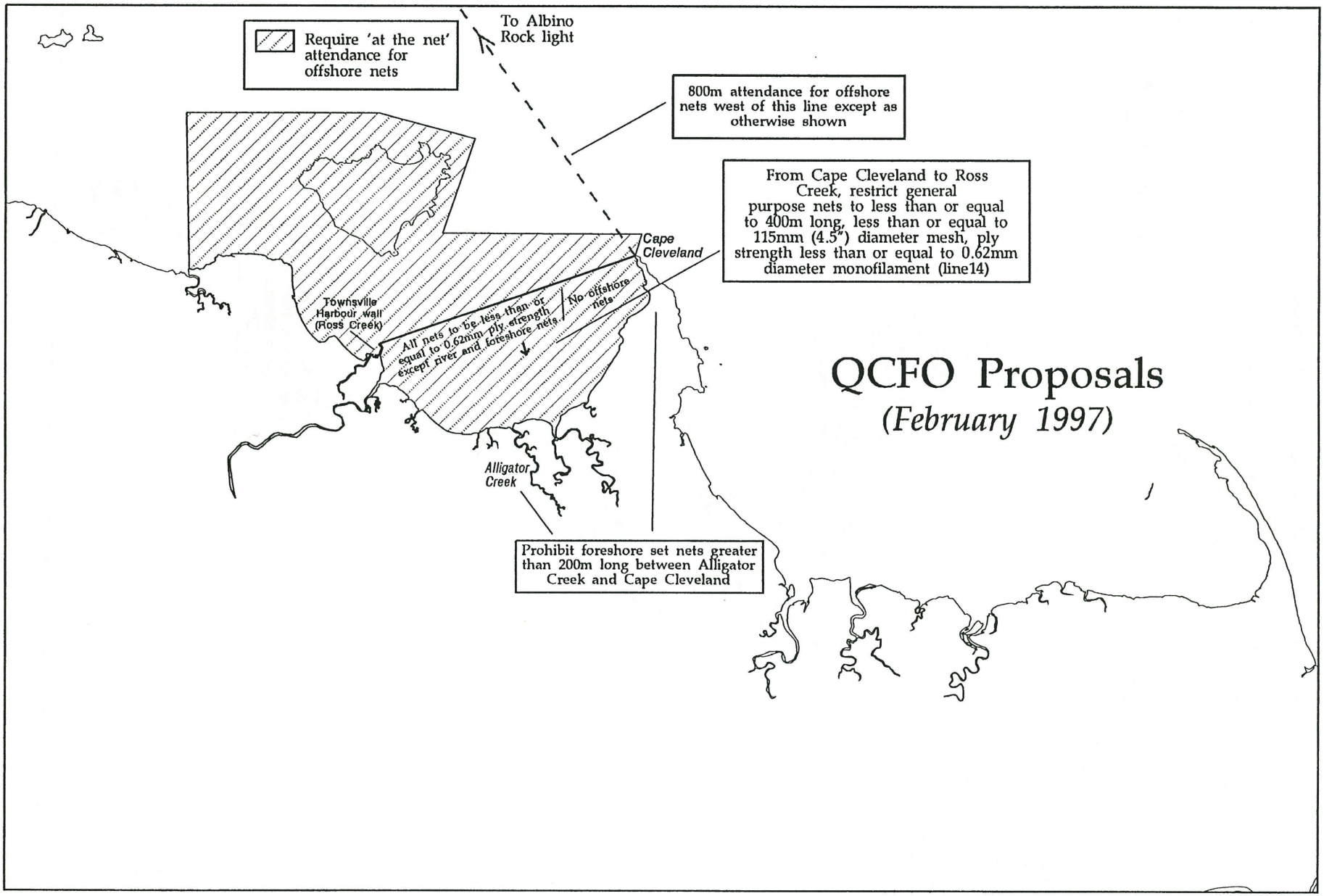
Map representation by GBRMPA of the Queensland Commercial Fishermen's Organisation proposal regarding dugong conservation
(Maps are overlays of those at Attachment E)

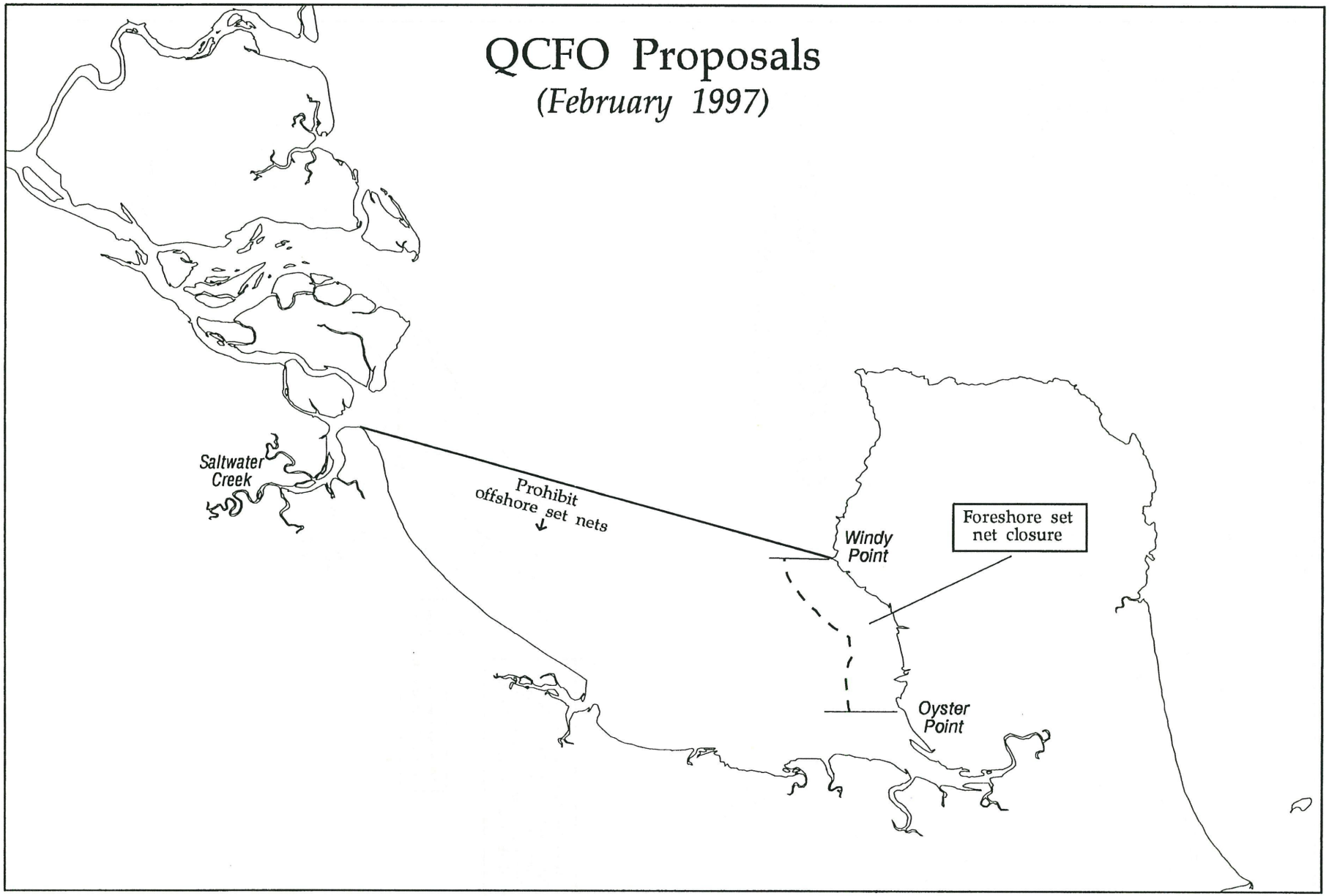


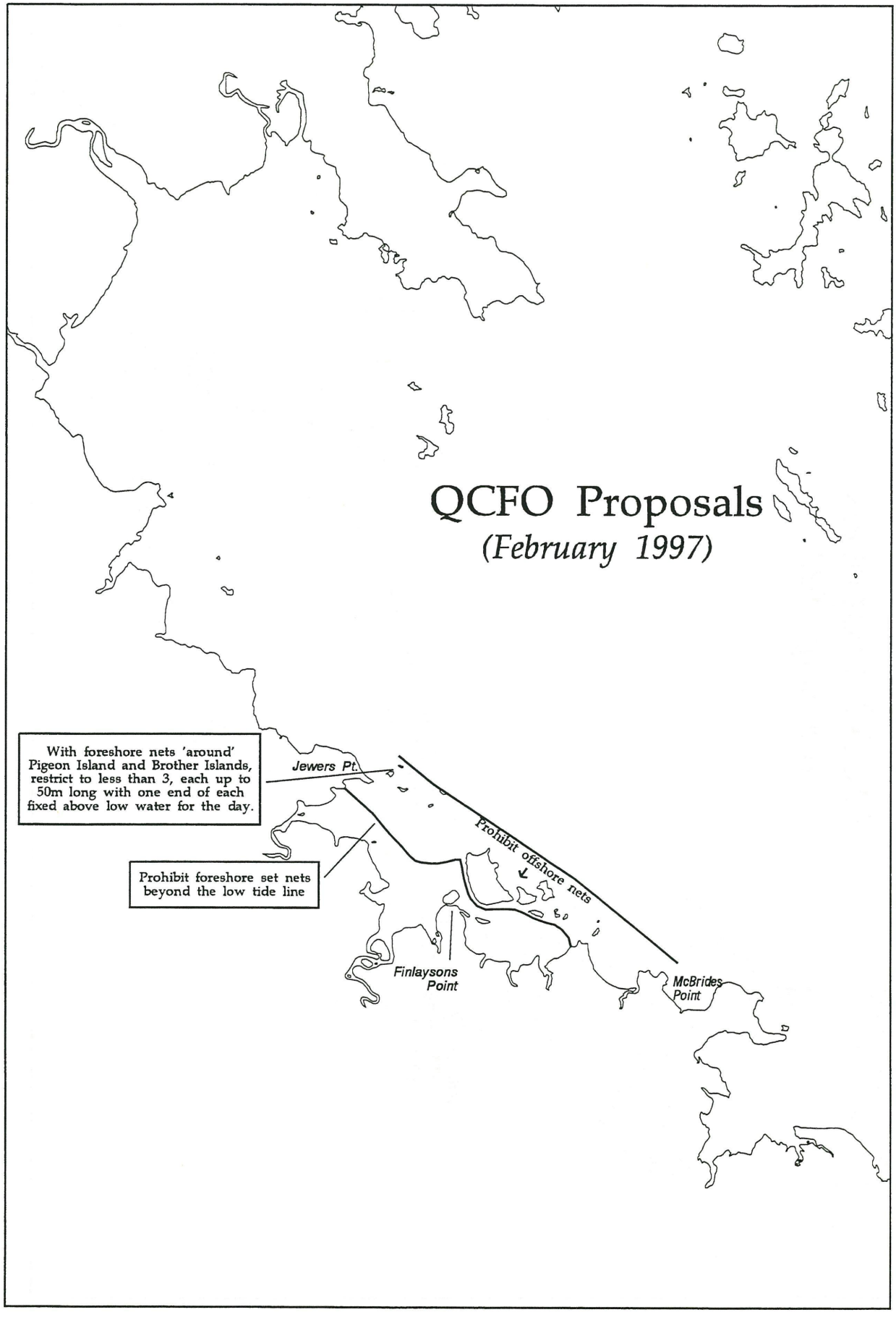
QCFO Proposals

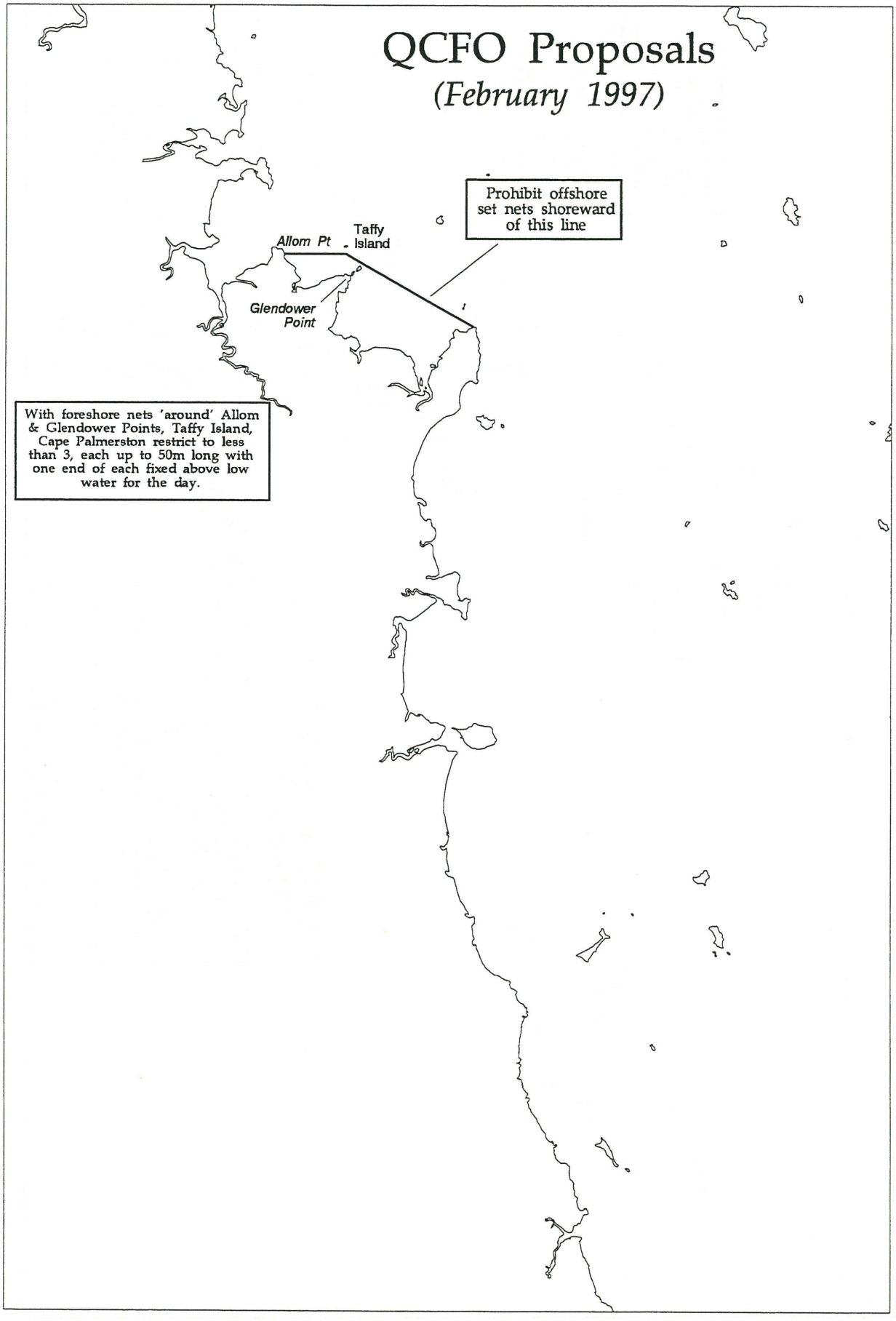
(February 1997)

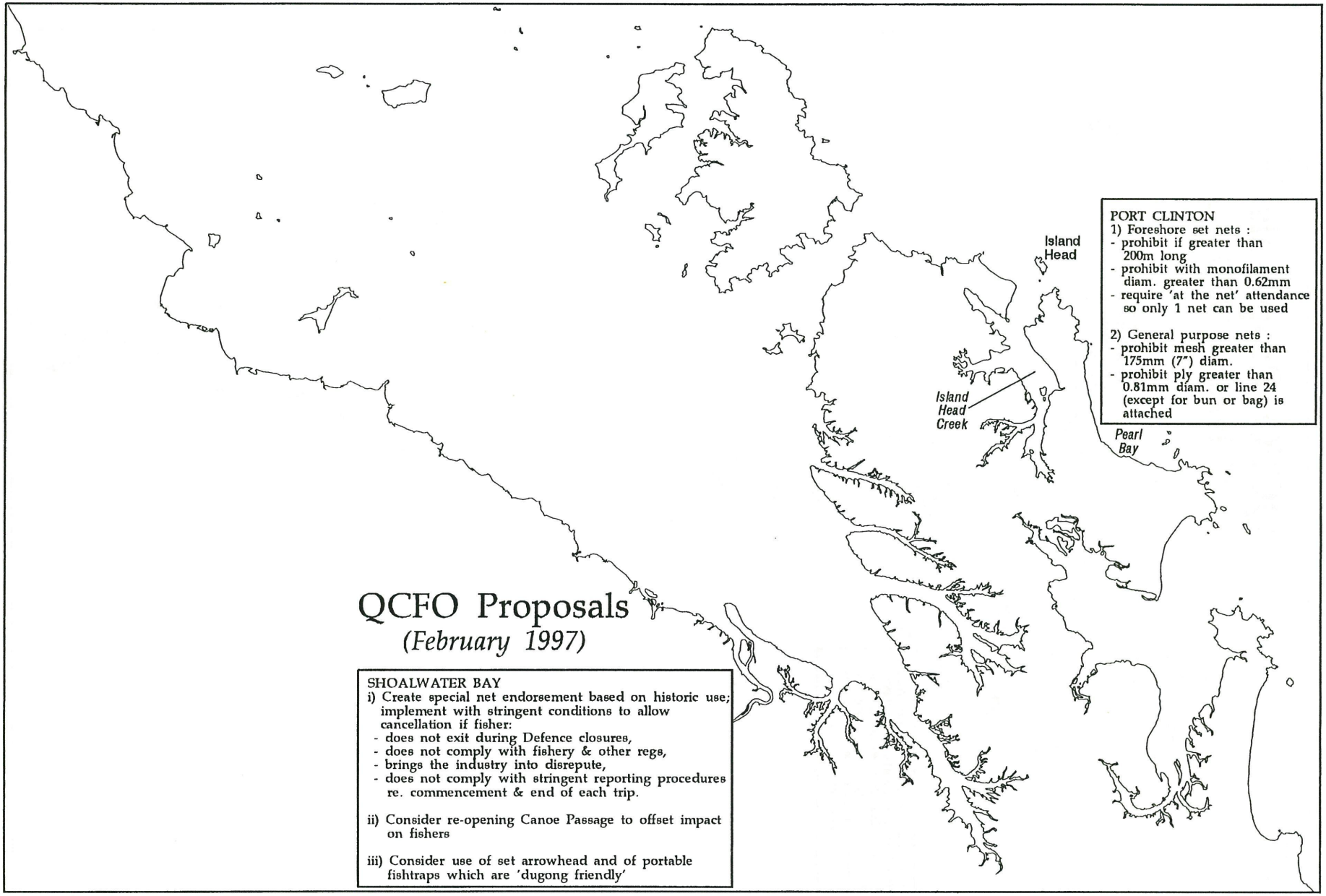

QCFO Proposals
(February 1997)
Prohibit foreshore set nets around 'Goold Island'
Offshore set net closure south of this line to the Hinchinbrook Channel
Meyunga Creek
Prohibit foreshore set nets
Require 'at the net' attendance of foreshore set nets from Hecate Point to Cape Sandwich thus allowing only 1 net to be used
Con Creek
Minimal dugong interaction as only river set nets are used
Neams Inlet
Prohibit foreshore set nets greater than 200m long from Neams Inlet to Lady Elliot Reef
Lady Elliot Reef


Require 'at the net' attendance for offshore nets
To Albino Rock light
800m attendance for offshore nets west of this line except as otherwise shown
From Cape Cleveland to Ross Creek, restrict general purpose nets to less than or equal to 400m long, less than or equal to 115mm (4.5") diameter mesh, ply strength less than or equal to 0.62mm diameter monofilament (line14)
Cape Cleveland
Townsville Harbour wall (Ross Creek)
All nets to be less than or equal to 0.62mm ply strength except river and foreshore nets
No offshore nets
Alligator Creek
Prohibit foreshore set nets greater than 200m long between Alligator Creek and Cape Cleveland
QCFO Proposals
(February 1997)

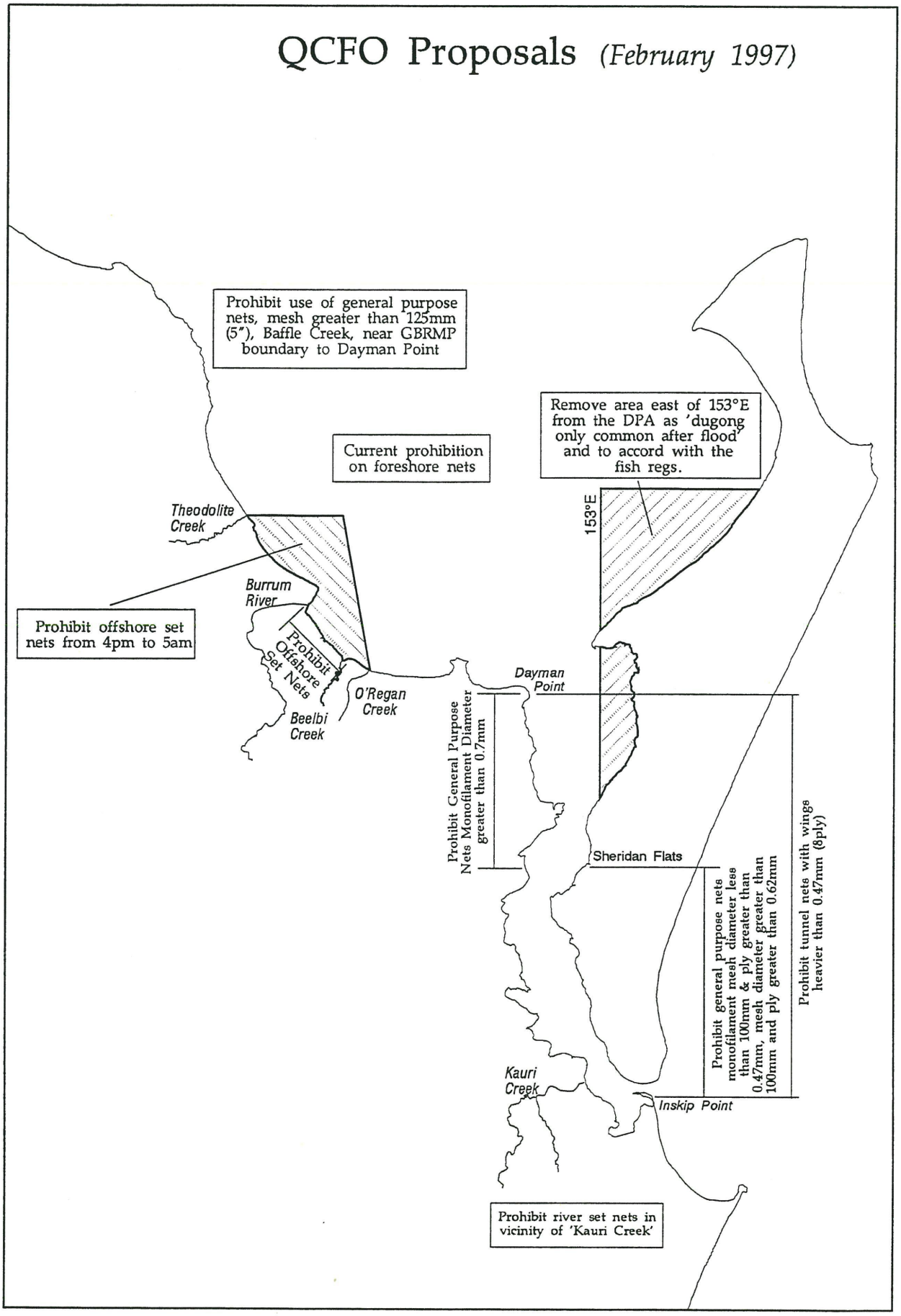

QCFO Proposals
(February 1997)
Saltwater Creek
Prohibit offshore set nets
Windy Point
Foreshore set net closure
Oyster Point


QCFO Proposals
(February 1997)
With foreshore nets 'around' Pigeon Island and Brother Islands, restrict to less than 3, each up to 50m long with one end of each fixed above low water for the day.
Jewers Pt.
Prohibit offshore nets
Prohibit foreshore set nets beyond the low tide line
Finlaysons Point
McBrides Point


QCFO Proposals
(February 1997)
Prohibit offshore set nets shoreward of this line
Allom Pt
Taffy Island
Glendower Point
With foreshore nets 'around' Allom & Glendower Points, Taffy Island, Cape Palmerston restrict to less than 3, each up to 50m long with one end of each fixed above low water for the day.


Island Head
Island Head Creek
Pearl Bay
PORT CLINTON
1) Foreshore set nets :
- prohibit if greater than 200m long
- prohibit with monofilament diam. greater than 0.62mm
- require 'at the net' attendance so only 1 net can be used
2) General purpose nets :
- prohibit mesh greater than 175mm (7") diam.
- prohibit ply greater than 0.81mm diam. or line 24 (except for bun or bag) is attached
QCFO Proposals
(February 1997)
SHOALWATER BAY
i) Create special net endorsement based on historic use; implement with stringent conditions to allow cancellation if fisher:
- does not exit during Defence closures,
- does not comply with fishery & other regs,
- brings the industry into disrepute,
- does not comply with stringent reporting procedures re. commencement & end of each trip.
ii) Consider re-opening Canoe Passage to offset impact on fishers
iii) Consider use of set arrowhead and of portable fishtraps which are 'dugong friendly'

QCFO Proposals *(February 1997)*



TABLES

Table 1: Comparison of Biogeographical Information on Interim and Proposed Dugong Protection Areas

(Notes: 1. All data is indicative only - additional appraisal is required; Bio-geographic data is from report #18;
2. The biogeographical information relates to the southern GBR only, not Hervey Bay/Great Sandy Strait and Princess Charlotte/Bathurst Bays;
1. *Int DPAs* means boundaries as at GBRMC 22; *Proposed* means boundaries as proposed in report #18, attached).

DPA	Dugongs sighted on aerial transect surveys 1986-87/1992/1994 (%) [differing survey intensities used in some places]	Coastal seagrasses in DPAs (%)	Area (km^2)	Distance to next DPA north (km)	Coastal waters in DPA (%)	Coastline in DPA (%)
1. Low Isles	Int DPAs = N/A Proposed = 1/3/0	Int DPAs = N/A Proposed = 0	Int DPAs = N/A Proposed = 1268	Int DPAs = N/A Proposed = 210	Int DPAs = N/A Proposed = 1.5	Int DPAs = N/A Proposed = 1
2. Hinchinbrook Island Region	Int DPAs = 8/8/24 Proposed = 8/9/23	Int DPAs = 18.6 Proposed = 18.6	Int DPAs = 694 Proposed = 815	Int DPAs = 473 Proposed = 240	Int DPAs = 2.6 Proposed = 3	Int DPAs = 4.5 Proposed = 4.8
3. Halifax, Cleveland Bay and Bowling Green Bays	Int DPAs = 8/4/18 Proposed = 13/7/21	Int DPAs = 19.3 Proposed = 20.9	Int DPAs = 646 Proposed = 1168	Int DPAs = 80 Proposed = 80	Int DPAs = 2.4 Proposed = 6.3	Int DPAs = 1.8 Proposed = 5.2
4. Upstart Bay	Int DPAs = 4/3/2 Proposed = 4/3/2	Int DPAs = 3.5 Proposed = 3.5	Int DPAs = 193 Proposed = 193	Int DPAs = 124 Proposed = 65	Int DPAs = 1.5 Proposed = 1.5	Int DPAs = 3.3 Proposed = 3.3
5. Edgecumbe Bay	Int DPAs = N/A Proposed = 8/3/1	Int DPAs = N/A Proposed = 2.4	Int DPAs = N/A Proposed = 412	Int DPAs = N/A Proposed = 80	Int DPAs = N/A Proposed = 2.5	Int DPAs = N/A Proposed = 2.4
6. Newry Island/Repulse Bay Region	Int DPAs = 0/1/2 Proposed = 11/3/2	Int DPAs = 0.8 Proposed = 2.1	Int DPAs = 150 Proposed = 752	Int DPAs = 143 Proposed = 100	Int DPAs = 1.2 Proposed = 5.2	Int DPAs = 2.6 Proposed = 7.3

Table 1 (cont.)

DPA	Dugongs sighted on aerial transect surveys 1986-87/1992/1994 (%) [differing survey intensities used in some places]	Coastal seagrasses in DPAs (%)	Area (km^2)	Distance to next DPA north (km)	Coastal waters in DPA (%)	Coastline in DPA (%)
7. Cape Palmerston (Ince Bay)	Int DPAs = 0/0/1 Proposed = 5/1/1	Int DPAs = 2.5 Proposed = 6.7	Int DPAs = 80 Proposed = 800	Int DPAs = 99 Proposed = 75	Int DPAs = 0.7 Proposed = 5.6	Int DPAs = 1.5 Proposed = 5.4
8. Shoalwater Bay/Port Clinton	Int DPAs = 21/31/31 Proposed = 21/31/31	Int DPAs = 21.4 Proposed = 21.4	Int DPAs = 1050 Proposed = 1080	Int DPAs = 160 Proposed = 100	Int DPAs = 5 Proposed = 5.5	Int DPAs = 9.7 Proposed = 10.4
9. Rodd's Bay	Int DPAs = N/A Proposed = 4/4/7	Int DPAs = N/A Proposed = 3.6	Int DPAs = N/A Proposed = 510	Int DPAs = N/A Proposed = 190	Int DPAs = N/A Proposed = 3.5	Int DPAs = N/A Proposed = 4.3
10. Great Sandy Strait/Sthn Hervey Bay (outside GBRMP)	Int DPAs = N/A Proposed = N/A	Int DPAs = N/A Proposed = N/A	Int DPAs = N/A Proposed = N/A	Int DPAs = 396 Proposed = 160.	Int DPAs = N/A Proposed = N/A	Int DPAs = N/A Proposed = N/A
11. Princess Charlotte Bay & Bathurst Bay *Under Consideration* (Northern GBR)	Int DPAs = N/A Proposed = N/A	Int DPAs = N/A Proposed = N/A	Int DPAs = N/A Proposed = 0	Int DPAs = 473 Proposed = 210	Int DPAs = N/A Proposed = N/A	Int DPAs = N/A Proposed = N/A
TOTALS(SGBR)	**Int DPAs = 41/47/78** **Proposed = 75/64/88**	**Int DPAs = 66.1** **Proposed = 79.2**	**Int DPAs = 2813** **Proposed = 6998**	**Int DPAs = 211 (average)** **Proposed = 130 (average)**	**Int DPAs = 13.4** **Proposed = 34.6**	**Int DPAs = 23.4** **Proposed = 44.1**

Table 2 : Species catch in mesh nets in interim and proposed Dugong Protection Areas

(Notes : 1. Catches - kg live weight - in 19951. 2. Based upon QFMA 6 minute logbook data, reworked by GBRMPA; 3. Discrepancy with total catches in some DPAs is due to non-inclusion of 30 minute data)

A. Interim DPAs agreed by 22nd meeting of GBRMinisterial Council

Summary of most important species

Species Name	Sum of live_wght species_code_num	Princess Charlotte Bay	Bathurst Bay	Hinchinbrook	Cleveland Bay	Upstart Bay	Ince Bay	Newry Region	Shoalwater Bay	Port Clinton	Southern Hervey Bay	Great Sandy Strait	Grand Total
Shark	**901034**	**20,023**	**1,100**	**6,518**	**6,527**	**321**	**5,738**	**1,140**	**2,027**	**440**	**11,696**	**5,641**	**61,170**
Barra	**610002**	**11,373**	**438**	**7,324**	**3,906**	**97**	**758**	**1,554**	**709**	**223**	**831**	**116**	**27,329**
Spotted Mackerel	441015	0	0	0	0	0	13	0	0	16	13,715	780	14,523
Mackerel Other	441800	326	72	1,713	813	0	184	268	2,230	0	1,671	2,894	10,171
Grey Mackerel	441018	52	0	2,258	1,089	0	31	20	32	122	203	771	4,578
School Mackerel	441014	0	0	0	0	0	29	15	0	0	3,397	1,657	5,099
Mackerel Total		**378**	**72**	**3,972**	**1,902**	**0**	**257**	**303**	**2,262**	**138**	**18,987**	**6,102**	**34,372**
Mullets	381000	46	10	5,487	6,001	234	258	232	154	195	22,296	28,145	63,058
Sea Mullet	381002	0	0	0	0	0	0	0	0	0	11,618	0	11,618
FANTAIL MULLET	381009	0	0	0	0	0	0	0	0	0	109	1,289	1,398
Mullet Total		**46**	**10**	**5,487**	**6,001**	**234**	**258**	**232**	**154**	**195**	**34,023**	**29,434**	**76,074**
Blue Salmon	383004	1,277	0	2,802	3,431	458	578	793	2,079	343	137	206	12,104
King Salmon	383005	1,880	20	1,337	118	107	408	1,181	791	140	508	616	7,105
Salmon Total		**3,157**	**20**	**4,140**	**3,550**	**565**	**986**	**1,974**	**2,870**	**483**	**644**	**821**	**19,209**
QUEENFISH	337905	399	0	607	1,444	77	0	351	186	6	119	43	3,231
TREVALLY	337900	166	60	7	902	0	21	292	632	0	474	274	2,827
BLACK TREVALLY	337800	0	0	0	0	0	0	0	0	0	693	1,336	2,029
Trevally Total		**565**	**60**	**614**	**2,345**	**77**	**21**	**643**	**818**	**6**	**1,286**	**1,653**	**8,087**
Whiting	330900	0	0	10	0	0	25	10	0	0	11,535	26,507	38,087
SUMMER WHITING	330800	0	0	0	0	0	0	0	0	0	1,555	871	2,426
Whiting Total		**0**	**0**	**10**	**0**	**0**	**25**	**10**	**0**	**0**	**13,090**	**27,378**	**40,513**
Yellow Finned Bream	353004	0	0	118	0	183	56	161	0	0	2,361	5,546	8,425
GRUNTER/BREAM	350800	280	10	89	1,340	34	89	346	620	12	0	0	2,819
Bream Total		**280**	**10**	**207**	**1,340**	**217**	**144**	**507**	**620**	**12**	**2,361**	**5,546**	**11,244**
Flat Head	**296000**	**0**	**0**	**78**	**173**	**85**	**242**	**80**	**46**	**123**	**582**	**3,886**	**5,295**
SEA GAR	**234000**	**520**	**0**	**973**	**287**	**0**	**0**	**0**	**0**	**0**	**145**	**1,441**	**3,366**
TAILOR	**334002**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**448**	**1,604**	**2,052**
Mixed Fish	**599000**	**1,186**	**20**	**490**	**515**	**0**	**257**	**323**	**0**	**0**	**991**	**1,442**	**5,224**
OTHERS	**999999**	**4,135**	**0**	**181**	**0**	**0**	**42**	**7**	**0**	**0**	**0**	**0**	**4,364**
Total per DPA		**41,663**	**1,7[illegible]**	**2[illegible]**	**[illegible]47**	**[illegible],595**	**8,7[illegible]**	**6,[illegible]**	**[illegible]7**	**[illegible]20**	**[illegible],99[illegible]**	**[illegible]7,6[illegible]**	**25[illegible]**

Table 2 (Cont.)

B. Extended and additional DPAs proposed in this Report

Summary of most important species

	species_code_num	Princess Charlotte Bay/	Low Isles	Hinchinbrook	Cleveland Bay/ Bowling Green Bay	Upstart Bay	Edgecumbe Bay	Newry/ Repulse Bay	Cape Palmerstone	Shoalwater Bay/ Port Clinton	Rod's Bay Gladstone	Hervey Bay/ Great Sandy Strait	Totals per Species
Shark	**901034**	**21,083**	**0**	**8,179**	**11,104**	**231**	**73**	**16,378**	**11,982**	**1,562**	**14,029**	**17,337**	**101,956**
Barra	**610002**	**11,751**	**492**	**7,884**	**9,472**	**97**	**66**	**6,429**	**1,420**	**604**	**1,255**	**947**	**40,417**
Spotted Mackerel	441015	0	0	0	0	0	0	0	13	16	0	14,494	14,523
Mackerel Other	441800	398	0	1,713	1,032	0	236	516	194	1,054	688	4,566	10,396
Grey Mackerel	441018	52	0	2,258	9,463	0	0	1,883	3,897	122	30	974	18,679
School Mackerel	441014	0	0	0	0	0	0	33	29	0	147	5,054	5,264
Mackerel Total		**450**	**0**	**3,972**	**10,495**	**0**	**236**	**2,432**	**4,133**	**1,192**	**865**	**25,088**	**48,863**
Mullets	381000	56	0	5,855	7,679	188	2	4,026	343	349	15,394	50,441	84,332
Sea Mullet	381002	0	0	0	0	0	0	0	0	0	0	11,618	11,618
FANTAIL MULLET	381009	0	0	0	0	0	0	0	0	0	0	1,398	1,398
Mullets Total		**56**	**0**	**5,855**	**7,679**	**188**	**2**	**4,026**	**343**	**349**	**15,394**	**63,457**	**97,348**
Blue Salmon	383004	1,277	678	3,463	7,602	217	156	3,966	726	1,156	4,189	342	23,773
King Salmon	383005	1,900	0	1,509	890	107	30	3,013	600	695	901	1,123	10,767
Salmon Total		**3,177**	**678**	**4,972**	**8,492**	**324**	**186**	**6,978**	**1,326**	**1,851**	**5,090**	**1,465**	**34,540**
QUEENFISH	337905	399	0	607	4,190	77	0	1,151	0	192	104	162	6,882
TREVALLY	337900	226	122	7	966	0	0	887	38	152	18	748	3,164
BLACK TREVALLY	337800	0	0	0	0	0	0	0	0	0	0	2,029	2,029
DART	337904	0	0	0	198	0	0	281	0	0	233	1,017	1,729
Trevally Total		**625**	**122**	**614**	**5,354**	**77**	**0**	**2,319**	**38**	**344**	**355**	**3,956**	**13,804**
Whiting	330900	0	0	15	0	0	0	659	25	0	213	38,042	38,954
SUMMER WHITING	330800	0	0	0	0	0	0	0	0	0	163	2,426	2,589
Whiting Total		**0**	**0**	**15**	**0**	**0**	**0**	**659**	**25**	**0**	**376**	**40,468**	**41,543**
GRUNTER/BREAM	350800	290	13	95	2,062	34	6	1,621	89	386	884	0	5,479
Yellow Finned Bream	353004	0	0	162	11	178	0	1,093	56	0	675	7,907	10,082
Bream Total		**290**	**13**	**257**	**2,073**	**211**	**6**	**2,714**	**144**	**386**	**1,559**	**7,907**	**15,561**
Flat Head	**296000**	**0**	**0**	**108**	**396**	**34**	**0**	**854**	**256**	**147**	**843**	**4,468**	**7,106**
SEA GAR	**234000**	**520**	**0**	**973**	**287**	**0**	**0**	**12**	**0**	**0**	**0**	**1,586**	**3,378**
TAILOR	**334002**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**0**	**2,052**	**2,052**
Mixed Fish	**599000**	**1,206**	**25**	**490**	**1,833**	**0**	**174**	**788**	**301**	**0**	**2,382**	**2,433**	**9,632**
OTHERS	**999999**	**4,135**	**0**	**181**	**433**	**0**	**0**	**7**	**63**	**0**	**934**	**0**	**5,752**
BAIT FISH	**599920**	**0**	**0**	**140**	**56**	**0**	**0**	**141**	**0**	**0**	**2,523**	**71**	**2,931**
Totals per DPA		**43,293**	**1,330**	**33,639**	**57,673**	**1,161**	**743**	**43,737**	**20,031**	**6,435**	**45,604**	**171,235**	**424,882**

Table 3: Comparison of Commercial fish netting in Interim and Proposed Dugong Protection Areas

(Notes: 1. All data is indicative only - additional appraisal is required; netting data is from GBRMPA appraisal of 1995 QFMA logbook returns;
2. * Significant netters means commercial netters who caught over 3 tonnes of fish of which the majority caught > 10% of their total product in the DPA;
3. *Int DPAs* means boundaries as at GBRMC 22; *Proposed* means boundaries as proposed in report #18, attached).

DPA	Effort in Original DPAs (km netlength used in 1995)	% Effort over all Original DPAs	Effort in Proposed DPAs (km netlength used in 1995)	% Effort over all Proposed DPAs	Catch in Original DPAs (tonnes live weight in 1995)	% Catch over all Original DPAs	Catch in Proposed DPAs (tonnes live weight in 1995)	% Catch over all Proposed DPAs	# netters who used the area / # of significant netters*
1. Low Isles	N/A	N/A	15	0.8	N/A	N/A	1	0.4	Int DPAs = N/A. Proposed = 3/2
2. Hinchinbrook Island Region	210	24.1	250	12.8	30	28.6	35	13.9	Int DPAs = 18/6 Proposed = 18/6
3. Halifax, Cleveland Bay and Bowling Green Bays	300	34.5	510	26.1	35	33.3	75	29.9	Int DPAs = 10/10 Proposed = 18/14
4. Upstart Bay	30	3.5	30	1.5	5	4.8	5	2.0	Int DPAs = 2/1 Proposed = 2/1
5. Edgecumbe Bay	N/A	N/A	10	0.5	N/A	N/A	5	2.0	Int DPAs = N/A. Proposed = 4/3
6. Newry Island/Repulse Bay Region	100	11.5	360	18.4	10	9.5	45	17.9	Int DPAs = 6/4 Proposed = 10/5
7. Cape Palmerston (Ince Bay)	110	12.6	230	11.8	10	9.5	25	10.0	Int DPAs = 5/4 Proposed = 10/6
8. Shoalwater Bay/Port Clinton	120	13.8	120	6.1	15	14.3	15	6.0	Int DPAs = 8/3 Proposed = 8/4

Table 3 (cont.)

DPA	Effort in Original DPAs (km netlength used in 1995)	% Effort over all Original DPAs	Effort in Proposed DPAs (km netlength used in 1995)	% Effort over all Proposed DPAs	Catch in Original DPAs (tonnes live weight in 1995)	% Catch over all Original DPAs	Catch in Proposed DPAs (tonnes live weight in 1995)	% Catch over all Proposed DPAs	# netters who used the area / # of significant netters*
9. Rodd's Bay	N/A	N/A	430	22.0	N/A	N/A	45	17.9	Int DPAs = N/A. Proposed = 15/9
10. Great Sandy Strait/Sthn Hervey Bay (outside GBRMP)	2,630 (1100) * See Note 1 below	N/A	2,630 (1100) * See Note 1 below	N/A	190 (65) * See Note 1 below	N/A	190 (65) * See Note 1 below	N/A	Int DPAs = 32/30 Proposed = 34/30
11. Princess Charlotte Bay & Bathurst Bay *Under Consideration* (Northern GBR)	320	N/A	320	N/A	45	N/A	45	N/A	Int DPAs = 9/5 Proposed = 9/5
TOTALS (SGBR)	**870**	**100.0**	**1955**	**100.00**	**105**	**100.0**	**251**	**100.0**	• **All Int DPAs = 90/63** **- without GSS/ HB = 58/33** **- without PCB/BB = 49/28** • **All Proposed DPAs = 131/85** **- without GSS/HB = 97/55** **- without PCB/BB = 88/50**

Note 1: Figures in brackets for Hervey Bay/Great Sandy Straits relate to those fisheries which pose a threat to dugong (ie: those targeting shark, barramundi and mackerel).

SUBMISSIONS AND REPORTS

Attachment C

List of Submissions and Reports

(numbered for reference purposes in this report)

Submissions

1. *Industry proposal for implementation of the QCFO Dugong Conservation Strategy;* plus supplementary fax of 26/2/97 on *'clarification of areas in QCFO Strategy'*.
   (by the Queensland Commercial Fishermen's Organisation)
2. *Dugong mortality from the perspective of recreational anglers in Queensland* (by Sunfish Queensland Incorporated)
3. *Dugong Shoalwater Bay* (by Sunfish Queensland Incorporated)
4. *Latest situation - nets - shark control program* (by QDPI)
5. Letter of 19/2/97 from Commissioner I Delaney, ATSIC Commissioner, Queensland Metropolitan Zone
6. Letter of 24/1/97 from Dr P Corkeron, James Cook University, to the Queensland Minister for Primary Industries (copied to GBRMPA) regarding shark nets at Magnetic Island.
7. Letters of 19/2/97 and 21/2/97 from Humane Society International
8. *Dugong Conservation Policy* (by Australian Marine Conservation Society, 20/2/97)
9. Letter of 21/2/97 from the Queensland Conservation Council
10. Letter of 21/2/97 from the Australian Marine Conservation Society
11. Letter of 21/2/97 from the Wildlife Preservation Society of Queensland (Proserpine/Whitsunday Branch Inc.)
12. Letter of 22/2/97 from the Wildlife Preservation Society of Queensland (Townsville Branch Inc.)
13. Letter of 23/2/97 from the Friends of Hinchinbrook Society Inc.
14. Letter of 23/2/97 from the North Queensland Conservation Council
15. Letter of 24/2/97 from Dr T. Preen, James Cook University, enclosing *'Comments on the Dugong Conservation Policy of the Australian Marine Conservation Society'*.
16. Letter of 24/2/97 from the Wildlife Preservation Society of Queensland (Tully & District Branch)
17. Letters of 17/2/97 and 25/2/97 from Professor H. Marsh, James Cook University, including the draft report, *'Attempts at minimising the bycatch of endangered species in commercial fishing operations in the United States: lessons for the Great Barrier Reef region'* .

Reports

18. *A system of dugong sanctuaries for the recovery and conservation of dugong populations in the Great Barrier Reef World Heritage Area and adjacent southern waters* ; plus supplementary report and comparative Table, received 26/2/97 [attached to main report are overheads and notes for verbal presentation to MPA 165, 20/2/97]
    (by Tony Preen and Nina Morissette, James Cook University)
19. *Mesh nets used in waters of Queensland's East Coast : The risk to dugongs in proposed Interim Dugong Protection Areas*
    (by Martin Russell, GBRMPA)

20. *Report on vessel use in the Interim Dugong Protection Areas* (by M. Gilbert and D Benzaken, GBRMPA)
21. *Report on effectiveness of voluntary cessation of dugong hunting* (by Greg Smith, GBRMPA, in consultation with Rick Hill and Bill White of ATSIC)
22. *Coastal development and pollution in Dugong Protection Areas* (by J. Brodie and D. Haynes, GBRMPA; J Cavanagh, AIMS; D. Pitts, Environment Science and Services)
23. *Dugong Protected Areas - Seagrass Issues* (by W. Lee Long, L. McKenzie, R. Coles, Queensland Dept of Primary Industries)
24. *Impacts on and responses of seagrasses in the Great Barrier Reef - issues for management* (by W. Lee Long and R. Coles, QDPI)
25. *The effects of trawl fisheries on Great Barrier Reef seabed habitat* (by C R Pitcher et. al., CSIRO Division of Marine Research)
26. *Large scale seagrass dieback* (by J. McLeod, Cooloola Seafood Festival)
27. *A part resurvey of long-term seagrass monitoring sites within the Great Sandy Strait and Tin Can Inlet* (by FRC Coastal Resource and Environmental; submitted by J McLeod)
28. *The Influence of water quality on the virulence of the seagrass pathogen, Labyrinthula* (by M Wnuczynski; submitted by J McLeod)
29. *Report on illegal take of dugong in the Great Barrier Reef region and in the proposed dugong sanctuary areas* (by T. Christensen, Queensland Department of Environment)
30. *Information on the conservation status of dugong in the Torres Strait Area* (Preliminary report; by G Anderson, Environment Australia - Biodiversity Group)
31. *Interim Policy - Traditional Hunting Dugong* (by Great Barrier Reef Marine Park Authority)

Further Additions

32 Letter of 25/2/97 from Mackay Conservation Group
33 Letter of 27/2/97 from Wildlife Preservation Society of Queensland (Proserpine/ Whitsunday Branch)
34 Letter of 25/2/97 from Cairns and Far North Environment Centre Inc.
35. *Dugong Management in the Northern Great Barrier Reef* (by J. Phillips, GBRMPA)
36. *Notes on seagrasses and seagrass-dugong interactions in the Hinchinbrook Region* (by W. Lee Long and R. Coles, QDPI)

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1. (P. 1)

Catching Fish for Everyone!

QCFO

QUEENSLAND COMMERCIAL FISHERMEN'S ORGANISATION

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11 February 1997



Mr Tony Stokes
Senior Planning Officer
Great Barrier Reef Marine Park Authority
PO Box 1379
TOWNSVILLE QLD 4810

Dear Mr Stokes

Please find enclosed the QCFO Proposal for the Implementation of the QCFO Dugong Conservation Strategy.

This comprehensive proposal again clearly illustrates the commercial fishing industry's commitment to taking all necessary steps to eliminate as much as possible its impact on dugong.

QCFO appreciates the opportunity which has been extended by the Board of the Great Barrier Reef Marine Park Authority to briefly address them on 14 February and we will ensure that relevant QCFO personnel are present.

However, QCFO President, Ted Loveday, who has personally managed the development and implementation of this strategy, will not be available for that meeting as he will be overseas with the Minister for Primary Industry's trade delegation to South-East Asia. Mr Loveday will return to the office on 25 February 1997 and would welcome any opportunity to brief relevant personnel, individually or collectively, on the details of our proposal.

Yours sincerely

AKennedy.

Annick Kennedy
A/State Secretary

1. (p. 2)

Industry Proposal for the Implementation

of the

QCFO Dugong Conservation Strategy

Emergency Measures Designed by the Commercial Net Fisherman
in response to the
Urgent Need for an Immediate Response
to
Protect Dugongs on the East Coast of Queensland

February 1997

1.0 Introduction

In November 1996 the Queensland Commercial Fishermen's Organisation (QCFO) prepared a Dugong Conservation Strategy (refer to Appendix 1). In support of this strategy the fishing industry recognises and accepts its obligation to mitigate and wherever possible eliminate its impact on dugongs.

QCFO has since conducted an extensive consultation program where over 900 net endorsement holders throughout Queensland were invited to participate in the implementation of the QCFO Strategy. During these meetings initiatives were strongly supported to that will go a long way to eliminate the impact of mesh netting on dugong. These initiatives significantly modify current net fishing operations along the coast, particularly within, but not restricted to the dugong conservation zones recommended by the Great Barrier Reef Ministerial Council (GBRMC).

In addition to the areas listed by the GBRMC many other areas habitated by dugongs were identified by fishers as being appropriate for review in relation to interaction with mesh netting and dugong. QCFO has already decided to undertake a process to review these areas as soon as the process currently underway is complete and resources become available.

The initiatives and outcomes that were suggested by the fishers, and which are contained in this report, reflect genuine concern for dugong protection and a determination by fishers to minimise the impact of their activities on dugongs throughout Queensland. The measures outlined in this report will have a significant adverse impact on net fishing operations, however, with the exception of Shoalwater Bay the Industry puts forward these measures on the basis that compensation will not be sought by industry to offset the losses to commercial fishers. However, it should be made quite clear that it is critical that each fishing area be treated as a completely separate entity due to the unique fishing practices and methods within each area, and that should any measures over and above the measures outlined in this report be considered the industry insists that provision for compensation for fishers be a fundamental element of those deliberations.

2.0 Implementation of QCFO Strategy

To comprehensively implement the QCFO Strategy QCFO held 5 meetings with net fishers along the coast. To adequately address the areas within the tight time frame allocated for this process meetings were held close to the Christmas period. The Cairns and Townsville meetings were held on 20 and 21 December respectively and the Mackay, Rockhampton, and Hervey Bay meetings were held on the 6, 7 and 8 January. Over 150 fishers attended these meetings which for an industry meeting of this type and at this time of year, is an extremely high attendance rate, indicating the high level of importance given to this issue by fishers.

Following are the detailed arrangements agreed to by fishers at these meetings.

2.1 Education and Awareness Strategy

As described in section 3.1 of the QCFO Strategy, QCFO is preparing an Endangered Species Awareness Course which has a dugong component incorporated. This program will be fully implemented during 1997. The final draft of the syllabus is currently being reviewed prior to its integration into the Queensland Trainee Master Fisherman's Course, which is a pre-requisite for obtaining a Queensland Master Fisher license. Further to this, it is expected that by the end of 1997 all existing commercial fishers in charge of mesh net operations will have achieved accreditation in the course prior to using mesh nets in waters adjacent to Queensland.

Commercial fishers strongly support education and training as a powerful tool for the long term protection of dugong and other listed species. Further to the current elements of the Endangered Species Awareness Course (ESAC), net fishers agreed that local modules within the course which require knowledge of specific rules in specific areas will further eliminate the impact of mesh netting on dugongs. These extra modules will be developed after the current syllabus is completed and implemented. Accreditation in the local modules will be an essential component for a net fisher to operate in the respective area.

QCFO RECOMMEND that:

The GBRMC note:

- ***The implementation of the Endangered Species Awareness Course as outlined in the QCFO Strategy is progressing well.***
- ***Localised modules will be developed for the Course as soon as the current course is implemented and resources are available.***

2.2 Legislation and Compliance Strategy

2.2.1 Legislation

QCFO believes it is critical that all legislative changes relating to fisheries management arrangements and fisheries practices must be implemented under the provisions of the Queensland *Fisheries Act 1994*. The "new" *Fisheries Act 1994* has been developed specifically to incorporate the recommendations of the Ecologically Sustainable Development Report on Fisheries. Of particular significance here is:

a) the requirement for an ecosystems approach to fisheries management whereby the impacts of fishing on target and non-target species is taken into account when developing fisheries management arrangements;

b) the requirement for flexibility in the legislative process to accommodate the rapidly changing needs of fisheries and associated resources; and

c) the requirement for proposed management changes to be developed in full and meaningful consultation with the fishing industry to ensure the proposed changes will have the desired effect.

Where legislative change is required to mitigate or eliminate the impact of fishing practices on dugong, QCFO is committed to ensuring any proposed changes have the highest possible priority to ensure a speedy and effective result.
Further, the inflexibility and long drawn out process for amending zoning arrangements makes the Marine Parks Legislation not only inappropriate but ineffective. This is particularly so given advice from fishermen that the precise locations of dugong populations varies over time depending on the location of seagrasses.

QCFO RECOMMEND that:

- ***The GBRMC agree that all legislative arrangements relevant to dugong protection with regard to fisheries be implemented under the Queensland Fisheries Act 1994.***

2.2.2 Compliance

As recognised in the QCFO Strategy, QCFO is of the very strong view that implementation of the education and monitoring strategy will significantly reduce the impact of fishing practices on dugong. However the issue of 'Cowboy' fishers remains a major concern to mesh net fishermen.

Net fishers strongly support severe penalties for instances of dugong deaths or mortality caused by intentional actions or gross neglect. Whilst suspensions and heavy fines were largely supported, loss of licence was received with mixed reactions. There was a strong fear of wrongful loss of endorsement and extreme care must be taken in developing the process for which a licence or an endorsement can be suspended or cancelled. It was felt that to overcome this problem the penalties should match the intensity of the crime, not impede or override natural justice, and when blatant disregard for rules designed specifically to protect dugongs occurs the punishment should be in three tiers with regard to repeat offences:

a) First Offence - Heavy fines

b) Second Offence - Heavy fines and suspended endorsement, then

c) Third Offence - Loss of endorsement.

This tiered concept needs to be developed between QCFO, QFMA and the relevant Management Advisory Committee's (MAC's).

QCFO RECOMMEND that:

- ***The GBRMC support the development of a system of harsher penalties, designed to purge the cowboy element from the fishing industry, by QCFO, QFMA and the relevant Management Advisory Committees.***

2.3 Monitoring and Research Strategy

2.3.1 Incident Reporting

The system of incident reporting for fishers as per the QCFO Strategy (section 3.2) was universally supported by the fishers.

To compliment the information reported by fishers to QCFO, it was widely agreed that autopsy reports of the carcasses found should be made available to QCFO. This would ensure a comprehensive information gathering strategy would be coupled with the data already collected and feedback could be offered to those participating.

Also, whilst every precaution is being taken to prevent dugong deaths from all anthropogenic impacts, deaths may still occur and carcasses will still be found. Currently, the carrying of a dugong carcass is prohibited and therefore clear guidelines need to be developed for the handling of dugong carcasses. These guidelines would need to be developed in conjunction with QCFO and Queensland Boating and Fisheries Patrol.

QCFO RECOMMENDS that:

- ***The GBRMC note the industry support for the incident reporting program, and the need for QCFO to receive all autopsy reports.***
- ***The GBRMC support the recognised need for clear guidelines for the management and handling of dugong carcasses.***

2.3.2 Research

Strong anecdotal evidence from fishers suggests major issues and short falls regarding the knowledge of dugongs and their habitat. Research focused on these issues is critical to ensure the long term viability of dugong and to ensure that irrelevant and unnecessary restrictions are not imposed on the fishing industry.

Priority research issues include:

I Loss of Critical Habitat including Seagrass

At all meetings fishers provided strong evidence of significant changes to and disappearance of seagrass beds, in particular intertidal species, which were important to dugongs in the past (specific details are under the relevant sections in this report). Collectively this information provides strong evidence of a **major environmental catastrophe** having occurred along the Queensland coast over the last 10 to 15 years. QCFO believes that research aimed at quantifying the level of seagrass die back, identifying the causes of the dieback and assessing the impacts this has had on dugong populations, must be an extremely high priority.

Such research should be commenced by commissioning an independent researcher to discuss with fishers throughout the state, changes they have observed to seagrass beds over the last 10 to 20 years and the causes the fishers believe are responsible for the changes. An assessment of the changes of dugong population can then be undertaken.

II Migration Patterns and Paths

Recent research has indicated that dugongs are able to travel considerable distances in relatively short periods of time. Anecdotal information from fishers suggests that in many areas dugongs consistently travel through specific paths.

The major reason for the implementation of the 'at the net' attendance rule for offshore set nets is because of the incidents of travelling dugong interacting with these nets. However, in the absence of knowledge regarding migration paths, the 'at the net' attendance is being applied mostly in areas where there is no dugong migration. It is therefore critical that precise migration paths are urgently established so that unnecessary impediments to industry can be relieved.

QCFO RECOMMENDS that:
The GBRMC agree with the following research priorities:

I **Loss and causes of critical habitat including seagrass and its impact on dugong populations**
II **Migration Patterns and Paths**

The GBRMC agrees that when dugong migration paths are identified, 'at the net' attendance for offshore set nets be reviewed.

3.0 Risk Identification and Mitigation Strategy

3.1 Region Non-Specific Measures

3.1.1 Offshore Set Net Attendance Ruling

The implementation of the 'at the net' attendance rule for offshore set nets (within 100m of the net) will have a significant impact on some fishers' livelihoods.

Impacts on Industry

Net Fisher Safety
Fishers in Halifax Bay and Cleveland Bay (near Townsville) and in the Mackay region raised issues of concern over safety. These areas of exposed waters and high tidal variation often experience very large seas. As most net fishing operations are carried out with small open vessels, anchoring at the net for prolonged periods of time would be the only option for operators with an 'at the net' attendance rule. In so doing the fishers will have to undertake dangerous practices or make considerable extra capital investments in larger vessels for operations to remain viable.

Emergency Breach
Fishers coming to the immediate aid of another fisher, such as to assist at the time of a dugong entanglement, may be in breach for leaving nets temporarily unattended.

Suggestions for Solutions
Despite the hardships that at the net attendance rule will cause the net fishing industry, commercial fishers have agreed with the implementation of the GBRMC Agenda item 2(d)(i) recommendation of November 30, except for the specific areas outlined above and subject to the following minor amendment regarding who can be in attendance.

Alternative Attendance
A lot of hardship to fishers could be prevented by allowing a trainee master fisher or an assistant master fisher who has been accredited with the ESAC, to satisfy the attendance requirement in place of the master fisher. This would not allow fishers under the crew/block licence to satisfy the attendance requirements.

While a trainee or assistant master fisher is attending the nets, the master fisher in charge of the operation would not be permitted to engage in any other fishery and would only be able to process product or undertake an activity directly related to the particular operation. The ESAC accredited assistant/trainee should also be permitted to work the net the same as a master fisher can when in attendance and therefore be able to take all measures necessary to avoid dugong entanglements and mortality.

800 Metre Attendance Rule
Commercial fishermen from the Halifax Bay and Repulse Bay regions require an attendance rule of 800 metres when in specific areas of exposed waters during the months between November and July. The fisher would be required to remain in sight of the net.

The 'at the net' attendance would be acceptable through August, September and October as this is the time of maximum potential for dugong and fishing interaction in the region.

The specific regions identified which require the 800 metre attendance are:

- Halifax Bay (near Townsville), west of the line drawn between Albino Rock light (18°46' S, 146°43' E) to Cape Cleveland (19°10'9" S, 147°1' E).
- Repulse Bay (near Mackay), west of the line drawn between Cape Conway (20°32'20" S, 148°55'45"E) to Cape Hillsborough (20°54'20" S, 149°3' E).

QCFO RECOMMENDS that:

- ***The GBRMC request the Queensland Government to amend the Queensland Fisheries Regulations 1995 so that a trainee master fisher can fulfil the attendance rule.***

- ***The GBRMC agree that the Queensland Government implement 'at the net' attendance for offshore set nets in all Queensland waters except:***
    - ***Halifax Bay (near Townsville), west of the line drawn between Albino Rock light (18 °46' S, 146 °43' E) to Cape Cleveland (19 °10'9" S, 147 °1' E).***
    - ***Repulse Bay (near Mackay), west of the line drawn between Cape Conway (20 °32'20" S, 148 °55'45"E) to Cape Hillsborough (20 °54'20" S, 149 °3' E).***

3.1.2 Identification of Nets

Commercial fishers unanimously agree that a system is required to identify all illegal nets and the owners of nets that are not being used in accordance with the regulations.

Whilst a system which requires the ownership of all nets to be clearly identified is seen by many fishers as imposing extra requirements on those people already doing the right thing, fishers also recognise that such a system is the only way that people who use nets while unlicensed, and commercial fishers who set nets while not complying with conditions of use can be identified and breached.

Given that illegal nets have been attributed to a significant proportion of the dugong mortality, the industry is strongly committed to developing such a system.
Options to be considered include:

Registering and/or tagging of nets

Increased identification such as names on corks and weights etc.

There are some concerns in industry that the introduction of a poorly designed system may simply facilitate nit picking by the Boating Patrol.

QCFO RECOMMENDS that:

- ***The GBRMC note that QCFO, through its Net Committee, will develop systems to facilitate ease of identification and thereby eliminate illegal netting practices.***

3.1.3 Reporting Illegal Netting

Fear of reprisals from illegal operators is another issue of concern to many fishers leading to the level of reporting to local Boating and Fisheries Patrol being limited. Therefore there is a distinct need for a method to facilitate reporting to the patrol without the fear of retribution.

QCFO RECOMMENDS that:

- ***That the GBRMC agree to the urgent development of a system whereby fishers can report illegal operations without fear of retribution.***

3.14 Displacement of Effort and Compensation

QCFO is very strongly of the view that should any displacement of fishing effort occur, such as in Shoalwater Bay, the arrangements must be accompanied by adequate compensation to offset the impacts of that displacement of effort into other areas. Compensation should include:

a) compensation to individual fishers for loss of income; and

b) funds to purchase fishing licences from the region so that displaced effort does not simply cause increased problems elsewhere.

The Queensland Government is currently developing a major policy dealing with industry restructuring which could provide the mechanism to take the necessary action required to offset displacement of effort. This policy will include a mechanism to purchase excess fishing licences with the funding being provided by a range of beneficiaries.

It is unrealistic and unacceptable to expect the fishing industry to contribute to the cost of purchasing licences required to offset the impact of displaced effort. It is therefore absolutely critical that the issues of funding for compensation and minimising the effects of displaced fishing effort be entrenched in any further discussions on any proposed closures.

QCFO RECOMMENDS that:

- ***The GBRMC agree that any arrangements that causes any displacement of fishing effort must be accompanied by adequate compensation to offset the impacts of that displacement of effort into other areas including:***

  a) compensation to individual fishers for loss of income; and
  b) funds to purchase fishing licences from the region so that displaced effort does not simply cause increased problems elsewhere.

4.0 Region Specific Measures

4.1 Introduction

Industry closely examined a wide range of issues and options to reduce impact on dugong in each of the 11 areas including:

- the geography of an area
- seasonal changes to the areas
- types of apparatus used in each area and the times it is used
- where and when dugong activity exists in the areas
- possible interaction between net fishing activity and dugongs in each area.

Specific measures were then designed within those areas utilising the above information. These measures include:

- modification of conditions of use for each type of net impacting on dugong
- lighter ply strength of nets
- prohibiting specific nets in specific areas
- hands on attendance of foreshore nets in specific regions.

QCFO staff and members have dedicated significant time and resources to exploring all possible options to resolve this issue. It is important for the reader to appreciate that a significant amount of detailed measures have been developed as a result of this process, which included 5 well attended industry meetings, each of which met for between 8.5 and 11 hours.

It is therefore critical that no changes are made to the outcomes of this report, as even minor changes may result in a significant impact on industry while doing little or nothing to help protect dugong.

Please Note: This report lists only those changes proposed to existing Regulations and practices regarding certain nets. The reader should recognise that all conditions of use of other nets would remain unchanged.

Further, where specific sections of the Fisheries Regulation are referred to in relation to changes required to conditions of use of particular nets, changes may also be required to other sections under other endorsements to fully implement the particular recommendation. The full extent of the changes required will need to be determined through the normal fisheries legislative review process which includes consultation with QCFO.

QCFO RECOMMENDS that:

- **That the GBRMC request the Queensland Government to amend the Queensland Fisheries Regulations 1995 to incorporate the changes to net operations as outlined in Section 4 of this report.**

- **That the GBRMC give consideration to undertaking the following actions which do not relate directly to net regulation changes.**

4.1.2 Conditions of Use of Foreshore Set Nets

Current conditions of use of a foreshore net require that not more than one third of the net may extend out to sea beyond low water. This condition has caused confusion and hardship for many years and now needs to be reconsidered in the context of proposals in this section to restrict the length of foreshore set nets to 50 metres in some areas.

1.fp 18

QCFO proposes that where a foreshore net is restricted to a maximum length of 50 metres, the above condition be changed to require one end of the net to be fixed above the low water. Failure to include this amendment will make the proposals restrict foreshore set nets in some areas to 50 metres unworkable, and as such would unnecessarily impede industry's initiatives to minimise it's impacts on dugong.

QCFO RECOMMENDS that:

- ***That wherever a maximum length of foreshore set nets of 50 metres applies, the condition of use which requires that not more than one third of the net's length may extend out to sea of the low water be changed to require one end of the net to be fixed above the low water mark.***

4.2 Princess Charlotte Bay, Bathurst Bay and Nearby Areas (refer Figure 1)

Offshore Set Nets

That the use of offshore set nets be prohibited in the following area:-

- *South of the line drawn from 14 °20' S; 143 ° 44' 30" E to Bathurst Heads (14 °17' 30" S; 144 ° 12'E).*

Foreshore Set Nets

1. *That use of foreshore set nets longer than 50m be prohibited during August, September and October in the following areas:-*
   - *Between the North-Eastern bank of the Bizant River and Cape Melville*
   - *Cape Bowen south to Cape Flattery.*

2. *The use of foreshore set nets longer than 50m be prohibited all year round in the following area:*
   - *Around the Rocky Islands in Bathurst Bay.*

Please note: Fishers would still be able to use up to 6 foreshore nets at any one time, however the maximum length of any net will be 50 metres.

Background

Anecdotal evidence suggests that early in the year seagrasses recede in the above regions, thought by many fishers to be due to the dramatically reduced salinity from the large rainfall experienced at that time. Similarly, fishers have noted that dugong populations during this time have also been absent until mid or late in the year from the lack of food. Shorter nets (50m) that do not extend into the regrown seagrass would prevent dugong entanglement during the periods of their activity in the region.

Rocky Islands in Bathurst Bay are recognised as a dugong migration path by most of the local fishers. Shorter foreshore nets will not extend into the migration path.

Other Nets

It is crucial that the remainder of Princess Charlotte Bay and Bathurst Bay remain open to all other legal netting practices. The amount of displaced effort would be significant should any further restrictions apply. For example, eighteen fishers would be forced to move to neighbouring regions.

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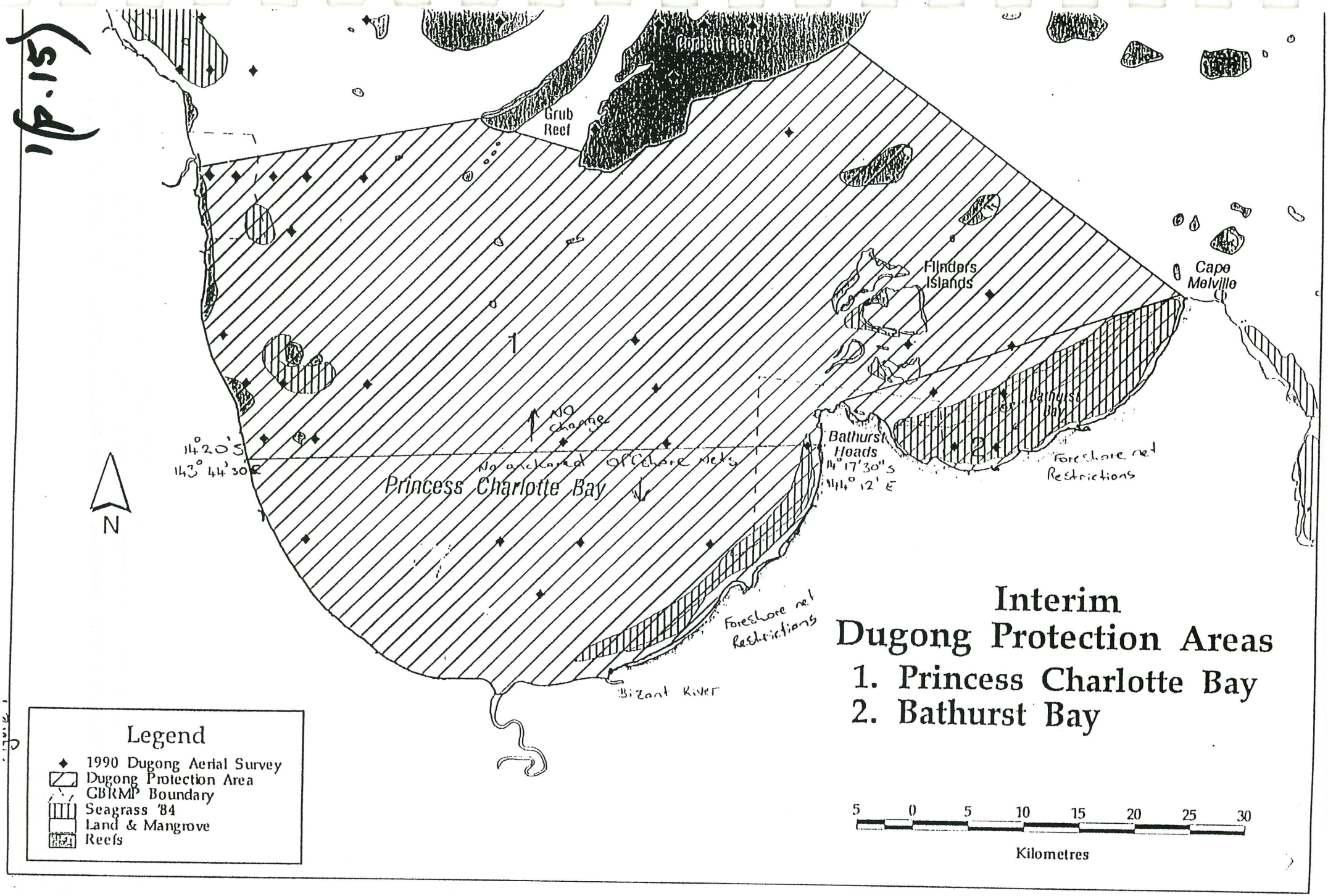
These 'hot spots' of increased pressure are not desirable within sustainable fishery resources management. For this reason the issue of compensation must be considered if further restrictions ever occur.



Interim Dugong Protection Areas

1. Princess Charlotte Bay
2. Bathurst Bay

1 (p. 16)

4.3 Hinchinbrook Region (refer Figure 2)

General

There are already considerable restrictions placed on net fishers in this area.

Between Con Creek and Seymour River (Neams Inlet) and within Hinchinbrook Channel there is minimal (if any) dugong interaction and no changes are proposed.

Offshore Set Nets

The use of offshore set nets be prohibited inside the area of:-

- *Meyunga Creek to Cape Richards to Eva Island to the northern point of Goold Island back to Meyunga Creek.*

Foreshore Set Nets

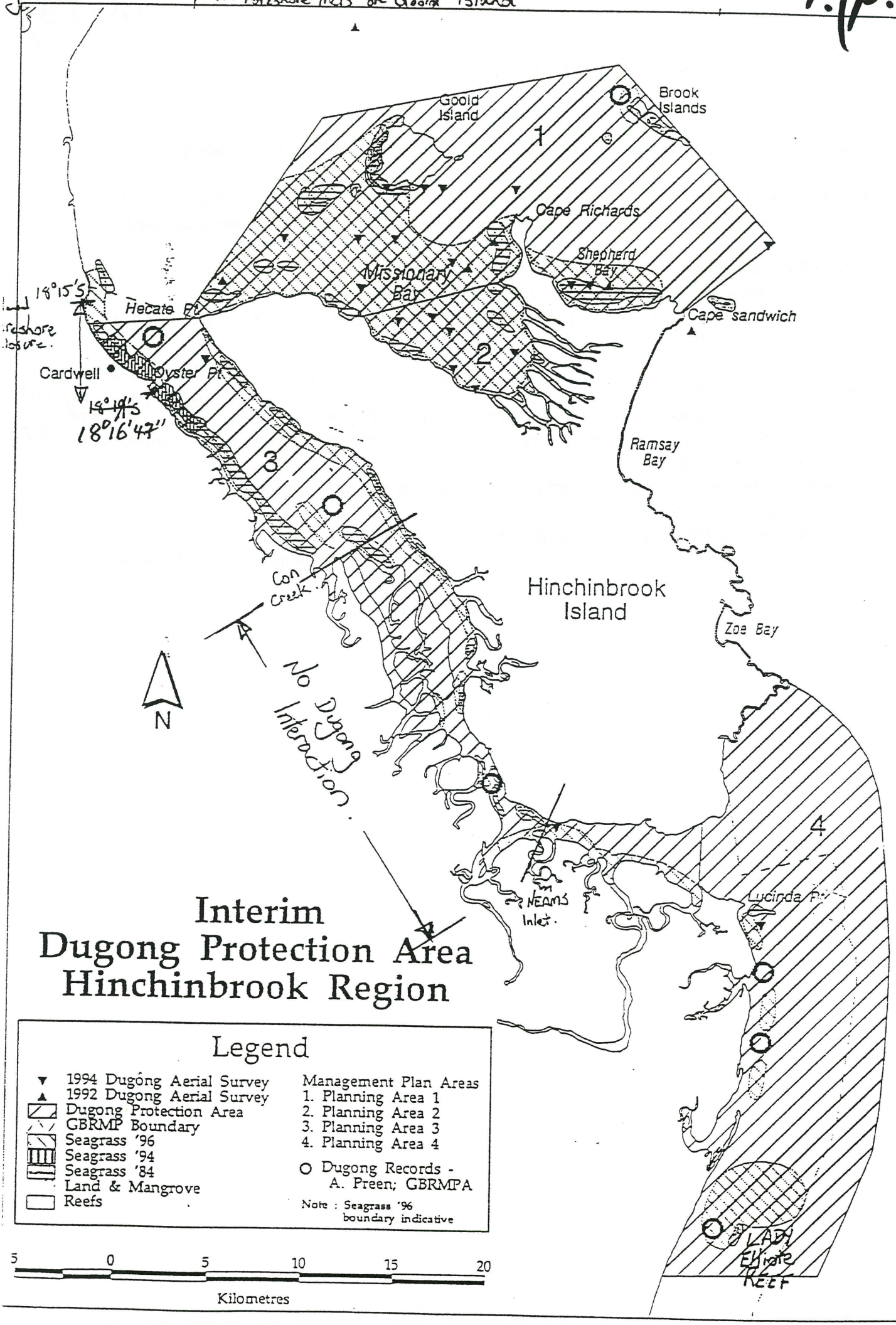
coords should be 18°16'47" (Oyster Pt. advice S. Tapsell QCFO 21/2/97)

1. *The use of foreshore nets be prohibited in the following area:-*
   - *From 18 °15'S to ~~18 °19'~~ S on the mainland side of Hinchinbrook Channel*
   - *On Goold Island*
2. *The "at the net" attendance requirement apply to the use of foreshore set nets in the following area:-*
   - *Hecate Point to Cape Sandwich*
3. *The use of foreshore set nets longer than 200m be prohibited in the following area:-*
   - *Neams inlet southwards to Lady Elliot Reef.*

Figure 2

- Hecate Point to Cape Sandwich - 1 foreshore net Hervey on attendance.
- No Foreshore nets on Goold Island

1. (p.17)



Interim Dugong Protection Area Hinchinbrook Region

Legend

- 1994 Dugong Aerial Survey
- 1992 Dugong Aerial Survey
- Dugong Protection Area
- GBRMP Boundary
- Seagrass '96
- Seagrass '94
- Seagrass '84
- Land & Mangrove
- Reefs

Management Plan Areas
1. Planning Area 1
2. Planning Area 2
3. Planning Area 3
4. Planning Area 4

- Dugong Records - A. Preen; GBRMPA

Note : Seagrass '96 boundary indicative

5 0 5 10 15 20

Kilometres

1. (p. 18)

4.4 Cleveland Bay (refer Figure 3)

Offshore Set Net

Minimal (if any) dugong interaction with netting operations has been experienced north of the following line.

From the eastern bank of the Bohle River (19 °11'5" S, 146 °42'1" E);
to 19 °5'4" S, 146 °42'1" E;
to 1NM north of White Rocks (19 °5'4" S, 146 °50'1" E);
to east of Orchard Rocks (19 °6'8" S, 146 °54'2" E leading lights in line);
to the No.1 Navigation Light (19 °9'9" S, 146 °52'7" E);
to Cape Cleveland (19 °10'9" S, 147 °1' E).

altered on advice S. Tapsall QCFO, 21/2/97

[redacted]ore set nets be prohibited in the following area:-

- *South of the line between Cape Cleveland and the ~~Harbour Limits~~ mouth of Ross Creek*

Foreshore Set Net

1. *The use of foreshore set nets longer than 400m (for a single net) be prohibited in the following area:-*
   - *Cleveland Bay*

2. *The use of foreshore set nets longer than 200m be prohibited in the following area:-*
   - *from Alligator Creek to Cape Cleveland (south eastern section of Cleveland Bay).*

Background

The non-grassed area, brought about from the area completely drying with the tide, is known to have dramatically less dugongs than the nearby grassed area. The shorter nets will avoid these grassed areas and thereby avoid possible dugong interaction.

General Purpose Net

That general purpose nets in the Harbour Limits of Cleveland Bay be restricted to:-

- *max length 400m*
- *max mesh size 115 mm (4 1/2") mesh*
- *max ply strength than 0.62mm diameter monofilament (line 14 ply).*

Maximum Ply Strength

That except for foreshore set nets, river set nets [redacted] the use of nets with a ply rating greater than line 14 ply (monofilament diameter 0.62mm) be prohibited in the following area :-

- *South of the line from Cape Cleveland to the Townsville Harbour mouth.*

1. (p. 19)

Interim Dugong Protection Area Cleveland Bay

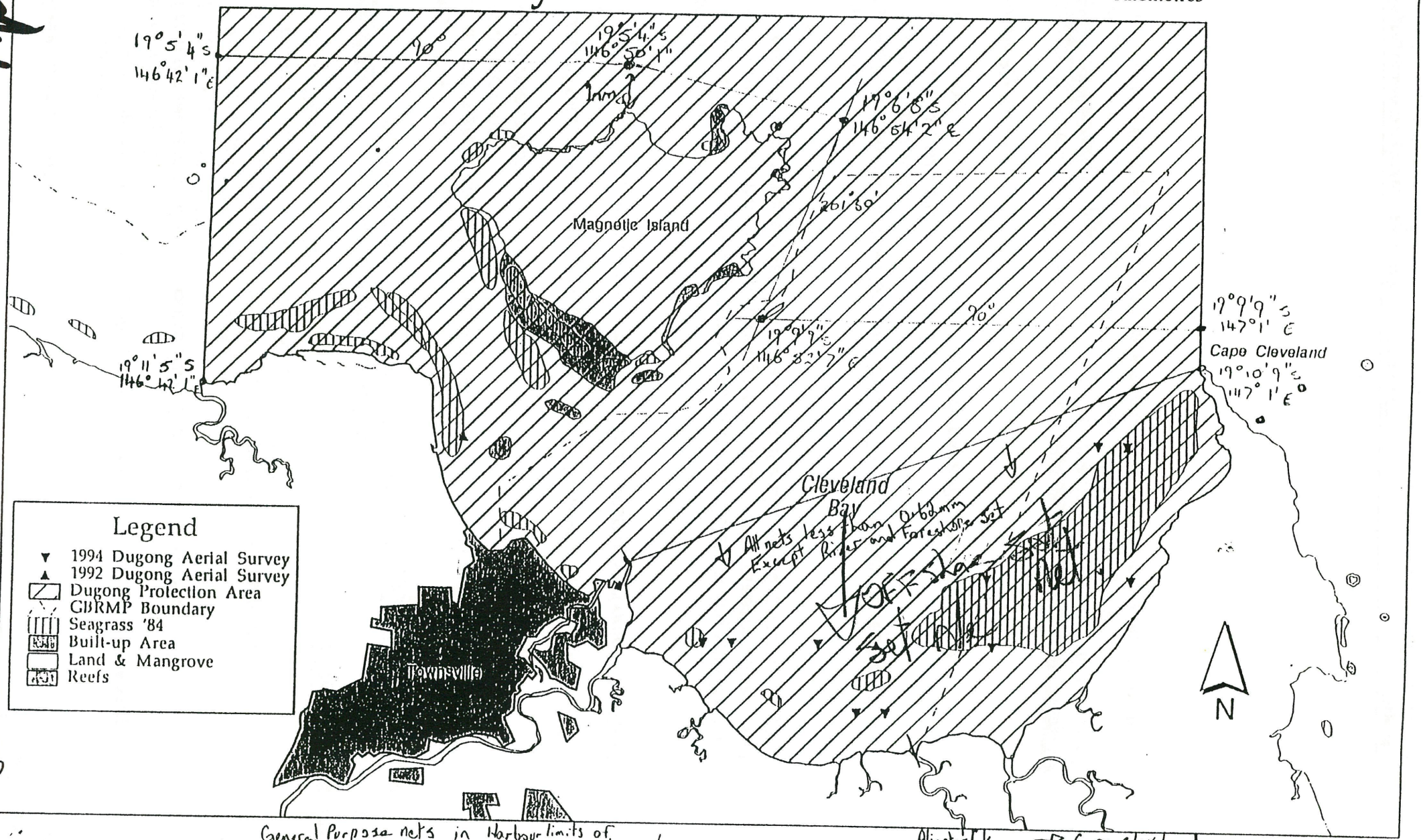


Figure 3

General Purpose nets in Harbour limits of Cleveland Bay be less than 400m, 4½ mesh and 14 ply.

Aligator Ck. → Cape Cleveland.

1. (p. 20)

4.5 Upstart Bay (refer Figure 4)

The Upstart Bay area currently has considerable restrictions to netting operations. These include closures of the major creeks in this area, barramundi spawning zones and the Marine National Park 'A' area north of Windy Point.

Offshore Set Nets

The use of offshore set nets be prohibited in the following area:-

- *south of the line from the point on the southern bank of Saltwater Creek (19 °50' S, 147 °35.5' E) to Windy Point (20 ° 46.2" S) inside Upstart Bay.*

Foreshore Set Nets

The use of foreshore set nets be prohibited in the following area:-

- *South of Windy Point (20 °46.2" S) to Oyster Point (20 °49" S) on the eastern side of Upstart Bay.*

Background

In this area there is regular dugong activity and dense seagrass beds.

From Windy Point north to Cape Upstart there is already a Marine National Park 'A' area which prevents the use of foreshore set nets.

Important Notes

- The area on the eastern side of Upstart Bay, which is noted by fishers as a priority area for dugongs in this region, also has upwards of 700 recreational vessels travelling over it during weekends. It is believed that this traffic is not only ushering dugongs away from the area but also contributing considerably to dugong mortality in the region from boat strikes.

- The southern section of Upstart Bay between Molongal Creek and Oyster Point has been identified by the Great Barrier Reef Marine Park Authority as having extensive seagrass beds. Anecdotal information supplied by fishers from this region indicates that this area is now without seagrass. Fishers have noted that the decline in seagrass in this area has occurred as the intensity of land use, particularly for agriculture has increased.

1. p. 21)

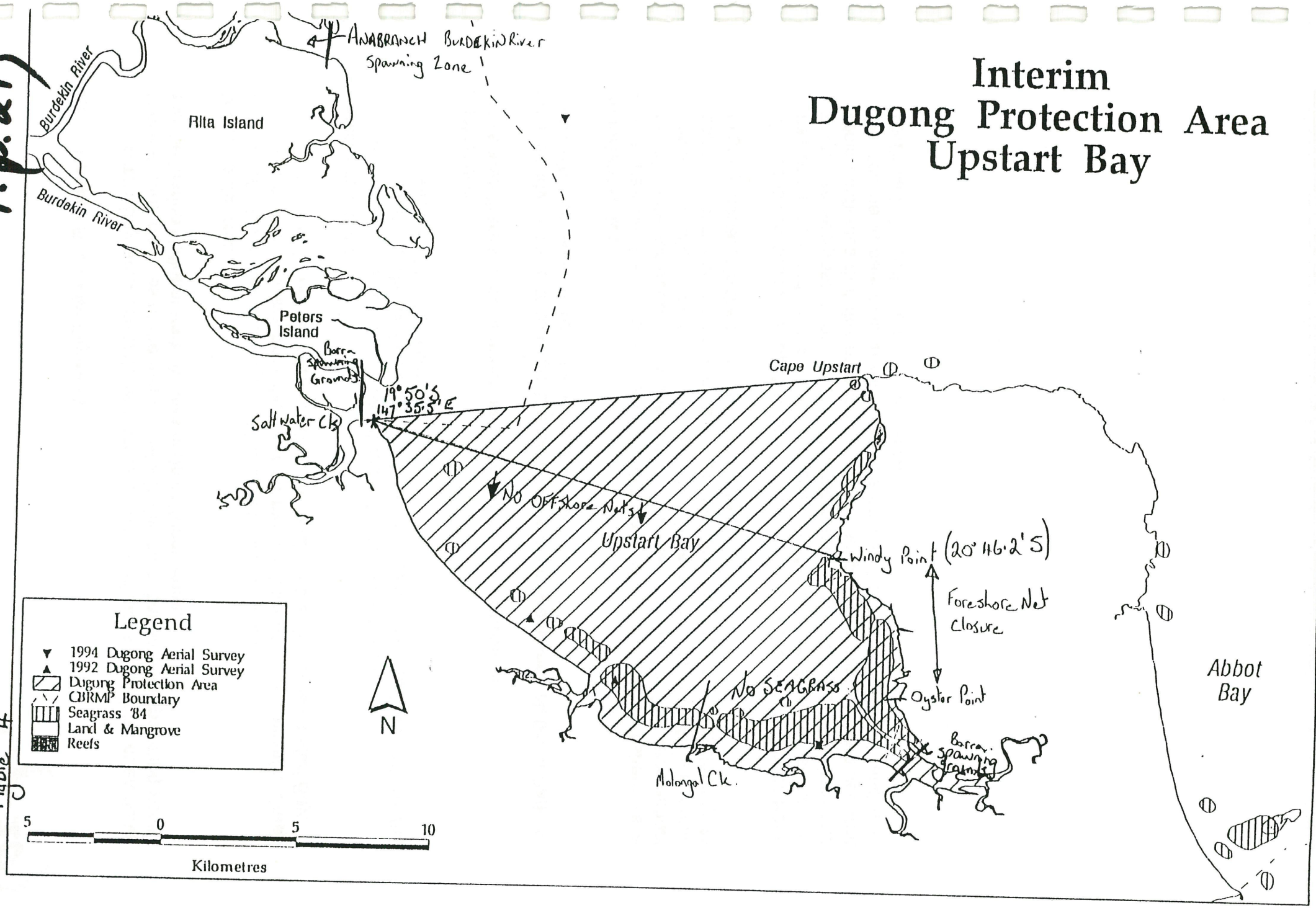


Figure 4

1. (p. 22)

4.6 Newry Region (refer Figure 5)

Barramundi is the major fishery in this region and is also subject to seasonal closures. This type of operation is complicated by the difficult to navigate areas due to large areas of shallow water, coupled with the high recreation traffic flow. To overcome these burdens in the Newry Region, existing commercial netters operate largely at night during the barramundi season to avoid incidents with the recreational boating activity.

General Environment

- It is well noted by fishers in the region that, due to the boat ramp to the south east of Rabbit Island, there is a large volume of recreational boating traffic as well as a considerable amount of recreational fishing between Rabbit Island and the mainland. This high activity level, especially during weekends, has lead to a reduction of intertidal seagrass habitat in this shallow area. There is also anecdotal information that indicates that the increase in traffic and loss of seagrass has resulted in reduced dugong activity in this area.

- The major dugong area within the Newry Region is found around the seagrass at the mouth of Black Rock Creek as well as close to the rocky headlands around St Helens Bay. Dugongs have been seen in these regions 12 months of the year.

Offshore Set Nets

The use of offshore set nets be prohibited in the following area:-

- *inside a line commencing 1km from Pigeon Island (20° 46' 50" S, 148° 52' 20"E) to 1km off outer Brother Island (20° 47' 40"S, 148°52'20" E), to 1 km from the Outer Newry Island (20°50'40" S, 148°56'50" E), to 1km off Redcliffe to 1km off McBrides Point (20°53'30" S, 149°1'E).*

Foreshore Set Nets — max. 600m (current) + 800m attendance rule

The foreshore set nets may not extend beyond the low tide line in the following area:-

- *Jewers Point south to Finnlysons Point.*

Note: Nets will remain at existing lengths.

Short Foreshore/Rocky Face Foreshore Set Net

That around Pigeon Island and Brother Islands the following conditions apply to foreshore set nets:

- *up to 3 nets may be used*
- *maximum length of any net be 50 metres*
- *one end of each net must be fixed above the low water mark of the day*

Background

Within the Newry Region there are many small rocky islands and rocky foreshore areas. There is anecdotal evidence from fishers that suggests that dugongs migrate close to these areas but rarely closer than approximately 60 metres from the shore.

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It is currently not possible to use foreshore nets in these areas because of the condition that requires not more than one third of the net to extend to sea beyond the low water. Therefore fishers are forced to use offshore set nets which then encroach in the areas frequented by the migrating dugongs.

If fishers were able to use short foreshore set nets with the changed condition of use as outlined earlier, they would still be able to operate viably and at the same time avoid the dugong. It is therefore essential that the use of short foreshore set nets as outlined above be permitted.

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Interim Dugong Protection Area Newry Region

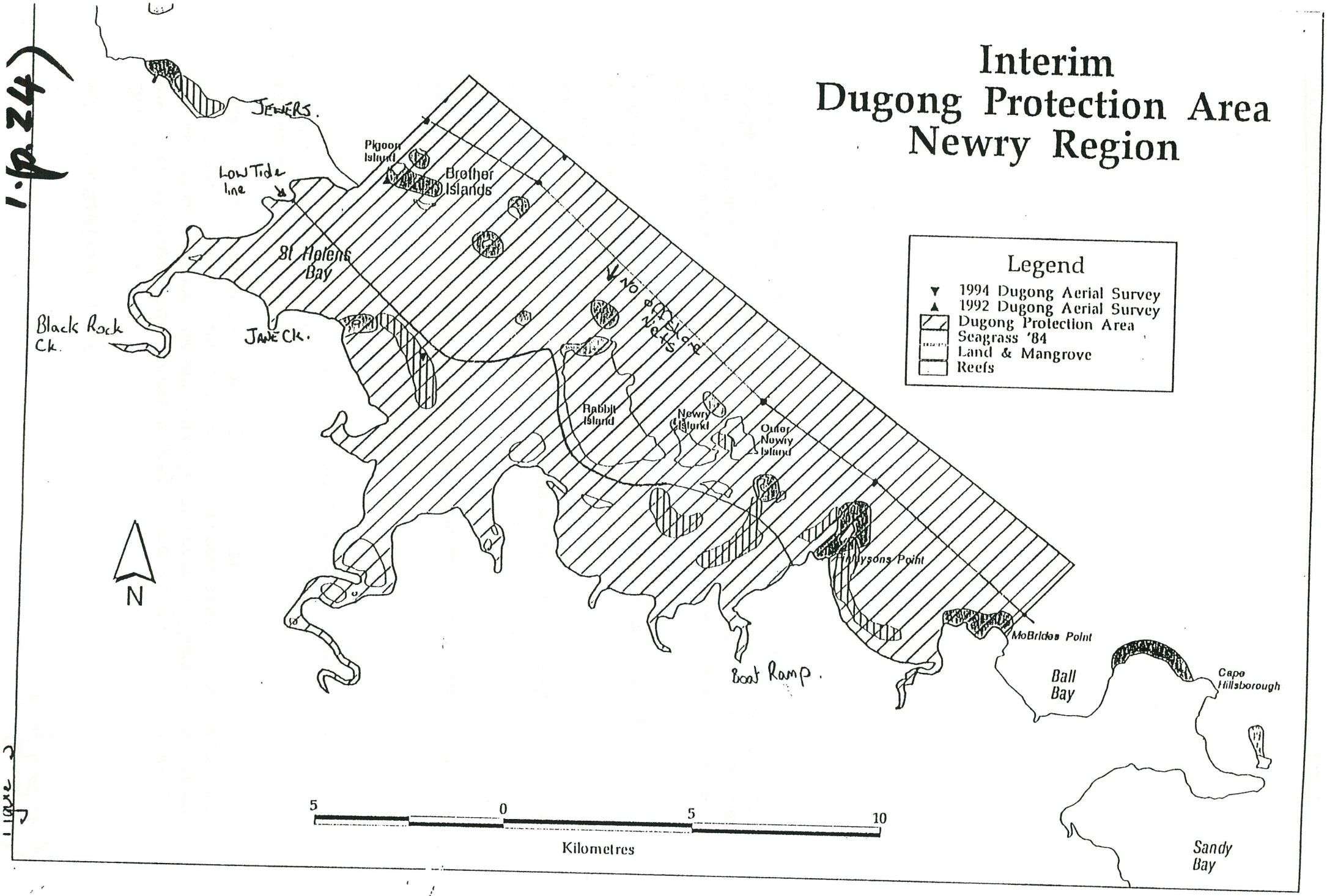


Figure 2

1.(p25)

4.7 Ince Bay (refer Figure 6)

General Environment

Anecdotal information from fishers suggests seagrass has been considerably reduced compared to the data supplied by Great Barrier Reef Marine Park Authority for this area. The most dramatic change was the near disappearance of the large beds in the south eastern corner leading into Cape Creek.

Offshore Set Nets

The use of offshore set nets be prohibited in the following area:-

- *Inside the line from Allom Point (21 °28'30" S, 149 °20'48" E) out 90 ° to south of Taffy Island (21 °28'30" S, 149 °23'10" E) to Cape Palmerstone (21 °32' S, 149 °29' E).*

Background

This area has been identified as the greatest potential dugong problem within this bay for the offshore nets.

Short Foreshore/Rocky Face Foreshore Set Net

That around Allom Point, Taffy Island, Glendower Point, and Cape Palmerstone the following conditions apply to foreshore set nets:

- *up to 3 nets may be used*
- *maximum length of any net be 50 metres*
- *one end of each net must be fixed above the low water mark of the day*

Background

As with the Newry region, the use of foreshore nets in this area is difficult because of the conditions of use. Therefore offshore set nets are used causing potential problems with dugong interaction. The use of a short foreshore set net under the conditions proposed would enable fishers to operate viably and avoid dugong.

1 (p. 26)

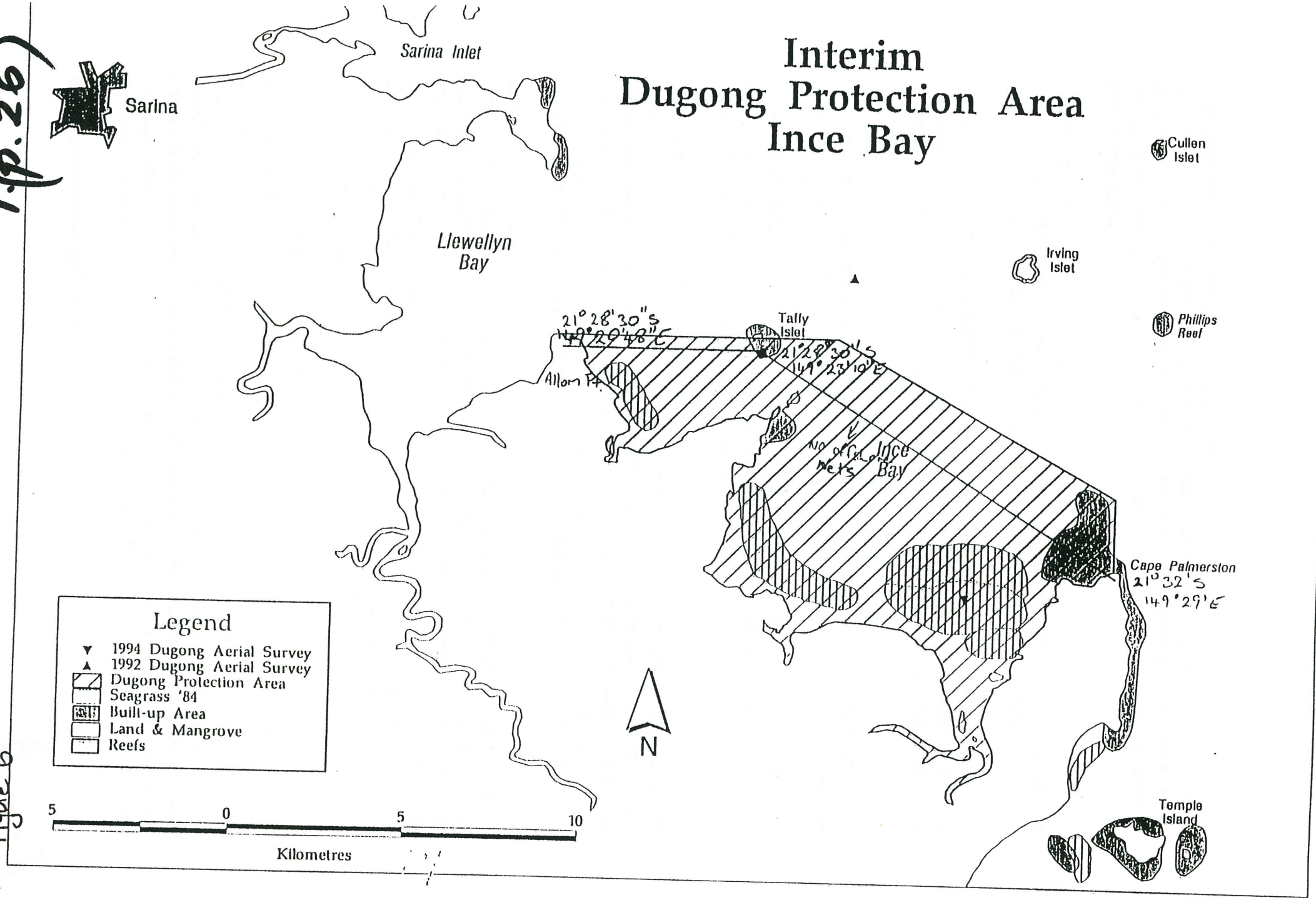


Figure 6

1.(p.27)

4.8 Shoalwater Bay (refer Figure 7)

It is well recognised that the banning of all netting apparatus in Shoalwater Bay was brought about by ineffective law enforcement of illegal netting operations which impacted on dugongs in this very remote region. The commercial fishing industry recognised the need for the adherence to these new regulations, however it is critical that the following points must be considered prior to the implementation of this ban which will cause all fishermen significant hardship because of the actions of a couple of operators who the industry have been calling to be apprehended over their blatant disregard of fisheries laws.

Displacement of Effort

Further to section 3.1.4 (above), it is necessary that an investigation be undertaken to develop specific methods to reduce the displaced effort from Shoalwater Bay. Due to the unique nature of Shoalwater Bay, brought about by the remoteness and number of fishers that regularly utilise this area, specific recommendations from fishers to remediate the displacement of effort and reduce the level of compensation required to offset the impacts of displaced fishing effort, were developed. These recommendations are:

(i) Create a special net endorsement for Shoalwater Bay, whereby a panel consisting of industry, QFMA, GBRMPA and the Army would determine which fishers with a history of net fishing in the area would be issued with the endorsement. The endorsement would also be implemented under very stringent conditions which would allow the cancellation of the endorsement on any of the following grounds:

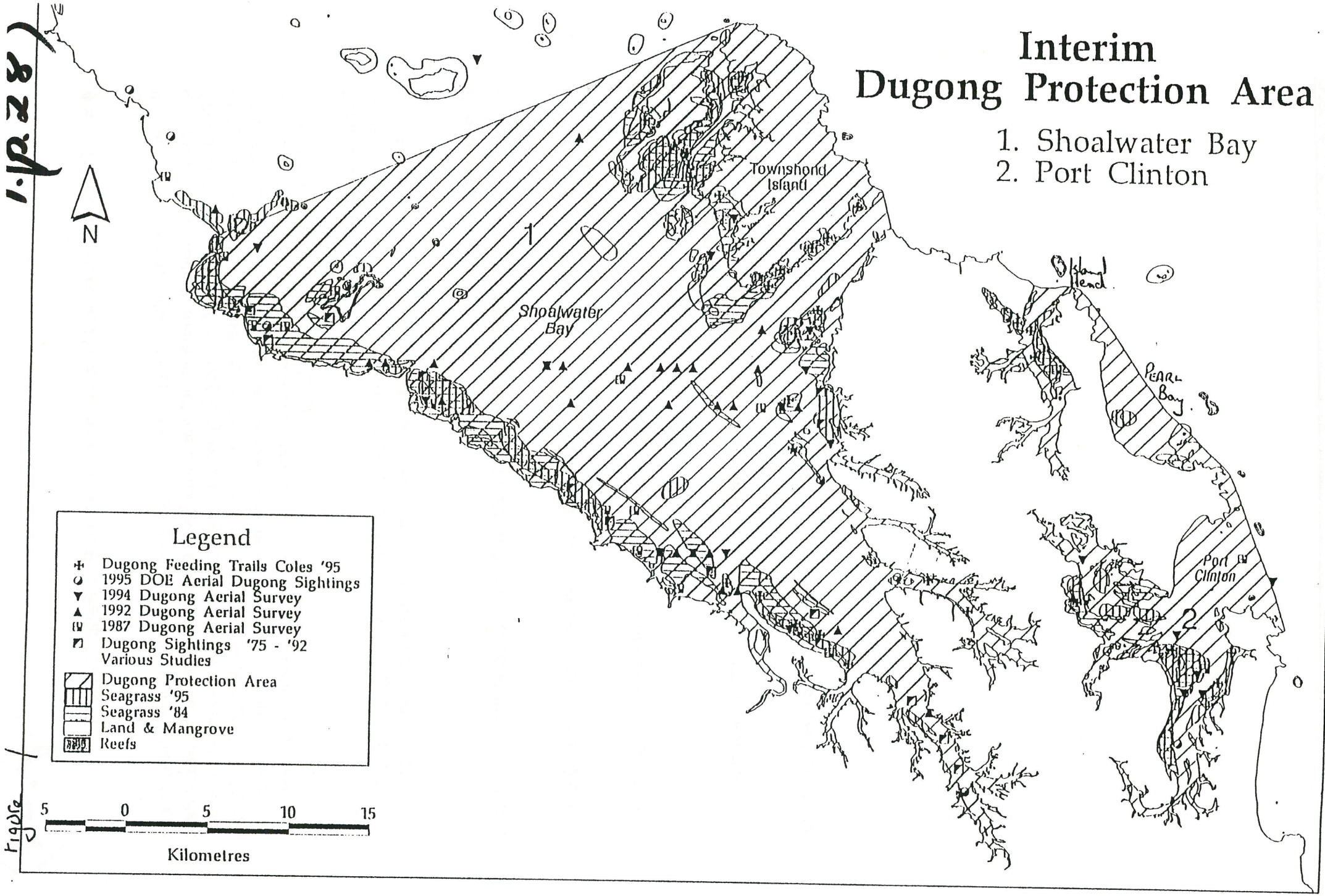
- failure to exit the area during a defence closure
- failure to comply with all fishery and other regulations at all times
- doing anything whatsoever in the area that brings the fishing industry into disrepute
- failure to comply with stringent reporting procedures which would require operators to report the commencement and end of each fishing trip in the area.

(ii) Many net entitlement holders of the region also have crab entitlements. To offset impacts on fishers of prohibiting net fishing in Shoalwater Bay, the reopening of Canoe Passage to commercial crabbing must be considered.

(iii) Set arrowhead fishtraps and portable fishtraps are dugong friendly fishing apparatus which have been used in Shoalwater Bay in the past and should be considered for future use in the bay.

Safe Anchorage

As the proposed net ban would apply to the use and carriage of all nets in Shoalwater Bay, in the instance of adverse weather conditions the safe anchorage offered by Shoalwater Bay would not be available to fishers. Some discretion needs to be exercised in the application of this rule.


Interim
Dugong Protection Area
1. Shoalwater Bay
2. Port Clinton
N
Townshond Island
Shoalwater Bay
Pearl Bay
Port Clinton
Legend
Dugong Feeding Trails Coles '95
1995 DOE Aerial Dugong Sightings
1994 Dugong Aerial Survey
1992 Dugong Aerial Survey
1987 Dugong Aerial Survey
Dugong Sightings '75 - '92 Various Studies
Dugong Protection Area
Seagrass '95
Seagrass '84
Land & Mangrove
Reefs
5 0 5 10 15
Kilometres

1.(p.29)

4.9 Port Clinton, Island Head Creek and Pearl Bay (refer Figure 7)

General

It is widely recognised that whilst there is dugong activity in the Island Head Creek and Port Clinton region, there is not the same level of activity as in Shoalwater Bay. This is particularly evident in Pearl Bay where dugongs are rarely observed. Fishers recognise peak dugong activity in the area of Island Head Creek and Port Clinton between the months of May to September, and particularly August and September. This seasonal inshore area information correlates with the information supplied from the Princess Charlotte Bay net fishers.

Offshore Set Nets

Fishers using the offshore set net in this region already voluntarily observe "at the net" attendance due to the considerable amount of recreational boating and high tidal influence in the area.

Foreshore Set Nets

1. *The use of foreshore set nets longer than 200m be prohibited in the Port Clinton area.*

2. *The use of foreshore set nets with a monofilament diameter greater than 0.62mm be prohibited in the Port Clinton area.*

3. *An "at the net" attendance requirement apply to the use of foreshore set nets in Port Clinton.*

General Purpose Net

1. *The use of general purpose nets with a mesh greater than 175mm (seven inches) be prohibited in the Port Clinton.*

2. *The maximum ply for general purpose nets in Port Clinton be 0.81 mm diameter or line 24 (except for the bun or bag) is attached.*

1. (p. 30)

4.10 Hervey Bay (refer Figure 8)

Background

It has been widely accepted that the measures which were implemented by the Hervey Bay fishers and placed into the Fisheries Regulations some years ago have dramatically reduced the impact of nets in this area on dugong. In over 5 years, the only deaths which have been attributed to fishing practices have occurred in the last year, and appear to have occurred from fishers using nets with an illegal ply strength.

It must be recognised that the following extra concessions made by fishers from this region are quite significant due to the restrictions already placed on the fishers in the region.

General

Dugong protection area as described by GBRMPA, should not include the area east of 153°E. This is as per the existing net restrictions in the Fisheries Regulations 1995 (Refer Appendix 2). The only time that dugongs are found in this eastern area is after a significant flood event.

Offshore Set Nets

The use of offshore set nets be prohibited in the following area:-

- *between the red beacon at the Burrum River mouth to the Red beacon at the mouth of Beelbi Creek.*

The use of offshore set nets be prohibited between the hours of 4:00pm and 5:00am in the following area:-

- *between the bank of Theodolite Creek to the southern bank of O'Regans Creek and along the shore to the southern bank of Theodolite Creek.*

Background

This is an extension of the night time closure by one hour to ensure the day break movement of dugongs to deeper water feeding grounds is facilitated.

Foreshore Set Nets

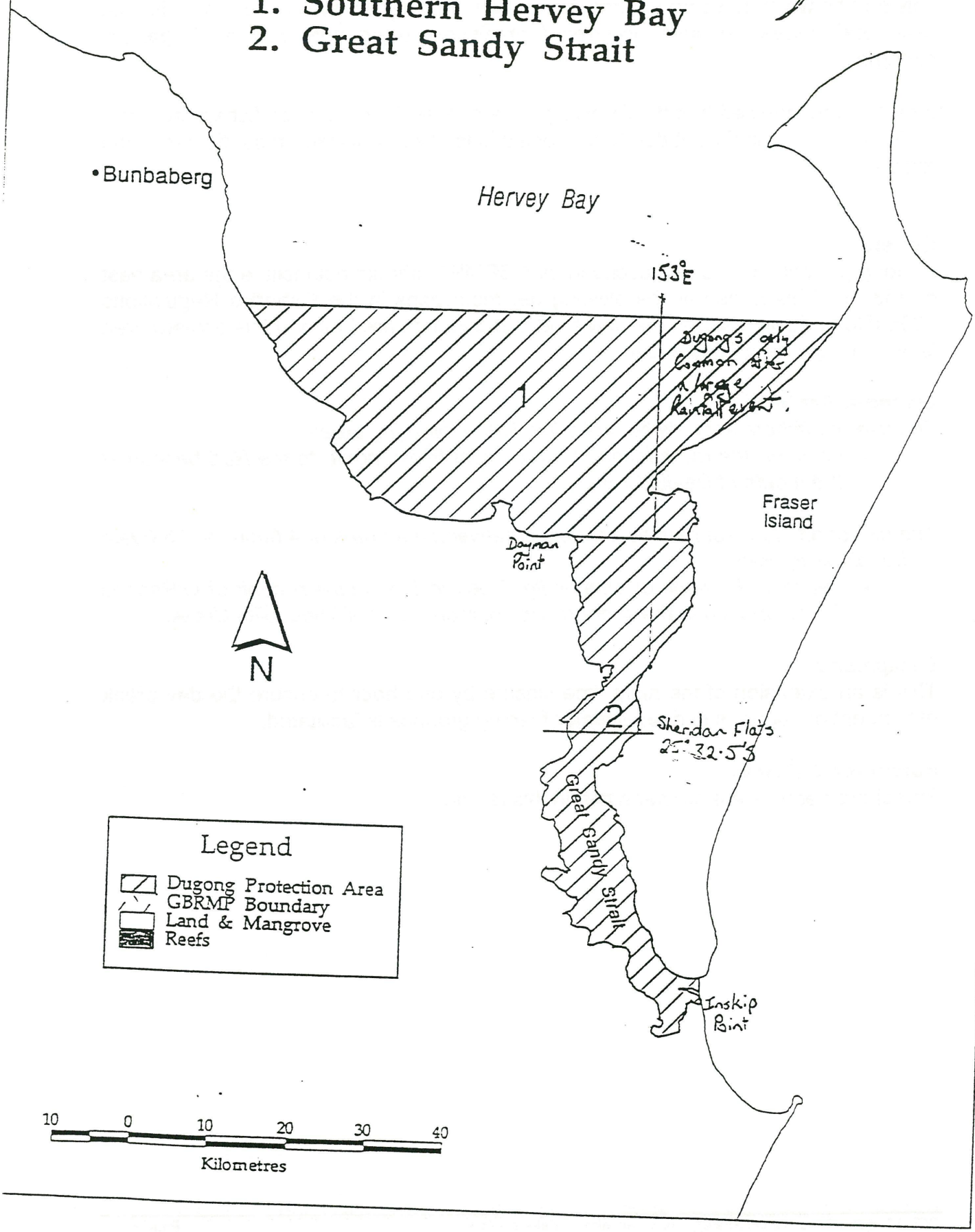
Foreshore set nets are not permitted in this region.

Figure 8

1. (p. 30)

Interim Dugong Protection Areas

1. Southern Hervey Bay
2. Great Sandy Strait



1. (p. 31)

4.11 Great Sandy Straits (refer Figure 8)

General Purpose Nets

1. *The use of general purpose nets with a monofilament diameter greater than 0.62 mm (line 14) and a mesh greater than 125 mm (5 inch) be prohibited:-*
   - *south of Sheriden Flats (25 °32.5' S) to Inskip Point.*

2. *The use of general purpose nets with a monofilament diameter greater than 0.70 mm (line 18 ply) be prohibited:-*
   - *north of Sheriden Flats (25 °32.5' S) to Dayman Point (25 °17' 20" S).*

3. *The use of general purpose nets with a mesh size greater than 125mm (5inch) be prohibited in the following area:-*
   - *south of Baffle Creek.*

4. *The use of general purpose nets with a mesh less than 100mm (4inch) and ply greater than 0.47mm - line 8 monofilament (except for buns, flaps and bags) be prohibited in the following area:-*
   - *south of Sheriden Flats (25 °32.5' S) to Inskip Point.*

5. *The use of general purpose nets with a mesh larger than 100mm and ply greater than 0.62mm - line 14 monofilament (except for buns, flaps and bags) be prohibited in the following area:-*
   - *south of Sheriden Flats (25 °32.5' S) to Inskip Point.*

Tunnel Net

The use of tunnel nets with wings heavier than 0.47mm (line 8 ply) monofilament or 9 ply supermeration be prohibited in the following area:-

- *south of Dayman Point (25 °17' 20" S) to Inskip Point.*

River set net

The use of river set nets be prohibited in the following area:-

- *Kauri Creek*

Background

There has been no noted interaction with dugongs and river set nets throughout Queensland. However, due to the possible confusion over the definition of the river mouth in this instance a closure was recommended.

Note:

In the past there has been little interaction with dugongs in the Great Sandy Straits. Due to the species being targeted, such as the smaller mackerel and whiting species, fishers of this region have less of a need for heavier ply than fishers in other areas.

1.(p.31)

5.0 Other Areas not identified

Whilst the dugong conservation areas listed were acknowledged as areas of concern for dugong, there are other areas of significance which have been identified by fishers. QCFO is committed to ongoing meetings with fishers throughout Queensland to develop measures which ensure dugong protection in all Queensland waters. QCFO will continue investigating other actions and priority areas as soon as funds and resources are available.

6.0 Conclusion

As stated in the QCFO Dugong Conservation Strategy, the commercial fishing industry recognises it has an obligation to mitigate and, wherever possible, eliminate its impact on dugong, regardless of the status of dugong populations. The QCFO firmly believes that the implementation of the QCFO Strategy and the above described initiatives will result in the immediate mitigation of the fishing industry's impacts on dugong populations.

Considerable concessions have been achieved after long and comprehensive discussions with genuinely concerned fishers who have had extensive experience in the relevant areas. The measures developed represent the limit available for the fishers to maintain their operations and it is therefore critical that no changes are made to the outcomes in this report, as even minor changes may result in a significant impact on industry while doing little or nothing to help protect dugong. Should further measures be required, compensation would need to be included into any subsequent deliberations.

The QCFO is committed to the ongoing consultation process with net fishers to ensure that systems are put in place to maximise dugong protection statewide. Coupled with the investigation to eliminate illegal netting operations in the state, and increased education and awareness through the Endangered Species Awareness Course, the fishing industry is ensuring the long term protection of the dugong.

Appendix 1

1. (p. 32)

QUEENSLAND COMMERCIAL FISHERMEN'S ORGANISATION

DUGONG CONSERVATION STRATEGY

November 1996

1.(p.33)

1. INTRODUCTION

Recent research into the population status of dugong under the direction of Professor Helene Marsh of James Cook University, Queensland, indicates the population of dugong in the southern Great Barrier Reef Marine Park (Cape Bedford to southern boundary) has declined by about 50 percent between 1987 and 1994. Anthropogenic influences (human impacts) are seen as the prime cause of this decline and include; habitat loss through urban growth and related industrial and agricultural activities, commercial mesh-netting, illegal harvesting of dugong for trade, the shark meshing program, vessel strikes, and traditional hunting.

The commercial fishing industry recognises it has an obligation to mitigate and, wherever possible, eliminate it's impact on dugong, regardless of the status of dugong populations. The Queensland Commercial Fishermen's Organisation (QCFO) firmly believes the implementation of strategies outlined in this paper will result in the immediate mitigation of fishing industry impacts on dugong populations.

2. GOAL

To mitigate, and wherever possible, eliminate the impact of commercial fishing on dugong by:

a) minimising the potential of dugong becoming entangled in commercial mesh nets; and
b) maximising the chance of survival of dugong that accidentally become entangled in commercial mesh nets.

QCFO firmly believes that to be effective any strategy aimed at mitigating the impact of commercial fishing practices on dugong must be based on the best available knowledge and be delivered through an appropriate balance between prescriptive regulatory mechanisms and strategies aimed at modifying individual fisher attitudes and behaviour through education. Taking this approach, immediate and sustainable results can be achieved by ensuring that dugong conservation is rapidly accepted by all fishermen as an essential part of their normal fishing practices.

3. MANAGEMENT STRATEGIES

3.1 Education and Training Strategy

Endangered Species Awareness Course

The QCFO initiated the development of an "Endangered Species Awareness Course" in late 1995 in response to concerns over the interaction between endangered/threatened species (eg. turtles, dugong, etc) and commercial fishing. The course is being developed by QCFO in full consultation with industry, coordinated through Queensland Fishing Industry Training Council (QFITC) and delivered by appropriate experts in the relevant fields.

1.(p. 34)

Now that funding assistance has been secured from the GBR Cooperative Research Centre (Reef CRC) and the Department of Environment (DoE) Coastcare Program, development of the course curriculum has commenced and will be completed by late 1996. All commercial fishers in charge of mesh netting operations will be required to achieve accreditation in the course prior to using mesh nets in waters adjacent to Queensland by the end of 1997. Additional accreditation to operate in specific areas of "high risk" where local knowledge is essential in reducing that risk will also be investigated and, where necessary, implemented.

Once completed, the course will be made immediately available to existing licensed commercial fishers by way of a series of regional training seminars to be held at major fishing ports throughout Queensland. Targeting existing commercial fishers in this manner will deliver immediate results by providing information to increase their knowledge of dugong, its conservation status and changes to fishing practices required to mitigate their impacts.

Concurrent with the above approach to train existing fishers, the course will also be included in the Trainee Master Fisher's course which must be successfully undertaken before being issued with a Queensland Commercial Fisher's Licences. This will ensure the positive results achieved with existing fishers are sustained by those entering into the industry.

Course development: (completion by late 1996)

Industry contribution	$17,000
DoE contribution	$17,000
Total	$34,000

Implemented into Trainee Master Fishers course and available to existing fishers as individual module: (by March 97)

Cost recovery basis

Regional Industry Training Seminars to existing fishers: (by mid 97)

Industry contribution	$17,000
Reef CRC contribution	$17,000
Total	$34,000

Note: Costs to other agencies in developing and implementing this program have not been identified.

Industry Codes of Practice

QCFO is developing a comprehensive industry "Code of Practice" which will clearly outline actions to enable fishermen to minimise the potential for their operations to impact on dugong. The first draft of the Code has now been developed and is based on procedures previously implemented by some fishers operating in areas of potential mesh net and dugong interaction (attached).

Where necessary, regional or local area supplements will be developed and attached to the generic "Codes of Practice" to address any unique requirements of specific areas along the coast, particularly "high risk" areas. The objective is to ensure that all commercial mesh net fishers have the necessary information to enable them to adopt risk averse fishing practices in their area of operation in the immediate future.

1. (p. 35)

In addition, input will be sought from all available experts to further develop the "Code of Practice" into a more comprehensive document to better inform fishers on dugong and the need for dugong conservation. This document will be similar in format to the QCFO/QDPI Turtle Recovery Brochure (attached) and will include basic information on dugong biology, habitat requirements, their movements, the above "Code of Practice", quick release procedures and, procedures for reporting dugong incidents. The Code will be printed on high quality waterproof paper, be distributed to all Queensland commercial fishers, and included in the "Endangered Species Awareness course".

Develop and distribute generic "Code of Practice" (completion Nov. 96)

Industry contribution	$10,000
Total	$10,000

Develop local area "Codes of Practice" ("high risk" areas by mid 97)

Industry contribution	$3,000	per code
Total (initial 5 areas)	$15,000	

Note: Costs to other agencies in developing and implementing this program have not been identified.

3.2 Monitoring and Research Strategy

Incident Reporting

There is currently little information on the frequency of dugong coming into contact with, becoming entangled in, or mortality from mesh nets. QCFO, in consultation with relevant government agencies is developing a comprehensive dugong incident reporting system for commercial fishers to report:

a) all incidents of dugongs breaking through mesh nets;
b) all incidents of dugongs becoming entangled in mesh nets; and
c) all dugong mortalities observed (whether caused by entanglement in mesh nets or otherwise)

A standard reporting form has been developed that will enable commercial fishers to report incidents of dugong/mesh net interaction to QCFO State office (attached). Information requested includes; date and time of incident, exact location, description of netting apparatus being used, species being targeted, details of the incident and description of the animal and its condition after the incident. The form will be distributed to all commercial fishers who will be requested to return completed forms or phone QCFO State office with details of the incident. A requirement to report all incidents is also included in the "Code of Practice".

The information provided will be recorded in a "Dugong Incident Register" established by QCFO and will be available for integration with incident reporting procedures established in other government agencies including; GBRMPA, DoE and QDPI Boating and Fisheries Patrol. This program will also be integrated with the "Dugong Carcass Recovery Program" currently being established by GBRMPA.

In addition to increasing industry awareness of the need to protect dugong, this program will provide individual fishers with an opportunity to do their part in protecting dugong populations by providing vital information on dugong movements, factors contributing to dugong incidents (fishing or otherwise) and how dugong incidents may be reduced or avoided.

Discussions between QCFO, QDPI and QFMA are also under way on the possibility of incorporating dugong sightings into the commercial fishing logbook system for the purpose of enhancing our knowledge of the seasonal and spatial distribution of dugong.

Develop reporting program and advise fishers (completion Nov. 96)

Industry contribution	$3,000
Total	$3,000

Implement reporting program and register (ongoing)

Industry contribution	$10,000
Total per annum	$10,000

Promote reporting program (ongoing)

Industry contribution	$5,000
Total per annum	$5,000

Note: Costs to other agencies in developing and implementing this program have not been identified.

Research

QCFO, its Branches and Members will actively encourage, financially support and participate in research aimed gaining better understanding of and at protecting dugong and their habitats, in particular, research directed at gaining greater knowledge of the interactions between commercial fishing practices and their potential impact on dugong.

The Queensland Fishing Industry Research Advisory Committee (QFIRAC), of which QCFO is a representative, strongly supported a detailed research proposal by QDPI to identify the impacts of mesh netting in Queensland on all non-target species including dugong. The proposal is budgeted to cost approximately $700,000 over the next 3 years and will be forwarded to the Fisheries Research and Development Corporation (FRDC) for funding. FRDC's budget is supported by direct financial contributions from the fishing industry.

QCFO will also be actively supporting research into identifying and quantifying other natural and anthropogenic impacts on dugong populations, in particular, disturbance to and loss of dugong habitat, factors influencing the movements of dugong along the east coast, the Torres Straits and Gulf of Carpentaria and, illegal mesh netting.

1.(p.37)

3.3 Risk Identification and Mitigation Strategy

QCFO has commenced the process of identifying specific areas of dugong/mesh net interaction, and developing specific arrangements to mitigate, and wherever possible, eliminate any adverse effects of mesh netting in each area. When determining the priority of areas to be addressed, QCFO will take into account high priority or "high risk" areas identified by all relevant agencies.

The process to be undertaken in each area will involve full consultation with local fishers for the purpose of identifying:

- all areas of mesh net and dugong interaction;
- current mesh netting practices in dugong areas;
- specific "high risk" areas; and
- appropriate management arrangements and fishing practices to mitigate the risk of dugong becoming entangled mesh nets, particularly in high risk areas

In addition to the "Endangered Species Awareness Course" and industry "Code of Practice" arrangements to mitigate and, wherever possible, eliminate the impacts of mesh netting on dugong may include any combination of the following:

- development of additional area or local codes of practice to cater for the unique requirements of specific areas, in particular, potential "high risk" areas;
- regulatory changes to the conditions of use of mesh nets on a State-wide, regional or area basis including changes to net attendance requirements;
- regulatory changes to mesh net specifications on a State-wide, regional or area basis including; number of nets, length of net, mesh size and ply size, etc; and
- regulatory changes to introduce appropriate; time, area, seasonal and total closures to the use of certain nets depending on the circumstances.

Due to the need for immediate action to address this issue, potential "high risk" areas are currently being given highest priority. "High risk" areas are to be identified and assessed in consultation with local fishers with the view to developing appropriate, area specific "risk abatement" strategies by early to mid November 1996. The following priority areas have been identified to date:

- Princess Charlotte Bay/ Bathurst Bay area;
- Hinchinbrook area;
- Cleveland Bay/ Magnetic Island area;
- Upstart Bay area;
- Newry area (Pigeon Island to McBrides Point);
- Ince Bay area;
- Shoalwater Bay/Port Clinton area;
- Southern Hervey Bay/Great Sandy Strait area.

As specific arrangements are developed for "high risk" areas industry proposals will be forwarded to relevant government agencies (QDPI, QFMA, GBRMPA and DoE) for endorsement and consideration of any necessary legislative changes and other arrangements required for implementation. Other "high risk" areas will be identified and addressed in their order of priority.

1.(p. 38)

Where seasonal or area closures are being considered, the potential for displaced commercial fishing effort causing similar problems, or exacerbating existing problems, in other areas must be taken into consideration and addressed. Where closures result in potential impacts in other areas, the removal of affected licence packages is likely to be required and compensation issues must also be addressed. QCFO firmly believes the agency (Commonwealth or State) proposing the closures must resolve any compensation issues with affected fishers prior to implementation. Compensation may be in monetary terms or other economic incentives to offset the financial impact of fishers losing access to fishing grounds.

Identify and develop measures for "high risk" areas (completion mid 97)

Industry contribution	$3,000	per area
Total (initial 7 areas)	$18,000	

Note: Costs to other agencies in developing and implementing this strategy are yet to be identified and will depend largely on the outcome of reviews of "high risk" areas. Agencies likely to incur some costs (human resource and financial) are QFMA, QDPI, GBRMPA and DoE. Where compensation is involved, these cost may be significant.

3.4 Legislation and Compliance Strategy

Legislation

QCFO believes that all legislative changes relating to fisheries management arrangements and fisheries practices must be implemented under the provisions of the Queensland *Fisheries Act 1994*. The "new" Fisheries Act 1994 has been developed specifically to incorporate the recommendations of the Ecologically Sustainable Development Report on Fisheries. Of particular significance here is:

a) the requirement for an ecosystems approach to fisheries management whereby the impacts of fishing on target and non-target species is taken into account when developing fisheries management arrangements;
b) the requirement for flexibility in the legislative process to accommodate the rapidly changing needs of fisheries and associated resources; and
c) the requirement for proposed management changes to be developed in full and meaningful consultation with the fishing industry to ensuring the proposed changes will have the desired effect.

Where legislative change is required to mitigate or eliminate the impact of fishing practices on dugong, QCFO is committed to ensuring any proposed changes achieve the highest possible priority to ensure a speedy and effective result. Resolution of the dugong/mesh net problem in Shoalwater Bay late last year is a good example of the rapid response capabilities afforded under the Fisheries Act.

Compliance

While QCFO is of the very firm view that implementation the education and monitoring strategy will significantly reduce the impact of fishing practices on dugong, the need for adequate surveillance and enforcement capabilities to ensure compliance with regulatory requirements will also be required.

1.(p.39)

It is well recognised that areas closed to fishing require as much, if not more, surveillance than areas that are open. Where additional surveillance is not provided, closures can often provide an ideal environment for illegal fishing activity, also recognised as having potentially significant impacts on dugong.

Where additional surveillance and enforcement is required, QCFO strongly supports the allocation of increased funds to Commonwealth and DoE funded compliance programs. However, QCFO will not accept a situation where current fisheries surveillance priorities are compromised through a realocation of existing QB&FP resources. It is anticipated the appointment of marine parks officers as enforcement officers under the Fisheries Act may partially offset the need for additional funds and this is fully supported by QCFO. A strategic approach to the compliance programs of Commonwealth and State agencies is essential if resources are to utilised effectively.

QCFO will also proposes the introduction of severe penalties for anyone (commercial fisher or otherwise) who deliberately or through gross negligence causes dugong mortality. A breach of Regulations or failing to comply with the relevant "Codes of Practice" resulting in a dugong mortality would certainly be considered a serious fisheries offence.

Note: Costs to other agencies in developing and implementing this strategy are yet to be identified and will be influenced largely by outcomes under strategy 3.3 . Any proposed changes to legislation and surveillance activities are likely to result in some costs (human resource and financial) to QFMA, QDPI, GBRMPA and DoE. These costs may be significant.

4. IMPLEMENTATION

To assist the Dugong Review Group (DRG) in its role, each stakeholder group with identified impacts on Dugong populations should establish their own process to develop, implement and monitor the effectiveness of strategies aimed at mitigating that groups impacts. It is envisaged that each stakeholder group would report directly to the DRG on its progress.

As a stakeholder group with identified impacts, the QCFO proposes the establishment of a QCFO Dugong Conservation Working Group consisting of one representative of each of the following agencies/groups. Conservation agency/group membership shall, where possible, consist of persons with appropriate scientific knowledge of dugong:

- Queensland Commercial Fishermen's Organisation.
- Australian Marine Conservation Society.
- Queensland Fishing Industry Training Council.
- Queensland Department of Primary Industries.
- Queensland Fisheries Management Authority.
- Queensland Department of Environment.
- Great Barrier Reef Marine Park Authority.

The Working Group's terms of reference will be to develop, implement and monitor the effectiveness of strategies aimed at mitigating the fishing industry's impacts on dugong populations and to report directly to the Dugong Review Group (DRG) on its activities.

Operation of QCFO Dugong Working Group (ongoing)		
Industry contribution	$6,000	per annum
Total	$6,000	

1.(p.40)

QUEENSLAND COMMERCIAL FISHERMEN'S ORGANISATION

Code of Practice to Reduce Interaction between Mesh Netting and Dugong

To be complied with when net fishing in areas of potential interaction with dugong.

1. Prior to deploying nets in unfamiliar areas, fishers to:
   - obtain and become familiar with any local Codes of Practice;
   - liaise with local net fishers to obtain necessary knowledge of recent dugong activity and actions required to reduce potential mesh net / dugong interaction.

2. Fishers avoid deploying nets in areas where dugong are present.

3. Fishers must comply with all Regulations and conditions of use of mesh nets they are using in the area.

4. Fishers design their nets to minimise potential dugong entanglement.

5. Fishers to maintain a vigilance of their own nets and also others in the area to ensure a rapid response should a dugong become entangled.

6. In the event of becoming aware of dugong moving into an area being fished, fishers should:
   - immediately be on high alert and take extra precautions such as remaining at the net while dugongs are present;
   - notify other fishers in the area about the presence of dugong in the area.

7. In the event of a dugong becoming accidentally entangled in a net, a fisher must:
   - immediately take all reasonable steps to release the dugong unharmed;
   - be prepared to sacrifice netting and/or ropes to release the dugong;
   - if necessary, call for assistance by radio or some other signalling method;
   - if a dugong is too entangled to be freed quickly and easily, all attempts must be made to maintain its ability to breathe.

8. Fishers must report the details of each incident of a dugong becoming entangled in a net to the nearest QCFO Office by phone or fax as soon as possible after the incident (standard fax forms will be provided by QCFO).

9. In the event of a fisher becoming aware of a dugong mortality (whether caused by entanglement in a mesh or not) as well as the reporting requirements outlined in 7 above, the fisher must immediately report the mortality to the nearest Queensland Boating and Fisheries Patrol office or the QFMA hot line.

1.(p.41)

QUEENSLAND COMMERCIAL FISHERMEN'S ORGANISATION

Dugong Incident Report

To be completed and forwarded to QCFO State Office in the event that dugong becomes entangled in, or breaks through , a fishing net.

Date of Incident: Time:

Location (Be as specific as possible, you may wish to draw a rough map on reverse side):

Description of fishing activity and species targeted (eg foreshore set netting for salmon with 600 metres of net in water.):-

Did animal break through the net or become entangled? (yes/no)

If the animal became entangled in the net please provide the following information:-

- Estimated time the animal was trapped in the net and how was it trapped (eg. by tail for about 2 minutes):

- When released from net what condition was animal in? (eg dead, swam away with no signs of damage)

- Description of animal if possible (eg large bull about 3 metres long)

We would appreciate your views on what are the major factors causing dugong incidents (fishing or otherwise) and suggestions on how these incidents can be avoided.

Contact number (optional):

Appendix 2.

1.(p.42)

SCHEDULE 13 (continued)

Division 2—Use of nets

Use of nets in offshore waters north of Hervey Bay

47.(1) A net may be used in waters north of Hervey Bay at least 2 m deep and—

(a) south of a line from the southern bank of Baffle Creek east to longitude 153° east and

(b) west of longitude 153° east; and

(c) north of the Burnett River.

(2) The net must not be longer than 600 m and must have a mesh size of at least 88 mm.

(3) A net used south of a line from the southern bank of the Elliott River east to longitude 153° east must be made of monofilament not more than 0.65 mm in diameter and must not be more than 33 meshes deep.

(4) A net must not be used in waters of Hervey Bay within the following boundary between 4.00 p.m. and 4.00 a.m. from 1 July to 31 October—

- from the southern bank of Theodolite Creek east to longitude 152°40' east
- to the southern bank of O'Regan Creek
- along the shore to the southern bank of Theodolite Creek.

(5) A person using a net north of a line from the southern bank of the Elliott River east to longitude 153° east need not be within 100 m of the net.

Use of nets in other offshore waters

48.(1) A net that is not fixed or hauled may be used in offshore waters only if the waters are at least 2 m deep and the net is not longer than 600 m and has a mesh size of at least 150 mm but not more than 245 mm.

(2) Two nets may be joined and used as a single net in waters deeper than 20 m north of Cape Moreton if the combined length of the nets is not more than 1 200 m.

1. (Suppl. #1 (p.43)

QUEENSLAND COMMERCIAL FISHERMEN'S ORGANISATION
PO Box 392, Clayfield, QLD 4011
Ph: (07) 32626855 Fax: (07) 32627650

FACSIMILE TRANSMISSION

DATE: 26 February, 1997

TO: Tony Stokes GRBMPA

FROM: Stephen Tapsall

SUBJECT: Clarification of Areas in QCFO Strategy

Cinchinbrook
The section that was indicated as no dugong interaction between Con Creek and Adams Inlet was indicated as the only method of net fishing in the area involves river set nets. Due to the method of legal operation of these style of nets interaction with dugongs is prevented.

Offshore Set Net
The closure for offshore set that was previously in an arrowhead shape has now been simplified. The closure for the offshore set net is as follows, from Meyunga Creek to the northern point of Goold Island to Cape Sandwich then west back to Meyunga Creek.

Foreshore Set Nets
With regard to foreshore set nets in the Missionary bay region, the at the net attendance was designed to reduce the number of nets possible to used by fishers in this region. In so doing it is not possible to fish with the allocated 3 nets. Fishers have indicated to me that using 2 nets was possible with the attendance rule and was the desired option, however in the interests of dugong protection the option of reducing the numbers of nets to only 1 net is possible.

4.9 Port Clinton
Foreshore Set Nets
Section 3. The at the net attendance suggested for the foreshore set net in this area is designed to be so that only 1 net is to be used.

Due to the barramundi season having already started it has been very difficult to contact fishers to get further details on other areas.

Good luck with it all.

Regards Steve.

1. (Suppl#2)

QUEENSLAND COMMERCIAL FISHERMEN'S ORGANISATION
PO Box 392, Clayfield, QLD 4011
Ph: (07) 32626855 Fax: (07) 32627650

(P.44)

FACSIMILE TRANSMISSION

DATE: 6 March, 1997

TO: Tony Stokes, GBRMPA

FROM: Stephen Tapsall, QCFO

SUBJECT: Clarifications for the QCFO Dugong Strategy Implementation

Foreshore Net Attendance
Whilst most fishers utilise the foreshore set net attendance with the intention of being able to work more than one net, a review is recognised as necessary to address the issue of distances the nets can be set apart. This review will require further consultation with net fishers to thoroughly address this issue in regard to dugong protection.

Princess Charlotte
The 50 metre foreshore net suggested in the Princess Charlotte Bay is not the Rocky Foreshore Set Net described for the Newry region and Ince Bay. The Princess Charlotte Bay 50 metre net is to be used in accordance with the standard foreshore set net regulations (2/3 rule applying). Note this change is to take place through the months of August September and October, existing regulations would apply for the rest of the year.

Cleveland Bay
Offshore Set Nets

- As stated in section 3.1.1 relating to 800 metre attendance, the use of offshore set nets in this region is to be 800 metres. The exception is south of the line as described in section 4.4, where it is to be at the net attendance (100m).
- The use of offshore set nets be prohibited in the following area:-
  South of the line between Cape Cleveland and Townsville Harbour wall.

General Purpose Net
This section is to be reworded to:
That general purpose nets from Ross Creek to Cape Cleveland be restricted to:-

- max length 400m
- maximum mesh size 115 mm (4.5 ") mesh
- max ply strength of 0.62 mm diameter monofilament (line 14 ply).

1. (p.45)

Upstart Bay
The barramundi spawning closures that are described in the Upstart Bay map is detailed in the following QFMA paper. Note this paper also highlights closures in other areas that are in dugong protection zones.

Hervey Bay
General purpose nets
points 3 and 4:- Dayman Point is to be changed to Sheriden Flats. (already advised)

The use of offshore set nets be prohibited in the area west of a line between the red beacon at Burrum River mouth to the red beacon at Beelbi Creek mouth.

If further information is required please do not hesitate to contact me.

Yours sincerely

Stephen Tapsall
ENVIRONMENT OFFICER

SPAWNING ZONES INTRODUCED FOR THE EAST COAST BARRAMUNDI FISHERY

THE Queensland Fish Management Authority (QFMA) initiated a comprehensive review of the East Coast Barramundi Fishery in February 1990 and subsequently introduced new management measures which came into effect from 1 July 1992.

One of the major new measures was the introduction of 1000 metre "spawning zones" around the mouths of specified rivers and creeks along the Queensland east coast. The use of nets capable of taking or disturbing barramundi is prohibited in these zones during the closed season (1 November to 1 February).

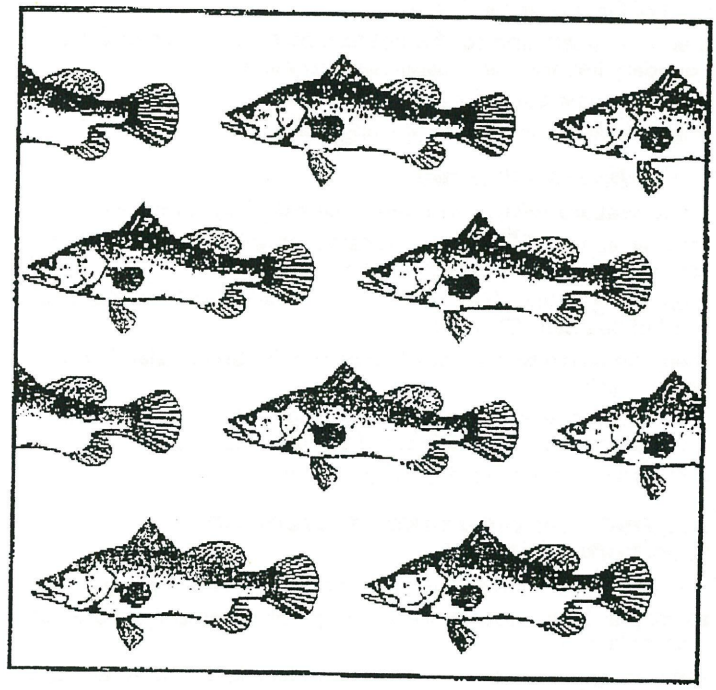
Generally spawning zones encompass an area 1000 metres either side of the river/creek mouth and 1000 metres seaward. However some, due to the topographical features, cannot be described in the general sense and therefore have been individually described. Most foreshore set gill nets will be prohibited from use in these zones during the closed season.

Why have Spawning Zones?

A closed season on barramundi was introduced in 1981 to protect barramundi during their peak spawning time. It is at this time when barramundi congregate around river mouths to spawn that they are most vulnerable to capture in large numbers.

There is strong evidence that the closed season has been responsible for an increase in barramundi numbers. It facilitates the spawning process and is a measure which clearly reduces fishing effort and catches for 25% of each year.

During the barramundi closed season commercial fishers on the east coast may continue to operate certain foreshore nets to target other species of fish. Of course any barramundi caught in those nets must be released. However the actual process of becoming meshed may cause female barramundi to release their eggs



prematurely thereby reducing the potential for an effective spawning. Additionally some fish inadvertently meshed, regardless of the requirement on fishers to release them immediately will not survive. The removal of foreshore set gill nets from these important spawning areas will reduce the occurrence of incidental capture of barramundi.

Consequently spawning zones have been introduced to combat that problem by prohibiting the use of nets capable of taking or disturbing barramundi during the closed season in those areas immediately adjacent to the mouths of rivers and creeks, areas which are recognised as prime spawning sites for barramundi. Rivers and creeks are already closed to the use of set gill nets during the closed season.

1. (P.47)

Sheep Station Creek to Barratta Creek

1 **The waters within the area bounded by a line —**

- starting at the north head of Sheep Station Creek
- then along a line (the "coastal boundary line") to the west head of Barratta Creek
- then in a direct line to the starting point.

Victoria Creek

1 . **The waters within the area bounded by a line —**

- starting at high water mark at the most northern point of the sand spit at the south head of Victoria Creek
- then due north to the coastline at high water mark
- then along a line (the "coastal boundary line") to the starting point.

Gentle Annie Creek

1 . **The waters within the area bounded by a line —**

- starting at a point 1 km south of Gentle Annie Creek at high water mark
- then along a line (the "coastal boundary line") to the north head of Gentle Annie Creek
- then in a direct line to the nearest point of the coastal 1 km boundary line for the coastal boundary line
- then along the coastal 1 km boundary line
- then in a direct line to the starting point.

Hinchinbrook Channel

. **The waters within the area bounded by a line —**

- starting at the F↑B board located at the east head of the eastern entrance to Neames Inlet

  then along a line (the "coastal boundary line") to the east head of Seaforth Channel
- then due north to the coastline of Hinchinbrook Island at high water mark

  then along the coast of Hinchinbrook Island at high water mark to the F↑B board located at Fisherman Point
- then in a direct line to the starting point.

Macushla Point to Forkey's Creek on Hinchinbrook Island

18. **The waters within the area bounded by a line —**

starting at high water mark at the point commonly known as Macushla Point

- then along a line (the "coastal boundary line") to where the parallel of latitude 18°16'50" south intersects with Hinchinbrook Island at high water mark (about 1km west of the west head of the creek commonly known as Forkey's Creek)
- then in a direct line to the starting point.

Thompson Point to Flying Fish Point (Johnstone River)

19. **The waters within the area bounded by a line —**

starting at high water mark at Thompson Point

then along a line (the "coastal boundary line") to Flying Fish Point

- then in a direct line to the starting point.

Trinity Inlet

20. The waters of Trinity Inlet inshore of a direct line between Stafford Point at high water mark and the southern landward end of the Marlin Jetty at the entrance to Trinity Inlet.

Barron River

21. **The waters within the area bounded by a line —**

- starting on the coastline at high water mark at a point 1km south of the south head of the Barron River
- then along a line (the "coastal boundary line") to a point 1km north of the north head of the Barron River
- then in a direct line to the nearest point of the coastal 500m boundary line for the coastal boundary line
- then along the coastal 500m boundary line
- then in a direct line to the starting point.

Four Mile Beach to Magazine Island

22. **The waters within the area bounded by a line —**

- starting at the most northern point at high water mark of Four Mile Beach
- then along a line (the "coastal boundary line") to the point where the parallel of latitude 16°29' south intersects with the mainland at high water mark east of Dickson's Inlet
- then in a direct line to the most eastern point of Magazine Island at high water mark
- then by high water mark to the most northern point of Magazine Island
- then due north 1km
- then due east to the intersection with the coastal 1km boundary line for the coastal boundary line
- then along the coastal 1km boundary line to its eastern end
- then in a direct line to the starting point.

Mossman River

23. **The waters within the area bounded by a line —**

- starting on the coastline at high water mark at a point 1km south of the south head of the Mossman River
- then along a line (the "coastal boundary line") to a point 1km north of the north head of the Mossman River
- then in a direct line to the nearest point of the coastal 500m boundary line for the coastal boundary line
- then along the coastal 500m boundary line
- then in a direct line to the starting point.

Endeavour River

24. **The waters within the area bounded by a line —**

- starting at the F↑B board located north of Point Saunders
- then along a line (the "coastal boundary line") to the most northern point of Grassy Hill
- then in a direct line to the starting point.

Definitions for the purpose of this information paper are —

River/Creek mouth – between the measured coastline for waterways mentioned and the coastal 1 km line for the waterway (see diagram).

Coastal 1 km line – for a waterway means a line on the seaward side of the coastline each point of which is —

(a) 1 km from the nearest point of the measured coastline for the way, and

(b) no closer than 1 km from the coastline at high water

Further Information

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10th Floor 157 Ann Street
BRISBANE Q 4000
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This document is a general summary of current fisheries legislation as at the date of publication. It should not be taken as a substitute for fisheries legislation which may be subject to change from time to time. Whenever such amendments to regulations are made they will be announced in the news media.

Printed 28 March 1994

SPECIFICALLY DESCRIBED SPAWNING ZONES

Some rivers and creeks have topographical features which are not conducive to the application of spawning zones in the general sense described above. The spawning zones applied to these areas are defined by specific point to point boundaries which are set out below.

Middle Head to Norton Point

1. The waters within the area bounded by a line —

- starting at the F↑B board located east of Middle Head
- then along a line (the "coastal boundary line") to the F↑B board located west of Norton Point
- then in a direct line to the nearest point of the coastal 1 km boundary line for the coastal boundary line
- then along the coastal 1 km boundary line
- then in a direct line to the starting point.

South Trees Inlet

2. The waters within the area bounded by a line —

- starting at the F↑B board located east of South Trees Inlet
- then along a line (the "coastal boundary line") to the F↑B board located west of South Trees Inlet
- then in a direct line to the nearest point of the coastal 1km boundary line for the coastal boundary line
- then along the coastal 1 km boundary line
- then in a direct line to the starting point.

Calliope River

3. The waters within the area bounded by a line —

- starting at the F↑B board located east of the Calliope River
- then along a line (the "coastal boundary line") to the F↑B board located west of the Calliope River
- then in a direct line to the nearest point of the coastal 1 km boundary line for the coastal boundary line
- then along the coastal 1 km boundary line
- then in a direct line to the starting point.

Graham Creek on Curtis Island

4. The waters within the area bounded by a line —

- starting at the F↑B board located south of Graham Creek on Curtis Island
- then along a line (the "coastal boundary line") to the F↑B board located north of Graham Creek
- then in a direct line to the nearest point of the coastal 1 km boundary line for the coastal boundary line
- then along the coastal 1 km boundary line
- then in a direct line to the starting point.

Cattle Point to Cardigan Point

5. The waters within the area bounded by a line —

- starting at high water mark at Cattle Point
- then along a line (the "coastal boundary line") to Cardigan Point
- then in a direct line to the starting point.

First Lagoon Creek on Curtis Island

6. The waters within the area bounded by a line —

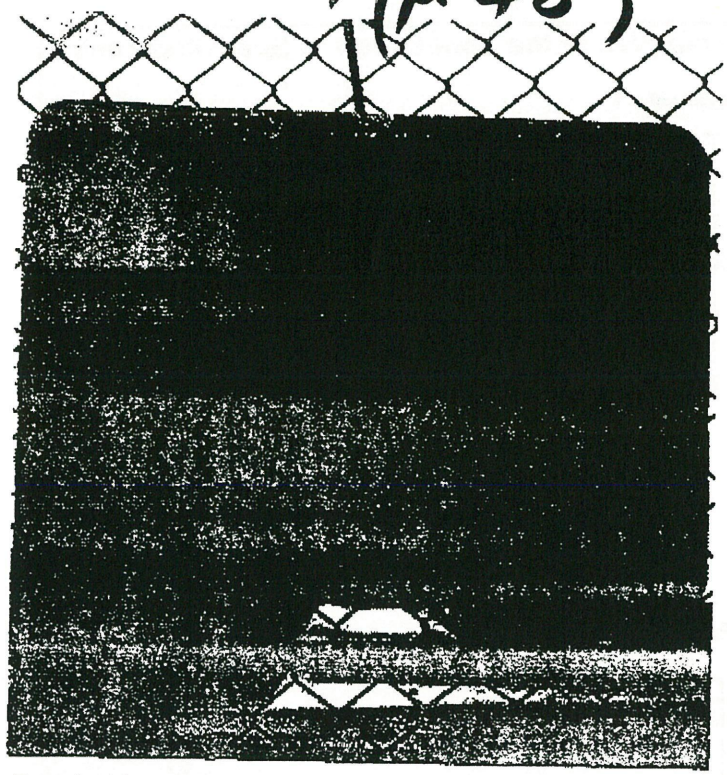
- starting at the F↑B board located east of the creek on Curtis Island commonly known as First Lagoon Creek
- then along a line (the "coastal boundary line") to the F↑B board located west of First Lagoon Creek
- then in a direct line to the nearest point of the coastal 1 km boundary line for the coastal boundary line
- then along the coastal 1 km boundary line
- then in a direct line to the starting point

Second Lagoon Creek on Curtis Island

7. The waters within the area bounded by a line —

- starting at the F↑B board located east of the creek on Curtis Island commonly known as Second Lagoon Creek
- then along a line (the "coastal boundary line") to the F↑B board located west of Second Lagoon Creek
- then in a direct line to the nearest point of the coastal 1 km boundary line for the coastal boundary line
- then along the coastal 1km boundary line
- then in a direct line to the starting point.

1. (p. 48)



South Bluff to Coconut Point

8. The waters within the area bounded by a line —

- starting at high water mark at South Bluff
- then along a line (the "coastal boundary line") to Coconut Point
- then in a direct line to the starting point.

Island Bluff to Charon Point

9. The waters within the area bounded by a line —

- starting at high water mark at Island Bluff
- then along a line (the "coastal boundary line") to Charon Point
- then in a direct line to the starting point.

Little Cape Creek to Shag Creek

10. The waters within the area bounded by a line —

- starting at the north head of Little Cape Creek
- then along a line (the "coastal boundary line") to the north head of Shag Creek
- then in a direct line to the starting point.

Constant Creek

11. The waters within the area bounded by a line —

- starting at the F↑B board located east of Constant Creek
- then along a line (the "coastal boundary line") to the F↑B board located north of Constant Creek
- then in a direct line to the nearest point of the coastal 1km boundary line for the coastal boundary line
- then along the coastal 1km boundary line
- then in a direct line to the starting point.

Nobbies Inlet

12. The waters of Nobbies Inlet inshore of a line —

- starting at a point 200m north-east of the north head of Sandy Creek at high water mark
- then due north to the northern bank at high water mark of Nobbies Inlet.

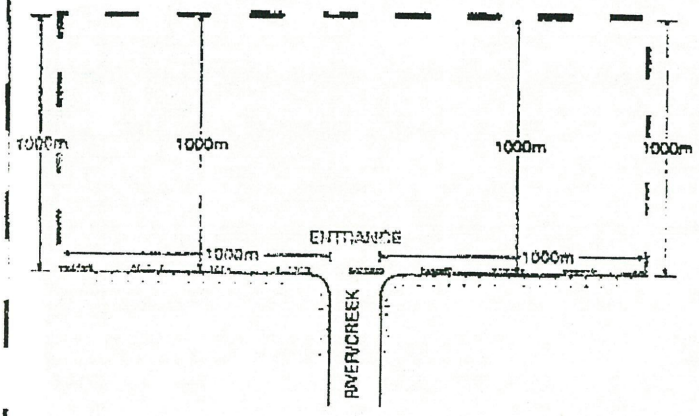
Burdekin River Anabranch

13. The waters within the area bounded by a line —

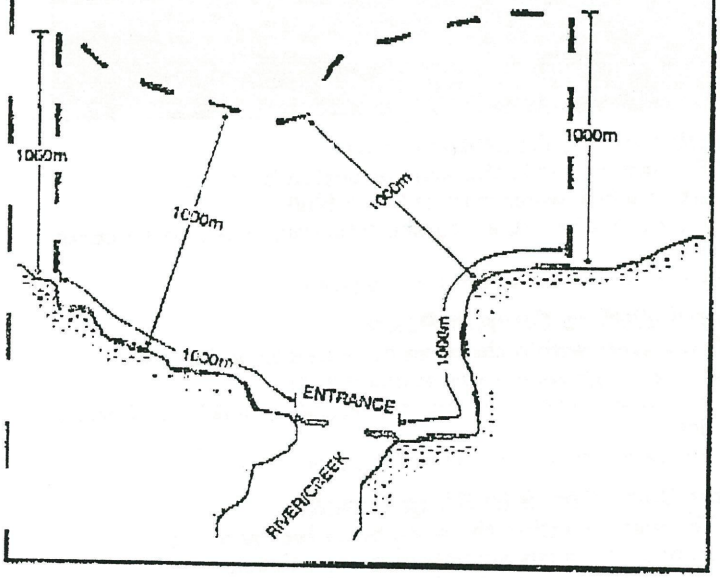
- starting at a point 500m south of the south head of the Burdekin River Anabranch at high water mark
- then along a line (the "coastal boundary line") to a point 1km north of the Burdekin River Anabranch
- then in a direct line to the nearest point of the coastal 1km boundary line for the coastal boundary line
- then along the coastal 1km boundary line
- then in a direct line to the starting point.

Examples of the application of Spawning Zones

Example 1



Example 2



Nets not permitted in Spawning Zone

The following nets are prohibited from use in the spawning zones during the closed season–

East Coast Foreshore Set Gill Net

- River Entrance Foreshore Gill Net

Fishers should refer to Fishing Industry Organisation and Marketing Regulations 1991 for descriptions of the abovementioned nets.

Nets permitted in Spawning Zone

The following nets are permitted within the spawning zones during the closed season –

General Purpose Nets Serial 3, Serial 4, Serial 6 and Commercial Bait Nets Serial 8, Serial 9.

Offshore Set Gill Net or Drift Net (Serial 17) permitted in waters deeper than two metres, provided that the net has a maximum line strength of 40 ply.

Fishers should refer to Fishing Industry Organisation and Marketing Regulations 1991 for descriptions of the abovementioned serial numbers.

SPAWNING ZONES

The area around the mouths of the following rivers and creeks have been designated as barramundi spawning zones. It is important to appreciate the definition of river/creek mouth described later in this information paper. Waters to a distance of 1000 metres either side of the mouths of rivers and creeks and to a distance of 1000 metres seaward are closed to the use of the east coast foreshore and river entrance foreshore set gill nets during the period midday 1 November each year to midday 1 February of the next year.

Bundaberg, Gladstone and Rockhampton regions

- Deepwater Creek
- Jenny Lind Creek
- Boyne River
- Auckland Creek
- Middle Creek (The Narrows)
- Boat Creek (The Narrows)
- Montecristo Creek
- Munduran Creek
- Badger Creek
- Mosquito Creek
- Barker Creek
- Maria Creek
- Seahill (Pacific) Creek
- Causeway Creek
- West Water Creek
- Island Head Creek
- East Creek
- Head Creek
- Mistake Creek
- Georges Creek
- Shoalwater Creek
- Styx River

Mackay region

- Carmilla Creek
- Louisa Creek
- Pioneer River
- Seaforth Creek
- Victor Creek
- Blackrock Creek
- Hervey Creek
- Dempster Creek
- O'Connell River
- Repulse Creek
- Dingo Creek
- Inlet Creek

Burdekin, Townsville and Ingham regions

- Elliott River
- Rocky Pond
- Groper Creek
- Yellow Gin Creek
- Haughton River
- Crocodile Creek
- Alligator Creek
- Ross Creek
- Creek Ross River
- Bohle River
- Cattle Creek
- Palm Creek
- Damper Creek

Innisfail region

- Meunga Creek
- Wreck Creek
- Dallachy Creek
- Murray River
- Tully River
- Hull River
- Moresby River

Cairns and Port Douglas regions

- Russell/Mulgrave River System (Mutchero Inlet)
- Daintree River
- Annan River

1. (p.50)

Catching Fish for Everyone!

QCFO

QUEENSLAND COMMERCIAL FISHERMEN'S ORGANISATION

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699A-713 Sandgate Road, Clayfield Q 4011
P.O. Box 392, Clayfield Q 4011, Australia
Telephone: 07 3262 6855 International: 61 7 3262 6855
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146

10 March 1997

RECEIVED
20 MAR 1997
QUEENSLAND FISHERIES MANAGEMENT AUTHORITY

Mr PL Appleton
Executive Officer
Queensland Fisheries Management Authority
PO ~~Box 344~~
Fortitude Valley Qld 4006

Dear Mr Appleton

Further to your recent letter requesting further information relating to the Industry's Proposal for the Implementation of the QCFO Dugong Conservation Strategy, QCFO has the following comments relating to the points raised by you.

- The large amount of attention that has been focused by the fishing industry towards the offshore set net is largely due to the fact that without an attendance ruling in the previous fisheries regulations. The river set net and the foreshore set nets all have an effective attendance rule. Therefore the offshore set net operation was viewed as having the greatest potential for dugong fatalities. It is for this reason that with the introduction of attendance rules to the offshore set net these concerns are eliminated.

- Your observations that concerns the travelling fisher is of considerable concern to the QCFO is correct. This issue has been largely addressed by a multitude of measures within the implementation of the QCFO Strategy. I am however unclear of your further concern on this issue.

- Whilst most fishers utilise the foreshore set net attendance with the intention of being able to work more than one net, a review is necessary to address the issue of distances the nets can be set apart. Review dealing with this specific issue will require further consultation with net fishers to thoroughly address this issue in regard to dugong protection.

- With relation to the suggestion that dugongs travel and feed in rivers and creeks, this may be the case, however I question whether there has ever been any evidence of dugongs being killed in river set nets. From anecdotal evidence by fishers all along the Queensland coast, dugongs are under no threat from fishing operations using this apparatus legally.

- The Questions that related to other areas such as Princess Charlotte Bay, Cleveland Bay, Upstart Bay, Newry Region, and Hervey Bay were sent directly to Tony Stokes at GBRMPA by fax prior to receiving your letter. A copy of that fax is enclosed for your information.

Since providing this information and due to the amount of requests from GBRMPA and yourself for more measures in the Newry region and Ince Bay, the local net fishers have gone back for another meeting to detail tighter controls in these regions. Once this information becomes available it will be forwarded to you.

Generally speaking for the level of resolution that is requested by you for the GBRMPA it has been suggested that further meetings with our organisation may be necessary prior to implementation. This is suggested as the detail that is being sought is overlooking the reason for the implementation which were designed by fishers to prevent dugong deaths, and thereby protect their industry.

The QCFO appreciates the QFMA's input into this process and look forward to a positive outcome.

Yours sincerely

Ted Loveday
PRESIDENT

2.(p.1)

SUNFISH
QUEENSLAND INC.

P.O.Box 212, Margate Qld 4019, Phone/Fax (07) 3284 5977

DUGONG MORTALITY FROM THE PERSPECTIVE OF RECREATIONAL ANGLERS IN QUEENSLAND.

SUNFISH'S view is that at the present time there is none or negligible damage done to dugong by recreational angling in Queensland waters.

Having said that, I would like to make it perfectly clear that SUNFISH do acknowledge that there could well be a problem with dugong disturbance in the foreseeable future by recreational anglers and the boating public in general.

I have made extensive inquiries within the Sunfish membership, including the Boating Industry Association of Queensland affiliate and also the QDPI and DEO. None of these organisations or Departments have any records of Dugong strikes or any Dugong injuries by small boat traffic, although there is some evidence of serious injuries to them by heavy boat traffic such as the barge type shipping which ply the Bay.

Sunfish have, however, some concerns for the future protection of dugong in areas such as the Hinchinbrook Channel where there are indications of development which will, in the long term, encourage a significant increase in boat traffic in these confined areas.

Sunfish have prepared a report, in conjunction with the QFMA, for GBRMPA, and this has been forwarded to the appropriate people.

I shall outline briefly here, the contents of that report to this meeting.:

SUNFISH will undertake to include in their education program, with both junior and senior angler groups and the recreational angling boat owners, an awareness section to include the need to be very cautious when boating or fishing in or near dugong habitat areas. This awareness program will include both dugong and turtles.

In relation to the possibility of implementing speed limits for areas of known dugong grazing or calving, Sunfish does not have any objection in principle but a number of matters need to be taken into account.

These include -

* The safety of people in recreational boats, or any boats for that matter is paramount. For example, in Moreton

Bay in the Rous Channel, which is a defined waterway (Channel) with access to the open sea, changed sea conditions can create safety problems for boats if slow boat speed limit were to be introduced. A speed limit may be implemented but it would need to take into account all sea conditions and how it may impact on boating safety.

* In restricted waterways such as Hinchinbrook Channel, the heavy boat traffic may justify a slow boat speed, provided sea conditions are analysed, and may only be for a defined distance, say 1-2 nautical miles. This defined distance would obviously be associated with the threat of dugong safety.

* Any Analysis of measures to limit boat speed would need to take into account the type and size of boats, eg. a displacement hull vis a speed boat (tinny with 30-40hp outboard).

* If an area is identified which requires absolute protection for dugong ie no boat traffic allowed, Sunfish would support the closure in principle but would want to have consultation and obtain the evidence supporting the proposal for closure.

  In these cases it would be assumed that if the area is closed to recreational boating then it would be closed to all boats and vessels unless authorised by the appropriate authorities.

* In terms of consultation for any proposed speed limit or closure (permanent or seasonal) it would be appropriate to approach the Sunfish regional Branch people as they would know the local conditions better. It would be appreciated if either the Executive officer or Chairman of Sunfish Central was advised of these conditions as they could then ensure that the whole organisation is advised.

* It is assumed that other major groups ie tourism (charter boat operators) and commercial fishers would be approached to obtained their views on any proposal.

* Sunfish would appreciate any information, from time to time, on dugong protection measures so that this information can be disseminated to members and the public through both the Sunfish network and its magazine.

* Sunfish believe that the recreational angling population are responsible for minimum dugong disturbance but are willing to co-operate in any reasonable way with the GBRMPA to reduce dugong mortality.

* SUNFISH HAVE DEVELOPED A DRAFT CODE OF CONDUCT FOR SMALL BOAT OPERATORS TO REDUCE THE IMPACT OF BOAT TRAFFIC OPERATION ON DUGONG.

This Draft Code of Conduct has to be ratified by the Sunfish State Council but that is expected to be achieved in the near future.

* THE FOLLOWING CODE OF CONDUCT SHOULD BE CONSIDERED IN CONJUNCTION WITH A LARGE DOSE OF COMMON SENSE AND AN APPRECIATION OF THE RIGHT FOR DUGONG TO EXIST IN A PEACEFUL AND PROTECTED MANNER.

1. Before entering an unfamiliar area take steps to ascertain details of Dugong habitat areas most frequented by them.

2. Observe all protected and NO GO areas.

3. Maintain observation for Dugong presence at all times

4. Reduce speed to a reasonable rate in recognised feeding areas or on identification of a Dugong in close proximity.

5. Avoid disturbing feeding Dugong

6. Assist net owner/operators where possible to release entangled Dugong and ensure every effort is made to enable extangled or injured Dugong to breathe.

7. Report all contacts with dead, injured or entangled animals as soon as possible to Department of Environment or Boating and Fisheries Patrol and record details with SUNFISH.

8. Educate others to protect Dugong.

John Doohan
Chairman
Sunfish Qld Inc.

3. (p.1)

SUNFISH
QUEENSLAND INC.

P.O.Box 212, Margate Qld 4019, Phone/Fax (07) 3284 5977

DUGONG SHOALWATER BAY

There is one more area I would like to address, and that is the removal of commercial fishing from Shoalwater Bay!

Sunfish do not necessarily have any brief for commercial fishing in Shoalwater Bay, however, we are concerned as to what happens to those who are displaced from this area.

Is the Commonwealth Government going to close commercial netting in the Bay and ignore the problem of where those who are being displaced go to fish?

Sunfish will not be impressed if the C/W Government have a warm and fuzzy feeling that they have somehow saved the Dugong in this area, and having spent no money in doing so, walk away without addressing the transfer of fishing effort by the fishermen being displaced from the region As I have stated Sunfish are not holding the torch for these commercial fishermen, however, we are being pragmatic, because we see severe pressure being placed on adjacent fishing areas by the very people you are displacing. The adjacent commercial fishing areas cannot absorb a further influx of commercial fishing effort without severe disruption to the fish stocks.

The Commonwealth Government have to bite the bullet and make funds available to by out the licences of these displaced fishermen.

I know there will be frowns and lip biting over this suggestion - but - there are eight or nine other areas which will be up for discussion for removal of commercial fishing effort in the GBRMP and SUNFISH are not going to be impressed if you close all or some of these areas and just transfer the fishing effort to adjacent areas.

As I stated earlier in this address, Sunfish agree with most of the measures contained so far in GBRMPA proposals. It has however, been a very inexpensive exercise (except for the paper work generated) and that is fine. But you have to look carefully at providing the funds to the State to buy out those who you intend to remove from the commercial fishery, if not, you will meet some stiff opposition in the future from Sunfish and also probably the commercial sector although I cannot speak for that industry. We cannot have the fishery throughout the area of influence of the GBRMPA, being put under the threat of excess pressure. This will occur if all we do is transfer commercial effort from one area to another, and the Commonwealth Government through GBRMPA washes its

hands of any responsibility towards the solution. That solution would be, in the main, to provide the funds to the State to buy out the effort within the areas which will be targeted for commercial fishing removal.

J.D.

4 (p. 1)

FACSIMILE TRANSMISSION

DPI
QUEENSLAND
DEPARTMENT OF
PRIMARY INDUSTRIES

DATE: 14 February 1997

TO: Tony Stokes, GBRMPA

FACSIMILE NO.: 077 726 093

FROM: Dan Currey, General Manager, Fisheries Resource Protection

NO. OF PAGES (INCLUDING COVER): 2

MESSAGE

Dear Tony

LATEST SITUATION - NETS - SHARK CONTROL PROGRAM

QDPI has been asked to investigate two issues associated with the Shark Control Program as part of th measures believed necessary by the Dugong Review Group to overcome threats to dugong.

1. **Review the use of nets in the Shark Control Program.**

   A review to consider this and other issues was initiated last year.

   While the Department is committed to finalising this review, the absence of Dr H Marsh overse for some months has prevented any further consideration of issues by the Review Team.

   This matter is now unlikely to be finalised until mid year.

2. **Consider removing shark nets from Magnetic Island beaches.**

   At the first meeting of the Review Group assessing the impact of the Shark Control Program, a recommendation was made that shark nets off Magnetic Island be removed.

   The Minister for Primary Industries, the Honourable T J Perrett, MLA, referred the matter to the Townsville Shark Control Program Focus Group in January 1997, for their comment.

Enquiries to: Dan Currey Our Ref:
Floor 5, Forestry House, 160 Mary Street, GPO Box 46, Brisbane Q 4001
Telephone: (07) 322 42161 Facsimile: (07) 322 98146 o:\r_bcr\l_fish\frpd\habitat\currey\fax\1997\stokes.doc

FISHERIES GROUP

Mr Perrett has now decided that the net at Nellie Bay can be replaced by six drum lines but that the net at Alma Bay will remain. This decision was made after consideration of comments of all stakeholders and is considered to maintain bather safety at existing levels.

The Minister is currently overseas. I expect his decision to be formally announced when he returns in late February.

D W Currey
GENERAL MANAGER
(FISHERIES RESOURCE PROTECTION)

5.(p.1)

IAN DELANEY
ATSIC COMMISSIONER
QUEENSLAND METROPOLITAN ZONE

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BRISBANE QLD 4002

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Statement by Commissioner Delaney to the February Meeting of the Great Barrier Reef Marine Park Authority

I would like to read and table the attached statement on co-management. The statement and process would, I am sure, be refined during a process of negotiation, but I have set down the basic minimum, that is that co-management is not negotiable from our point of view.

I acknowledge that Ms Evelyn Scott has been appointed a member of the Authority and I welcome this appointment and would like to congratulate her, but the policy process remains far removed from the hands of traditional owners. For significant reasons of traditional practice and customary law we require a major say in policy and planning in management of the Great Barrier Reef. Although we are currently involved to some degree, I believe that it is not enough.

I would now like to turn to the matter at hand, that is the issue of Dugong protection.

First, let me say that Aboriginal and Torres Strait Islander people understand the necessity to manage and conserve the remaining Dugong populations and that we are pleased to be part of this process. We know that we have the knowledge and skills which are critical to the management of Dugong; our cultural and spiritual practices (which differ amongst coastal people) place us in a unique position to be the major partner in the process. The Dugong is so important to our people because it is an integral part of our culture. In coastal areas a great deal of cultural practice revolves around the Dugong and therefore our continuing association with it is important to our cultural survival. We therefore support the conservation of Dugong for two reasons. The first is for the very survival of the species; the second, and equally important, is that the survival of the species ensures the survival of important cultural practices. Our management of the Dugong then is intimately tied up with our cultural survival. Any management plans that we support will need to take this into account.

This occasion appears to me to be the proper one to raise a few questions of principle in relation to Dugong management conservation.

(I) any curtailment of hunting or use will not be acceptable if this diminishes native title in any way;
(ii) any Dugong management scheme must embody the principal of co-management;

(iii) if compensation is to be paid to QCFO members as proposed because of cessation or curtailment of an activity, then compensation must be paid to all members of the community who have had their rights curtailed;

(iv) any voluntary agreements entered into with traditional owners must be negotiated direct with those owners; negotiations must be between equally well informed parties, accordingly the traditional owners may need assistance/funding in their negotiations.

(v) sufficient resources must be provided to ensure that the protection of Dugong is achieved in the Dugong Protection Areas (DPAs)

(vi) Any demands made to restrict important cultural practices must be supported by commitments of other interest groups and relevant authorities to positively contribute. This includes seagrass protection, boating activities, gill netting and other threatening processes or activities.

Whilst we acknowledge and accept our role in the main, there are some Aboriginal people who do not agree with the curtailment of our rights because they see it as a lessening of our rights. There is a strong feeling in the communities that equally tough measures should be applied to all parties, and that enforcement should be a priority. ATSIC has asked the Authority for a statement from the Minister to this effect,. It would help if an unequivocal statement was made by the Minister.

Several short term partial solutions have been suggested, based on different views as to what is the principal cause of the Dugong decline. These include a moratorium on traditional hunting and use; the banning of gill nets in some areas, and the requirement to have a constant watch over some nets when in use; a total ban on fishing in DPAs; speed limits and a possible ban on boating in certain areas and so forth. Any immediate action must be supplemented by long term strategies; both methods must be under the umbrella of a co-management approach.

Arguments put forward by the QCFO in relation to the manning of nets on a full time basis are :

- that in certain areas it is dangerous and therefore should not be enforced;

- manning should only take place, in the long term, where there are known migration pathways and only after these have been established.

We have sympathy with the latter, but precise knowledge of corridors or pathways would require research in the medium term *and in the meantime in common with the QCFO we support "at net attendance" for all off-shore netting operations.* I would suggest that traditional owners would be able to assist with this research.

There is argument put forward by others that all forms of fishing and other activity in the Dugong sanctuaries should cease. In principle we would support this, but we would want to examine the detailed proposals before committing ourselves. We will defend the right for the traditional owners to hunt and fish within Dugong sanctuaries so that they can fulfil cultural needs and household needs, the latter refers to food and subsistence requirements.

We support the educational approach to implementing change, but there will also be a need for a regulatory regime running side by side, We see implementation of a regulatory approach as very much a partnership between the authorities and the traditional owners. I would like to inform the Authority that there are trained Aboriginal rangers along the East Coast who would be able to assist with implementation of policy.

Vessel strikes are an acknowledged source of Dugong mortality. The movement of vessels in Dugong sanctuaries needs to be strictly monitored. Aboriginal and Torres Strait Islander people are at loss to understand the reasoning behind the approval of development in and around known Dugong habitats which encourage greater boat usage, and also the possibility of increasing sedimentation. Sunfish have declared that in the event of an area being declared out of bounds to recreational boat traffic, they would agree to this restriction provided that *all* vessels were banned. We would find it unacceptable that co-owners who have social, cultural and spiritual ties to an area should also be banned.

We are of the opinion that the illegal trade in Dugong should be stamped out and we would support any moves to this end.

Finally, I would like to pose a question to both the State Government and the Authority. To the State Government - I seek clarification about how the DPAs *outside the GBRMPA area* will be managed. Under what Act will co-management be authorised. How will the principle of co-management co-exist with the current legislation. If there needs to be changes to facilitate co-management when can we expect these? The same question can be asked of the Great Barrier Reef Marine Park Authority, is co-management permissible under the various Acts, or are changes needed, if so when will these occur?

Ian Delaney.

Ian Delaney,
Commissioner,
ATSIC Queensland Metropolitan Zone.
19th February, 1997.
gbrwha1b

5.(p.4)

Great Barrier Reef Marine Park Authority
Co-Management

The Great Barrier Reef area including the waters and almost all the islands would have co-existing ownership and rights. These rights, and their exercise belong to the State and the Native Title Holders (there is legal argument that common law rights extend offshore). These are the two basic interests in the Reef, *thus all other users are interested third parties.* The rights that third parties possess in the past have been granted by the State, generally through regulatory processes and are not grounded in common law ownership. Co-management, with the recognition of Aboriginal property rights, will require Aboriginal input and agreement in the decision making process relating to the granting of rights.

Thus it follows that decision making in relation to the reef should be exercised in equity by representatives of the co-owners that is the Crown and the Native Title Holders. The structure of decision making within the Great Barrier Reef Marine Park Authority's area of control then needs to be on a shared basis. This is particularly so when it comes to planning and management of the various zones.

A very clear distinction needs to be drawn between the advice function and the decision making function. Advice can be tendered by any individual or organisation to the decision makers. Policy and its implementation is the prerogative of the decision makers. This becomes particularly important when there is a need to marry the expertise of the traditional owners and the scientific community. This is a problem, and research will be needed to resolve the issue as there are times when both sorts of expertise will be required.

Decision making groups would need 50% Aboriginal membership *with the chairperson being from the traditional owners.* There are a number of examples of traditional owners being in the majority on policy boards involving co-management of resources, of which Uluru and Kakadu are the most well known. It must be borne in mind that some Aboriginal people have common law ownership of the area *and, as such, have a right to exercise their ownership rights.*

It is acknowledged that intially there may be legislative complications with implementing such management processes, but these could be overcome in time.

17th February, 1996.
gbrwha1

6.(p.1)

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Facsimile

To: Peter McGinnity
@Fax: 726093
From: Peter Corkeron
Date: Tuesday, 11 February 1997 @ 11:17
Re:
Pages: 8, including this

Dear Peter

Please find attached my submission to the Minister, Department of Primary Industries on the issue of replacing the shark nets off Magnetic Island with drumlines.

Yours Sincerely

Peter Corkeron

6.(p.2)

JAMES COOK UNIVERSITY
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THE DEPARTMENT OF TROPICAL ENVIRONMENT STUDIES AND GEOGRAPHY

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24 January 1997

The Minister
Department of Primary Industries
per the attention of
Mr Tom McNamara
District Officer, Queensland Boating and Fisheries Patrol
P O Box 2239
TOWNSVILLE QLD 4810

Dear Sir

As requested at the meeting held on 14th January 1997 to discuss the issue of the fate of the Queensland Shark Control Programme (QSCP) nets off Magnetic Island, this submission outlines my analysis of the evidence and issues related to the use of nets and drumlines to control shark numbers.

It is my strongly held view that the nets under the jurisdiction of the QSCP remaining in the waters off Magnetic Island should be removed and replaced with drumlines. This conclusion has three bases.

1) There are beaches elsewhere in Queensland which rely solely on drumlines, and no fatal attacks have occurred there.
2) Nets catch an unacceptably high number of non-target organisms. This is reduced by using drumlines.
3) There is no evidence to suggest that changing from a mixed strategy of using nets and drumlines to drumlines only will result in reduced bather protection. Drumlines may provide increased bather protection.

The number of baited hooks required to replace the nets should be estimated by the QSCP, as they have the best data available on the relative efficiencies of the two methods.

I suggest that to further increase bather protection in the Townsville region, the QSCP should consider:

- Installing signage at popular beaches, incorporating information on ways in which people can reduce the likelihood of shark attack, such as that contained in the "10 commandments of avoiding sharks", as outlined in the Queensland Boating and Fisheries Patrol booklet "Sharks and beach safety". This approach is taken in the Northern Territory, and to a lesser extent in Queensland, to minimise danger associated with crocodiles.
- Producing television or radio advertising incorporating information on ways in which people can reduce the likelihood of shark attack, such as that contained in the "10 commandments of avoiding sharks", as outlined in the Queensland Boating and Fisheries Patrol booklet "Sharks and beach safety".
- Experimenting with setting baits on drumlines as late in the afternoon as is practicable, allowing for weather and sea conditions.
- Contracting or encouraging research on the biology of sharks of particular concern to the QSCP, particularly Tiger and Bull sharks.

I suggest that in order to assess the ecological impact of the programme in the Townsville region, the QSCP should consider:

- Requiring as a condition of contract that all bycatch retrieved dead (cetaceans, dugongs, turtles, fish and rays) be kept for biological examination.
- Liaising with biologists with relevant expertise to develop and implement population assessments of those species affected by the QSCP.

This morning (24th January) I was contacted by Mr Steve Brown of the Queensland Boating and Fisheries Patrol, Townsville, who informed me that consideration was being given to installing "dolphin alarms" to the net at Alma Bay. I do not recollect discussion of the issue of "dolphin alarms" at the meeting on 14th January. There **is no evidence that "dolphin alarms" work** from any study to date.

The people swimming off Magnetic Island will be as safe with the protection of drumlines as they were with nets. The dugongs, dolphins and turtles swimming off Magnetic Island will be safer.

In the pages below I discuss in greater detail my reasons for drawing these conclusions.

Yours sincerely

Dr Peter Corkeron
Postdoctoral Fellow

cc members of the Townsville QSCP Focus Group

6.(p4)

Why the nets under the jurisdiction of the QSCP remaining in the waters off Magnetic Island should be removed and replaced with drumlines - background information.

There are beaches elsewhere in Queensland which rely solely on drumlines, and no fatal attacks have occurred there.

- In the 19 years since 1977, the QSCP programme off Bundaberg has relied entirely on drumlines. No fatal attacks have occurred there in this time (CRSMO 1992).
- In the 17 years since 1979, the QSCP programme off Point Lookout, North Stradbroke Island, has relied entirely on drumlines. No fatal attacks have occurred there in this time (CRSMO 1992).
- In the 4 years since 1992, the QSCP programme off Rockhampton has relied entirely on drumlines. No fatal attacks have occurred there in this time (Gribble *et al.*, in preparation).

Summary

If the incidence of fatal shark attack is considered the appropriate measure of shark control effectiveness, as implied by the QSCP (CRSMO 1992), then drumlining has proved effective in providing bather protection from fatal shark attack.

Nets catch an unacceptably high number of non-target organisms, which can be reduced by using drumlines.

Dugongs

One of the World Heritage values of the Great Barrier Reef Region is that it "provides major feeding grounds for large populations of the endangered species *Dugong dugon*" (GBRMPA 1981, p7). Between 1963 and 1995, 299 dugongs were taken (either animals that died or were recorded as "unknown") in QSCP nets off Townsville (Paterson 1979, CRSMO 1992, B. Lane personal communication). The population of dugongs in the vicinity of Townsville was estimated in 1987 and 1994 to be approximately 360 and 340 animals respectively (360 $\pm$ 92 and 340$\pm$ 82 (population estimate $\pm$ standard error), Central Section Blocks 8 and 9, Marsh *et al.* 1996).
The take of 28 dugongs by the QSCP between 1988 and 1995 (CRSMO 1992, B. Lane pers. comm.) in the Townsville region represents approximately 1% of the local population per year. Due to their life history traits, it is unlikely that dugong populations can sustain human-related mortality levels of more than 1-2% (Marsh et al. 1984). The Townsville region is one of the only areas on the Queensland coast between Cairns and Brisbane where dugong numbers are stable. However, numbers are not increasing, and as dugongs along much of the Queensland coast can be classified as critically endangered (Marsh et al. 1996), all methods to reduce dugong deaths must be sought. Dugongs are almost never caught on drumlines, the only case being one off Bundaberg (CRSOM 1992).

Dolphins

Between 1974 and 1995, 65 dolphins were caught in QSCP nets off Townsville, of which 15 were released alive (CRSOM 1992, B. Lane pers. comm.). Based on specimens provided to the Queensland Museum (Paterson 1994), it appears that the catch is (approximately 60% Irrawaddy River dolphins, 30% humpback dolphins, and a few 10% bottlenose dolphins (Paterson ref). No population estimates for any dolphin species in the Townsville region is available. At a rate of 2-2.5 dolphins per year, these takes may seem trivial, however dolphins have reproductive patterns and life histories similar to dugongs. Consequently, these takes may represent a significant proportion of the possible sustainable mortality of dolphins in the region ,and should be stopped. For comparison, only two dolphins have been caught on drumlines off Point Lookout over the past 17 years, and both were released alive.

Turtles

Of the six turtle species found in the waters of the Great Barrier Reef, five are listed as "Endangered" or Vulnerable" by the World Conservation Union (Marsh *et al.* in press). Two hundred and twenty-nine turtles were caught by QSCP equipment off Townsville between 1974 and 1995 (CRSOM 1992, B. Lane pers. comm.), of which 98 are listed as being released alive. No data are available to assess the regional significance of this take. Drumlines take fewer turtles than do nets (Gribble et al. in preparation).

Summary

Shark netting by the QSCP results in significant bycatch of rare and threatened species in the Great Barrier Reef World Heritage Area. Drumlining would eliminate almost all mortality of dugongs, dolphins and turtles.

There is no evidence to suggest that changing from a mixed strategy of using nets and drumlines to drumlines only will result in reduced bather protection.

The evidence from the QSCP to date is that drumlining has proved effective in providing bather protection from fatal shark attack. At the meeting to discuss the removal of nets from Magnetic Island beaches on 14th January 1997, staff from the Northern Fisheries Centre of the Queensland Department of Primary Industries presented information suggesting that drumlines were less effective than nets at catching Bull sharks, a dangerous species found in Queensland waters. Dr N. Gribble and Messrs G. McPherson and B. Lane graciously allowed me access to their draft paper reviewing this information. From the available data, I conclude that replacing nets with drumlines in the waters off Magnetic Island is likely to result in increased bather protection, as outlined below.

Tiger sharks

Drumlines are clearly more efficient than nets at catching Tiger sharks, the other dangerous species in reef waters (Simpendorfer 1993, Gribble et al. in preparation).

Bull sharks

Bull sharks are less likely to occur off Magnetic Island than of mainland beaches.

- As Gribble *et al.* note, referring to Horseshoe Bay and Alma Bay "(t)he probability of encountering Bull sharks should be lower at such beaches than at coastal beaches, given known behaviour patterns of this species".

Nets are not effective than drumlines at catching bull sharks off Magnetic Island.

- In the two years between 1992 and 1994 (the only years when Bull sharks were identified conclusively), drumlines at Horseshoe Bay caught **5** Bull sharks (Table 10a, referring to the table in Gribble *et al.* in preparation), while the nets and drumlines at Alma Bay caught **0** Bull sharks (Table 11a). Prior to 1992, the only sharks which could have been Bull sharks off Townsville were identified as "Whaler". Between 1990 and 1992, drumlines off Horseshoe Bay took 10 "Whalers" while nets took 11 (Table 8a), and in Alma Bay, drumlines took 5 Whalers and nets took 2 (Table 9a). Acknowledging these small sample sizes, the most reasonable and conservative interpretation of these data is that nets are **not** more effective than drumlines at catching Bull sharks off Magnetic Island. Indeed, nets may be less effective.

Evidence elsewhere is equivocal on the relative efficiencies of nets versus drumlines at catching bull sharks.

- Gribble *et al.* compare catches off Rockhampton (where nets were replaced with drumlines in 1992) and Mackay (where a mixed fishing strategy was maintained) between 1990 and 1994. They conclude "(t)he level of risk (in Rockhampton) may have increased, however, due to the decrease in the catch of Bull sharks....". This is because the catch of Bull sharks off Rockhampton 1992-1994 (on drumlines only; 21 Table 4a) was less than the catch of "Bronze Whalers" off Rockhampton 1990-1992 (on nets and drumlines; 34, Table 2a. Over the same time periods a similar "reduction" in the take of Bull sharks versus "Bronze Whalers" occurred in Mackay, where a mixed strategy of nets and drumlines was continued (1990-1992, 109 sharks, Table 3a; 1992-1994 , 48 sharks Table 5a). The data do not allow for the conclusion that the change to drumlines at Rockhampton was the reason for the decline in catches. It may also be due to confusion as to species identity, or to changes in the ecology of Bull sharks on the central Queensland coast.

Summary

It is apparent that:
- drumlines are more efficient at catching tiger sharks than are nets;
- bull sharks may be uncommon off Magnetic Island;
- drumlines off Magnetic Island appear at least as efficient as nets at catching bull sharks, and
- evidence elsewhere on the relative efficacy of nets versus drumlines at catching bull shark is equivocal.

Consequently, replacing nets with drumlines off Magnetic Island is more likely to increase than decrease bather protection.

There is no evidence from any study to date that "dolphin alarms" work.

The idea of increasing the acoustic detectablility of nets which catch cetaceans has a relatively long history, a review of which is beyond the scope of this submission. Two recent reviews are those of Reeves *et al.* (1996) and Dawson (1994). Only two studies have provided any evidence that "pingers" might possibly work. These two experiments to assess the efficacy of "pingers" to reduce harbour porpoise bycatch in gillnet fisheries, demonstrated a significant reduction in bycatch (Reeves *et al* 1996, Anon 1996a). However, when one experiment was repeated, no significant reduction in bycatch was observed (Anon 1996b). This may have been due to habituation, pinger malufnction, improper useage of pingers or foraging -relatwde changes to porpoise behaviour (Anon 1996b). The second experiment has not been repeated, and changes in porpoise abundance over the course of the experiment may have introduced bias (Anon 1996b). At best, the results of these experiments are equivocal. The first run of the first experiment cost $500,000 (US) to conduct (Anon 1996a).

Also worth considering are that :
- Bottlenose and humpback dolphins appear to be behaving differently when caught in nets (Cockcroft 1994). "Pingers" may attract one species and repel another.
- No sounds within human hearing have been recorded from Irrawaddy River dolphins. The only sounds recorded for this species are ultrasonic sonar clicks (Marsh et al. 1989). Can they hear over the range that dolphin "pingers" transmit at? We simply don't know.
- Responses of dugongs to acoustically modified nets are completely unknown. Conducting experiments on the efficacy of "pingers" to reduce dugong entanglements would require the deaths of many dugongs. Given the decline of the dugong population along most of the Queensland coast, this is totally inappropriate.
- The statistical power of any test to determine the impact of "pinger" use will be practically zero (see Reeves *et al.* 1996 pp 33-37). In other words, if "pingers" are attached to a net at Alma Bay, we'll never know if it works or not.

One of the principal findings of Reeves et al. (1996, p50) is particularly appropriate. "Other management strategies, not involving the introduction of artificial sound into the underwater environment, should always be sought, even after an acoustic solution appears to have been found"

Summary

Available evidence indicates that placing "pingers" on nets is unlikely to result in reduced mortality of dolphins. No data are available for dugongs, but there is no reason to suppose that dugongs would be more likely than dolphins to avoid nets with "pingers" in place. As drumlines off Magnetic Island should provide at least the same level of bather protection as the current nets, there is absolutely no reason to consider the use of "pingers".

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7.(p.1)

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FACSIMILE MESSAGE

TO	: Dr Ian McPhail
COMPANY	: GBRMPA
FAX NUMBER	: (077) 726 093
FROM	: Bill Foster
DATE	: 21.2.97
SUBJECT	: GBRMPA Dugong conservation meeting 20.2.97
NO. OF PAGES	: 2

Dear Dr McPhail,

As a result of yesterdays meeting in Brisbane, we would ask that the GBRMC take the following observations on board:

The objective of the meetings is to establish '<u>Emergency</u> measures for Great Barrier Reef and adjacent area Dugong recovery and conservation. We do not consider the proposals put forward by QCFO and endorsed by AMCS and WPSQ to constitute anything like emergency measures, as they will inevitably lead to a further population decline of dugong;

HSI and the other organisations who signed the nomination of gill-netting as a key threatening process, consider that the total removal of gill-netting from the entire dugong range is an appropriate and necessary emergency measure;

These organisations represent the views of hundreds of thousands of Australians concerned about marine conservation and with the case of HSI and Greenpeace alone, millions of concerned global citizens - many of whom will be awaiting the outcome of this process with interest. For as you stated yesterday, if the dugong cannot be saved from extinction in the Great Barrier reef Marine Park and World Heritage Area, what chance has it anywhere else ?

It should also be noted that although they endorsed the AMCS and therefore the QCFO proposals yesterday, WPSQ are also a signatory to the key threatening process nomination;

7.(p.2)

We were surprised at how little debate had taken place on the subject of compensation for the removal of gill net licences. We hope that this will be rectified over the next seven days.

Yours sincerely

Bill Foster

Bill Foster
Executive Officer

7 (p.3)

Dr Ian McPhail
Chairperson, GBRMPA
PO Box 1379
Townsville
Q4810

19 February, 1997

Dear Dr McPhail

Report from HSI on views raised by GBR Ministerial Council, Brisbane 30/11/96

HSI welcomes the opportunity to comment on the above views and are pleased to see recognition that we are past the need for more data and voluntary management initiatives for these critically endangered animals and that the need to take action is immediate.

Re (c)
HSI supports the 10 sanctuaries proposed by Tony Preen and Nina Morissette in their interim report of 31/1/97.

Re (d)
HSI considers gill netting to be a significant factor in dugong mortality. Indeed, based on Hervey Bay data, gill netting accounts for around 90% of stranded dugong carcasses. Fisher attendance and other management measures will not be sufficient to reverse the population decline.
A voluntary moratorium on dugong hunting by indigenous people is also unlikely whilst gill netting, even with restrictions, is still permitted.
In order for the dugongs to be able to travel between the sanctuary areas which allows exchanges between populations and ensures genetic diversity, safe corridors will be required. Dugong mortalities are likely to occur outside sanctuary areas whilst they are travelling up and down the coast if gill netting is permitted outside these areas.
Australia is privileged to support the last relatively healthy population of dugong. As such, and as the only developed mega biodiverse country on earth, we have an obligation and responsibility to ensure that the precautionary principle is applied and every effort made to immediately halt the decline in dugong numbers.

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HSI and other organisations have therefore nominated gill netting as a key threatening process under schedule 3 of the Endangered Species Protection Act 1992.

HSI and AMCS have nominated the Dugong for listing under schedule 1, part 1, of the Endangered Species Protection Act 1992, in order that a recovery plan is implemented throughout its range in Australia.

HSI urge the GBR Ministerial Council to address, as a matter of urgency before their final report on February 28th 1997, the issue of compensation for the removal of gill net licences, both active and latent.
A practical, financial solution involving the Federal and State governments and the fishing industry has to be formulated by this date if this threat to dugong populations is to be eliminated.
HSI also consider shark netting to be a major source of dugong mortality, with 837 recorded fatalities between 1962 and 1991. HSI is therefore compiling a nomination for shark netting as a key threatening process under the above legislation.

HSI proposes an immediate moratorium on large scale coastal developments in and adjacent to critical dugong habitat.

HSI also considers that there should be a prohibition on underwater explosives in ALL dugong habitats, including Shoalwater Bay.

HSI considers there should be strong and enforceable controls on motorised vessel speeds in dugong habitat.

HSI further considers that a far greater degree of urgency and seriousness needs to be given to carrying out necropsies on stranded carcasses.

Re (f)
HSI recognises that no recovery of the dugong population will be possible without a similar recovery of seagrass beds. HSI therefore supports increased research into the as yet unknown causes of seagrass decline and to eliminating known anthropogenic factors leading to seagrass loss, such as sedimentation, nutrient enrichment and trawling.

Yours sincerely

Bill Foster
Executive Officer

7(P5)

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3rd October, 1996

Nomination of Gill-Netting for Schedule 3 of the *Endangered Species Protection Act, 1992*

Dear Peter

Please find enclosed nomination for "Gill-Netting" as a "Key Threatening Process" and listing in Schedule 3 of the *Endangered Species Protection Act, 1992.*

The organisations listed below declare that the information in this nomination is true and correct to the best of our knowledge.

We look forward the early deliberations of ESSS in regard to this important conservation matter.

Yours sincerely

Michael Kennedy
on behalf of:

Australian Conservation Foundation
Cairns and Far North Environment Centre
Conservation Council of Western Australia
Humane Society International
Greenpeace Australia
Mackay Conservation Group
Northern Territory Environment Centre
North Queensland Conservation Council
Queensland Conservation Council
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NOMINATION OF "GILL NETTING" FOR SCHEDULE 3 OF THE *"ENDANGERED SPECIES PROTECTION ACT, 1992"*

The following information follows the requirements for nominations specified in the Endangered Species Protection Regulations 1993, Part 2 , s. 6., and under the provisions of Section 25 of the Act:

(a) a description of the threatening process that is sufficient to distinguish it from any other threatening process by reference to its biological components and its non-biological components, and the interactions of those components, that are known to the person or persons making the nomination:

This submission refers only to gill netting conducted around Australia's tropical and subtropical coast, from Moreton Bay in the east to Shark Bay in the west. This is the range of the dugong in Australia.

Gill nets are square-meshed nets that are now almost universally made from monofilament (like fishing line) or multi-monofilament. The nets are typically structured with a lead-line along the bottom of the net, which pulls the net down, and a float-line along the top of the net, which pulls the net up. Tension on the net is determined by the depth of the net(number of meshes), the depth of water and the amount of lead and buoyancy. 'Set nets' are gill nets that are anchored at one or both ends. They are generally angled across the current flow. Such nets may remain set for several days at a time, and are usually cleared on slack tides. 'Drift nets' are gill nets deployed in deeper water and are not anchored, although one end may be attached to the fishing boat. They drift with the currents.

Fish are caught in gill nets when they try to swim through the mesh. Mesh size is used to determine the size of fish caught - small fish swim through the mesh, larger fish get caught by their gill-covers (hence the name). The larger the mesh, the more likely that large species, such as dugongs will get caught. This is because large mesh nets allow flippers, noses and tips of tails to go through meshes, and because large meshed nets are made of stronger monofilament. Gill nets that threaten dugongs and inshore dolphins are generally large with a mesh size of at least 88 mm (but often 150-170 mm) and a monfilament diameter of >0.5 mm and usually <1.17 mm. Target species are usually barramundi and associated species (salmon, jewfish etc) and mackerel. States and Territories have different regulations governing net lengths, mesh sizes, monofilament size, number of meshes and mode of operation.

See also Kailola et al., 1993 "Australian Fisheries Resources" Pages 46 - 48 for detailed description of all forms of gill netting.

Why gill net mortality matters

Internationally, the dugong is listed as Vulnerable (IUCN, 1990). However, the status of the dugong has not been reviewed for several years, and the database on the dugong, and the criteria for assessing threatened species have now changed substantially. A revised status assessment, using IUCN's new criteria (IUCN 1994), would significantly elevate the dugong's conservation status.

Dugongs are believed to be facing extinction throughout most of their range, largely due to the proliferation of synthetic gill nets. Although dugongs are still widely hunted in Australia (Marsh and Lefebvre 1994), Papua New Guinea (Hudson 1981) and Palau (Marsh et al. 1995b), hunting has declined in the eastern Red Sea and the Arabian Gulf (Preen 1989) and east Africa (Jarman 1966; Wamukoya et al. 1995), largely because dugongs are now too rare to justify the effort. Despite an apparent overall decline in hunting pressure throughout the dugong's range, there is no suggestion that mortality rates have declined. This is because synthetic gill nets are now extremely abundant in coastal waters throughout the dugong's range. Synthetic gill nets are now standard fishing apparatus not only for commercial fisheries, but also for artisanal and traditional fisheries. Deliberate or incidental netting of dugongs has been

reported from Mozambique Hughes and Oxley-Oxland 1971; Cockcroft et al. 1994; Dutton 1994), Kenya (Jarman 1966; Cockcroft et al. 1994; Wamukoya et al. 1995), Djibouti (Robineau and Rose 1982), Sudan (Vine and Schmid 1987), Egypt (Gohar 1957), Israel (Lipkin 1975), Saudi Arabia, Yemen, Bahrain, Qatar and the United Arab Emirates (Preen 1989), India (Nair et al. 1975; Lal Mohan 1976; Jones 1980), Sri Lanka (Jones 1980; Leatherwood and Reeves 1991) and Australia (Heinsohn 1972; Marsh 1985; Marsh et al. 1996; Paterson 1990; Preen 1994). The abundance of gill nets in dugong habitats around the world means that it is unlikely that dugongs will survive in the wild outside Australia. Dugongs appear to have been exterminated from a number of archipelagos, including the Mascarene, Laccadive, Chagos, Nicobar, Barren, Narcondom, Cocos (Keeling) and Christmas Islands (Husar 1978; Snow 1970; Stoddart 1972).

The gill net bycatch problem in Australia

Australia is fortunate in that only professional fishers are legally allowed to have and use gill nets. This may be why dugong numbers in Australia are still relatively high, compared with other parts of their range. It is becoming increasingly apparent, however, that the incidental take of dugongs in gill nets in Australia is ecologically unsustainable and socially unacceptable. Gill net mortality has been recorded from all parts of the dugong's range in Australia (Marsh et al. 1996).

The gill net problem is not new. In the early 1980's Marsh (1985) assembled some reliable data on dugong deaths in gill nets. She wrote:

> "Dugongs are killed incidentally in the inshore gill-net fisheries of northern Australia. Reports of this incidental take give cause for concern, but it has not been possible to obtain precise figures. An informant involved in fisheries research, who interviewed fishermen along the west coast of Cape York in 1980, reported that 17 professional barramundi fishermen each caught between five and ten dugongs per year. One operator working on a seagrass bed in a river estuary allegedly accidentally caught 23 dugongs in one net before he removed his nets. Mr Rod Garrett (Northern Fisheries Research Centre) reported that in the first 19 days of the 1982 commercial barramundi netting season, five of 40 operators at Karumba in the Gulf of Carpentaria had each caught one dugong; two of these five animals drowned. Over the period March 1979 to March 1983, Queensland Fisheries Research Branch personnel set gill nets over a total of 135 nights in the Princess Charlotte Bay, Bathurst Bay, Ninian Bay region. Eleven dugongs were caught.....When one considers this anecdotal information in the perspective of the recent growth of the barramundi fishery, the implications for dugong populations are extremely worrying." (Marsh 1985, p 497-8).

In more recent times there have been a couple of events that have focussed attention on the gill netting problem. In 1995 some 36 dugongs were drowned in one gill net being operated by commercial barramundi netters near the mouth of the Wearyan River near Borroloola in the southwest Gulf of Carpentaria. This carnage occurred over approximately 10 days. Photographs and video of these animals are available. This incident recently went to court in Darwin. Although the fishers admitted killing some dugongs in the net, and the magistrate found a prima facie case, the case was thrown out on a technicality. This event received regional and national media coverage in the press and on radio.

In response to this event, and local outrage, the Northern Territory Fishing Industry Council proposed a netting closure in the area to minimise dugong mortality. Recognising that this proposal was primarily a public relations exercise because it proposed to close areas that are not used by commercial barramundi fishermen, the Traditional Owners of the area have proposed a much more extensive and meaningful gill net closure, which has been endorsed by dugong experts (Northern Territory News 20/9/96).

Also in 1995, there was a spate of gill net related dugong deaths in Shoalwater Bay (100km north of Rockhampton). Some 13 carcasses were found over a short period. Some stranded, some were found tied to mangroves up small creeks and some eviscerated carcasses were actually found on the bottom of the bay

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in clear water. Shoalwater Bay is the most important dugong habitat along the central Queensland coast and the dugong population had fallen by approximately 350 animals (47%) in just eight years (Marsh et al 1995a). As the Shoalwater area has no major catchments draining into it, has no grazing and no industry, and as there has been no Aboriginal hunting of dugongs in the area for 100 years, it was difficult not to conclude that commercial gill netting, which is common in the area, has been responsible for this population decline. Consequently, as a result of public reaction and media coverage, a partial ban on gill netting was implemented under the Queensland Fisheries Act.

The listing of gill netting as a key threatening process will require a Precautionary approach, as in most situations it is difficult to prove, beyond doubt, that gill netting is threatening dugong populations. There are two reasons for this: there are insufficient data on dugong population trends, and; there are few data on dugong mortality in gill nets.

Approximately 65% of the dugongs range in Australia has never been surveyed or has been surveyed only once (Marsh et al. 1996). In this huge region (from Torres Strait to Exmouth Gulf in WA), it is impossible to know whether dugong populations are stable or in decline. Only in Shark Bay and Ningaloo/Exmouth (Western Australia), Moreton Bay (southeast Queensland) and perhaps off eastern Cape York Peninsula have repeat aerial surveys indicated that dugong populations are not declining (Preen et al. in press; Preen and Marsh 1995; Marsh et al 1993). In the region between Cooktown and Hervey Bay (approximately 75% of the length of the Great Barrier Reef Marine Park), where three surveys have been conducted, the dugong populations have declined by 50%-80% in less than eight years (Marsh et al. 1995a). Dugongs in this region are now considered to be Critically Endangered (Marsh et al. 1995a). Gill nets were identified in this study as one of the factors most likely to be responsible for this decline. Evidence from Aboriginal elders along the coast, and from shark meshing records suggest that these surveys have only measured the tail-end of the decline, and that the decline actually started about 20 years ago. Some commercial fishermen have attributed the decline to the replacement of cotton and twine gill nets with much stronger and less visible synthetic gill nets 15-16 years ago.

There are few data on gill net mortality because gill net fishers do not report bycatch mortality and most netting operations in dugong habitat occur in relatively to very remote areas where there are no people to report carcasses that strand or are seen in nets.

Furthermore, fishers take active measures to dispose of carcasses. Fishers typically eviscerate dugong carcasses to release the buoyant guts. With the guts removed the carcasses sink and do not refloat. This practice is widely known and is admitted by fishers. On some occasions, however, the evisceration is incomplete and mutilated carcasses do come ashore. The proportion that does eventually strand is unknown, but it is expected to be very low. Hence, any statistics on gill net mortality that are based on stranded mutilated carcasses are likely to greatly underestimate the problem.

This nomination of gill netting as a key threatening process is likely to be criticised by fishing industry organisations and fisheries management agencies, especially in the Northern Territory and Western Australia where there are relatively few data. It is a fact, however, that these organisations cannot even begin to assemble credible estimates of marine mammal mortality in inshore gill nets.

The best data set on dugong mortality probably comes from Hervey Bay, in southeast Queensland, where reasonable records have been kept since 1983. There are good data from this location because (1) it had a large dugong population in a relatively discrete area (Preen and Marsh, 1995); (2) the coastal morphology, relative to the dugong habitat and winds, is favourable for the collection of carcasses; (3) the area has a very vigilant local human population that reports carcasses (see later); and (4) the local Queensland Boating and Fisheries Patrol office has, until recently, been required under law to investigate and record carcasses reported to them. Even in Moreton Bay, with the nearby population of Brisbane, does not have comparable data as the dugongs are on the opposite side of the Bay to the people, and many carcasses wash out to sea. In Townsville, where biologists have been salvaging dugong carcasses for 25

years, most records come from urban beaches. Carcasses that strand along most of the coast have a very low chance of being reported.

In Hervey Bay 67% of all stranded dugong carcasses can be attributed to gill nets (based primarily on mutilations such as slit bellies, cut-off tails etc). These data exclude carcasses related to the 1992-3 die-off that resulted from the loss of 1000 km2 of seagrass (Preen and Marsh, 1995). Of the 33% of stranded carcasses that resulted from unknown causes, it is likely that a significant proportion were also due to gill nets, as the signs of gill-nets only last a matter of hours post-mortem (unless the carcass is mutilated). It is possible to further resolve this possibility because in November 1988 the gill netting regulations in Hervey Bay were amended in an effort to reduce dugong mortality (see below). The rate of gill-net related deaths (number/month) fell by 53% following the change in regulations (see below), suggesting that the changes were beneficial. However, the rate of deaths due to unknown causes also fell by 49% over the same period. These data strongly suggest that in the order of 88% of carcasses that strand in Hervey Bay are attributable to gill nets.

Over the past three months (June-September 1996) 11 dugongs are known to have died in the Townsville-Mackay region. Eight of these deaths can definitely be attributed to gill nets. Annualizing this rate of gill net mortality suggests that gill nets are killing 8.3% of the dugong population in this region (total population of approximately 385; Marsh et al. 1995). Although it is possible that this three month mortality rate may not continue all year, it is certain that only a small proportion of netted dugongs are ever reported, and that more than eight of these 11 cases were related to gill nets. Hence, the estimate of 8.3% mortality is likely to be very conservative. Due to their low reproductive potential, dugong populations are likely to decline if human-induced mortality exceeds 1-2% of females (Marsh et al. 1984). Gill netting in this region is clearly not ecologically sustainable and threatens the very survival of this dugong population.

Despite the evidence that gill netting is a threat to dugong populations, some fishing industry representatives continue to deny that gill netting mortality of dugongs is anything but a rare occurrence. The most recent example occurred on 26/9/96 on ABC radio. The Vice President of the Queensland Commercial Fishermans Organisation maintained that dugongs rarely get caught in gill nets, and when they do they are usually released alive. He also suggested that a recent dugong carcass found on Magnetic Island with knife gashes to the stomach had been hit by a boat. On the same day a gill net fisher admitted that he had drowned and subsequently slashed this dugong (Townsville Bulletin 27/9/96).

(b) a name for this threatening process:

Gill-netting

(c) any species listed in Schedule 1 to the Act and any ecological communities listed in Schedule 2 to the Act that are considered by the person or persons making the nomination to be adversely affected by the threatening process:

Loggerhead turtle (*Caretta caretta*) (E)
Pacific Ridley Turtle (*Lepidochelys olivacea*) (V)
Green Turtle (*Chelonia mydas*) (V))
Hawksbill Turtle (*Eretmochelys imbricata*) (V)
Leathery Turtle (*Dermochelys coriacea*) (V)

(d) any species or ecological communities, other than those referred to in paragraph (c) that could become endangered or vulnerable, as the case may be, because of the threatening process:

Dugong (*Dugong dugon*)
Irrawaddy dolphin (*Orcaella brevirostris*)
Humpback dolphin (*Sousa chinensis*)

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Estuarine crocodile (*Crocodylus porosus*)
Flatback Turtle (*Natator depressus*)

(e) the reasons why the preparation of a nationally co-ordinated threat abatement plan is considered to be an effective and efficient means of abating the threatening process by the persons making the nomination:

This submission deals primarily with the threat of gill netting to dugong populations. It is believed that gill nets pose an equally serious threat to tropical inshore cetaceans. However, there are virtually no data on the populations of these species and evidence of their decline is anecdotal. In addition, turtles are known to be caught and sometimes drowned in such nets, though for the purposes of this submission, our evidence is primarily anecdotal.

What can and can't be done

Most fishing-related marine mammal mortalities in the US occur in gill nets (MMPA 1995). Under the Marine Mammal Exemption Program, which was established by a 1988 amendment to the Marine Mammal Protection Act, the National Marine Fisheries Service is required to classify fisheries according to their interactions with marine mammals. The NMFS publishes an annual List of Fisheries which lists the classification of each fishery. The classification is based on the rate, in numbers of animals per year, of serious injuries and mortalities due to commercial fishing relative to the Potential Biological Removal level (PRD) for each marine mammal stock. PRD is defined as the maximum number of animals that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population. The classification of fisheries relies on data collected from observer programs, from fisher's logbooks and from stranding data. Of these the observers provide the most reliable data (MMPA 1995).

It would be impossible to manage Australia's gill net fisheries along these lines. Although we have good data on the PRD for dugongs (1-2%), the data on mortalities comes only from strandings. Any expectations that improved data could be obtained by requiring fishers to record marine mammal bycatch are naive. Fishers know the implications of the mortality they are causing. Hence, any logbook data on marine mammal bycatch, that are not independently validated, are likely to be misleading (Robbins, 1995). An observer program is required to validate such data and to get accurate estimates of dugong and tropical dolphin mortality. However, an observer program will never be feasible in the Australian fisheries that catch these species. There are two reasons for this:

1. The barramundi and mackerel fisheries that catch dugongs are more akin to artisanal fisheries than to the large industrial fisheries of the US. The fishing is generally done by individuals or small teams of 2-3 fishers. Most operators have a low level of capitalisation and operate from small boats. They operate independent of one and other. They operate out of a large number of ports, towns and hamlets, and they operate over most of the vast tropical coastline of Australia. To quote the Chairman of the Queensland Fisheries Management Authority: "In many respects it is one of the State's most exotic fishery (sic) characterised by harsh climatic conditions, independent yet community minded people and stretching remoteness." (QFMA 1996a, p V). Net fishers are generally allowed to fish anywhere they choose, when they choose. In this sense there is virtually no management. To get meaningful data from an observer program would require a large number of observers if a statistically meaningful number of operators are to be sampled. Observers would need to be attached to an operator for an extended period if typical fishing activity was to be sampled. Observers would often need to provide their own boat as many operators would not have room in their small net boats for an observer.

2. The gill net fisheries do not have the financial value to justify the expense of an observer program. Tropical gill net fisheries are worth relatively little money. For example the Queensland Gulf Fishery has an annual value of $5.7M which gives an average annual gross income of only 51,800 to the 110 licensed netters. There is no fat in this fishery to support an observer program. In the Northern Territory, where the fishery is better managed (excluding bycatch considerations), the number of netters has been reduced to 28, but still the fishery is worth only $3.5M/year.

The combination of these factors - the large number of dispersed individual fishers operating in remote areas, and the low value of the fishery - seems to have resulted in a history of minimal management and enforcement. Many of these fisheries have been conducted in the absence of basic data on the target species, let alone impacts on bycatch species. To quote the Queensland Fisheries Management Authority's recent discussion paper on the Queensland Gulf of Carpentaria Inshore Finfish Fishery: "Without exception, biological information is lacking about the condition of Gulf populations of any fish species, and whether or not fish stocks truly can sustain the demands being imposed by fishery harvest." (QFMA 1996a, p 17). Under such a management regime, management agencies could hardly justify a large and expensive enforcement capacity. Consequently, enforcement of netting regulations is not known for its rigor or frequency. This is a product not only of the dispersed and individualist nature of the fishery, but also because most netting occurs at night and in shallow inshore waters. The need to work at night in small boats in shallow, unfamiliar waters, in the presence of crocodiles and mosquitos tends to be a disincentive to many enforcement officers. Combine this situation with the fact that it is not illegal to catch dugongs and dolphins in nets, no matter how threatened they may be, and it is not hard to see that efforts to enhance enforcement are unlikely to solve the problem of gill nets and dugongs. Other approaches are required.

In some locations overseas the solution has been the outright banning of gill nets. Gill nets are banned in Florida and Texas, while in California, Louisiana and Mississippi there are partial bans or there are initiatives for full bans. These bans have resulted from public disquiet with the level of bycatch associated with gill nets.

There is only one small location along the Australian coastline where gill nets have been banned because of their dugong bycatch. In Shoalwater Bay gill nets are no longer allowed to be set on the seagrass banks adjacent to the shore. However, nets are allowed to be set in the creeks and mangrove channels, and drift nets are allowed in the deeper water of the bay (Gibbs 1995). In the 12 months since this ban was enacted, surveillance by the Queensland Boating and Fisheries Patrol and Marine Parks has be unprecedented. However, this has not deterred fishers and illegal nets continue to be set and dugongs continue to die in gill nets in Shoalwater Bay.

There is only one location where gill netting practices have been changed by regulation in an effort to reduce dugong mortality. In the late 1980s local outrage at ongoing dugong deaths in gill nets forced the Department of Primary Industries to enact specific fisheries regulations for Hervey Bay. The mesh size and monofilament strength of nets was reduced to increase the likelihood that dugongs could break through nets, and the hours when fishers could set nets were altered to prevent netting in the late afternoon and night when the dugongs move into shallow water to feed (Fisheries Regulations 1995). In the 63 months from September 1983 to December 1988, when the regulations were changed, there were 30 recorded dugong deaths in Hervey Bay. Of these 23 were attributable to gill nets and 7 were due to unknown causes. In the 57 months from January 1989 to October 1983 (by which time most dugongs had left the bay due to the loss of seagrass [Preen and Marsh 1995]) there were 13 recorded deaths (excluding those related to the seagrass die-off), of which 10 were attributable to gill nets. Hence, the rate of gill net deaths (number/month) decreased by about 53% following the change in regulations. This is a significant rate reduction, and the change in regulations can claim some success. However, there are three important points that rule out the possibility of these changes being more universally applied to solve the dugong bycatch problem.

1. Throughout the dugong's range in Australia there is no location where the general public keeps vigilant watch over the commercial fishers as in Hervey Bay. There are several small communities around the edge of southwest Hervey Bay where the main dugong habitat occurs. These communities are populated primarily by retirees who spend a lot of time on the water fishing or walking the beaches. Hervey Bay is also a mecca for recreational fishers from southeast Queensland and beyond, so there are always lots of people on the water. These people form a very efficient surveillance network. Hence, there is little scope for commercial fishers to disregard the fisheries regulations, so there is a uniquely high level of compliance. No other significant dugong habitat in Australia can boast surveillance comparable to Hervey Bay, and this surveillance has nothing to do with the Queensland Boating and Fisheries Patrol.

2. The netting in Hervey Bay is for mackerel and smaller fish. Hence, it is possible to use smaller mesh, lighter strain nets (mesh size as small as 88 mm with a monofilament diameter of not more than 0.65 mm [Fisheries Regulations 1995]). However, most of the netters in most of the dugong's range primarily target barramundi, and they require much larger, stronger nets. The Queensland Gulf net fishery mandates a mesh size of 162.5 mm (QFMA 1996b) while the Northern Territory Barramundi Management Plan dictates a mesh size of not less than 150 mm with a monofilament diameter of not more than 1.17 mm (Dept. Primary Industries and Fisheries 1991).

3. The dugong population of the Hervey Bay region decreased from 2206 (+/-420) in 1988 to 600 (+/-126) in 1993 due to the loss of seagrass habitat (Preen and Marsh 1995). If this population is to recover, all human related mortality must be minimised. Hence, the ongoing dugong deaths in gill nets in Hervey Bay, although half what they were, are unacceptable. Given that dugong populations throughout 75% of the Great Barrier Reef Marine Park have suffered a decline of 50-80% (Marsh et al.1995a), the survival of every dugong is important and any gill net mortality is unacceptable. The stated management aim of the GBRMPA in this region is to "reduce unnatural loss to zero" (GBRMPA briefing notes for conservation group forum, April 1996).

The solution to the gill net bycatch problem will rest with the large-scale banning of gill nets. As a matter of urgency large sanctuary areas must be created where dugongs and inshore dolphins will be protected from netting and other threats. However, this may not be enough. The very large home ranges of dugongs, plus the fact that dugongs move along the entire tropical coastline of Australia will mean that large-mesh gill netting must be banned throughout the dugong's Australian range.

It is encouraging to see that this has been realised in some sections of the industry, and that alternatives to gill nets are now being considered. In response to media about the death and mutilation of a large healthy lactating female dugong on Magnetic Island in September 1996, the fisherman responsible pointed out that fish traps would be an ecological alternative to gill nets. The Chairman of the Queensland Fisheries Management Authority was quoted as being supportive of this idea, saying "I think that the point he's making is perhaps we should look at environmentally-friendly apparatus, which shows a bit of lateral thinking and being positive. ... if someone wanted to put in an exploratory permit to undertake the activity, we'd have a look at it." (Townsville Bulletin 27/9/96).

All efforts of management agencies should now be directed at rationalising gill net fisheries (the East Coast Queensland Fishery has ridiculous latent potential, with over 1,000 licensed operators) while at the same time developing ecologically acceptable alternatives to gill nets.

Final comments

There can be no doubting that gill netting is a key threatening process to dugongs along the 2,000 km coastline of the Great Barrier Reef Marine Park south of Cooktown. There are few data to establish the extent to which gill netting is currently a key threatening process in other areas. Logically, however,

events in the central and southern section of the Great Barrier Reef coast, where pressures on dugong populations are greatest (due to greater human population) should be viewed as a harbinger of events in other areas.

If Australia is to maintain large and viable dugong populations, and it is apparent that this may only happen in Australia, then a precautionary approach to their management will be required. It is just too difficult to collect the data to do otherwise in an appropriate time-frame. The first action should be to declare gill netting as a key threatening process.

Gill nets, as operated by the Australian fishing industry, threatens, at minimum, the species listed in sections (c) and (d) above. Only through nationally coordinated efforts of Commonwealth and state agencies responsible for both marine conservation and the fisheries management, can programs be implemented to reduce, and eventually eliminate, dugong, sea turtle and other marine species bycatch. The preparation and implementation of a nationally coordinated threat abatement plan is, in the view of the nominating organisation, a feasible, effective and efficient way to abate the process of decline.

(f) references to any scientific literature that supports the other information given in the nomination:

Cockcroft, V. G., R. V. Salm, and T. P. Dutton. 1994. The status of dugongs in the western Indian ocean. In First International Manatee and Dugong Research Conference, 11-13 March 1994. Gainesville, Florida.

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Declaration to accompany nominations:

The nominees declare that the information included in this nomination is correct to the best of our knowledge.

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Nomination of the Dugong (*Dugong dugon*) for Schedule 1, Part 1,of the *Endangered Species Protection Act 1992*

The following information follows the requirements for nominations specified in the *Endangered Species Protection Regulations 1993*, Part 2, s.4(1), under the provisions of Section 25 of the Act.

(a) the scientific name (if any) of the species:

Dugong dugon

(b) any common name, or names, by which the species is known to the person or persons making the nomination:

Dugong

(c) not applicable

(d) in the case of an animal species - whether the species is a vertebrate or a non-vertebrate animal:

Vertebrate

(e) not applicable

(f) the Part of the Schedule for which listing of the species is nominated:

Schedule 1, Part 1 - Species that are Endangered

(g) the reasons why the species is considered to be endangered, vulnerable or presumed extinct within the meaning of section 6, 7 or 8 of the Act by the person or persons making the nomination:

Internationally, the dugong is currently listed as Vulnerable (IUCN, 1990 &1994), although its status has not been reviewed for several years, and the data base on the dugong, and the categories of threatened species have now changed substantially.

The dugong's range spans the tropical and sub-tropical rim of the Indian Ocean and extends into the south-west Pacific: from Mozambique and Madagascar to the head of the Red Sea and east to Brisbane and Vanuatu (Husar 1978; Nishiwaki et al., 1979; Nishiwaki and Marsh 1985). Over much of this range dugongs are now believed to occur as isolated populations separated by large areas where they are all but extinct (Husar 1978; Nishiwaki and Marsh 1985). Dugongs appear to have been exterminated by hunting from a number of Indian Ocean archipelagos, including the Mascarene, Laccadive, Chagos, Nicobar, Barren, Narcondom, Cocos (Keeling) and Christmas Islands (Husar 1978; Snow 1970; Stoddart 1972).

The abundance of dugongs has been determined by quantitative aerial surveys along the Saudi Arabian coast of the Red Sea and the western and southern areas of the Arabian Gulf (Preen, 1989), Shark Bay and Ningaloo/Exmouth in Western Australia (Preen et al.,1995a), the Northern Territory (Bayliss and Freeland, 1989), around the Wellesley Islands area Torres Strait (Marsh and Lefebvre, 1994), the northern (Marsh and Saalfeld, 1989) and southern (Marsh et al., 1995a) Great Barrier Reef, and Hervey Bay and Moreton Bay in southern Queensland (Preen and Marsh 1995). Population estimates sum to approximately 85,000 in surveyed areas of Australia, and 8,000 in the Arabian region. Systematic surveys have also been conducted along the Kenyan coast (Wamukoya et al., 1995), in part of Mozambique (Dutton 1994), and in Palau (Marsh et al., 1995b), although the low number of sightings, or the survey design prevent the calculation of population estimates. Although dugongs are legally protected in many countries, there is generally little enforcement and dugongs are still widely hunted and netted. Hunting is still common in Australia (Marsh and Lefebvre 1994), Papua New Guinea (Hudson 1981) and Palau (Marsh et al., 1995b), but has apparently declined in the eastern Red Sea and the Arabian Gulf (Preen 1989) and east Africa (Jarman 1966; Wamukoya et al., 1995), largely because dugongs are now too rare to justify active hunting. In most areas direct hunting now seems to be less of a threat than the take of dugongs in gill nets, which are extremely abundant in coastal waters throughout the dugong's range.

Deliberate or incidental netting of dugongs has been reported from Mozambique (Hughes and Oxley-Oxland 1971; Cockcroft et al., 1994; Dutton, 1994), Kenya (Jarman 1966; Cockcroft et al., 1994; Wamukoya et al., 1995), Djibouti (Robineau and Rose 1982), Sudan (Vine and Schmid 1987), Egypt (Gohar 1957), Israel (Lipkin 1975), Saudi Arabia, Yemen, Bahrain, Qatar and the United Arab Emirates (Preen 1989), India (Nair et al., 1975; Lal Mohan 1976; Jones 1980), Sri Lanka (Jones 1980; Leatherwood and Reeves 1991) and Australia (Heinsohn 1972; Marsh 1985; Paterson 1990). Large trawl nets also take dugongs in some areas (Wamukoya et al., 1994). Due to their low reproductive potential, dugong populations are likely to decline if human- induced mortality exceeds 1-2% of females (Marsh et al., 1984). On this basis, over-hunting is occurring in Torres Strait (Marsh and Lefebvre, 1994) and in Palau (Marsh et al., 1995b). Similarly, gill-net mortality, estimated from interview surveys of fishermen, is a threat to dugong populations in the southern Red Sea (south-west Saudi Arabia and Yemen), and the southern Arabian Gulf (Qatar and the United Arab Emirates; Preen, 1989). Although gill net mortality has not been quantified in Australia (but see Marsh, 1985 for some alarming data), gill netting is seen as a threat to dugong populations (Marsh et al., 1995a).

This nomination of the dugong as an Endangered species is guided by IUCN's recent and detailed analysis of threatened species categories (IUCN, 1994). Those new threatened species categories are the result of more than five years of continual drafting, consultation and validation by IUCN's world-wide network of scientists and managers, including its Species Survival Commission, which is comprised of specialists actively working on nearly all taxa.

One of the strengths of the IUCN categories, which is not explicitly reflected in the Endangered Species Protection Act 1992, is that they take into account life history characteristics. This is particularly important in the case of the dugong, which is a

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long-lived (Marsh, 1980), slow-breeding species (Marsh et al., 1984). While declines in this species can occur rapidly due to hunting, netting or other causes of mortality (Marsh et al., 1995a; Preen and Marsh, 1995), any recovery will inevitably be very slow. The IUCN categories can accommodate this slow response by assessing the conservation status of a species in terms of its generation time.

Using the IUCN criteria, a taxon can be considered Endangered when it has suffered an observed, estimated, inferred or suspected reduction of at least 50% over the last three generations (or 10 years, whichever is longer). Furthermore, a taxon can be considered Endangered if a decline of 50% is projected or suspected during the next three generations.

Dugongs do not become sexually mature until they are 9-17 years old and can live to at least 70 years of age. They are likely to have a generation time (average age of parents in the population; IUCN, 1994) of about 40 years. Hence, three generations will span a period in excess of 100 years.

While there are few hard data on dugong population sizes, and fewer on trends, virtually every author to assess the status of the dugong over a substantial part of its range has concluded that its conservation prospects are bleak. In so doing, they have inferred or implied a decline equivalent to 50% over the previous 100 years (Baldwin and Cockcroft, 1995; Bertram and Bertram, 1973; Cockcroft, 1995; Husar, 1978; IUCN, 1990; Jones, 1980; Marsh and Lefebvre, 1994; Marsh et al., 1995a; Nishiwaki and Marsh 1985; Nishiwaki et al., 1979; Preen, 1989; Wamukoya et al., 1995). Population reduction can be based on a number of factors other than measured population decline (IUCN, 1994). Other parameters include a decline in the extent of occurrence (range) or a decline in the area of occupancy (occupied area of range; IUCN, 1994). The extinction of dugong populations from many island regions (see above), and their impending extinction in Palau (Marsh et al., 1995b) is graphic evidence of a reduction in their extent of occurrence. The very extensive recent survey of Kenya (Wamukoya et al., 1994) has demonstrated a substantial reduction in the area of occupancy, compared with the dugong's previous distribution.

Only in parts of Australia have repeat aerial surveys been able to establish some trend data on dugong populations. In the area where most data are available (three surveys), a population decline of more than 50% has occurred along 2,000 km of the Queensland coastine in less than eight years (Marsh et al., 1995a). Over most of this area, the decline has been in the order of 80%. Furthermore, there is evidence from other sources that this decline commenced many years before the surveys started, so the actual decline is likely to be considerably greater. Dugongs in the Great Barrier Reef region south of Cooktown are now considered to be Critically Endangered (Marsh et al., 1995a). In Hervey Bay, the dugong population dropped from approximately 2,200 in 1988 to 600 in 1993 (Preen and Marsh, 1995) following the large-scale loss of seagrasses (Preen et al., 1995b). In Torres Strait the number of dugongs killed each year (>1200 in the early 1990's; Harris et al., 1994 cited in Marsh and Lefebvre, 1994) is almost certainly unsustainable. In contrast, the dugong populations in Shark Bay/Ningaloo (Preen et al., 1995a) and Moreton Bay (Preen and Marsh, 1995) appear to be stable. However, the majority of the Australian coastline that is within the dugong's range has not been surveyed, or has been surveyed only

once. There is evidence that dugong populations in some of these areas are under considerable pressures from gill nets and hunting (Marsh, 1985; Sullivan, 1995).

Although catastrophic environmental change can have a serious impact on dugong populations (Preen and Marsh, 1995), gill nets and hunting are the factors most commonly implicated in dugong deaths in Australia (Marsh et al., 1995a). It is difficult to imagine that mortality resulting from these factors is likely to decline in the future. Commercial fisher's organisations in Queensland and the Northern Territory deny that significant numbers of dugongs are killed in nets and are not prepared to make serious concessions to conservation. Ironically both the Queensland Commercial Fishermans Organisation and the Northern Territory Fishing Industry Council have, by their actions conceded their role in dugong declines. The QCFO voted to partially ban set gill nets in Shoalwater Bay following a spate of dugong deaths and bad publicity in 1995 (Gibbs, 1995). The NTFIC released a strategy to minimise the capture of dugongs in gill nets following the charging of two commercial fishermen in relation to the deaths of some 36 dugongs over a short period in the south western Gulf of Carpentaria in 1995 (Palmer and NTFIC, 1996). This strategy makes much of a proposed barramundi netting closure to reduce the accidental capture of dugongs. The area proposed for closure, however, is not fished for barramundi, which cast a question mark over the sincerity of the effort.

In Queensland there are over 1000 licensed gill net fishers along the eastern shoreline, and over 100 along the western coast. These fishers can use up to 14 different types of nets and can roam all over the State at will. Consequently, there is virtually no management of netting activities. Furthermore, much netting occurs in remote areas where there is virtually no surveillance, and even in areas where patrols are routine, they do not work at night or in the shallow waters where set netting occurs. As a result, it seems that the strategy may be more about public relations than about reducing dugong mortality. Experienced netters eviscerate dead dugongs (to release gases) and sink them in deep water, so relatively few carcasses are ever found. Even if there is some concession from the fishing industry and the amount of gill netting is reduced, at least in important dugong habitat (and there is NO reason to believe that this will happen), then it is likely that any reduction in gill net mortality will be exceeded by an increase in Indigenous hunting. Section 211 of the Native Title Act (1993), which overrides other Commonwealth legislation, allows indigenous peoples to hunt. There is no provision in that Act to limit hunting where threatened species are involved, or to limit the areas where hunting can occur. Hence, Torres Strait Islanders living along the Queensland coast (where half the population lives) are free to hunt dugong, despite a lack of traditional association with the area, and despite the Critically Endangered status of dugongs in that area. With the exception of a few areas where dugongs are now so rare as to not justify the effort of hunting (eg Bowen, Mossaman), Indigenous hunting in Queensland is increasing.

Of the 50 countries that claim part of the dugong's range, only Australia is developed. Australia is viewed as the dugong's stronghold, and critical for the survival of the species (Bertram and Bertram, 1973; Marsh and Lefebvre, 1994). Dugong populations have suffered a catastrophic decline in eastern Queensland in recent years. To date no action has been taken to arrest that decline. Because the main factors contributing to the decline are believed to be gill netting and hunting, and because of the very real

difficulties in modifying practices in both these areas, the future of dugongs in eastern Queensland is indeed bleak. These dugongs are already considered to be Critically Endangered. Even in the unlikely event that the decline could be stopped immediately then it will take several decades for these populations to recover. In reality, the mortality rate may be reduced over the next 5-10 years, in which case dugongs in this region may become extinct in the wild before conservation measures bite. It must be remembered that gill netting and hunting occur throughout the dugong's range in Australia. Factors affecting the eastern Queensland populations will already be affecting most other populations. Due to the nature of dugongs and their habitat, aerial surveys have low power at detecting population trends. This was demonstrated in eastern Queensland, where the number of dugongs had been reduced by 50% before a statistically significant change could be detected.

Mindful of these factors, ESSS is beholden to adopt a precautionary approach in the listing of the Dugong. In this regard guidance from the IUCN (1994) criteria may be useful, including comments on data quality and uncertainty. *"... the absence of high quality data should not deter attempts at applying the criteria, as methods involving estimation, inference and projection are empahsised to be acceptable throughout."* (pg. 6). *" Given that data are rarely available for the whole range or population of a taxon, it may often be appropriate to use the information that is available to make intelligent inferences about the overall status of the taxon in question. In cases where a wide variation of estimates is found, it is legitimate to apply the precautionary principal and use the estimate (providing it is credible) that leads to listing in the category of highest risk."* (pg. 6).

(h) the best estimation that is available to the person or persons making the nomination:

(i) the distribution of the species in 1788:

Shark Bay (WA) to Moreton Bay (Qld)

(ii) the current distribution of the species:

as for 1788. However, there may be changes in the area of occupancy (sensu IUCN, 1994). Aerial surveys indicate that we are on the cusp of a serious decline in the area of occupancy in eastern Queensland (Marsh et al., 1995a).

(iii) the current population of the species:

Approximately 85,000 in surveyed areas in Australia. This estimate includes calves and sub-adults. The IUCN criteria consider the number of mature individuals only when assessing the size of a population (IUCN, 1994). Based on the lengths of dugongs in samples from Townsville and Mornington Island (Marsh 1980) and relationship between body length and sexual maturity (Marsh et al., 1984), it is apparent that 30-40% of a dugong population are immature

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(assuming no bias in the samples). Hence, this estimate may be reduced to approximately 55,000 mature dugongs. A bias in the aerial survey methodology means, however, that this could be an underestimate (Marsh et al., 1995a).

(I) references to any scientific literature that supports the other information given in the nomination:

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(j) not applicable

Declaration to accompany nominations

Humane Society International and the Australian Marine Conservation Society declares that the information included in this nomination is correct to the best of our knowledge.

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20 February 1997

Australian Marine Conservation Society
DUGONG CONSERVATION POLICY

1. AMCS believes that sufficient data exist to conclude that dugong are critically endangered in the southern Great Barrier Reef Region.

2. AMCS supports the measures for dugong recovery and conservation announced at the GBR Ministerial Council Meeting on 30 November, 1996.

3. AMCS believes that the extinction of dugong in the southern Great Barrier Reef Region will be averted only by effectively eliminating *all* major human-induced threats to dugong. The calculations by Professor Helene Marsh of what may be a sustainable human-induced dugong mortality (cited by Preen & Morissette, 1997, p.7.) suggest that drastic new measures are necessary to prevent dugong extinction in the southern Great Barrier Reef and Hervey Bay. Consequently, continuation of activities that lead to dugong mortality must not just be prohibited, but also must be enforced through a greatly increased effort by GBRMPA and Queensland Government agencies to ensure that activities that lead to dugong mortality do not continue.

Commercial Net Fishing

4. It is clear that all net fishing does not lead to dugong mortality. Dugong numbers in Moreton Bay do not appear to be in decline despite the fact that it is the most intensively net fished area in Queensland and that dugong feeding and much of the net fishing activities take place in close proximity. Consequently, AMCS does not support a total ban on net fishing.

5. It is equally clear that net fishing along the Great Barrier Reef coastline and in Hervey Bay has led to some of the dugong mortality which now makes the species critically endangered. We believe that this has been due primarily to staked nets of both licensed and unlicensed fishers being left unattended.

6. AMCS supports the efforts that QCFO has undertaken to determine from its members, on an area by area basis, the best way to eliminate dugong mortality from net fishing. We are not optimistic about the future for dugong in the southern Great Barrier Reef and Hervey Bay, but we believe the best hope for dugong survival rests with a commercial fishing industry that is doing everything possible to ensure the survival of dugong. We know many commercial net fishers and believe that some will do this because it is the socially responsible thing to do, while others will do it simply because the survival of their own industry is now linked to the survival of the dugong.

7. We propose that net fishing should be restricted in the Dugong Protection Areas proposed by Preen & Morissette (1997) in line with the industry proposal for the implementation of the QCFO Dugong Conservation Strategy (except 4.8 i & ii, see below). We propose that QCFO should be given three years to demonstrate that it can reduce dugong mortality resulting from the activities of licensed fishers to "insignificant levels approaching a zero value"[1]. Independent observer checks need to be built into the QCFO proposals to validate that dugong mortality is not continuing. If mortality does continue, we advocate total closure of the net fisheries within the Dugong Protection Areas as proposed

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[1] The United States Marine Mammal Protection Act requires that the level of incidental take be at "insignificant levels approaching a zero value". To AMCS this seems an appropriate standard for a critically endangered species within the Great Barrier Reef World Heritage Area.

by Preen & Morissette (1997).

8. We do not support the fishing industry suggestions for Shoalwater Bay outlined in Section 4.8 i & ii of their proposal, and we have inadequate data to assess 4.8 iii. However, our Society strongly supports the QCFO viewpoint (Section 3.14) on the need to avoid displacement of effort to other localities for the same fishery or to other fisheries by providing compensation and buy-backs for the Shoalwater Bay fishers who have been displaced to ensure dugong survival.

9. We believe that it is crucially important that GBRMPA participate with Queensland Government agencies in current efforts to develop policies for providing fair compensation and for avoiding displacement of fishing effort to other parts of the fishery in any Queensland fishing industry restructuring.

This issue is relevant to GBRMPA not just on the topic of dugong recovery, but also in attaining a representative system of IUCN Categories I and II Marine Protected Areas within the Great Barrier Reef Region, as agreed by all parties who participated in the development of the Great Barrier Reef World Heritage Strategy.

We strongly urge GBRMPA to consult closely with the commercial fishing industry on the potential compensation/buy back funds that would be required to close any one of the proposed Dugong Protection Areas to net fishing. One scenario that should be considered is that the QCFO proposals for preventing dugong mortality will work in some of the Dugong Protection Areas, but not others.

We are alarmed that GBRMPA and the Great Barrier Reef Ministerial Council have progressed the idea of Dugong Protection Areas where net fishing might be excluded, without having looked closely at the economic and social implications of such actions. We are reminded of the huge and largely unnecessary controversy that arose over compensation to the rainforest logging industry in the Wet Tropics because the Federal Environment Minister of the day and his Department failed to heed the warning of environment group leaders that the issue could not be resolved without both early and prolonged discussions between all parties and a detailed planning strategy to deal with the issues.

10. It appears from the calculations of Professor Marsh (cited by Preen & Morissette, 1997, p.7.) that dugong numbers could continue to decline in the southern Great Barrier Reef just through mortality of the small populations that remain outside the proposed Dugong Protection Areas or are in transit between those areas. The obvious implication for commercial fishers is that detailed strategies for preventing dugong mortality also need to be developed for the areas between the Dugong Protection Areas as a matter of urgency.

Indigenous Hunting

11. AMCS commends indigenous groups that have imposed voluntary moratoria in relation to indigenous take of dugong. Our Society can not condone hunting of endangered species. We believe that all humans have a moral obligation to ensure the survival of other species. Clearly dugong survival is particularly important to Aborigines and Torres Strait Islanders because of their long cultural associations with dugong.

12. AMCS is concerned that not all indigenous hunters and fishers will comply with the voluntary moratoria. We seek the advice of indigenous groups as to how dugong mortality by non-complying indigenous hunters and fishers can be effectively prevented.

Illegal Net Fishing

13. AMCS believes that illegal net fishing has been one of the significant factors contributing to the rapid decline in dugong numbers in the southern Great Barrier Reef. We urge GBRMPA and QDoE to give high priority to work with the appropriate Queensland Government agencies to develop within six months a more effective program of fisheries surveillance and enforcement to ensure that offenders are caught and severe penalties imposed. One or two million dollars additional expenditure here may be far more effective for dugong conservation than paying many more million dollars closing down licensed fishing operations. We agree with QCFO that there is an urgent need to develop a system that will allow fishers to report illegal operations without fear of retribution.

Shark Meshing

14. AMCS is strongly of the view that all shark meshing should cease as a matter of urgency in Queensland. The mortality of dugong and other harmless marine life caused by shark meshing is unacceptable.

Carcass Monitoring

15. The current system for determining the cause of dugong mortality is inadequate. If dugong continue to die, it is crucially important to know why. A more rapid response capability must be developed to examine carcasses before they decompose. This requires a co-operative approach by GBRMPA and the Queensland agencies, and should also involve QCFO, aboriginal communities, Sunfish and environment groups.

Loss of Seagrass Habitat

16. We strongly support the QCFO proposal (pp. 4-5 of the industry submission) for an oral history survey of seagrass decline along the Queensland coast. Once this method has been used to identify probable localities where seagrass decline is likely to have occurred, aerial photographs can be examined to quantify changes in seagrass area over time. Extensive aerial photography is available for much of the Queensland coastline. Intertidal and even some shallow subtidal seagrass beds are readily identifiable on most 1:12,000 and 1:25,000 colour airphoto sets, and several runs have been flown for most areas over the last decade.

References

Anonymous (1997). Industry proposal for the implementation of the QCFO Dugong Conservation Strategy.

Preen, T. & Morissette, N. (1997). A system of dugong sanctuaries for the recovery and conservation of dugong populations in the Great Barrier Reef World Heritage Area and adjacent southern waters.

9. (P.1)

Queensland Conservation Council

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Postal Address: P.O. Box 12046, Elizabeth St., Brisbane, Australia, 4002
Telephone: (07) 3221 0188. Fax: (07) 3229 7992. Email: qcc@peg.apc.org

Dr Ian McPhail
Chair
Great Barrier Reef Marine Park Authority
PO Box 1379
TOWNSVILLE Q 4810

Dear Dr McPhail,

Following on from yesterday's meeting of the GBR Marine Park Authority in Brisbane, QCC asks that you note the following comments at the next meeting of the GBR Ministerial Council.

QCC, which is the peak umbrella body of conservation groups in Queensland, is extremely concerned that two environment groups represented at the meeting, the Australian Marine Conservation Society and the Wildlife Preservation Society of Queensland, threw their support behind the QCFO proposals for dugong conservation. The QCFO submission does not comprise a package of emergency measures, as requested by Senator Hill.

The status of the dugong is well recognised as critical and requires an emergency response, not one that will take three years to test, and where the compensation regime will take at least two years to develop (as recommended by AMCS).

Anything less than the removal of gill-netting throughout the dugong's habitat and range will not result in dugong recovery. To continue to allow gill-netting in the 11 identified dugong sanctuaries would make a mockery of the whole exercise of identifying and mapping Dugong Priority Areas.

QCC also calls on the parties involved in the development of the emergency package to stress the critical importance of developing a comprehensive compensation regime. All fishing licences that allow for gill netting must be bought out and governments must ensure that displacement of effort does not occur, thereby creating problems elsewhere in waters of the GBR.

Finally, funding for monitoring and enforcement continues to be seriously lacking. A package of emergency measures must include recommendations for increased funding in order for these two activities to be carried out effectively.

Yours sincerely,

Imogen Zethoven
Coordinator

21 February 1997

9.(p2)

Queensland Conservation Council

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Presentation to the Great Barrier Reef Marine Park Authority
Recovery of the Dugong
20th February 1997

Conservation Requirements

With regard to the proposed interim Dugong Protection Areas, the Queensland Conservation Council (QCC) support the implementation of large scale dugong sanctuaries, not more than 200 km apart, in the GBRMP on the condition that human activities in them are severely limited and controlled. We also wish to put on record that the entire GBR Marine Park should provide a sanctuary for these animals which have been exterminated throughout most of their range elsewhere in the world. Ensuring protection of the dugong in the entire GBR World Heritage Area is the only appropriate protection of the dugong and the appropriate method of living up to our World Heritage obligations.

Due to the time constraints, I am unable to list all of QCCs concerns with regard to human induced mortality of dugongs. I understand that the Authority have had access to our of submissions to the Draft Emergency Measures where these concerns have been articulated. Rather, I will focus on actions necessary to eliminate or, where this is not possible, minimise the key threats to dugongs.

These threats are gill netting, hunting, coastal development, boat traffic and defence force activities. Loss of seagrass beds is also important.

The immediate removal of gill netting operations in the interim Dugong Protection Areas (sanctuaries) and throughout the dugongs range

I quote from the Ministers respective press statements, "fishing practices which may result in dugong mortality will not be permitted in dugong sanctuary areas." We agree with Ministers Hill and Littleproud and believe this statement unequivocally commits the Ministers to prohibit gill netting in the dugong sanctuaries. However, we do not think that this action alone will ensure the RECOVERY of the dugong.

Gill netting must be prohibited throughout the ENTIRE dugong range because it is demonstrably ecologically unsustainable. The banning of gill netting from Shoalwater Bay had the support of the commercial fishing industry. In this case, the industry acknowledged that they were responsible for the dugongs which were found dead, gutted, mutilated and tied up in mangroves or sunk to the bottom of the Bay.

With regard to the rest of the GBR, during 1995 and 1996 gill netting accounted for approximately 66% of reported dugong strandings. It is possible that some of the remaining 33% of dugongs were net related mortalities. These reports were not all from proposed sanctuary areas which is why the entire GBRMP should be a sanctuary for dugongs.

Why QCFO's Dugong Conservation Strategy will not work
Primarily the goal is flawed. It reads, "To mitigate, and wherever possible, eliminate the impact of commercial fishing on dugong". It should read, "To eliminate the impact of commercial fishing on dugong." Clearly QCFO understand if netting continues fishers will not be able to eliminate mortality. This fact is reflected in their following proposals.

The Endangered Species Awareness Course, Industry Codes of Practice and legislating for fisher to attend nets.
It takes 4-8 minutes for a dugong to drown. Reaching and releasing a dugong within that time frame, even with the best of knowledge about how to release the animal, is difficult at best. It assumes that someone is constantly watching the net which is highly unlikely as fishers move between nets they have set, have breaks during netting and would find it difficult to observe nets set at night.

It also assumes that fishers will value and treat dugongs with care, ignoring the fact that historically dugongs have been a nuisance to netters who have mutilated them to salvage their nets. Most telling is the fact that a Code of Practice for Fishers was in place for Shoalwater Bay DURING the dugong population decline.

Where fishers flout net attendance laws, it is unlikely that they will be caught because adequate resources are not available for monitoring and enforcement, netters set at night and they set in remote coastal areas. Even enhancing surveillance and enforcement is a reactive measure and, at best, may help monitor a continued decline.

A primary concern is that if these dubious measures are adopted as a means to reduce mortality, netters will become more effective at gutting and hiding dugong carcasses. This will give the fishing industry reason to claim that fewer dugongs are being caught in nets because education programs and net attendance requirements are working.

It is already too late to monitor changes in dugong populations in the vast majority of the GBR because numbers are too low. The population decline data has provided a limited opportunity to turn around the decline. An opportunity that if lost now, will not come again.

Net specifications and netting times In Hervey Bay, net types and times of operation were specified by regulation, yet gill net mortality was reduced by only 50% (based on stranded dugongs). This was despite the best available information on the movements of dugongs in the Bay being made available. This information does not exist for most of the coast. Anyway even if it did a further 50% decline in any area in the southern GBR is unacceptable.

Dugong Incident Reporting Scheme This measure is reactive and, at best, may help monitor a continued decline. The data provided will be suspect because it is unlikely that all fishers will accurately report dugong caught in nets. For this reason QDPI scientists are skeptical of the turtle mortality data from trawlers.

Perhaps the Authority should listen to some words of wisdom from Ted Loveday on this issue: "Remember you will not have to worry about your impact on dugong if net fishing is banned like it has been in Shoalwater Bay" (The Queensland Fisherman, February 1997). We say to you, ban it and you won't have to worry about it.

Permitted traditional hunting of dugong only where ecological sustainability of the population hunted can be demonstrated

Because dugong populations have been reduced to such low numbers, hunting is now a major threat and ecologically unsustainable in the southern Great Barrier Reef. Management agencies should reach agreement with Aboriginal communities to suspend hunting until dugong numbers recover and hunting can be conducted on an ecologically sustainable basis.

An immediate moratorium on large-scale development in and adjacent to critical dugong habitats & strong and enforceable controls on vessel speeds on dugong habitats

Vessel traffic is a difficult issue. Not even Senator Hill in his "Statement of Reasons" for allowing the proposed development at Oyster Point to proceed could address this issue. The only way to prevent displacement is to restrict the number, size, shape and speed of vessels in important dugong habitat. Equally important is to prevent the construction of marinas in areas adjacent or near dugong sanctuary areas.

An immediate prohibition on under water explosives and military activity in all dugong habitats

The Shoalwater Bay closure to gill nets will not ensure the survival of the Shoalwater dugongs for two reasons: 1. gill netting will continue in Port Clinton and nearby coastal waters which the Shoalwater dugongs frequent and 2. because of planned military exercises.

Tandem Thrust is perhaps the most extreme example of the inappropriate use of an area that requires protection. Over 25 000 personnel, hundreds of warships, supersonic aircraft, bomb dropping, amphibious landings, underwater detonations, all being allowed without any quantified idea of the extent to which noise effects dugongs or the expected activities in Shoalwater Bay. The Draft Shoalwater Bay Management Plan makes it clear that noise has the potential to prevent dugongs from feeding, can results in their being driven from their range and can result in their death due to starvation.

Compensation

Without compensation, all the good measures in the world wont be implemented. Compensation is the oil to make things happen. Compensation must be provided to Aboriginal communities as well as to gill netters, as a matter of equity. There is $5 million within QDPI to facilitate the restructuring of the fishing industry. This needs to be supplemented with Commonwealth assistance. A compensation regime must be holistic to ensure that the potential for displaced effort is not actualised.

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FACSIMILE TRANSACTION

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February 21, 1997

Dr. Ian McPhail,
Chair,
Great Barrier Reef Marine Park Authority

Dear Ian,

We did not have time to discuss all the papers distributed to organisations attending the Authority meeting yesterday. The "Report on Vessel Use in the Interim Dugong Protection Areas" was an interesting summary on vessel use, but the section entitled "Main Issues" certainly fell short of what we in AMCS regard as the main issues.

There is a lot of literature on the boat strike problem with manatee in Florida that could have been reviewed and may have proved instructive. Unfortunately, I do not think we can make a direct comparison, because manatee generally are found in more confined waters than dugong, so there is probably a greater risk of being hit by a boat. I have only seen manatee in estuaries in Florida. I also am left with the impression that dugong are faster and better at "ducking" boats than manatee.

I think the key question is "At what speed do boats become a threat to dugong?" The issue is undoubtedly more complex, because if the vessel is large and has a lot of hull under the surface, the dugong has further to duck, or if the water is very shallow, the animal has nowhere to duck. For speedboats, I suspect that a vessel travelling at less than 20 knots in 5+ metres of water poses little threat to dugong (unless they are very sick or injured animals).

Certainly the AMCS boat which does up to 38 knots (in very calm water) has never come even close to hitting a dugong, at least as far as I am aware. We sometimes see them when we do wetlands research off Moreton Island and North Stradbroke Island in Moreton Bay and we frequently transit the areas where Tony Preen's aerial surveys have shown them to be most abundant. I have only seen one dugong with propellor cuts on its back. Helene Marsh with all her vast amount of field time in dugong country only has seen one with propellor cuts.

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However, John Doohan from Sunfish said that there are reports that a Stradbroke Island vehicle ferry, which probably travels at less than ten knots, hits one occasionally. It is a big boat with a lot of hull under the surface. A substantially improved carcass monitoring program could give us a better understanding of the significance of boat strikes as a cause of dugong mortality. We need to get people in the field fast, before the dead dugong turn into goo.

The issue that does concern me most about boats impacting on dugong relates to disturbance rather than collisions. There is a large amount of potential dugong habitat on the western side of Moreton Bay that historically is known to have supported dugong, but where today they are rarely seen, such as around Green Island. Boat traffic is moderate to heavy in these areas. I really do not know if diminished water quality is part of the problem. It could be, but I am more inclined to think disturbance by boats really is a significant issue.

I have no idea how you could study the problem. GBRMPA and the CRC do not need an Ethics Committee to realise that chasing dugong with boats to see how much boat traffic causes them to abandon areas would be far less acceptable to the community than your previously most unpopular research proposals. I suspect you would even get protest letters from the governments of Nigeria and Afghanistan.

I support the comments on p. 5 of the Gilbert & Benzaken report about anchoring and dredging damage to seagrass beds. However, I believe the remarks on p.7 about the "degradation" of deep seagrass beds by otter trawls are merely speculation. If anyone in QDOE does know something about the topic, their name should at least be cited in the report. I would have thought that the people in QDPI who are actually studying deep seagrass beds, like Warren Lee Long, would have been able to offer a more informed opinion, rather than clutching at straws. I think that the impact of both otter and beam trawls on seagrass beds should be studied. However, at the end of the day, it may not prove to be anything like as significant as many people currently believe. We still need to know, and I believe that the industry should help fund the work.

Yours sincerely,

Eddie Hegerl

Eddie Hegerl
Director

cc. Imogen Zethoven - QCC
Pat Comben - WPSQ
Bill Foster - HSI

ATTN 11 (P.1)
IAN McPHAIL
GBRMPA

Wildlife Queensland

Wildlife Preservation Society of Queensland
Proserpine/Whitsunday Branch Inc.

21/02/97
facsimile

Brian Littleproud
The Minister for Environment

Dear Minister,

Interim protection of dugongs

We are greatly concerned that recent plans for the protection of dugongs are inadequate.

It would appear that the proposed dugong sanctuaries offer no more protection than the inadequate measures that already exist.

The research clearly shows that without strong and decisive action, dugongs on the southern GBR will become extinct in the near future.

Our branch fully endorses the WPSQ Head Office stance on the proposed measures (see enclosure).

Furthermore, we would suggest that encouraging professional fishermen to adopt protection measures through "voluntary compliance" will not work in time to save these creatures. (Just as voluntary compliance has been totally ineffective in protecting turtles through the introduction of turtle excluder devices on trawlers.)

Gill netting in all sanctuary areas should be banned forthwith and stronger measures to detect illegal fishing activities introduced.

Because dugongs are in immediate danger of becoming extinct we call on you to act now, and then consult further with community groups.

Ian Sutton
Branch Coordinator
phone/fax 079 464 170

P.O. BOX ~~848, PROSERPINE, Q. 4800~~
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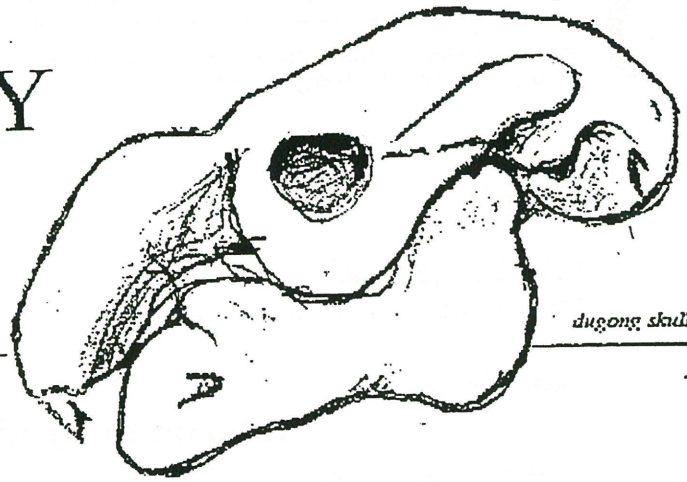
WHITSUNDAY WILDLIFE



dugong skull

Newsletter of the Wildlife Preservation Society of Queensland Proserpine/Whitsunday Branch Inc.
Number 16 December 1996

Our Dugongs Face Extinction in New Plan

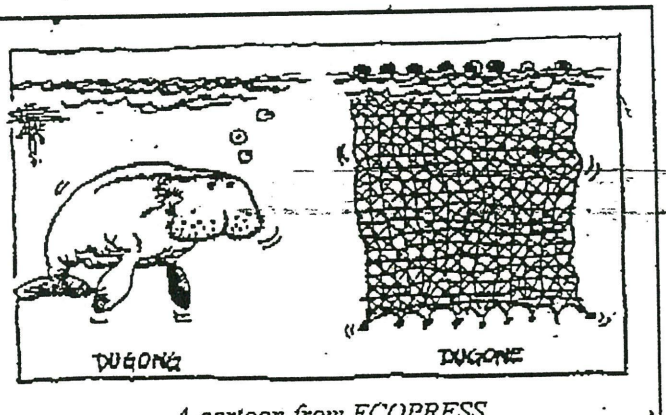
The welfare of Whitsunday Dugongs has been sacrificed in the latest Draft Program of Emergency Measures for Dugong Recovery and Conservation in the GBRWHA and Adjacent Waters.

Eight areas are to be declared **Interim Dugong Protection** Areas, but none of these areas, where gill netting will become illegal, are in the Whitsunday region. It seems likely that with gill netters leaving the interim areas, the survival pressure on our dugongs will actually increase. This appalling prospect; despite the Repulse Bay region being a major dugong habitat. So much so that a commercial dugong fishery was pursued here 100 years ago.

Reaction from WPSQ Central Office in Brisbane has been swift:

In a response to the Draft Program for Emergency Measures they conclude:

"It appears that relevant agencies are either inept or politically restrained from initiating the measures required to save the dugong. It goes without saying that we are very disappointed with the relevant agencies and individuals involved in the Working Group. We should all be ashamed that we have once again demonstrated our preoccupation with the exploitation of nature, rather than living with it."



A cartoon from ECOPRESS Mackay Conservation Group

The report also states that: "It is the responsibility of the fishing industry to demonstrate it is capable of operating without causing environmental harm to the dugong or its habitat.

Therefore, the fishing industry must be immediately precluded from critical dugong habitat and sea grass beds until such stage it can:

- Prove fishing operations are not detrimental to dugongs or their habitat.

- prove that it can effectively deal with its members who continue to cause environmental harm to dugongs and dugong habitat.

- Prove that its members comply totally with their proposed code of practice.

Those in the industry which suffer income loss from this preclusion will need to be adequately compensated. Assistance should be given to QCFO to finalise and implement their code of practice."

Looking at the world picture, the future of dugongs looks bleak, and the future of manatees, a close relative looks even worse:

This group of animals, commonly known as Sea Cows, have already had one of its representatives become extinct from European impact: Stellar's Sea Cow was last recorded in 18th century.

Manatees are also slipping towards their final fate: Depleted through habitat destruction, gill netting and boat strike, large numbers have also died recently, poisoned by red tides, no doubt exacerbated by nutrient enrichment from land runoff.

As for dugongs, their last hope appears to be Australia, as numbers have been decimated throughout South East Asian and African waters. But here, decimation from fishing nets, habitat loss and boat strikes are already a facts of life. Only poisonings from algal blooms remain to be recorded here!

If this Claytons weak proposal for protection is not significantly strengthened, the fate of dugongs living in the Whitsundays will be sealed. Likely, it will also eventually lead to the demise of all dugongs in the southern and central sections of the GBR.

The views expressed in this newsletter are not necessarily those of the Wildlife Preservation Society of Queensland Proserpine/Whitsunday Branch Inc. PO Box 815, PROSERPINE Q 4800

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The Wildlife Preservation Society of Queensland

Townsville Branch Inc.

P.O. Box 857, Aitkenvale, Qld 4814

URGENT

Dr. Ian McPhail,
Chairperson,
Great Barrier Reef Marine Park Authority,
PO Box 1379,
Townsville, Qld, 4810.

22 February 1997

Dear Dr. McPhail,

The Townsville Branch of the Wildlife Preservation Society of Queensland wishes to convey to you unequivocally its position on the practice of gill-netting as it affects the health of dugong populations.

* We support public Ministerial statements that fishing activities which may harm dugong will be prohibited in dugong protection areas (sanctuaries)

* It follows that we strongly support an immediate ban on the practice of gill-netting within the sanctuaries and its speedy removal from other critical dugong habitat

* We believe that to delay implementation of such bans in order to allow for further periods of monitoring or QCFO self-regulation trials is likely to be catastrophic for the dugong. In view of the known status of the dugong in the southern Great Barrier Reef, there can be no justification for further delay.

* We refute, as naive and misleading, an argument that because dugong are apparently able to co-exist with gill-netting in Moreton Bay, a total ban is unnecessary elsewhere. It is known that the situation at Moreton Bay is exceptional because nets are set high up on sand and seagrass banks where dugong do not usually go. The situation elsewhere along the coast is quite different and *gill-netting is known to be a major cause of dugong death.*

In a recent letter to Senator Hill we also called for the implementation of the following measures :

* Trawling to be ended across sea-grass beds
* Strict controls on speed and numbers of vessels in the DPAs, and other habitat areas
* A moratorium on large-scale development in, or adjacent to, the protected areas and other critical dugong habitat
* A ban on underwater explosives in dugong habitat
* Traditional hunting to be permitted only where ecological sustainability can be demonstrated
* Shark-meshing to be replaced by alternative methods such as drumlines, wherever possible, throughout the dugongs' range.

We strongly encourage GBRMPA to advocate the strongest and most immediate measures to halt the shocking decline in dugong numbers.

Yours sincerely,

Liz Downes

Liz Downes
Secretary

13.

Friends of Hinchinbrook Society Inc.
PO Box 281 Cardwell Q 4849

22.2.1997

Mr Stokes

Dr Ian McPhail
Chairman
Great Barrier Reef Marine Park Authority
PO Box 1379
TOWNSVILLE Q 4810

Dear Dr McPhail,

Our concerns continue to increase about the threat to dugongs in their world range, but more particularly in the southern Great Barrier Reef.

We strongly support the moves to discontinue gill netting in the 11 identified dugong sanctuaries and feel that this should be the first action and be implemented without further delay. Compensation, even if considerable now, in the long run would be less costly than postponing this action, then finding later that much more drastic and expensive measures are needed to avert utter catastrophe for the dugong and shame for our country.

Among other points of concern are boat traffic and speed. We feel that in the identified sanctuaries that boat numbers and speed be kept at a reasonable level. Boat strike is always a danger, but displacement from feeding seagrass meadows and disruptions to life patterns are even more serious threats.

We can no longer plead ignorance for inaction. However if wise decisions are made now the rapid decline of the dugong will be arrested. Professor Helene Marsh's message of six years ago - Australian Geographic 1991 - has become even more urgent : "If we choose now to close our ears to the siren's call we run the risk of banishing her for ever to the faded pages of a story book."

We urge you to take the necessary action to protect the dugong.

With good wishes,

Margaret Thornborne

(Mrs Margaret Thornborne)



24/02/97 09:12 Pg: 1

14.

North Queensland Conservation Council inc.

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Phone (077) 716226 Fax (077) 211713 nqcc@ozemail.com.au

Robert Hill
Minister for the Environment
c/o Parliament House
Canberra ACT 2601

By facsimile

23rd February 1997

Dear Minister Hill

We are writing to reaffirm our support for your commitment to ensure the recovery of dugongs in the southern Great Barrier Reef region.

The best available scientific evidence shows that gill netting is ecologically unsustainable primarily because of its impact on dugong populations. Subsequently it is our position that gill netting should be prohibited throughout the dugongs range, especially in the proposed GBR dugong sanctuaries.

Yours sincerely

Jeremy Tager
Coordinator

cc: Ian McPhail
Chair
Great Barrier Reef Marine Park Authority

15(p.1)

Department of Tropical Environment Studies and Geography

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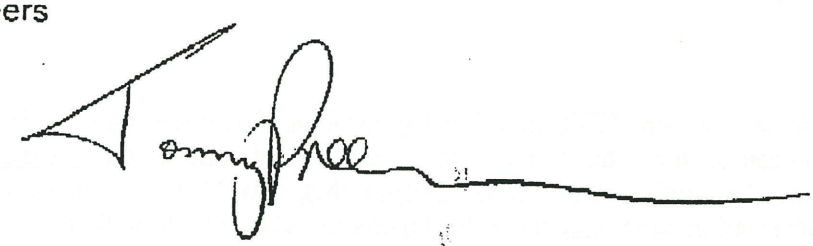
To: Peter McGinnity, Director, Planning Fax: 726093

From: Tony Preen Date: 24 February 1997 No. pages: 5

Dear Peter,

I have prepared some comments on AMCS's Dugong Policy, and am sending a copy for your information. I doubt AMCS will change their policy, but I'm confident that the Wildlife Preservation Society will - at their State Council meeting tomorrow.

cheers



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Comments on the Dugong Conservation Policy of the Australian Marine Conservation Society

Tony Preen
24 February 1997

The Director of the Australian Marine Conservation Society, Mr Eddie Hegerl, presented the AMCS Dugong Conservation Policy to the 165th meeting of the Great Barrier Reef Marine Park Authority in Brisbane on 20 February 1997. That meeting was held to receive submissions from industry, science, ATSIC, recreational fishers and conservation groups on the management of the system of dugong sanctuaries previously proposed by Senator Hill and Mr Littleproud. Both Environment Ministers had released statements saying that fishing practices that may harm dugongs would not be allowed in the sanctuaries.

I attended the meeting and presented the case, based on the scientific knowledge of dugongs, for stringent management of the sanctuaries. As a scientist with more than ten years of dugong research experience around Australia and overseas, and as a past member of the Executive of the Australian Littoral Society (more recently known as AMCS) I was astounded by the AMCS policy, and attitude. Consequently, I have prepared the following brief analysis of the AMCS policy so that its flaws, and the risks that it advocates are clearly understood.

AMCS acknowledges that dugongs in the southern GBR are critically endangered (Policy point 1); is not optimistic that dugongs in this region can be saved from extinction (point 7); and believes that all major human-induced threats to dugongs must be eliminated (point 3). Despite this, AMCS policy advocates the continuation of what is widely accepted as the major threat to dugong populations. AMCS is proposing an extremely high-risk strategy for dealing with the catastrophic decline in dugongs. This is the antithesis of a precautionary approach to a very critical situation.

Major criticisms

Ample evidence that mesh netting (commonly referred to as gill netting) is the major cause of human-related dugong mortality has been presented in numerous submissions to the GBRMPA, to the Dugong Review Group, and to the Interagency Dugong Working Group (the organisations that have been addressing the dugong decline). As AMCS is represented on the Dugong Review Group, it has received all of this information.

Despite this, AMCS policy states:

> **"7. We propose that net fishing should be restricted in the Dugong Protection Areas proposed by Preen and Morissette (1997) in line with the industry proposal for the implementation of the QCFO Dugong Conservation Strategy..."**

The essence of the QCFO proposal (QCFO, 1997) is to tinker with the detail of the fisheries regulations, based on fishers *perceptions* of dugong habitat use, movement patterns and behaviour. It proposes that gill netting will continue in all the dugong 'sanctuaries' and that there will be no reduction in fishing effort.

At the 20/2/97 meeting, Mr Hegerl proposed that fishers, scientists and Indigenous people should collaborate and share their knowledge of dugong activity along the near 2000 km coastline where dugongs have declined. The outcome of such collaboration being site-specific fisheries regulations that have the *potential* to reduce dugong deaths in nets. This approach would require consultation with virtually every gill-netter along the coast (approximately 900 [QCFO, 1997]); consultation with Indigenous groups, some of which have not been prepared to make their knowledge of dugong activity available; and critical analysis of the beliefs of these groups (fishers and hunters) in the context of the scientific knowledge of dugong biology and ecology. Such a process, if possible, would take a long time.

AMCS policy (point 7) continues:

> **"We propose that QCFO should be given three years to demonstrate that it can reduce dugong mortality resulting from activities of licensed fishers to "insignificant levels approaching zero..."'**

Given that the consultative process advocated by AMCS could not be completed until at least the end of 1997 (but most likely much later), the three-year trial period proposed by AMCS would then last at least until the end of the year 2000. The extent of the dugong decline has been known since the last dugong population survey, which was done in 1994. It is now 1997 and no actions to address the issue have been implemented (save a partial ban on gill netting in Shoalwater Bay). Under AMCS's proposal, no firm actions would be taken to address the main cause of the dugong decline for ***at least six years*** (1994-2000). In the preceding seven years (1987-1994), dugong populations declined by 80-90% along most of the southern Great Barrier Reef coast and by more than 50% overall. Another six years without action could allow *a further 90% decline* of the depleted populations. Dugongs would then be so rare along most of the coast that unexpected and unmanageable events (such as cyclones, seagrass die-backs, diseases, boat strikes etc.) could cause regional extinctions. Given the extreme consequences of the failure of the industry's proposal (and they presented no compelling evidence that it would be successful), it is extraordinary that AMCS should be prepared to wait another 3-4 years before assessing the situation. The current situation is too critical to allow a 3-4 year trial period. AMCS essentially concede this when they say *"We are not optimistic about the future for the dugong in the southern Great Barrier Reef and Hervey Bay..."* (AMCS Policy, point 6).

Of course the AMCS policy presumes that at the end of the year 2000 we will be able to assess the success or failure of the QCFO efforts. This will only be possible if they failed and dugongs had become virtually extinct over large areas. Unfortunately, there are now so few dugongs in the southern GBR that it is not possible to monitor the population size. Short of near extinction, it will not be possible to determine, with statistical rigor, whether the dugong population is increasing or decreasing for a long time - probably at least a decade.

At the meeting on 20/2/97 Mr Hegerl suggested that the success the QCFO measures could be judged by the incidence of dugong carcasses showing characteristic signs of gill net entanglement. As was explained in previous submissions to the Dugong Review Group etc., this will not work. Already fishers take active measures to hide dugong carcasses. This has involved tying carcasses to trees up small mangrove creeks and actively burying carcasses on beaches. Most commonly though, fishers slice open the belly of the dugongs to allow the gaseous guts to escape. When this is done properly, the carcasses sink and do not re-float. There is little doubt that, from now on, many fishers will be taking extra measures to dispose of dugong carcasses. To expect a correlation between the number of net-marked carcasses and the incidence of dugong deaths in gill nets is to demonstrate an ignorance of the history of bycatch issues in this fishery. The incidence of stranded net-marked carcasses cannot be used to assess the success or failure of the QCFO measures.

AMCS policy also proposes that:

> **"Independent observer checks need to be built into the QCFO proposals to validate that dugong mortality is not continuing."** (Point 7).

This sounds fine, but in fact it highlights, again, a lack of understanding of the nature of the gill-net fisheries. Observer programs are a standard way of assessing compliance to regulations in many fisheries around the world. Typically, these are industrial fisheries, like trawl fisheries, that are conducted from substantial boats, and which generate hundreds of millions of dollars of revenue each year. The gill-net fisheries in northern Australia are not like this.These are essentially artisanal fisheries conducted by individual operators, using small boats, all working in different, often very remote areas, and generating very modest revenues. Although there are practical reasons why observer programs are not conducted in these types of fisheries (try to picture a government observer, with clipboard in hand, crouched in the bow of a 14 foot tinny with rain tumbling down and mosquitos swarming, as the owner-operator fisher driving the boat works his nets, at night, around a crocodile-inhabited mangrove-lined shore a hundred kilometers or so from the nearest town), they would also be uneconomical. A significant proportion of the 900-odd netters in eastern Queensland would need to be observed. Observation of each fisher would have to run over an extended period, and the program would have to run all year - to cover seasonal changes.

The cost of the observer program would probably approach or even exceed the value of the fishery. Artisanal fisheries, like our tropical gill-net fisheries, are monitored not by observers but by monitoring the points where the fishers return to offload their catch. But when the catch of interest is dugongs, and these are disposed of at sea, then this approach cannot work. It is not feasible to devise a cost-effective, unbiased, and independent check of the incidental take of dugongs in gill nets.

Minor criticisms

- The AMCS policy assumes that fishers will behave responsibly in relation to the QCFO proposal, and that consequently, the number of dugongs killed in gill nets will decrease (point 6). The situation in Shoalwater Bay demonstrates the problem with this faith. In Shoalwater Bay, just two commercial netters, who are well known to QCFO, Queensland Boating and Fisheries Patrol, Dept. of Environment, Army, and GBRMPA were, apparently, responsible for the bulk of the approximately 50% decline in the dugong population over a 7 year period. There is no doubt that the vast majority of netters will behave responsibly, but the tragic fact remains that just a small percentage of "cowboys" amongst the gill-netting fraternity will still be able to drive dugongs in the southern GBR to extinction.

- The AMCS policy maintains (point 10) that based on calculations of Potential Biological Removal (PBR) presented in our report (Preen and Morissette, 1997, p7), the number of dugongs in the southern GBR could continue to decline due to net mortality outside the sanctuary areas. After the meeting on 20/2/97, Mr Hegerl put it more strongly, stating that banning gill netting in the sanctuaries would not prevent extinction, because the PBR would be reached anyway, as a result of mortality in nets outside the sanctuaries. This stance comes from a misunderstanding of what PBR actually is. As stated in our report: *"The Potential Biological Removal is defined as the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population."* (Preen and Morissette, 1997, p7). Even if the PBR is accounted for by the number of dugongs that die in nets outside the sanctuaries, this does not mean the population will continue to decline. Of course it depends on the extent of out-of sanctuary mortality. But as our proposed system of sanctuaries would contain in the order of 99% of the dugongs (Preen and Morissette, 1997), the level of between-sanctuary mortality should be relatively low. Furthermore, as the populations of protected dugongs increase, the PBR increases, thus further reducing this problem.

- Catching and successfully prosecuting illegal netters (point 13) is not as simple as may be implied in the AMCS policy. Illegal netters are often commercial netters who illegally set extra nets. All they have to do is take their identification off the net and they can't be prosecuted, even though they may be caught right beside the net.

- The AMCS policy uses the fact that gill nets and dugongs are not necessarily incompatible in Moreton Bay to show that gill netting is not a problem everywhere, and hence should not be banned (point 4). What is not stated, although I have explained it to Mr Hegerl before, is that the situation in Moreton Bay is exceptional. The gill nets and dugongs are spatially separated in Moreton Bay. The netting occurs high on the sand and seagrass banks - higher than the dugongs go under normal circumstances. Consequently, dugongs are not often caught in nets. Furthermore, the targeted species are small, like whiting and bream, so the nets are fine meshed and relatively weak. A caught dugong may be able to break free. North from the Great Sandy Strait, however, the target species in gill net fisheries are barramundi, salmon, mackerel, and shark. These are large fish, which necessitate the use of large and strong nets. Furthermore, these nets are often set on the seagrass banks where the dugongs feed.

- At the conclusion of the meeting on 20/2/97 Mr Hegerl challenged the veracity of the data on dugong deaths in gill nets. According to Mr Hegerl, it had been claimed that five dugongs died in gill nets in Hervey Bay in 1996, but he knew from AMCS members that the number was fewer than this. The inference was that if the Hervey Bay data were incorrect, then there is no reason to believe any of the data. Had Mr Hegerl carefully read the report that is cited in the AMCS policy, he would be aware that only one definite gill-net death was recorded from Hervey Bay in 1996: *"In the southern GBR in 1996, 35 dead dugongs were recorded, of which there is evidence that 16 died in gill nets. In Hervey Bay, at least one of seven dead dugongs died in a gill net (Preen, unpubl. data)."* (Preen and Morissette, 1997, p.

7). No other organisation, not even the QCFO, has questioned these data, which are compiled from the records of GBRMPA, Department of Environment and James Cook University.

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16.

THE WILDLIFE PRESERVATION SOCIETY OF QLD.

TULLY & DISTRICT BRANCH
P.O. BOX 771
TULLY Q. 4854

Original passed to Tony Stokes FYI.

Dr.Ian McPhail,
Chairperson,
Great Barrier Reef Marine Park Authority,
PO. Box 1379,
TOWNSVILLE Q. 4810

24th February 1997

Dear Dr. McPhail,

Tully and District branch of the Wildlife Preservation Society of Queeensland is most concerned over the implementation of measures to halt the drastic decline of dugong numbers along the Queensland coast. We strongly feel that recommendations of the draft document to establish Dugong protection areas or sanctuaries should be implemented immediately.

We support Ministerial statements that fishing activities which may harm dugong would be prohibited in these sanctuaries. It is therefore essential that gill-netting, which is known to be a major cause of dugong death, is immediately banned in these sanctuaries. We also support a range of other measures which are also needed to conserve the species in the long term. We feel that GBRMPA 's report on the Draft Emergency Measures should include recommendations to end trawling across sea-grass beds, controls on boat speeds in habitat areas, a ban on underwater explosives in habitat, alternative shark protection methods and a moratorium on any large-scale developments in or adjacent to critical dugong habitat.

We are actively promoting the Dugong and Dolphin Sighting Record sheet put out by Dr.Tory Preen, as that is the most pertinent way that the public can help in our area. This research is critical to the recovery of the dugong and has our full support.

Cessation of gill-netting in the nominated sanctuaries is the minimum immediate measure needed for the recovery plan to have any worth.

Yours faithfully,

Suzanne Smith

Suzanne Smith(Hon.Sec.)

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17 February 1997.

Dear Ian,

I have read the reports that have been prepared for the Dugong Review Group and noted the titles of the additional reports that are expected.

As a result of my inquires in the United State about the history of dealing with endangered species/bycatch issues (attached), I conclude that history is repeating itself. The same mistakes are being made that were made with the turtle-TED issue in the United States:

GBRMPA is setting itself up for a protracted war with the fishing industry which will threaten its capacity to tackle other fishing impacts such as the bycatch of turtles in trawls and the effects of trawls on the benthos.

There are several anomalies in the approach to date but the most serious is the **concentration on the technical aspects of the problem at the expense of the need to investigate how to get the stakeholder groups whose livelihoods are threatened to comply with the proposed solutions.**

Despite the repeated calls of members of the Dugong Review Group for the closure of Dugong Protected areas to mesh netting there is no paper outlining options as to how this might be done.

At worst, this oversight could increase the overall number of dugongs killed by mesh nets in marine park. Fishers with netting endorsements are legally entitled to fish anywhere on the east coast of Queensland. There is anecdotal evidence that fishers who are unfamiliar with an area are most likely to catch dugongs. If the mesh netting effort is simply displaced, fishers will be forced into new areas with which they are unfamiliar. Adoption of the comprehensive system of Dugong Protection Areas suggested by Preen and Morissette (1997) (which I support) will minimise the chance of this happening in the southern Great Barrier Reef. However, such substantial closures south of Cooktown increase the risk of displacing fishing effort, at least seasonally, to the remote northern regions where most of the dugongs are. In addition, squeezing the same number of fishers into a smaller area will compromise their livelihoods which will increase the chances of conflict and political interference.

If mesh netting effort is to be reduced as a consequence of closures, there are several major policy issues that need to be addressed as a matter of urgency:

- Will there be a reduction in fishing licences or endorsements? If the latter, how will effort be controlled in associated fisheries such as crabbing?

- What is the policy on compensation? The QCFO submission indicates that organisation still expects compensation to be offered. If a transparent, public compensation policy is not developed as a matter of urgency, history has shown that the government is likely to respond to political pressure from the fishing industry by offering compensation which is not based on economic principles. This could set an expensive precedent if GBRMPA wishes to negotiate additional trawl closures to protect the benthos.

The measures advocated by the QCFO are very unlikely reduce mesh netting by-catch to a level which will allow dugong numbers to recover. I do not believe that it is appropriate to allow lower standards for endangered species by-catch in a World Heritage Area than those which are applied routinely in all US waters (see attachment). In addition, the measures proposed by the QCFO are too complicated for effective implementation and enforcement.

Experience in the US suggests that bycatch problems are most effectively addressed in the overall context of fisheries management. If this is to be done in the GBRWHA, urgent action is required as management plans for the inshore mesh net fisheries and for the trawl fishery are in preparation.

Many of these issues, especially the issue of compensation, have also been raised by Indigenous peoples in anticipation of a reduction in the areas in which they are allowed to hunt. I am also concerned that Mission Bay next to Yarrabah has not been included in the list of proposed Dugong Protected Areas. Has that community been formally consulted about this?

My concern about these issues is based on my experience on the Great Barrier Reef Consultative Committee and the Board of the Queensland Fisheries Management Authority and my discussions with managers and conservation groups in the United States. I believe that if these issues are not addressed as a matter of urgency, that GBRMPA's relationship with the fishing industry, Indigenous peoples and the public at large will deteriorate.

I look forward to discussing these issues with you this afternoon.

Yours sincerely,

Helene Marsh

Helene Marsh

cc. Tony Stokes

17(p.3)

Attempts at minimising the bycatch of endangered species in commercial fishing operations in the United States: lessons for the Great Barrier Reef region.

Helene Marsh, CRC Reef Research and Department of Tropical Environment Studies and Geography, James Cook University, Townsville, Australia, 4811.

The current management arrangements in the Great Barrier Reef World Heritage Area (GBRWHA) have failed to prevent declines in the endangered megafauna. Declines have been documented for breeding female loggerhead turtles (Limpus and Reimer 1994; Heppel *et al.* 1996) and for dugongs (Marsh *et al.* 1996). There are indications of declines in nesting green and hawksbill turtles (Limpus *et al.* 1996). These declines are caused by multiple impacts both inside and outside the GBRWHA including habitat loss, bycatch in fishing operations and the Queensland Shark Protection Program, and directed catches. Directed catches include traditional hunting in the GBRWHA and the commercial harvest of green turtles in Indonesia. The relative importance of impacts is unquantified but varies spatially within the GBRWHA. The declines indicate the need for new management arrangements to protect the endangered megafauna in the GBRWHA.

Dugongs, dolphins and sea turtles are drowned in gillnets (Marsh *et al.* 1996) and sea turtles are drowned in trawls (Robins 1995). Although the development of Dugong Protection Areas should significantly reduce bycatch in the inshore mesh net fishery, I believe they are unlikely to reduce the overall mortality to levels which would be acceptable under United States legislation (see Attachment 1) and which are designed to promote recovery. Actions also need to be taken to reduce the turtle bycatch.

During my recent visit to the United States, I had the opportunity to talk with the following people about their experience with the attempts to minimise the bycatch of endangered species in commercial fishing operations:

- Dr Karen Bjorndahl, University of Florida, former Chair IUCN Sea Turtle Specialist Group and Member of US Academy of Science, National Research Council, Committee for Sea Turtle Conservation.
- Dr Deborah Crouse, Centre for Marine Conservation, Washington DC.
- Mr Mark Gosliener, Environmental lawyer, US Marine Mammal Commission.
- Ms Barbara Schroeder, National Sea Turtle Coordinator, National Marine Fisheries Service, Washington, DC.
- Mr Dean Swanson, Chief, International Fisheries Division, National Marine Fisheries Service, Washington, DC.
- Mr John Twiss, Executive Officer, US Marine Mammal Commission, Washington, DC.
- Ms Nina Young, Centre for Marine Conservation, Washington DC.

The attempts to control these impacts in the US date from the 1970s. They are marked by a

history of controversy, acrimony, delay and denial. I hope that we can achieve at least as much as they have in the United States, but much more quickly. I believe we can learn from their experience as outlined below.

The US situation is exacerbated by the way fishing is managed in that country. Fisheries are open access. For some fisheries (such as the shrimp fishery), the National Marine Fisheries Service does not even know how many vessels are operating. Further obscuring the picture is the patchwork of state fishery regulations and the proprietary nature of much of the information about fishing, landings and vessel operations is state waters. In addition, most fisheries legislation does not include ecosystem protection and ESD in its objectives.

Another complication is the size of the fleets. For example, in the commercial shrimp fishery in the Gulf of Mexico, an estimated 13,000 vessels and boats landed 249.5 million pounds (113,171 tonnes) of shrimp in 1990 valued at US $398.6 million (A$533 million) along a coast comparable is length to the east coast of Queensland. The offshore fleet which is most comparable to the Queensland fleet comprises 5,000 vessels. In comparisons, the latest figures for the Queensland east coast prawn fishery indicate that 823 otter trawls and 222 beam trawls land 5800-7200 tonnes of prawns valued at $A100 million each year (QFMA 1995).

The situation in the GBRWHA in the 1990s has several advantages over that in the US:

- A strong legislative basis for ecosystem management through Commonwealth and Queensland Marine Park legislation.
- A *Fisheries Act 1994* (Qld) with the primary objective of 'ensuring that fisheries resources are used in an ecologically sustainable way'.
- Limited entry fisheries.
- Compulsory log books provide data on who has been fishing, where they have fished and the effort since 1988.

This situation is certainly much more conducive to solving the endangered species bycatch problem than the situation in the United States, but we should take note of their experience.

I think the following are worth noting:

1. Because of the unmanaged status of many US fisheries, the endangered species bycatch problem has been addressed solely under the Endangered Species Act (US ESA) (turtles) or the Marine Mammal Protection Act (US MMPA) (marine mammals). This approach has several problems:

    - The only mechanisms available to solve the problem are changing gear or fishing practices. It is generally not possible to use ecosystem level measures such as spatial closures.
    - Fishers (justifiably) believe they are being singled out for attention as the ecosystem level impacts on endangered species are not being addressed.

Lesson 1

Address the bycatch problem in the overall context of ecosystem management with particular attention to other impacts on the endangered species.

2. Attempts to solve the bycatch problem have been independent of attempts to rationalise the fisheries. Thus the fishers see additional restrictions on their activities (resulting in higher operating costs) being imposed on them while the economic problems of the fishery are being neglected. The fishers then fight the increased restrictions as a perceived threat to their livelihood, while the real problem is that there are too many fishers.

   This is a major problem for the shrimp fishery. Shrimp are seen as an annual crop, so the sustainablity of the fishery is not in question and it is believed that the number of fishers should be rationalised by market forces. Turtle Excluder Devices (TEDS) have been used as a scapegoat for the economic problems of the fishery. This, of course, has been capitalised on by local politicians to polarise the situation.

3. Another effect of addressing the bycatch problem in isolation is that the only options for bargaining have been the fishery operations *per se*. Thus most of the negotiations over ways to solve the turtle bycatch problems in the shrimp fishery have been over details such as when and where TEDS are to be used, tow times etc. Inevitably, these negotiations over the turtle bycatch resulted in a watering down of the effectiveness of the management measures. Focus groups with the fishers have indicated that they would have liked to negotiate over incentives to comply with the rules. Economic incentives e.g. a substantially reduced licence fee for using a TED, were obviously not an option in an open entry fishery which was supposed to be managed by competition between fishers.

4. Another unfortunate by-product of this bargaining process was an increase in the complexity of the management rules. The fishers were inconsistent about this. The complexity arose at their request as a result of the bargaining process. Then the fishers complained that the rules were too complicated! The effectiveness of these complicated rules in reducing turtle bycatch was also questionable, especially given that several species of sea turtles, all with different biologies, were being caught.

Lesson 2

Address the bycatch problem in the overall context of fisheries management. (If this is to be done in the GBRWHA, urgent action is required as management plans for the inshore mesh net fisheries and for the trawl fishery are in preparation).

Lesson 3

Educate the staff of local politicians about the problem.

Lesson 4

Keep management actions as simple as possible despite pressures from fishers to complicate them as part of the bargaining process.

5. Much of the legislative responsibility for the bycatch problem rests with the National Marine Fisheries Service. This agency took a long while to take the problem seriously. The agency regarded the welfare of the fishing industry as its major responsibility and endangered species' bycatch issues as low priority. I suspect that greater attention was paid to marine mammal bycatch problems than sea turtle bycatch problems because the US MMPA has higher standards for incidental take than the US ESA:

   - The US ESA requires that the take not jeopardise a species survival or recovery.
   - The US MMPA requires that the level of incidental take be at insignificant levels approaching a zero value.

   Also the US MMPA has stringent reporting requirements. If the Marine Mammal Commission writes to a federal agency asking them to take an action, that agency is required by the US MMPA to explain in writing if they decide to ignore this request.

Lesson 5

The problem of incidental take of endangered species cannot be left to fisheries management agencies alone. At the very least, there should be a transparent reporting requirement to an agency with conservation responsibilities.

6. Social science research conducted relatively late in the sea turtle/TED saga indicates that there was a disproportionate effort spent on fine-tuning the technical information about the impact of incidental take on sea turtles and the benefits of using TEDS in the belief that more information would alter the position of the opponents of TEDS. Of course, this did not happen and the need for more technical information was used as a delaying tactic by opponents of TEDS. The research showed that scientists and managers (who tend to come from a science background) do not appreciate that information alone will not change attitudes. It is now recognised that much more effort should have been spent on education of the fishers and the development of incentives for them to comply. Scientists and fisheries managers assume that compliance can only be achieved by enforcement but the experience in the US shows that education and incentives are also very important and that compliance was higher among groups exposed to education programs than groups that were not.

Lesson 6

Do not concentrate on the technical aspects of the problem at the expense of the need for incentives and education. Educate not only the fishers but the fisheries managers and the enforcement officers as well.

7. In the early 1980s, the National Marine Fisheries Service promoted the voluntary use of TEDS with a target of 50% of fishers using TEDS by the end of 1986. This approach was supported by environmental groups. However, voluntary compliance failed and regulations has to be adopted from 1987. By this time, of course, the environmental groups were up in arms as the stocks of Kemp's ridleys, the sea turtles of most concern, had declined further.

Lesson 7
Industry self-regulation alone is unlikely to work.

8. As efforts to minimise the incidental take of marine mammals and reptiles in commercial fisheries in the US has concentrated on gear modifications and changes in fishing practices rather than changes in effort, compensation to fishers has not really been an issue. The exception is the net ban in Florida which was effected by a change to the Florida State Constitution in 1994. Concern about gillnetting first arose in 1989-90 as a result of netting being implicated as the cause of death of juvenile green turtles stranding in a local area in southeast Florida. There were several attempts at modifying fishing practices (soak times, net length, mesh size, night closures etc). Trammel nets were banned. The issue was then taken up by the recreational fishers who considered that gillnetting was competing with their activities. The recreational fishers succeeded in getting the issue on the 1994 state ballot. As a result, net fishing (not just gillnetting) was banned in the state waters of Florida. The fishers were compensated for the values of their nets via a buy back scheme. As the information on commercial fishers in Florida is poor, I understand that the compensation process was abused and that many claims were made based on nets which had not been used for years.

Lesson 8.
If compensation is going to be offered, it needs to be based on transparent criteria and logbook evidence of fishing effort.

9. There is anecdotal evidence (Dr S. Wright, Coordinator Florida manatee carcass salvage program 1997) that more manatees were caught (not drowned) in crab lines after the Florida net ban as fishing effort moved from netting to crabbing.

Lesson 9
If effort is reduced in one component of a fishery in which fishers have multiple endorsements, it is important to consider the impacts of a resultant increase in effort in other fisheries.

Recommendations

The GBRMP Act be modified to require:

- *that, within the GBRWHA, anthropogenic impacts on endangered and threatened species be reduced within a specified time frame to levels which*

will allow recovery of the stocks, and
that, in particular, the level of incidental take of endangered and threatened species be at insignificant levels approaching a zero value within that timeframe.

(These levels have been defined under the US MMPA see Attachment 1).

- *The Great Barrier Reef Ministerial Council require the relevant agencies to present an annual report on their progress in solving the endangered species bycatch problems in the GBRWHA.*

  Agencies could be required to develop a take reduction plan for the gill net fishery and the prawn fishery and to report progress on the implementation of this plan each year. A model for such reporting under the US MMPA has been developed (see Attachment 1) .

  If this approach were adopted, there would presumably have to be some funding to Queensland for this purpose.

It is important to view these recommendations in the context of the following question:

- **Should the standards for the bycatch of endangered species in the GBRWHA be less than those routinely applied in US waters?**

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17(p.9)

Attachment 1:

Significant changes to the US Marine Mammal Protection Act provisions concerning marine mammal-fishery interactions enacted in 1994

based on: Marine Mammal Commission, Annual Report to Congress 1994.

- Section 117 requires the preparation of marine mammal stock assessments to constitute the scientific basis for the new regime to govern the taking of marine mammals incidental to commercial fisheries.

- Section 118 sets forth the requirements of a new incidental take regime which focuses priority on reducing the incidental mortality and serious injury of marine mammals from strategic stocks. i.e. Those that are listed as endangered on threatened under the US ESA or declining and likely to be listed in the foreseeable future, those designated as depleted under the US MMPA, and those for which human rated mortality exceeds the estimated replacement yield.

Stock Assessments

Section 117 requires the Secretary of Commerce, in consultation with an appropriate scientific review group consisting of individuals with expertise in marine mammal biology and ecology, population dynamics and modelling, commercial fishing technology and practices, and stocks taken by Alaskan natives, to prepare a draft stock assessment for each marine mammal that occurs in waters subject to the jurisdiction of the US. These reports are to be made available for public comment leading to the development of a final stock assessment for each species. Each stock assessment has to:

- describe the geographic range of the stock;
- provide a minimum population estimate, the stock's current and maximum net productivity rates and current population trend including a description of the information on which these are based;
- estimate the annual human caused mortality and serious injury, by source, and for stocks determined to be strategic stocks, describe the factors that may be causing a decline or impeding recovery;
- describe the commercial fisheries that interact with the stock including an estimate of the number of vessels in each fishery, fishery specific estimates of mortality and serious injury, and an analysis of whether mortality levels are approaching a zero mortality and serious injury rate;
- assess whether the level of human-caused mortality and serious injury is not likely to cause the stock to be reduced below its optimum sustainable population or alternatively whether the stock should be categorised as a strategic stock; and
- estimate the potential biological removal level for the stock and describe the information used to calculate it.

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Stock assessments are to be reviewed at least annually for strategic stocks.

Potential Biological Removal (PBA)

The US MMPA defines PBA to mean:

- the maximum number of animals, not including natural mortalities, that may be removed from a marine mammals stock while allowing that stock to reach or maintain its optimum sustainable population. The potential biological removal level is the product of the following factors:
  - the minimum population estimate fo the stock (defined as the 20th percentile of a log-normal distribution based on an estimates of an estimate of the number of animals in that stock);
  - one half of the maximum theoretical or estimated net productivity rate of the stock r_{max} at small population size; the default values for r_{max} are 0.04 for cetaceans and manatees;
  - a recovery factor of between 0.1 and 1; (0.1 for endangered species including the manatee; 0.65 for threatened or depleted cetaceans).

An insignificant removal was defined as 10% of the potential biological removal.

Take Reduction Plan

- The US MMPA requires that a take reduction plan be developed for each strategic stock (including all those that are endangered, threatened or depleted). These plans are to include recommended regulatory or voluntary measures designed to reduce incidental mortality or serious injury and recommended dates for achieving specific objectives.
- The immediate goal of a take reduction plan for a strategic stock is to reduce within six months, incidental mortality and serious injury to levels less than the potential biological removal level in the stock assessment.
- The long-term goal of the take reduction plans is to reduce incidental mortality and serious injury to insignificant levels approaching zero rate within five years taking into account the economics of the fishery, existing technology, and applicable State or regional fishery management plans.

Applying the PBR concept to the GBR and Hervey Bay.

Stock	Latest population estimate	s.e.	CV	N_{min}	0.5 R_{max}	Recovery Factor	Potential Biological Removal
Northern GBR	8190	1172	0.143	8120	0.02[1]	0.65[2] 1.00[3]	105.3 162
Southern GBR	1682	236	0.140	1668	0.02	0.1[4]	3.3
Hervey Bay	807	151	0.187	795	0.02	0.1[4]	1.6

[1]default value for manatees in US (probably high for dugongs as manatees breed earlier and faster than dugongs).
[2]assuming stock is considered threatened
[3]assuming stock is classified as within its optimum population range
[4]stock meets IUCN criteria for critically endangered

These results indicate that virtually any anthropogenic mortality of dugongs in the Great Barrier Reef south of Dunk Island or Hervey Bay will exceed the potential biological removal level as defined in the US. The known net related mortality in the Southern GBR in 1996 (at least 15 dugongs, J. Slater pers comm.) is more than four times the PBR. The total PBR for the Great Barrier Region north of Cooktown (Indigenous take plus traditional harvest) is between 105 and 162 dugongs per year depending on whether the stock is classified as 'within its optimum range' or 'threatened'.

If the PBR approach is used to determine catch quotas for dugong in Australia, it will be important to ensure the accuracy of the population estimates, which at present are likely to be underestimates because the correction for dugongs which are invisible due to water turbidly is conservative. Improving the accuracy of these estimates (which were designed to detect trends rather than to calculate quotas) will be technically difficult and probably expensive.

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26 February 1997

Dr I McPhail
Chair
Great Barrier Reef Marine Park Authority
P O Box 1379
TOWNSVILLE QLD 4810

Dear Ian

Dugong Conservation Issues

I obtained additional figures on mesh netting effort from the QFMA database for a paper I am writing. I report the following statistics for 1994:

Area	No. of vessels	No. of netting days	Netting days/vessel
Cooktown to Cape York	20	1220	61
Southern boundary of GBRMP and Cooktown	338	10476	31
Shoalwater Bay	29	526	18
Hervey Bay - Great Sandy St (including east coast of Fraser Is)	97	3354	34.6

These figures indicate that, if more than 5% of vessels are displaced to Cape York from the region between Hervey Bay and Cooktown, the number of vessels operating in the Cape York region (where dugong densities are higher than in the southern GBR) would double.

I note that the Tropical Finfish MAC is concerned about displacement from the east coast mesh net fishery to the Gulf of Carpentaria fishery.

The fishers are also confused at the fact that many important dugong areas on the east coast of Queensland have not been declared interim Dugong Protection Areas. This inconsistency is anomalous in view of the areas which were closed to mesh netters in the Far Northern Section zoning in the 1980s to protect dugongs and should be rectified.

Please do not hesitate to contact me if you have further queries on these matters.

Yours sincerely
Helene Marsh
Helene Marsh

c.c. Tony Stokes

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A system of dugong sanctuaries for the recovery and conservation of dugong populations in the Great Barrier Reef World Heritage Area and adjacent southern waters

Report to

Great Barrier Reef Marine Park Authority

Tony Preen and Nina Morissette

Department of Tropical Environment Studies and Geography

James Cook University

7 February 1997

Executive Summary

- Dugong populations along the Queensland coast between Cooktown and the Sunshine Coast have collapsed by 50 to 90% in seven years to 1994. The implications for such a decline for a species with the life history traits of the dugong are very serious. Dugongs in this vast region are now Critically Endangered.
- The Dugong Review Group has committed itself to urgent action to ensure the recovery of these dugong populations. The Great Barrier Reef Ministerial Council has adopted proposals from the Dugong Working Group that include a system of dugong sanctuaries along the Queensland coast.
- It is apparent that the decline in dugong populations commenced well before the first quantitative aerial survey in 1986-7 that established a population baseline against which to monitor change.
- Recovery of the dugong populations will require the protection of all significant dugong habitats, not just those areas where dugongs were abundant in 1986-7.
- A variety of independent data that provide information on dugong distribution was assembled in an effort to identify those areas that should be included in the sanctuary system. Only the transect aerial surveys were essentially free of bias. The low survey intensity (approximately 10% coverage repeated three times since 1986-7), however, means that these surveys provide an incomplete picture of dugong distribution, at the scale required to determine the boundaries of sanctuaries. Fortunately, the additional data derived from other sources were in general agreement with the transect survey data, and the combination of all data sets provided the best available picture of dugong distribution.
- A review of this data suggested the modification of the boundaries of some of the interim sanctuaries, plus the addition of three new sanctuaries: near Gladstone, Bowen and Port Douglas.
- Nine sanctuaries are recommended for the Great Barrier Reef region between Cape Bedford and Bundaberg. These sanctuaries would contain approximately 99% of the dugong population (based on 1986-7 population estimates) and 79% of coastal seagrass meadows while enclosing only 34% of nearshore coastal waters (out to 3 nm). Thus, the vast majority of dugong habitat could be protected while leaving two-thirds of coastal waters available for gill net fishing and other activities incompatible with dugong conservation.
- A single sanctuary is recommended for southern Hervey Bay and the Great Sandy Strait. It would have contained 92% of the regional population in 1988, and 86% in 1994.
- The dugong sanctuaries in this system are separated by distances of 65-240 km (as the dugong swims), with an average separation of 132 km. Satellite tracking has demonstrated that dugongs regularly make hops of 40-50 km, often make movements of up to 100 km and occasionally travel distances of 200-500 km. Hence, the system of sanctuaries should allow for the exchange of dugongs and genes between populations.

Background

The decline in dugong populations in the southern Great Barrier Reef (GBR) was first detected in 1993, following a November 1992 aerial survey (Marsh et al., 1994). That survey repeated the original 1986-7 survey of coastal waters between Tin Can Bay and Cape Bedford which had established the first estimate of dugong populations in the southern and central GBR (Marsh and Saalfeld, 1990) and in Hervey Bay (Marsh et al., 1990). The extent of the dugong decline was confirmed after a third survey was conducted in November 1994. The number of dugongs in the southern and central GBR had declined by approximately 50% since 1986-7 (Marsh et al., 1996). Along much of the coast the decline exceeded 80%. A number of factors may be responsible for the decline, although there is strong evidence that incidental take in mesh nets is the most important factor (see below).

Dugongs in Hervey Bay and the Great Sandy Strait, which is immediately south of the Great Barrier Reef World Heritage Area (GBRWHA) have also declined. The population collapsed from approximately 2,200 in 1988 to approximately 600 in 1993, a decline of 73% (Preen and Marsh, 1995). Partially as a result of immigration, the population estimate had increased to 807 (+/-151) by November 1994 (Marsh et al., 1996). Unlike the decline in the GBR, the Hervey Bay decline was precipitous and followed two floods and a cyclone in 1992. Those events resulted in the near total loss of seagrass from Hervey Bay, followed by the death and emigration of emaciated dugongs (Preen et al., 1995; Preen and Marsh, 1995).

Using the latest World Conservation Union criteria (IUCN, 1995), dugongs in the GBRWHA south of Cooktown and dugongs in the Hervey Bay area are classified as Critically Endangered.

A meeting of the Great Barrier Reef Marine Park Authority's (GBRMPA) Dugong Review Group was convened in Townsville on 4 October 1996 to discuss the dugong decline. In opening the meeting Senator Hill requested the Group to "identify emergency measures designed to eliminate or at least substantially reduce, dugong mortality in the Great Barrier Reef area." (Hill, 1996). Subsequently, the Group committed itself "to the *recovery* and conservation of dugong populations over the entire Great Barrier Reef World Heritage Area and adjacent waters" and agreed that urgent and immediate action was required to *reverse* the recently detected declines (Dugong Review Group, 1996).

On 20 November 1996 the GBR Ministerial Council considered a package of emergency measures delivered by the Dugong Working Group (a group of government agency and ATSIC representatives extracted from the Dugong Review Group). Ministerial Council agreed to the

formation of a sanctuary system, the basis of which were nine interim Dugong Protection Areas in the region south of Cape Bedford, plus a possible two more off eastern Cape York (Ministerial Council, 1996). Details of permitted and prohibited activities in the dugong sanctuaries are to be negotiated by 28 February 1997. Significantly, however, Ministerial Council stated "that fishing practices that may result in dugong mortality will not be permitted in those areas".

As part of the process of refining the sanctuary proposals, the GBRMPA commissioned us to collate existing data on dugongs and seagrasses along the GBR coast and adjacent waters south of Cape Bedford; to assess the appropriateness of the proposed boundaries of the interim sanctuaries; and to consider the need for additional sanctuaries.

Data sources

Within the limited time frame, all available sources of data on dugong and seagrass distribution were accessed. These included the existing databases of dugong sightings made on transects during standardised aerial surveys conducted by Helene Marsh and associates at James Cook University and the existing seagrass distribution data based on Queensland Department of Primary Industries' (QDPI) surveys. While being an excellent resource, these data provide only a limited picture about dugong habitats because:

- only three dugong surveys have been conducted along most of the coast;
- survey transects are mostly 2.5 or 5 nm apart, and as the same transects are flown each survey, most habitat has never been viewed;
- the dugong surveys commenced in 1986 and there is evidence that the dugong decline commenced many years before then. Hence, the transect surveys do not necessarily indicate all of the most important dugong habitat, as some areas may have been depleted before the surveys commenced;
- the seagrass surveys are of low resolution and are biased towards shallow areas (except for the Hinchinbrook and Shoalwater Bay areas).

To supplement these data sets information from the following sources was also assembled:

Dugong carcasses: The dugong group at James Cook University has collected data on dead dugongs in the Townsville area since the early 1970s. Essential information from datasheets from 1981 to the present were computerised, although data sheets were missing for the periods August 1988 and September 1992, and July 1995 and January 1996. A substantial data set also exits for Hervey Bay. These data cover the period 1986 to present and were compiled from the records of the Queensland Boating and Fisheries Patrol and T. Preen. There are relatively few data available

from remainder of the coast, although the situation improved in 1996, when GBRMPA began collating Department of Environment (DoE) records. Further data were also available from the catches of dugongs in shark nets. Some 837 dugongs were caught in shark nets set in Queensland for bather protection between 1 November 1962 and 30 June 1991 (QDPI, 1992). Site specific data on dugong captures were extracted from Paterson (1979) and QDPI (1992).

Shoreline aerial surveys: George Heinsohn conducted some shoreline aerial surveys along the Queensland coast in the 1970's and some of the results had been collated by Peter Spencer (Spencer, 1989). In addition we conducted two shoreline surveys along most of the coast between Townsville and Rodd's Bay in December 1996. Two 1992 shoreline surveys of the Great Sandy Strait were also available (T.Preen, unpublished data).

Whale surveys: Hervey Bay has been surveyed for Humpback whales during a number of whale-watching seasons. From August through October 1991 the then Department of Environment and Heritage conducted 13 transect surveys of the eastern two-thirds of Hervey Bay. Observers also recorded dugong sightings and these data show the general distribution of dugongs in the bay the year before the seagrass die-off that affected the dugong population (see below).

Satellite tracking: Seventeen dugongs have been tracked by satellite in the southern and central GBR and Hervey Bay. The locations derived from these animals were plotted to provide information on habitat use by dugongs in Upstart Bay (one dugong), Shoalwater Bay (11 dugongs) and Hervey Bay/Great Sandy Strait (five dugongs). Shoalwater dugongs also travelled to Hervey Bay, Clairview and Hay Point.

Incidental sightings: Spencer (1989) compiled a list of incidental sightings of dugongs collected between 1973 and 1988. These sightings were comprised of Coastwatch records and sightings made by the general public and forwarded to James Cook University as part of its Marine Mammal Sighting Program coordinated by H. Marsh, G. Heinsohn and P. Arnold. We extended this data set by including incidental records collected by T. Preen as well as dugong sightings from Marine Parks surveillance flights. Specific requests were also made to DoE staff at Rockhampton, Mackay, Whitsundays, Townsville and Cairns for incidental records that may have been collected in those offices. Some members of the public with an interest in dugongs were also contacted in attempt to collect more incidental sightings.

Information from Indigenous groups: Recognising that there are very few data available for many areas of the coast, and that dugong hunters may have the best available information for some areas, indigenous groups in Gladstone, Mackay, Bowen and Mossman were contacted. Unfortunately, the

very short period available to collect dugong information, plus a justified suspicion in some cases that the information may be used to restrict hunting has been an impediment to the provision of Indigenous knowledge. Nevertheless, some very valuable data were provided. The recollections of hunters about those areas that used to be important for dugongs are particularly valuable as this data pre-dates any scientific data by 1-2 decades.

Most of the data listed above was georeferenced and entered into a GIS to produce maps that indicate the relative importance of different areas for dugongs. There are a number of qualifications that must be borne in mind when these maps are viewed. With the exception of the standardised transect aerial surveys, different data sets are not directly comparable. This is because they are all biased in different ways and they are all very incomplete. Incidental sightings may reflect where people tend to be most common, not just where dugongs are most common. The carcass data reflects this phenomenon as the majority of records come from within about 2 km of human settlements. Some areas have much more dugong information because of the research that has been conducted there. Hence, we know a lot about dugongs in Shoalwater Bay and Hervey Bay. Had similar research been conducted in other areas, data-dense maps may have been created for those areas also. Despite these qualifications, this assemblage of data from a diversity of sources provides a particularly useful summary of dugong habitats along the GBR and Hervey Bay coasts.

Some of these databases contain errors, not all of which have been corrected.

Recovery to what?

The aim of the sanctuary system is to facilitate the recovery of the dugong populations, particularly south of Cooktown. When addressing the issue of recovery it is important to realise that the 50-80% declines recently detected do not represent the full extent of the decline. The measured decline covers the period 1986-7 to 1994. All available evidence suggests that the decline started much earlier, and consequently, is much greater. In the region from Cape Bedford to Dunk Island (including Cairns), for example, the number of dugongs seen on the standardised aerial surveys has been so low that it has never been possible to calculate a population estimate (Marsh et al., 1994). Hence, no decline has been detected in this region. Bertram and Bertram's (1973) paper on dugong distribution, however, tells a different story. Under the title 'Cairns and Yarraba' they wrote:

> *'An enquiry in 1952/3 had apparently concluded that* [dugongs were] *abundant locally and not being depleted by the large numbers being taken at nearby Yarraba Settlement for Aborigines. At the time of our visit in 1956 some 200 were being taken by half a dozen fishermen from the settlement, one (Police Sergeant John Maloney, our informant) having*

taken 64 in a single year. A herd of 100 had recently been seen. There was thought to be as many as 40 years ago. There was a local anecdote of the "Bay being full of dugongs", but there was seemingly much variation from year to year, and in 1966 there were reported to be almost none. Shark nets at Cairns took 42 animals between 1964 and 1969, ranging from 4 ft 2 in. to 11 ft.' (Bertram and Bertram, 1973, p 313)

The greatest shark-net captures of dugongs at Cairns occurred between 1969 and 1974 (Paterson, 1979; QDPI, 1992). In this 5-year period 55 dugongs were caught. Subsequently very few dugongs were caught (QDPI, 1992).

It is clear that in the Cairns region dugongs were abundant in the mid- to late-1960's, but that by the mid-1980's when the first standardised aerial survey was conducted, they were very rare. Aboriginal Elders believe that dugongs have been in decline for the past 20 years *throughout the southern GBR* (Ross Williams, pers. comm.) suggesting that the situation in Cairns is more likely to be the norm, rather than the exception.

Comparing the density of dugongs off Cape York north of Cape Bedford, where dugong numbers have remained stable between 1985 and 1995 (Marsh and Corkeron, unpubl. data), with dugong density in the southern GBR may give some indication of the decline in dugong numbers that occurred in the southern GBR before the first aerial surveys. In 1985 the density of dugongs north of Cape Bedford was 0.26 dugongs/km^2 (Marsh and Saalfeld, 1989), while in 1986-7 in the GBR south of Cape Bedford it was only 0.09 dugongs/km^2 (Marsh and Saalfeld, 1990). There are no obvious topographic or geomorphological features that might suggest that either the northern or southern GBR is inherently better dugong habitat, and the abundance of dugongs in Hervey Bay (0.51 dugongs/km^2 in 1988; Preen and Marsh, 1995), south of the GBR suggests that latitude is not a significant determinant of dugong abundance over this region. The aim of dugong conservation measures should be to allow dugong stocks to reach or maintain their optimum sustainable population. The population levels measured during the 1986-7 survey should not be used as a recovery objective.

The need for a system of sanctuaries

The main direct threats to dugong populations, especially in the southern GBR, appear to be gill nets and hunting. Unless these issues are adequately addressed dugongs will go extinct locally along much of the Queensland coast (and throughout most of their world range).

In Hervey Bay, where there is very little hunting, gill netting is the main cause of dugong

mortality. Between September 1983 and September 1996, 57 dead dugongs were reported from the Great Sandy Strait and Hervey Bay (excluding the dugong deaths associated with the 1992-3 seagrass die-off [see Preen and Marsh, 1995]). Of these, 68.4% had physical signs that they had died in gill nets (eg. net marks or mutilations). In Hervey Bay alone, where 51 of the carcasses were reported, 66.6% were clearly gill net related, while 33.3% were due to unknown causes. In an effort to reduce dugong mortality, gill net regulations were changed in Hervey Bay in November 1988. Comparing the rate of gill net mortality in the 63 months prior to the change (the period for which data are available), with the rate of gill net mortality in the 57 months after the change (until most of the dugongs had left the area in 1993), it is apparent that the changed regulations decreased mortality by 53%. However, the rate of dugong deaths due to unknown causes also fell by a similar proportion (49%). This suggests that about half of the dugongs that die of unknown causes may in fact die in gill nets (pressure marks from nets last less than 24 hours post mortem). Using this assumption, the Hervey Bay data indicate that 88% of all dead dugongs that strand (an unknown proportion are gutted and sunk and do not strand) die as a result of gill nets. There is no reason to suggest that Hervey Bay is in anyway unique, so this figure is likely to be applicable throughout most of Queensland.

Helene Marsh has used the guidelines of the US Marine Mammal Protection Act to estimate the Potential Biological Removal for dugong populations in the southern GBR and Hervey Bay. The Potential Biological Removal is defined as the maximum number of animals, not including natural mortalities, that may be removed from a marine mammal stock while allowing that stock to reach or maintain its optimum sustainable population. The Potential Biological Removal from the southern GBR is estimated to be 3.3 dugongs/yr, while in Hervey Bay it is 1.6 (H. Marsh, unpubl. data). In the southern GBR in 1996, 35 dead dugongs were recorded, of which there is evidence that 16 died in gill nets. In Hervey Bay, at least one of seven dead dugongs died in a gill net (Preen, unpubl. data). Clearly the level of mortality in these critically endangered dugong populations must be reduced.

The Hervey Bay example demonstrates why the modification of fishing practices will not result in an adequate reduction in dugong mortality. Queensland Commercial Fishermans Organisation (QCFO) supported changes to attendance rules, net specifications and permitted hours of operation resulted in a reduction in gill net mortality (based on stranded carcasses) of only about 50% .

Shoalwater Bay demonstrates why a gill-netter's Code of Practice will not result in an adequate reduction in dugong mortality. Despite the presence of a Code of Practice that required that 'all nets are to be attended at all times, and that nets are not to be set in areas frequented by dugongs when dugongs are present' (letter from QCFO dated 27 July 1995) the size of the dugong

population fell by about 50% over eight years The continuing high rate of gillnet related dugong deaths forced the closure of most of Shoalwater Bay to netting in 1995.

In reality, the types of nets that are strong enough to catch barramundi, salmon and mackerel (the target species in most net fisheries from Hervey Bay north), are strong enough to catch and drown marine mammals such as dugongs and coastal dolphins. Most netting is conducted in areas used by these species. It is difficult to see how changes in attendance rules or setting patterns can achieve an adequate reduction to the level of dugong mortality.

While gill netting continues in dugong habitat, it is unlikely that voluntary moratoria on hunting will be embraced by most Indigenous hunters. Consequently, dugong recovery and conservation will best, and possibly only, be effected by establishing a network of sanctuaries where gill netting is banned and where hunting controls are incorporated into locally generated hunting management plans.

Sanctuary characteristics

To allow dugong populations to recover to their optimum sustainable level all significant dugong habitat, both past and present, should be protected in sanctuaries. Protection of only a subset of dugong habitats, like those that still contain substantial dugong numbers may prevent dugong extinction in the southern GBR, but it will not allow for recovery.

Dugongs are relatively mobile and utilise large home ranges. Six dugongs tracked in the Gulf of Carpentaria occupied partial home ranges (based on minimum convex polygon) of 61, 172, 215, 274, 416 and 1,938 km^2. Five dugongs tracked in northeast Queensland occupied an average home range of 79 km^2, while 13 dugongs in Moreton Bay used a mean home range of 85 km^2 (Preen, unpubl. data). Consequently, dugong sanctuaries must be relatively large if they are to be effective. If the sanctuaries are small, then most dugongs will move in and out of protected waters and the population could still decline rapidly. Furthermore, large protected areas can be more effectively policed as the boundary areas, where some illegal netting may continue, will be smaller relative to the area of the sanctuary.

The sanctuaries need to extend to the high water mark as much seagrass, often favoured seagrass, occurs in the inter-tidal region. The sanctuaries also need to extend into the mouths of estuarine streams. Satellite tracking in Shoalwater Bay (Preen, unpubl. data) and near Starcke (Marsh and Rathbun, 1990) has demonstrated that dugongs occasionally use these areas.

The dugong sanctuaries must form a network that facilitates the movement of dugongs between populations. Dani Tikel's DNA analysis of dugong populations suggests that interbreeding only occurs between neighboring populations, so the distance between populations must be small enough to allow for adequate mixing. The greater the distance between sanctuaries, the lower will be the exchange rate of dugongs between populations, and the greater the likelihood of eventual genetic isolation. Of the ten dugongs tracked in Shoalwater Bay, two moved some 460 km to Hervey Bay, one travelled about 200 km to Hay Point and then returned, and one travelled about 100 km to the Clairview area and returned. Six dugongs tagged in the western Gulf of Carpentaria made 10 non-stop movements of 30-50 km, two of 70-90 km and one of 374 km (Preen, unpubl. data).

Taking the above factors into account we have made a number of amendments to the boundaries of the interim sanctuaries and we have proposed an additional three sanctuaries south of Cooktown. In all we recommend a series of 10 sanctuaries between Cape Bedford and the Sunshine coast (Fig. 1). Figure 2 (A-I) shows the boundaries of the original interim sanctuaries and those recommended in this document. These figures also show the location of major seagrass meadows.

The nine sanctuaries that are within the Great Barrier Reef World Heritage Area would enclose most of the dugongs within the GBR south of Cape Bedford (Table 1). Some of the proportions of the population that may be contained within each sanctuary (Table 1) are over-estimates because the survey blocks used to estimate regional population sizes are often larger than the sanctuaries (most of the sightings, however, occurred within the sanctuaries).

Figure 3 shows the proportion of the dugong population (1986-7), between Cape Bedford and Bundaberg, that would have been contained in each sanctuary, relative to the proportion of the coast (nearshore coastal waters out to 3 nm, and the length of the mainland coastline) that would also occur within each sanctuary. Generally, the more coastal waters or mainland coastline occupied by the sanctuaries, the more dugongs that would also be protected. The system of nine GBR sanctuaries would enclose approximately 99% of the 1986-7 dugong population and 82% of the 1994 estimated population (Table 1). They would also enclose 79% of coastal seagrasses. This level of population protection would require 34% of nearshore coastal waters and 44% of the mainland coastline to be within dugong sanctuaries. This arrangement would leave two-thirds of coastal waters available for gill net fishing and other activities incompatible with dugong conservation.

The ten sanctuaries, which range in size from 193 km^2 to 1268 km^2, are separated by distances of 65 km to 240 km (average = 132 km; Table 1), which should ensure adequate interchange of dugongs between populations.

The proposed network of dugong sanctuaries

The compilation of all dugong records (Fig. 4A, B) demonstrates the clustering of most sightings in a limited number of areas. These clusters, when interpreted in terms of historic and recent changes in dugong abundance, form the natural units of the sanctuary network.

Hervey Bay/Great Sandy Strait sanctuary

Prior to the seagrass die-off of 1992, Hervey Bay contained approximately 24% of the known area of seagrass along Queensland's eastern coast (Preen et al., 1995) and Hervey Bay and the Great Sandy Strait supported the largest dugong population surviving south of the Starcke region of Cape York Peninsula (Preen and Marsh, 1995). Following the seagrass die-off, the dugong population decreased by 73% (see Background, above).

A dugong fishery had been conducted in the south-western corner of Hervey Bay until 1965, when dugongs were protected. Department of Harbours and Marine Annual Reports (cited in Marsh, 1984) show 240 dugongs were taken in 1941 and 1942, although annual takes of 30-60 were more common. Earlier dugong fisheries had been conducted in the Great Sandy Strait, where local depletions of dugongs forced the regular movement of operations.

Standardised and shoreline aerial surveys have established the southern half of Hervey Bay and the southern half of The Great Sandy Strait as the most important areas of dugong habitat (Preen and Marsh, 1995; Fig. 5A). Dugong sightings from multiple whale surveys of the eastern two thirds of Hervey Bay suggest that while dugongs occurred throughout the full extent of the bay, they were most abundant in the southern half (Fig. 5A). The locations received from satellite tracked dugongs that were tagged at the north of the Great Sandy Strait demonstrated the use of that region as well (Fig. 5A). At the time of that tracking (1992-3) there was no seagrass and virtually no dugongs in Hervey Bay. The locations received from two dugongs that were tagged in Shoalwater Bay in 1996 and that travelled to Hervey Bay showed that dugongs were again using their favoured areas in the south-west of Hervey Bay (Fig. 5A). The dugong carcass data further reinforces the importance of southern Hervey Bay, as the majority of carcasses for the region come from this region (Fig. 5A).

The interim sanctuaries of Hervey Bay and the Great Sandy Strait are physically contiguous and constitute a single dugong habitat. Hence, they have been amalgamated into a single sanctuary (Fig. 2A). The appropriate management of this sanctuary will ensure the eventual recovery of this important dugong population.

Rodd's Bay/Gladstone sanctuary

Dugongs were once abundant in this area. An early report describes herds of dugongs in Rodd's Bay in 'almost incredible numbers' (Brisbane Courier, 1869 cited in Marsh, 1984) . By the 1970's, shoreline aerial surveys indicated that dugongs were common, but not abundant, in the area (Heinsohn, 1975; Heinsohn and Marsh, 1980). Between 1986-7 and 1994 the regional population fell by 65% (from 301 +/-95 to 104 +/-56), based on the results of the transect aerial surveys (Marsh et al., 1996). Carcass data suggests that this decline was buffered, to some extent by immigration of dugongs from Hervey Bay, following the loss of seagrass there in 1992.

A pilot who flew one of us (TP) for work in Shoalwater Bay described how he used to practice his aerial mustering skills on the dugongs in Rodd's Bay. He said that groups of dugong in shallow water responded to the plane in the same way that cattle do, but there were no trees or hills to dodge. He added that the dugongs seem to be gone from that area now (Greg Clark, pers. comm.).

Figure 5B indicates that dugongs are most frequently seen in two areas in this region: from the southern end of The Narrows through to the southern end of Facing Island (including the Gladstone shoreline) and Rodd's Bay. Local Aborigines are concerned that the reclamation of dugong feeding areas at Gladstone is jeopardising the declining dugong population (Wally Ingra, pers. comm.).

The dugong habitat of the Rodd's Bay/Gladstone area stands mid-way between the important dugong populations at Shoalwater Bay and Hervey Bay. As those areas are approximately 400 km apart, the Rodd's Bay/Gladstone sanctuary will be important in maintaining the interchange of dugongs between central and south-east Queensland. This sanctuary would support approximately 8.7% of dugongs in the GBR south of Cape Bedford, based on 1986-7 population estimates (Table 1).

Shoalwater Bay/Port Clinton sanctuary

Shoalwater Bay/Port Clinton supports the largest dugong population between Hinchinbrook and Hervey Bay/Great Sandy Strait (Marsh et al., 1996). Both the seagrasses communities of the area (Lee Long et al., 1996) and the dugong population (Preen, unpublished data) are particularly well known as a result of recent research. The results of the satellite tracking of ten dugongs (Fig. 5C) provides the best information on habitat use in the area. The dugongs did not differentiate between Port Clinton and Shoalwater Bay as they moved freely between the two areas. Dugongs moved throughout the bay, although it became apparent that there are a number of preferred areas where dugongs tend to spend most of their time. Some of these results would not have been predicted

from the seagrass data, demonstrating the need to be cautious in deducing information about dugong distribution and habitat use from seagrass maps.

Four of the dugongs made trips out of the bay. Two travelled to Hervey Bay, to the proposed Hervey Bay sanctuary. One travelled to Hay Point (near Mackay) and Cape Palmerston, in the proposed Cape Palmerston sanctuary. Another travelled to near Clairview, also in the proposed Cape Palmerston sanctuary. These movements provide useful information on the scale of movements that dugongs undertake and the appropriate locations of other sanctuaries.

The current boundaries of the Shoalwater sanctuary are appropriate except for a need to amalgamate it with the Port Clinton interim sanctuary by including a swimway around the top of the Peninsula Range (Fig. 2C). This sanctuary would contain approximately 22% of dugongs in the GBR south of Cape Bedford, based on the 1986-7 estimates (Table 1).

Cape Palmerston sanctuary

There has been a particularly rapid decline in dugong numbers in Ince Bay aerial survey block (area south of Hay Point and including Sarina Inlet, Llewellyn Bay, Ince Bay, all waters to Clairview, Broad Sound and north and east of Stanage Bay). The number of dugongs in this area has collapsed from 542 (+/-293) in 1987 to 82 (+/-60) in 1994: a decline of 85% (Marsh et al., 1996). This decline may be due to a combination of netting and hunting. There has been a recent spate of gill-net deaths in the Cape Palmerston-Sarina Beach area, and Indigenous groups hunt out of Clairview and Sarina Beach.

Although the aerial survey data indicate that dugongs are now rare in this area, the facts that significant numbers are still caught in nets, and that hunting continues, suggests that a meaningful number of dugongs still survive there. In the absence of active management, however, it is unlikely that dugongs, other than those visiting from Shoalwater Bay, will continue in the area.

The aerial survey, carcass, incidental and tracking data indicate that there are two coastal areas where dugongs tend to occur in this region (Fig. 5D). They are between Sarina Beach and Cape Palmerston (including Sarina Inlet, Llewellyn Bay and Ince Bay) and between West Hill Island and Clairview Creek. The interim Ince Bay sanctuary does not encapsulate most of the important dugong habitat in the region and, as initially draw, is too small, relative to the scale of dugong movements, to be of any practical conservation value. Consequently, we have substantially extended the interim sanctuary and suggest that it be referred to as the Cape Palmerston sanctuary.

Newry/Repulse Bay sanctuary

Dugongs were abundant enough in this region to support two dugong fisheries; one at Newry Island, which operated until the 1920s (Mackay Daily Mercury, 10 August 1983, cited in Marsh, 1984) and one at Repulse Bay (Saville-Kent, 1900). Dugong populations in these two areas have suffered dramatic declines in recent years. In the Newry area dugong numbers have been reduced by about 84% between 1986 and 1994 (240+/-104 to 38+/-37; Marsh et al., 1996). In nearby Repulse Bay it appears that the decline in dugong numbers may have occurred well before the start of systematic aerial surveys. A the time of the first aerial survey in 1986-7, the population estimate for the whole area was only 31 (+/-35). During 1992 the estimate was 70 (+/-59), but in 1994 no dugongs were seen (Marsh et al., 1996).

Although there are now very few dugongs surviving in the Newry/Repulse Bay area, it is likely that the population could recover if it was afforded adequate protection. We propose that the interim Newry sanctuary should be extended to include Sand Bay to the south and Repulse Bay to the north. The available data (Fig. 5E) indicates that most dugong records occur in the vicinity of the Newry Islands and in the north of Repulse Bay. It is also known that hunting is conducted out of Midge Point (southwest corner of Repulse Bay) indicating the continued presence of dugongs in this area. The Newry/Repulse sanctuary would encompass approximately 21% of the 1986-7 population estimate of dugongs between Cape Bedford and Bundaberg (Table 1).

Edgecumbe Bay sanctuary

The number of dugongs in Edgecumbe Bay has fallen by 88% between 1986 and 1994; from 173 (+/-77) to 20 (+/-17) in 1994 (Marsh et al., 1996). These figures are in agreement with peoples' recollections. John Locke recalls regularly seeing herds of 15-20 dugongs off the northern edge of Bowen when he was a youth, 20 years ago (John Locke, pers. comm.). Another informant saw a herd of 30 dugongs in Sinclair Bay, in the south-east of Edgecumbe Bay in about 1985 and a herd of 10-12 in the same area as late as 1995 (Dorothy Paul, pers. comm.). Today there are few dugong in the Bay although there are regular sightings made by Aborigines hunting turtle in the southern half of the Bay (John Locke, pers. comm.). There has been very little hunting of dugong in the area since the early 1950s and the Girradalla Council of Elders has recently imposed a moratorium on dugong hunting in the area to ensure no dugong are taken (John Locke, pers. comm.).

The location of a sanctuary at Edgecumbe Bay should facilitate the recovery of this dugong population. The available data (Fig. 5F) indicates that all of Edgecumbe Bay should be included.

The recovery of dugong populations at Repulse Bay and Edgecumbe Bay should eventually result in an increase in the number of dugongs residing around the Whitsunday Islands. Edgecumbe Bay contained 5% of the southern GBR dugongs in 1986-7 (Table 1).

Upstart Bay sanctuary

The transect aerial surveys indicate that the number of dugongs in Upstart Bay has declined by some 89% between 1987 and 1994 (171+/-87 to 19+/-19; Marsh et al., 1996). Despite this, a herd of up to 30 dugongs was seen there by Artie Jackobson as recently as 1993 (John Locke, pers. comm.). The movements of a dugong tagged in Cleveland Bay, which spent most of its time in Upstart Bay (Fig. 5G; Marsh and Rathbun, 1990), demonstrated a link between the dugongs in these two areas.

The western shore of Cape Upstart is lined with an estimated 100 huts and houses. These appear to be within the boundary of the Cape Upstart National Park . The only access to these houses is by boat and it appears that they are used primarily as fishing retreats by people from the Burdekin delta. Illegal gill netting may be a potential management problem in this sanctuary. Five percent of the 1986-7 dugong population of the southern GBR was located in Upstart Bay (Table 1).

Cleveland Bay/Bowling Green Bay sanctuary

The shark net data alone demonstrates the importance of the Cleveland Bay region as a dugong habitat. At least 289 dugongs have been caught in shark nets set at Townsville and Magnetic Island (Fig. 5G). This figure far eclipses the capture rates of shark nets in other areas (Paterson, 1979; QDPI, 1992). The number of stranded dugong carcasses recorded in the Townsville area (Fig. 5G) also demonstrates the apparent abundance of dugongs in this area. It must be noted, however, that the abundance of dugong carcasses in the Townsville area, relative to other areas, is due substantially to the active recording of this data by James Cook University researchers since the early 1970s.

A recent shoreline survey (December 1996), which inspected most of the coast and all of the interim sanctuaries between Townsville and Rodd's Bay highlighted the current importance of Bowling Green Bay as dugong habitat. Thirty-one dugongs were seen in Bowling Green Bay. This compares with just 32 dugongs seen in all other areas combined (excluding Shoalwater Bay/Port Clinton).

The proximity of Cleveland Bay and Bowling Green Bay argues strongly for the expansion of the

Cleveland sanctuary to include Bowling Green Bay. It is also suggested, primarily on the basis of carcass data, that the western boundary of this sanctuary should be extended to the mouth of Bluewater Creek (Fig. 2G).

The population of dugongs in the Cleveland/Bowling Green region has fared better than most, decreasing by 52% between 1987 and 1994 (down from 496 +/-151 to 237 +/-48; Marsh et al., 1996). This sanctuary would contain approximately 14.2% of the 1987 estimated dugong population of the GBR south of Cape Bedford (Table 1).

Hinchinbrook sanctuary

The transect surveys indicate that the Missionary Bay/Goold Island area at the northern edge of Hinchinbrook Island is the most important dugong habitat in this region (Fig. 5H). Incidental sightings and carcass records show that the Cardwell coast, the Lucinda coast, and the east coast of Hinchinbrook Island are also used by dugongs. It is suggested, therefore, that the boundary of the Hinchinbrook sanctuary should be amended to include the Cardwell coast to north of Meunga Creek, and the Island's east coast (Fig. 2H).

The population estimate for the Hinchinbrook region actually increased between 1987 and 1994: up from 284 (+/-131) to 484 (+/-170; Marsh et al., 1996). This increase must be due, in part, to movement of dugong into this area. The Hinchinbrook sanctuary contained approximately 29% of all dugongs between Cape Bedford and Bundaberg in 1994, but just 8.2% in 1986-7 (Table 1).

Low Isles sanctuary

No population estimates exist for the region between Dunk Island and Cape Bedford, indicating the relative rarity of dugongs in this large region, at least since the mid-1980s. The relatively high number of dugongs caught in shark nets set at Cairns (92; Fig. 5I), together with the information published by Bertram and Bertram (1973), however, demonstrate that dugongs were abundant in the Cairns region in the mid-1960s (see above). The establishment of a dugong sanctuary in this region should encourage the recovery of this dugong population. It will be important that a sanctuary is established in this region if genetic continuity is to be maintained between the important dugong populations at Hinchinbrook and Starcke, 500 km to the north.

Based on the historical information and some undocumented anecdotal records, it would seem apparent that the Yarrabah area would be the strongest candidate for a sanctuary. At present, however, hunting pressure may prevent the recovery of dugongs here. An alternative area, off

Mossman, appears to be a very viable alternative. Transect surveys and Marine Parks surveillance flights have identified dugongs on Batt and Tongue Reefs (Fig. 5I), supporting strong Aboriginal belief that these reefs are an important nursery area for dugongs (Buddy Swindley, pers. comm.). In addition there are many recent and old records of dugong groups along the adjacent mainland coast. These records come from local Aborigines and from Port Douglas-based ultra-lite and parasailing operators that maintain a log of sightings. These data establish that dugongs are commonly seen in the area between White Cliffs and Rocky Point (Fig. 5I). These data may over-represent the number of the dugongs in the area, as some of the records come from similar locations on consecutive days, suggesting possible recounts of the same animals. Despite this qualification, records of herds of 27 and 19 dugongs (possibly the same herd) just west of Port Douglas in 1994 and 20 dugongs at Agincourt Reef in 1996 demonstrate that significant numbers occur in this area at times.

It is suggested that the Low Isles sanctuary should extend along the mainland coast between Dayman (Rocky) Point and White Cliffs and out around Batt and Tongue Reefs (Fig. 2I). The Kuku Yalanji Marine Resource Management Committee has, since 1994, imposed a moratorium on dugong hunting in this area. Pending agreement by local stakeholders it would be desirable to extend the dugong sanctuary to include the waters from False Cape around Yarrabah and south to the mouth of the Russell River.

Dugong populations north of Cape Bedford

Dugongs on the east side of Cape York Peninsula have not shown the widespread decline that was detected south of Cape Bedford (Marsh and Corkeron, unpubl. data). Two of the interim sanctuaries covered Bathurst and Princess Charlotte Bays in this region. A close analysis of the data should be undertaken before deciding on sanctuary boundaries. There are some very important dugong areas that should be included in any sanctuary system. The Starcke coast, between Lookout Point and Cape Melville is particularly significant. Although some of this area already has high conservation zoning, there are some anomalies. The inshore waters, from low water mark out 100 m is apparently zoned to allow gill netting. Other important areas are Port Stewart to Colmer Point, Cape Sidmouth, Temple Bay, Shelburne Bay, and possibly Lloyd Bay. Management of sanctuaries in this region would, to a large extent, need to be instigated by the local Aborigine groups.

When considering planning for dugong conservation in Cape York Peninsula, the western coast should not be ignored. This area has never been surveyed, but anecdotal information on the incidence of gill net take and hunting suggests that the dugong populations in this region could be

in severe decline. In the absence of a base-line population estimate, however, it may never be possible to establish this.

Acknowledgements

Thanks to QDPI and Helene Marsh for allowing access to unpublished seagrass and dugong survey databases. Many people helped with the provision of unpublished data for this report, often at very short notice. DoE officers Grahame Byron (Rockhampton), Rob Buck (Mackay), Meredith Hall (Whitsundays), Mark Burnham (Ingham) and Linda Craig (Cairns) made particular efforts to collect and record dugong sightings in their regions in recent years. Ian Sutton (WPSQ, Whitsundays) and Dorothy Paul (resident Sinclair Bay) did the same. Ben Cropp and the operator of the parasailing business at Port Douglas provided many sightings through the Cairns DoE office. John Locke, from the Bowen Council of Elders, Buddy Swindley from the Kuku Yalanji Marine Resources Committee at Mossman and Wally Ingra from the Local Aborigines Employment Promotion Committee at Gladstone collected and provided information from Aborigines in their regions. Ross Williams, GBRMPA, provided some useful records and provided contacts to Indigenous community groups. Jeff Sherrin transfered numerous data from GBRMPA's GIS. Janet Slater extracted the Marine Parks observations of dugongs from that GIS. Thanks to Clive Grant for his expertise with computers.

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Table 1
Details of proposed dugong sanctuaries south of Cape Bedford.
Percentages calculated for southern Great Barrier Reef (Cape Bedford to Bundaberg) only.
Coastal waters are arbitarily defined as being within 3 nm of the shore.
Coastline is measured along the mainland coast.

Sanctuary	% of southern GBR population estimate 1986-7	1994	Distance (km) to next sanctuary to north	Area (km2)	% coastal waters in sanctuary	% coastline in sanctuary	% coastal seagrass in sanctuary
Hervey Bay/GSS			180	1903	70.4		68.5
Gladstone/Rodd's Bay	8.7	6.2	190	510	3.5	4.3	3.6
Shoalwater Bay	22.0	24.1	100	1080	5.5	10.4	21.4
Cape Palmerston	15.6	4.9	75	800	5.6	5.4	6.7
Newry/Repulse	20.7	2.3	100	752	5.2	7.3	2.1
Edgecombe	5.0	1.2	80	412	2.5	2.4	2.4
Upstart	4.9	1.1	65	193	1.5	3.3	3.5
Cleveland/Boling Greer	14.3	14.1	80	1168	6.3	5.2	20.9
Hinchinbrook	8.2	28.8	240	815	3.0	4.8	18.6
Low Iles	0	0	210	1268	1.5	1.0	0.0
Total	**99.3**	**82.6**			**34.5**	**43.9**	**79.2**

18(12.4)

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C. Shoalwater Bay/Port Clinton

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E. Newry/Repulse Bay

F. Edgecumbe Bay and Upstart Bay

G. Cleveland Bay/Bowling Green Bay

H. Hinchinbrook

I. Low Iles

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C. Shoalwater Bay/Port Clinton

D. Cape Palmerston (Ince Bay)

E. Newry/Repulse Bay

F. Edgecumbe Bay

G. Upstart Bay and Cleveland Bay/Bowling Green Bay

H. Hinchinbrook

I. Low Iles

18 (p.23)

Figure 1: Location of the 10 Dugong Sanctuaries proposed for the southern Great Barrier Reef and Hervey Bay

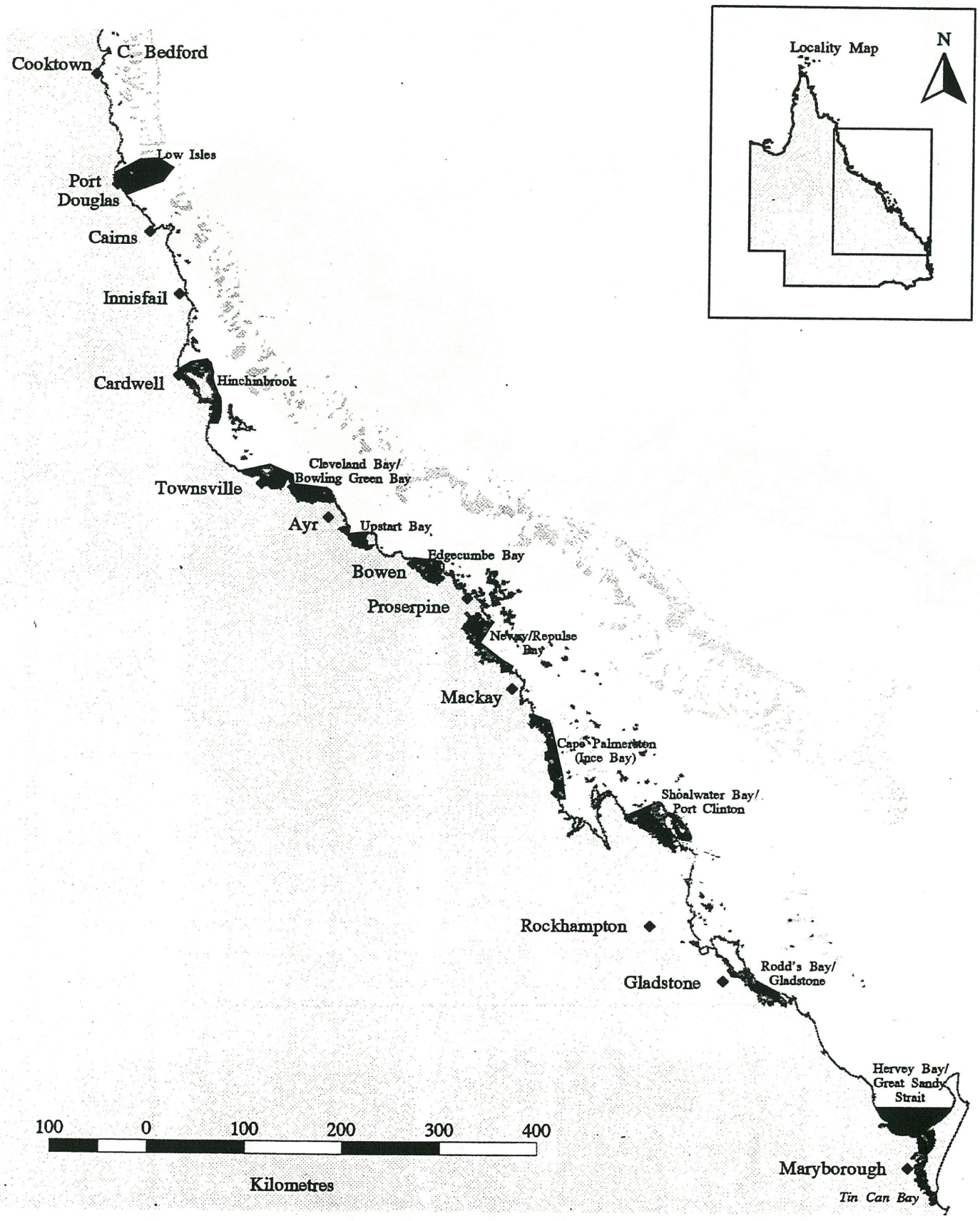

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Figure 2A: Original and amended boundaries of the dugong sanctuaries: Hervey Bay

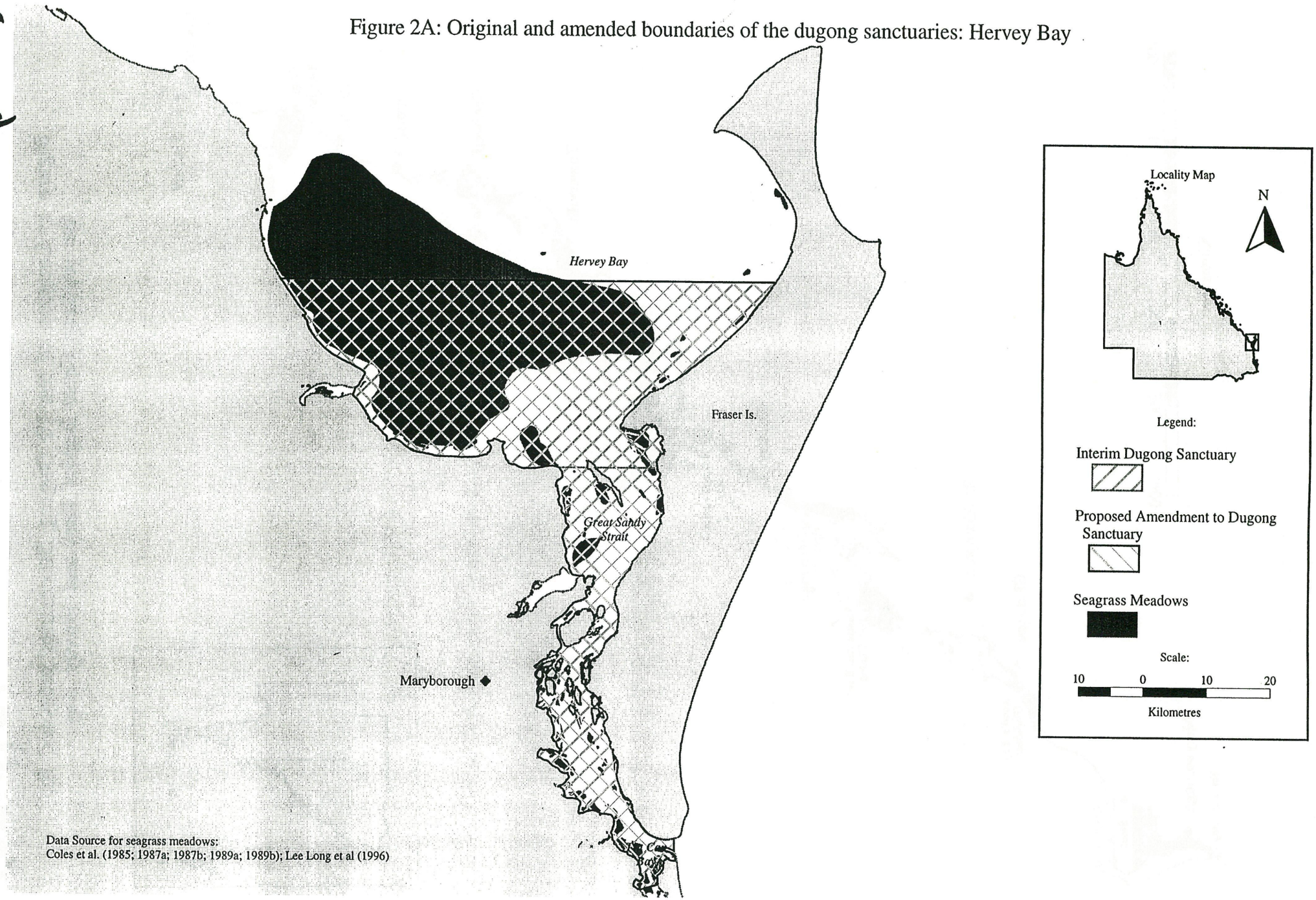

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Figure 2B: Original and amended boundaries of the dugong sanctuaries: Rodd's Bay/Gladstone

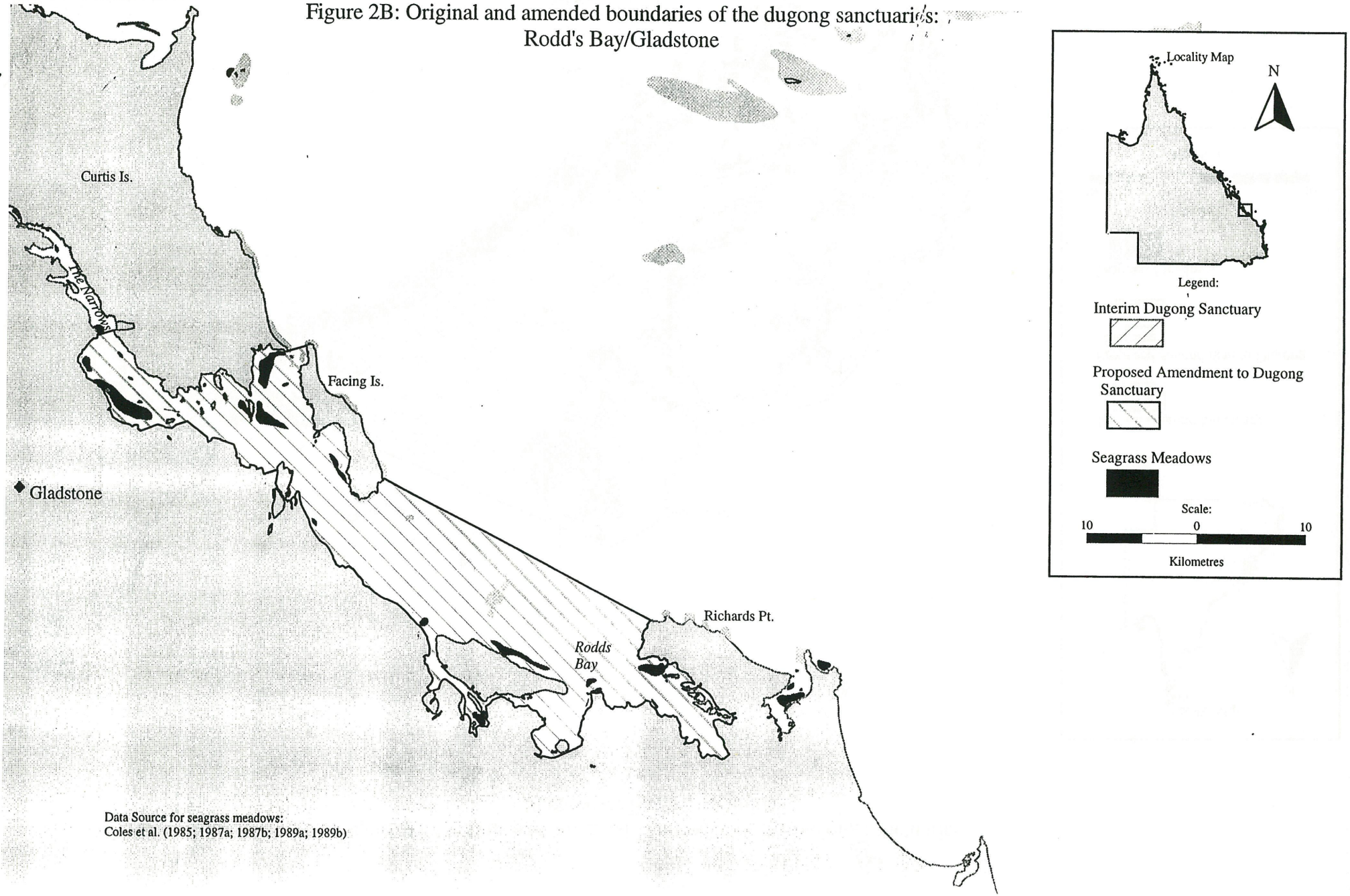

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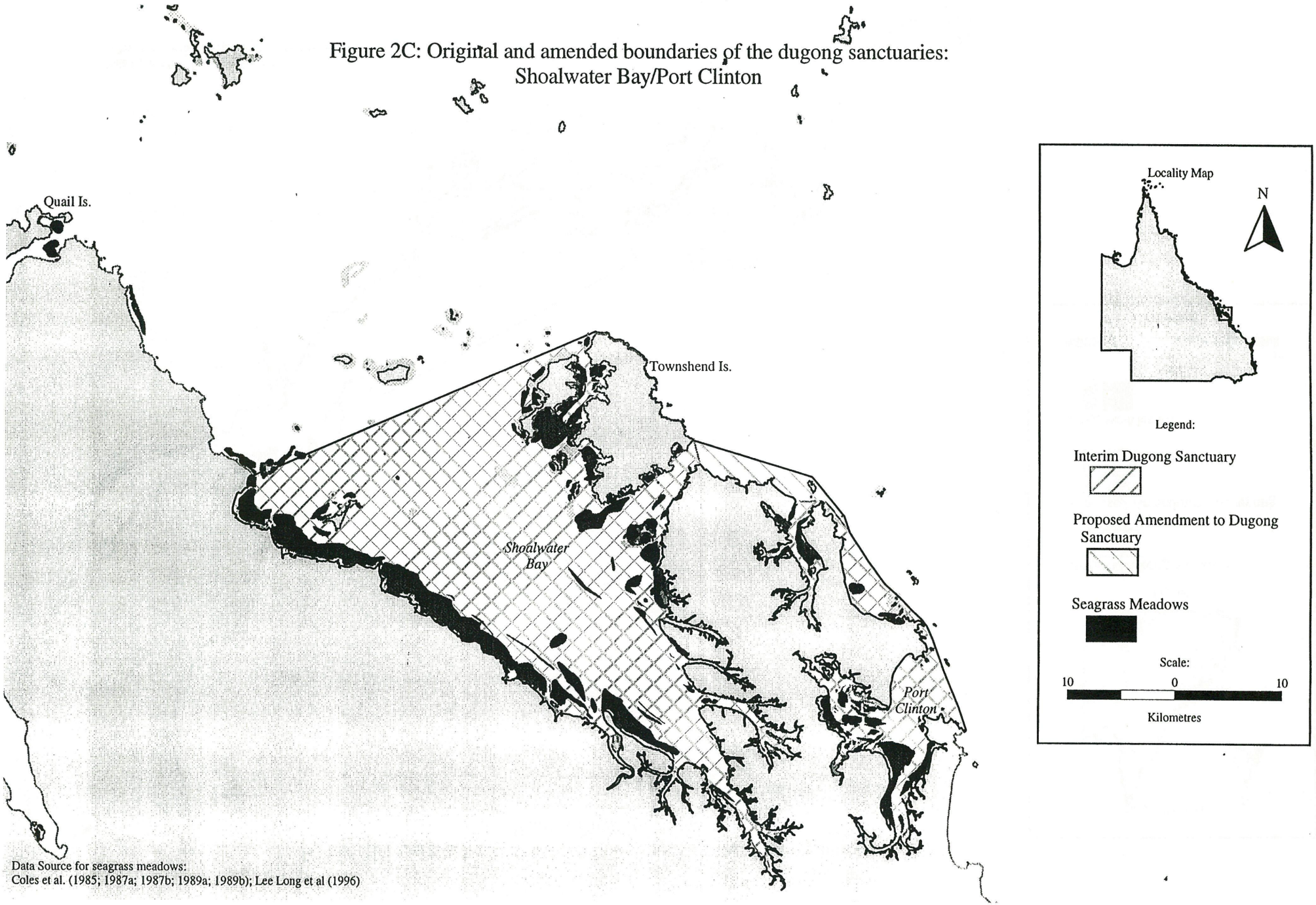
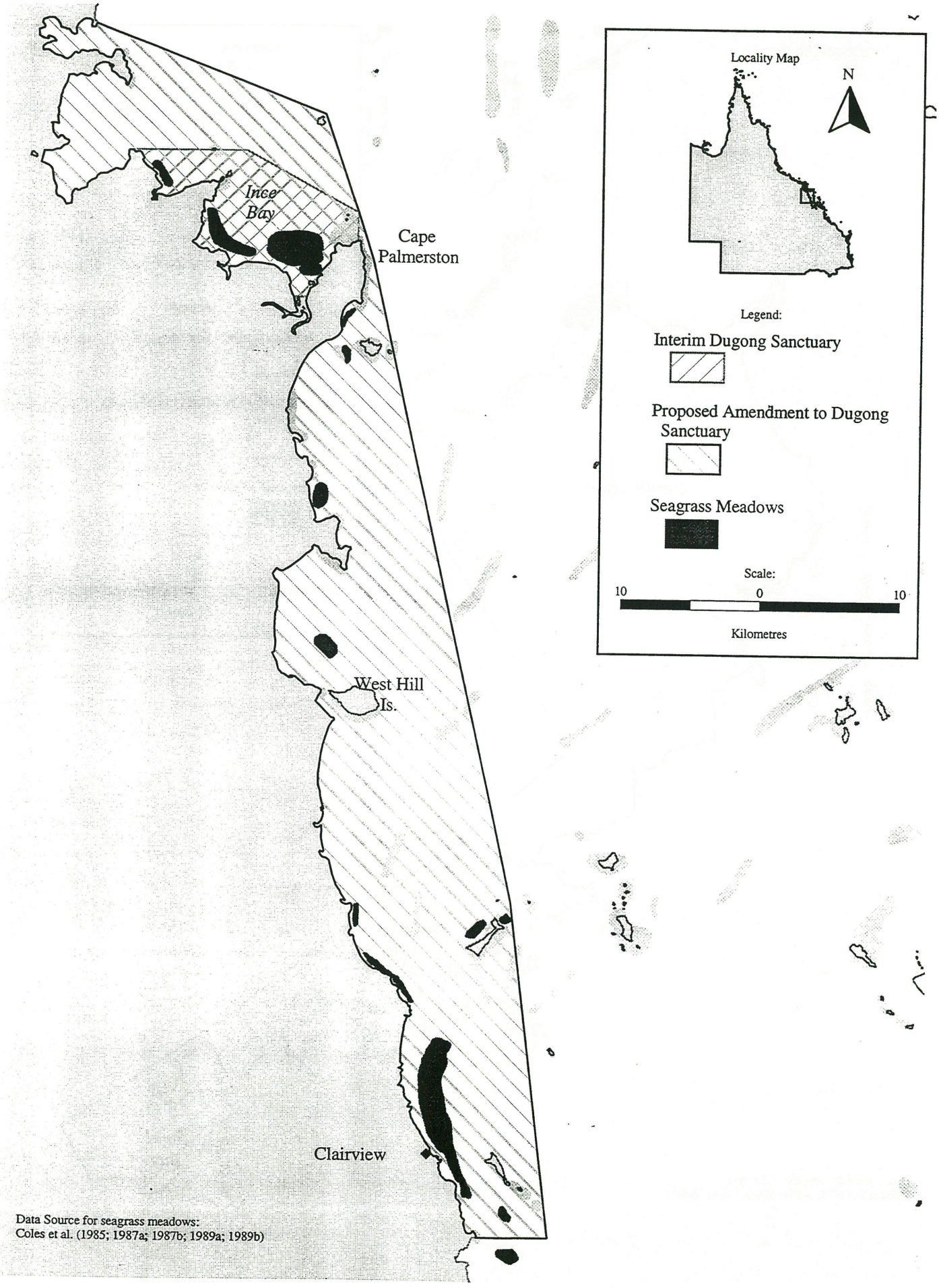
Figure 2C: Original and amended boundaries of the dugong sanctuaries: Shoalwater Bay/Port Clinton



Data Source for seagrass meadows:
Coles et al. (1985; 1987a; 1987b; 1989a; 1989b); Lee Long et al (1996)

Figure 2D: Original and amended boundaries of the dugong sanctuaries:
Cape Palmerston (Ince Bay)



Data Source for seagrass meadows:
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Figure 2E: Original and amended boundaries of the dugong sanctuaries: Newry/Repulse Bay

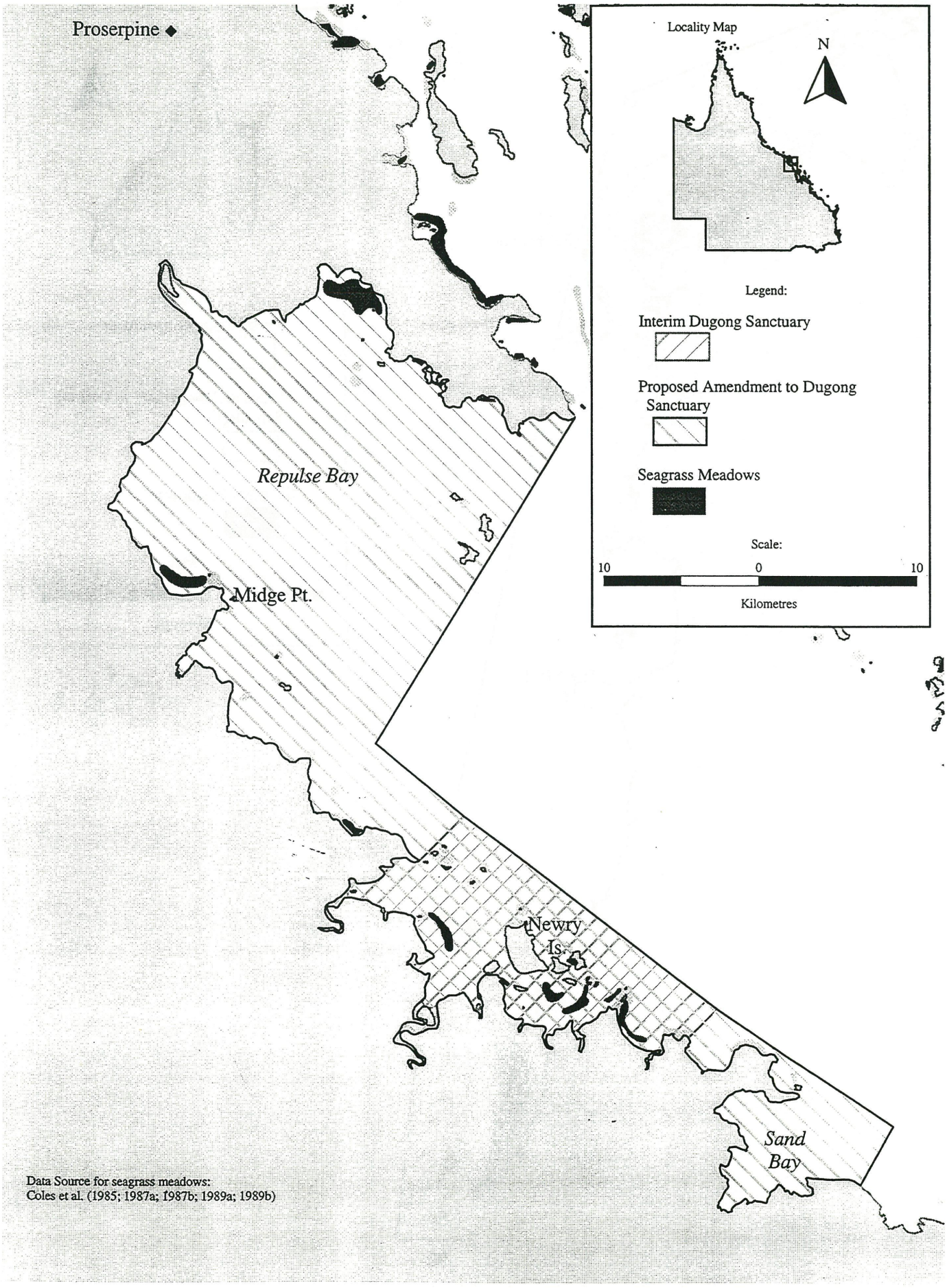

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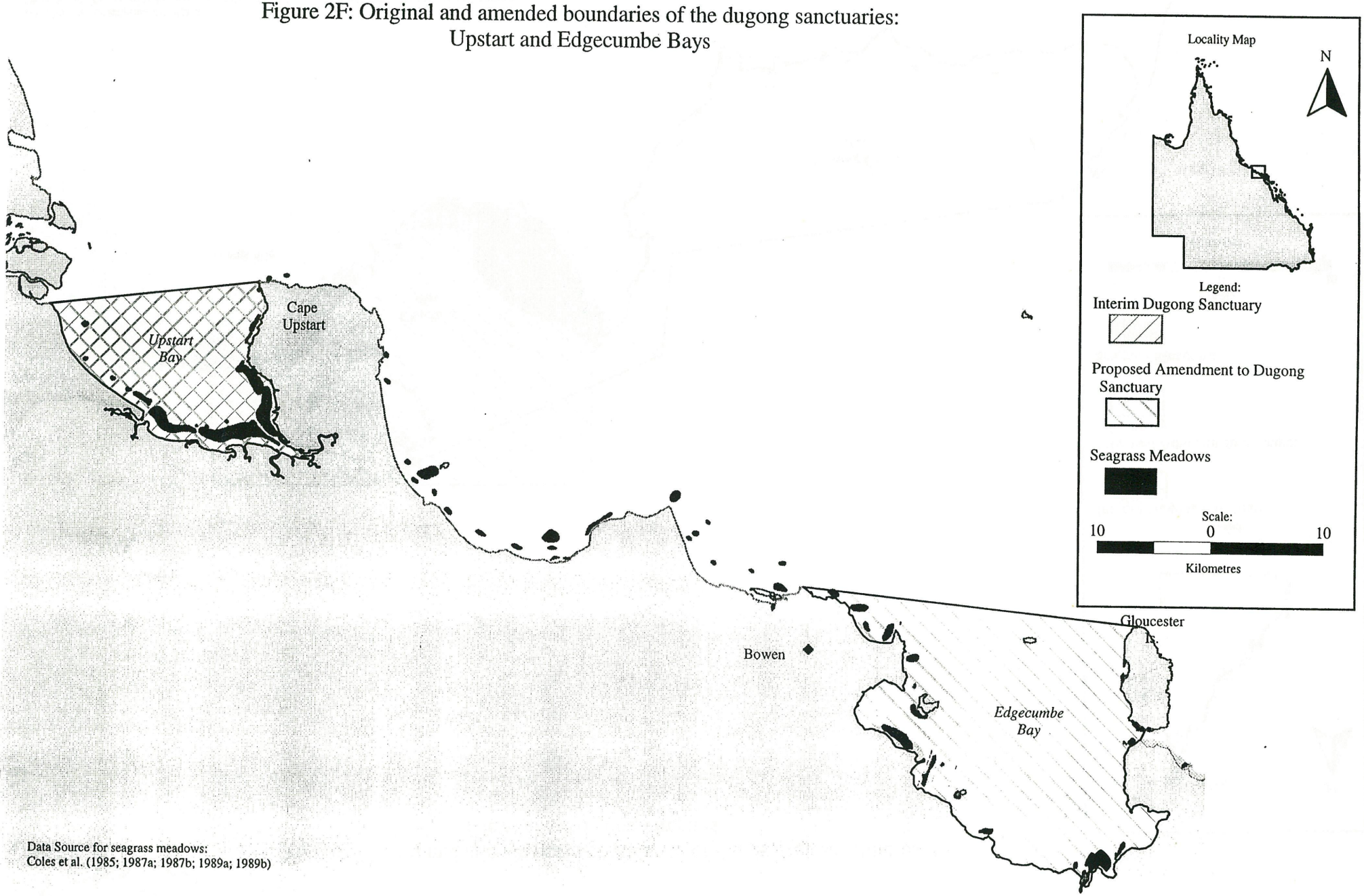
Figure 2F: Original and amended boundaries of the dugong sanctuaries:
Upstart and Edgecumbe Bays



Data Source for seagrass meadows:
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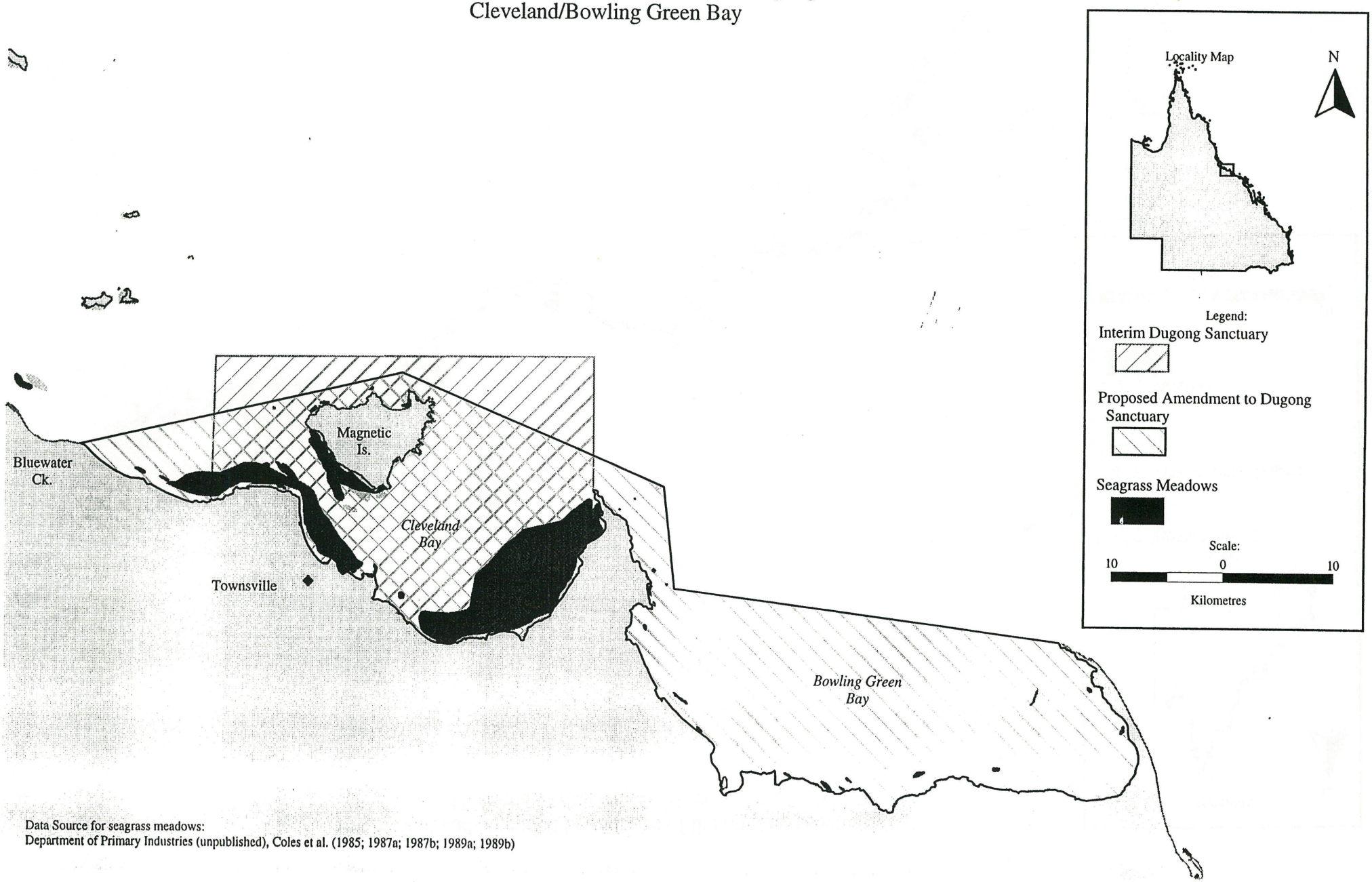
Figure 2G: Original and amended boundaries of the dugong sanctuaries: Cleveland/Bowling Green Bay



Data Source for seagrass meadows:
Department of Primary Industries (unpublished), Coles et al. (1985; 1987a; 1987b; 1989a; 1989b)

18(P.31)

Figure 2H: Original and amended boundaries of the dugong sanctuaries: Hinchinbrook

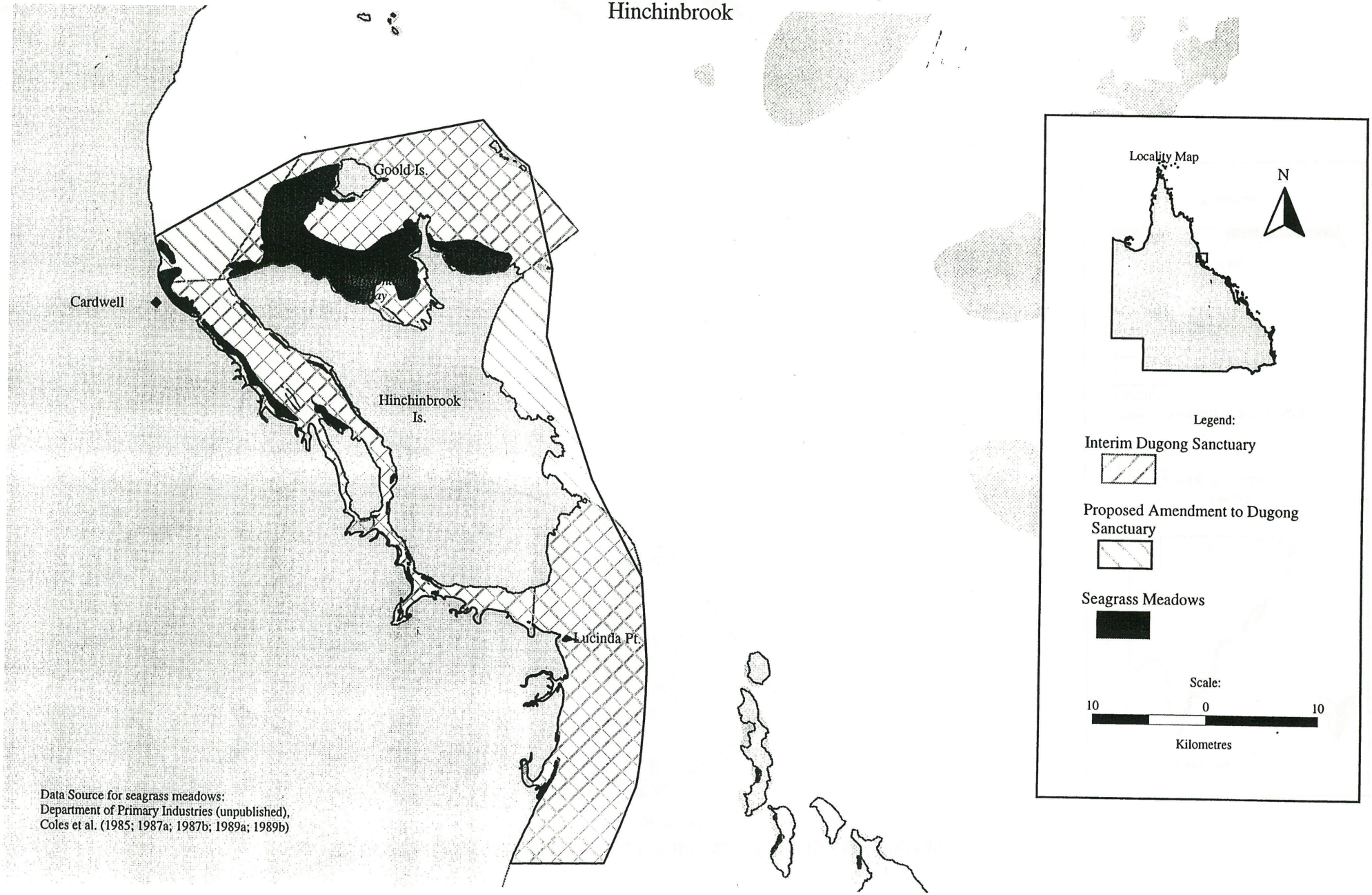


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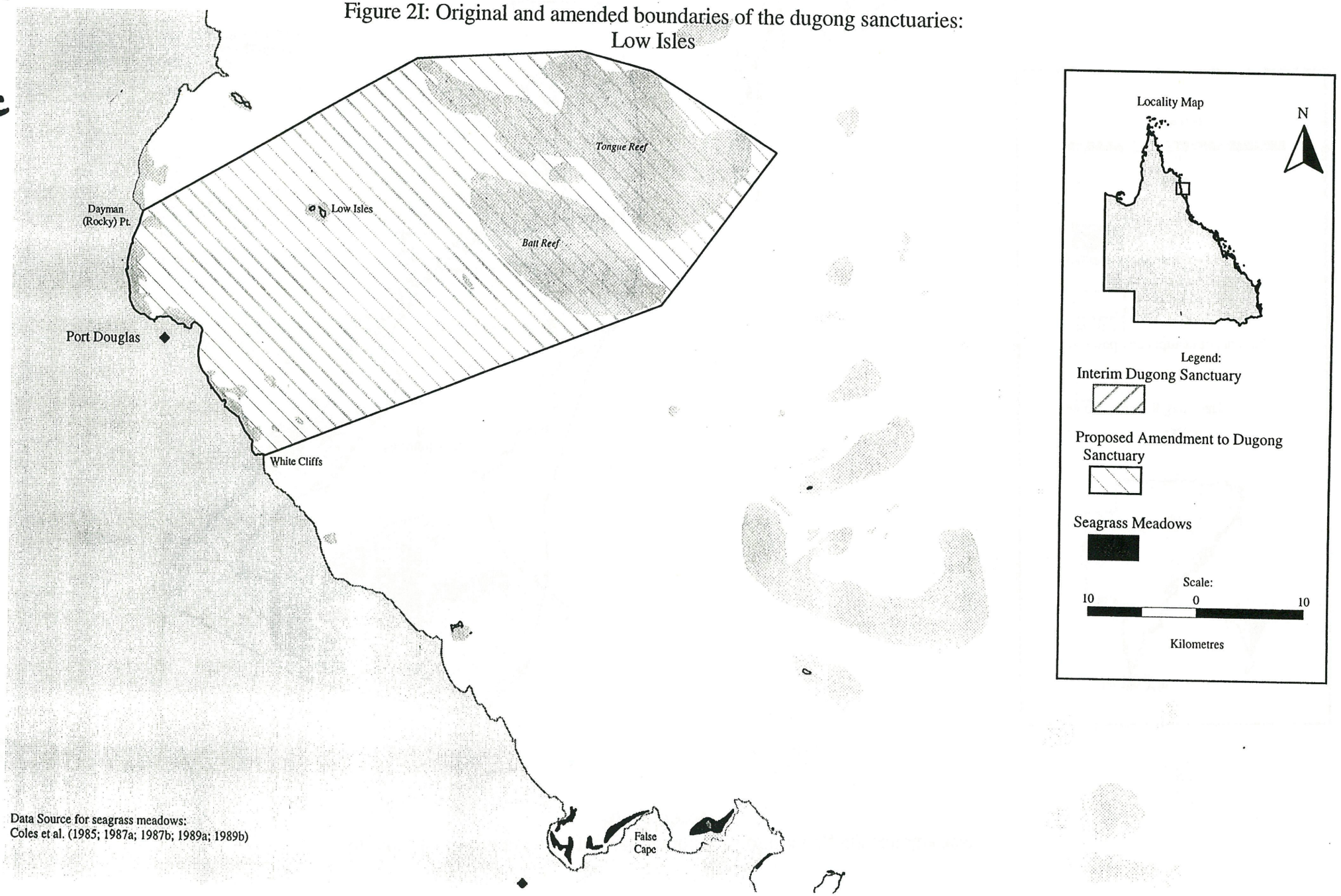
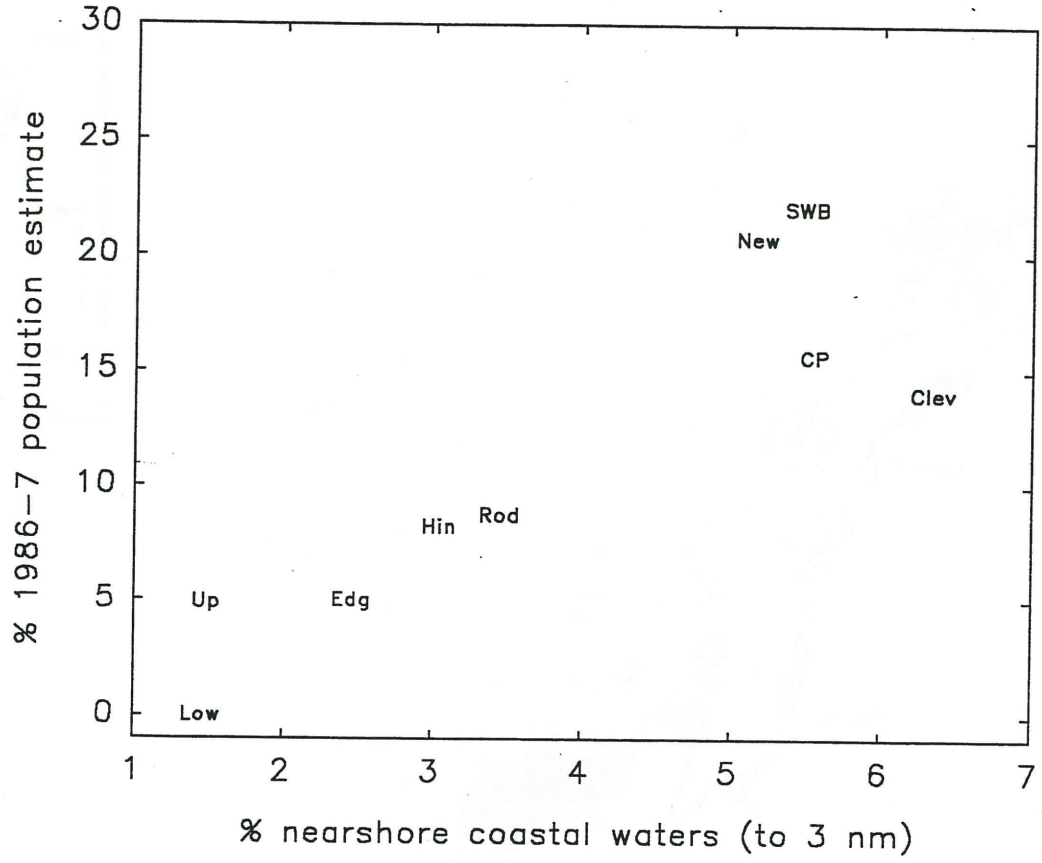
Figure 2I: Original and amended boundaries of the dugong sanctuaries: Low Isles



Data Source for seagrass meadows:
Coles et al. (1985; 1987a; 1987b; 1989a; 1989b)

Fig. 3 Relationship between potential proportion of the southern GBR dugong population (1986–7) protected in dugong sanctuaries, and the porportion of nearshore coastal waters (A) and mainland coastline (B) enclosed by sanctuaries.



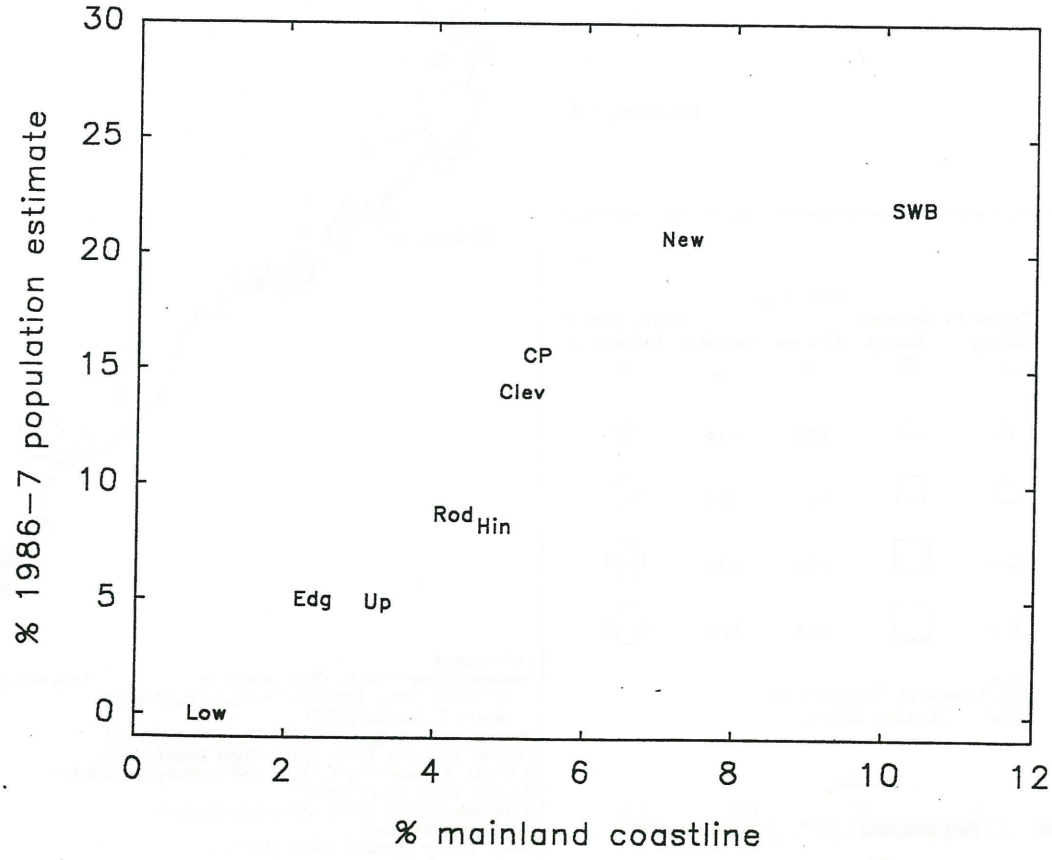


Figure 4A: All dugong records between Tin Can Bay and Repulse Bay

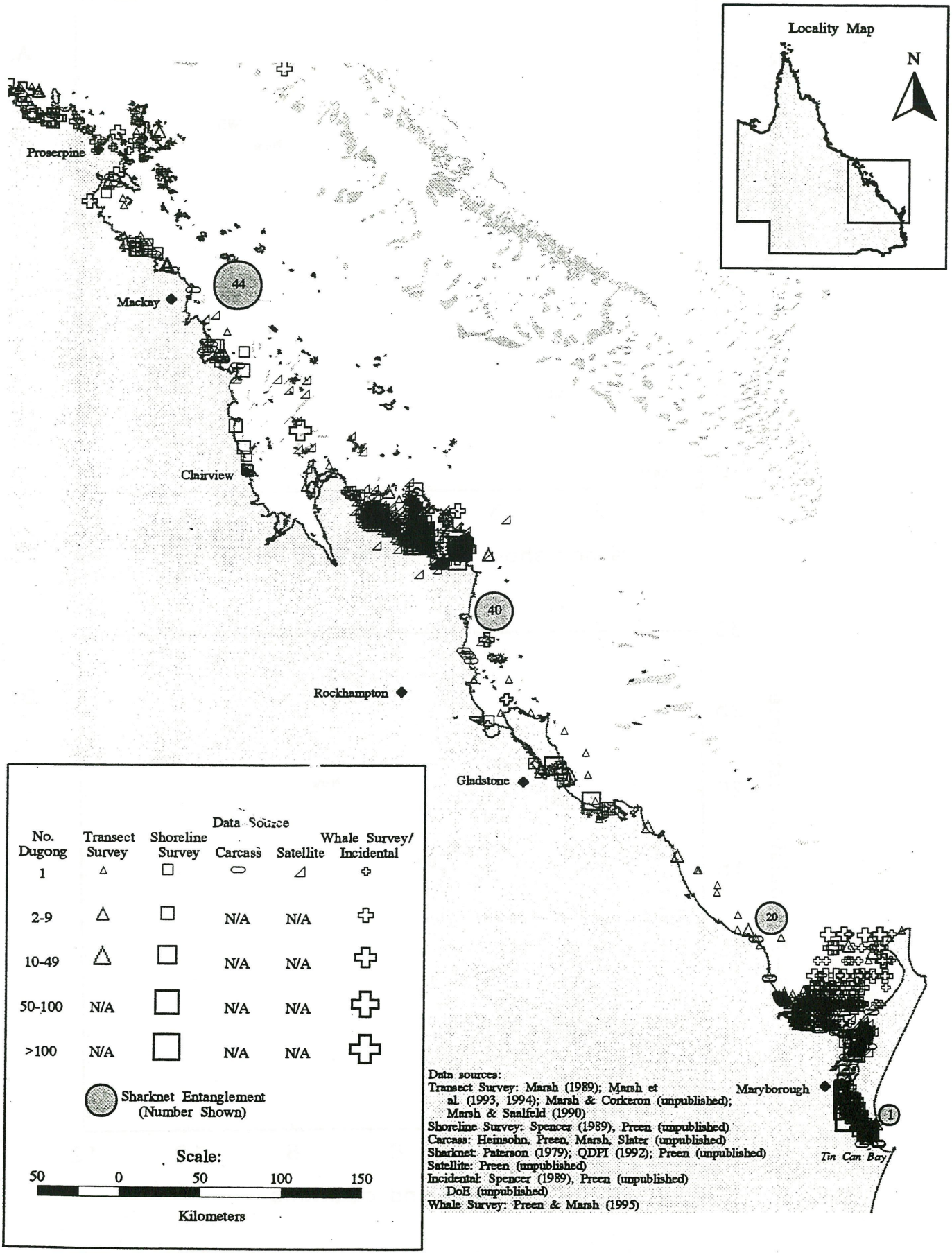
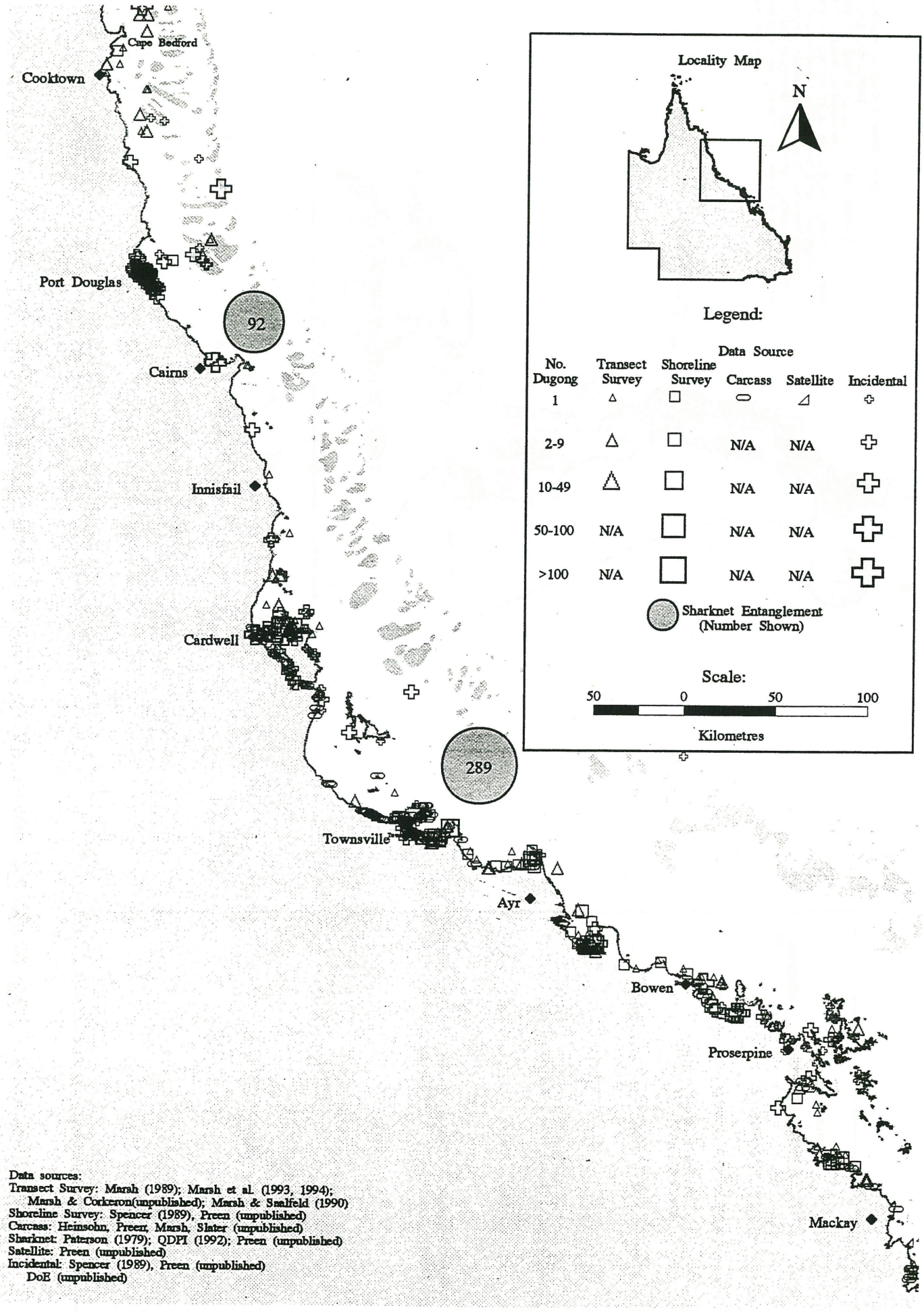


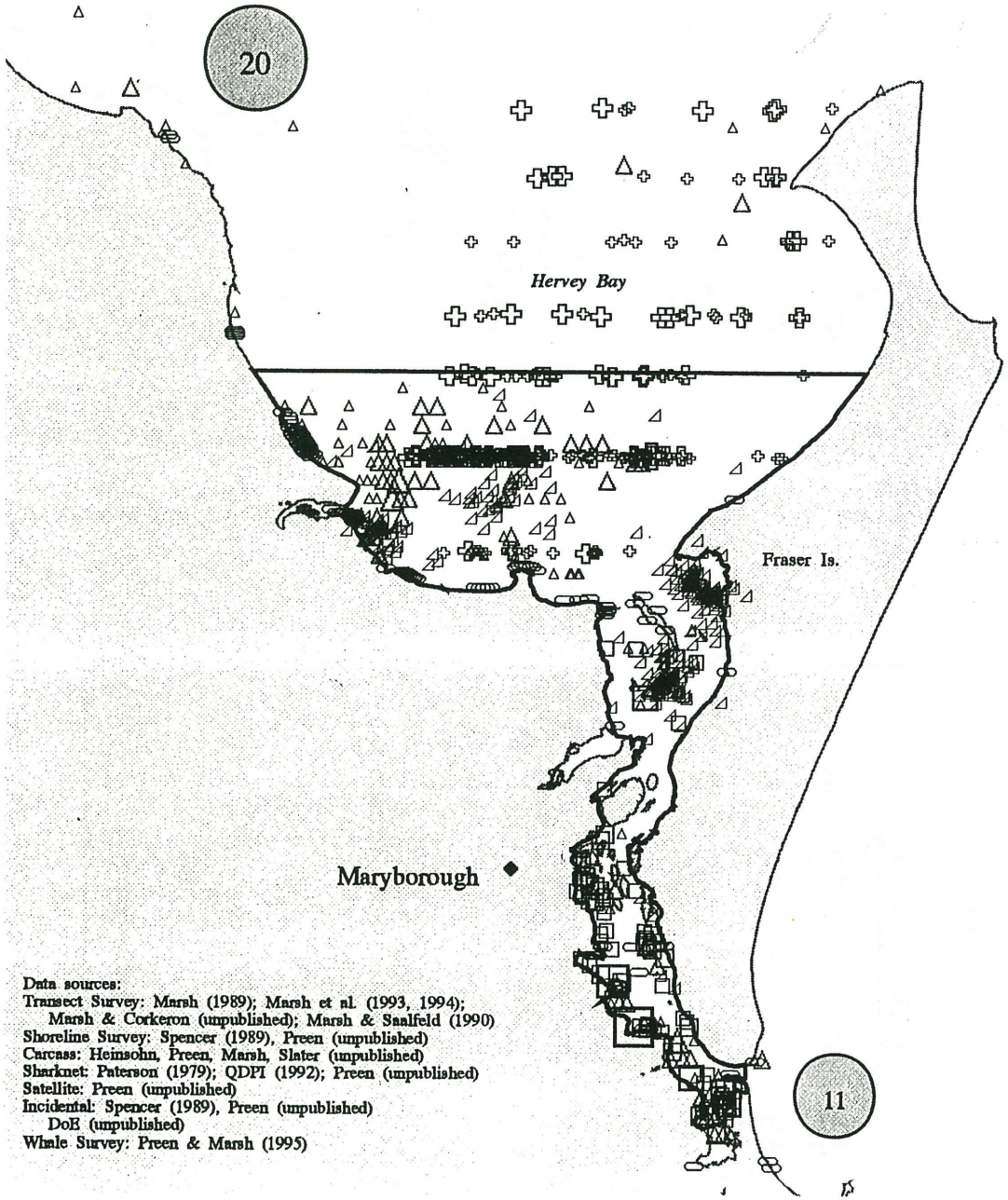
Figure 4B: All dugong records between Repulse Bay and Cape Bedford



Data sources:
Transect Survey: Marsh (1989); Marsh et al. (1993, 1994); Marsh & Corkeron(unpublished); Marsh & Saalfeld (1990)
Shoreline Survey: Spencer (1989), Preen (unpublished)
Carcass: Heinsohn, Preen, Marsh, Slater (unpublished)
Sharknet: Paterson (1979); QDPI (1992); Preen (unpublished)
Satellite: Preen (unpublished)
Incidental: Spencer (1989), Preen (unpublished)
DoE (unpublished)

18 (P.36)

Figure 5A: Dugong records from the region of the Hervey Bay/Great Sandy Strait Sanctuary



Data sources:
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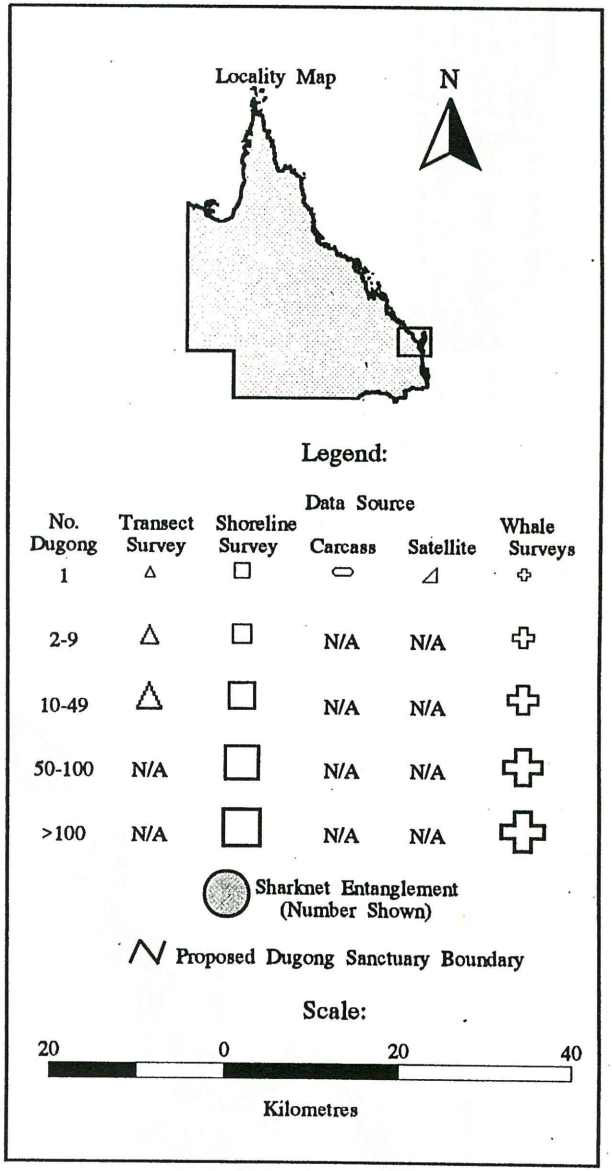
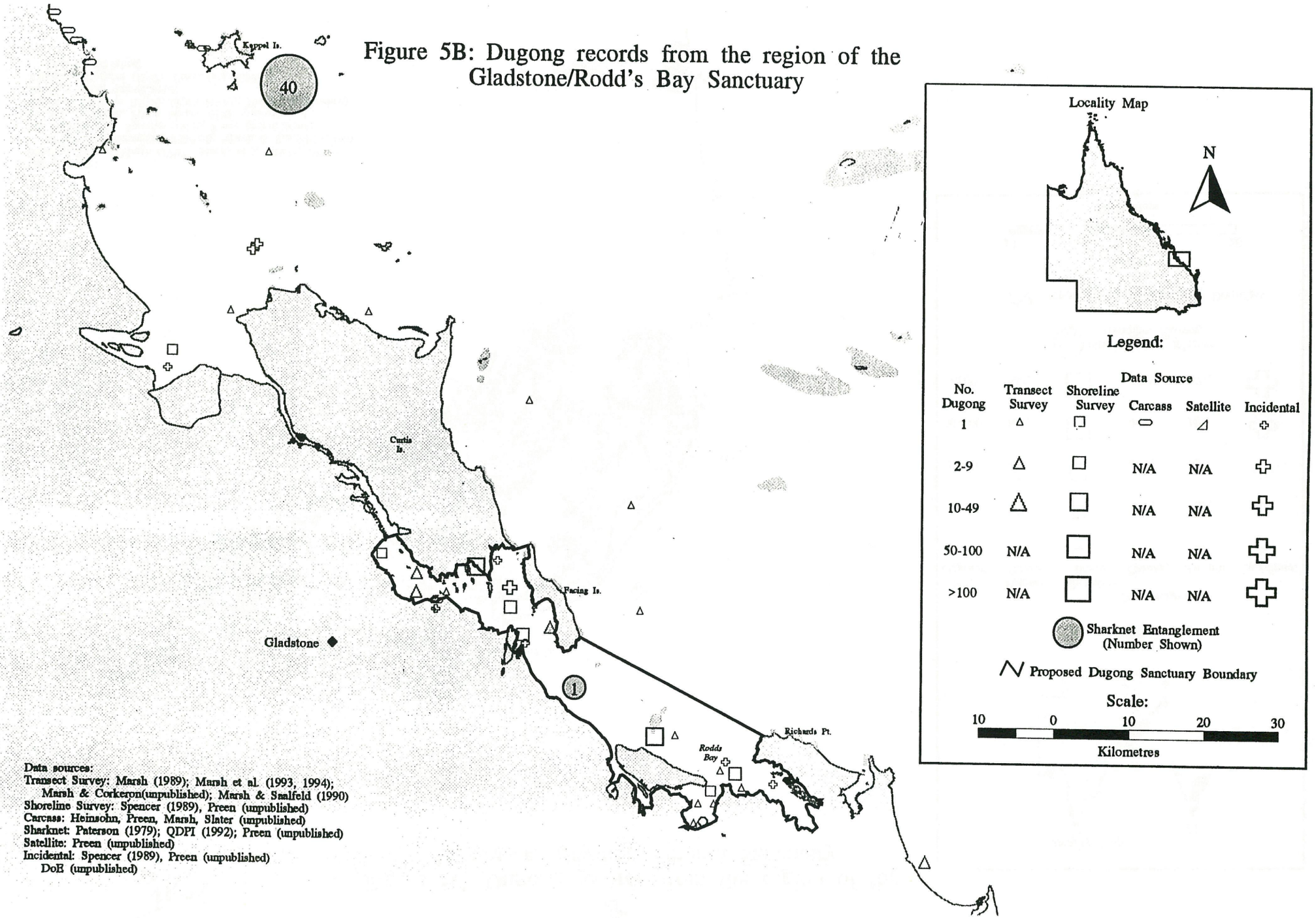
Shoreline Survey: Spencer (1989), Preen (unpublished)
Carcass: Heinsohn, Preen, Marsh, Slater (unpublished)
Sharknet: Paterson (1979); QDPI (1992); Preen (unpublished)
Satellite: Preen (unpublished)
Incidental: Spencer (1989), Preen (unpublished)
DoE (unpublished)
Whale Survey: Preen & Marsh (1995)



18(P.37)

Figure 5B: Dugong records from the region of the Gladstone/Rodd's Bay Sanctuary



Data sources:
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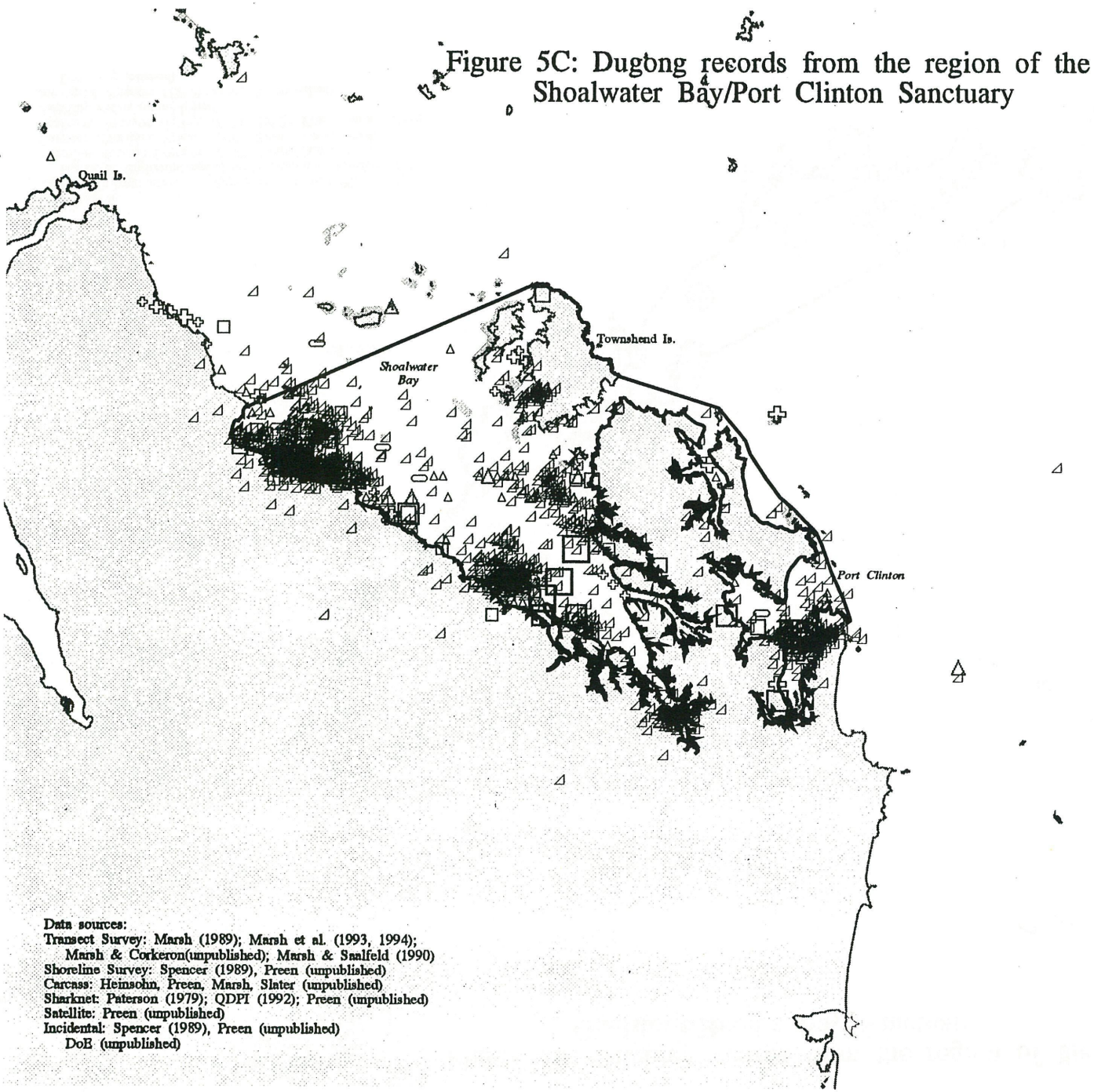
Shoreline Survey: Spencer (1989), Preen (unpublished)
Carcass: Heinsohn, Preen, Marsh, Slater (unpublished)
Sharknet: Paterson (1979); QDPI (1992); Preen (unpublished)
Satellite: Preen (unpublished)
Incidental: Spencer (1989), Preen (unpublished)
DoE (unpublished)

18(p.38)

Figure 5C: Dugong records from the region of the Shoalwater Bay/Port Clinton Sanctuary



Data sources:
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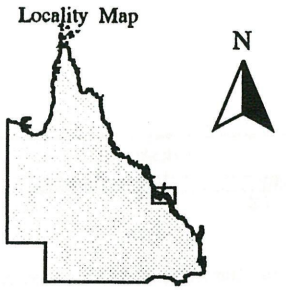
Shoreline Survey: Spencer (1989), Preen (unpublished)
Carcass: Heinsohn, Preen, Marsh, Slater (unpublished)
Sharknet: Paterson (1979); QDPI (1992); Preen (unpublished)
Satellite: Preen (unpublished)
Incidental: Spencer (1989), Preen (unpublished) DoE (unpublished)

Locality Map



N

Legend:

No. Dugong	Data Source: Transect Survey	Shoreline Survey	Carcass	Satellite	Incidental
1	△	□	⬭	◿	✚
2-9	△	□	N/A	N/A	✚
10-49	△	□	N/A	N/A	✚
50-100	N/A	□	N/A	N/A	✚
>100	N/A	□	N/A	N/A	✚

Sharknet Entanglement (Number Shown)

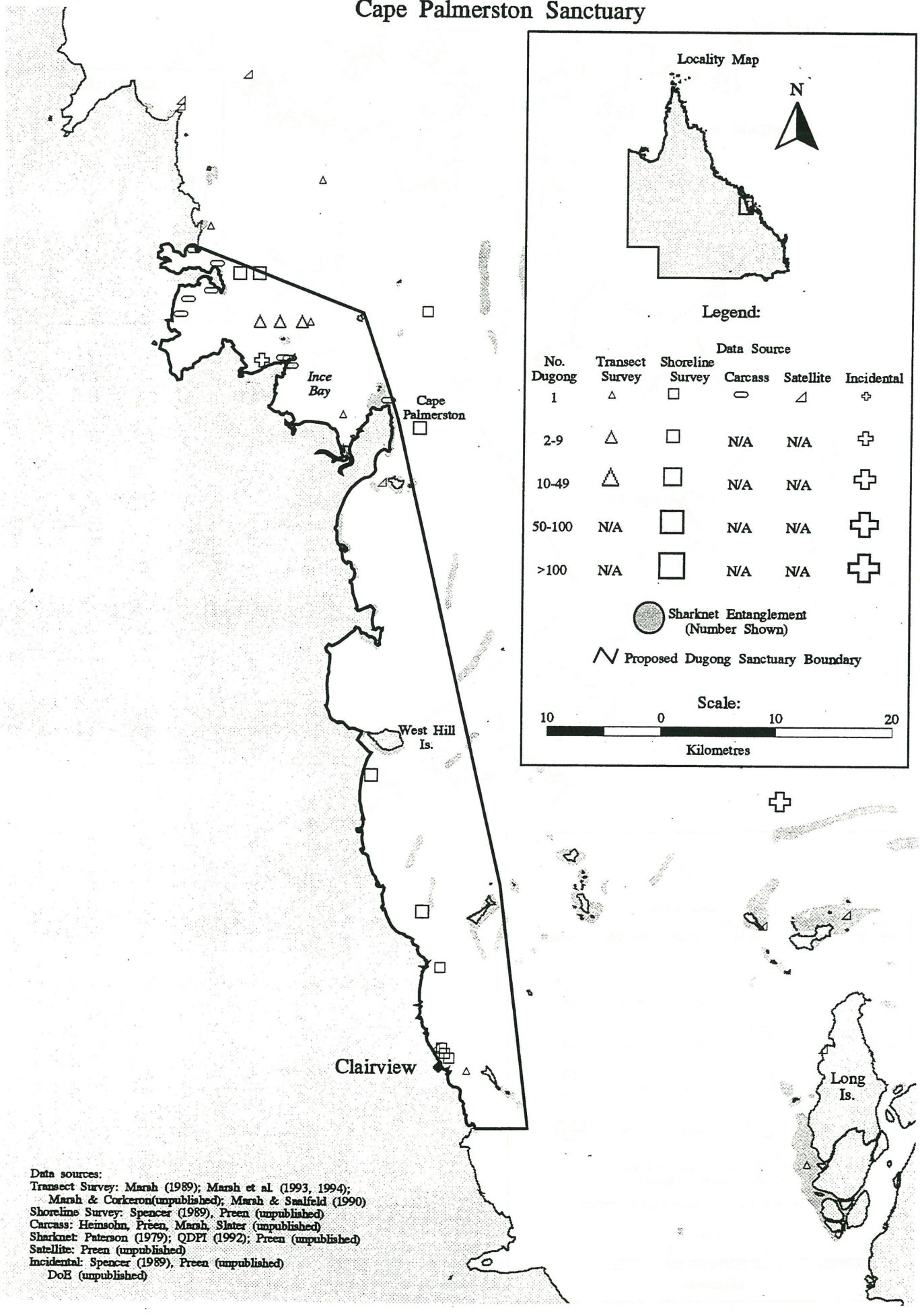
Proposed Dugong Sanctuary Boundary

Scale:

10 0 10 20

Kilometers

Figure 5D: Dugong records from the region of the Cape Palmerston Sanctuary



Data sources:
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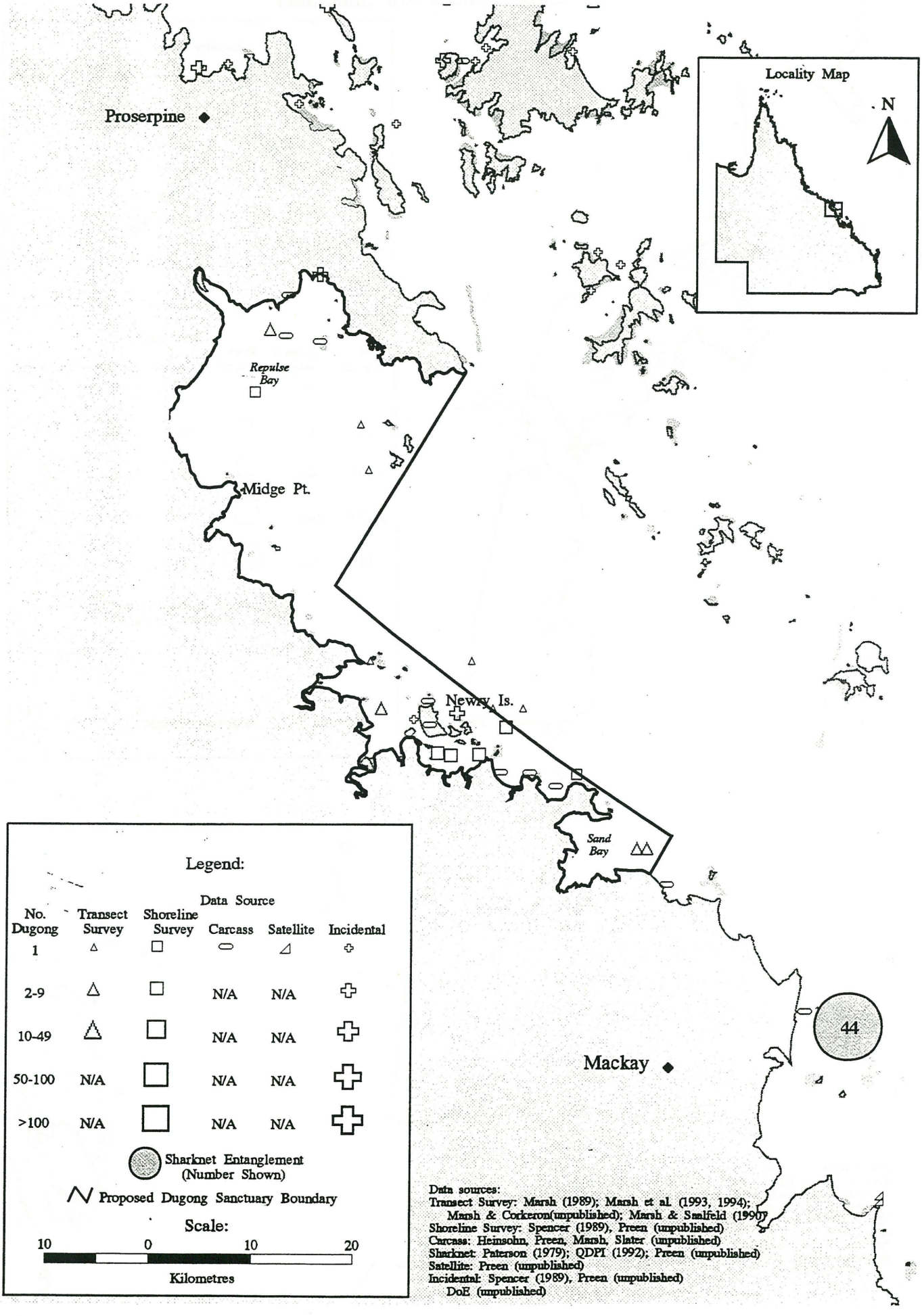
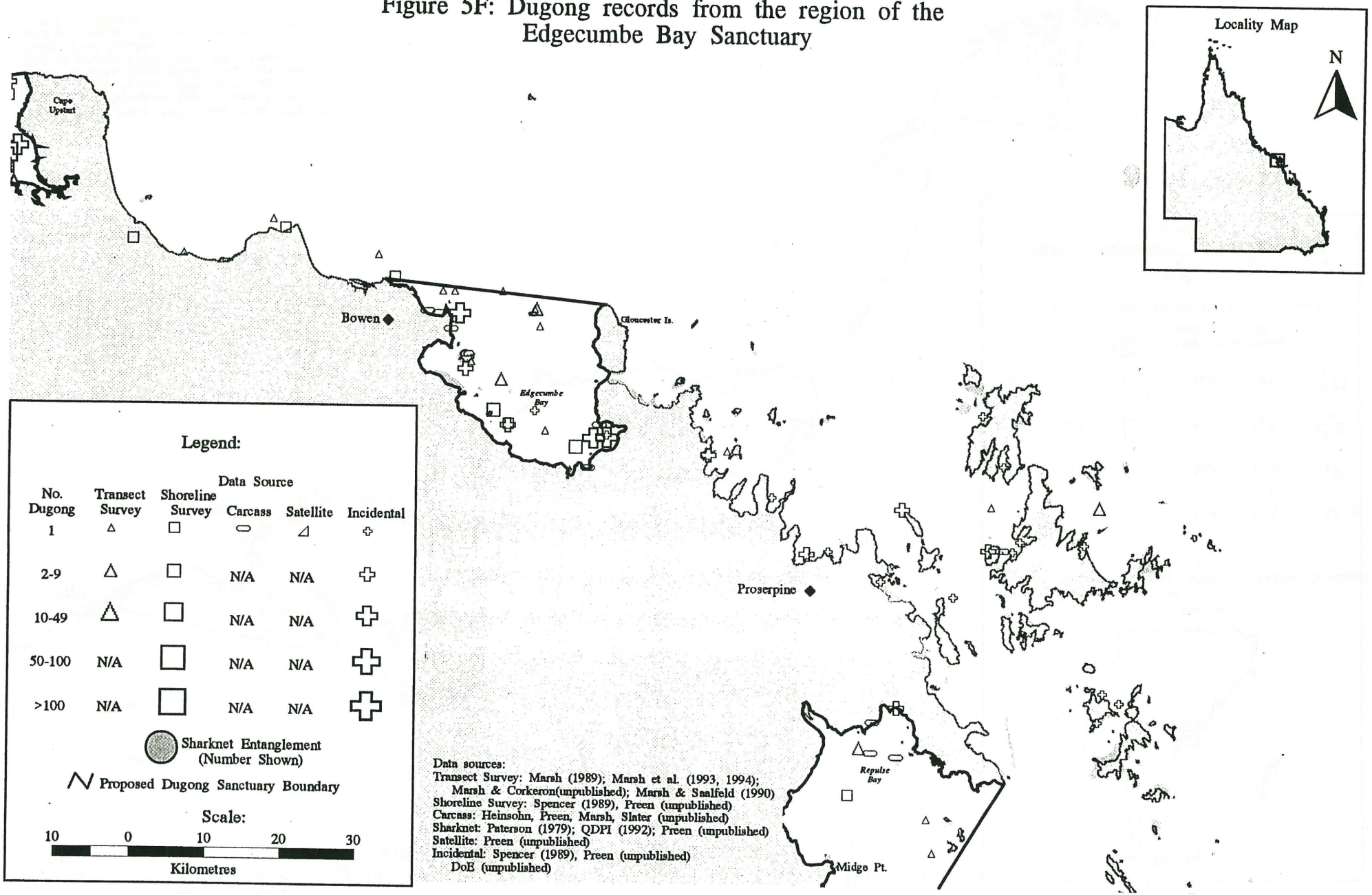
Shoreline Survey: Spencer (1989), Preen (unpublished)
Carcass: Heinsohn, Preen, Marsh, Slater (unpublished)
Sharknet: Paterson (1979); QDPI (1992); Preen (unpublished)
Satellite: Preen (unpublished)
Incidental: Spencer (1989), Preen (unpublished)
DoE (unpublished)

Figure 5E: Dugong records from the Newry/Repulse Bay Sanctuary



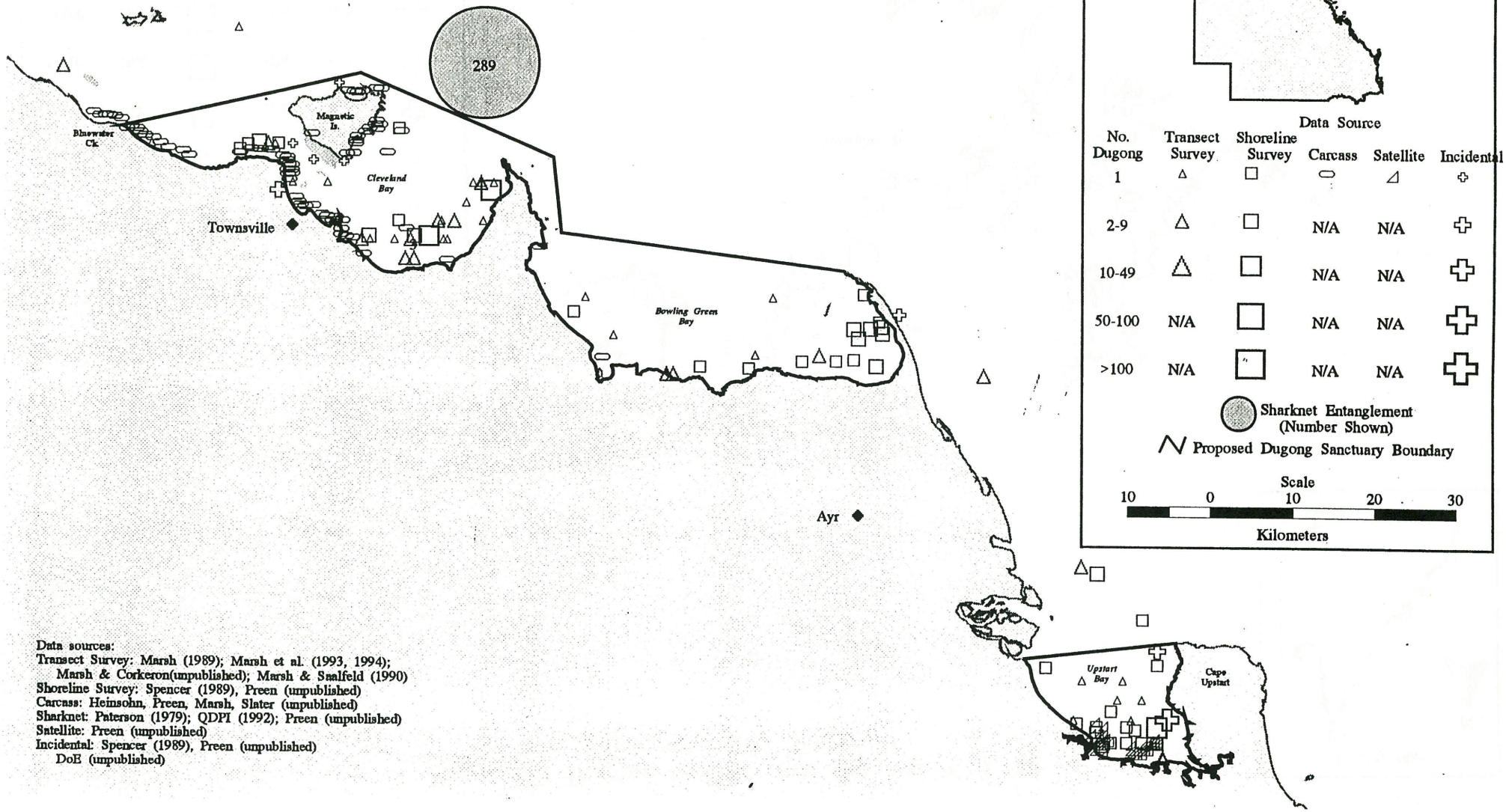
18 (R41)

Figure 5F: Dugong records from the region of the Edgecumbe Bay Sanctuary



18(P.42)

Figure 5G: Dugong records from the region of the Upstart Bay and Cleveland/Bowling Green Bay Sanctuary



Locality Map

N

Data Source

No. Dugong	Transect Survey	Shoreline Survey	Carcass	Satellite	Incidental
1	△	□	⬭	◿	✣
2-9	△	□	N/A	N/A	✣
10-49	△	□	N/A	N/A	✣
50-100	N/A	□	N/A	N/A	✣
>100	N/A	□	N/A	N/A	✣

Sharknet Entanglement (Number Shown)

Proposed Dugong Sanctuary Boundary

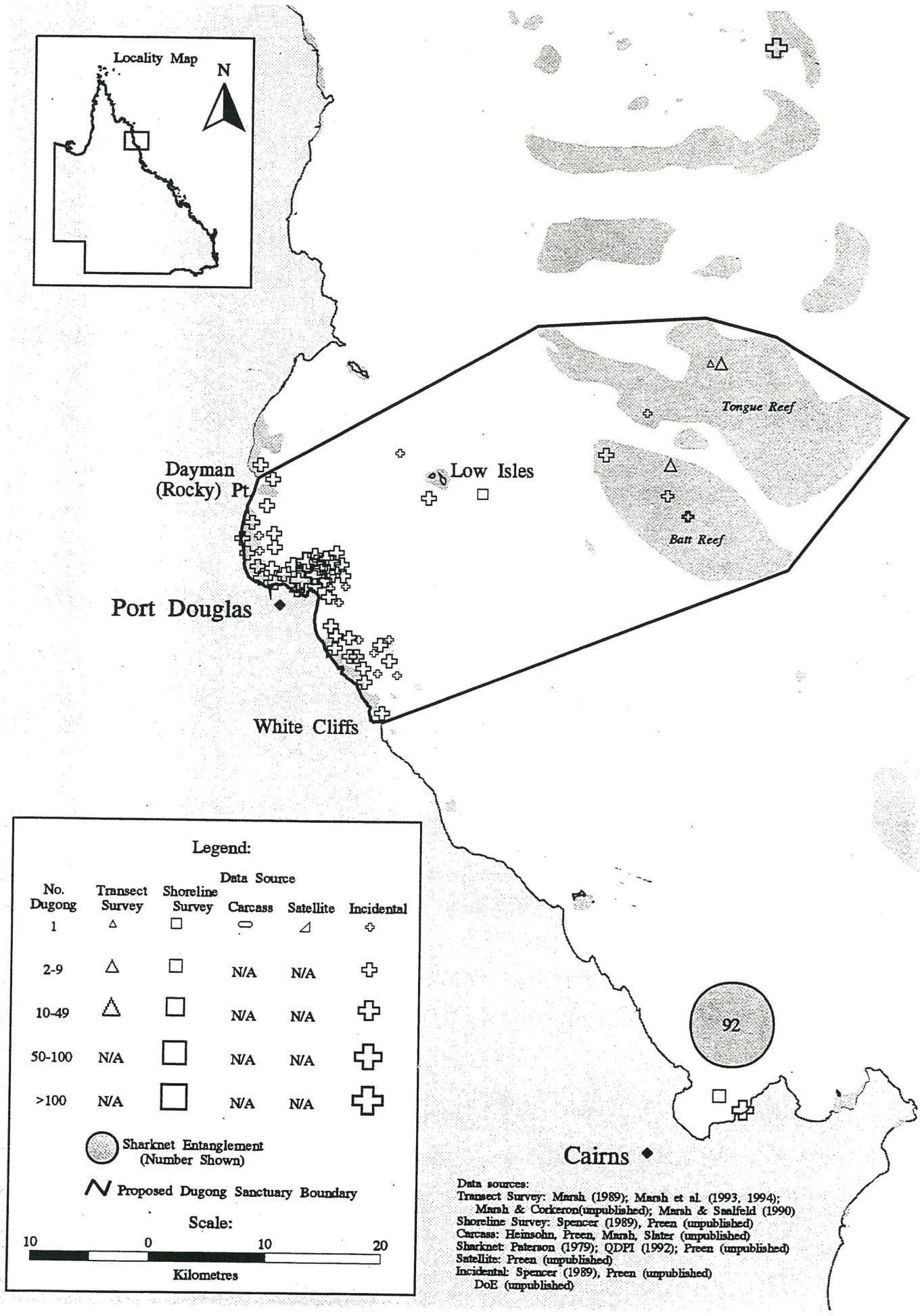
Scale

10 0 10 20 30

Kilometers

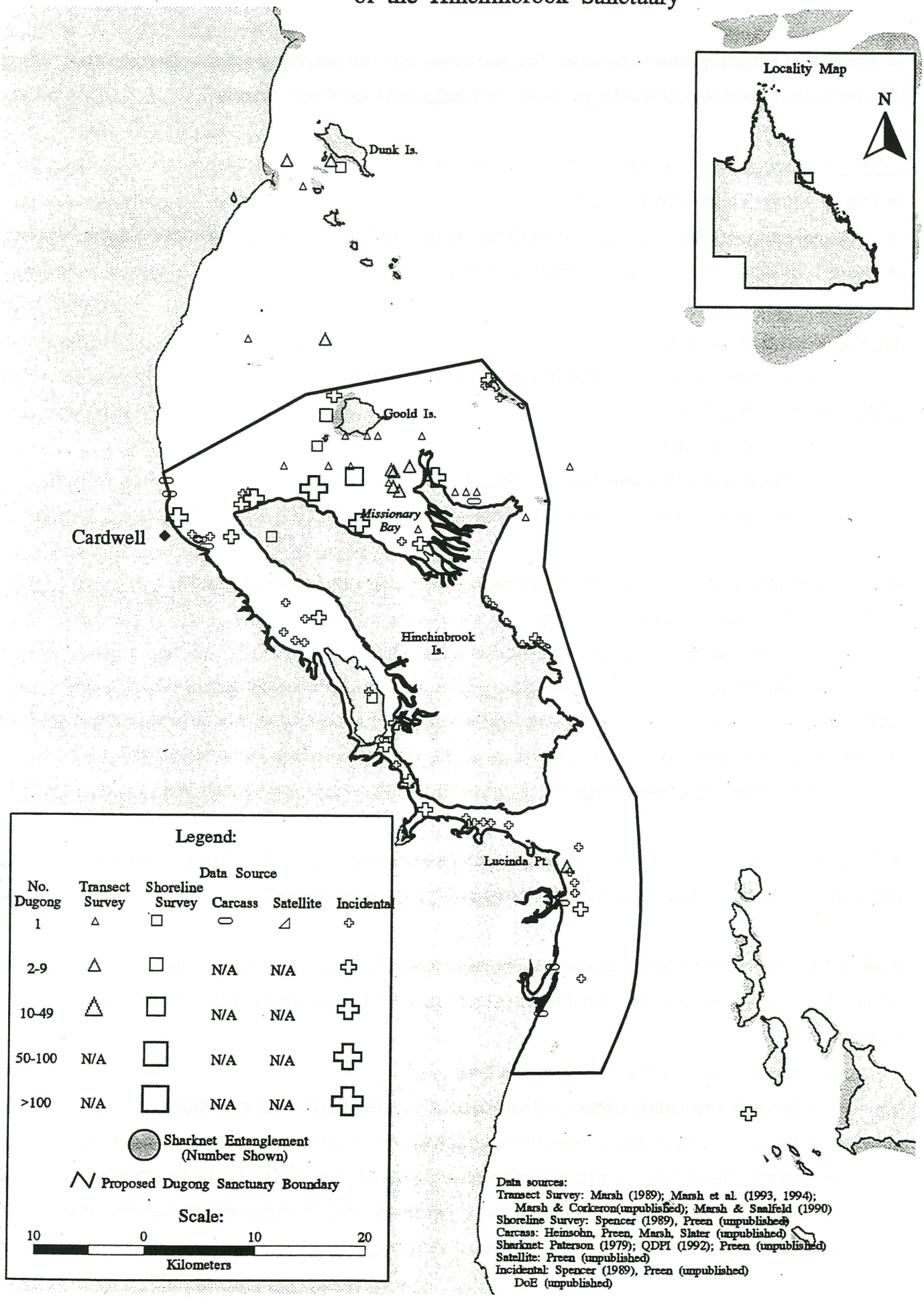
Data sources:
Transect Survey: Marsh (1989); Marsh et al. (1993, 1994); Marsh & Corkeron(unpublished); Marsh & Saalfeld (1990)
Shoreline Survey: Spencer (1989), Preen (unpublished)
Carcass: Heinsohn, Preen, Marsh, Slater (unpublished)
Sharknet: Paterson (1979); QDPI (1992); Preen (unpublished)
Satellite: Preen (unpublished)
Incidental: Spencer (1989), Preen (unpublished)
DoE (unpublished)

Figure 5I: Dugong records from the region of the Low Isles Sanctuary



18(P.44)

Figure 5H: Dugong records from the region of the Hinchinbrook Sanctuary



Presentation to the 165th meeting of the Great Barrier Reef Marine Park Authority
Brisbane, 20/2/97
Tony Preen

18(p.45)

A system of dugong sanctuaries for the recovery and conservation of dugongs in the Great Barrier Reef World Heritage Area and adjacent southern waters.

OHP 1 (Sanctuary cartoon from Mackay Mercury)

- The situation for dugongs is critical
- Available information indicates that dugong are in decline throughout their range.
- The risk of extinction, within my lifetime is real.

OHP 2 (Kenya situation)

---> microcosm of world pattern; extinct by 2000

OHP3 (Cairns situation)

---> strong parallels

---> decline started well before 1986/7

---> decline is much greater than 50-80% recognised

- Now that it is recognised, population recovery must be of highest priority
- Must establish the level of recovery

---> 1986/7 level clearly not appropriate UNLESS

we are to accept very substantial (>80%), avoidable reduction in the size of the population of a species of unusual and high biodiversity value and that is recognised as a threatened species internationally, under state law and soon under federal law.

Given, among other things the World Heritage context; not an option?

- Substantial recovery will in my view require the establishment of a comprehensive sanctuary system where, among other things, netting is excluded.

- Nina Morisette and I have looked at the available data on dugong habitats and distribution and have recommended 10 sanctuaries in the southern GBR and Hervey Bay regions

---> cover most of the important habitat

---> several are quite large and will support large resident populations

---> form a navigatable chain to facilitate the movement of dugongs & genes

---> there are enough, and the spread is great enough to provide insurance against unforeseeable catastrophes, such as what happened at Hervey Bay

---> would have enclosed 99% of 1986/7 dugongs

18(P.46)

--> enclose only 34% of nearshore (3nm) waters

■ Rather than work through the detail of each proposed sanctuary, which is provided in the report, I want to use the brief time available to address some of the management issues critical for effective functioning.

■ Main threats to dugongs are (in order)
nets and hunting
habitat loss
boats

Hunting

■ very serious threat to some populations
■ legal situation unclear:

Sect 211 Native Title Act allows ATSIs to hunt in marine parks with or without permits in the absence of a specific law in relation to wildlife hunting. Arguably, Sect 93 NCA is such a law, but as it is not proclaimed it does not qualify Sect 211.
So, Under Sect 211, all hunting is legal in a marine park, but in the absence of the proclamation of Sect 93 all hunting in other Qld waters is illegal!

■ Irrespective of these complications, there are practical reasons why control of hunting will have to be, substantially, a local initiative.
■ GBMPA and DoE must convince local groups of the seriousness of the situation (in this they have a long way to go) and must encourage self regulation, including ~10 yr moratoria, through formal management plans.
■ This will only be successful if other threats, particularly netting, are dealt with.

Netting

■ Our report gives some indication of the seriousness of the threat posed by netting activities
OHP4 (Marsh quote)
■ Our report also gives some 'case studies' that show (1) that attempts to deal with this issue are not new; and (2) why changes in regulations and codes of conduct will not reduce the rate of mortality to anything near the required level.
■ Helene Marsh has done some calculations on acceptable human-related mortality in

the southern GBR using the formula for calculating the Potential Biological Removal that is part of the US Marine Mammal Protection Act.

–> 1994 PRD = 3.3

–> 1996 dugong carcasses = 35. Evidence 16 died in gill nets

■ I thought the message on netting in the dugong sanctuaries was clear.

OHP5 (Senator Hill Press Release)

OHP 6 (Mr Littleproud Statement to Parliament)

■ Despite this, QCFO have in their report, proposed the most extraordinary and complex set of site-specific regulatory changes

■ This has been done without any compelling evidence that anything like the appropriate level of mortality reduction could be achieved.

■ The reality is that the industry is, and will remain, poorly policed and compliance will always be a problem.

■ SWB shows how just two "cowboys", well known to QCFO, QBFP, DoE, Army can, apparently, be responsible for the bulk of a 50% population decline in 7-8 yrs.

■ It does not matter how good the complex regulations are, just a small percentage of "cowboys" amongst the gill-netting fraternity will still be able to drive dugongs in the Southern GBR to extinction.

■ Now is not the time to go through the QCFO report in detail, but I want to make one point on it.

■ The report puts great store in the local knowledge of fishers to justify the proposed regulatory changes. I do not question this local knowledge at all, except to point out that because of the way it is collected, this knowledge can be biased and very incomplete.

■ For example, in Port Clinton, fishers recognise peak dugong activity to be between May and September, but mostly August and September. Last year I did aerial surveys of the area in March, April, May, July, September and early and late December. Dugongs were present on all surveys except April. The largest count (154) occurred in May. Dugongs seem to use the area all year. Significantly though, the number of dugongs in Port Clinton can change dramatically overnight.

■ This brings me to my second point: dugongs are constantly moving between SWB and Port Clinton. As well as overnight changes in the number of dugongs present, 5 of the 10 dugongs tagged in the region moved between the two areas, and most of them did it several times. My point is that all these movements occur through the Pearl Bay area. Yet, according to the QCFO report, Pearl Bay is an area "where dugongs are rarely

observed"

- Fishers are not aware of all the so-called "migration paths" of the dugongs, and to design a netting regime around their perceptions would be imprudent in the extreme.

- I agree strongly with QCFO, however, that netting effort from sanctuary areas must not be displaced into adjoining areas, the northern GBR or GoC. It is imperative that licences are bought out and the fishers adequately compensated.

OHP 7 (Courier Mail Cartoon - dugongs and Oyster Point)

- My final point is that addressing the the dugong decline should not be considered as a problem but as a great opportunity to achieve a lot of major conservation actions.
- Currently there is unprecedented public awareness of dugongs: being featured in cartoons in large newspapers; and protesters chained to the Prime Minister's office chanting "Save the Dugong" are graphic evidence of this.
- Dugongs are what Reed Noss calls Flagship species: charismatic megafauna that can be a symbol for major conservation efforts
- But they are also what he calls Umbrella species: species that have such large range requirements that the protection of their habitat will afford protection to a suite of other species as well.
- In the dugong's case these include
  - Irrawaddy (Qld: listed as rare)
  - Humpback (Qld: listed as rare)
  - Green Turtle (Internationally listed as Endangered)
  - Loggerhead turtle (regionally critically endangered)
  - Esuarine Crocodile (?)

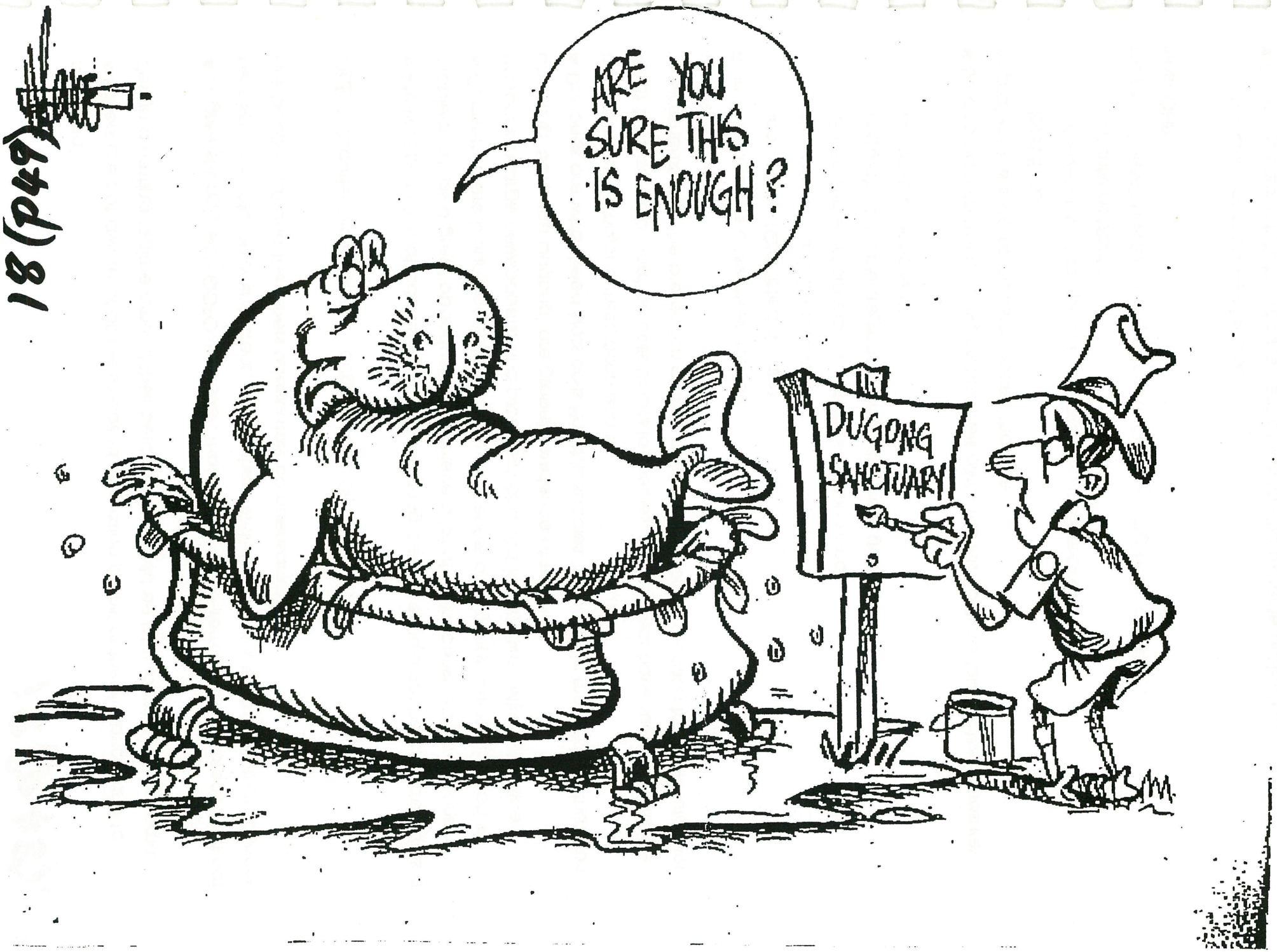
- So dealing with the dugong problem will allow the Authority to take active measures to protect this suite of species; species that are
  - long lived
  - relatively rare (compared with most marine species)
  - patchily distributed

that the GBRMP has failed to protect under its zoning plans and actions.

Noss OHP

- recognises 5 categories of species
- Dugongs clearly fulfil the requirement of warranting extreme protection

18 (P49)



18(p.50) OHP2

The demise of dugongs in Kenya

"Nowadays the accidental netting of dugong probably far outweighs the hunting of them. The lines of shark nets catch at least twelve each year in the Lamu sea. Three were caught in the month from July 15th to August 15th by fishermen from Patta Island alone. ... The total number of fishing boats in the sea must be less than thirty, and not all these will be fishing at the same time, so that the high annual catch of dugong indicates the relative abundance of the species."

— indeed - Lamu - best in E Africa

Jarman, P.J. 1966. The Status of the Dugong (Dugong dugon Muller): Kenya. 1961.

November 1995: several days searching for dugongs from boat and plane with Kenya Wildlife Service. None seen

March 1996: Kenya Wildlife Service conducted a detailed aerial survey of Lamu area.

- **Found 4 dugongs** including 1 calf in Siyu Channel behind Patta Island

October 1996: email from colleague:

"... since then, three of the four (including the young one) have drowned in gill nets in Siyu channel."

18(p.51) OHP

The demise of dugongs around Cairns

'*Cairns and Yarraba*

An enquiry in 1952/3 had apparently concluded that (dugongs were) *abundant locally and not being depleted by the large numbers being taken at nearby Yarraba Settlement for Aborigines. At the time of our visit in 1956 some 200 were being taken by half a dozen fishermen from the settlement, one (Police Sergeant John Maloney, our informant) having taken 64 in a single year. A herd of 100 had recently been seen. There was thought to be as many as 40 years ago. There was a local anecdote of the "Bay being full of dugongs", but there was seemingly much variation from year to year, and in 1966 there were reported to be almost none. Shark nets at Cairns took 42 animals between 1964 and 1969, ranging from 4 ft 2 in. to 11 ft.'*

(Bertram and Bertram, 1973. The modern Sirenia: their distribution and status. p 313)

In the 5-year period between 1969 and 1974, **55** dugongs were caught in shark nets set at Cairns. Subsequently few dugongs have been caught (Paterson, 1979; QDPI, 1992) (QDPI, 1992).

Since 1987, the number of dugongs seen on the standardised aerial surveys in the region from Cape Bedford to Dunk Island (including Cairns) has been so low that it has never been possible to calculate a population estimate (Marsh et al., 1994).

18(p.52) OHP4

"Dugongs are killed incidentally in the inshore gill-net fisheries of northern Australia. Reports of this incidental take give cause for concern, but it has not been possible to obtain precise figures. An informant involved in fisheries research, who interviewed fishermen along the west coast of Cape York in 1980, reported that 17 professional barramundi fishermen each caught between five and ten dugongs per year. One operator working on a seagrass bed in a river estuary allegedly accidentally caught 23 dugongs in one net before he removed his nets. Mr Rod Garrett (Northern Fisheries Research Centre) reported that in the first 19 days of the 1982 commercial barramundi netting season, five of 40 operators at Karumba in the Gulf of Carpentaria had each caught one dugong; two of these five animals drowned. Over the period March 1979 to March 1983, Queensland Fisheries Research Branch personnel set gill nets over a total of 135 nights in the Princess Charlotte Bay, Bathurst Bay, Ninian Bay region. Eleven dugongs were caught....."
(Marsh 1985, p 497-8).

A 1991 aerial survey of the Karumba region sighted no dugongs (Marsh and Lawler, unpubl. data)

■ Over a 10-day period in 1995 some 36 dugongs were drowned in one gill net being operated by commercial barramundi netters near the mouth of the Wearyan River near Borroloola in the southwest Gulf of Carpentaria.

18(p.53) OH 5

ıtor the Hon Robert Hill
ler of the Government in the Senate
ster for the Environment

Media Release

URGENT ACTION TAKEN ON DUGONG DECLINE

Federal Environment Minister Robert Hill has unveiled a new rescue strategy aimed at arresting and reversing the alarming decline in dugong numbers on the Great Barrier Reef.

The historic strategy will establish a dugong sanctuary system along the Queensland coast.

Senator Hill says the strategy represents the turning point in the battle to save the dugong.

"Dugongs are beautiful and graceful mammals - recognised as a world heritage value on the Great Barrier Reef. This government is committed to taking urgent action to protect the dugong."

The number of dugongs which inhabit the Great Barrier Reef World Heritage Area south of Cooktown has fallen by 50-80% in the last ten years. Gillnetting, along with habitat loss, shark meshing and indigenous hunting, represent the greatest threats to dugong.

The strategy builds on the Government's recent announcement of a draft management plan for Shoalwater Bay which will prohibit all forms of gillnetting in the Bay.

Senator Hill says he has gained support from the Queensland Government for the listing of nine Interim Dugong Protection Areas intended to form the basis of a sanctuary system.

"The dugong sanctuaries include the Hinchinbrook region, Cleveland Bay, Upstart and Ince Bays, the Newry Region and Hervey Bay. A further two areas are to be considered for listing shortly.

"The Commonwealth and Queensland Governments have endorsed the principle that there should be dugong sanctuaries at approximately 200km intervals along the coast.

Senator Hill has also directed the Great Barrier Reef Marine Park Authority (GBRMPA) to report on the threats posed to dugongs in the nine identified sanctuaries by certain fishing practices.

"I want GBRMPA to report by February 28 1996 on what action is necessary to ensure no further dugong mortality in the nine dugong sanctuaries.

"Fishing practices which may result in dugong mortality will not be permitted in these areas.

...12

18(P.54) HP6

Minister for Environment
Hon. Brian Littleproud, MLA

160 Ann Street • Brisbane Queensland • PO Box 155 • BRISBANE ALBERT STREET QLD 4002
Telephone (07) 3227 8819 • Facsimile (07) 3221 7082

PARLIAMENTARY STATEMENT BY HON. BRIAN LITTLEPROUD, MINISTER FOR ENVIRONMENT ON PLAN FOR DUGONG CONSERVATION

Mr Speaker, on Saturday, a meeting of the Great Barrier Reef Ministerial Council was held in Brisbane.

An important item on the agenda was emergency measures needed for dugong recovery and conservation for the Great Barrier Reef and adjacent areas.

The Ministerial Council adopted a recommendation that included confirmation that urgent action is required to ensure recovery of dugong populations in the Great barrier Reef and adjacent waters.

The council agreed to a list of nine interim Dugong Protection Areas (DPAs) and to consider listing a further two areas as the basis of a sanctuary system. The principle of having such areas at approximately 200 kilometre intervals was recognised.

The Great Barrier Reef Marine Park Authority, in co-operation with the Queensland departments of Environment and Primary Industries, and Queensland Fish Management Authority, is to report to both governments by February 28 next year on what action is necessary to ensure no further dugong mortality occurs as a result of commercial and recreational fishing practices in each of the protection areas.

The aim is to ensure that fishing practices which may result in dugong mortality will not be permitted in these areas. The report will be prepared in consultation with the fishing industry.

Other measures include:

- Legislation to require attendance at offshore set mesh nets;

- Enhanced surveillance and enforcement targeting areas of high dugong risk;

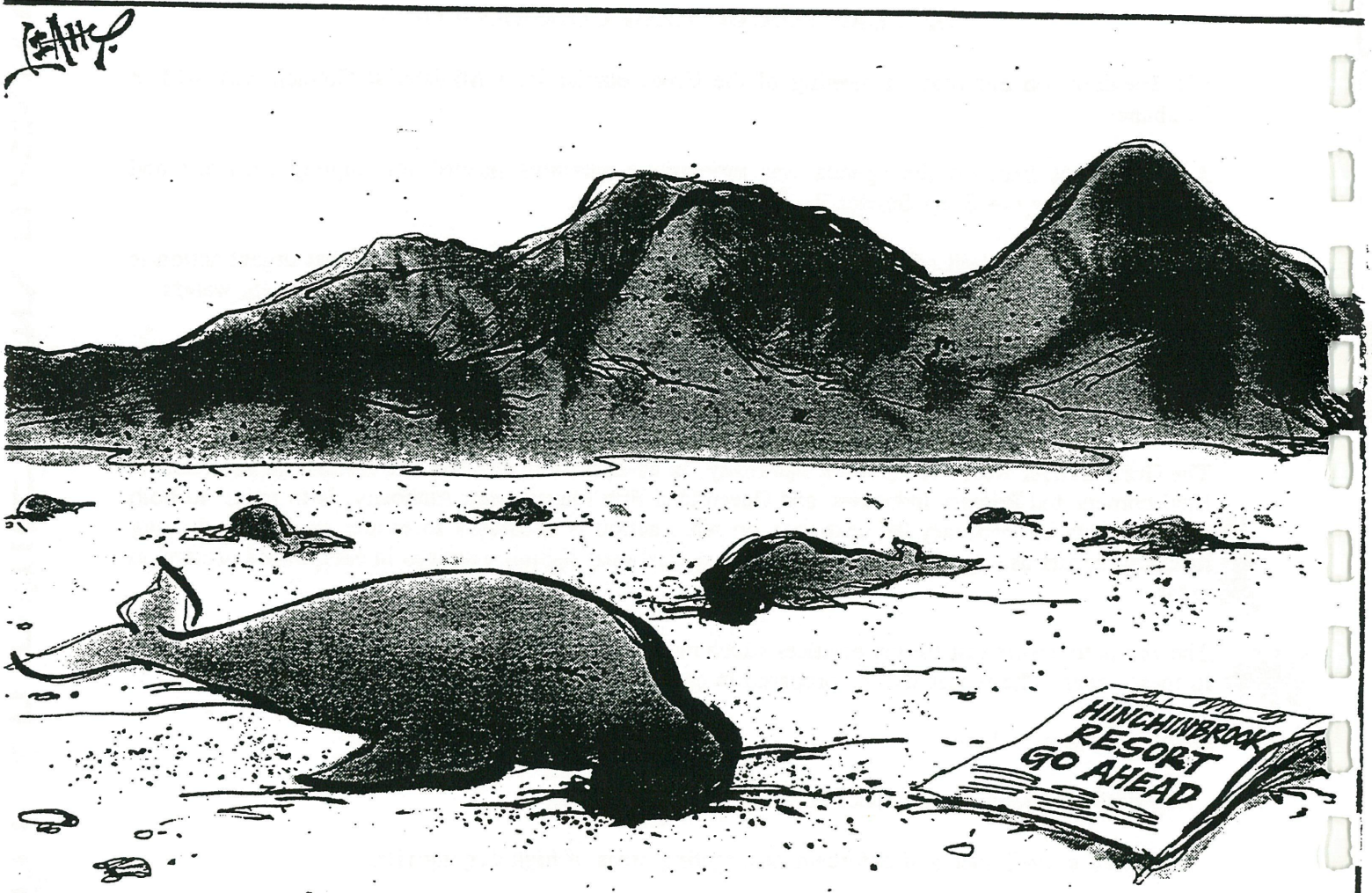
- Restrictions on the use of explosives by the Department of Defence;

- Addressing the issues of Aboriginal and Islander involvement in taking of dugong; and

- Asking for a report on the status of research into the health and distribution of seagrasses.

Mr Speaker, I seek leave of the House to table the resolution of the Great Barrier Reef Ministerial Council with regard to dugong and a map showing the interim Dugong Protection Areas.

18(p.55)



Valentine's Day Massacre

FAX Supplementary Report 18. (Suppl.

To TONY STOKES P.1

FRM Nina & Tony. 26/2/96

Morrissette Preen

Brief comments on comparison of sanctuary proposals

Table 1 of Preen and Morrissette records 99% of 1986\7 dugong population and 83% of the 1994 population estimate being contained in the sanctuaries. The estimates dugong sightings in each sanctuary in the attached table are different. The previous estimtes used the population estimates from the associated survey block. These were acknowledged to be overestimates : "*Some of the proportions of the population that may be contained within each sanctuary (Table 1) are over-estimates because the survey blocks used to estimate regional population sizes are often larger than the sanctuaries (most of the sightings, however, occurred within the sanctuaries).*" (P & M, pg 9).

The new table, comparing interim and modified sanctuaries, could not use this approach because some of the interim sanctuaries were far too small, relative to the survey blocks. Hence we compared on the basis of the actual number of dugongs seen in each sanctuary version. This is more precise, but arguably not more accurate, as it does not acknowledge the scale of movement dugongs routinely undertake.

Some of the interim sanctuaries (ince, newry) were too small to be of any value

Some of the new sanctuaries are necessary to, amongst other things, to reduce the gaps between sanctuaries.

Data on incidental sightings excludes transect surveys, carcasses and satellite locations. These data are number of records not number of dugongs ie. a record of a herd of 30 dugongs counts as 1 record, as does a sighting of 1 dugong.

Comparison of details of interim and modified dugong sanctuaries in the southern GBR

Sanctuary name		% dugong sightings on transect surveys			% incidental dug sightings		Distance (km) to next sanctuary to north		Area (km2)	% coastal waters in sanctuary	
Interim	Preen & Morissette	1986/7	1992	1994	Interim	P&M	Interim	Preen & M		Interim	P&M
HB/GSS							396				
	HB/GSS							180			
None		0	0	0	0				0	0	
	Rodd's Bay	4	4	7		3.4		190	510		3.5
SWB+PC		21	31	31	14.4		160		1050	5	
	SWB/PC	21	31	31		19.3		100	1080		5.5
Ince Bay		0	0	1	0.3		99		80	0.7	
	Cp Palmerstone	5	1	1		2.6		75	800		5.6
Newry		0	1	2	1.6		143		150	1.2	
	Newry/Repulse	11	3	2		3.7		100	752		5.2
None		0	0	0	0				0	0	
	Edgecumbe	8	3	1		2.9		80	412		2.5
Upstart Bay		4	3	2	4.2		124		193	1.5	
	Upstart Bay	4	3	2		4.2		65	193		1.5
Cleveland Bay		7.8	4	18	2.1		80		646	2.4	
	Cleveland/BowlingG Bay	13	7	21		11.2		80	1168		6.3
Hinchinbrook		8	8	24	11.7		473		694	2.6	
	Hinchinbrook	8	9	23		13.8		240	815		3
None		0	0	0	0				0	0	
	Low Isles	1	3	0		15.9		210	1268		1.5
Total		40	48	79	34.3		211 (average)			13.4	
	Total	74	66	89		77	(average) →	132			34.5

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% coastline in sanctuary		% coastal seagrass in sanctuary	
Interim	P&M	Interim	P&M
0		0	
	4.3		3.6
9.7		21.4	
	10.4		21.4
1.5		2.5	
	5.4		6.7
2.6		0.8	
	7.3		2.1
0		0	
	2.4		2.4
3.3		3.5	
	3.3		3.5
1.8		19.3	
	5.2		20.9
4.5		18.6	
	4.8		18.6
0		0	
	1		0
23.4		66.1	
	44.1		79.2

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MESH NETS USED IN WATERS OF QUEENSLAND'S EAST COAST:

The Risk to Dugongs in the Proposed Interim Dugong Protection Areas

Final Report
Version 2.0

Prepared by

Martin Russell

Effects of Fishing
Research and Monitoring
Great Barrier Reef Marine Park Authority

February 1997

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Mesh Nets in Waters of Queensland's East Coast: The Risk to Dugongs in the Proposed Interim Dugong Protection Areas

Executive Summary

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Introduction

The mesh net fishery in Queensland waters comprises of many different gear designs depending on the fishery symbol, the target species and location of fishing operation. The gear design is regulated under the *Queensland Fisheries Act 1994* by the *Queensland Fisheries Regulation 1995*, in which the net specifications that can be used in a specified location and how these nets are handled are described per fishery symbol. The purpose of this report is to provide information on the design principles of a mesh net, and the types of nets allowed to be used in the waters of Queensland's east coast and the proposed Interim Dugong Protection Areas (IDPAs). From basic design principles of these mesh nets an assessment of the risk a net design may pose to a dugong is given.

Mesh Nets in Waters of Queensland's East Coast and the Proposed Interim Dugong Protection Areas

The classification of gear can be defined as being a panel of net held vertically in the water column and either in contact with the sea bed or suspended from the sea surface. The nets are often made from almost invisible monofilament nylon strands. Target and non-target species passively encounter these nets and are either gilled, entangled or enmeshed. There are seven different mesh net designs identified in the *Queensland Fisheries Regulation 1995* for commercial use in Queensland waters: 1) Mesh Nets; 2) Set Mesh Nets; 3) Seine Nets; 4) Tunnel Nets; 5) Set Pocket Nets; 6) Ring Nets; and 7) Cast Nets.

Mesh Net Risk to Dugongs in the IDPAs

There must be a spatial and temporal overlap between the mesh nets and dugongs for capture to occur. A dugong must encounter the net before being caught in the mesh, and then retained in the net. When considering the capture of dugong, the only way of retaining an animal in a net is by entanglement. Mesh nets appear to be difficult for dugongs to detect, as they rely on eyesight at close range and touch sense to locate seagrass and obstacles. Dugongs appear to become entangled in mesh-nets by their appendages such as the tail and flippers, which shows that entanglement occurs after the dugong has encountered the net and attempts to pass through, around, under or over the net, ie an avoidance response.

For each of the IDPAs, there can be a variety of net designs used according to the location of fishing operation and the fishery symbol. Table 1a is derived from the *Queensland Fisheries Regulation 1995*. This table provides an indication of the specification 'ranges' of net design specifications for each IDPA. The mesh size will determine whether or not an appendage can pass through the mesh and become entangled. As shown in table 1a, a mesh net can range in mesh size from 25 mm to 245 mm depending on location of fishing operation and fishery

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symbol. A 245 mm mesh size may allow a dugong's flipper to pass through the mesh. In addition to this, the twine diameter and therefore the breaking strain will determine if an animal is able to break sections of the mesh and either break free or cause further entanglement. If a mesh size is too small for an appendage to pass through, only the breakage of the twine will allow the appendage to pass through the net and facilitate escape or cause further entanglement. Most importantly, the hanging ratio is a major determinant of capture and retention of an animal larger than the mesh size. A mesh net with a low hanging ratio (E <0.5) will be slack while set in the water column, and a mesh net with a high hanging ratio (E>0.5) will be taut. An encounter with a net by an animal larger than the mesh size, will result in entanglement more easily in a slack net than a taut net. A mesh net designed to not capture a dugong would therefore need to have a very high hanging ratio of close to 0.7. In addition to this the net should break easily during an avoidance response by the dugong, and therefore would need a very fine twine diameter and a large mesh size (this 'may' facilitate breakage of the twine, as a net with a small mesh size such bait nets used in Queensland waters would pose a greater barrier against breakage even with a fine twine diameter and high hanging ratio). Such a net described above would be very inefficient at catching most fin-fish species targeted by the Queensland net fishery.

The mesh net gear designs are relatively non destructive to the environment, and any measure to make them further environmentally friendly is seen to be very difficult. The gear design can be varied according to the target species, and also to reduce by-catch, but due to the effectiveness of entangling large animals such as dugong, it would be very difficult to eliminate dugong as a by-catch from a particular mesh net design.

The IDPAs that a fishery symbol can be used in are given in table 1b. A fisher with an symbol of N1, N6, or N7 may operate in all tidal waters of any IDPA. These symbols are held by 90% of the licensed net fishers in the Queensland east coast net fishery.

The capture and retention of a dugong in a mesh net is determined firstly by the nets location relative to dugong distribution secondly by the usage of the net and thirdly by the nets resistance to the avoidance response movements by the dugong after the encounter with the net. In conclusion, any mesh net or set mesh net used in an area inhabited by dugong pose a threat of capture to those animals. These net designs are efficient at entangling animals larger than the mesh size, and the degree of entanglement depends on the hanging ratio of the net as well as the breaking strain and the mesh size. Any seine net, tunnel net, set pocket net or ring net used in an area inhabited by dugong pose some threat of capture to those animals depending on the method and location of use. A dugong encountering these net designs will react with an avoidance response which may cause capture similar to that of the target species, ie being guided into the net. A cast net due to the small size and minimal soak time poses little or no threat of capture to dugong. Therefore it is the spatial and temporal overlap between mesh nets and dugongs that is of concern rather than the net design and specifications.

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Table 1a. Summary of all net specification ranges for each IDPA. A net, depending on the design, location of fishing operation and symbol can be used within these specification ranges in a IDPA.

IDPA	Net Length Range (m) All Net Designs	Mesh Size Range (mm) All Net Designs	Twine Diameter max (mm) All Net Designs (if given)
Great Sandy Strait	120 to 800 (1700 tunnel)	25 to 245	0.65
Southern Hervey Bay	120 to 800	12 to 245	0.65
Port Clinton	120 to 600	12 to 245	
Shoalwater Bay	120 to 600	12 to 245	
Ince Bay	120 to 600	12 to 245	
Newry Bay	120 to 600	12 to 245	
Upstart Bay	120 to 600	12 to 245	
Cleveland Bay	120 to 600	12 to 245	
Hinchinbrook Region	120 to 600	12 to 245	

Table 1b. Summary of the net design, the number of QFMA fishing symbols and the IDPAs that a fishery symbol can be used in.

Symbol	Net Design	QFMA Fishery Symbols	IDPA	Area
N1	Mesh/ Seine Net	1022	All	All tidal waters
N2	Mesh Net	272	All but not Great Sandy Strait	All tidal waters
N4	Seine Net	70	Great Sandy Strait	Within 400 m of h.w.l
N5	Mesh/ Seine Net	4	Great Sandy Strait; Southern Hervey Bay	All tidal waters
N6	Mesh/ Seine Net	1965	All	All tidal waters
N7	Mesh/ Seine Net	9	All	All tidal waters
N8	Mesh Net	2	All but not Great Sandy Strait and some of Hinchinbrook Region	Out from 3 nm line

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1. INTRODUCTION

Mesh-nets have been identified as a major cause of dugong population decline in waters of the southern Great Barrier Reef World Heritage Area (GBRWHA). Nine Interim Dugong Protection Areas (IDPAs) have been proposed to eliminate potential causes of dugong mortality in the GBRWHA. The mesh-net fishery in Queensland waters comprises many different gear designs. The type of gear employed depends on the target fish species. The gear design is regulated under the *Queensland Fisheries Act 1994* by the *Queensland Fisheries Regulation 1995*, in which the types of nets that can be used in a specified location and how these nets are handled are described.

The purpose of this paper is to provide information on the design principles of a mesh-net and the types of nets allowed to be used in the GBRWHA and the IDPAs. A mesh-net design in Queensland waters can vary in specification according to the *Queensland Fisheries Regulation 1995*. From basic design principles of these mesh-nets and their efficiency at capturing target and by-catch species, an assessment of the risk a net design may pose to a dugong is given.

2. TYPES OF MESH-NETS

The classification of gear can be defined as being a panel or panels of net held vertically in the water column and either in contact with the sea bed or suspended from the sea surface. The nets are often made from almost invisible monofilament nylon strands. The netting or mesh is the actual panel of mesh that fish will encounter and be retained in. Fish passively encounter these nets and are either gilled (the strands lock behind the opercula of bony fish or the gill slits of sharks), entangled (the fish are held by the teeth, maxilla and other projections, not necessarily caught by the gill covers) or enmeshed (held tightly around the body by a mesh). The net is held open by a combination of floats on the headline and weight on the ground line.

Schedule 13 of the *Queensland Fisheries Regulation 1995* details usage of nets in Net Fisheries (Commercial) for Queensland waters. There are eight fishery symbols or endorsements included in Schedule 13, seven of which are for the Queensland east coast. The following fish may be taken under this schedule: black or spotted jewfish; blue salmon; grey mackerel; jewel fish; king salmon; queenfish; spotted grunter bream; barramundi (certain restrictions); other fish taken while taking fish mentioned.

There are seven different mesh-net designs identified in the *Queensland Fisheries Regulation 1995* for commercial use in Queensland waters. Each design can have many different specifications depending on the target species and area of use. The seven designs are as follows:

2.1 Mesh-Nets

A mesh-net is set with the float line on the sea surface (positively buoyant) or suspended sub-surface by weights on the lead line(negatively buoyant), and is not fixed to a place or hauled.

2.2 Set Mesh-Nets

A mesh-net is set with the float line on the sea surface (positively buoyant) or suspended sub-surface by weights on the lead line (negatively buoyant). The net is used to take fish by anchoring or fixing it to a place. When this particular net is set as a surface set mesh net, a rapid sink rate of the lead line is not required, so the weight is kept to a minimum. This minimal weight on the lead-line allows a mesh greater selection by size of species taken, with larger sized fish tangling easily in the slack net.

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2.3 Seine Nets

In its simplest configuration consists of a long panel of netting which is dragged around shoreline schools of fish (King, 1995). The net is weighted to keep the lead-line in contact with the sea floor, and has floats to keep the float line at the sea surface. Some nets have a central panel of loose netting which forms a bunt or codend to retain fish.

2.4 Tunnel Nets

The net is constructed of 2 long wings and a central pocket or 'tunnel'. An area in which fish concentrate, or a school of fish, is located at high tide and the net is staked in position to form a large arrow shape with the wing ends circling inwards to lead escaping fish back into the net. The net relies on fish encountering the net as they move with the receding tide. The fish become concentrated in the tunnel, which remains in the water at low tide. The tunnel section is finally lifted onboard a dinghy and emptied (Kailola, et al 1993).

2.5 Set Pocket Net

The gear resembles a small mesh prawn trawl and can be set in two ways. The first has the net staked by the wing ends across the current, using the current to open the net and direct the target fish into it. The second has the net set into the current with stakes along the net to hold it open. The net is set close to the shore.

2.6 Ring Nets

Also called an encircling net , is a net shot from a boat to encircle fish by hauling one end of the net around the other to form a figure six.

2.7 Cast Nets

This form of net is circular and can be up to 6 metres in diameter (*Queensland Fisheries Regulation 1995*). The net is thrown onto the surface of the water and sinks rapidly with the assistance of weights on the outer edge. This form of net is not set in the water, and is attended constantly.

3. MESH-NET GEAR SPECIFICATIONS

3.1 Mesh Size :

The mesh size is measured as the distance between the centre of two knots in the same mesh when the netting is fully extended or stretched, and is called the stretched mesh length (figure 1). Mesh sizes can vary according to the species of fish targeted.

a = stretched mesh size
b = hung distance
c = depth of mesh after hanging

$$c = \sqrt{(a^2 - b^2)}$$

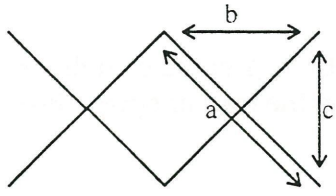

Figure 1. Mesh size diagram

3.2 Hanging Ratio (E) :
The hanging ratio determines how taut or slack a net is while fishing. The formula for calculating the hanging ratio (E) is as follows:

E = Float Line Length/ Stretched Length of Net
(Where the stretched length of net = Number of meshes x stretched mesh size.)
The maximum E value that can be achieved is 0.7071, which achieves the maximum selectivity of target species by size. An example of how the E value can be varied is for Hinchinbrook Channel:

eg.1 120 m float line (maximum allowed, Qld Fisheries Regulations 1995)
1200 meshes
150 mm stretched mesh size (minimum allowed)

E = 120/ (1200 x 0.15)
E = 0.66 (a high E value, close to the maximum selectivity E of 0.7071)

eg.2 for Hinchinbrook Channel
120 m float line (maximum allowed)
1200 meshes
215 mm stretched mesh size (maximum allowed)

E = 120/ (1200 x 0.215)
E = 0.46 (a low E value, less than 0.5)

When E is less than 0.5, it is regarded as an entanglement net.

Another method for working out E is:
E = b/a (figure 1)

3.3 Twine Diameter:
The twine diameter used for mesh-nets can vary according to the target species and the mesh size. The *Queensland Fisheries Regulation 1995* does not state the maximum or minimum allowable twine diameter for all Queensland mesh-net symbols. The only stated regulation is for fishery symbol N1, N5 and N8, in waters south of Elliot River, where the maximum twine diameter is 0.65mm. The twine diameter dictates the breaking strain of a net, and a general rule of thumb for twine breaking strain is:

0.05mm => breaking strain approx. 1 to 2 kg.
2.5 mm => breaking strain approx. 200 to 300 kg.

4. MESH-NET SELECTIVITY AND EFFICIENCY

4.1 Selectivity :
For an animal to be captured in a mesh-net, the animal must:
- overlap in the net range (space and time);
- encounter the net;
- gill, entangle or enmesh in the net; and then
- be retained in the net.

The selectivity (S) of a mesh-net = the proportion of animals captured and retained divided by those encountering the net. The assumption for this is the probability of encounter does not vary with animal size.

Therefore the selectivity of fish being gilled in a mesh-net is given in figure 2. The highest selectivity occurs at the optimum fish length. Curves are traditionally bell-shaped and multi-modal. The right hand side could be large fish caught by the head while the left side could be smaller fish wedged by their body.

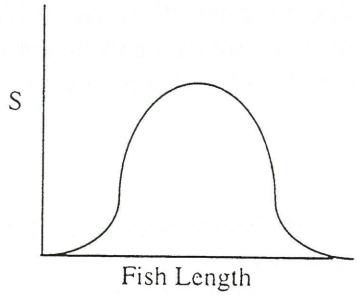

Figure 2. Mesh-net selectivity curve for fin fish

The effect of the hanging ratio on any selectivity curve will be to flatten it as the E value decreases. As the E value drops below 0.5 it becomes a tangle net and thus becomes less selective. The only way an animal larger than the mesh size can be retained in a mesh-net, is to be entangled. The lower the E value, the greater the probability of entanglement. The selectivity curve for animals larger than the mesh size will not be a bell shape as for fish, but a curve approximately as shown in figure 3. As the E value is increased (net becomes more taut), the number of animals retained in the net decreases.

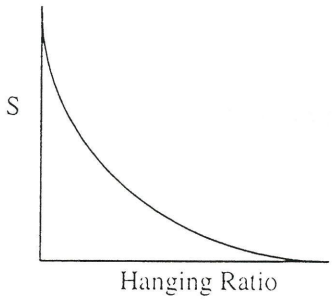

Figure 3. Selectivity curve for animals larger than the mesh size that are entangled in a mesh-net.

4.2 Efficiency:

The best net for capturing a species of fish is a design with a specific combination of twine diameter, hanging ratio and mesh size. Whether the fish is to be caught by gilling or entanglement will depend mainly on the hanging ratio. The following net specifications are a guide to the capture:

- Twine Diameter:
  If the mesh-net has a very fine twine diameter of 0.05, the strands have a breaking strain of around 1 to 2 kg, and if the mesh-net has a heavy twine diameter of 2.5 mm, the strands have a breaking strain of around 200 to 300 kg. If the vector force required to break the twine is applied at <60°, the twine will break, but if applied > 60°, the twine will not break (figure 4). As in mesh-net designs, the vector force will increase in angle with the decrease in hanging ratio. Secondly, the meshing of twine in a net creates added resistance to breakage, and therefore a greater than normal vector force is required to break through the twine.

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Therefore the strength of a net is not only gauged by the twine diameter, but also by the hanging ratio. The lower the E value (the more slack the net), the higher the mesh strength.



Figure 4. (a) Vector force applied to a twine strand at less than 60 ° and (b) greater than 60°. The strand shown in (b) should break given the vector force required to break that twine diameter.

- Hanging Ratio (E):
  The lower the E value, the more flexible or loose a net will be. A loose net will entangle an animal easier than a taut net.

  High E => low capture probability for animals larger than mesh size.
  Low E => high capture probability for animals larger than mesh size.

- Mesh Size:
  There are two categories of size that effect the selectivity of a mesh-net:

  1) Mesh size allows an appendage or body part to pass through the mesh.
  2) Mesh size does not allow an appendage or body part to pass through the mesh.

  If either 1) or 2), the retention of the animal will depend on the twine diameter and the E value, but most importantly the E value.

The following is a guide for net design and the corresponding strength and capture efficiency, given a force needed to break a particular twine diameter:

High E + Large Mesh Size =	Should Break
High E + Small Mesh Size =	Should/ May Break
Low E + Small Mesh Size =	May Entangle
Low E + Large Mesh Size =	Will Entangle

From this the following can be deduced:
- any net with Low E value may or will entangle a broad size range of animals;
- any net with High E value but Small Mesh Size may break; and
- any net with High E value and Large Mesh Size should break.

Therefore as King, (1995) states 'The main advantage of mesh-nets is that they are highly selective; that is, they usually have a mesh size designed to catch fish of a specific size range, and do not gill very small fish and very large fish. The main determinant of the range of lengths of fish caught by mesh-nets is the hanging ratio. If the hanging ratio is low, say less

than 0.5, the net will hang slack in the water rather than taut. In this case the net becomes less selective, as it will entangle fish as well as gill them. Some nets, referred to as tangle nets are deliberately made this way.'

5. MESH-NET SELECTIVITY/ RISK FOR DUGONGS

There must be a spatial and temporal overlap between the mesh-nets and dugongs for capture to occur. A dugong must encounter the net before being caught in the mesh, and then retained in the net. When considering the capture of dugong, the only way of retaining an animal in a net is by entanglement. Mesh-nets appear to be difficult for dugongs to detect, as they rely on eyesight at close range and touch sense to locate seagrass and obstacles. A mesh-net will only capture a dugong if that dugong attempts to swim through the net. Dugongs appear to become entangled in mesh-nets by their appendages such as the tail and flippers, which indicates that entanglement occurs after the dugong has encountered the net and attempts to pass through, around, under or over the net, ie an avoidance response. As discussed in section 3, the mesh size will determine whether or not an appendage can pass through the mesh and become entangled. In addition to this, the twine diameter and therefore the breaking strain will determine if an animal is able to break sections of the mesh and either break free or cause further entanglement. Most importantly the hanging ratio is the major determinant of capture and retention of an animal larger than the mesh size. A mesh-net with a low hanging ratio (E<05) will be slack while set in water column, and a mesh-net with a high hanging ratio (E>0.5) will be taut. An encounter with a net by an animal larger than the mesh size, will result in entanglement more easily in a slack net than a taut net. A mesh-net designed to not capture a dugong would therefore need to have a very high hanging ratio. In addition to this the net should break easily during an avoidance response by the dugong, and therefore would need a very fine twine diameter and a large mesh size (this may facilitate breakage of the twine, as a net with a small mesh size such as a bait net used in Queensland waters would pose a greater barrier against breakage even with a fine twine diameter and high hanging ratio).

A mesh net, surface set mesh-net or bottom set mesh-net are efficient at entangling animals larger than the mesh size, and the degree of entanglement depends on the hanging ratio of the net as well as the breaking strain and mesh size. A seine net, tunnel net, set pocket net or ring net used in an area inhabited by dugong poses some threat of capture to those animals. This of course will depend on where and how these nets are used. A seine net may be regarded as a high activity net, which can cause enough 'noise' to scare any dugongs in the area away from the net, but if fish are successfully herded into a seine net, then there is also the possibility of a dugong being herded into the net. A tunnel net, a set pocket net and a ring net may be regarded in the same way, and still pose some threat to a dugong encountering the net and triggering an avoidance response which causes capture similar to that of the target species, ie being guided into the net. A cast net due to the small size and minimal soak time would pose very little if not no threat to a dugong.

Therefore the capture and retention of a dugong in a mesh-net is determined firstly by the nets location relative to dugong distribution, secondly by the method of using the net and thirdly by the nets resistance to avoidance movement by the dugong after the encounter.

6. QUEENSLAND MESH-NET REGULATIONS

Schedule 13 of the *Queensland Fisheries Regulation 1995* describes each fishery symbol for waters of Queensland. Table 1 summarises the *Queensland Fisheries Regulation 1995* for the Queensland east coast net fishery in 'fishery symbol' order. As the table is a summary, not all details of the regulations are included, only the relevant information for net design and fishing practice. The type of apparatus for use under a fishery symbol can be summarised as follows:

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- All tidal waters on the east coast of Queensland:

  N1 - mesh/ seine/ tunnel/ set pocket nets
  N2 - mesh-net, 800 metre attendance rule
  N6 - mesh bait/ seine bait nets
  N7 - mesh bait/ seine bait nets

- All tidal waters within 400 metres of high water on ocean beaches between Breaksea Spit (Fraser island) to the Qld/NSW border:

  N4 - seine nets

- All tidal waters between the northern bank of Baffle Creek and the southern bank of Kauri Creek:

  N5 - mesh/ seine/ tunnel nets

- All tidal waters on the east coast of Queensland out to sea from the 3 nautical mile line:

  N8 - mesh-nets

Mesh-nets can range in specifications from 120 to 600 metres net length, and from 50 to 245 mm mesh size. A bait net however, can range from 200 to 800 metres net length, and from 12 to 88 mm mesh size. Depending on the target species and location of use, the net design can vary considerably. An example of the complexity is for Hinchinbrook Channel:

- N1 symbol for Net Fishery (east coast No.1):

  Waters in rivers and creeks:

  Mesh Net
  length 400 m;
  min mesh size 50 mm (no max, but 50 to 115 mm during barramundi season)

  Seine Net
  length 200 m;
  min mesh size 50 mm (no max, but 50 to 115 mm during barramundi season)

  Offshore waters (in at least 2 m of water):

  Mesh-Net
  length 600 m;
  mesh size 150 to 245 mm

  Other waters

  Mesh/ Seine Net
  length 400 m
  min mesh size 50 (no max, but 50 to 115 mm during barramundi season)

- N2 symbol for Net Fishery (Set Net - east coast):

  Hinchinbrook Channel and tributaries:

  Mesh-net
  length 120 m;
  mesh size 150 to 215 mm.

- N6 symbol for Net Fishery (Bait No. 1:

  Waters other than rivers and creeks:

  Mesh Bait/ Seine Bait Net
  length 400 m;
  mesh size 12 to 45 mm

  Rivers and Creeks:

  Mesh Bait/ Seine Bait Net
  length 200 m;
  mesh size 25 to 45 mm.

7. Interim Dugong Protection Areas

Mesh-netting has been identified as a major threat to dugongs. A list of nine Interim Dugong Protection Areas (IDPAs) have been proposed to eliminate the risk of dugong capture in mesh-nets in these areas. Figure 5 is a detailed map of the Queensland east coast showing the IDPAs and all relevant rivers, bays, lakes etc mentioned in the *Queensland Fisheries Regulation 1995*.

The *Queensland Fisheries Regulation 1995,* Schedule 13 details where a specific net design can and cannot be used. Table 2 is an extract summary of table 1, providing the regulations by 'location' for each of the IDPAs. For each of the IDPAs, there can be numerous mesh-net specifications depending on the location within the IDPA, and the fishery symbol.

Therefore due to the complexity of the *Queensland Fisheries Regulation 1995*, tables 1 and 2 give the briefest description of what mesh-net specifications are allowed under the *Queensland Fisheries Regulation 1995* for each of the IDPAs. To provide an overview of the type of nets allowed to be used in each IDPA, a range of net specifications is provided in table 3. This table details a range of all net design specifications allowed in a IDPA. A net within the specification ranges given can be used in the IDPAs depending on the fishery symbol held by a fisher and location of operation. The IDPAs that a fishery symbol can be used in are given in table 4. A fisher with a symbol of N1, N6, or N7 may operate in all tidal waters of any IDPA. These symbols are held by 90% of the endorsed fishers in the Queensland east coast net fishery

8. CONCLUSION

Mesh-nets are very efficient and selective at catching a target species. They are however, also efficient at entangling animals larger than the mesh size that are unable to detect a net as an obstacle, such as dugong. The entanglement and retention of a dugong in a mesh-net requires the dugong to encounter the net and then become entangled as a result of an avoidance response. Dugongs may die as a result of drowning or stress whilst entangled in a mesh-net, or

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are killed by fishers to simplify their removal from the net. Studies show that dugongs are susceptible to death from capture stress and they may subsequently die in spite of being released alive from the net (Marsh and Anderson 1983). Rescue techniques have proved to be difficult and are mostly unsuccessful.

The mesh-net gear design is relatively non destructive to the environment, and any measure to make them further environmentally friendly is seen to be very difficult. The gear design can be varied according to the target species, and also to reduce by-catch, but due to the effectiveness of entangling large animals such as dugong, it would be very difficult to eliminate dugong as a by-catch from a particular mesh-net design. If a mesh-net could be designed to not catch dugong, it would need to have the highest hanging ratio, a very light twine diameter, and a large mesh size allowing appendages to pass through (this 'may' facilitate breakage of the twine). Such a net would be very inefficient at catching the fin fish species targeted by the Queensland net fishery.

The capture and retention of a dugong in a mesh net is determined firstly by the nets location relative to dugong distribution, ie a spatial and temporal overlap, secondly by the method of using of the net and thirdly by the nets resistance to the avoidance response movements by the dugong after an encounter with the net. In conclusion, any mesh net or set mesh net used in an area inhabited by dugong pose a threat of capture to those animals. These net designs are efficient at entangling animals larger than the mesh size, and the degree of entanglement depends on the hanging ratio of the net as well as the breaking strain and the mesh size. Any seine net, tunnel net, set pocket net or ring net used in an area inhabited by dugong pose some threat of capture to those animals depending on the method and location of use. A dugong encountering these net designs will react with an avoidance response which may cause capture similar to that of the target species, ie being guided into the net. A cast net due to the small size and minimal soak time poses little or no threat of capture to dugong. Therefore it is the spatial and temporal overlap between mesh nets and dugongs that is of concern rather than the net design and specifications.

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Figure 5. Location of Interim Dugong Protection Areas

(1. Boundaries of individual areas may be altered in discussion with stakeholders

2. ▨ Proposed, subject to discussion in the current review of the Far Northern Section Zoning Plan of the GBRMP)

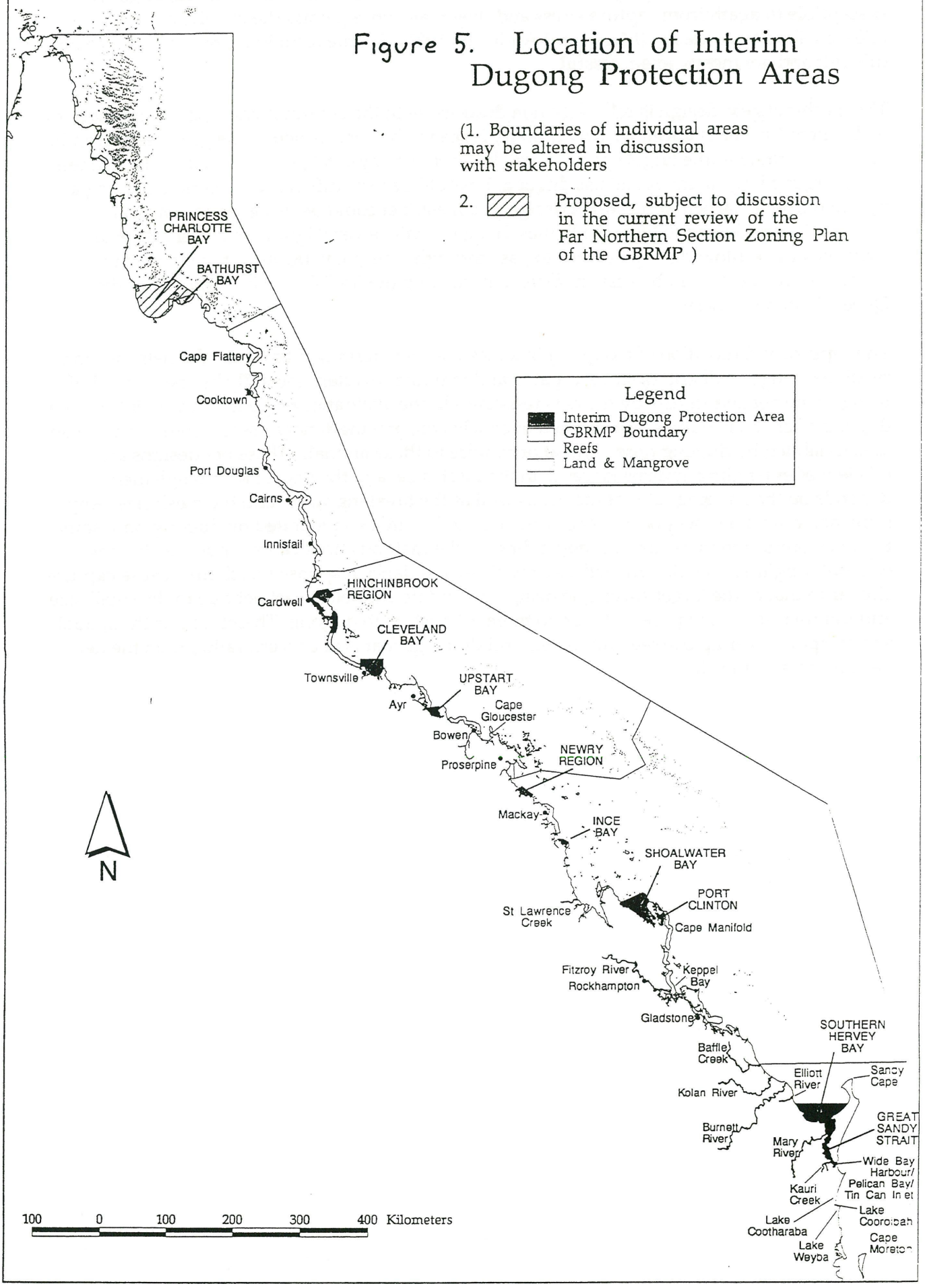

Table 1. *Queensland Fisheries Regulation 1995*, Schedule 13, Net Fisheries (Commercial) summary for the Queensland east coast.

N1 **1022 Symbols**	**NET FISHERY (East Coast No. 1)** **All tidal waters on the east coast of Queensland**			**100 m attendance rule unless otherwise stated**
		MESH NET		
Location	**Net length max (metres)**	**Mesh Size min (mm)**	**Twine Diameter max (mm)**	**Additional Regulations**
Lake Cootharaba; Cooroibah; Weyba	1500	50		
Hervey Bay	600	88		In at least 2 m of water not fixed or hauled
South of Elliot River	600	88	0.65	33 meshes deep maximum
North of Elliot River	600	88		Need not be within 100 m of it
South of Baffle Creek	800	50		
North of Baffle Creek	400	50		115 mm mesh size max in barramundi closed season
Cape Manifold to Cape Gloucester		88		Both ends of net may be fixed for 1 hour
Keppel Bay	200	150 to 245		In at least 2 m of water
Offshore Waters	600	150 to 245		In at least 2 m of water. 2 nets may be joined in waters deeper than 20 m Need not be within 100 m of it unless in Shoalwater Bay.
Offshore waters North of Cape Moreton	600	150 to 245		Two nets may be joined (max 1200 m)
Rivers and Creeks	400	50		115 max mesh size in barramundi closed season
Cape Gloucester to St Lawrence Creek		75		Both ends of net may be fixed for 1 hour
Rivers and Creeks between Kauri and Baffle Creeks	120	150 to 215		50 meshes deep 3 nets max Distance between first and last net 1 mile 800 m attendance rule
Foreshore nets between Burnett River and Baffle Creek	120	100 to 245		50 meshes deep

Table 1. Cont...

N1 1022 Symbols	NET FISHERY (East Coast No.1) All tidal waters on east coast of Queensland			100 m attendance rule unless otherwise stated
		SEINE NET		
Location	Net length max (metres)	Mesh Size min (mm)	Twine Diameter max (mm)	Additional Regulations
Lake Weyba	25	25		
North of Mary River	100	31 pocket 45 remainder		Prawns only
South of Baffle Creek	800	50		
North of Baffle Creek	400	50		115 mm max mesh size in barramundi closed season
Rivers and Creeks	200	50		115 mm max mesh size in barramundi closed season
Cape Gloucester to St Lawrence Creek	200	75		
Set pocket nets used in the Fitzroy, Kolan, Albert and Logan Rivers	10	25		Need not be within 100 m of it
Tunnel nets used in Moreton Bay, Tin Can Inlet, Pelican Bay, Tin Can Bay, Great Sandy Strait and Wide Bay Harbour	1700 200 tunnel	50 tunnel 25 for 400 m each side 44 rest		1.5 to 4 m tunnel entrance

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Table 1. Cont...

N2 272 Symbols	NET FISHERY (SET NETS-East Coast) All tidal waters on the east coast of Queensland			800 m attendance rule unless otherwise sated
		MESH NET		
Location	Net length max (metres)	Mesh Size min (mm)	Twine Diameter max (mm)	Additional Regulations
Baffle Creek to Cape Flattery- foreshores	600	100 to 215		North of St Lawrence Creek 115 mm mesh size max in barramundi closed season. 3 nets max Distance between first and last 1 mile.
Kauri Creek to Cape Flattery- Rivers and Creeks	120	150 to 215		50 meshes deep 3 nets max Distance between first and last 1 mile
Hinchinbrook Channel and tributaries	120	150 to 215		50 meshes deep 3 nets max Two nets may be joined Distance between first and last 1 mile.
North of Cape Flattery- Rivers and Creeks	120	150 to 215		50 meshes deep 6 nets max Distance between first and last 1 mile.
North of Cape Flattery- Foreshores	600	150 to 215		1/3 of net max may extend beyond low water. 6 nets max. Distance between first and last 1 mile.

Table 1. Cont...

N4 70 Symbols	NET FISHERY (Ocean Beach) All tidal waters within 400 metres of high water on ocean beaches between Breaksea Spit (Fraser Island) to the Qld/NSW border.			Seine Nets only between 1 April to 31 August
		SEINE NET		
Location	Net length max (metres)	Mesh Size min (mm)	Twine Diameter max (mm)	Additional Regulations
North of the S/E tip of North Stradbroke Island	200 to 500	50 to 70		150 meshes deep for at least ½ of length
South of the S/E tip of North Stradbroke Island	150 to 500	50 to 70		150 meshes deep for at least ½ of length

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Table 1. Cont...

N5 4 Symbols	NET FISHERY (BAFFLE CREEK TO KAURI CREEK) All tidal waters between the northern bank of Baffle Creek and the southern bank of Kauri Creek			100 m attendance rule unless otherwise stated 1 end may be fixed
		MESH NET		
Location	Net length max (metres)	Mesh Size min (mm)	Twine Diameter max (mm)	Additional Regulations
All waters in this fishery area unless otherwise stated	800	50		
Offshore waters	600	150 to 245		In at least 2 m of water Need not be within 100 m of it
North of Cape Moreton-offshore waters	600	150 to 245		2 nets may be joined in waters deeper than 20 m Need not be within 100 metres of it
Rivers and Creeks	400	50		115 mm mesh size max in barramundi closed season
Hervey Bay	600	88		In at least 2 m of water Closed between 1 July to 31 October
South of Elliot River	600	88	0.65	33 meshed deep
North of Elliot River	600	88		Need not be within 100 m of it
Rivers and Creeks-Set mesh-nets	120	150 to 215		50 meshes deep 3 nets max Distance between first and last 1 mile. 800 m attendance rule
Burnett River to Baffle Creek- foreshores	120	100 to 215		50 meshes deep 1 September to 1 February closure

Table 1. Cont...

N5	NET FISHERY (BAFFLE CREEK TO KAURI CREEK) All tidal waters between the northern bank of Baffle Creek and the southern bank of Kauri Creek			100 m attendance rule unless otherwise stated 1 end of net may be fixed
		SEINE NET		
Location	Net length max (metres)	Mesh Size min (mm)	Twine Diameter max (mm)	Additional Regulations
All waters in this fishery area unless otherwise stated	800	50		
Rivers and Creeks	200	50		115 mm max mesh size in barramundi closed season
Tunnel Nets used in Great Sandy Strait and Wide Bay Harbour	1700 200 tunnel length	50 tunnel 25 for 400 m each side 44 rest		1.5 to 4 m tunnel entrance

Table 1. Cont...

N6 1965 Symbols	NET FISHERY (Bait No. 1) All tidal waters on the east coast of Queensland			100 m attendance rule unless otherwise stated
		MESH NET		
Location	Net length max (metres)	Mesh Size min (mm)	Twine Diameter max (mm)	Additional Regulations
Burnett River to Sandy Cape (Fraser Island)	600	12 to 45		Only 1 end of the net may be fixed
North of Burnett River	400	12 to 45		Only 1 end of the net may be fixed
Moreton Bay	400	12 to 45		Only 1 end of the net may be fixed
Hervey Bay	400	12 to 45		Only 1 end of the net may be fixed
Great Sandy Strait	400	12 to 45		Only 1 end of the net may be fixed
Wide Bay Harbour	400	12 to 45		Only 1 end of the net may be fixed
Pelican Bay	400	12 to 45		Only 1 end of the net may be fixed
Tin Can Inlet	400	12 to 45		Only 1 end of the net may be fixed
Rivers and Creeks	200	25 to 45		Only 1 end of the net may be fixed
		SEINE NET		
Location	Net length max (metres)	Mesh Size min (mm)	Twine Diameter max (mm)	Additional Regulations
Burnett River to Sandy Cape (Fraser Island)	600	12 to 45		Only 1 end of the net may be fixed
North of Burnett River	400	12 to 45		Only 1 end of the net may be fixed
Moreton Bay	400	12 to 45		Only 1 end of the net may be fixed
Hervey Bay	400	12 to 45		Only 1 end of the net may be fixed
Great Sandy Strait	400	12 to 45		Only 1 end of the net may be fixed
Wide Bay Harbour	400	12 to 45		Only 1 end of the net may be fixed
Pelican Bay	400	12 to 45		Only 1 end of the net may be fixed
Tin Can Inlet	400	12 to 45		Only 1 end of the net may be fixed
Rivers and Creeks	200	25 to 45		Only 1 end of the net may be fixed

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Table 1. Cont...

N7 9 Symbols	NET FISHERY (Bait No. 2) All tidal waters on the east coast of Queensland			100 m attendance rule unless otherwise stated
		MESH NET		
Location	Net length max (metres)	Mesh Size min (mm)	Twine Diameter max (mm)	Additional Regulations
South of Baffle Creek	800	50		115 mm max mesh size in barramundi closed season Only 1 end of the net may be fixed
North of Baffle Creek	400	50		115 mm max mesh size in barramundi closed season Only 1 end of the net may be fixed
Cape Manifold to Cape Gloucester		88		Both ends of net may be fixed for 1 hour
		SEINE NET		
Location	Net length max (metres)	Mesh Size min (mm)	Twine Diameter max (mm)	Additional Regulations
South of Baffle Creek	800	50		115 mm max mesh size in barramundi closed season Only 1 end of the net may be fixed
North of Baffle Creek	400	50		115 mm max mesh size in barramundi closed season Only 1 end of the net may be fixed

Table 1. Cont...

N8 2 Symbols	NET FISHERY (East Coast No. 2) All tidal waters on the east coast of Queensland out to sea from the 3 nautical mile line			100 m attendance rule unless otherwise stated
		MESH NET		
Location	Net length max (metres)	Mesh Size min (mm)	Twine Diameter max (mm)	Additional Regulations
North of Hervey Bay	600	88		In at least 2 m of water
South of Elliot River	600	88	0.65	In at least 2 m of water 33 meshes deep
North of Elliot River, east of 153°	600	88		Need not be within 100 m of it.
Other offshore waters	600	150 to 245		In at least 2 m of water Two nets may be joined in waters deeper than 20 m.
Hervey Bay				Closed between 1 July to 31 October

Table 2. *Queensland Fisheries Regulation 1995*, Schedule 13, Net Fisheries (Commercial) summary for each IDPA by 'location'.

	GREAT SANDY STRAIT	MESH NETS			
Fishery Symbol	Location	Net length max (metres)	Mesh Size min (mm)	Twine Diameter max (mm)	Additional Regulations
N1	South of Elliott River	600	88	0.65	33 meshes deep max
N5	South of Elliott River	600	88	0.65	33 meshes deep
N1	Offshore waters	600	150 to 245		In at least 2 m of water Need not be within 100m of it 2 nets may be joined in waters deeper than 20 m
N1	Rivers and Creeks	400	50		115 max mesh size in barramundi closed season
N5	Rivers and Creeks	400	50		115 mm max mesh size in barramundi closed season
N6 Bait	Rivers and Creeks	200	25 to 45		Only 1 end of net may be fixed
N1	Rivers and Creeks between Kauri and Baffle Creeks	120	150 to 215		50 meshes deep 3 nets max Distance between first and last net 1 mile 800 m attendance rule
N2 Set Net	Kauri Creek to Cape Flattery- River & Creeks	120	100 to 215		3 nets max 800m attendance rule Distance between first and last net 1 mile
N5	Baffle to Kauri Creeks-offshore waters	600	150 to 245		2 nets may be joined in waters deeper than 20 m Need not be within 100 m of it
N5	Baffle to Kauri Creeks other waters	800	50		100 m attendance rule
N5	Rivers and Creeks-Set Mesh-nets	120	150 to 215		50 meshes deep 3 nets max Distance between first and last net 1 mile 800 m attendance rule
N6 Bait	Great Sandy Strait	400	12 to 45		Only 1 end of net may be fixed
N7 Bait	South of Baffle Creek	800	50		115 mm max mesh size in barramundi closed season Only 1 end of the net may be fixed

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Table 2. Cont...

	GREAT SANDY STRAIT	SEINE NETS			
Fishery Symbol	Location	Net length max (metres)	Mesh Size min (mm)	Twine Diameter max (mm)	Additional Regulations
N1	South of Baffle Creek	800	50		
N7 Bait	South of Baffle Creek	800	50		Only 1 end of the net may be fixed
N1	North of Mary River	100	31 in pocket 45 rest		prawns only
N1	Rivers and Creeks	200	50		115 mm max mesh size in barramundi closed season
N5	Rivers and Creeks	200	50		115 mm max mesh size in barramundi season
N6 Bait	Rivers and Creeks	200	25 to 45		Only 1 end of net may be fixed
N1	Tunnel Nets	1700 200 tunnel	50 tunnel 25 for 400 m each side 44 rest		1.5 to 4 m tunnel entrance
N5	Tunnel Nets	1700 200 tunnel length	50 tunnel 25 for 400 m each side 44 rest		1.5 to 4 m tunnel entrance
N5	All waters	800	50		
N6 Bait	Great Sandy Strait	400	12 to 45		Only 1 end of net may be fixed

Table 2. Cont…

	SOUTHERN HERVEY BAY	MESH NETS			
Fishery Symbol	Location	Net length max (metres)	Mesh Size min (mm)	Twine Diameter max (mm)	Additional Regulations
N1	Hervey Bay	600	88		In at least 2 m of water not fixed or hauled
N5	Hervey Bay	600	88		In at least 2 m of water Closed between 1 July to 31 October 9:00pm to 4:00am
N6 Bait	Hervey Bay	400	12 to 45		Only 1 end of net may be fixed
N1	South of Elliott River	600	88	0.65	33 meshes deep max closed between 1 July to 31 October 4:00pm to 4:00am
N5	South of Elliott River	600	88	0.65	33 meshes deep max
N8 From 3nm line	South of Elliott River between Theodolite and O'Regan Creeks	600	88	0.65	Closed between 1 July to 31 October 33 meshes deep max
N1	Offshore waters	600	150 to 245		In at least 2 m of water 2 nets may be joined in waters deeper than 20 m
N1	Rivers and Creeks	400	50		115 max mesh size in barramundi closed season
N5	Rivers and Creeks	400	50		115 mm max mesh size in barramundi closed season
N6 Bait	Rivers and Creeks	200	25 to 45		Only 1 end of net may be fixed
N1	Rivers and Creeks between Kauri and Baffle Creeks	120	150 to 215		50 meshes deep 800 m attendance rule can not be used in barramundi closure 3 nets max Distance between first and last net 1 mile
N5	Rivers and Creeks- Set Mesh-nets	120	150 to 215		50 meshes deep 800 m attendance rule 3 nets max Distance between first and last net 1 mile
N2 Set Net	Kauri creek to Cape Flattery- foreshores	600	100 to 215		3 nets max Distance between first and last net 1 mile
N5	Baffle to Kauri Creeks- Offshore waters	600	150 to 245		2 nets may be joined in waters deeper than 20 m Need not be within 100 m of it
N6 Bait	Burnett River to Sandy Cape (Fraser Island)	600	12 to 45		Only 1 end of net may be fixed
N7 Bait	South of Baffle Creek	800	50		115 mm max mesh size in barramundi closed season Only 1 end of the net may be fixed

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Table 2. Cont...

	SOUTHERN HERVEY BAY	SEINE NETS			
Fishery Symbol	Location	Net length max (metres)	Mesh Size min (mm)	Twine Diameter max (mm)	Additional Regulations
N1	North of Mary River	100	31 pocket 45 remainder		Prawns only
N1	South of Baffle Creek	800	50		
N7 Bait	South of Baffle Creek	800	50		115 mm max mesh size in barramundi closed season Only 1 end of the net may be fixed
N1	Rivers and Creeks	200	50		115 mm max mesh size in barramundi closed season
N5	Rivers and Creeks	200	50		115 mm max mesh size in barramundi season
N6 Bait	Rivers and Creeks	200	25 to 45		Only 1 end of net may be fixed
N5	All waters unless otherwise stated	800	50		
N6 Bait	Burnett River to Sandy Cape (Fraser Island)	600	12 to 45		Only 1 end of net may be fixed
N6 Bait	Hervey Bay	400	12 to 45		Only 1 end of net may be fixed

Table 2. Cont...

	PORT CLINTON/ SHOALWATER BAY	MESH NETS			
Fishery Symbol	Location	Net length max (metres)	Mesh Size min (mm)	Twine Diameter max (mm)	Additional Regulations
N1	North of Baffle Creek	400	50		115 mm max mesh size in barramundi closed season
N7 Bait	North of Baffle Creek	400	50		
N1	Cape Manifold to Cape Gloucester	400	88		Both ends of net may be fixed for 1 hour
N7 Bait	Cape Manifold to Cape Gloucester	400	88		Both ends of the net may be fixed for 1 hour
N1	Offshore waters	600	150 to 245		In at least 2 m of water 2 nets may be joined in waters deeper than 20 m Need not be within 100 m of it unless in Shoalwater Bay
N8 Out from 3nm line	Offshore waters	600	150 to 245		In at least 2 m of water Two nets may be joined in waters deeper than 20 m
N1	Rivers and Creeks	400	50		115 mm max mesh size in barramundi closed season
N6 Bait	Rivers and Creeks	200	25 to 45		Only 1 end of net may be fixed
N2 Set Net	Baffle Creek to Cape Flattery- foreshores	600	100 to 215		3 nets max 800 m attendance rule Distance between first and last net 1 mile
N2 Set Net	Kauri Creek to Cape Flattery- Rivers and Creeks	120	150 to 215		50 meshes deep 800 m attendance rule 3 nets max Distance between first and last net 1 mile
N8 Out from 3nm line	North of Elliott River	600	88		Need not be within 100 m of it
N6 Bait	North of Burnett River	400	12 to 45		Only 1 end of net may be fixed

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Table 2. Cont...

	PORT CLINTON/ SHOALWATER BAY	SEINE NETS			
Fishery Symbol	Location	Net length max (metres)	Mesh Size min (mm)	Twine Diameter max (mm)	Additional Regulations
N1	North of Baffle Creek	400	50		115 mm max mesh size in barramundi closed season
N7 Bait	North of Baffle Creek	400	50		115 mm max mesh size in barramundi closed season only 1 end of the net may be fixed Both ends of net may be fixed for 1 hour
N1	Rivers and Creeks	200	50		115 mm max mesh size in barramundi closed season
N6 Bait	Rivers and Creeks	200	25 to 45		Only 1 end of net may be fixed
N6 Bait	North of Burnett River	400	12 to 45		Only 1 end of net may be fixed

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Table 2. Cont...

	INCE BAY/ NEWRY REGION	MESH NETS			
Fishery Symbol	Location	Net length max (metres)	Mesh Size min (mm)	Twine Diameter max (mm)	Additional Regulations
N1	North of Baffle Creek	400	50		115 mm max mesh size in barramundi closed season
N7 Bait	North of Baffle Creek	400	50		
N1	Cape Manifold to Cape Gloucester	400	88		Both ends of net may be fixed for 1 hour
N7 Bait	Cape Manifold to Cape Gloucester	400	88		Both ends of the net may be fixed for 1 hour
N1	Offshore waters	600	150 to 245		In at least 2 m of water 2 nets may be joined in waters deeper than 20 m Need not be within 100 m of it unless in Shoalwater Bay
N8 Out from 3nm line	Offshore waters	600	150 to 245		In at least 2 m of water Two nets may be joined in waters deeper than 20 m
N1	Rivers and Creeks	400	50		115 mm max mesh size in barramundi closed season
N6 Bait	Rivers and Creeks	200	25 to 45		Only 1 end of net may be fixed Both ends of net may be fixed for 1 hour
N1	Cape Gloucester to St Lawrence Creek		75		Both ends of net may be fixed for 1 hour
N2 Set Net	Baffle Creek to Cape Flattery- foreshores	600	100 to 215		3 nets max Distance between first and last net 1 mile 115 mm max mesh size during barramundi closure 800 m attendance rule
N2 Set Net	Kauri Creek to Cape Flattery- Rivers and Creeks	120	150 to 215		50 meshes deep 800 m attendance rule 115 mm max mesh size during barramundi closure 3 nets max Distance between first and last net 1 mile
N8 Out from 3nm line	North of Elliott River	600	88		Need not be within 100 m of it
N6 Bait	North of Burnett River	400	12 to 45		Only 1 end of net may be fixed Both ends of net may be fixed for 1 hour

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Table 2. Cont...

	INCE BAY/ NEWRY REGION	SEINE NETS			
Fishery Symbol	Location	Net length max (metres)	Mesh Size min (mm)	Twine Diameter max (mm)	Additional Regulations
N1	North of Baffle Creek	400	50		115 mm max mesh size in barramundi closed season
N7 Bait	North of Baffle Creek	400	50		115 mm max mesh size in barramundi closed season only 1 end of the net may be fixed Both ends of net may be fixed for 1 hour
N1	Rivers and Creeks	200	50		115 mm max mesh size in barramundi closed season
N6 Bait	Rivers and Creeks	200	25 to 45		Only 1 end of net may be fixed Both ends of net may be fixed for 1 hour
N1	Cape Gloucester to St Lawrence Creek	200	75		
N6 Bait	North of Burnett River	400	12 to 45		Only 1 end of net may be fixed Both ends of net may be fixed for 1 hour

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Table 2. Cont...

	UPSTART BAY/ CLEVELAND BAY	MESH NETS			
Fishery Symbol	Location	Net length max (metres)	Mesh Size min (mm)	Twine Diameter max (mm)	Additional Regulations
N1	North of Baffle Creek	400	50		115 mm max mesh size in barramundi closed season
N7 Bait	North of Baffle Creek	400	50		
N1	Offshore waters	600	150 to 245		In at least 2 m of water 2 nets may be joined in waters deeper than 20 m Need not be within 100 m of it unless in Shoalwater Bay
N8 Out from 3nm line	Offshore waters	600	150 to 245		In at least 2 m of water Two nets may be joined in waters deeper than 20 m
N1	Rivers and Creeks	400	50		115 mm max mesh size in barramundi closed season
N6 Bait	Rivers and Creeks	200	25 to 45		Only 1 end of net may be fixed
N2 Set Net	Baffle Creek to Cape Flattery- foreshores	600	100 to 215		3 nets max 800 m attendance rule 115 mm max mesh size during barramundi closure Distance between first and last net 1 mile
N2 Set Net	Kauri Creek to Cape Flattery- Rivers and Creeks	120	150 to 215		50 meshes deep 800 m attendance rule 115 mm max mesh size during barramundi closure 3 nets max Distance between first and last net 1 mile
N8 Out from 3nm line	North of Elliott River	600	88		Need not be within 100 m of it
N6 Bait	North of Burnett River	400	12 to 45		Only 1 end of net may be fixed

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Table 2. Cont...

	UPSTART BAY/ CLEVELAND BAY	SEINE NETS			
Fishery Symbol	Location	Net length max (metres)	Mesh Size min (mm)	Twine Diameter max (mm)	Additional Regulations
N1	North of Baffle Creek	400	50		115 mm max mesh size in barramundi closed season
N7 Bait	North of Baffle Creek	400	50		115 mm max mesh size in barramundi closed season only 1 end of the net may be fixed
N1	Rivers and Creeks	200	50		115 mm max mesh size in barramundi closed season
N6 Bait	Rivers and Creeks	200	25 to 45		Only 1 end of net may be fixed
N6 Bait	North of Burnett River	400	12 to 45		Only 1 end of net may be fixed

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Table 2. Cont...

	HINCHINBROOK REGION	MESH NETS			
Fishery Symbol	Location	Net length max (metres)	Mesh Size min (mm)	Twine Diameter max (mm)	Additional Regulations
N1	North of Baffle Creek	400	50		115 mm max mesh size in barramundi closed season
N7 Bait	North of Baffle Creek	400	50		
N1	Offshore waters	600	150 to 245		In at least 2 m of water 2 nets may be joined in waters deeper than 20 m Need not be within 100 m of it unless in Shoalwater Bay
N8 Out from 3nm line	Offshore waters	600	150 to 245		In at least 2 m of water Two nets may be joined in waters deeper than 20 m
N1	Rivers and Creeks	400	50		115 mm max mesh size in barramundi closed season
N6 Bait	Rivers and Creeks	200	25 to 45		Only 1 end of net may be fixed
N2 Set Net	Baffle Creek to Cape Flattery- foreshores	600	100 to 215		3 nets max Distance between first and last net 1 mile 115 mm max mesh size during barramundi closure 800 m attendance rule
N2 Set Net	Kauri Creek to Cape Flattery- Rivers and Creeks	120	150 to 215		50 meshes deep 800 m attendance rule 3 nets max Distance between first and last net 1 mile
N2 Set Net	Hinchinbrook Channel and tributaries	120	150 to 215		50 meshes deep 800 m attendance rule 3 nets max Two nets may be joined Distance between first and last net 1 mile Cannot be used in Barramundi closure
N8 Out from 3nm line	North of Elliott River	600	88		Need not be within 100 m of it
N6 Bait	North of Burnett River	400	12 to 45		Only 1 end of net may be fixed

Table 2. Cont...

	HINCHINBROOK REGION	SEINE NETS			
Fishery Symbol	Location	Net length max (metres)	Mesh Size min (mm)	Twine Diameter max (mm)	Additional Regulations
N1	North of Baffle Creek	400	50		115 mm max mesh size in barramundi closed season
N7 Bait	North of Baffle Creek	400	50		115 mm max mesh size in barramundi closed season only 1 end of the net may be fixed
N1	Rivers and Creeks	200	50		115 mm max mesh size in barramundi closed season
N6 Bait	Rivers and Creeks	200	25 to 45		Only 1 end of net may be fixed
N6 Bait	North of Burnett River	400	12 to 45		Only 1 end of net may be fixed

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Table 3. Summary of all net specification ranges for each IDPA. A net, depending on the design and symbol can be used within these specification ranges in a IDPA.

IDPA	Net Length Range (m) All Net Designs	Mesh Size Range (mm) All Net Designs	Twine Diameter max (mm) All Net Designs (if given)
Great Sandy Strait	120 to 800 (1700 tunnel)	12 to 245	0.65
Southern Hervey Bay	120 to 800	12 to 245	0.65
Port Clinton	120 to 600	12 to 245	
Shoalwater Bay	120 to 600	12to 245	
Ince Bay	120 to 600	12 to 245	
Newry Bay	120 to 600	12 to 245	
Upstart Bay	120 to 600	12 to 245	
Cleveland Bay	120 to 600	12 to 245	
Hinchinbrook Region	120 to 600	12 to 245	

Table 4. Summary of the net design, the number of QFMA fishing symbols and the IDPAs that a fishery symbol can be used in.

Symbol	Net Design	QFMA Fishery Symbols	IDPA	Area
N1	Mesh/ Seine Net	1022	All	All tidal waters
N2	Mesh-net	272	All but not Great Sandy Strait	All tidal waters
N4	Seine Net	70	Great Sandy Strait	Within 400 m of h.w.l
N5	Mesh/ Seine Net	4	Great Sandy Strait; Southern Hervey Bay	All tidal waters
N6	Mesh/ Seine Net	1965	All	All tidal waters
N7	Mesh/ Seine Net	9	All	All tidal waters
N8	Mesh Net	2	All but not Great Sandy Strait and some of Hinchinbrook Region	Out from 3 nm line

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REPORT
ON
VESSEL USE
IN THE INTERIM DUGONG PROTECTION AREAS

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Executive Summary

Aims

The aim of this report is to assess the levels of vessel use within the interim Dugong Protection Areas (DPA's), including recreational, commercial use and shipping, and to identify the main issues relating to vessel impact on dugong and dugong habitat.

Methods

There are few existing datasets which give reliable information on levels of vessel use within the Queensland coastal waters. The following databases have been queried to assist with gauging trends in vessel use but can only be regarded as indications of current situations for each DPA: the Queensland Coastwatch aerial surveillance database, the Great Barrier Reef Marine Park Authority (GBRMPA) returns database, Queensland Department of Transport Private Boat Registrations district annual statistics, Queensland Fish Management Authority (QFMA) commercial fishing database, and existing site-specific research and reports on use within any of the DPA's.

Interviews were carried out with Queensland Department of Primary Industries Boating and Fisheries Officers, and Queensland Department of Environment field staff as a source of anecdotal information on vessels and the types of activities occurring in each DPA. Maps of the relevant DPA were used in the interviews and where appropriate were annotated to illustrate as well as possible the spatial distribution and extent of information obtained for vessel use. These maps were then combined to produce as series of vessel-use maps for each DPA including additional positional information on existing marine infrastructure and important anchorage sites. Officer's were also asked to summarise their perception of the major threats to dugong and dugong habitat for their area.

Main Trends in Vessel Use

Shipping

There are three DPA's where shipping is a major component of vessel, namely Princess Charlotte Bay, Cleveland Bay and Hinchinbrook Region. In Princess Charlotte Bay DPA the charted shipping lane crosses over the northern perimeter of the DPA. Johnston *et al.* (1994) identified this inner route as 'well established' with shipping traffic generally staying within the bounds of the charted shipping lane. During a 9 month period for 1993/4 there were 1208 - 1213 vessel movements passing through the Princess Charlotte Bay section of shipping lane (Johnston et al. 1994 Appendix A-2).

Shipping traffic entering the Port of Townsville must pass through the Cleveland Bay DPA. Leading lights marking the channel into the port are shown on Map 6. For the 12 months June 1995/1996 the Townsville Port Authority recorded movements of 720 commercial vessels in excess of 200 gross weight tonnage into the port. These included cargo, passenger, naval and bunker vessels (Townsville Port Authority 1997).

The Hinchinbrook DPA Management Area 4 is affected to a perhaps lesser extent by ships entering from the northern side of the Palm Island Group to access the Bulk Sugar Terminal at Lucinda. For 1996, 54 vessel movements were recorded all of which were piloted. Generally the commercial shipping traffic is confined to well defined paths.

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Recreational Vessel Use

There are few datasets on recreational vessel use in either the GBRMP or the Queensland coastal waters in general, except where site-specific research has been carried out such as the GBRMPA reports' 'Recreational Usage Patterns of Shoalwater Bay and Adjacent Waters' (Jennings 1996), the 'Bramble Reef Socio-economic Study' (Benzaken et al) and the Great Sandy Region Management Plan. The results from these surveys have been outlined in the following Shoalwater Bay, Hinchinbrook Region and Southern Hervey Bay/Great Sandy Strait DPA detailed section. For other areas, recreational vessel use must be inferred from a variety of existing datasets which, in most instances, were not designed for this purpose.

The potential recreational vessel use for each DPA has been drawn from Queensland Transport private boat registrations for the districts adjacent to the DPA's. The greatest increase in private boat registrations for the DPA's occurred in Cairns and North District (72.54%) where 7930 vessels were registered for 1995 compared with 4596 vessels for 1984. The next highest total was for Southern Hervey Bay/Great Sandy Strait DPA (Maryborough, Burnett Valley and Bundaberg combined) of 11222 boat registrations in 1995, an overall 50.25% increase from 7469 registrations in 1984. Townsville, Mackay and Rockhampton also register high vessel numbers. However, these have not seen the same degree of increase in boat registrations since 1984 (34.07%, 18.84%, and 39.44% respectively) compared with those recorded at the sites above.[1]

Intense levels of recreational use occur in the Southern Hervey Bay/Great Sandy Strait DPA. and the high degree of marine infrastructure development throughout the area reflects this. Hinchinbrook Region, Cleveland Bay and Newry Region are also relatively high use areas with many of the other DPA's being less accessible and therefore experiencing less recreational vessel use.

Commercial Fishing Vessel Use

Commercial net and crabbing fisheries are located inshore, around islands and in estuaries within all of the DPA's. Small fast moving vessels with shallow draughts are generally used to access fishing sites and may pose a threat to dugong in terms of potential vessel strike.

In terms of the total days fished, Hervey Bay/Great Sandy Strait supported 8094 days for the years 1993,1994, and 1995 combined. This figure is far higher than any other DPA. Hinchinbrook Region, Princess Charlotte Bay and Cleveland Bay recorded the next highest totals (2027, 1898 and 1632 Days, respectively) for the three years of data analysed.

Vessels engaged in Otter and Beam trawling also work many areas within the DPAs and their impact on seagrass beds requires investigation. Research on the East Coast Trawl Fishery trawl effort calculated for 1995 identified Princess Charlotte Bay and Upstart Bay as hot-spots in terms of high trawl effort (pers. comm. Francis Pantus GBRMPA 1996).

Tourist Vessel Use

The GBRMPA Returns database was queried to obtain data on the number of tourist vessels visiting reefs which fall inside the DPA's over a twelve month period from July 1995 under the GBRMPA permit system. The highest visited DPA was Hinchinbrook Channel and islands (762 vessel visits), followed by Cleveland Bay with 543 visits, and Princess Charlotte Bay recording 55 visits. As the Great Barrier Reef Marine Park boundary often does not extend to all areas within the DPAs, further research into the Queensland Marine Park Permit system would be required to gain the full picture for tourist vessel movements within the DPA's. Southern Hervey Bay/ Great Sandy Strait has high tourist vessel use but is difficult to compare with other DPA's due to data limitations. Bareboat and houseboat charters operate both in Southern Hervey Bay/Great Sandy Strait and Hinchinbrook Region.

[1]Note: Although Cairns is not located close to a DPA it is likely that many of the recreational use of Princess Charlotte Bay is drawn from this area and possibly Townsville as well. Hinchinbrook Region similarly is used by residents of Townsville as well as Ingham, Cardwell and Tully residents. Further research would be required to ascertain the user group catchment areas for each DPA

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Main Issues

Vessel strike

Vessel strike appears to be of greatest threat in areas where vessels travel at high speeds in shallow water over seagrass beds. This type of vessel activity is often associated with the net fisheries and crabbing (commercial and recreational) where dinghies are used to access nets and pots at inshore and estuarine fishing sites. Boating and Fisheries Officers for Hervey Bay/Great Sandy Strait stated that this was of primary concern as there are currently no restrictions on vessel speed in inshore and estuarine environments. Given the speed and spatial extent of vessel use in the DPA's it would appear that vessel strike is likely to be a significant cause of dugong mortality in Queensland coastal waters.

Activities such as the water-ski races that have been run in the past in Hinchinbrook Channel, where vessels are traveling at high speeds (70kn) often across shallow water areas near mangroves, are of particular concern (see M. Burnham 1993, Queensland Department of Environment Marine Park Report: Hinchinbrook Ski Classic 1993, Hinchinbrook Channel).

Damage to seagrass beds

Seagrass beds appear to be under threat from 2 major activities associated with vessel use. These are anchorages and dredging.

Anchorages are of primary concern where high use level anchorages occur over seagrass beds. Queensland Department of Environment staff suggested that damage to seagrass beds from the sweep of anchor chains is discernible in high use anchorages. The introduction of appropriate mooring structures or practices is required in several locations where anchorages and seagrass beds coincide. Further investigation would be required to identify all of the anchorages within the DPAs where seagrass damage is an issue. The GBRMPA GIS could be used to perform this task.

Particular attention should be focused on the monitoring of new marina developments and the dredging of channel access within DPAs. Currently several DPAs have proposed access and infrastructure developments pending. These include marinas at Oyster Point and Dungeness, the upgrade of Fishers Creek Boat Ramp at Hinchinbrook, and channel access to Molongal Creek in Upstart Bay. Molongal Creek has a history of illegal dredging (Pers. comm. Boat and Fisheries), and currently there is a channel dredging proposal before the Bowen Council.

The Southern Hervey Bay/Great Sandy Strait DPA is currently under the Great Sandy Region Management Plan which proposes future guidelines for the development of further marine infrastructure for the area. No further marina developments will be permitted between River Heads and Kauri Creek in the central section. Future marina proposals will be for shallow draught vessels to avoid the need for dredging, however existing channels will be maintained and new channels will be dredged where there is a demonstrated need. Spoil dumping is permitted in approved sites with impact monitoring. Vessel pollution and water quality guidelines will be applied to all new marinas. (Great Sandy Region Management Plan)

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Overview Of Each Vessel Use Type

Recreational Vessel use

There are few datasets on recreational vessel use in either the GBRMPA or the Queensland coastal waters in general, except where site-specific research has been carried out such as the GBRMPA reports' 'Recreational Usage Patterns of Shoalwater Bay and Adjacent Waters' (Jennings 1996) and the 'Bramble Reef Socio-economic Study' (Benzaken *et al.*) and the Great Sandy Region Management Plan. Results from this research is presented in the relevant DPA overview. For other areas, recreational vessel use must be inferred from a variety of existing datasets which, in most instances, were not designed for this purpose. Here the potential recreational vessel use has been drawn from Queensland Transport private boat registrations for the districts adjacent to the DPA's (See Table 1).

Dugong Protection Area	Local District User Catchment	Boat Registrations 1995	Boat Registrations 1984	Percentage Increase (%)
Princess Charlotte Bay/ Bathurst Bay	Cairns and North	7930	4596	72.54
Hinchinbrook Region	Ingham	1604	1294	23.96
Cleveland Bay	Townsville	6336	4726	34.07
Upstart Bay	Ayr/Home Hill Bowen	2275 1381	2136 1141	6.51 21.03
Newry Region/ Ince Bay	Mackay	6635	5583	18.84
Shoalwater Bay/ Port Clinton	Rockhampton	5583	4004	39.44
Southern Hervey Bay/ Great Sandy Strait	Maryborough Burnett Valley Bundaberg	5104 1343 4775	3180 677 3612	60.50 98.38 32.20

Table 1 Private boat registrations for the districts for the years 1995, 1984 and the total percentage increase in registrations over this 11 year period.

The greatest increase in private boat registrations for the DPA's occurred in Cairns and North District where there was a 72% increase from 4596 registered vessels in 1984 to 7930 vessels in 1995. The next highest increase was for Southern Hervey Bay/Great Sandy Strait DPA(Maryborough, Burnett Valley and Bundaberg combined) of 7469 registrations in 1984, an overall 50% increase to 11222 boat registrations in 1995. Townsville, Mackay and Rockhampton also register high vessel numbers however have not seen as much increase in boat registrations since 1984 (34%, 18%, and 39% respectively).

Commercial Vessel Use

There two DPA's which show high levels of trawl effort. These are Princess Charlotte Bay and Upstart Bay. Trawling occurs in all DPA's in deeper offshore waters except in the case of Beam Trawling in Southern Hervey Bay/Great Sandy Strait where inshore estuaries are open to fishing. Further analysis of QFMA databases is required to give more detail on trawl effort within the DPA's.

A summary of commercial Net was obtained from the Queensland Fish Management Authority (QFMA) commercial logbook data for each DPA for the period 1993,1994 and 1995. Southern Hervey Bay/Great Sandy Strait recorded 8094 days fished for the three years, a significantly higher use level than any of the other DPA's (See Figure 1).

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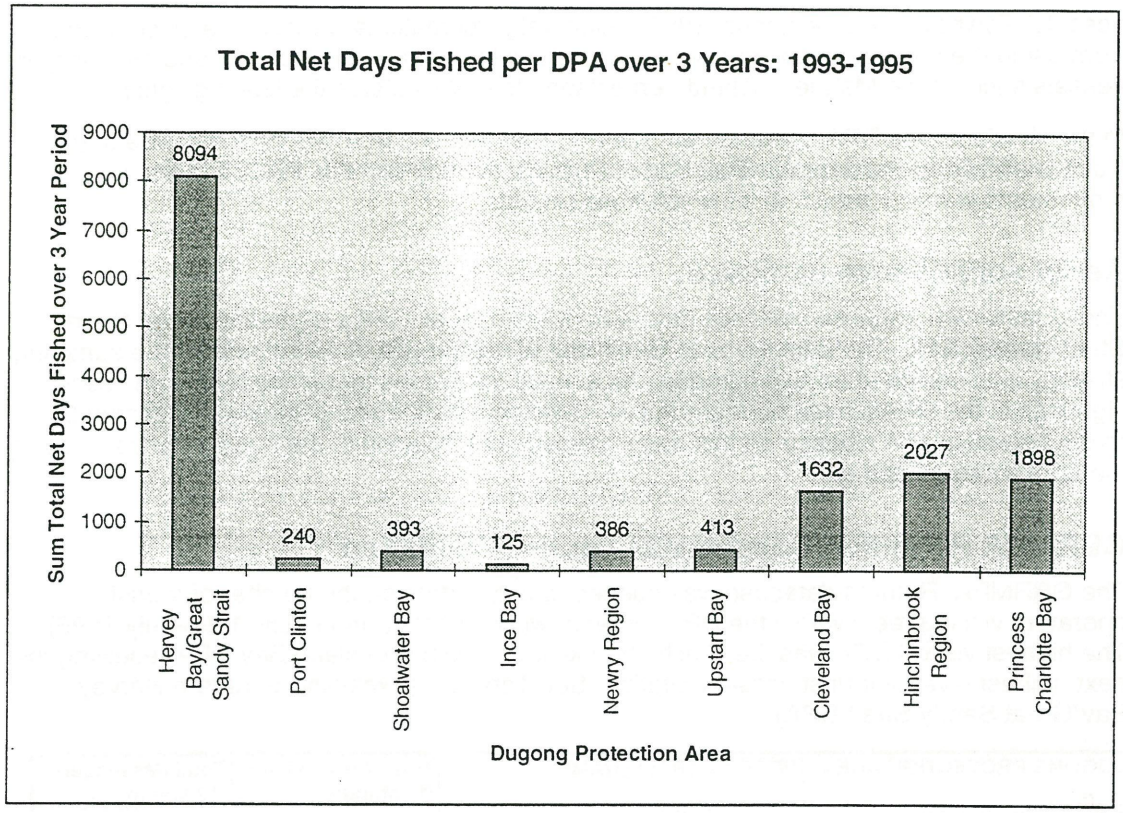

Figure 1 Commercial Net Fishery - Total Days Fished over a 3 Year Period (1993,1994, and 1995) for each Dugong Protection Area[1]
Source: QFMA Commercial Fishing Database (reworked by Francis Pantus)

[1] Note: The DPA extent used does not perfectly coincide with the QFMA database grid unit. As a result these figures may be slightly under the real value.

Further information about the number of vessels operating in the commercial net fishery within each DPA are summarized in each DPA overview.

The main issues attributed to commercial fisheries in terms of dugong and habitat decline, are firstly, mortality due to entrapment in nets, particularly where set nets are left unattended, secondly, vessel strike as vessels accessing fishing sites travel quickly in shallow waters. (pers. comm. Boating and Fisheries) The third issue is the impact of vessels anchoring over seagrass beds, and finally the degradation of deep seagrass beds due to otter trawling. (pers. comm. QDOE staff).

Shipping

There are three DPA's where shipping traffic is a significant component of vessel use, namely Princess Charlotte Bay, Cleveland Bay and Hinchinbrook Region. Shipping traffic occurs in the Princess Charlotte Bay DPA where the charted shipping lane crosses over the northern perimeter of the DPA.

Johnston *et al.* (1994) described this inner route as 'well established' with shipping traffic generally staying within the bounds of the charted shipping lane. There were approximately 1208 - 1213 vessel movements recorded for the Princess Charlotte Bay section of the shipping lane for 9 month period in 1993/4. (Johnston *et al.* 1994 Appendix A-2).

Shipping traffic entering the Port of Townsville must pass through the Cleveland Bay DPA. Leading lights mark the channel into the port. For the 12 months June 1995/1996, the Townsville Port Authority recorded movements of 720 commercial vessels in excess of 200 tonnes (gross weight) into the port. These included cargo, passenger, naval and bunker

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vessels (Townsville Port Authority 1997). Generally, recreational vessels are discouraged from using the shipping lead channel, therefore smaller recreational vessels and even larger vessels such as the Magnetic Island Ferries' tend to travel outside the leading lights.

In the Hinchinbrook DPA Management Area 4 ships entering from the northern side of the Palm Island Group access the Bulk Sugar Terminal at Lucinda. For 1996, 54 vessel movements were recorded, all of which were piloted.

Aerial surveillance database

The Coastwatch aerial surveillance data was queried for all DPA's excluding Great Sandy Strait/Hervey Bay. The data tends to be difficult to use for actual vessel use as the sampling strategy isn't designed for this purpose. As a result the graphs presented based on vessel sightings in the DPA's must be regarded with extreme caution and comparisons cannot be made between DPA's based on this data, however an indication of the range of vessels using the DPA's can be gained.

GBRMPA Permitted Commercial Tourism Visitation

The GBRMPA Returns database was queried to obtain data on the number of tourist operators visiting reefs within the DPA's over a twelve month period (July 1995-July 1996). The highest visited DPA was the Hinchinbrook Region with Cleveland Bay DPA receiving the next highest level of tourist vessel visitation (See Table 2). (Excluding Southern Hervey Bay/Great Sandy Strait DPA)

DUGONG PROTECTION AREA	REEF_ID	REEF_NAME	Total Vessel Visits /12 Months	Total Passengers /12 Months
Princess Charlotte Bay	14007	Taiwan Shoal	1	4
Princess Charlotte Bay	14011	Olive Patch	2	10
Princess Charlotte Bay	14022	Wharton Reef	1	10
Princess Charlotte Bay	14026	Stanley Island Reefs	3	16
Princess Charlotte Bay	14031	Blackwood Island Reef	8	51
Princess Charlotte Bay	14042	Flinders Island Reefs	40	242
DPA TOTAL			**55**	**333**
Hinchinbrook Region	18008	Brook Islands Reef	61	343
Hinchinbrook Region	18010	Goold Island Reef	218	744
Hinchinbrook Region	18011	Garden Island Reef	53	199
Hinchinbrook Region	18014	Hinchinbrook Island Reef	429	11854
Hinchinbrook Region	18015	Agnes Island Reef	1	2
DPA TOTAL			**762**	**13142**
Cleveland Bay	19006	Orchard Rocks Reef	4	7
Cleveland Bay	19007	Bay Rock Reef	2	4
Cleveland Bay	19009	Magnetic Island Reefs	537	3100
DPA TOTAL			**543**	**3111**
Newry Region	20219	Cave Island Reef	2	13
Newry Region	20228	Newry Island Reef	5	69
DPA TOTAL			**7**	**82**
Shoalwater Bay/Port Clinton	22038	Clara Island Reef	1	10
Shoalwater Bay/Port Clinton	22075	Clara Group Reef	2	10
Shoalwater Bay/Port Clinton	22078	Island Head Island Reef	27	229
Shoalwater Bay/Port Clinton	22081	U/N Reef	1	5
DPA TOTAL			**31**	**254**

Table 2 Tourist vessel visitation to reefs within the DPA's for the period July 1995 to July 1996. Data obtained from the GBRMPA RETURNS database.

Southern Hervey Bay/Great Sandy Strait as outlined in the following discussion on the area, experiences heavy tourist vessel activity, particularly in the whale watching season. However, the area most heavily visited for whale watching is outside the DPA boundary.

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Bareboat and houseboat charters operate both in Southern Hervey Bay/Great Sandy Strait and Hinchinbrook Channel.[1]

[1] (For more information on tourist vessels movements the Queensland Department of Environment permits database will need to be queried).

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DETAILS OF VESSEL USE IN EACH INTERIM DUGONG PROTECTION AREA

Great Sandy Strait/Hervey Bay DPA

The Great Sandy Strait and Hervey Bay supports the highest level of vessel use of all the DPA's and is one of the busiest vessel traffic areas in Queensland. Currently, the area is under the review of the Great Sandy Region Management Plan which coordinates use and development within the area.

Vessel use in the waters of the Great Sandy Strait/Hervey Bay encompasses a range of activities such as recreational and commercial fishing, spearfishing, charter boats, diving snorkelling, motorised watersports, jet skis (hire and private), glass bottom boats, parasailing, sailing, yacht races, bareboat charter, whale and turtle watching, and cruise ships. Vehicular ferries operate in several locations throughout the bay.

Great Sandy Strait

Geographically, the Great Sandy Strait area provides a range of channels, intertidal flats, mangrove estuaries and sheltered waters for all vessel types. The main traffic areas follow deeper water channels which are delineated by navigation guides, however shallow draught vessels including a large fleet of aluminum dinghies, regularly use the intertidal estuarine environments. There are no speed restrictions on vessels at this time. Most of the vessel use in this shallow area is for recreational and commercial fishing. Tinnanbar, Shark Inlet and Kauri Creek are popular recreational destinations for day trippers from the Tin Can Bay area. South from Kauri Creek to Tin Can Bay the recreational and commercial fishing environments are over seagrass beds. This combined with the speed at which boats are traveling in shallow waters, would appear to greatly increase the potential for vessels striking dugong. An estimated 500 vessel movements a week occur between Tin Can Bay and Inskip Point. (Anecdotal information source: Boating and Fisheries).Bareboats and Houseboat charters work from Tin Can Bay and Carlo. Some water skiing occurs at Pelican Bay.

Anchorages

As an anchorage, Great Sandy Strait and Hervey Bay waters are protected by Frazer Island with most anchorages occurring either in the waters just off the main channel along the western perimeter of Frazer Island, or on the western perimeter of the strait in the mouths of rivers and estuaries such as Tin Can Bay, Pelican Bay, Kauri Creek, Big Tuan Creek, Susan River, and in particular the Mary River. Gary's Anchorage, between Frazer Island and Stewart Island provides good shelter and is a popular anchorage, particularly for yachts. Pelican Bay located to the south of Frazer Island is sheltered by Inskip Point and is commonly used by boats including trawlers, sheltering inside the bar. There is a significant trawler fleet based at Tin Can Bay. Anchor damage to seagrass beds has been reported in the Pelican Bay area and is likely to be important in other areas where high-use anchorages occur over seagrass meadows. The issue of anchor damage to seagrass beds needs to be addressed if these environments are to be preserved. Further research is recommended to identify areas where anchorages occur over seagrass in all the DPA's.

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Marine Infrastructure

The Great Sandy Region Management Plan recognizes a need for more marinas to service the commercial and recreational boat owners in the area.

Current infrastructure:

Public Boating facilities include 21 boat ramps, 4 jetties, 1 pontoon and 16 separate public boating facilities. The Great Sandy Strait Management Plan provides guidelines for the future development of marine infrastructure in the area. No further marina developments will be permitted between River Heads and Kauri Creek in the central section. Future marina developments will be for shallow draught vessels to avoid the need for dredging. However, existing channels will be maintained and new channels will be dredged where there is a demonstrated need and spoil dumping is permitted in approved sites with impact monitoring. Vessel pollution and water quality guidelines will be applied to all new marinas.

Recreational Vessel Use

Maryborough is the closest major town to the Southern Hervey Bay/Great Sandy Strait DPA . Boat registrations give an indication of the potential recreational use of the area by privately registered boat owners living adjacent to the DPA. There has been a 50% overall increase in the number of boats registered to the Maryborough, Burnett Valley and Bundaberg district in 11 years (See Table 3).

District	Boat Registrations 1995	Boat Registrations 1984	Percentage Increase (%)
Maryborough	5104	3180	60
Burnett Valley	1343	677	98
Bundaberg	4775	3612	32
Region Total	**11222**	**7469**	**50**

Table 3 Hervey Bay District - Total number of privately registered vessels for 1995,1984 and percentage increase over the 11 year period.

Recreational use by private vessels in this area is predominantly for fishing (97%), mainly in the Great Sandy Strait, but it is also used for pleasure boating, and water-skiing (Cuthill 1994). It was estimated that recreational fishing effort for the area for 1994 was approximately 362 975 angler days (Cuthill 1994). This does not include visitor angler days which was estimated at 100 000 angler days in 1991 (Cuthill 1994).

Commercial Fishing Vessels

Hyland (1993) reported an annual average of 293 commercial vessels worked the Hervey Bay Region between 1989 and 1991 with an average annual total of 9372 days.

(NB. The grids used for the 'Hervey Bay Region' in the Hyland study extend from Ungowa 25° 30' north to 24° 30' latitude and so doesn't include the Great Sandy Strait itself).

There are a range of commercial fisheries' endorsements for the Hervey Bay Region (see Table 4), however this does not imply that all of these vessels actually work the DPA area, but only gives an indication of fishing vessel activity. Fishing vessels based in the area undertake a range of fishing methods, including trawling, potting, line fishing, gill, set, drift netting, and beach seining.

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CATEGORY	Hervey Bay	Bundaberg	TOTAL
No. of Master Fishers	139	176	315
No. of Assistant Fishers	189	296	485
No of Primary Endorsements	106	120	226
No. of Tenders	176	160	336
Ocean Beach Endorsements	2	-	2
East Coast Barramundi Endorsements	11	19	30
Otter Trawl Endorsements	36	65	101
Crab Endorsements	72	75	147
Beam Trawl Endorsements	18	9	27
Line Endorsements	103	120	223
Net Endorsements	77	86	163
Bait Endorsements	2	-	2

Table 4 The total number of fishing endorsements for Hervey Bay Region for 1991
Source: Hyland (1993) p. 10

Offshore otter trawling occurs to the north of the DPA, and inshore otter trawling south from Woodgate to Point Vernon. (See Maps of Extent of Vessel use for each fishery in Appendix A.) Extensive seagrass meadows exist in the western half of Hervey Bay, with smaller seagrass areas interspersed from Urangan to River Heads. (Hyland 1993)

Four River Beam Trawlers were working the Mary River in 1993, while 18 fishers had endorsements to use river beam trawl between Double Island Point and Burrum Heads. The Burrum, Isis, Cherwell and Gregory Rivers and the northern region of the Great Sandy Strait from River Heads to Woody Island are open for river beam trawling. The Mary River is also used for set netting. (Hyland 1993)

Urangan is a base for many of the Scallop vessels working in the north of Hervey Bay with 130 vessels working this fishery in the Hervey Bay region in 1990. Scallop refuse is dumped in the Urangan area. Heavy boating traffic occurs in the Urangan to Round Island waters (Hyland 1993).

Commercial Net Fishery

Hervey Bay/Great Sandy Strait recorded the highest level of net fishing days for all DPA's. In 1995, 65 vessels logged a total of 2288 days for the area, a decrease from the two preceding years (see Figure 2).

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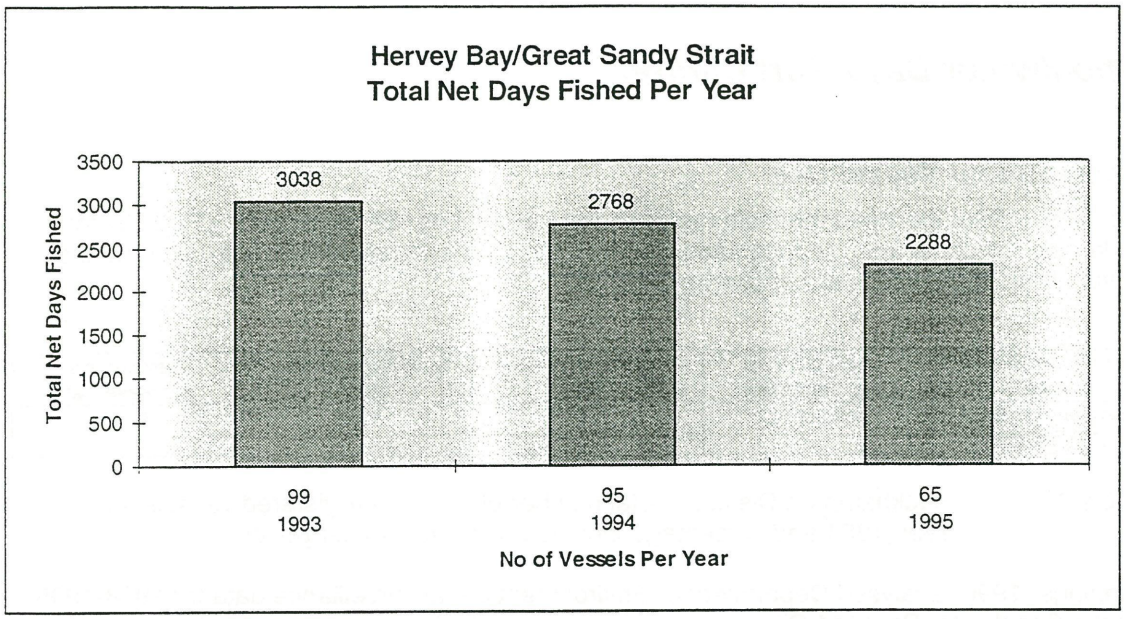

Figure 2 Southern Hervey Bay/Great Sandy Strait Commercial Net Fishery
Total Number of Days Fished for Years 1993, 1994 and 1995
Note: The total number of vessels working the DPA for each year is written above the year on the bottom axis.
Source: QFMA Commercial Fishing Database (Reworked by Francis Pantus)
Note: The DPA extent used does not perfectly coincide with the QFMA database grid unit. As a result these figures may be slightly under the real value.

Tunnel Netting is permitted in the Great Sandy Strait (Moreton Bay being the only other location where this practice is permitted) and occurs in the intertidal zone below mangrove communities, particularly in the area south of Urangan.

Crabbing

Crabbing is carried out both commercially and recreationally (see Table 5). Pots are accessed by fishers using dinghies with outboard motors often traveling at speeds up to 40 knots (Anecdotal information source: Boating and Fisheries).

Target	Main area Fished	Method	Recreational Effort
Sand Crabs			
Portunus pelagicus	Burrum Heads, Gatakers Bay North of Urangan	Potting	High Recreational fishing value exists
Mud Crabs			
Scylla serrata	Mangrove Areas between Mary River and Pulgul Creek	Potting	High Recreational fishing value exists

Table 5 Main Crab Fisheries in Southern Hervey Bay/Great Sandy Strait
Source Hyland 1993

20(P.15)

Shoalwater Bay / Port Clinton

Recreational Vessel Use

Jennings (1996) identified the main recreational use group for Shoalwater Bay/Port Clinton as largely residents from Yeppoon and Rockhampton. The trends for Rockhampton District private boat registrations are shown in Table 6.

Dugong Protection Area	Local District User Catchment	Boat Registrations 1995	Boat Registrations 1984	Percentage Increase (%)
Shoalwater Bay/ Port Clinton	Rockhampton	5583	4004	39.44

Table 6 Rockhampton District - Total number of privately registered vessels for 1995,1984 and percentage increase over the 11 year period.

Jennings (1996) analysed Department of Environment aerial surveillance data for 1988-1995 for the Shoalwater Bay/Port Clinton area and despite data limitations was able to ascertain that the Shoalwater bay area was primarily used by motorised vessels, with sailing vessels tending to use the outer coastal areas (see Table 7) It is important to note that these data are not absolute vessel numbers for recreational use but are indications of the proportional trends for each vessel type. It should also be noted that the Shoalwater Bay DPA corresponds the Section B tabled here, although the data is grouped with section A which lies to the north and outside of the DPA boundary.

Year	Location	No	Class Of Activity	No	Vessel Types	No.
1988-1995	Section A & B (Shoalwater Bay)	493	Recreational	376	Motorised	313
			Commercial	117	Sail Powered	29
					Vehicle	26
					Camps	8
	Fishing Vessels 109					
					Trawlers	8
Subtotal		493		493		493
	Island Head Ck	458	Recreational	1190	Motorised	540
	Port Clinton	236	Commercial	201	Sail powered	484
	Section E	393			Vehicle	147
	Corio Bay	274			Camps	19
					Fishing Vessels	69
					Trawlers	133
Subtotal		1361		1361		1361
Total		1854		1854		1854

Table 7 Results of Jennings (1996) analysis of Department of Environment aerial surveillance data for 1988-1995

20(p.16)

The Recreational Usage Patterns of Shoalwater Bay and Adjacent Waters survey included data gathered by 4 different means: Mail survey (Mail), Club Member Survey (Club), Self selected and administered surveys (Self) and survey of commercial operators (Comm). The highest response rate was for the respondents surveyed by mail and so these results have been graphed and are shown below for the results of the destination, departure and main activity undertaken. Section B referred to in the following tables corresponds to the Shoalwater Bay DPA area, while the Port Clinton DPA is roughly aligned with the area here called Section D.

Destinations:

The destinations most frequently used by the respondents are summarised in Table 8.

		Mail	Club	Self	Comm
	Location	% (of 256)	% (of 38)	(% of 27)	(% of 27)
A	Section A Northern area of Shoalwater Bay	28.1	18.2	70.4	
B	**Section B Southern area of Shoalwater Bay**	**5.5**		**66.6**	**3.70**
C	Section C Island Head Ck environments	40.6	55.3	96.3	40.74
D	**Section D Port Clinton environments**	**19.5**	**60.5**	**63**	**14.81**
E	Section E above cape Manifold to Cape Clinton	40.6	36.8	18.5	
F	Section E above five rocks to Cape Manifold	39.5	28.9	33.3	7.41
G	Section E Little Corio Bay to Five Rocks	27.3	36.8	14.8	
H	Corio Bay	48.1	71.1	29.6	
I	Yeppoon, Keppel & Fitzroy River	30.5	26.3	40.7	
J	Outside study area	12.9	13.2	37	

Table 8 Destinations used by the respondents for each survey type, as a percentage of the total for that survey type.
(Jennings 1996)

The Shoalwater Bay dugong protection area coincides with Area B (see figure 3) in the Jennings report which receives low use levels, a point which was confirmed by Boating and Fisheries patrol staff working in the Shoalwater Bay area. The reason for this seems to be the presence of the Military Training Area which deters recreational vessel users from frequenting the area even when it is open. Port Clinton DPA is covered in Sector D and in a small proportion of Sector C. From this research it can be shown that the Shoalwater Bay DPA receives minimal recreational vessel use. Port Clinton however is more popular as a destination and is identified as a key use area for the study, but even so lower than other areas that are more easily accessible from departure points.

20(p.17)

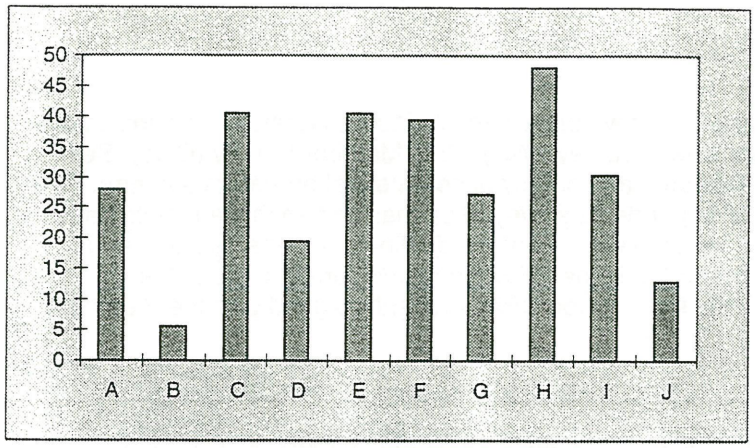

Figure 3 Mail Survey - Level of use per destination as a Percentage (Jennings 1996)

Departure points

The most popular departure point for accessing the survey area was from Rosslyn Bay (H) followed by the Curio Bay area (B). (See Table 9 and Figure 4)

		Mail	Club	Self	Comm
	Departure points	% (of 256)	% (of 38)	(% of 27)	(% of 27)
		%			
A	Bungalee	0.8		9	
B	Corio Bay area	21.5	18	3	
C	Fitzroy Motor Boat Club	0.4		0	
D	Five Rocks	2.3		0	
E	Farnborough Bch	2.3		0	
F	Gladstone	2.3		3	33.3
G	Rockhampton	5.1	36.8	6	
H	Rossyln Bay	54.9	81.6	51	66.7
I	Ross Creek	6.6	2.6	3	
J	Stanage Bay	7.8		31	
K	Sandy Bay			0	
L	Mackay			0	
M	Marlborough	0.4		0	
N	Kellys / Cooberry	10.9		6	
O	Hollins Bay	0.4		0	
	Other	10.2	10.5	11	

Table 9 Departure points used by the respondents for each survey type, as a percentage of the total for that survey type. (Jennings 1996)

20(p.18)

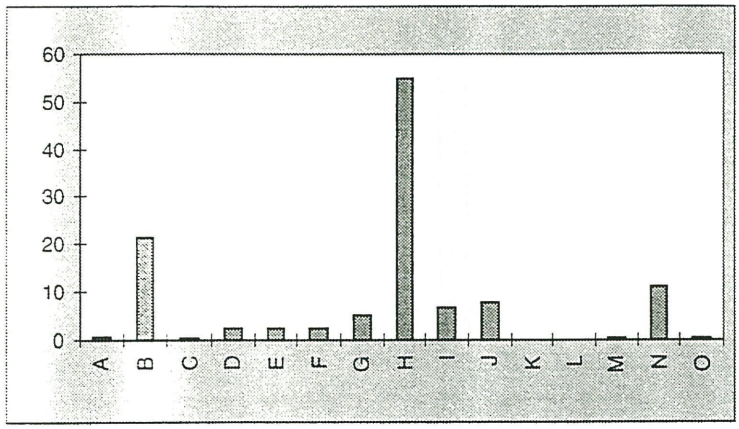

Figure 4 Percentage of departures per departure point for the Mail Survey (Jennings 1996)

Activities:

The main activity undertaken by respondents by all survey methods was Recreational Fishing (See Table 10).

		Mail	Club	Self	Comm
		% (of 256)	% (of 38)	(% of 27)	(% of 27)
	Main activity	%			
A	Boating	4.7	5.2	17	50
B	Recreational fishing	52.3	55.3	51	100
C	SCUBA diving				16.6
D	Kayaking				
E	Tourist activity				66.7
F	Spearfishing	0.4			
G	Snorkelling	0.4			16.6
H	Sightseeing	1.6	2.6		67.7
I	Camping	3.5			
	Other	12.1	2.6	26	

Table 10 Results of the main activities engaged by survey respondents as a percentage of the totals for each survey method. (Jennings 1996)

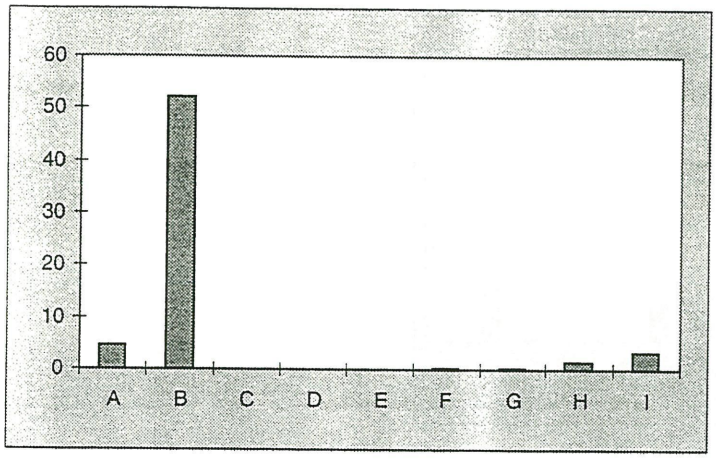

Figure 5 Frequency (%)of recreational activity undertaken in the study area from Mail survey results.

Recreational fishing was considered by most mail survey respondents to be an appropriate activity for Section B and D (69% and72%), while predominantly trawling, commercial netting, collecting and fishing were not considered to be suitable activities to be permitted in either areas.

Tourist Vessel Use

Approximately 6-8 charter vessels operate in the area in the Port Clinton area and south, with little or no activity in the Shoalwater Bay DPA. Island Head Creek and Port Clinton are used as fishing destinations and anchorages for charter vessels. (Fitzsimmons 1996) Tourist operators predominantly use Island Head Reef with a total of 27 visits recorded for 12 months See Table 11.

DUGONG PROTECTION AREA	REEF_ID	REEF_NAME	Total Vessel Visits /12 Months	Total Passengers /12 Months
Shoalwater Bay/Port Clinton	22038	Clara Island Reef	1	10
Shoalwater Bay/Port Clinton	22075	Clara Group Reef	2	10
Shoalwater Bay/Port Clinton	22078	Island Head Island Reef	27	229
Shoalwater Bay/Port Clinton	22081	U/N Reef	1	5
DPA TOTAL			**31**	**254**

Table 11 Tourist Vessel visitation to reefs within Shoalwater Bay/Port Clinton DPA
From GBRMPA returns database.

Commercial Fishing Vessels

Under current research being carried out by the GBRMPA into Shoalwater Bay, a report on the Status of Fishing in Shoalwater Bay is available for more detailed information on fisheries in Shoalwater Bay.

The shallow bathymetry of Shoalwater Bay excludes it as a significant trawl ground and this is supported by the lack of fishing effort recorded in the QFMA logbook database.

The commercial net fishery is minor also, as shown below in Figure 6, with only 8 vessels recording catch data for the area in 1995 with a total of 61 Days fished. The level of use has decreased over the three years shown. The Port Clinton commercial net fisheries recorded slightly higher however this also experienced a decline over the 3 years.

20(p.20)

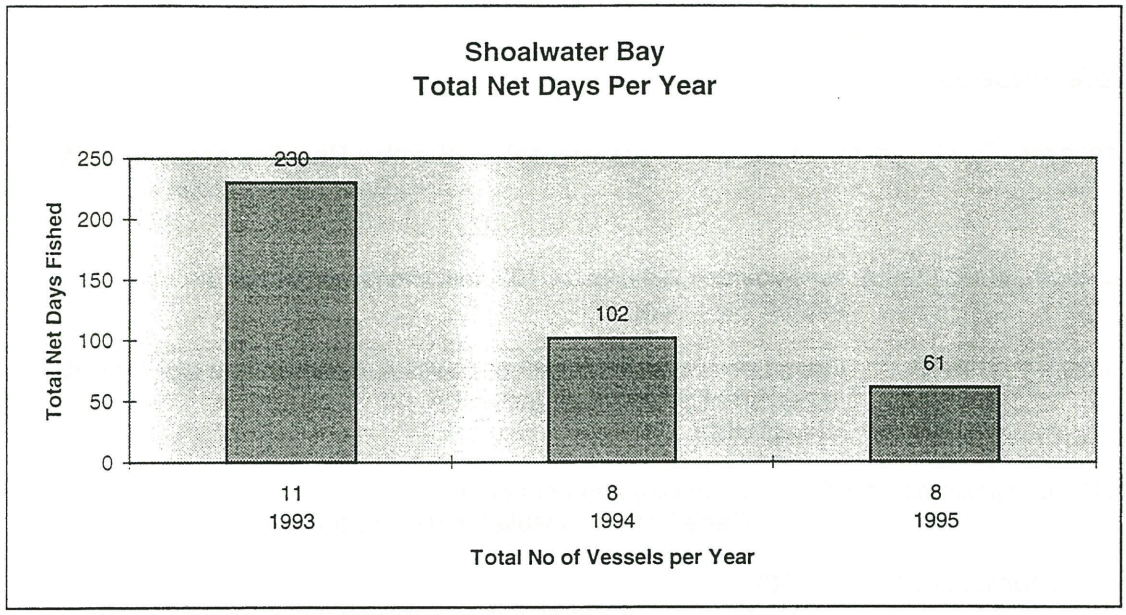

Figure 6 Shoalwater Bay Commercial Net Fishery
Total Number of Days Fished for Years 1993, 1994 and 1995
Note: The total number of vessels working the DPA for each year is written above the year on the bottom axis.
Source: QFMA Commercial Fishing Database (Reworked by Francis Pantus)
Note: The DPA extent used does not perfectly coincide with the QFMA database grid unit. As a result these figures may be slightly under the real value.

20(p.21)

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Queensland Department of Environment

Maryborough

20(p.22)

Ince Bay

Recreational Vessel Use

Ince Bay is a relatively remote DPA with access limitations, and therefore appears to support low levels of recreational use. There are camp sites located in Cape Palmerston National Park. Recreational users access the bay from Cape Palmerston by traveling along the beach from the township of Greenhill, or from Armstrong Beach to the north. Beach launching of smaller vessels occurs from the national park sites. Generally the area is tidal and the shallow bathymetry excludes use of the area by larger vessels. (Anecdotal information source: Boating and Fisheries).

Sarina and Mackay are the nearest main population centers to Ince Bay. Private boat registrations in this case are probably not a good indication of potential recreational vessel use (See Table 12). Recreational fishing and crabbing appear to be the main activities undertaken in the area.

Dugong Protection Area	Local District User Catchment	Boat Registrations 1995	Boat Registrations 1984	Percentage Increase (%)
Newry Region/ Ince Bay	Mackay	6635	5583	18.84

Table 12 Mackay District - Total number of privately registered vessels for 1995,1984 and percentage increase over the 11 year period.

Commercial Fishing Vessels

Otter and Beam Trawling occurs between Armstrong Beach to Ince Bay, but does not appear to occur in the DPA area.

Netting and crabbing are the main commercial fishing activities occurring inside the DPA with approximately 7 professional fishers currently working the area. (Anecdotal information source: Boating and Fisheries). This would appear to be supported by the QFMA database which gives 5 fishers working the area in 1995. (See Figure 7)

20(p.23)

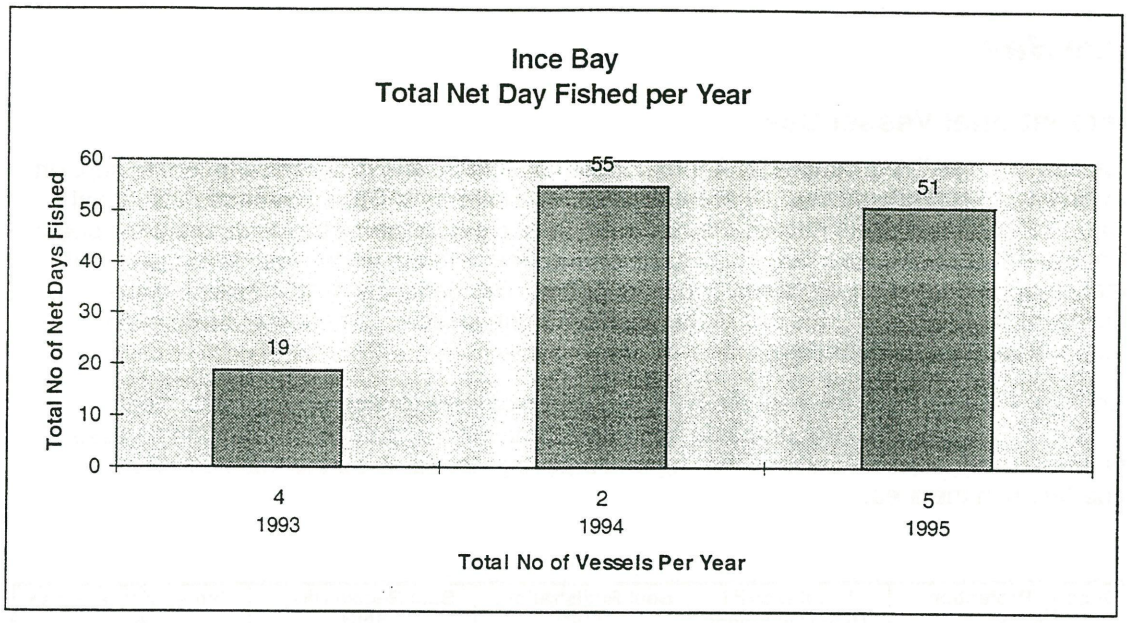

Figure 7 Ince Bay Commercial Net Fishery
Total Number of Days Fished for Years 1993, 1994 and 1995
Note: The total number of vessels working the DPA for each year is written above the year on the bottom axis.
Source: QFMA Commercial Fishing Database (Reworked by Francis Pantus)
Note: The DPA extent used does not perfectly coincide with the QFMA database grid unit. As a result these figures may be slightly under the real value.

The practice of setting offshore set nets perpendicular to headlands and islands could be a potential threat to dugong in the area (Anecdotal information source: Boating and Fisheries).

20 (p. 24)

Newry Region

Recreational Vessel Use

The Newry Region is more popular than Ince Bay as a recreational destination, however use levels are difficult to estimate. Road access into settlements within the area makes it more accessible than Ince Bay. The main boat ramp at Seaforth is often busy with at times up to 100 boats a day being launched. Other access points are from St. Helens Beach boat ramp, Murray Creek boat ramp, Mathers Creek (an informal ramp) and probably access is gained via private property along creeks. (Anecdotal information source: Boating and Fisheries). The main local population using the DPA are probably from the Mackay district. Private boat registrations for this area is shown in Table 13. There are picnic and camping areas located within the DPA and a couple of resorts. A small amount of water skiing is at times carried out offshore from the resort at Ball Bay.

Dugong Protection Area	Local District User Catchment	Boat Registrations 1995	Boat Registrations 1984	Percentage Increase (%)
Newry Region/ Ince Bay	Mackay	6635	5583	18.84

Table 13 Mackay District - Total number of privately registered vessels for 1995,1984 and percentage increase over the 11 year period.

There is a resort located on Newry Island but this does not contribute greatly to the recreational vessel traffic.

Commercial Fishing Vessels

Redcliffe Island, Ball Headland and Hillsborough are fished for Barramundi and small mackerel in the season October to December. Vessels are generally 4-5m dinghies with 30-90hp outboard motors. Approximately 6-7 professional fishers are known to work the area regularly, of these, several are from Sarina, one is based at Midge Point, and one is based at Ball Bay permanently. (Anecdotal information source: Boating and Fisheries). The total number of days fished for the area is shown in Figure 8. Offshore gill nets can be used off steep headlands where 2 meter water depths remain at low tide. These nets as in Ince Bay may be a potential threat to dugong as they move around the headlands.

20(p.25)

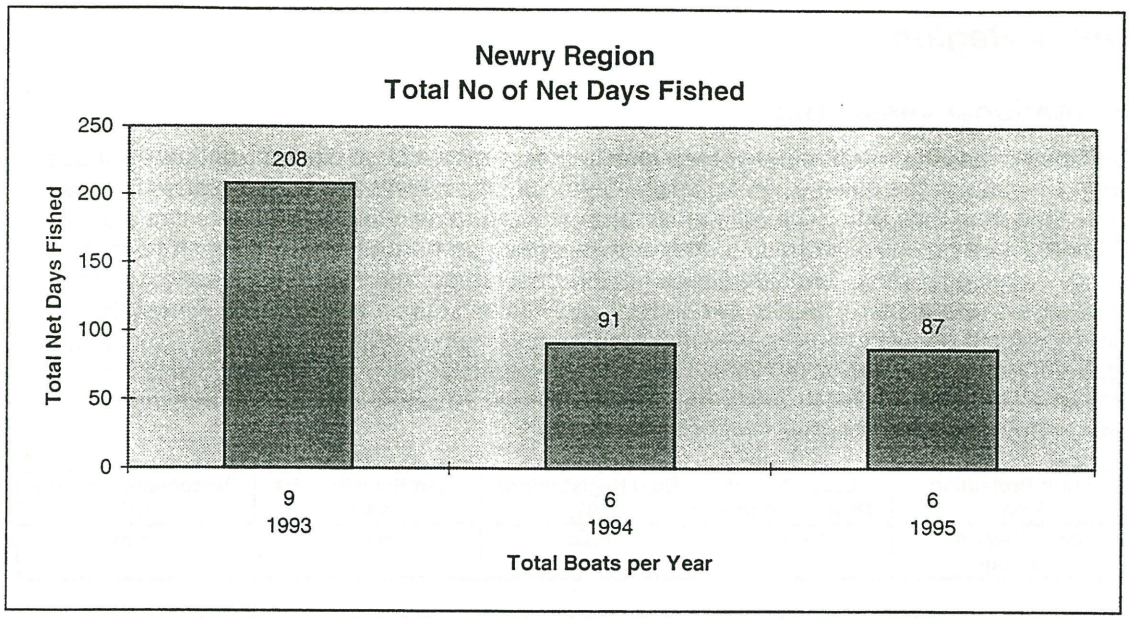

Figure 8 Newry Region Commercial Net Fishery
Total Number of Days Fished for Years 1993, 1994 and 1995
Note: The total number of vessels working the DPA for each year is written above the year on the bottom axis.
Source: QFMA Commercial Fishing Database (Reworked by Francis Pantus)
Note: The DPA extent used does not perfectly coincide with the QFMA database grid unit. As a result these figures may be slightly under the real value.

Oyster Leases operate at Rocky Island, Newry and Rabbit island however, these have little associated vessel traffic.

20(p.26)

Upstart Bay

Recreational Vessel Use

It is difficult to assess the levels of recreational use for Upstart Bay. The current proposal to dredge an access channel through Molongel Creek would suggest that as a departure point it must receive a reasonable amount of use. During long weekends up to 50 boats can be observed to use the access facilities. The south eastern corner of the bay is reported to be fairly heavily used, particularly for crabbing. (Anecdotal information source: Boating and Fisheries).

The total number of privately registered vessels for 1995,1984 and percentage increase over the 11 year period is shown in Table 14. There have not been any large increases in private vessel registrations for the area over the last 11 years.

Dugong Protection Area	Local District User Catchment	Boat Registrations 1995	Boat Registrations 1984	Percentage Increase (%)
Upstart Bay	Ayr/Home Hill	2275	2136	6.51
	Bowen	1381	1141	21.03

Table 14 Ayr/Home Hill/Bowen - Total number of privately registered vessels for 1995,1984 and percentage increase over the 11 year period.

Commercial Vessel Use

Upstart Bay supports quite high trawl effort, with some banana trawling occurring early in the season, but most of this use falls largely outside the perimeter of the DPA.

The net fisheries are shown below based on the QFMA log book data (See Figure 9). 10 commercial netters recorded 87 days of fishing for 1995, a decrease from the previous 2 years.

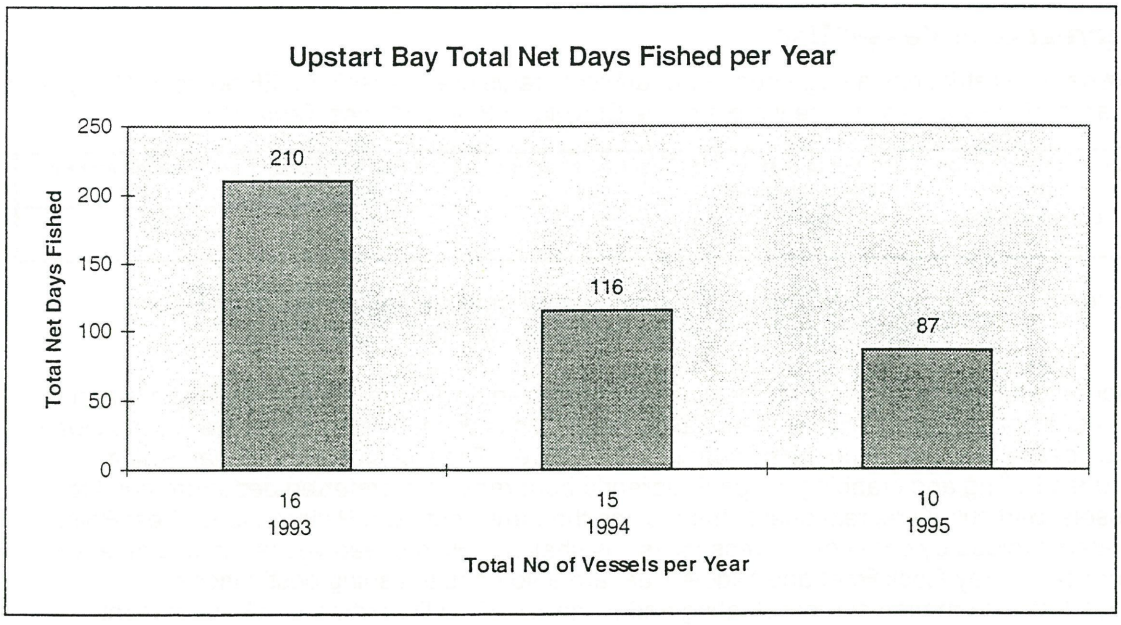

Figure 9 Upstart Bay Commercial Net Fishery
Total Number of Days Fished for Years 1993, 1994 and 1995
Note: The total number of vessels working the DPA for each year is written above the year on the bottom axis.
Source: QFMA Commercial Fishing Database (Reworked by Francis Pantus)
Note: The DPA extent used does not perfectly coincide with the QFMA database grid unit. As a result these figures may be slightly under the real value.

20 (p.27)

Cleveland Bay

Cleveland Bay DPA is the only DPA located around the entrance to a major port and major population center. As a result, shipping, commercial and recreational vessel traffic is considerably high.

Marine Infrastructure

Ross Creek: 123 Moorings which are used mainly by yachts and recreational vessels.
Ross River: 153 Moorings of which approximately 70% are filled. Generally there are between 50-60 trawlers berthed each season.
Breakwater Marina: 169 berths which are rented with an average occupancy of 88% (approximately 148 boats) on average for the last 12 months, 77 berths are owned and occupied permanently.
Townsville Motor Boat Club: 90 berths, 95% are permanent residents. There are approximately 200 visiting boats on average each year.
Townsville Ross River Marina: 44 moorings with 38 leases held by commercial fishers 70% occupancy.
There are three main boat ramps with Townsville, and one boat ramp at Pallarenda.

Shipping

Shipping traffic entering the Port of Townsville must pass through the Cleveland Bay DPA. Leading lights mark the channel into the port. For the 12 months from June 1995 the Townsville Port Authority recorded movements of 720 commercial vessels in excess of 200 tonnes (gross weight) into the port. These included cargo, passenger, naval and bunker vessels (Townsville Port Authority 1997). Generally, recreational vessels are discouraged from using the shipping lead channel, therefore smaller recreational vessels and even larger vessels such as the Magnetic Island Ferries' tend to travel outside the leading lights.

Recreational Vessel Use

Townsville District has a large number of privately registered vessels (6336 boats in 1995), in an area of easy access to the waters of the Cleveland Bay DPA (see Table 15).

Dugong Protection Area	Local District User Catchment	Boat Registrations 1995	Boat Registrations 1984	Percentage Increase (%)
Cleveland Bay	Townsville	6336	4726	34.07

Table 15 Townsville District - Total number of privately registered vessels for 1995,1984 and percentage increase over the 11 year period.

Recreational use of the inshore/coastal waters adjacent to Townsville and Magnetic Island is reportedly high, particularly recreational fishing which is concentrated in inshore waters close to access points and immediately south of Ross River. The types of recreational fishing includes trolling and crabbing. Cape Pallarenda boat ramp is a preferred departure point for vessels, particularly recreational fishers, using the banks out from Pallarenda to West Point, an area avoided by commercial vessels as it is shallow. High speed vessels in this area are of concern. Bay Rock Reef and Middle Reef are also popular fishing destinations. (Anecdotal information source: Boating and Fisheries, QLD Department of Environment).

Magnetic Island is visited by boats from Townsville as well as the resident island fleet. Horseshoe Bay supports all forms of recreational fishing. Trawlers and yachts use this bay as an anchorage. Shark mesh nets are in place off Horseshoe Bay. There is one jet-ski operation based here and some water-skiing takes place occasionally. Parasailing is conducted off Picnic Bay jetty.

20(p.28)

Tourist Vessel Use

Cleveland Bay was the second most visited DPA for tourist vessels operating under the GBRMP permit system. A total of 543 vessel visits were recorded for the DPA over 12 months, 537 of the total visits were to Magnetic Island.(See Table 16)

DUGONG PROTECTION AREA	REEF_ID	REEF_NAME	Total Vessel Visits /12 Months	Total Passengers /12 Months
Cleveland Bay	19006	Orchard Rocks Reef	4	7
Cleveland Bay	19007	Bay Rock Reef	2	4
Cleveland Bay	19009	Magnetic Island Reefs	537	3100
DPA TOTAL			**543**	**3111**

Table 16 Tourist vessel visitation to reefs within Cleveland Bay for the period July 1995 to July 1996. Data obtained from the GBRMPA returns database.

Commercial Fishing Vessels

Otter Trawling for banana prawns is concentrated around the mouths of Ross Creek and Ross River early in the year. Other than this there is limited trawling effort carried out in the eastern half of Cleveland Bay.

In 1995, 12 commercial net fishing vessels worked the coastal zone in Cleveland Bay compared to 23 for 1993 (see figure 10). The commercial net fishery tends to concentrate in the south-eastern corner of Cleveland Bay.

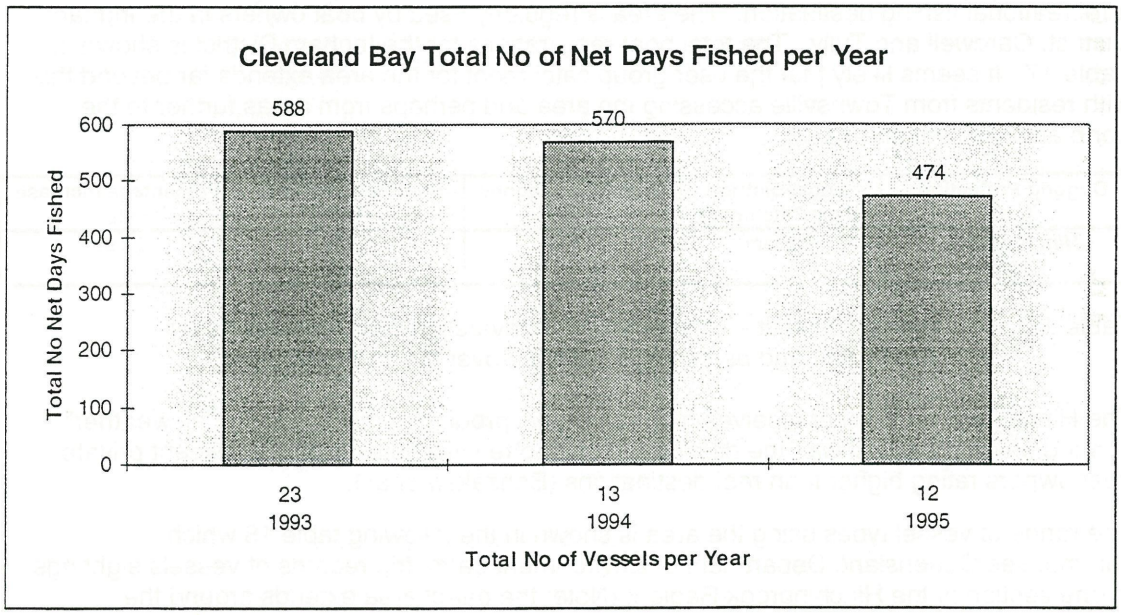

Figure 10 Cleveland Bay Commercial Net Fishery
Total Number of Days Fished for Years 1993, 1994 and 1995
Note: The total number of vessels working the DPA for each year is written above the year on the bottom axis.
Source: QFMA Commercial Fishing Database (Reworked by Francis Pantus)

Note: The DPA extent used does not perfectly coincide with the QFMA database grid unit. As a result these figures may be slightly under the real value.

20(p.29)

Hinchinbrook Region

Marine Infrastructure

The Hinchinbrook Region can be accessed from boat ramps located at Cardwell, Mission Beach, South Mission Beach, Hull Heads, Dungeness and a range of formal and informal access landing on the estuaries flowing into the channel. One of these, Fishers' Creek boat ramp is about to be upgraded. This boat ramp is located right on the perimeter of the channel estuary system. As it is accessible from the Highway, it is used as the Hinchinbrook Channel access point for recreational boaters from Townsville and probably northern centers as well. (Anecdotal information source: QDOE Cardwell and Dungeness).

Jetties are located at Cardwell and Lucinda and are used by the Tourist vessels located in the area.

Anchorages

The Hinchinbrook Region provides a range of anchorage sites for all types of vessels. Trawlers frequently anchor behind Brook Islands, Goold Island, with yachts and shallow draught vessels frequenting anchorages further inside the channel. Several anchorages occur over seagrass beds in the area.

Recreational Vessel Use

The Hinchinbrook Region has high recreational value as well as being particularly popular as a recreational fishing destination. The area is regularly used by boat owners in the Ingham District, Cardwell and Tully. The total boat registrations for the Ingham District is shown in Table 17. It seems likely that the user group catchment for the area extends far beyond this with residents from Townsville accessing the area and perhaps from areas further to the north also (Benzaken *et al.*).

Dugong Protection Area	Local District User Catchment	Boat Registrations 1995	Boat Registrations 1984	Percentage Increase (%)
Hinchinbrook Region	Ingham	1604	1294	23.96

Table 17 Ingham District - Total number of privately registered vessels for 1995,1984 and percentage increase over the 11 year period.

The Hinchinbrook Channel receives high use levels predominantly due to its "all weather" boating environment. It was the destination most often visited by Ingham resident private boat owners rating higher than reef destinations (Benzaken *et al.*).

The range of vessel types using the area is shown in the following table 18 which summarises Queensland Department of Environment patrol trip records of vessels sightings in one section of the Hinchinbrook Region. (Note: the patrol area extends around the southern half of Hinchinbrook Island, both eastern and western sides)

20(p.30)

	23-Jan	27-Feb	21-Mar	7-Apr	12-Aug	4-Sep	10-Oct	16-Sep	8-Sep	14-Oct	12-Oct	13-Oct	14-Oct	Total
Dinghy	13	8	3	8	5	9	4	5			3	6	4	68
Comm fisher		2		1				1						4
Half cabin	1	1		10	1							1		14
Trawler		2			2		1	2	1					8
Private pleas			1					1						2
Single mast		1			4	6	7	5	3		1	4	4	35
Twin mast				2				1	2			1		6
Trimaran						2			1					3
Catamaran	1			1	2	3		3	3					13
Motor vessel						2		3			1			6
House boat			2	2	4	2	3					2		15
Missing data				1		1	1		1					4
														0
Cruiser				3										3
Rent a					1									1
Charter								1	1	3				5
Barge								1						1
Pilot vess								1						1
Water taxi								1						1

Table 18 Summary table of vessel types observed by QDOE patrols in the Southern Hinchinbrook Area. Data supplied by QDOE, Dungeness

The results of this table (see Figure 11) show clearly the high proportion of recreational dinghies using the sheltered waters of Hinchinbrook area, and the range of recreational and commercial vessels using the area.

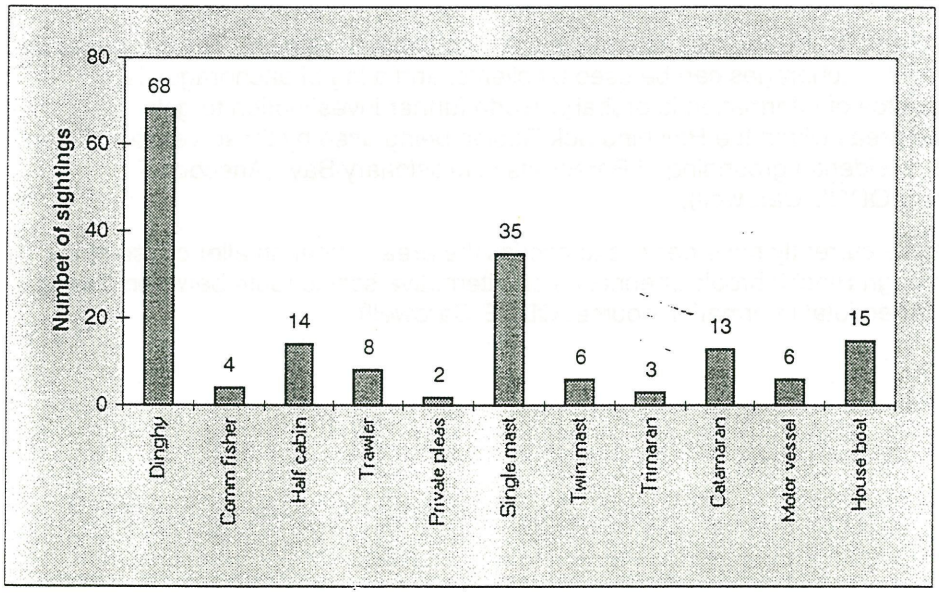

Figure 11 The number and types of vessels observed by QDOE in a sample of their patrols of southern section of Hinchinbrook Region
Source: Trip record Sheets from QDOE Dungeness

While dinghies tend to use the channel waters, larger half cabin and private pleasure speedboats are able to utilize areas less sheltered and travel at much faster speeds.

20(p.31)

Accidental groundings of recreational vessels occur on the tidal flats in Missionary Bay (Anecdotal information source: QDOE Cardwell).

In the past, water-skiing races have been held in the channel. These are of major concern as racing vessels achieve speeds of up to 70 knots and travel across shallow water areas throughout Hinchinbrook Channel. In the past, the event has been monitored by QDOE staff and is of great concern (see Burnham 1994).

Tourist Vessel Use

Of all the DPAs in the GBRMP (this excludes Southern Hervey Bay/Great Sandy Strait), Hinchinbrook Region received the highest tourist vessel visitation under the GBRMPA returns system. 762 vessel visits carrying 13142 passengers were recorded in a twelve month period. (See Table 19) This is an understatement of the real number of tourist vessel visits as part of the Hinchinbrook Region falls under the jurisdiction of Queensland (state) Marine Parks. Vessels permitted to use the area under the state marine parks have not been included as there is no returns data available.

DUGONG PROTECTION AREA	REEF_ID	REEF_NAME	Total Vessel Visits /12 Months	Total Passengers /12 Months
Hinchinbrook Region	18008	Brook Islands Reef	61	343
Hinchinbrook Region	18010	Goold Island Reef	218	744
Hinchinbrook Region	18011	Garden Island Reef	53	199
Hinchinbrook Region	18014	Hinchinbrook Island Reef	429	11854
Hinchinbrook Region	18015	Agnes Island Reef	1	2
DPA TOTAL			**762**	**13142**

Table 19 Tourist vessel visitation to reefs within the Hinchinbrook DPA for the period July 1995 to July 1996.
Data obtained from the GBRMPA RETURNS database.

Under the state marine permits regular ferry and tourist operations run from both Cardwell and Dungeness, making regular trips through the Hinchinbrook channel, and to Hinchinbrook and Goold Islands.

Bareboat and yacht rental businesses operate in the Hinchinbrook Region. The operators do give advice on which anchorages can be used by clients, and a log of anchorages is recorded. This source of information is probably worth further investigation to gain information on the areas within the Hinchinbrook Region being used by these vessels. There are also cases of accidental grounding of Bareboats in Missionary Bay. (Anecdotal information source: QDOE Cardwell).

Large cruise vessels currently have permits to access the area. Other smaller cruise ships regularly pass through Hinchinbrook Channel as an alternative scenic route between Cairns and Townsville. (Anecdotal information source: QDOE Cardwell).

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Commercial Fishing Vessel

Commercial Net fishers in the Hinchinbrook Channel numbered 26 in 1995 with a total of 617 days fished, a slight decrease on the total days fished in the two years previous.

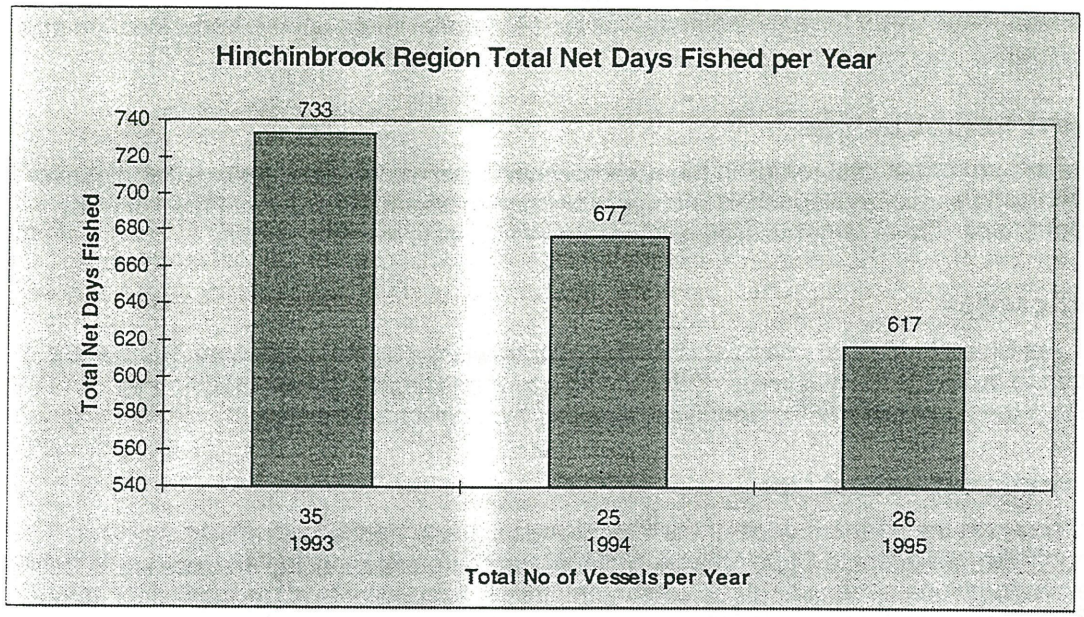

Figure 12 Hinchinbrook Region Commercial Net Fishery
Total Number of Days Fished for Years 1993, 1994 and 1995
Note: The total number of vessels working the DPA for each year is written above the year on the bottom axis.
Source: QFMA Commercial Fishing Database (Reworked by Francis Pantus)
Note: The DPA extent used does not perfectly coincide with the QFMA database grid unit. As a result these figures may be slightly under the real value.

20(p.33)

Princess Charlotte Bay / Bathurst Bay

Princess Charlotte Bay and Bathurst Bay are the most remote of the DPA's. Despite this, recreational use of the area has steadily increased over the last ten years, as four wheel drive trips to the Cape have grown in popularity. (Anecdotal information source: Boating and Fisheries).

Marine Infrastructure

There are no formal boat ramps in the area however most recreational vessels are dinghies transported by road and launched into rivers or from the coast via National Parks or from Marina Plains. Other larger vessels such as yachts travel to the area by sea.

Anchorages

Princess Charlotte Bay is a popular anchorage for trawlers working in the area, particularly sheltering behind the Cliff Islands, Clack Island and King Island. The Owen Channel between the islands of the Flinders Group is used by trawlers and yachts.

Recreational Vessel Use

Located along the northern edge of Lakefield National Park, Princess Charlotte Bay and Bathurst Bay (adjacent to Cape Melville National Park) are experiencing an increase in levels of recreational use. The user group catchment area is large with its extent difficult to identify as there is no large local population nearby however there are anecdotal reports of regular use of the area by residents from Cairns and Townsville. (Anecdotal information source: Boating and Fisheries). For total vessels privately registered to Cairns and North District see Table 20.

District	Boat Registrations as at 1995	Boat Registrations as at 1984	Percentage Increase (%)
Cairns and North	7930	4596	72.54

Table 20 Cairns & North District - Total number of privately registered vessels for 1995,1984 and percentage increase over the 11 year period.

Access into the area is restricted during the wet season. However, when the roads are open recreational vessels are launched into rivers in Lakefield National Park and through Marina Plains. The Cape York Peninsula Landuse Study (Cyplus, 1993) describes the Princess Charlotte Bay area as a major area for freshwater, estuarine, inshore and reef recreational fishing. It is difficult to obtain definite numbers for the recreation use but it appears from reports of field officers working in the area that use levels are increasing. The types of recreational vessels sighted by coastwatch include: dinghies, game fishing vessels, yachts and pleasure craft (see Figure 13).

20(p.34)

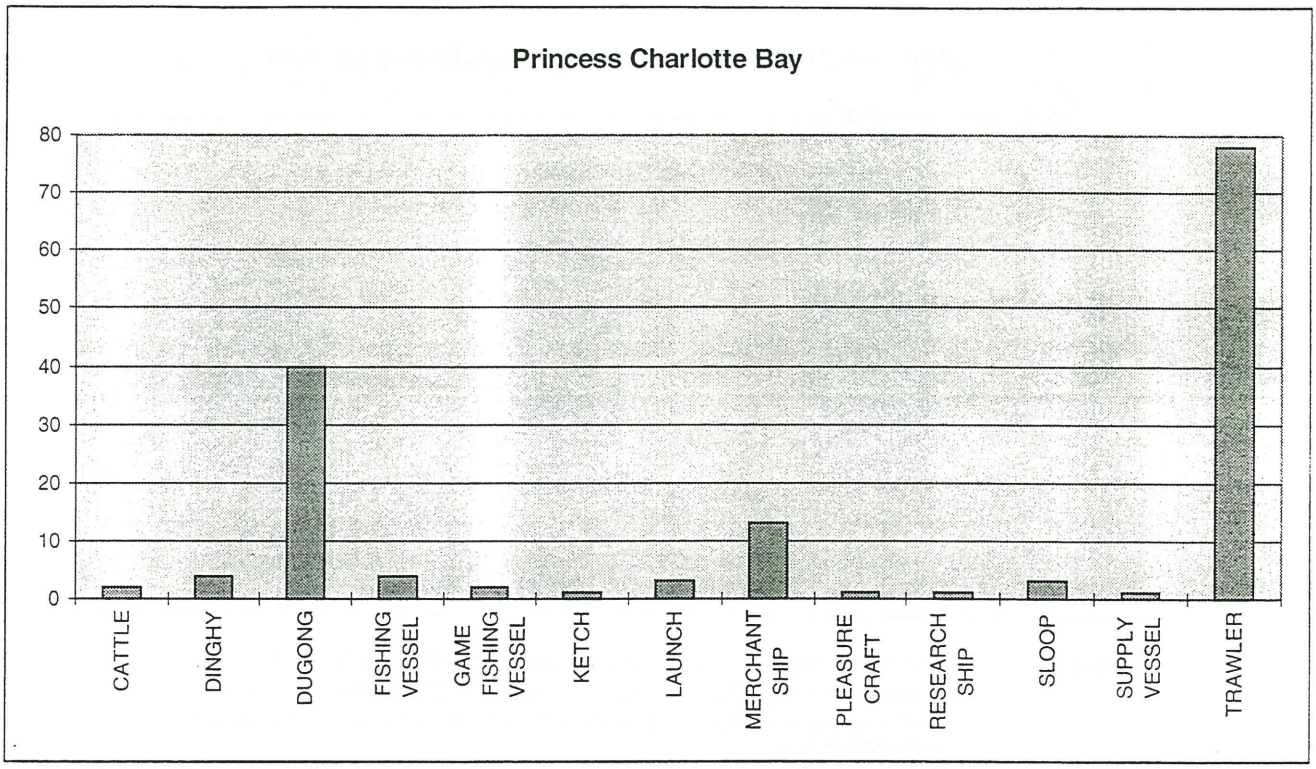

Figure 13 The total number of vessels sighted during Coastwatch Aerial Surveillance for the Princess Charlotte Bay and Bathurst Bay areas.

Tourist Vessel Use

Tourist vessels use is fairly low compared to other northern DPA's. 55 tourist vessel visits were recorded for twelve months with most visits being to the Flinders and Stanley Island Group. (See Table 21)

DUGONG PROTECTION AREA	REEF_ID	REEF_NAME	Total Vessel Visits /12 Months	Total Passengers /12 Months
Princess Charlotte Bay	14007	Taiwan Shoal	1	4
Princess Charlotte Bay	14011	Olive Patch	2	10
Princess Charlotte Bay	14022	Wharton Reef	1	10
Princess Charlotte Bay	14026	Stanley Island Reefs	3	16
Princess Charlotte Bay	14031	Blackwood Island Reef	8	51
Princess Charlotte Bay	14042	Flinders Island Reefs	40	242
DPA TOTAL			**55**	**333**

Table 21 The total number of tourist vessels and passengers visits over twelve months. Data Source: GBRMPA returns database.

Commercial Fishing Vessels

Sections of Princess Charlotte Bay and Bathurst Bay are zoned General Use 'B' excluding trawling in the southern and inshore section of the bays. North of this zone the East Coast Otter Trawl Fishery operates. The high number of trawlers operating in the area is reflected in the aerial surveillance data (see Figure 13).

Princess Charlotte Bay and Bathurst Bay are also major areas for East Coast Net Fishery, the East Coast Barramundi Set Gill Net Fishery, the Mud Crab Fishery, and the Ornate Rock Lobster Fishery (CYPLUS 1993). A total number of 14 vessels recorded using the area for net fisheries in 1995, with 499 total days fished (See Figure 13). Reef Line fishing is carried out on Corbett and Grub reefs at the northern edge of the DPA boundary.

20(p.35)

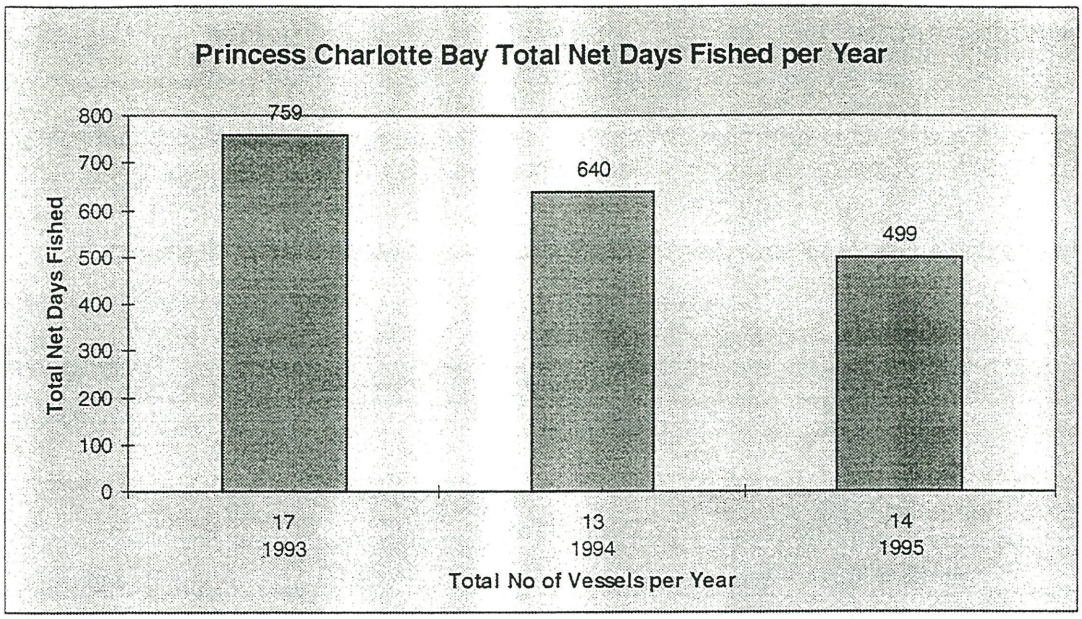

Figure 14 Princess Charlotte Bay/Bathurst Bay Commercial Net Fishery
Total Number of Days Fished for Years 1993, 1994 and 1995
Note: The total number of vessels working the DPA for each year is written above the year on the bottom axis.
Source: QFMA Commercial Fishing Database (reworked by Francis Pantus)
Note: The DPA extent used does not perfectly coincide with the QFMA database grid unit. As a result these figures may be slightly under the real value.

20(p.36)

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James Innes
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Jamie Storrie
Julie Bahr

20 (p.37)

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Conducted on the behalf of:
Queensland Department of Environment

Maryborough

EFFECTIVENESS OF VOLUNTARY CESSATION OF DUGONG HUNTING

Background

Dugong hunting is an integral part of indigenous use and management of marine resources. The management regime is based on traditional laws which embody an individual or particular group's rights and responsibilities in relation to marine estates and resources. Hunting is not practised by all people. Amongst some groups the dugong has spiritual and totemic significance and cannot be hunted by indigenous law. Where dugong hunting is practised only a limited number of designated men actually hunt.

Dugongs are culturally significant to those groups who hunt as well as those who do not. There is a complex mix of groups who hunt and those who do not, along the Queensland coast. The forced relocation of Aboriginal people, Torres Strait Islander people and South Sea Islanders in earlier times has resulted in dugong hunting being introduced and continuously practised in most parts of the east Queensland coastal area. Hunting by South Sea and Torres Strait Islanders in non territorial waters is seen by traditional marine estate custodians as an infringement of native title rights.

South of Cooktown it appears that dugong are mainly taken for special events and celebrations although there are consistent but unconfirmed anecdotal reports of dugong being taken for sale in some areas. There is no accurate data on the numbers of dugong taken. Permits to hunt dugong south of Cooktown have not been issued by the Authority for some eighteen months. The Yarrabah Community is still operating on an old permit which allows dugong to be taken, this is currently being renegotiated.

Indigenous people have expressed concern over declining dugong numbers for some time. These concerns relate, primarily, to the loss of a cultural icon and resource which reflects on indigenous identity. They are concerned about the loss of dugong in fishing nets and they believe, trawl nets as well as from pollution of sea grass, direct boat strikes and disturbance to habitat resulting from coastal development. Past attempts to limit hunting have been seen as discriminatory whilst these other threats have not been seriously dealt with.

There has been a reduction in hunting by some people, in some areas, on a voluntary basis as well as by formal MOU in the case of the Darumbal people of the Shoalwater Bay/Port Clinton area. There is no data available to demonstrate the degree of compliance with voluntary agreements not to hunt. Certainly none of the groups who have indicated that they have suspended hunting have applied for permits nor is there any evidence to suggest that they are hunting illegally.

The Authority has developed an interim policy advising all assessing officers and permit delegates that hunting of dugong in the area south of Cooktown is not generally sustainable and that permits for dugong hunting should not be recommended on environmental grounds. Staff have been instructed that if people seek a permit to hunt dugong then they should explain the circumstances and advise hunters that permits cannot be recommended. A fact sheet explaining the situation has been prepared for staff to give to hunters.

Issues

This is a highly sensitive issue, culturally and politically, for indigenous peoples. Voluntary cessation of hunting is not comprehensive but where people have agreed not to hunt there is no evidence to suggest that they are not abiding by that agreement. Comprehensive coverage of all areas and groups has not been possible due to the large geographic area, wide range of groups, political complexities between groups and a lack of resources to adequately address this issue.

Those people who continue to hunt, or support hunting, are extremely strong advocates for the maintenance of what is seen to be a very significant cultural activity. People are angry that dugong have been killed for many years by non indigenous activities in much greater numbers than hunting and that nothing has seemingly been done about it.

Indigenous peoples are not prepared to willingly suspend an important cultural activity if serious attention is not being given to ***all*** other threats. There are reports that people are not prepared to continue existing voluntary suspensions if serious measures are not implemented to remove all other threats. Indigenous people have also stated that formal joint management arrangements or regional agreements are a necessary part of future management for dugong or DPA's.

The issue is further complicated by the fact that hunting, as a cultural activity which has been maintained, is seen by some as a significant assertion of native title rights. Indigenous groups are being advised by their advocates and advisers not to enter into formal written agreements giving up, or suspending, hunting rights as there is concern that this may constitute a diminishing of native title rights.

In addition to cultural disruption ceasing hunting could have a significant impact on the economy of some groups as they rely on hunting to provide meat for the table. Many indigenous people are in the lower socio-economic bracket and are increasingly reliant on finding non store sources of food.

There is strong reaction, by some, to Governments imposing permit systems and controls over traditional cultural activities. After so many years of being subjugated, dispossessed and denied rights, indigenous peoples are concerned that imposed management systems on traditional activities are yet another means of cultural genocide.

Despite the issues and concerns raised there are indications that a resolution could be found in the development of formal management agreements with indigenous people for both proposed Dugong Protected Areas (DPA's) and dugong as a species. Such agreements are possible under part VB of the Great Barrier Reef Marine Park Act. The nature and content of any such agreements would need to be negotiated according to a framework of basic principles during the development of management plans for DPA's. Similar State arrangements would also be required as many of the dugong habitats are outside of the GBRMP.

Recommendations

That joint management arrangements for DPA's be investigated and developed as a part of management planning for those areas.

That staff of the Authority work with Queensland D of E and ATSIC staff to inform all indigenous groups of the plight of dugong and seek to extend voluntary suspension of hunting to all groups in the Southern GBR as an interim measure while joint management arrangements are being developed.

That following advice to indigenous groups, illegal hunting activities be vigorously investigated and prosecuted.

Greg Smith
GBRMPA in conjunction with

Rick Hill
ATSIC
Qld State Office

Bill White
ATSIC
Cairns

Gale Duell
ATSIC
Townsville

February 1997

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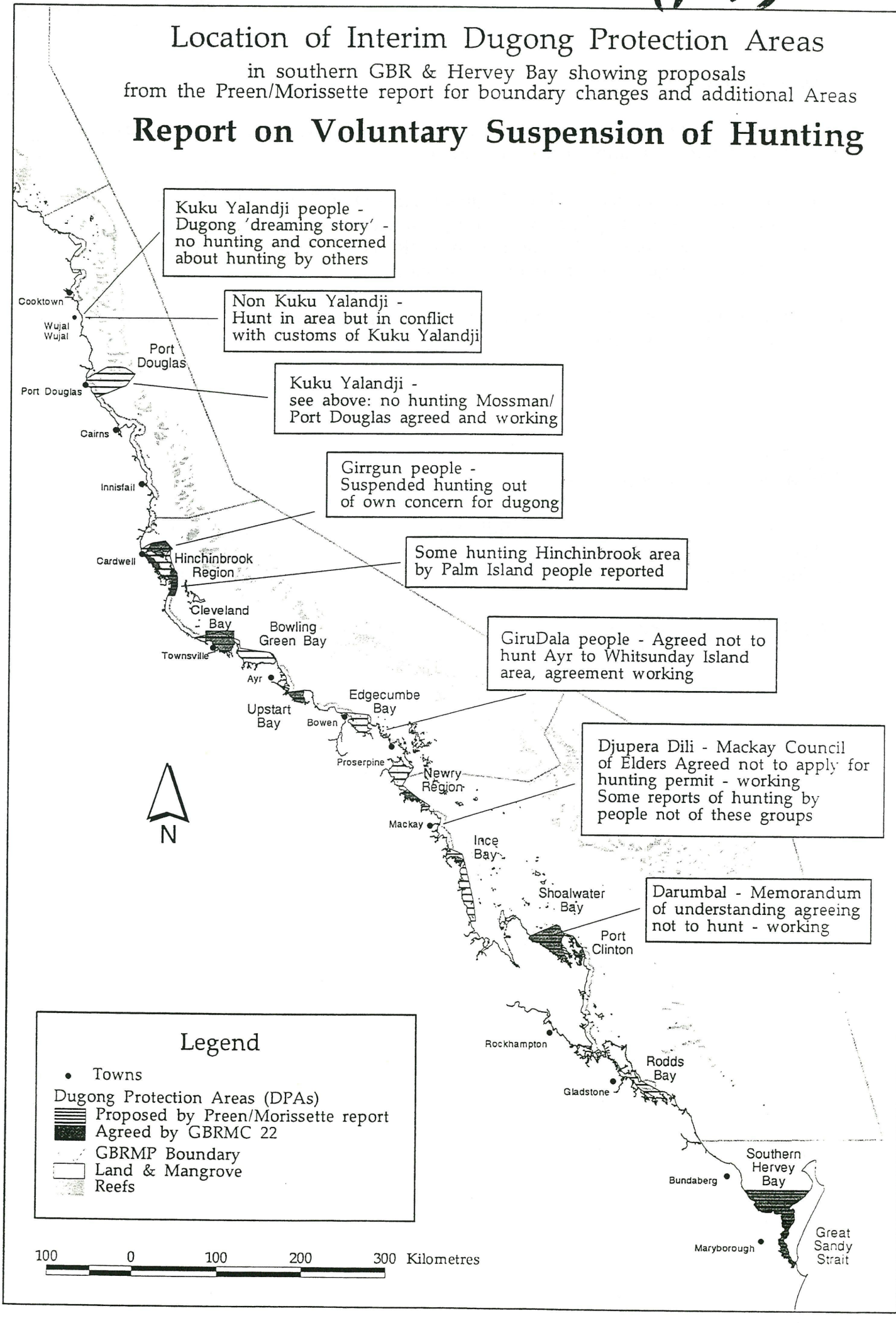
Location of Interim Dugong Protection Areas

in southern GBR & Hervey Bay showing proposals
from the Preen/Morissette report for boundary changes and additional Areas

Report on Voluntary Suspension of Hunting



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Coastal Development and Pollution in Dugong Protection Areas

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January 1997

Introduction

Activities associated with urban settlement and development along the Queensland coast have the potential to increase water column pollutant concentrations. This may result in loss of nearshore seagrass habitat (Marsh, 1992; Anon, 1993; Preen *et al.*, 1995) or result in the increased availablity of bioaccumulable pollutants. Both influences may adversely impact internationally significant Great Barrier Reef dugong populations (GBRMPA, 1981; Marsh, 1992; Preen, 1993).

Queensland coastal development

Queensland local governments adjacent to coastal World Heritage Areas contain approximately 15% of the State's population, all but one of the State's major ports and are amongst the fastest growing areas in Queensland. There have been no attempts made to systematically assess the impacts of coastal urban development on the Great Barrier Reef World Heritage Area.

a. Water column pollutants

Agriculture, public health and urban settlement and industrial activities around the world have contributed to the widespread contamination of aquatic ecosystems with pollutants such as organochlorine compounds and heavy metals (Fowler, 1990; Tatsukawa *et al.* 1990), as well as with increased sediment loads (Moss *et al.* 1992). Heavy metals and organochlorine pollutants are conservative and are essentially permanent additions to the environment (Clark, 1992). They are also often highly toxic to biota (Richardson, 1995).Various reviews conducted over the last 10-12 years indicate the sparsity of information available on the extent of organochlorine and metal pollution in the Great Barrier Reef Lagoon and Queensland in general (Dutton, 1984; Hunter and Rayment, 1991; Hunter, 1992).

I. Organochlorine pollution

Organochlorine release has been implicated in reproductive and immunological abnormalities observed in terrestrial bird populations and in marine mammal

populations (Boon *et al.*, 1992). The few studies of the impact of organochlorine compounds carried out on Australian marine environments indicate that environmental contamination by organochlorine substances has occurred at relatively low concentrations and that highest pollutant concentrations have been associated with centres of urbanisation (Connell, 1993; Richardson, 1995). Most studies have focussed on pollutant distribution in biota (von Westernhagan and Klumpp, 1995; Smillie & Waid, 1985; Olafson, 1978; McCloskey & Deubert, 1972). A number of audits on pesticide usage have recently been conducted (eg. Hamilton & Haydon 1996; Simpson *et al.* 1993; Rayment & Simpson, 1992) and management options for the monitoring of pesticide residues suggested (Simpson *et al.,* 1993; Rayment & Simpson, 1992; Rayment, 1991). However, very little information on the quantitative distribution of pesticide residues in Queensland is available.

II. Metal pollution

Metals such as arsenic, cadmium, copper, mercury, lead, nickel and zinc are also released into the aquatic environment through urban storm-water and wastewater discharges and from runoff from agricultural lands. Metal toxicity can interfere with growth, reproduction and behaviour of contaminated organisms. Results of Australian studies of marine environmental metal contamination indicate that surficial sediments adjacent to most urbanised and industrialised estuaries are contaminated with metals, particularly lead and zinc (Connell, 1993; Batley, 1995). Most investigations of metal concentrations in Queensland coastal environments were carried out in the late 1970s and early 1980s. These studies documented heavy metal concentrations in seawaters, sediments and biota from selected locations along the Queensland coast. With the exception of samples associated with harbour developments, environmental metal concentrations were typically found to be low compared with levels collected from other parts of the world (Burdon-Jones *et al.* 1982; Klumpp & Burdon-Jones, 1982).

b. Sediments

The ecosystems of the Great Barrier Reef receive sediments and nutrients from a range of sources including upwelling, effluent discharges and river runoff. Based on land-use and catchment runoff models, Moss *et al.* (1992) calculated that runoff of sediments and nutrients from catchments draining into the Great Barrier Reef has increased several fold since European settlement following the development of significant pastoral and agricultural industries. The primary cause of increased sediment loss is removal of natural vegetation (Beckman 1991). The current average annual sediment input into the Great Barrier Reef from river runoff has been estimated to range from 14 - 25 x 10^6 tonnes per year (Furnas *et al.* 1996). Seagrass meadow decline in Australian waters has been associated with the general hypothesis of reduced plant photosynthesis caused by increased water turbidity, epiphyte growth and silt deposition (Clarke & Kirkman, 1989; Walker & McComb, 1992; Abal & Dennison, 1996). Storm water runoff and effluent discharges, vegetation clearing, and local dredging and trawling can all be a consequence of urbanisation and agricultural expansion and are important factors effecting water clarity and seagrass health (Preen *et al.* 1995). The extent of anthropogenic impact on seagrass meadows within the Great Barrier Reef World heritage Region is unknown (McKenzie *et al.* 1996)

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Interim Dugong Protection Areas: Urbanisation and pollution

Data detailing urban development and pollutant impact on designated interim Dugong Protection Areas are summarised below.

Princes Charlotte Bay/Bathhurst Bay

Development

This a relatively isolated and undeveloped section of the coastline. The nearest urban centre is Cooktown, more than 150km to the south-east. Existing 'urban' development is restricted to a number of fishing camps on the Marrett River, Normanby, the North Kennedy, the Annie Rivers and at Port Stewart at the mouth of the Stewart River. There are coal deposits in the Bathurst Range and Bathurst Heads has been identified as a potential port site for a coal loading facility. There have been proposals for a small nature-based tourist facility on Kalpower Station near the Marrett River. The draft Stage 2 report for the Cape York Peninsula Land Use Strategy recommends that improved port facilities be provided at Port Stewart. The Flinders Islands are a popular stop-over point for cruising yachts, although there are no developments on the island group.

Catchment condition

Over 60% of the catchment of the north-east Cape York is classified as grazing land (Moss *et al.* 1992). The catchment is characterised by highly variable rainfalls with large sediment discharges under high flow conditions. Seagrasses off the coast of Cape York do not face the immediate threats from urban and agricultural runoff that potentially impact the GBR coast further south (Lee Long & Coles 1996).

Pollutant levels

No information is available on pollutant concentrations in Princess Charlotte Bay. α-HCH was detected in relatively high concentrations in Coral Sea seawaters in 1987 (Kurtz & Atlas, 1990). Because of the limited sampling undertaken at this time, it was unclear whether the high concentrations detected were a short term increase caused by improper local pesticide disposal or were indicative of long term regional contamination caused by southern-moving airborne contaminant from Asia.

Hinchinbrook Region

Development

This section of the coastline is approximately mid-way between the major cities of Cairns and Townsville in the local government areas of Cardwell Shire and Hinchinbrook Shire. The nearest large urban centre is Ingham which is inland from the southern boundary of the proposed interim dugong protection area (DPA). The main urban centre adjacent to the proposed interim DPA is the township of Cardwell, located on the Bruce Highway at the northern end of the Hinchinbrook Channel. It has

a population of approximately 1,300 and a small number of tourist accommodation establishments. Cardwell is a popular departure point for houseboats, yacht hire and cruises to nearby islands. A major resort complex is under construction at Oyster Point, just south of Cardwell.

The other sizeable coastal township is Lucinda (population 800) at the southern end of the Hinchinbrook Channel. It is the site of a major port facility for the export of raw sugar and a departure point for private vessels and charter boats. There are two other small holiday villages on the mainland adjacent to this proposed interim DPA. Dungeness is a small fishing port and recreational boating base some 2 km north-west of Lucinda. Taylors Beach is a small residential holiday village south of Lucinda.

The proposed interim DPA includes Hinchinbrook Island, Goold Island and the Brook Islands. The only development on these islands is a small 50 bed resort at Cape Richards on Hinchinbrook Island. There is a proposal for the development of a small harbour and marina at Dungeness and the possible establishment of a ferry/barge service between Taylors Beach and Great Palm Island. The township of Cardwell is designated as an urban growth centre in the Cardwell Shire draft Strategic Plan.

Catchment condition

Principal land uses in the Herbert catchment include upland tin mining, grazing and sugar cane cultivation in the lower river flats and coastal plains (Anon 1993). Water quality in the catchment is affected by diffuse agricultural runoff and turbidity (Moss *et al.* 1992). Extensive wetland degradation has occurred in lower catchment areas (Anon 1993). The Herbert is characterised by large discrete flood events separated by extended periods of low flows (Furnas *et al.* 1996), and as a consequence, large volumes of sediments and associated nutrients are discharged irregularly under flood conditions. On average, 500,000 tonnes of sediment are estimated to be discharged by the Herbert River each year.

Pollutant levels

Point sources in the catchment include sewage effluent from the Ingham STP, sugar mill effluent and runoff from closed tin mines. There are also a number of mariculture operations (prawn farms and caged barramundi) present in the Hinchinbrook Channel. Discharge of effluents from these may contribute suspended ediment loads to local areas of the channel. The Hinchinbrook region has been the focus of recent investigations examining sedimentary processes and contaminant loadings (Brunskill, 1995). The distribution of lead, copper, mercury and cadmium in sediments has been investigated and the distribution of organochlorine pesticide residues in sediment cores is currently being undertaken (Cavanagh, 1997). Marine sediments have been found to contain locally elevated concentrations of heavy metals suspected of being sourced from current and past agricultural and mining activities. These concentrations are however low by world standards. Low levels of DDT (3ng/g) were detected in one surface sediment sample collected in Hinchinbrook Channel (Brunskill, *pers. comm.*).

<u>Cleveland Bay</u>

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Development

This proposed interim DPA is located adjacent to the City of Townsville - a major residential, industrial, tourist, transport, service and defence centre. Townsville City has a population of approximately 90,000 while the greater Townsville area (including Thuringowa Shire) has a population of some 135,000 persons. Townsville City and Thuringowa Shire have annual growth rates of approximately 1% and 4% respectively. Townsville is a major private and commercial boating centre on this section of the Queensland coast. It generates large concentrations of recreational boating activity in Cleveland Bay as well as tourist ferry and charter boat trips to the Great Barrier Reef. The proposed interim DPA also includes Magnetic Island, a major residential area and tourist destination in Cleveland Bay. Magnetic Island has a population of approximately 3,000 and a further capacity to accommodate approximately 1,400 overnight visitors. It is also a major day trip destination from Townsville. The anticipated future population of Magnetic Island is expected to be of the order of 6,000 persons. Townsville has significant concentrations of heavy industry including a nickel and copper refinery. Townsville Port is a major facility for import of nickel ore and export of refined metal products. Likely future developments within and adjacent to this proposed interim DPA include the construction of a major zinc refinery, further expansion of port facilities, upgrading of road and rail access to the port, and further residential development on both the island and on the mainland.

Catchment condition

The major type of land use in the Ross River catchment is grazing. 250,000 tonnes of sediments are estimated to be discharged by the Ross River each year (Moss *et al.* 1992). Point source discharges of nutrients are a relatively significant contributor of nutrients to Cleveland Bay. Water quality in Cleveland Bay is also influenced by northward flowing flood waters sourced from the Burdekin River following heavy rainfall events.

Pollutant levels

Seawater metal concentrations in samples collected in nearshore waters between 1976-1977 in Cleveland and Bowling Green Bays and between Townsville and Cardwell in 1979 were within the range of mean world data reported at that time (Burdon-Jones *et al.* 1982; Klumpp & Burdon-Jones, 1982). Seawater and sediment samples collected in the vicinity of the Townsville Port have been found to contain locally elevated concentrations of nickel, chromium, iron and zinc (Reichelt & Jones, 1993). These were associated with Port nickel ore loading berths (Reichelt & Jones, 1993). Polyaromatic hydrocarbons (PAHs) have also been detected in sediments collected from Townsville Harbour and were believed to be a consequence of fuel discharges and motor exhaust emissions to the water (Smith *et al.* 1985). Background tissue metal concentrations have been assessed in 9 species of tropical bivalves collected from the greater Townsville region in 1979 (Klumpp & Burdon-Jones, 1982). The relationship between bivalve tissue metal concentration, location and environmental impact was not assessed in this study. Seagrass metal concentrations were also been assessed in 1975 (Denton *et al.* 1980). Concentrations of manganese and zinc were relatively high in samples assessed. Average muscle tissue concentrations of chlorinated organics (PCBs,

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DDTs, HCHs, aldrin, dieldrin and chlordanes) in coastal marine fish species collected in the vicinity of Townsville between 1989 and 1993 were reported by Kannan and co-workers (Kannan *et al.* 1995). Concentrations of all compounds were low compared to samples from the Brisbane region and other urbanised centres.

Denton and co-workers reported metal concentrations in muscle, liver, kidney, lung and brain tissue and in the blood of 48 dugongs collected from Torres Strait and Townsville between 1974 and 1978 (Denton *et al.* 1980). These studies detected unusually high concentrations of Fe and Zn in liver tissue and high concentrations of Cd in kidney tissue. Concentrations of Cu, Cd, Co and Ag were also elevated in the liver compared with concentrations in other species of marine mammals. Levels of Fe, Zn, Cd and Co in the liver and Cd in the kidney were positively correlated with age of the animal. The concentrations were similar to those in dugong from the Gulf of Carpentaria (Denton *et al.* 1980) and more recent samples from the Torres Strait (Gladstone 1996). It was considered unlikely that the high metal concentrations accumulated by dugongs were a reflection of anthropogenic impacts, given the remoteness of the sampling sites (Denton *et al.* 1980). Heinsohn and Marsh reported very low lindane and dieldrin concentrations in the liver of four dugongs collected from Townsville (Heinsohn & Marsh 1978); and Smillie & Waid (1984) reported PCB concentrations in the muscle, liver and blubber of a single dugong caught at Magnetic Island.

Upstart Bay

Development

This section of the coastline is located between the urban centres of Ayr/Home Hill and Bowen. It is located within the Burdekin Shire. It is an undeveloped section of the mainland coastline with no urban centres adjacent to the proposed interim DPA. The small fishing and holiday village of Groper Creek is located just north of the proposed area.

Catchment condition

Grazing is the predominant land use in the Burdekin catchment (Anon 1993). Soil erosion is widespread and severe. Cane cultivation is practiced on the lower reaches of the river delta. The Burdekin is characterised by large discrete flood events separated by extended periods of low flows (Furnas *et al.* 1996).

Pollutant levels

Metal concentrations have been assessed in a number of seagrass species collected from Upstart Bay in 1975 (Denton *et al.* 1980). No data exists for levels of organochlorine pesticide residues in Upstart Bay. A previous study on Burdekin River sediment detected lindane at 5.2 ng/g (Dyall & Johns, 1985). A study of groundwater of the Burdekin Region detected levels of 0-5ng/L lindane and 0-3 ng/L heptachlor (Brodie *et al.*, 1984). These levels are below the Australian drinking water quality criteria of 30 and 10ng/L for lindane and heptachlor respectively although in some

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cases exceed the water quality criteria set for the protection of the aquatic environment (1 and 0.3ng/L for lindane and heptachlor respectively, Nicholson, 1984).

Newry Region

Development

This section of coastline is located some 40km north of the major coastal city of Mackay. It is located within the local government area of Mackay City. There are a number of small holiday/retirement/fishing settlements on the mainland coast adjacent to this proposed interim DPA. These are located at St Helens Beach, Seaforth and Port Newry. Tourist accommodation facilities are found at Halliday Bay. There is a small resort on Newry Island. Limited urban and tourist growth is expected to occur in the Seaforth area. Additional rural residential development is likely to occur in the Helens Beach area adjacent to the northern section of the proposed interim DPA.

Catchment condition

The Pioneer subcatchment is used for extensive sugar cane production (Anon 1993). Land use practices have resulted in severe soil erosion and a deterioration in soil structure.

Pollutant levels

No information available

Ince Bay

Development

This proposed interim DPA is located south of Sarina in the Sarina Shire. Most of the mainland coast in this area is located within the Cape Palmerston National Park. There is no urban development along this section of the mainland coast. The closest coastal settlement is the small holiday/fishing village of Armstrong Beach to the north. The large coal loading facility at Hay Point lies 25 km to the north . Large numbers of bulk carriers lie anchored up to 10 km offshore of this area.

Catchment condition

No major waterways discharge near Ince Bay. The predominant land use in the area is dryland grazing. Areas are overgrazed and have suffered from inappropriate land-clearing practices, resulting in erosion problems (Anon 1993).

Pollutant levels

No information available

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Shoalwater Bay

Development

Much of the mainland coastline adjacent to this proposed interim DPA is located within the Shoalwater Bay Military Training Area approximately midway between Mackay and Gladstone. There are a number of small, isolated fishing settlements along the western side of Shoalwater Bay north of the proposed interim DPA. The largest of these is located at Stannage. A collection of approximately 20 islands is found in Shoalwater Bay. Most of these islands are owned by the Commonwealth and are located within the Military Training Area. Port Clinton is a remote section of coastline and is located within the Shoalwater Bay Military Training Area approximately 80 km north of Yeppoon. There is no urban development along this section of the mainland coastline although Port Clinton has been identified as a potential port site.

Catchment condition

No major river systems enter Shoalwater Bay. Grazing lands in the southern catchment surrounding the bay are relatively stable, although there has been deterioration in vegetation cover (Anon 1993).

Pollutant levels

Metal concentrations have been assessed in a number of seagrass species collected from Shoalwater Bay in 1975 (Denton *et al.*, 1980). No other information on pollutant concentrations is available.

Hervey Bay

Development

This proposed interim DPA is located between Fraser island and the mainland. It includes approximately 150 km of coastline from Woodgate south to Inskip Point. It is located within the local government areas of Hervey Bay City, Maryborough City and Cooloola Shire.

The main urban centres on the mainland coast are:

Hervey Bay. A regional service centre and tourist destination that is experiencing rapid population growth. It is the fastest growing city in the Wide Bay region and population numbers are expected to double to around 75,000 by the year 2010. The Urangan Boat Harbour is a major embarkation point for tourist vessels.

Bingham/River Heads. A satellite development area south of Hervey Bay at the mouth of the Mary River. It is one of two major ferry gateways to Fraser Island.

Tin Can Bay/Cooloola Village. Tin Can Bay is a local fishing and holiday village that is experiencing increasing development pressure and population growth. Cooloola Village is a major new subdivision that is being developed south of Tin Can Bay.

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Rainbow Beach. This expanding holiday and tourist township is located adjacent to the southern boundary of the proposed interim DPA. It is a major gateway to and service centre for Fraser Island. Ferry services to Fraser Island operate from Inskip Point.

Maryborough is a large regional population centre.

North of Hervey Bay, smaller coastal settlements are located at Burrum Heads and Woodgate. South of Hervey Bay, smaller coastal settlements are located at Maroom, Boonooroo, Tuan, Poona Point and Tinnanbar. The character of these small holiday and fishing villages is changing as they experience subdivision pressure and population growth. On the west coast of Fraser Island, the main centre of development is the Kingfisher Bay resort. This integrated resort development includes a hotel, convention centre, a commercial centre, houses, condominiums and sporting/recreation facilities. The mainland coastline adjacent to this proposed interim DPA is experiencing rapid subdivision, tourist and population growth. This is occurring at both the larger population centres and the smaller coastal villages. Possible future tourist development includes the expansion of the Kingfisher Bay resort, a possible small resort on Bandicoot Island at the mouth of the Mary River and several mainland marina/resort proposals. Additional town planning controls (including possible Development Control Plans) are being considered for coastal communities in this area. This is being undertaken as part of the implementation of the management plan for the Great Sandy Region.

Catchment condition

The Mary River catchment has been extensively cleared for agriculture and the lower reaches of the Mary River are under significant pressure from grazing and agriculture (Anon 1993). Land clearing and concommittantly increased erosion and sediment transport were implicated in massive losses of seagrass from Hervey Bay, Queensland, following cyclonic storms and flooding of the Mary River in 1992 (Preen *et al.* 1995). This catastrophic seagrass loss was followed by mass migration and presumed mortality of a majority of the bays dugong population (Preen & Marsh 1995).

Pollutant levels

Herbicide and insecticide concentrations present in the Mary River and in Hervey Bay sediments were measured between 1993 and 1996 (Anon 1996). Sediment and river water pollutant concentrations were below detection limits for most compounds. The herbicides 2,4-D and Triclopyr were detected at trace concentrations (<0.2 ug/l).

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Dugong Protected Areas - Seagrass Issues

A Report to the Great Barrier Reef Marine Park Authority

January 1997

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Background to Great Barrier Reef Seagrass Management

The importance of Great Barrier Reef region seagrasses to commercial and recreational fisheries production and to dugong and turtle populations is widely recognised. Seagrass management initiatives have included special protection measures for areas of importance to commercial fisheries production (eg., fisheries coastal strip closures). Information on areas grazed by dugong and turtles is needed to help establish protected areas necessary for conservation of these megafauna.

There are difficulties for management of seagrasses because of a scarcity of detailed information on the natural variability in seagrasses and the causes of change. The Great Barrier Reef seagrass resource inventory is also incomplete, particularly in deepwater areas. Priorities for study include establishment of long-term seagrass monitoring programs at sites over a range of latitudes, locations and habitat types, and areas of conservation priority. Studies which identify the causes of change in seagrasses and seagrass responses to anthropogenic impacts will help in developing tools for monitoring impacts and the health of Great Barrier Reef systems. Seagrass losses are not the only indicators of ecological impact. Increases in seagrass, when due to nutrient additions, might be used as important early warnings of negative environmental impact.

Integrated catchment management programs which seek to address downstream impacts of land run-off may be one of the best management measures for successful seagrass conservation. Protection of coastal seagrasses may be particularly important in southern regions where potential threats are currently greatest and where dugong populations appear to have no alternative offshore feeding areas.

Seagrasses and Dugongs

Coastal seagrasses in northern Queensland are often restricted to the intertidal and immediate subtidal depths to less than 5 m. The relatively turbid coastal waters of northern Queensland limit light penetration and therefore limit the depth distribution of seagrasses in these areas. Very little seagrass was found in offshore during recent deepwater seagrass surveys south of Dunk Island (QDPI, unpublished information). Thus the primary food source of dugongs along much of the Queensland coast, is restricted to a relatively narrow band close to shore. This area overlaps with some of the main areas of gill netting in these regions, and presents immediate high risks to dugongs of capture in gill nets. If the area of subtidal seagrass habitat is small or restricted, there are few alternative feeding areas for dugong.

Large-scale losses of seagrass can cause large scale dugong mortality and emigration (eg., the 1992 seagrass and dugong losses in Hervey Bay, Preen *et al.* 1995). It is currently believed that small changes in seagrass distribution and abundance are likely to only affect dugong fecundity and dugong movements, but not likely to be the cause of mortalities (Marsh, pers comm.).

Long-term variability in seagrasses

For most of the nine proposed Dugong Protected Areas there is little or no data on long-term variation in seagrass distribution and abundance. Baseline maps of seagrass biomass information for coastal locations was obtained in Queensland Department of Primary Industries broadscale surveys during the 1980's.

Princess Charlotte Bay

Broadscale surveys conducted in October 1994 (Coles, Lee Long and Squire 1985) indicated the location of coastal seagrass meadows in Princess Charlotte Bay, but have not been repeated. Numerous dugong feeding trails were observed during surveys on the reef platform of Clack Reef. A large area of seagrass habitat dominated by *Halophila* species was found in the sheltered northeastern side of Corbett Reef during deepwater seagrass surveys (Coles *et al.* 1995) and dugong were sighted in this area during seagrass surveys.

Hinchinbrook Region

Seagrass habitats in the Hinchinbrook region (including Dunk Island to Cape Cleveland) were first mapped in October 1987 during a broadscale survey between Cairns and Bowen (Coles *et al.* 1992). That survey indicated where the main areas of seagrass habitat occurred and noted that seagrasses in the Hinchinbrook Island area are important regionally (Lee Long, Mellors and Coles 1993). The nearest large areas of seagrass are to the south around Townsville and dugong populations in Hinchinbrook Island area probably use seagrasses in a regions which extends at least from Dunk Island to Cape Cleveland.

A detailed survey of Dunk Island to Cape Cleveland in October 1996 (Lee Long *et al.* In Prep.) provides the only source of quantitative data to assess region-wide changes in seagrasses since 1987. This survey indicated significant increases in the distribution of seagrasses across the region since the 1987 broadscale survey, with most increases in the area of subtidal seagrass habitat. However, we have no measure of any other changes in seagrass distribution and abundance during the intervening nine-year period.

Anecdotal information has indicated a possible decrease in seagrass distribution and abundance in the region during 1990 and 1991. There is no quantitative record of the scale of these possible changes, so we cannot make any confident comment on the likely impacts on animals such as dugongs and green sea turtles. Detailed annual surveys are required at a number of localities to reliably measure regional variations in seagrasses over long term periods.

Cleveland Bay

As for the Hinchinbrook region, long-term change in seagrasses from Cape Pallarenda to Cape Cleveland and Magnetic Island come only from a broadscale survey in October 1987 and a detailed survey in October 1996. No data is available for changes over the intervening period.

Upstart Bay

The only published maps of seagrass distribution and abundance for Upstart Bay are from the initial broadscale survey in November 1987 (Coles *et al.* 1992). Unpublished maps were obtained from two brief surveys of Upstart Bay to assess the impacts of Cyclone Ivor in 1989 (Queensland Department of Primary Industries, unpubl. information).

Port Newry

Since the initial broadscale survey of Port Newry in March 1987 (Coles *et al.* 1990), no subsequent surveys have been conducted here.

Ince Bay

Since the initial broadscale survey of Ince Bay in March 1987 (Coles *et al.* 1990), no subsequent surveys have been conducted here.

Shoalwater Bay

Detailed baseline maps for Shoalwater Bay seagrasses were obtained in Spring (September 1995) and Autumn (April 1996) (Lee Long *et al.* 1996). The area of seagrass mapped in both surveys was of the same magnitude as was found in the initial broadscale survey (Coles *et al.* 1992), but more habitat was recorded in areas previously unsurveyed.

Turbid waters in Shoalwater Bay restrict the seagrass depth distribution to mostly the large intertidal flats. Very little subtidal seagrass habitat was found in the Shoalwater Bay region. Thus

the time available for dugongs to feed is limited to the period when water over the intertidal flats is sufficient for access.

Port Clinton
See comments for Shoalwater Bay (above).

Hervey Bay
Initial broadscale surveys mapped approximately 1000 km^2 of seagrass habitat in Hervey Bay in November 1988. Detailed surveys helped document the loss of almost all of this habitat, and its partial recovery following a cyclone and two floods in 1992 (Preen, Lee Long and Coles 1995).

Causes of seagrass changes

Seagrasses in northern Australia display large seasonal variation in abundance (Mellors 1993; McKenzie 1994; Lanyon and Marsh 1995; Lee Long *et al.* 1996). Year-to-year variation is less studied. Large changes can occur from catastrophic impacts (eg., cyclones and floods), but the causes of normal year-to-year variation are less understood. Light and nutrients are two of the most important parameters which influence seagrass growth and survival, but extremes of temperature, salinity or exposure can also lead to stresses and disease. Natural long-term change in seagrass might therefore be related to specific long-term changes in climatic conditions, and this requires investigation.

Human influences on long-term seagrass growth and survival can include stresses related to land-use, land run-off and coastal zone modifications. These include soil and nutrient loads, agricultural and industrial chemicals and changes in coastal hydrology (drainage, currents, shelter and exposure). Stress from anthropogenic impacts could lead to disease and loss of resilience or seagrass death.

Diseases affecting seagrassBiologistPortsmith, Cairns Northern Fisheries Centre38-40 Tingira Street5396Cairns4870nfc(070) 351 401(070) 529 814leelonw@dpi.qld.gov.auFisheries Business Group WL:WLWarren Lee LongDugong Protection Areas - Seagrass Issues
Five fungal pathogens were recently identified from samples and suspected as the cause of widespread death of seagrasses in Tin Can Bay and Great Sandy Straits (Wnuczynski 1996). One of these isolated pathogens was the slime mould *Labyrinthula*, which was the causative agent for wasting disease in seagrasses in North America and Europe (see Den Hartog 1987). If diagnoses are confirmed this would be the first documented case of wasting disease for Australian seagrasses. Widespread and lethal infections of these fungal pathogens is likely to be a result of stresses on seagrasses (see above) leading to outbreaks of the normally-dormant fungal populations. Reports by McLeod (1996), Thorogood (1996) and Wnuczynski (1996) highlight the need to investigate further the possibility of fungal pathogens causing seagrass losses in Queensland.

The occurrence of *Labyrinthula* and other fungal seagrass pathogens elsewhere in Queensland has not been investigated and has not been indicated as a likely cause of seagrass loss. All other large-scale seagrass losses in Queensland have been linked to causes such as cyclones and floods (Preen, Lee Long and Coles 1995; QDPI unpubl. Information) rather than chronic or acute disease infections. The above-mentioned anecdotal records of reductions in seagrass abundance at some northern Queensland localities in 1990 and 1991 were not formally investigated, so the involvement of disease agents cannot be confirmed. Note that long-term climatic change, and its influence on light and nutrient availability, is still considered an extremely important influence on region-wide changes seagrass distribution and abundance. Further study is required to establish the influence of environmental stresses and fungal pathogens in year-to-year changes in seagrasses in northern Queensland.

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Conference Abstract 24 (P)

Impacts on and responses of seagrasses in the Great Barrier Reef - issues for management

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An estimated 3000 km^2 of coastal seagrass habitat and at least 2000 km^2 of deepwater seagrass habitat has been mapped in the Great Barrier Reef region from broad-scale coastal surveys in the 1980s and ongoing inter-reef surveys. Seagrasses have been found in estuaries, shallow coastal bays and inlets, on fringing and barrier reef platforms, and in inter-reef areas to depths greater than 60 m. Most of the fourteen known species are common to the Indo-West Pacific region, but some reach the latitudinal limits of their distribution in Queensland and at least two *Halophila* species may be endemic to the Great Barrier Reef region or northeastern Australia.

All seagrasses are important in primary production and therefore in supporting complex marine food webs. Estuarine and shallow coastal seagrass meadows appear to be more important than deeper meadows as nursery habitat for juvenile prawns and fish. Dugong and green sea turtles - species listed as endangered or threatened - depend on seagrasses for survival. Large areas of seagrass at depths between 10 and 30 metres are associated with large dugong populations in the Cairns and Far Northern Sections, and in Hervey Bay immediately south of the Great Barrier Reef Marine Park. Coastal seagrasses help to maintain nutrient and sediment stability and water clarity. The role of seagrasses in deep water (>10 m) is less understood and requires attention. Large areas of macro-green algae communities in deep water, mostly on the outer shelf, are little known or understood and receive no special protection measures.

Natural cyclone and flood events can cause widespread loss of seagrasses in shallow and deep water, but agricultural land-use practices may exacerbate the effects of these natural events or reduce the resilience and recovery of seagrasses from natural impacts. The most immediate threats from urban and agricultural runoff, or coastal and Barrier Reef development appear in southern, populated regions. Localities which provide shelter and water conditions ideal for productive seagrass habitat are often targets for port development, and at the downstream end of heavily impacted catchments. Reducing the threats to seagrasses and dependent fauna from oil-spills requires improved management of shipping traffic and oil-spill responses. Current fisheries legislation, marine parks and area closures to trawl fishing help protect valuable inshore seagrass prawn nursery and dugong feeding habitat, but deepwater seagrasses do not yet receive formal protection measures.

Natural year-to-year change in Queensland seagrasses is not recorded and the causes, scale and ecological consequences of long-term changes remain poorly understood. Seagrass monitoring programs need long-term support and methods for hindcasting seagrasses in the tropics require development. Impacts on seagrasses in the Great Barrier Reef currently appear low to moderate, but land-use practices and coastal management need careful attention to minimise adverse impacts of increasing population and development. Research must help describe the responses of seagrass to natural and human impacts and attempt to determine acceptable levels of changes in seagrass meadows and water quality conditions which may cause those changes. Catchment management programs and heightened community awareness of the alternatives for reducing run-off impacts are considered essential for maintenance of Great Barrier Reef seagrasses.

Land-clearing kills off vital seagrass meadows
27/11/96 T'ville Bulletin

NUTRIENT run-off from agricultural and urban development had killed many seagrass meadows, researcher Warren Lee Long told the Great Barrier Reef conference yesterday.

Coastal seagrass meadows were vital nursery habitats for juvenile prawns and fish, as well as major food sources for dugongs, Mr Long said. "The loss of more than 1000sq km of seagrasses in Hervey Bay in 1992 followed two cyclones and prolonged flooding," he said.

The influence of nutrients on this area of seagrass was aggravated by coastal land-clearing and agriculture.

Mr Long said that when the first Great Barrier Reef conference was held in 1983, little was known about seagrass in the GBR region.

Broadscale surveys of seagrass meadows followed recognition in the 1980s of the importance of seagrass for tiger prawn fisheries, dugongs and green sea turtles.

Several new species of seagrass had been discovered in recent months. Scientists were concerned about incremental increases in pressures.

Impacts on and responses of seagrasses in the Great Barrier Reef - issues for management

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Abstract

An estimated 3,000 km^2 of coastal seagrass habitat and at least 2,000 km^2 of deepwater seagrass habitat has been mapped in the GBR region from broad-scale coastal surveys in the 1980's and ongoing inter-reef surveys. Seagrasses have been found in estuaries, shallow coastal bays and inlets, on fringing and barrier reef platforms, and in inter-reef areas to depths greater than 60 m. Most of the fourteen known species are common to the Indo-West Pacific region, but some reach the latitudinal limits of their distribution in Queensland and at least two *Halophila* species may be endemic to the Great Barrier Reef region or northeastern Australia.

All seagrasses are important in primary production and therefore in supporting complex marine food webs. Estuarine and shallow coastal seagrass meadows appear to be more important than deeper meadows as nursery habitat for juvenile prawns and fish. Dugong and green sea turtles - species listed as endangered or threatened - depend on seagrasses for survival. Large populations of dugong have also indicated the existence of large areas of seagrass at depths between 10 and 30 metres. The ecological role of seagrasses in deep water (>10 m) is not well understood and requires study. Large areas of macro-green algae communities in deep water, mostly on the outer shelf, are little studied and receive no special protection measures.

Natural cyclone and flood events can cause widespread loss of seagrasses in shallow and deep water. Agricultural land-use practices may exacerbate the effects of these natural events or reduce the resilience and recovery of seagrasses from natural impacts. The most immediate threats from urban and agricultural runoff, or coastal and Barrier Reef development appear in southern, populated regions. Localities which provide shelter and water conditions ideal for productive seagrass habitat are often targets for port development, and at the downstream end of heavily impacted catchments. Reducing the threats to seagrasses and dependant fauna from oil-spills requires improved management of shipping traffic and oil-spill responses. Current fisheries legislation for marine plant protection, policies for protection and sustainable use of seagrass habitat areas, marine parks and area closures to trawl fishing help protect valuable inshore seagrass prawn nursery and dugong feeding habitat, but seagrasses in deep water do not yet receive formal protection measures.

Natural year-to-year change in Queensland seagrasses has not been recorded in any detail and the causes, scale and ecological consequences of long-term changes are poorly understood. Seagrass monitoring programs need long-term support and methods for hindcasting seagrasses in the tropics require development. Impacts on seagrasses in the Great Barrier Reef currently appear low to moderate, but incremental increases in the total impact must be managed. Land-use practices and coastal management need careful attention to minimise adverse impacts of increasing population and development. Research must help describe the responses of seagrass to natural and human impacts and attempt to determine acceptable levels of changes in seagrass meadows and water quality conditions which may cause those changes. Catchment management programs and heightened community awareness of the alternatives for reducing run-off impacts are considered essential for maintenance of Great Barrier Reef seagrasses.

Status of Seagrasses in the Great Barrier Reef

At the time of the first Great Barrier Reef Conference (1983) we knew close to nothing about the extent of seagrasses in the Great Barrier Reef (GBR) region. Collections for taxonomic classifications (den Hartog 1970, Greenway 1979) and studies of succession in intertidal seagrasses at Townsville (Birch and Birch 1984) formed the strength of our knowledge then. Broad-scale seagrass surveys along the Queensland coastline were initiated by the Queensland Department of Primary Industries (Coles *et al.* 1985a,b, 1987a,b, 1992, Lee Long *et al.* 1992, 1993) following recognition of the importance of seagrasses as nursery habitat for juvenile prawns of commercially valuable tiger prawn fisheries (Coles and Lee Long 1985). The dietary dependence of dugongs and green sea turtles on seagrasses was also established at about this time (eg., Lanyon *et al.* 1989). Dugong and green sea turtle conservation became an additional impetus for subsequent seagrass research, mapping and monitoring. Conservation management priorities for these endangered or threatened species strongly influences the direction of Great Barrier Reef seagrass studies today.

Broad-scale surveys of separate regions from 1984 to 1989 (Coles *et al.* 1985; Coles *et al.* 1987a,b; Coles *et al.* 1992; Lee long *et al.* 1992) indicated where seagrasses occurred in estuaries, shallow coastal bays and inlets, on some fringing reefs, barrier reef platforms and limited sites in deep water. Coastal waters were broadly mapped for all of Queensland, but surveys of deeper water (>10 m), inter-reef, inshore-reef and barrier-reef platform areas have only recently begun. Seagrasses have been found to depths of 58m in the Cairns and Far Northern Sections (Lee Long, McKenzie and Coles 1996

Approximately 3,000 km^2 of coastal (<15 m depths) seagrass habitat was mapped during initial broadscale surveys in the Great Barrier Reef region (Lee Long, Mellors and Coles 1993), and at least a further 2,000 km^2 of deepwater seagrass habitat has been estimated so far (Lee Long *et al.* 1996). Fourteen known seagrass species were recorded from surveys of Queensland coastal, island and reef waters between 1984 and 1989 (Lee Long, Mellors and Coles 1993). Most of these species are common to the Indo-West Pacific region, but some reach the latitudinal limits of their distribution in Queensland (Lee Long, Mellors and Coles 1993) and at least two species (*Halophila tricostata* and *Halophila* sp.) may be endemic to the Great Barrier Reef region. One recently described species (*Halophila capricorni*, Larkum 1996) has since been described and taxonomic studies of additional undescribed plants in the Genus *Halophila* may lead to further increases in the species list for the Great Barrier Reef (Kuo, Pers. Comm.).

There are few records of seasonal variability in Queensland seagrasses. Mellors *et al.* (1993) recorded a two-fold increase from winter to summer biomass in a *Halodule uninervis/Cymodocea serrulata* meadow at Green Island, but McKenzie (1994) measured up to six-fold change in above-ground biomass of a coastal *Zostera capricorni* meadow from winter to summer, at Cairns nearby. Information on year-to-year variability in tropical seagrasses remains limited because of few opportunities for long-term studies. Long-term variation in seagrasses has potentially large consequences on prawn fisheries, dugongs and sea turtle populations, and successful management of these populations requires much better information on seasonal and long-term variation in seagrass distribution and abundance. Attempts at formalising seagrass monitoring programs are just beginning.

Seagrasses represent important components of coastal primary production and support complex marine food webs. They are often valuable nursery grounds for commercially and recreationally important species of prawns and fish. Estuarine and shallow coastal seagrass meadows appear to be much more important as nursery habitat for juvenile prawns and fish (Derbyshire *et al.* 1995). Seagrasses in the Great Barrier Reef are also major sources of food to dugong and green sea turtles - species listed as threatened or endangered. Meadows dominated by *Halophila* and *Halodule* species

are preferred dugong feeding areas. Seagrasses in coastal regions play important roles in maintaining sediment stability and water clarity. Their physical role in deep water (>10 m) is less understood.

Impacts on, and Responses of, Seagrasses in the Great Barrier Reef

Research on the responses of seagrass to nutrients is very limited, but current work indicates seagrass growth at coastal and reef localities is nutrient limited (Mellors, Udy pers comm.). Excessive nutrient inputs from agricultural and urban run-off however, have led to widespread loss of seagrasses at locations in Australia and overseas (Shepherd *et al.* 1989). The loss of over 1000 km^2 of seagrasses in Hervey Bay in 1992 followed two cyclones and prolonged flooding (Preen *et al.* 1995) and the influence of suspended sediments and nutrient loads on seagrass mortality was probably exacerbated by coastal land-clearing and agriculture. The responses of seagrasses to increased light attenuation (caused by high concentrations of phytoplankton and suspended sediments) has been used to develop models where seagrass growth and distribution are used as broad indicators of water quality and environmental health (Dennison *et al.* 1993). Simple models of the responses of Great Barrier Reef seagrasses to light and nutrient concentrations will be useful when assessing the status and impacts on Great Barrier Reef water quality.

Current land-use practices and continued urban and agricultural expansions present a chronic threat and may exacerbate the effects of natural events through increased soil erosion and nutrient run-off. Land run-off impacts may also affect the recovery of seagrasses after loss. Integrated Catchment Management (ICM) programs seek to address these issues and are seen as an important part of good management for continued survival of seagrasses in the Great Barrier Reef.

Seagrasses are common in sheltered areas where coastal developments are concentrated and bring increased threats of urban and industrial runoff, dredging or burial. Impacts which increase water column sediments and nutrients, or phytoplankton or epiphyte density can lead to greater attenuation of light and reduced seagrass survival at depth (Dennison *et al.* 1993). Introduction of exotic marine species to Queensland ports, via ships' hulls or ballast water, present potential threats to local seagrass communities. Sea-urchins or other seagrass grazers could denude seagrass areas, and other introduced invertebrates or plants could compete against native species. The abovementioned threats are greatest in semi-enclosed bays and ports where water exchange rates are low. Far Northern Section seagrasses do not yet face the same immediate threats from urban and agricultural runoff, or coastal and Barrier Reef development that occur in southern populated regions.

Accidental and non-accidental impacts of trawling may impact on seagrasses - including chronic, low level disruption within meadows (causing patchiness and erosion) or incremental impacts on the edges of meadows. Most seagrasses in shallow, coastal bays and inlets are in water too shallow for trawlers to operate and damage to inshore seagrass meadows by trawling activity should be minimal under the fishery management policy of strip closures. Dense meadows in deep water are usually avoided by trawlers when possible. Low density seagrass meadows in deep water may receive greater fishing pressure. Many of these areas are dugong feeding habitat, but receive no special zoning or protection from trawling and may be at risk of damage.

Increases in shipping traffic along eastern Queensland will lead to the increased likelihood of oil spills. Oil spills may cause severe and immediate damage to intertidal seagrass meadows but subtidal seagrasses may be at lesser risk (Jackson *et al.* 1989; Kenworthy *et al.* 1993). Impacts on the invertebrate and fish communities which seagrasses support can be severe, but may respond positively to subsequent regeneration of seagrasses.

Management Issues

Widespread loss of seagrasses in shallow and deep water in Hervey Bay had devastating effects on dugong populations (Preen *et al.* 1995; Preen and Marsh 1995). There have been few opportunities for documenting seagrass losses in the Great Barrier Reef and associated impacts on associated fisheries and fauna have been less studied. Management plans and management responses to impacts on Great Barrier Reef region seagrasses are designed primarily around the maintenance of seagrasses for commercial prawn fisheries and for dugong and turtle populations. The Great Barrier Reef Marine Park Authority and port authorities at Cairns, Mourilyan, Gladstone, and other areas, support seagrass management measures which also consider the broader ecological importance of seagrasses in maintaining coastal water quality, sediment stability, and as the basis for other marine fisheries and food-webs.

Management policies and options

In 1990, the Queensland Fish Management Authority (QFMA), in consultation with fishing industry, acknowledged the value of seagrasses to tiger and endeavour prawn stocks, and added to the seasonal prawn closures with a coastal strip closure system to protect juvenile prawns and their seagrass habitat. Most shallow, coastal seagrass habitat in the Far Northern and Cairns Sections north of Cape Tribulation, is thus currently in areas zoned as free from trawling activity, either within the QFMA policy of coastal strip closures or within Great Barrier Reef Marine Park Authority zoning. An extension of this reasonably effective strip closure system to protect coastal seagrasses south of Cape Tribulation is also being considered for evaluation in Queensland trawl fisheries management.

Important dugong feeding areas inshore between the Starcke River and Barrow Point receive special protection through scientific and preservation zones. In this area, seagrasses offshore in deep water (>10m) are important dugong feeding habitat (eg., Lee Long *et al.* 1989), but are not afforded complete protection through zoning. There may be other unsurveyed areas of deep water seagrasses in the Great Barrier Reef important to dugongs and green sea turtles, but which receive no special protection. Seagrasses are listed as protected marine plants under Section 51 of the Queensland Fisheries Act 1994. This Act also includes Chief Executive powers to enable prosecutions for wilful and unlawful damage to seagrass habitat, or for unlawfully causing damage to seagrass habitat.

Integrated catchment management programs have wide acceptance across Queensland and should be encouraged from a seagrass conservation perspective, since seagrasses are at the 'downstream end' of catchment run-off. This may be one of the best management measures for successful seagrass conservation. Point-source discharges are also being addressed and effluent controls are being slowly introduced at reef locations to help minimise impacts on seagrasses and corals. Gradual, incremental increases in all of the above impacts, associated with an expanding population, presents a serious threat to long-term survival of seagrasses in the Great Barrier Reef region. Planning for and management of these increasing pressures must be acknowledged by the whole community. We strongly recommend greater community education, awareness and involvement in land-use practices and programs which minimise downstream impacts on seagrasses. Programs to monitor the status of seagrass systems need to be formalised to evaluate the effectiveness of seagrass management in the Great Barrier Reef.

Seagrass research priorities

Mechanisms or structures for directing research and management of seagrasses in the Great Barrier Reef region include the interchange of information at annual Great Barrier Reef and CRC researcher conferences, and through *ad hoc* workshops and discussions. The Great Barrier Reef Marine Park Authority, The Queensland Fish Management Authority (QFMA), The Queensland Department of Environment (QDoE), and The Queensland Department of Primary Industries (QDPI) are the major

organisations responsible for seagrass management in marine park and fisheries areas. The Cooperative Research Centre for Sustainable Development of the Great Barrier Reef supports new initiatives in seagrass studies to obtain information of direct use toward management of the Great Barrier Reef. Research on Great Barrier Reef region seagrasses is conducted primarily by the QDPI, the James Cook University's Tropical Environment Studies and Geography group and the University of Queensland's Marine Botany group. Requests from the above organisations, and initiatives from scientists, are currently the major avenue for generation of research and monitoring, and information gained on seagrass habitat distribution and ecology is distributed to these organisations and extended for public use.

The Great Barrier Reef Marine Park Authority holds an archival GIS database using Arc-Info® to store QDPI data on survey sites and seagrass distribution for research and management use. The Queensland Department of Primary Industries' MapInfo® GIS databases include full sets of the raw data generated from a series of fine- and broad-scale mapping and monitoring programs.

Initial QDPI surveys conducted in the 1980's and 1990's provided information on seagrass distribution and abundance for large parts, but not all, of the Great Barrier Reef region. This information is now very dated and should be used with some caution in zone planning. Large areas of deep-water and reef-platform habitat remain unsurveyed for seagrasses, and the immediate priority is to collect at least preliminary information on seagrass habitats for the remainder of the Great Barrier Reef.

There is a paucity of information on year-to-year change in seagrass distribution and abundance for most seagrass species and community types. There is no formal strategy or program in place for monitoring seasonal or long term change in seagrass distribution and abundance for any part of the Great Barrier Reef region. Limited studies of year-to-year change at specific coastal and deep water sites in the Cairns Section are currently supported by some port authorities and by the CRC Reef Research Centre. An effective monitoring program would include a range of localities - coastal, reef, deep-water, near population centres and remote. Seagrass growth rate (or productivity) is at least as important as standing crop to the populations which depend on seagrasses, and information on temporal variation in seagrass production rates, for a range of species and localities, would enable much better interpretations of how seagrasses support marine animal populations, fish and prawn production.

The CRC Reef Research Centre is now conducting studies on a) growth responses to natural and human impacts (eg., nutrients and light), and b) mechanisms of seagrass recovery after loss. These will provide for inclusion within management plans: guidelines on ecologically acceptable water quality standards and a better understanding of the requirements and potential for recovery of seagrasses after loss.

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Conference Abstract 25 (p.1)

The effects of trawl fisheries on Great Barrier Reef seabed habitat

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The non-reefal seabed area of the Great Barrier Reef (GBR) accounts for about 95% of the Marine Park region and comprises many different types of habitats that support a great diversity of seagrasses, algae, seabed animals and fishes, some of which are commercially important and others that are rare and/or endangered. The GBR also supports a valuable prawn trawl fishery of about 900 vessels that earn about $60 million per year. However, in spite of the extent and importance of the non-reefal area, there have been few studies of the non-reefal seabed habitat.

The few large scale studies of GBR seabed benthos have, nevertheless, yielded quite consistent patterns, showing that the habitats and their flora and fauna are closely related to sediment type. The muddier areas tend to be the least diverse, whereas sandier and harder areas are more diverse with a more abundant fauna. Large epibenthos, which form living structural habitat attached to the seabed, usually are restricted to rubbly or rocky patches. Because of the habitat requirements of the fauna, there are distinct cross-shelf zones related to the change from terrigenous muddy sediments of the inshore lagoon through to coarse calcareous sediments of the offshore inter-reef.

Most of the management issues for GBR seabed habitats are related to the effects of prawn trawling and these effects have been documented most comprehensively by a 5 year CSIRO/QDPI study in, and adjacent to, the Cross-Shelf Closure in the Far Northern Section of the GBR. The seabed and associated communities in the study area were described, then sampling was conducted to compare areas open and closed to trawling. There were few significant differences between the benthic communities in open and closed areas — but this should not be interpreted as a direct comparison of trawled vs untrawled areas because the inshore area of the closure was trawled before the closure, and some trawling has continued in this area. Also, much of the area open to trawling has not been trawled and effort is highly aggregated. Next, a Before-After-Control-Impact experiment was conducted, in which twelve 2.7 x 1.2 km treatment plots were trawled entirely once-over and compared with control plots. Between 1–7 t of benthic material was removed from each treatment plot. Despite this obvious impact, there were few significant differences between the benthic communities in trawled plots and control plots. To determine the impact of intensive trawling on seabed benthos, a repeated-trawl depletion experiment was conducted. Preliminary analyses indicated that each trawl removed roughly 5-20% of the available biomass of sessile benthos and that 12-13 trawls removed roughly 70-90% of the apparent initial biomass. These results show that the impacts of trawling may not be detectable in areas that are trawled sparsely or infrequently; however, the cumulative effect of frequent trawls over the same grounds may be substantial.

Extension of these trawl impact results to the remainder of the GBR will require information on the distribution and dynamics of benthos communities as well as the distribution and intensity of trawler effort, at fine spatial scales (GPS resolution). This information will be essential for developing management strategies that ensure trawling is conducted in a manner consistent with the principles of ecologically sustainable development.

Trawling nets $150m

By COLLEEN DAVIS

TRAWLING produced 10 times more bycatch than the amount of prawns and other target species, CSIRO marine researcher Roland Pitcher said yesterday.

He was presenting a paper at the national Great Barrier Reef conference at James Cook University about the effects of prawn trawling on GBR seabeds.

Dr Pitcher said trawling was a valuable fishery involving about 900 boats and annual landings valued at $150 million a year.

About 7000 tonnes of prawns were caught annually, as well as about 1000 tonnes of scallops, he said.

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"Trawling is most extensive off Townsville and Princess Charlotte Bay," Dr Pitcher said.

He said there was evidence that prawn trawling had, and continued to have, direct impacts on the seabed.

It had also changed the ecosystem.

Although repeated trawls of an area caused significant damage, those areas that were trawled occasionally suffered only marginal damage.

"The cumulative effects of trawling are substantial," Dr Pitcher said.

"Research has demonstrated that the impacts of trawling depend on the intensity of trawling, and it is clear that trawl grounds are subjected to widely varying effort.

"Further, the impacts of trawling probably depend on the type of trawl gear used."

Dr Pitcher said researchers needed to look at rates of recovery of seabeds after trawling, and whether there was scope for different strategies of trawling.

Proceedings Paper

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The effects of prawn trawl fisheries on GBR seabed habitats

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Abstract

The non-reefal seabed area of the Great Barrier Reef (GBR) accounts for about 95% of the Marine Park region and comprises many different types of habitats. These seabed habitats support a great diversity of seagrasses, algae, seabed animals and fishes, some of which are commercially important while others are rare and/or endangered. The GBR also supports a valuable prawn trawl fishery of about 900 vessels that land catches worth about $150 million annually. However, despite of the extent and importance of the non-reefal area, there have been few studies of the non-reefal seabed habitat.

The few large-scale studies of GBR seabed benthos have consistently showed that the habitats and their flora and fauna are related closely to sediment type. Muddier areas tend to be the least diverse, whereas sandier and harder substrata are more diverse and support a more abundant fauna. Large epibenthos, which form living structural habitats on the seabed, usually are restricted to rubbly or rocky patches. Because of the habitat requirements of the fauna, there are distinct cross-shelf zones related to the change from the terrigenous muddy sediments of the inshore lagoon to the coarse calcareous sediments of the offshore inter-reef.

Most of the management issues for GBR seabed habitats are related to the effects of prawn trawling. These effects have been documented most comprehensively by a 5 year CSIRO/QDPI study in, and adjacent to, the Cross-Shelf Closure in the Far Northern Section of the GBR. The seabed and associated communities in the study area were described, then sampling was conducted to compare areas open and closed to trawling. There were few significant differences between the benthic communities in open and closed areas — but this should not be interpreted as a direct comparison of trawled vs untrawled areas because the inshore area of the closure was trawled before the closure, and some trawling has continued in this area. Also, given that fishing effort is highly aggregated, much of the area open to trawling has not been trawled. A Before-After-Control-Impact experiment was then conducted, in which twelve 2.7 × 1.2 km treatment plots were trawled entirely, once-over, and compared with control plots. Between 1-7 t of benthic material was removed from each treatment plot. Despite this obvious impact, there were few significant differences between the benthic communities in trawled plots and control plots. The impact of intensive repeated-trawling on seabed benthos was then determined by conducting a repeated-trawl depletion experiment. Preliminary analyses indicated that each trawl removed roughly 5-20% of the available biomass of sessile benthos and that 13 trawls removed roughly 70-90% of the apparent initial biomass. These results show that the impacts of prawn trawling may not be detectable in areas that are trawled sparsely or infrequently; however, the cumulative effect of frequent prawn trawls over the same grounds may be substantial.

Extension of these trawl impact results to the remainder of the GBR will require information on the distribution and dynamics of benthos communities, as well as the distribution and intensity of prawn trawler effort at fine spatial scales (GPS resolution). This information will be essential for developing management strategies that ensure ecologically sustainability of the fishery and of the rich and diverse lagoon seabed fauna.

Introduction

Most research in the Great Barrier Reef (GBR) has concentrated on coral reefs because of their visual appeal and accessibility in shallow water. However, the coral reefs themselves account for only about 5% of the region. The deeper water seabed areas between the reefs have been neglected (Hutchings 1990). This may be because they have been perceived as less "charismatic" than the coral reefs and certainly less obvious than the reefs, and because of the difficulties of working in the deeper seabed areas. As a consequence, little is known about the non-reefal seabed habitats and their faunal communities (Hutchings 1990). This meagre knowledge contrasts distinctly with the size and extent of the major user of these deeper seabed areas, ie. the prawn trawl fishery; as well as with the strong public perception that trawling damages the seabed environment; and with the magnitude of difficulties that managers face in addressing these issues in the absence of scientific knowledge (Zann 1995). It is commonly believed that the fauna living on the seabed are delicate in their structures and, in many areas of the GBR, they are exposed to trawling (Hutchings 1990).

In this paper, we define the non-reefal seabed habitats and describe briefly the prawn trawl fishery as the main user of the seabed. We also identify the management issues related to these habitats and summarise the available information on non-reefal habitats. Recent research on the impacts of trawling on these habitats in the GBR is described. Finally, the implications of the scientific knowledge for addressing the management issues are discussed, and we identify the information needs.

What are the GBR seabed habitats ?

The non-reefal seabed habitats of the GBR encompass the relatively protected area between the outer barrier reefs and the Queensland coast. The entire area in the lee of the barrier reefs can be described as a lagoon (Mather and Bennett 1993); however, the inshore side of this area has relatively few coral reefs and is often referred to as the "*main lagoon*", whereas the offshore side has many coral reefs and the non-reef part is often referred to as the "*inter-reef*" area (Fig. 1, inset b). Together, the main lagoon and the inter-reef areas comprise the "GBR lagoon" and account for about 95% of the area of habitat of the GBR Marine Park region. In this paper, the term "GBR lagoon" will refer to the entire non-reefal area, unless the italicised terms defined above are specifically used.

The GBR lagoon includes many different types of physical habitats, ranging from nearshore terrigenous muds, silts and sands through to offshore carbonate sands of various grades — all variably interspersed with rubbly and rocky cracks and patches, deep reefs and shoals with hard corals, and exposed areas of bedrock. These habitats support a great diversity of seabed (benthic) fauna: from the microscopic to macroscopic; meiofauna within the sediments to the large epibenthic structural organisms; sessile and mobile invertebrates; seagrasses and algae; and many species of fishes (Hutchings 1990). Some of these seabed organisms (benthos) are commercially important, particularly those targeted by prawn trawlers. These habitats are also used by rare and endangered vertebrate species (eg. turtles and dugongs). Despite the extent and importance of the lagoon seabed, however, our knowledge of the benthos is limited to only 4-5 descriptive studies (see below) and there is no information on long term trends, which may indicate any alteration in the state of these habitats .

What is the nature of the trawl fishery ?

The GBR Lagoon supports a valuable otter-trawl fishery, with about 900 boats and annual landings with a value of about $150 million (Queensland Fisheries Management Authority data). The boats are licensed to trawl from Cape York to the NSW border, but within this region, most effort is concentrated in Princess Charlotte Bay, the Townsville region, and Moreton Bay. In the cross-shelf axis, effort is concentrated in the main lagoon, but also extends into the offshore inter-reef at some latitudes (Hutchings 1990). Penaeid prawns are the primary target species group (with ~7,000 t landed per annum). Scallops (~1,000 t), sand crabs, scyllarid lobsters, squid, and a few fin-fish species are also landed (QFMA data). All vessels are required to complete a daily logsheet of catch and effort, using a 30 minute grid reference.

The target species are caught by dragging otter trawl nets (typically "quad-gear", comprising 4 nets with a combined foot-rope length of ~44 m) across the seabed. In the process, many other seabed organisms, both mobile and sessile are caught and/or damaged — these are called bycatch (Zann 1995). There have been many anecdotal reports and a few scientific studies that have demonstrated that prawn trawl nets remove benthos. However, the overall ecological significance of this impact is not yet clear.

What are the management issues ?

The management issues for lagoon seabed habitats are driven primarily by the need to manage their sustainable multiple use (by prawn trawlers, tourism, line fishery, shipping, and conservation interests). There is also an obligation to report on their status and World Heritage Values, and a requirement for feedback on the goals and objectives of the GBR 25-year Strategic Plan (GBRMPA 1994). Questions that arise about management of the seabed include: What are the pressures and impacts on these habitats? What are the ongoing impacts? Is biodiversity being lost? Do impacts differ in different seabed habitats? What is the distribution and intensity of habitat use? How should the lagoonal and inter-reefal areas be classified for representative marine protected areas? How should the zoning system be reviewed to manage seabed areas to maintain biodiversity? — currently the lagoon seabed is not well represented in protected areas of the GBR. Should some currently unprotected areas be set aside in reserves? If so, how should they be selected? For impacted areas, what kind of recovery can be expected, and over what time period? The underlying problem is that there is insufficient scientific knowledge available to answer these questions and manage the related issues.

The activity most likely to have significant impacts on GBR seabed benthos is prawn trawling (Hutchings 1990). This is because there is an extensive prawn trawl fishery operating in the lagoon, and the available evidence suggests that there have been, and continue to be, direct impacts on the lagoon seabed habitat due to prawn trawling, as well as indirect changes to other components of the ecosystem (eg. trophic structures). Consequently, most of the management issues for lagoon benthos are related to the effects of prawn trawling on the seabed (Zann 1995). Confounding the issue is that very little is known about the distribution, composition and status of the lagoon habitats.

The impacts of prawn trawling on seabed habitats and the benthic communities they support is an important issue (Zann 1995). This is because of the indirect effects on target species (eg. through impacts on predator or prey species, or habitat) and indirect effects on other valuable species (eg. commercial or recreational finfish species), and direct but more general environmental effects and conservation issues (eg. destruction of structural habitat, loss of biodiversity, loss of rare and/or endangered species).

What is known about the GBR seabed habitats ?

The fauna of the seabed are classified broadly by their relationships with the substratum and their size (Gray 1981, Longhurst and Pauly 1987). Animals living on the seabed are known as epifauna (or epibenthos) and animals living in the sediment are known as infauna. Animals washed through a 1 mm sieve from a grab sample are meiofauna, whereas those retained are macrofauna (or macrobenthos). Animals too large to be properly sampled by a 0.1 m^2 grab are megafauna (or megabenthos) and those firmly attached to the substratum are sessile.

Previous studies of GBR seabed benthos, with significant spatial coverage, include the following:

- Birtles and Arnold (1983 and 1988) used a 1.6 m epibenthic dredge to sample inter-reefal epibenthos during a series of integrated studies at up to ~90 sites, on a roughly 8 n. mile grid off Townsville, at various intensities between 1977 and 1983. Most sites were in the main lagoon area, between the coast and the reef-matrix, a few sites were sampled on the outer half of the shelf, in the offshore inter-reefal area.

- Cannon, Goeden and Campbell (1987) conducted classification and ordination analyses of prawn trawl bycatch (including macro- and mega-benthos and fishes) from two of a series of seven exploratory prawn trawl surveys in three main areas of the GBR. Samples were collected primarily with 2 m prawn try-shot nets at about 230 sites between 1979 and 1982. Although providing significant latitudinal coverage, most sampling was unstructured, with the objective of identifying new commercial prawning grounds.

- Jones and Derbyshire (1987), Watson and Goeden (1989), and Watson et al. (1990) used commercial prawn trawl gear to sample fauna at monthly intervals in up to 24 sites distributed from the inshore, across the main lagoon, into the offshore inter-reef matrix, over a ~1°x1° region off Townsville in 1985 and 1986.

- Coles et al. (1996) conducted a video survey over ~4° of latitude north of Cairns, primarily for broad-scale mapping of seagrass. Sediment, algae and epibenthic megafauna were recorded also. The sampling strategy for the survey was to divide the region into 15-minute-of-latitude blocks and select a cross-shelf transect at random from each block. Each transect was divided into 1 n. mile segments and a randomly placed video transect ~100-300 long was conducted in each segment.

These studies of GBR seabed benthos consistently showed that the physical habitats, and the flora and fauna associated with them, are strongly influenced by sediment type (ie. the continuum through mud, sand, rubble and rock). These patterns were similar to the typical patterns previously described for the ecology of the seabed (see reviews by Gray 1981 for soft seabed; also Longhurst and Pauly 1987). The GBR studies focussed on the larger animals living on the seabed, ie. the macrobenthos, and in many cases just the subset of species sampled as bycatch in prawn trawls. This epifauna has high species richness — typically 700+ species would be found in a representative set of samples from the GBR. The infauna was not included in these GBR studies, but similar work in adjacent regions (eg. Gulf of Carpentaria, Long and Poiner 1994) showed that tropical infauna also has high species richness — again, typically 700+ species larger than ~1 mm, and at least as many < 1 mm. It is likely that the infauna would have similar richness in a representative series of samples from the lagoon in any section of the GBR.

The GBR studies showed that the least diverse areas had muddier sediments, where the dominant animals were deposit feeders. Sandier and harder areas tended to be more diverse, at least partly because of the greater range of physical habitats. The fauna of harder areas were also

more abundant, and the dominant animals were filter feeders, scavengers or carnivores. The megabenthic epifauna, which form living structural habitat attached to the seabed, generally were restricted to rubbly or rocky patches, or areas where the bedrock or coarse substrata were exposed by fast currents. Such patterns are also typical of other regions (eg. Torres Strait: Pitcher et al. 1992; Gulf of Carpentaria: Long and Poiner 1994, Long et al. 1995).

The physical habitat requirements of inter-reefal benthos are responsible for the distinct cross-shelf zonation of benthic fauna in the GBR, related to the change from terrigenous muddy sediments of the inshore lagoon through to coarse calcareous sediments of the offshore inter-reef. Typically, multivariate analyses separated the fauna into three main groups: inshore lagoon, offshore inter-reef, and a mid-shelf lagoon transition area. This zonation was apparent in all the GBR studies, although the composition of the species groups among the different studies has not been examined for consistency. Only one of the studies (Cannon et al. 1987) compared samples from a range of latitudes (~12°S to ~18°S) and showed an overlapping continuum rather than discrete groupings of (prawn trawl bycatch) faunal variation. However, the authors treated this result with caution due to their unstructured sampling strategy.

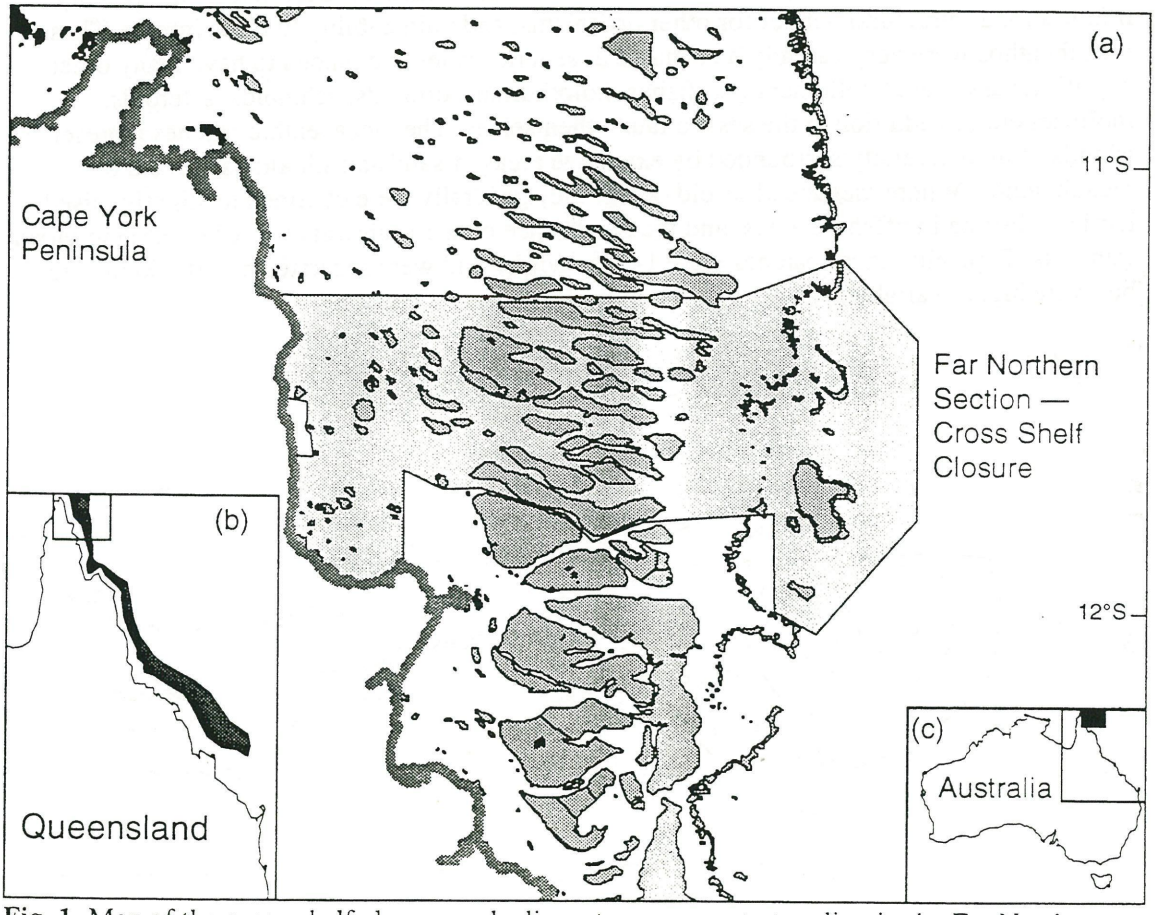

Fig. 1. Map of the cross-shelf closure and adjacent areas open to trawling in the Far Northern Section of the Great Barrier Reef (a). The entire area between the coast and the ribbon of outer barrier reefs is the lagoon, although the outer shelf area among the reef matix is often termed the inter-reefal area (shaded in inset b) and the inshore area with few reefs is often termed the main lagoon (not shaded in inset b). Insets (b) and (c) show the location of the study area relative to Queensland and Australia.

In 1992-93, CSIRO and QDPI used commercial fish and prawn trawls, a 3 m epibenthic dredge, a video sled and a grab, to sample fish, prawns and benthos at >150 stations in the Far Northern Section of the Great Barrier Reef. The stations were distributed representatively, from the coast to the outer barrier, throughout the ~1°×1° area of the cross-shelf closure and adjacent open

zones (Fig. 1; Blaber et al. 1993 and 1994). Note that stations were restricted to trawlable, or semi-trawlable ground. The patterns documented for epibenthic dredge fauna were similar to those of previous studies, with cluster analyses of sites by taxa showing three main cross-shelf groupings. These patterns are shown more informatively by a two-dimensional plot of the ordination of sites by taxa (Fig. 2a), which shows relatively close grouping of inshore sites, clearly separated from offshore sites, and with midshelf sites scattered mostly in between. Offshore sites were much more heterogeneous in composition than inshore sites. Ordination of high-level taxa by sites (Fig. 2b), clearly showed different cross-shelf distributions. The echinoids and bivalves were much more abundant inshore, whereas the ophiuroids, crinoids and zoanthids were much more abundant offshore. Other groups of taxa showed a range of patterns in between. Different species within each high-level group of taxa sometimes had quite different cross-shelf patterns of abundance to the group as a whole and these details are currently being analysed. As with the other GBR studies, these patterns were correlated with depth, sediment and carbonate content.

Part of the CSIRO/QDPI study focussed on the large (mega) benthic epifauna (ie. sponges, gorgonians, seawhips, soft corals, hard corals), because of their contribution to biodiversity, importance as structural habitat for other organisms, and vulnerability to trawl impact. These megabenthos were very patchily distributed at several scales and tended to have many other organisms associated with them (eg. fishes, holothurians, crinoids, echinoids, asteroids, molluscs etc), in addition to the sessile fauna themselves. The megabenthic patches represented islands of high diversity surrounded by extensive areas of sand and silt almost devoid of megabenthos. Where megabenthos did occur, they generally were confined to slightly raised harder substrata in offshore areas, and the occurrence of such substrata was often <5% in video transects. Typically, these patches were 1-10 m across and were separated by 10-100 m (Fig. 3), but were highly variable.

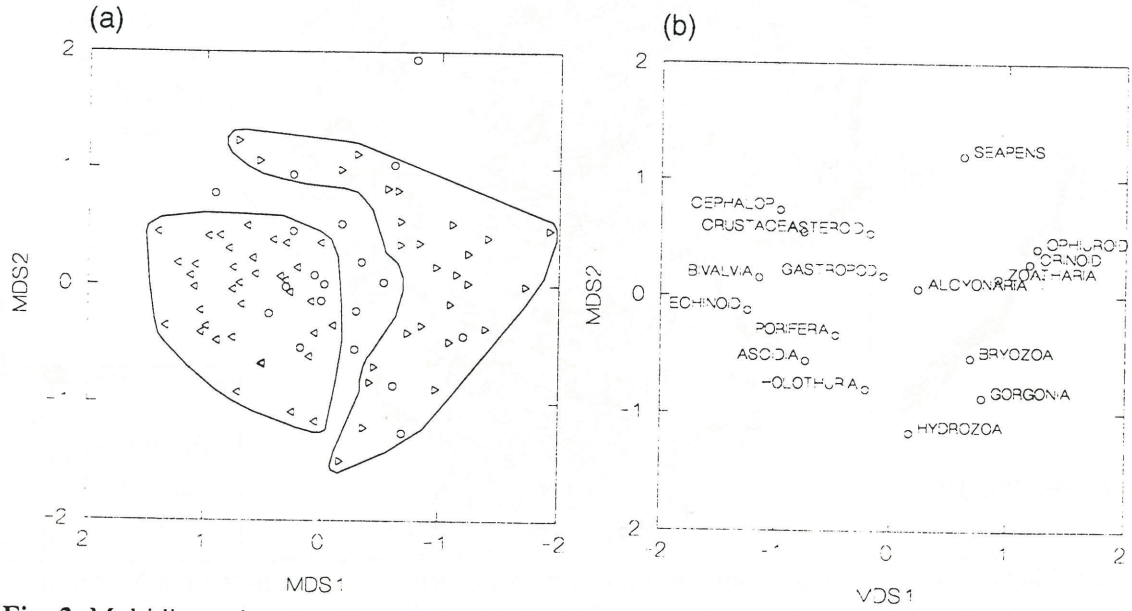

Fig. 2. Multidimensional scaling plots of (a) dissimilarities of sites, by taxa, inshore sites (3), midshelf sites (η) offshore sites (4), and (b) dissimilarities of high-level taxa, by stations. Note, the MDS1 axis corresponds primarily with inshore to offshore orientation, left to right.

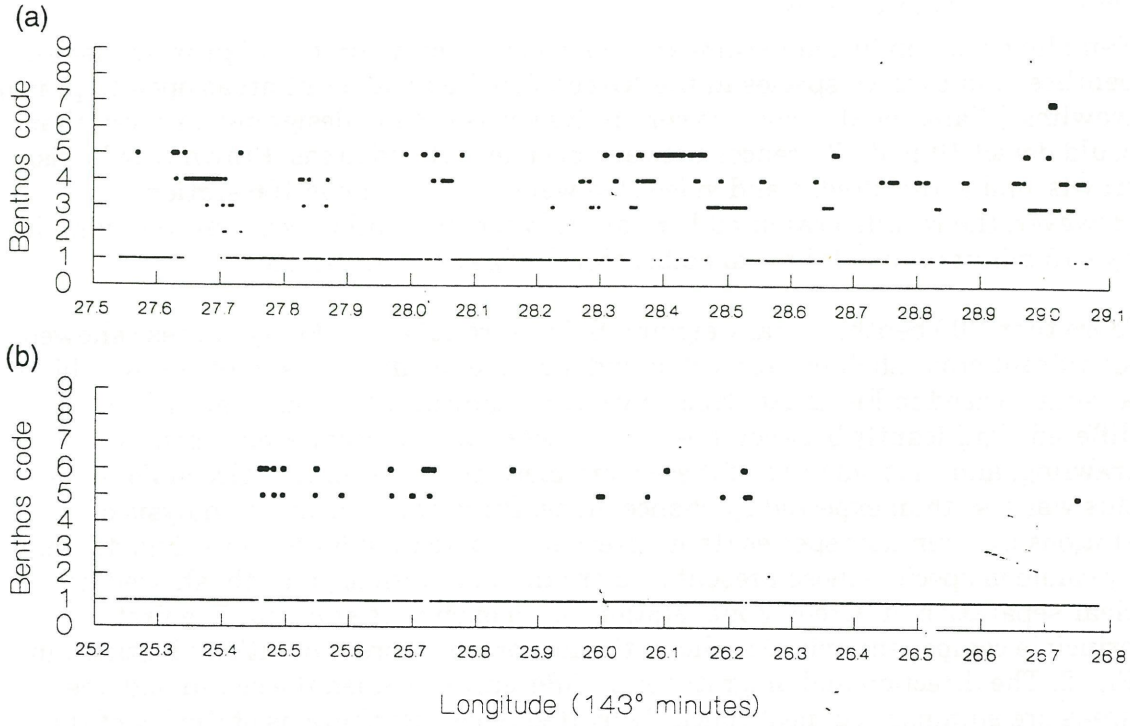

Fig.3. Distribution of major benthos types in ~2.8 km long coded video transects along (a) shallow (~20 m) shoaling seabed and (b) deeper (~35 m) seabed in the midshelf of the Cross Shelf Closure. Codes: 1=silt/sand, 2=rubble, 3=algae, 4=shell beds, 5=patches of seawhips and gorgonians, 6=5+sponges, 7=6+hard corals, 8=rocks, 9=reef. The multiple scales of patchiness of benthos are clearly apparent.

What are the documented effects of prawn trawling on seabed habitats ?

The effects of prawn trawling have been documented most comprehensively by a recent 5 year study conducted by CSIRO and QDPI in the Cross-Shelf Closure ("Green Zone") and adjacent open areas in the Far Northern Section of the GBR (Fig. 1). One aspect of this study was to measure the impact of prawn trawling on seabed communities. This was examined in three ways:

1. by surveying the cross-shelf closure and comparing the species composition and abundance with that in adjacent areas north and south that were open to prawn trawling;
2. by conducting a Before-After-Control-Impact experiment in the mid-shelf section of the area closed to prawn trawling, to determine the impact of a single trawl per unit area;
3. by conducting a repeated trawl depletion experiment on selected tracks in the mid-shelf section of the area closed to prawn trawling.

The study area was initially sampled to describe the seabed and associated communities. This survey provided the distributional information described in the previous section (Fig. 2) and the statistical information needed for designing the subsequent studies.

Open vs Closed Comparisons

Sampling was conducted to compare the demersal communities of prawns, fishes, benthos, and bycatch species in the "Green Zone" and adjacent areas open to prawn trawling (Blaber et al. 1994). Power analysis was used in designing a survey that could detect 10-fold differences between open and closed areas. Prawn trawls, fish trawls, epibenthic dredge and video sled were used to sample 166 stations. However, the results presented here are only for the benthos communities sampled by ~15 minute tows of the 3 m epibenthic dredge at each station..

More than 700 benthic taxa, weighing 6-7 t, were collected. Many of these showed significant cross-shelf patterns of abundance due to differences in physical habitat, as summarised in Fig. 2. Analysis of variance indicated that only seven taxa differed significantly between the "Green Zone" and adjacent areas open to trawling, and that only two of these were more abundant in the "Green Zone" — this was less than expected by chance alone. Principal component analysis of stations by abundant species (those present at more than 60 stations, Fig. 4a) and by common species (those present at more than 20 stations, Fig. 4b) showed no clear separation of "Green Zone" stations from open zone stations. The first principle component axis also shows the inshore–offshore separation identified in Fig. 2. The direction and magnitudes of differences between the closed and open areas are summarised most concisely by frequency distributions of the log of the ratio of species abundances in the closed and open zones (Fig. 5). A log-ratio value of +1 would indicate 10 times higher abundance in the "Green Zone" and a value of -1 would indicate 10 times lower abundance in the open zone. Clearly, the abundance of most species differed little between the two zones, and the mean of the frequency distributions is close to zero — in fact, there were a few more species slightly more abundant in the open zone, but the means of the distributions were not significantly different from zero.

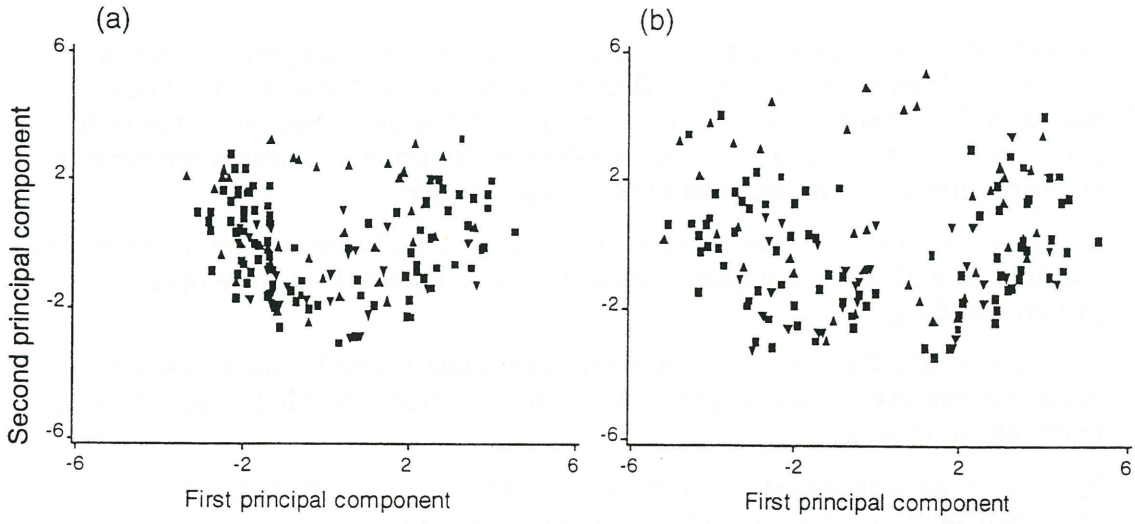

Fig. 4. Principal component analyses of sites in open and closed areas for (a) very common species present at more than 60 stations, and (b) common species present at more than 20 stations. Symbols: ■=closed area, ▲=open area north, ▼=open area south.

The comparisons of the "Green Zone" with adjacent areas open to trawling showed that, at this scale and resolution, there were few significant differences between the benthic communities of the closed and open areas. However, these results should

not be interpreted as indicating that prawn trawling has no impact, because there was not a direct comparison of trawled vs untrawled areas. It is known that the inshore area of the closure was trawled before the declaration of the closure and some trawling has continued in this area. Further, in the area open to trawling much of the trawling is highly aggregated and some areas are rarely if ever trawled (Gribble and Robertson 1996).

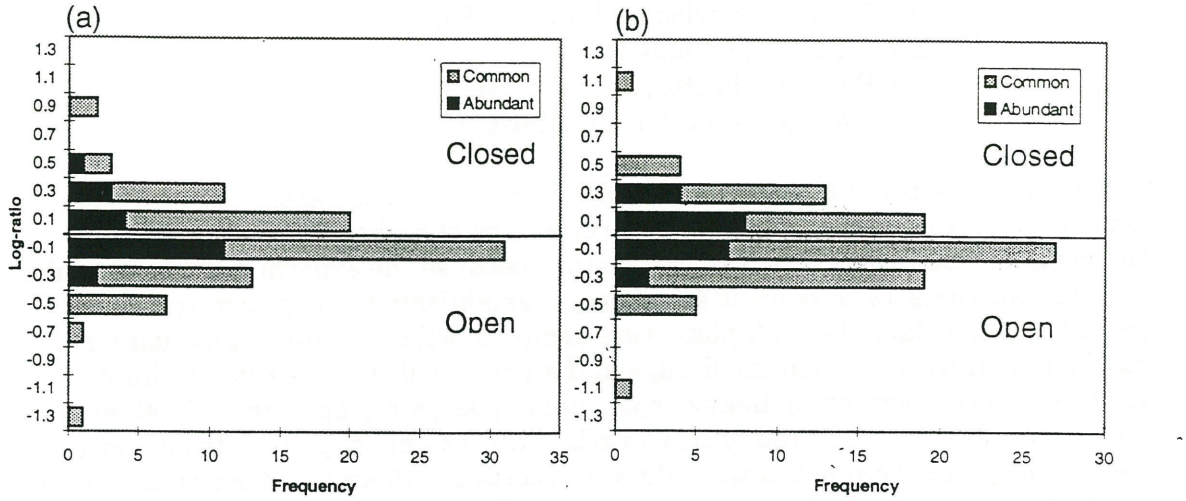

Fig. 5. Frequency distributions of the log of the ratio of species abundances in the closed and open zones (a) by weights and (b) by numbers, showing the direction and magnitudes of differences.

Before-After-Control-Impact Experiment

The next phase of the study was to conduct a controlled trawling experiment where defined plots of seabed were sampled before half of them were trawled entirely, once-over, then all plots were sampled again after 6 months (Pitcher and Thomas 1992). This is known as a Before-After-Control-Impact (BACI) experiment. The experiment was intended to simulate prawn trawlers moving into new mid-shelf inter-reefal areas to target high-value red-spot prawns and the situation for grounds that are not trawled intensively (ie. the majority of the area of GBR trawl grounds). The size of the experimental plots had to be large to be relevant to the scale of commercial prawn trawling operations and the movement patterns of fishes, prawns and other non-sessile organisms, yet small enough to permit sufficient replicate plots to be established. Due to the need for "before" sampling, the experiment could not be designed to answer questions about past impacts in previously trawled grounds. Also, due to the scale of plots required to assess impacts on mobile species, the experiment could not address the situation represented by the relatively small areas of very intensively trawled grounds. Power analysis was used to design the experiment to detect, with >80% power, order-of-magnitude decreases in the abundance of most benthic groups because this was at least the effect-size expected from previous research and anecdotal reports.

The final design was for 24 plots of seabed, each 2.7 x 1.2 km to accommodate replicate sampling trawl-shots. The optimum number of stations to sample within each plot was estimated by cost-benefit analysis, for both the before and after time periods, at ~3 stations per plot. The experiment was split into two phases started at different times of the year to counter seasonal differences in the biology of organisms and uncontrollable environmental risk factors (eg. cyclones, ENSO).

There were two main types of trawlable ground in the area and trawling was simulated in both. They were deeper areas (35–50 m) where almost all ground within the plot could be trawled, and shallower areas (17-25 m) containing patches within the plot that were too rough to trawl. The factors and sampling hierarchy for this design were:

2 × Seasons (wet and dry)
2 × Habitats (shallow and deep)
2 × Impact (trawled and un-trawled)
2 × Time (before and after)
3 × Plots (replicates, a total of 24)
3 × stations, a total of 144 stations.

Establishing the BACI Experiment involved searching large areas with a video camera on a towed sled to locate appropriate plots of seabed for the experiment. The plots needed to include benthic structure because the experiment was intended to assess the impacts on benthic structure, of establishing new prawn trawl grounds. Once established, all plots were sampled before the impact by using fish trawls, prawn trawls, a benthic dredge and a video sled. The treatment phase involved two trawlers using heavy exploratory type gear. Approximately 45 hours of trawler effort was required to trawl each of the 12 impact plots entirely, once-over. All material retained in the nets was recorded. Differential GPS was used for accurate positioning of adjacent trawl tracks. All plots were sampled again 6 months after the impact, using the same methods. The design and timing of sampling for the experiment is shown in Fig. 6.

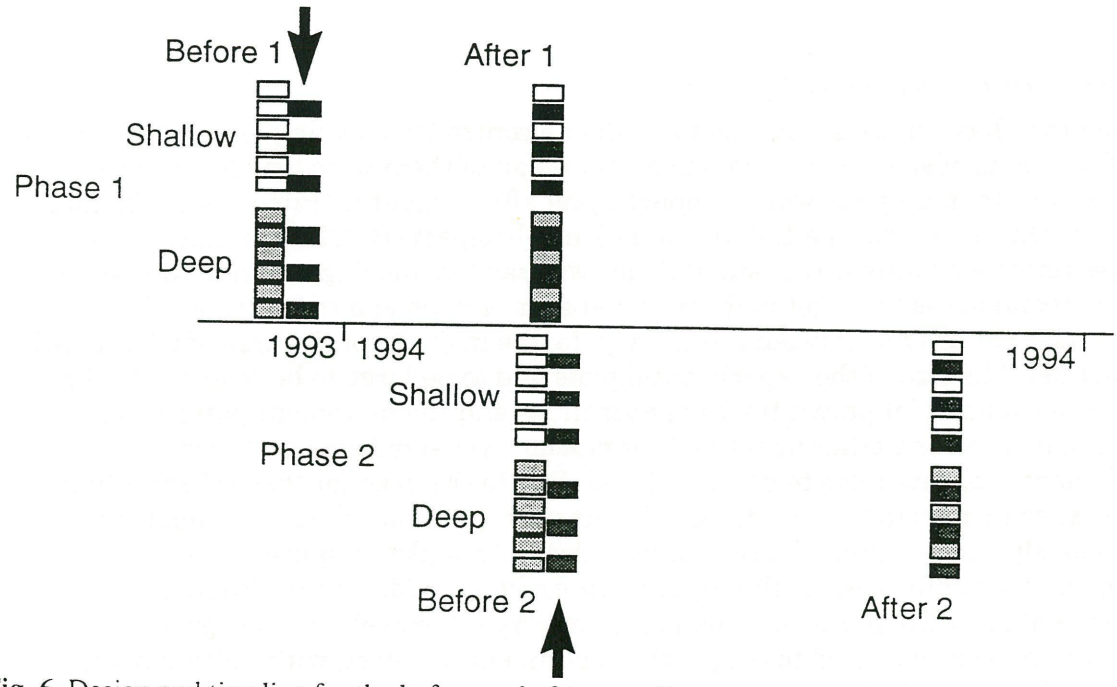

Fig. 6. Design and timeline for the before and after sampling, and manipulation (arrows), of shallow and deep plots in phases 1 and 2 of the BACI experiment.

(a) (b)

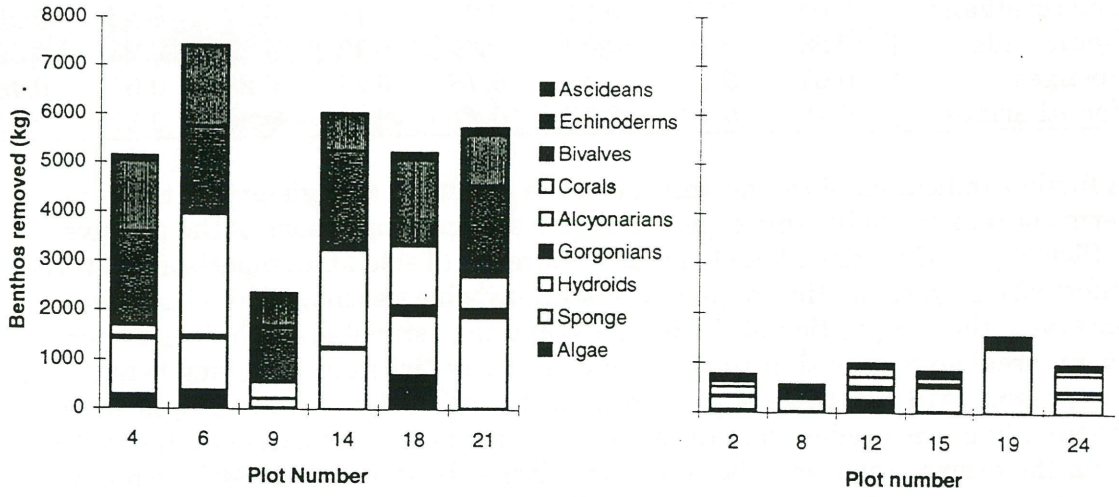

Fig. 7. Amount of benthic material, by major benthic class, removed by trawl gear from each of the (a) shallow and (b) deep experimental plots, during the manipulation of the BACI experiment.

During the treatment phase, almost 40 t of benthos material was removed from all 12 trawled plots (Fig. 7). Of this, about 32 tonnes came from the 6 shallow plots (equivalent to ~13 kg/Ha) and the amount from each shallow plot varied between 2–7 t. About 6 tonnes came from the 6 deep plots (equivalent to ~2.5 kg/Ha) and the amount from each plot varied between ½–1½ t. Despite this obvious indication of some impact, and that the power of the experiment met the design criteria, few of the estimated impacts for benthos were significant (Table 1; Burridge et al. 1996). Direct observations of structural habitat also showed little change. Clearly, the impact of a single trawl per unit area was less than one order-of-magnitude.

Table 1. Estimates of impact (from log-weights) for benthic classes in benthic dredge and prawn trawl. Shaded cells highlight negative effects, ie. abundance of benthic class decreased in treatment plots relative to controls, but all estimates were not significant, except perhaps one borderline case (bolded cell — estimated impact effect with a probability level for a t-test $0.05<=p<0.01$).

CLASS	Dredge: Impact after 6 months		Prawn Trawl: Impact after 6 months		Combined: Impact after 6 months		Prawn Trawl: Impact after 12 months	
	Est.	S.E.	Est.	S.E.	Est.	S.E.	Est.	S.E.
Algae	-0.01	*0.22*	0.33	*0.21*	0.16	*0.15*	0.09	*0.21*
Ascidians	-0.02	*0.25*	0.04	*0.44*	0.01	*0.25*	0.41	*0.44*
Asteroids	0.15	*0.31*	0.24	*0.33*	0.20	*0.23*	0.27	*0.33*
Bivalves	-0.27	*0.33*	0.55	*0.36*	0.14	*0.24*	0.42	*0.36*
Bryozoans	-0.03	*0.21*	**0.56**	***0.31***	0.27	*0.19*	0.13	*0.31*
Cephalopods	0.28	*0.24*	0.19	*0.30*	0.24	*0.19*	-0.11	*0.30*
Crinoids	-0.18	*0.18*	-0.05	*0.27*	-0.12	*0.16*	-0.13	*0.27*
Crustaceans	-0.23	*0.16*	0.07	*0.21*	-0.08	*0.13*	0.19	*0.21*
Echinoids	-0.12	*0.30*	-0.01	*0.29*	-0.07	*0.21*	0.46	*0.29*
Gastropods	-0.35	*0.21*	0.21	*0.27*	-0.07	*0.17*	0.25	*0.27*
Holothurians	0.32	*0.33*	0.39	*0.34*	0.36	*0.24*	0.07	*0.34*
Hydrozoans	-0.06	*0.21*	0.26	*0.26*	0.10	*0.17*	0.11	*0.26*
Marine plants	-0.04	*0.24*	-0.26	*0.23*	-0.15	*0.17*	-0.28	*0.23*

Octocorallians	0.04	*0.30*	0.31	*0.29*	0.18	*0.21*	-0.46	*0.29*
Ophiuroids	-0.09	*0.16*	-0.24	*0.39*	-0.17	*0.21*	-0.23	*0.39*
Sponges	0.07	*0.31*	0.41	*0.46*	0.24	*0.28*	0.67	*0.46*
Zoantharians	0.16	*0.22*	-0.17	*0.41*	-0.01	*0.23*	0.37	*0.41*

A further indication of the magnitude of the impact of a single prawn trawl in terms of removal of benthic organisms comes from comparisons of the relative "efficiency" of the prawn trawl versus the dredge (Table 2). Comparisons of three information types (ie. the frequency of stations where each benthic class was observed, the composition of the benthos, and the estimated catch density per swept area) suggested that the dredge was more efficient at removing benthos than the prawn trawl (Burridge et al. 1996). Most benthic classes were caught more frequently in the dredge than in the prawn trawl; the composition of the benthos from the prawn trawl was biased towards larger benthic fauna (64%; sponges, crustaceans, zoantharians and octocorallians) compared with the dredge (14%); and the estimated density of most benthic classes from the prawn trawl was only ~5% of that from the dredge. Overall, the prawn trawl caught ~7 kg/Ha whereas the dredge caught ~340 kg/Ha, but the prawn trawl does not appear to have an equal impact on all classes of benthos — at least in terms of what it removes. Assuming the dredge catch was a reliable indicator of the actual density of benthos on the seabed, Table 2 gives an indication of the amount of each class that would be removed by a single pass of the trawl nets. For example, about 5% of the sponges would be removed.

Table 2. Comparisons of the sampling properties and benthos densities estimated by the epibenthic dredge and prawn trawl. Column headers: % presence = proportion of sites where benthic class was sampled by gear type; % weight = proportion of total weight of samples made up by each benthic class by gear type; kg/ha density = total catch of benthic class divided by estimated swept area (hectares). Sessile benthos are highlighted with shading.

CLASS	Dredge % presence	Trawl % presence	Dredge % weight	Trawl % weight	Dredge kg/ha density	Trawl kg/ha density	Trawls % of Dredge
Algae	99	94	14	1	42.16	0.09	<1
Ascidians	84	66	4	1	13.24	0.11	<1
Asteroids	92	48	5	4	14.85	0.26	2
Bivalves	84	73	52	12	159.69	0.89	<1
Bryozoans	85	65	2	1	7.13	0.04	<1
Cephalopods	29	90	<1	3	0.43	0.21	48
Crinoids	94	84	4	3	10.95	0.18	2
Crustaceans	98	99	1	18	3.19	1.28	40
Echinoids	74	30	<1	<1	1.30	0.03	3
Gastropods	83	52	<1	1	1.42	0.07	5
Holothurians	74	58	3	7	9.65	0.49	5
Hydrozoans	75	62	1	<1	2.92	0.01	<1
Marine plants	21	7	<1	<1	0.24	0.01	4
Octocorallians	87	94	3	14	8.90	1.02	11
Ophiuroids	96	80	1	2	1.85	0.17	9
Sponges	92	82	2	20	37.71	1.45	4
Zoantharians	97	63	8	12	24.07	0.83	3
TOTAL					339.70	7.14	2.10

SUB-Total Sessile Benthos	93.97	3.46	3.7%

It is arguable that the amount of material actually removed is irrelevant because the prawn trawl could damage much of the material that the ground-gear touches, without actually removing it. However, severely damaged organisms would have died and decayed in the time between the treatment and the after-sampling. If this effect was large, it should have been detected by the BACI experiment. The fact that it was not, suggests that only an unmeasureable fraction was severely damaged, and left in situ, during the manipulation.

Repeated-Trawl Depletion Experiment

A repeated-trawl depletion experiment was also conducted to determine the intensity of prawn trawling that would cause a substantial impact on the sessile benthos; to place the results of the BACI experiment in perspective and to document the rate of impact of intensive trawling on seabed benthos (CSIRO/QDPI unpubl.). The repeated trawls were conducted on six 2.7 km tracks from within the BACI plots, for which there was detailed information about their "before" status. Each track was trawled 13 times over, with precise vessel navigation accomplished using differential GPS. The overall width of the trawled area in each track was ~35 m, compared with the width of the trawl gear at ~17 m. A central area of 10–15 m wide in all tracks was trawled at least 10 times (Fig. 8).

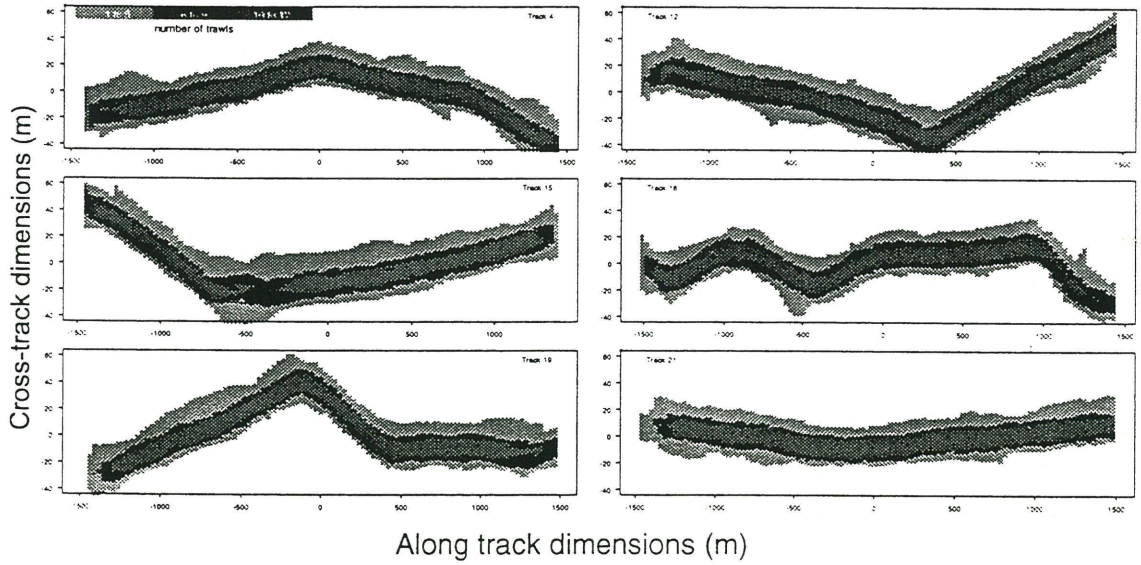

Fig. 8. Spatial distribution and intensity of repeated trawls on the depletion tracks. Note different scales that exaggerate cross-track dimensions. Actual tracks were almost straight; bends indicate waypoints through which the trawler had to pass.

In the process of conducting the depletion experiment, about 2.25 t of sessile benthos was removed from the six tracks, corresponding to ~55 kg/Ha. Preliminary Leslie-Davis regression analyses of the biomass of sessile megabenthos removed by each repeated trawl and recorded on the trawler during the experiment (Fig. 9), indicated that the rate of removal of sessile benthos (= slope) by each trawl was roughly 5–20% of the estimated available biomass and that 13 trawls removed roughly 70–90% of the estimated initial trawlable biomass (= x-intercept). The biomass of benthos and depletion rate varied substantially among tracks (Fig. 9)

and only one track (on Plot 18) did not shown a significant overall depletion trend during the experiment. Note that at the time of writing, these are oversimplified results based on incomplete data, and that more detailed analyses in progress are indicating that the results are much more complex, with depletion rates differing within and among different types of organisms (CSIRO Report in prep.).

Preliminary estimations, based on raw depletion data, indicated that initial sessile benthos biomass was in the range ~130 kg to ~710 kg per track, an average of ~470 kg, which corresponded to ~70 kg/Ha (depending on preliminary estimates of the effective area of the tracks). These biomass density estimates contrast with a biomass of ~95 kg/Ha from the dredge during the BACI experiment (Table 2). If the dredge biomass can be used as an approximation of the actual benthos biomass, this suggests that ~25 kg/Ha of benthos was more resistant to removal by prawn trawls. In this case, the ~55 kg/Ha of benthos removed by the depletion trawls, which was 70-90% of the apparent (x-intercept) biomass, may have been only ~60% of the actual benthos biomass on the seabed. This result concurs with remote video observations that suggest some fauna (eg. some gorgonians and seawhips) are very resilient to removal. The results from the more rigorous analyses in progress will differ in detail, although we anticipate that the overall implications will be similar.

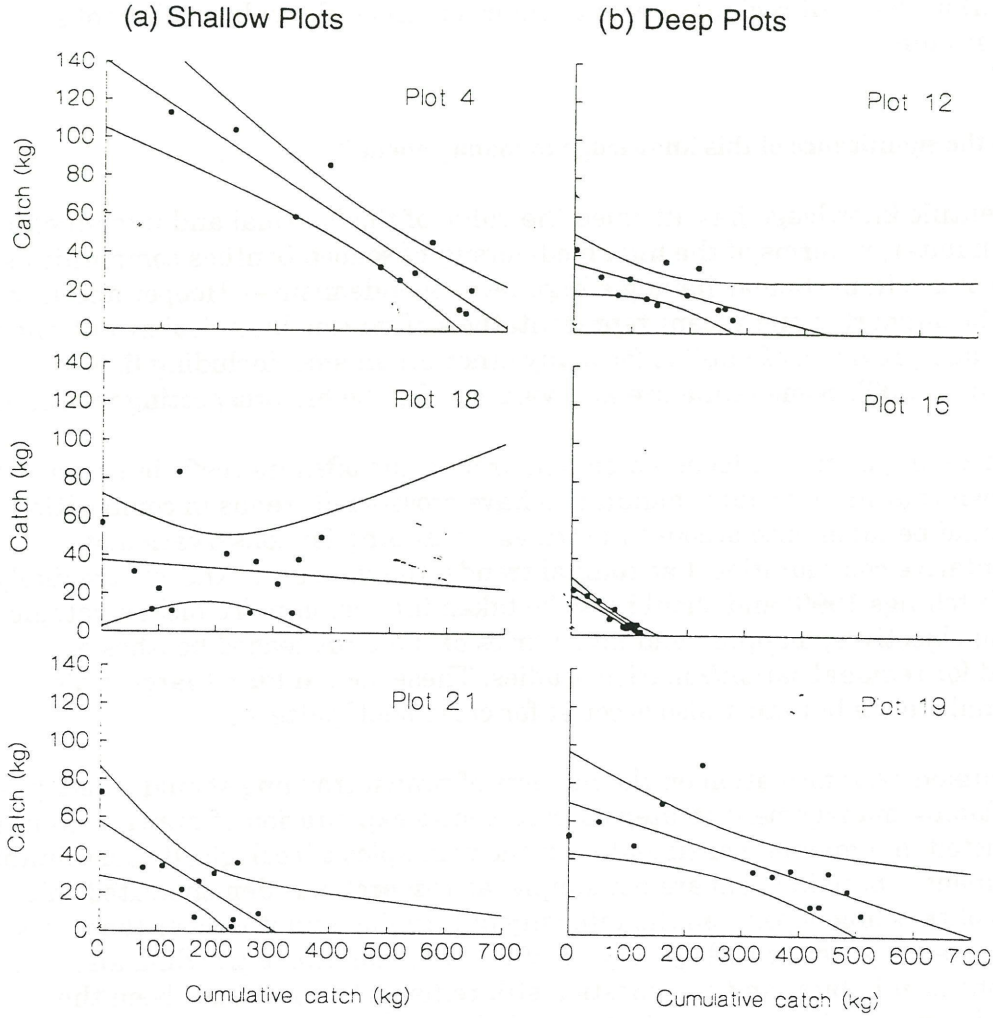

Fig. 9. Leslie-Davis Plots of the depletion of sessile benthic classes (see shaded taxa in Table 2) on (a) three shallow tracks and (b) three deep tracks, all trawled repeatedly 12-13 times (● = catch data included in regression; ✱ = data excluded).

Conclusions about the Effects of Prawn Trawling

Clearly, prawn trawling can degrade the state of the inter-reefal benthos and despite the absence of long-term data sets to confirm trends, anecdotal reports, circumstantial evidence and, extension of these research results, suggest that there have indeed been changes. The CSIRO/QDPI experiments showed that the cumulative effect of high intensity prawn trawling is likely to be substantial on epibenthos in species rich offshore areas, but the impacts may not be detectable in areas that are trawled infrequently or sparsely. This result is important because the intensity of trawling is not uniform; some areas are trawled intensively, but large areas are trawled only occasionally or sparsely. The experiments could not be designed to answer questions about past impacts in previously trawled grounds on soft sediments of the main lagoon, especially smaller infauna. These lagoonal soft sediment fauna may, however, be less vulnerable to trawling. Because the intensity of trawling and impacts in soft sediments are poorly known, the overall significance of trawling effects on the GBR ecosystem is not yet fully clear. To determine whether the impacts of trawling on benthos are sustainable, more information is required on the distribution and dynamics of benthos communities, the spatial distribution and intensity of prawn trawl effort (at much finer scales than presently

collected) in the GBR region, as well as information on the vulnerability of soft sediment fauna.

What is the significance of this knowledge to management ?

The scientific knowledge has affirmed the value of the lagoonal and inter-reefal seabed habitat, in terms of the high biodiversity of seabed benthos communities (with sponges in particular having a high level of endemism — Hooper and Lévi 1994), the support of significant representatives of marine biological evolutionary history, and provision of habitat for many other organisms, including fishes (Hutchings 1990). Some fauna are also valuable for the bio-prospecting industries.

Current zoning plans are focussed on and around the offshore reefs, but research has shown that inter-reefal communities have cross-shelf trends in composition that should be taken into account in strategic planning for conservation of representative communities. Latitudinal trends, though poorly known, are likely to exist (Hutchings 1990) and should also be taken into account. To meet strategic planning objectives, mapping and inventories of the GBR seabed benthos are required for regionalisation/zonation studies. These should target large scale latitudinal trends but must also account for cross-shelf patterns.

The documented information on the impacts of prawn trawling should be adopted by developing management strategies that ensure exploitation of prawn resources is conducted in a manner consistent with the principles of ecologically sustainable development. These impacts are not simple, as research has demonstrated that the impacts of trawling depend on the intensity of trawling and it is clear that trawl grounds are subjected to widely varying effort. The impacts of trawling also depend on the physical habitat and the question still remains "...what have been the impacts in previously and intensively trawled grounds in the main lagoon?" Particularly in softer sediments, as opposed to structured habitat patches. To properly address this question, information will be needed on fine-scale distribution of trawl effort (GPS resolution) so that sampling can be designed to cover a range of trawl-intensities and control for natural differences in habitat. Further, the impacts of trawling probably depend on the type of trawl gear used. There are many types of demersal trawl nets and their use depends on the target species and nature of the seabed. The gear used for trawling for demersal fishes is very different from that used for prawns, and the types of habitat targeted also differ, consequently the impacts of fish trawling are almost certainly different.

Documenting the direct impact of prawn trawling on the sessile seabed communities has been very important. But it is now perhaps even more important to determine the natural dynamics of benthos populations and the ecological processes structuring them, as well as their rates of recovery after trawling or other impacts. Such research would provide an assessment of the sensitivity of the fauna to a range of pressures and establish expected time frames for recovery. This knowledge is needed because large areas of the GBR have already been trawled, and for future management of the region, it is necessary to understand if and how these areas may recover if they were closed to trawling or if different strategies for trawling were implemented.

Strategies for managing prawn trawling will be required to ensure ecological sustainability, whilst allowing reasonable use. Certainly, seabed benthos can be

impacted substantially and thus zoning plans should aim to preserve representative areas of such habitat and its biodiversity. Impacts on lagoonal soft-bottom benthos are suspected (Hutchings 1990), based on bycatch composition, but have not yet been formally documented. In the absence of rigorous information, the precautionary principle should initially be adopted and representative areas of this habitat and its biodiversity should also be preserved in zoning plans. Gaps in the biological and ecological information should be addressed and, in addition, systems to provide more reliable information on the fine-scale distribution and intensity of prawn trawling should be introduced. Such information could be obtained with the introduction of a vessel monitoring system and will be essential for assessing and managing the environmental impacts and ecological sustainability of prawn trawling.

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Table and Figure Captions

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Fig. 1. Map of the cross-shelf closure and adjacent areas open to trawling in the Far Northern Section of the Great Barrier Reef (a). The entire area between the coast and the ribbon of outer barrier reefs is the lagoon, although the outer shelf area among the reef matix is often termed the inter-reefal area (shaded in inset b) and the inshore area with few reefs is often termed the main lagoon (not shaded in inset b). Insets (b) and (c) show the location of the study area relative to Queensland and Australia.

Fig. 2. Multidimensional scaling plots of (a) dissimilarities of sites, by taxa, inshore sites (3), midshelf sites (η) offshore sites (4), and (b) dissimilarities of high-level taxa, by stations. Note, the MDS1 axis corresponds primarily with inshore to offshore orientation, left to right.

Fig.3. Distribution of major benthos types in ~2.8 km long coded video transects along (a) shallow (~20 m) shoaling seabed and (b) deeper (~35 m) seabed in the midshelf of the Cross Shelf Closure. Codes: 1=silt/sand, 2=rubble, 3=algae, 4=shell beds, 5=patches of seawhips and gorgonians, 6=5+sponges, 7=6+hard corals, 8=rocks, 9=reef. The multiple scales of patchiness of benthos are clearly apparent.

Fig. 4. Principal component analyses of sites in open and closed areas for (a) very common species present at more than 60 stations, and (b) common species present at more than 20 stations. Symbols: ■=closed area, ▲=open area north, ▼=open area south.

Fig. 5. Frequency distributions of the log of the ratio of species abundances in the closed and open zones (a) by weights and (b) by numbers, showing the direction and magnitudes of differences.

Fig. 6. Design and timeline for the before and after sampling, and manipulation (arrows), of shallow and deep plots in phases 1 and 2 of the BACI experiment.

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26 (p.1)



Cooloola Seafood Festival

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LARGE SCALE SEAGRASS DIEBACK.

The Cooloola Fishermans Festival Assoc. Inc was formed after the 1992 deepwater seagrass die back in Hervey Bay.The group mainly consists of net and trawl fishers and their families along with other community members.

It had been suggested that a seagrass die back was occuring and had been happening for quite a while but previously we had no means of knowing how to address the issue. We now hold a Seafood Festival each year to raise money to put towards research into what is happening to seagrass in the area.

We got involved with the Dept Of Environment, Maryborough, in establishing 9 long term monitoring sites in the Great Sandy Straits- Hervey Bay intertidal areas and are still involved. We engage a private consultant to carry out the research work.

CFFA Inc also funded work done by Matthew Wnuczynski-
(1) Seagrass Pathogens: A Review of their occurrences, symptoms and factors influencing the outbreak of disease and
(2) The influence of water quality on the virulence of the seagrass pathogen Labyrinthula.

Matthew is now a Bachelor of Applied Science (Natural Systems and Wildlife Management). He was also involved in isolating the pathogen Labyrinthula within this area.

We needed to know more about large scale die backs and what was happening here in the Great Sandy Straits and Hervey Bay areas. We were only looking in our own back yard, thinking that it was only a problem here, but communications with other fishers along the coast have suggested that this is not the case. Government agencies were not saying much about the problem so it was difficult to get an all over picture.

Some areas may have localised concerns caused by man made influences but the overall picture is still not clear.

We now know that from Townsville south, there have been major changes in seagrass populations in the intertidal areas. This was made known at the meetings of QCFO with fishers in relation to ways to remediate the impacts of netting on dugong in DPAs and along the Qld coast.

It appears that seagrass die back has been occuring in intertidal areas along the coast for as much as two decades, more so in some areas than others. The total area affected may range from Townsville to the Qld/ NSW border.

It has also been suggested that two of the most productive plants, cymodocea serrulata (common names- buffalo grass or dugong grass) and zostera capricorni (common names- eel grass or mullet grass) have been reduced to only a small percentage of their normal coverage area.

Cymodocea Serrulata, once, according to old time fishers, the most common intertidal plant, has almost gone. Growing from half way up a tidal area to 1 to 1½m below the low tide mark. It has a broad leaf and can grow to 30cm long and around 1cm wide. With lots of rizomes, the plant can grow on firm to soft sediment that is not boggy or too hard and likes open bays and protected foreshore areas. This plant was the most sought after by dugong in the intertidal areas because it had the greatest mass and was easier to obtain than the other seagrasses. The telltale sign of dugong presence is Cymodocea Serrulata leaves and Rizomes floating in tide marks in an area so fishers would know to take care.

It has been suggested that dugong predominantly feed on and have a preference for species of the genera Halophila and Halodule which are "pioneering species" or a"weed like species" They have a broad NICHE. It has been suggested that dugong grazing promotes sparse meadows of pioneer species, such as Halophila ovalis which has a very broad niche, probably the broadest of the seagrass in the Southern Great Barrier Reef and can be found from the deepest water, along with Halophila spinulosa, to the the intertidal area, with Zostera capricorni.

Halophila and halodule on the subtidal and intertidal areas are usually very small but in much deeper water, up to 10m, can grow much bigger, almost doubling their size.

If dugongs consume 25kgs dry weight of seagrass, or 10% of their body weight in wet seagrass in 24 hours, then each animal would need many square kms of cover if consuming halophila and haludule rather than cymodocea serrulata to maintain good body condition to fight off bacteria and parasitic infestation such as cryptosporidiosi. It is not known how widespread crytosporidiosis is in animals in the SGBR.

Cymodocea serrulata can grow more densly and much more concentrated in the areas it prefers. Dugong also consume zostera capricorni, when it is higher up on the intertidal area it is quite dark and looses its green look, so the dugong only eat it when there is nothing else to eat. They like zostera when it is very young and very green.

Over the time that fishers have been looking at seagrass, we have become very aware that seagrasses are different and have their own niches. The seagrass in Hervey Bay, growing in water over 10m deep, that was destroyed in the 92 flood, has recovered very well. These include Halophila spinnulosa, Halophila ovalis and Halodule uninervis but Halophila spinnulosa is the most dominant.

This has occured in an area where trawling has been going on during that recovery time, with little or no recovery in areas where no trawling happened.

Dugong were dying and sick looking animals were sighted between July and November, with dead animals coming up throughout the area, the number depending on the amount of seagrass and total number of dugong in the area. Seagrass growth picks up from about November to May then dies back from June to November.The highest number of dugong deaths has been in late 96.

Fishers report that the seagrass on the intertidal area is at the lowest level they can remember for many years. Net fishers have existed for more than a hundred years, along with dugong in this area. The only thing that is different is the amount of seagrass.

CFFA Inc were looking at the seagrass die back from a marine production point of view because some of the species of fish and crustaceans were down in number. We felt that the carrying capacity was affected by the downturn in seagrass so we could expect lower than normal catches. It appears that the carrying capacity is as flat as it can go now and with any increase in seagrass we can expect an increase in productivity. One would expect that along with other species, dugong numbers would have to be less as well.

I would like to point out the work done in 1996 by CFFA Inc with the part resurvey of seagrass transects in the Great Sandy Straits area and the work on pathogens and assessment of impacts on seagrass world wide.

A copy of the two papers is attached for your information.

The part resurvey of long term seagrass monitoring sites within the Great Sandy Straits and Tin Can Inlet was done in November 96 by FRC Coastal Resource and Environmental. Money for the research came from CFFA Inc and a Coastcare grant.

Part of the report states -"Whilst only a part resurvey, this study suggests a significant acceleration in the trend of declining seagrass distribution within the Great Sandy Strait, first reported by FRC in 1992".

Part of the research done by Matthew Wnuczynski, on the influence of water quality on the seagrass pathogen Labyrinthula states- "Thus seagrass growing in lower salinity areas within the Great Sandy Straits may be experiencing an external environmental stress which is reducing the productivity of the plant. A reduction in productivity, stunted leaves and less leaves per tiller may predispose the seagrass to attack by fungal diseases and/or Labyrinthula. This is evident from the significantly higher frequency of isolation of fungus from seagrass collected at lower salinity sampling areas and a greater degree of disease

symptoms, exhibited by the seagrass. The fungi isolated may be a secondary invader of seagrass following infection by Labyrinthula. The presence of fungi may be detrimental to seagrass contributing to the massive die off throughout the Great Sandy Straits.".

Part 3.6 Of that paper.
Environmental and other factors associated with an outbreak of wasteing disease.
"Bacterial and fungal infection, changes in SOLAR-RADIATION, extremes in precipitation, reduced light, temperature increase, long term lunar cycles that influences ocean circulation or tidal effects have all been suggested as possible stressors".
(Whelan and Cullinane, 1987, Den Hartog. 1987.)

Shoalwater Bay is an area without a lot of man induced activity and yet the seagrass die back has been similar to that in the Great Sandy Straits. WHY?

Refer Map.1 Shoalwater Bay. Sea grass die back area.

Refer Map.2 Showing large areas of seagrass die back in the Northern Hemisphere.

Refer Map.3 Qld east coast Townsville to NSW Border

Refer Diagram.1 Cymodocea Serrulata and Halophila Ovalis sizes

Figure 1: 9 long term monitoring sites established within the Great Sandy Straits. Three of these were resurveyed in Nov 96.

It appears that Northern Hemisphere seagrass collapsed over large areas in different continents at a similar time. So why should our seagrass here in Australia be more tolerant to such widespread climatic changes, and if dugong were in the Northern Hemisphere seagrass collapsed area, what would their fate be.?

I think that dugong and fishers can live together and given the chance fishers could become the long term caretakers of the DPAs. Who else is there? Its about time some of the agencies involved worked with some of the fishers to formulate an agenda to assist with the future development of fishing gear to help reduce the impact on the animals that they are so concerned about. That should be the number one priority, development of high tech alarms, nets or other gear that would have the desired effect.They should be trying to work out what is fact and what is fiction and what is propoganda put together by that element in the conservation groups who would not think twice about gutting a dead dugong on the beach and getting the best media they can out of it.

Commercial fishers who are of that element that shows disregard for the criteria set down by their peers should be removed from the industry.

There shoud be a retrieval plan put in place for dugong recovery

in the event of an accidental drowning in a net or boat strike to get the best result from an autopsy. The person involved should be given immunity if they follow the retrieval plan.

There is no reason why other fishers in the DPAs cannot be involved in monitoring the long term sites of seagrass as in the Sandy Straits. If we had not become involved we would not have been as aware as we are today.

Part of the fishers commitment to a DPA would be to look after the sites and help monitor them. Fishers are people who walk over look at, and work in areas that support seagrass and yet are only used when experts want to know something that isn't in a book. Their information is vital to the long term survival of dugong, seagrass and coastal habitat.

As for Cymodocea serrulata (buffalo grass or dugong grass), it doesn't matter what you call it, there needs to be a lot more work done to find out where it was and how much is left now.
Lets hope Cymodoca rotundata and the other broad leaf seagrass north of Townsville are in better shape.
CFFA Inc has not yet had sufficient funds to have some one develope a formula to isolate the presence of Labyrinthula and/or fungi in Cymodocea serrulata and there needs to be a solar radiation check done -i.e the number of cloud free days, over the last thirty years, in the southern Great Barrier Reef to Fraser Island area - so that it can be factored into the equation.

The other mystery is why the deep water halophila are doing so well in areas that are trawled? The more fishers know about seagrass identification the more they can help seagress.

TRUST US! DONT DESPISE US! HELP US TO DEVELOPE THE GEAR WHICH WOULD GIVE A WIN/WIN SITUATION FOR THE ANIMAL, THE FISHERS AND THE AGENCIES INVOLVED.

A list of CFFA Inc funded or part funded work is attached.

FRC

1. Establishment of long term seagrass monitoring sites within the Great Sandy Straits and Tin Can Inlet. July 1994

2. A part resurvey of long term seagrass monitoring sites within the Great Sandy Straits and Tin Can Inlet. March 1995.

3. The occurrence of the pathogen Labyrinthula sp. in South East Queensland, Australia. February 1996.

4. A part resurvey of long term seagrass monitoring sites within the Great Sandy Straits and Tin Can Inlet. November 1996.

Matthew Wnuczynski
Natural Resource Management Studies UQ Gatton 1996

1. Seagrass pathogens: A review of the occurrence, symptoms and factors influencing the outbreak of disease.

2. The influence of water quality on the virulence of the seagrass pathogen, Labyrinthula. December 1996.

JOE MCLEOD

Cooloola Fishermans Festival Assoc Inc

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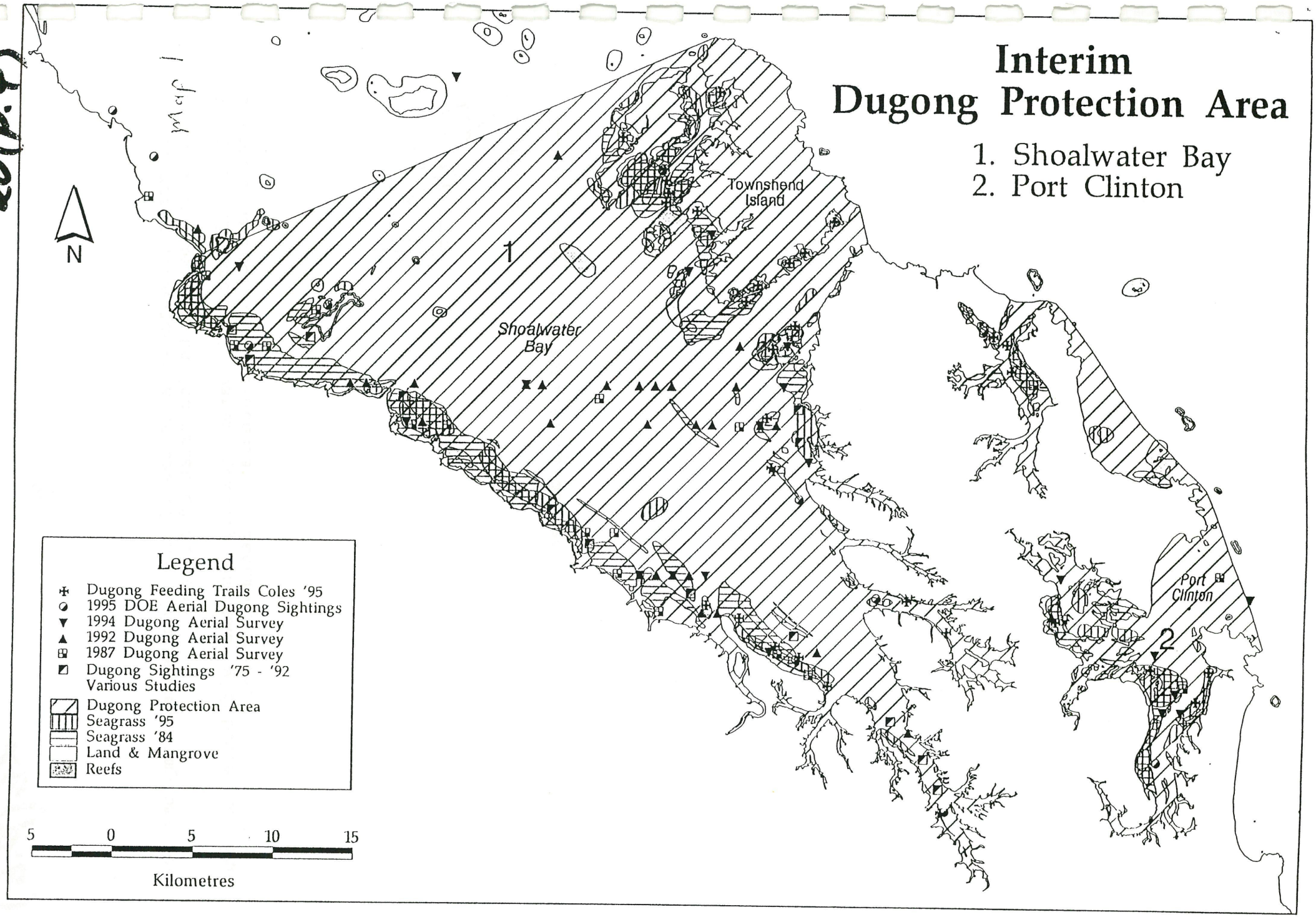
Interim Dugong Protection Area

1. Shoalwater Bay
2. Port Clinton



26(p.8)

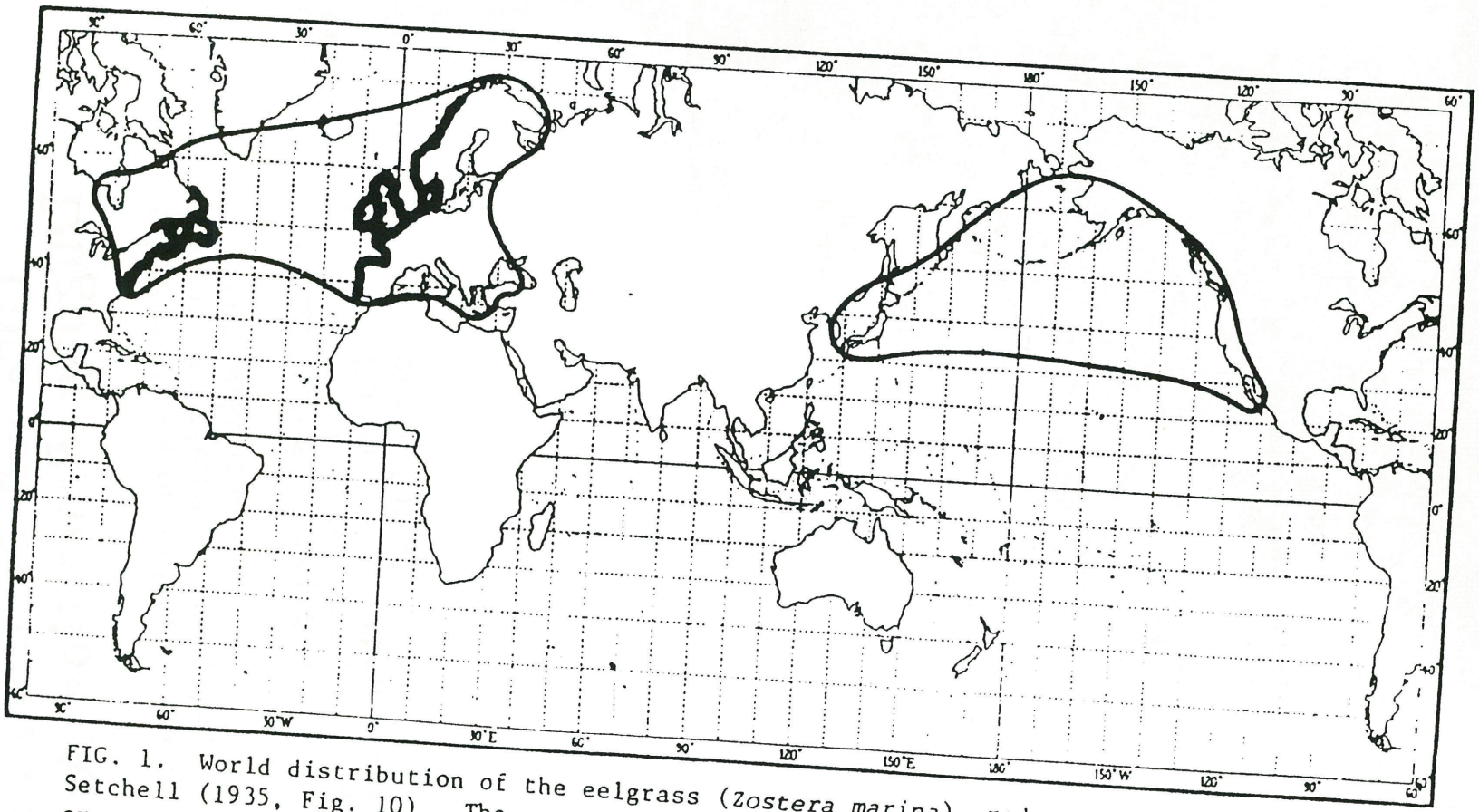


FIG. 1. World distribution of the eelgrass (*Zostera marina*), redrawn and modified after Setchell (1935, Fig. 10). The coastal areas marked with a black signature indicate the areas with the mass destruction in the 1930s. After Rasmussen (1973).

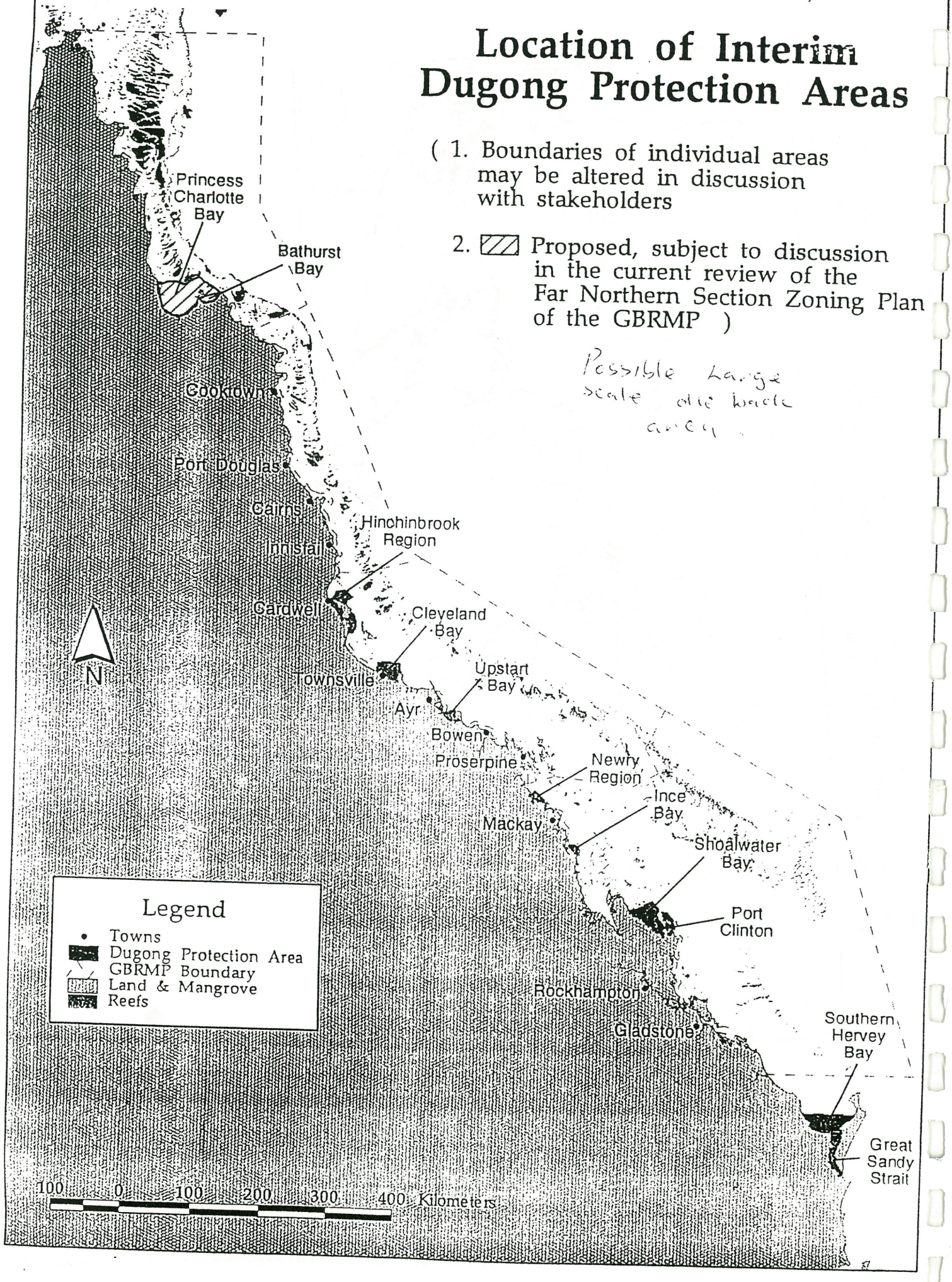
Map 3

Location of Interim Dugong Protection Areas

(1. Boundaries of individual areas may be altered in discussion with stakeholders

2. ▨ Proposed, subject to discussion in the current review of the Far Northern Section Zoning Plan of the GBRMP)

Possible Large scale die back area



26(P.10)

Cymodocea serrulata
size comparisons
with Halophila Ovalis.
Halodule uninervis.

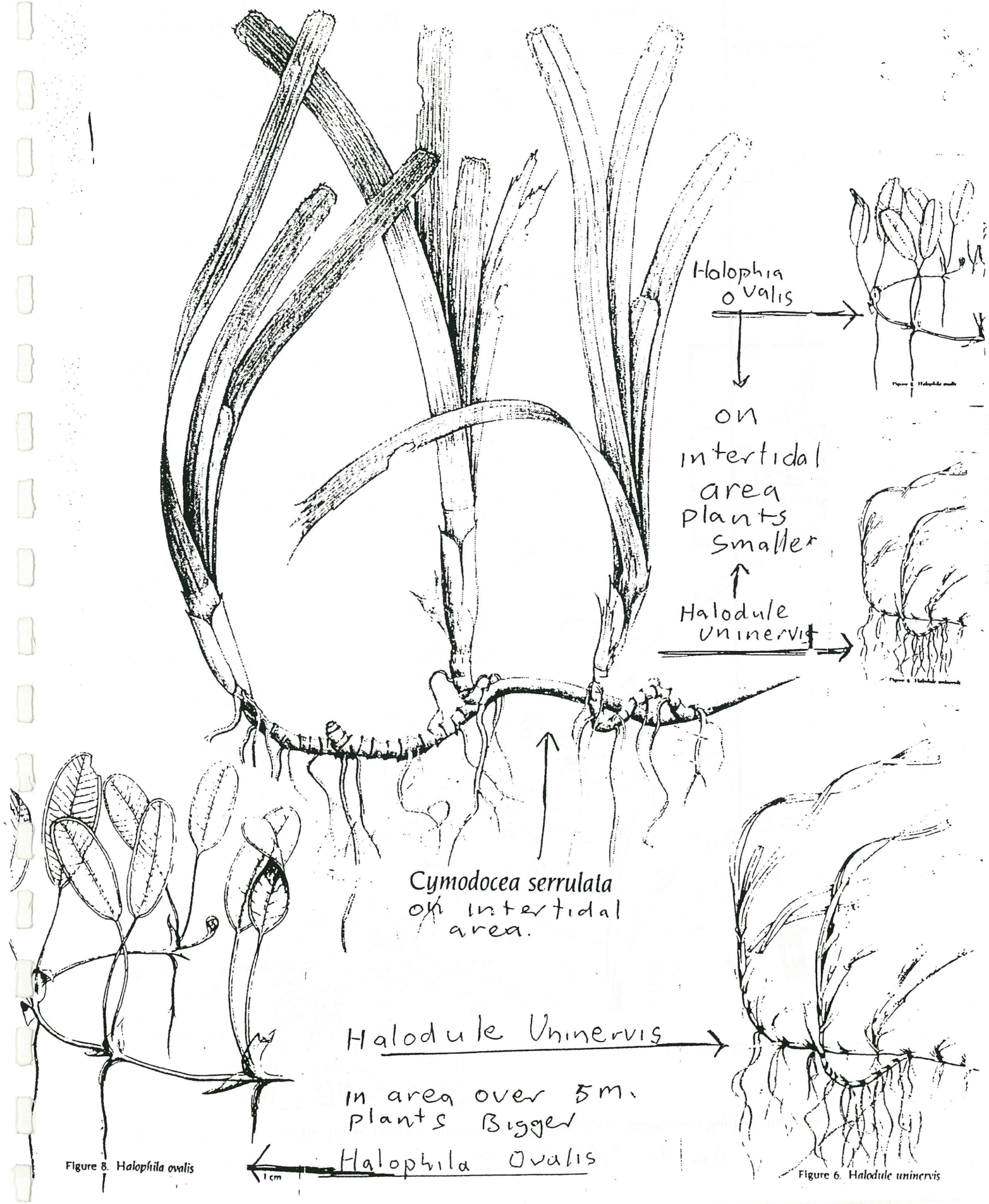


Figure 8. *Halophila ovalis*

Figure 6. *Halodule uninervis*

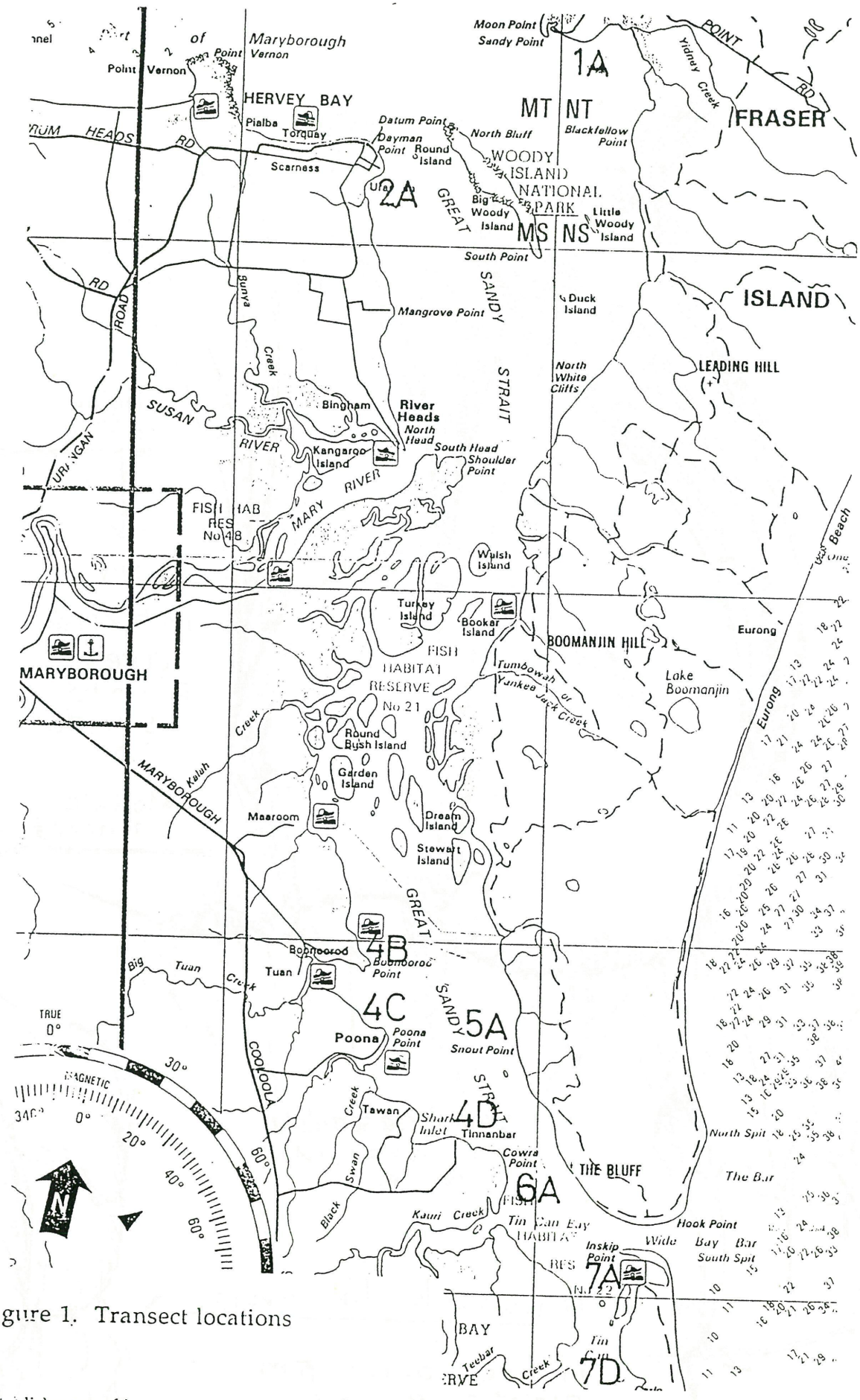


Figure 1. Transect locations

Nov 96 Site areas.

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The Influence Of Water Quality On The Virulence Of The Seagrass Pathogen, *Labyrinthula*

By

Matthew Wnuczynski

Ba.App.Sci.(Natural Systems & Wildlife Management)

A report submitted to the

Cooloola Fisherman's Festival Association Inc.
Queensland Commercial Fisherman's Organisation

November, 1996

27(p.2)

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1.0 : SUMMARY

Seagrass communities are located throughout the world in relatively shallow sediments protected from wave action of the open ocean (Walker & McComb, 1992; Environmental Protection Authority (EPA), 1990; Den Hartog, 1987). They are among the most productive and dynamic element of aquatic ecosystems (Sterrenburg, Erftemeijer & Nienhuis, 1995). The growth and survival of seagrass communities is of major importance to coastal waters as seagrasses aid in the prevention of nearshore coastal erosion.

As well, seagrass communities are considered high in ecological value as they provide a breeding ground and nursery for a diverse array of finfish and crustaea, and support large populations of dugongs, turtles and prawns in the tropical seagrass beds of northern Australia (Walker & McComb, 1992). A number of environmental factors determine the growth and distribution of seagrasses along the coastlines around the world such as ocean currents, nutrient concentrations, water temperature, light availability and salinity (Abal & Dennison, 1996).

Throughout the world there have been periodic declines in the areas covered by seagrass. These declines have been attributed to a combination of natural and anthropogenic influences. *Labyrinthula* spp. (marine slime-moulds) have been implicated as causing declines of seagrass meadows of the northern hemisphere: a phenomenon that has been commonly referred to as 'wasting disease'.

Seagrass communities growing in the Great Sandy Strait region exhibited similar decline phases to communities growing in the northern hemisphere. The decline of seagrass within the Great Sandy Strait began in the early to mid 1980's with the loss of *Zostera capricorni* from the upper Tin Can Bay Inlet (McLeod, pers.comm,.1996). By 1988 seagrass die-off was noted at Inskip Point, Kauri Flats and throughout large seagrass meadows within the Great Sandy Strait. Preliminary investigations conducted

seagrass meadows within the Great Sandy Strait. Preliminary investigations conducted during the winter of 1995 successfully isolated *Labyrinthula* from *Zostera capricorni* meadows growing in the Tin Can Bay region.

The continual die-off of seagrass within the Great Sandy Strait raised concerns over the ecological impact associated with the wide-spread loss of seagrass. Variations in water quality, in particular salinity, was one factor which may predispose seagrass to infection by *Labyrinthula*. Seagrass was collected from a number of sampling areas within the Great Sandy Strait which varied in salinity levels to test that hypothesis.

The representative seagrass collected was assessed using a wasting disease index key to determine the severity of disease symptoms. Although the seagrass exhibited a high degree of wasting disease symptoms the frequency of isolating the pathogen during laboratory investigations was minimal.

However, four species of fungi were consistently isolated from seagrass. The frequency in isolating one of the four species of fungi was correlated to low salinity and high wasting disease symptoms. The isolation of the three other species of fungi between distinct sampling areas was not statistically significant.

The vigour of the seagrass collected was also correlated to salinity. Seagrass collected from low salinity sampling areas were stunted in comparison to seagrass collected from standard salinity sampling areas. The number of leaves per seagrass tiller also varied with changes in salinity as plants collected from standard salinity sampling areas tended to have a greater number of leaves per individual seagrass frond (tiller).

Thus, seagrass growing in lower salinity areas within the Great Sandy Strait may be experiencing an external environmental stress which is reducing the productivity of the plant. A reduction in productivity, stunted leaves and less leaves per tiller, may

predispose the seagrass to attack by fungal diseases and/or *Labyrinthula*. This is evident from the significantly higher frequency of isolation of fungus from seagrass collected at lower salinity sampling areas and greater degree of disease symptoms exhibited by the seagrass. The fungi isolated may be a secondary invader of seagrass following infection by *Labyrinthula*. The presence of the fungi may be detrimental to seagrass contributing to the mass die-off throughout the Great Sandy Strait.

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2.0 : INTRODUCTION

Seagrasses are submerged vascular plants botanicallly classified within four families of monocotyledonous plants (McRoy & Hefferich, 1980; Plate & McComb, 1981). They are located throughout the world in nearshore coastal areas protected from the wave action of the open ocean (Walker & McComb, 1992; Environmental Protection Authority (EPA), 1990; Den Hartog, 1987). Seagrasses grow in relatively nutrient rich shallow sediments and are among the most productive and dynamic elements of aquatic ecosystems (Sterrenburg, *et al.*, 1995; Walker & McComb, 1992).

The morphological structure and high productivity of seagrass communities influence various physical, chemical and biological processes of coastal aquatic ecosystems (Burdick, Short & Wolf, 1993; Walker & McComb, 1992). They provide a breeding ground and nursery for a diverse array of finfish and crustacea and contribute to the organic food chain through the direct grazing activities of dugongs, turtles and prawns.

The fronds of these vascular plants provide a suitable substrate for the colonization, growth and reproduction of a diverse range of epiphytes (Orth & Van Montfrans, 1984; Sterrengburg *et al.*, 1995). The epiphytes associated with seagrass communities add to the calcium carbonate concentrations within ocean sediments and form an important dietary component of many invertebrate and vertebrate marine fauna, such as gastropods, amphipods, isopods and fishes (Howard, 1982; Orth & Van Montfrans, 1984; Walker & McComb, 1992).

The growth and survival of seagrass communities is also of major importance in the prevention of nearshore coastal erosion. Seagrasses reduce water currents and bind coastal sediments aiding in the stabilization of the marine benthos and a subsequent

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increase in the nutrient status of coastal waters (Walker & McComb, 1992; Bulthuis, Brand & Mobley, 1984).

There are several water quality parameters which determine the growth and spatial distribution of seagrasses along coastlines throughout the world. These include: turbidity; the nutrient concentration of coastal waters, water temperature; submarine irradiance; and salinity (Abal & Dennison, 1996). Generally seagrass plants are restricted to shallow waters less then 30 metres in depth (Pate & McComb, 1981). However, the amount of light available for seagrass determines the depth at which the plant can grow. The depth of seagrass growth is influenced by factors affecting water clarity, such as increased turbidity and sedimentation, phytoplankton blooms and enhanced nutrience input from the land (EPA, 1990; Abal & Dennison, 1996). A decline in the amount of light available to seagrasses is considered to be the major external environmental factor causing a decline in seagrass meadows in some Western Australian coastal waters and harbours (EPA, 1990).

Throughout the world there has been a general reduction in seagrass meadows which has been attributed to a combination of natural factors and anthropogenic influences (Walker & McComb, 1992; Burdick *et al.*, 1993). The decline of the most predominent species of seagrass growing in the Northern Hemisphere, *Zostera marina* (L.), has been caused primarily by two factors: excess nutrient pollution due to coastal eutrophication; and a recurrence of 'wasting disease' (Burdick *et al.*, 1993). Eutrophication causes a decline in water clarity and a subsequent reduction in the photosynthetic ability of seagrasses (Walker & McComb, 1992).

Both coastal eutropication and wasting disease have led to the loss of seagrass meadows causing a degeneration of species diversity (Den Hartog, 1987; Burdick *et al.*, 1993). The rejuvenation of a seagrass community may be achieved by the regenerative and degenerative stages being in equilibrium, where losses and gains are compensated. However, these two stages were not in balance during 1930 and 1931 as an outbreak of 'wasting disease' almost caused a complete loss of *Z. marina* beds in the North Atlantic (Den Hartog, 1987).

Wasting disease has been implicated for repeatedly causing dramatic reductions of Z. marina during the 1930's along the east coast of the United States and the west coast of Europe (Short, Porter, Iizumi & Aiai, 1993). A number of species of slime moulds, from the Family Labyrinthulacea, primarily consisting of saprophytic marine slime moulds, have been isolated from seagrass meadows along the Atlantic coast of North America, the coast of Nova Scotia (Canada), Roscoff (France) and Devon (England) (Muehlstein, Porter & Short, 1988; Short, Ibelings & Den Hartog, 1988).

The causal organism of wasting disease that affected *Z. marina* along the north-eastern coast of the United States of America was identified as a pathogenic strain of *Labyrinthula zosterae* (Porter et Muehlstein), which produced symptoms similar to those recorded during the 1930's (Muehlstein *et al.*, 1988; Short, Muehlstein & Porter, 1987).

At present there is no evidence to suggest that the presence of *Labyrinthula* on macrophytes under optimal growing conditions has resulted in any detrimental effects on the plant (Vergeer & Den Hartog, 1994). The recorded decline in seagrass meadows attributed to wasting disease may have been significantly influenced by other

factors causing stress within seagrass meadows and subsequently increasing the macrophytes susceptibility to invasion by pathogens (Den Hartog, 1987). Factors placing a stress on seagrass are numerous and include: seasonal growth patterns, changes in environmental growing conditions, erosion by floating ice, fouling by epiphytes, exposure of the macrophyte to frost, and the grazing effects of water fowl (Den Hartog, 1987).

Within the Great Sandy Strait region, South-East Queensland, seagrass meadows have been rapidly declining over the past ten years (McLeod, pers.comm., 1995). Regions once covered with a diverse array of dense seagrass have exhibited many characteristics similar to reported cases of seagrass die-off throughout the world (McLeod, pers.comm., 1995). As well as this, approximately 1,000 km² of seagrass meadows were destroyed in the Hervey Bay region during early 1992 following two major floods and a cyclone within a three-week period (Thorogood, Unpublished). During the winter of 1995 a pilot investigation was conducted over a six month period within the Great Sandy Strait to isolate *Labyrinthula* from seagrass exhibiting necrotic lesions (symptoms commonly associated with wasting disease). Based upon the results of this study further research was initiated at the beginning of 1996 to investigate the influence of water quality on the virulence of the seagrass pathogen *Labyrinthula*.

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3.0 : LITERATURE REVIEW

3.1 : A History Of Wasting Disease

Wasting disease caused a dramatic reduction in the size of *Z. marina* meadows along the North American Atlantic coast during 1930 and the Atlantic coast of Europe in 1931 (Den Hartog, 1987; Cotton, 1933; Short, *et al.*, 1988; Burdick *et al.*, 1993). The recovery of *Z. marina* beds in many locations was hampered by the constant die-back due to the recurrence of the disease. It was not until 1955-1965 that recovery occurred, but some patches that were once occupied by *Z. marina* were still left uncolonised more than 20 years later (Short *et al.*, 1987; Short *et al.*, 1988; Muehlstein, *et al.*, 1988).

The spread of the wasting disease which destroyed seagrass beds along the south coast of Ireland during 1932 to 1933 was slow, taking two years to spread six miles (Renouf, 1934). Yet the recovery of *Z. marina*, *Zostera nana* and the hybrid, which were all equally effected, was relatively rapid (Renouf, 1934).

Early investigations regarding the destruction of *Zostera* in a number of localities in France indicated that a pathogenic bacterium was the causative agent (Cotton, 1933). However, American and Canadian scientists were not successful in finding the causative organism which lead to the wide-spread death of *Zostera* (Cotton, 1933). The cause of the wasting disease and the subsequent decline of *Z. marina* throughout the North Atlantic during the 1930's was suspected to be a marine slime mould but this has never been conclusively determined (Cotton, 1933; Short *et al.*, 1987; Muehlstein, 1992; Short *et al.*, 1988; Den Hartog, 1987; Burdick *et al.*, 1993).

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Investigations based on herbarium material of *Z. marina* from the British Museum, London, the United Kingdom and the Rijksherbarium (Leiden), indicated that the wasting disease is an inconspicuous but widespread endemic phenomenon naturally occurring in seagrass beds (Den Hartog, 1989). The oldest diseased specimen from the British collection dates back to approximately 1840, and from the Netherlands to 1856 (Den Hartog, 1989).

Investigations conducted during the 1930's on *Z. marina* established that within the blackened spots on the leaves caused by the wasting disease the mycelium of a fungus was consistently present (Petersen, 1933). The leaves of *Zostera* were affected by the mycelium throughout winter, but young shoots produced in spring were generally without infection until the beginning of summer (Petersen, 1934). This mycelium was present in the outer cortex of *Zostera* rhizomes during winter and spring and is the source of infection of new leaf material. The mycelium also extends throughout the mesophyll cells of the seagrass leaves by extending through air-spaces and along the cell-walls (Petersen, 1933). Successful isolation of this fungus by Petersen (1933) was achieved once during this particular experiment and it is believed that the fungus belongs to the group Hyphomycetes which, when growing in agar blocks, infected the leaves of *Zostera marina* producing dark spots. It has been suggested that the fungus commonly associated with the infected seagrass leaves is the cause of the notorious wasting disease (Petersen, 1934).

Further investigations during the wasting disease outbreak of the 1930's identified a thin walled, tenuous, spindle-shaped organism located within the air spaces and cells of diseased *Zostera* leaves (Renn, 1934). However, recent investigations by Muehlstein (1992) reported that *Labyrinthula* cells were rarely found in the large air spaces of the

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plant tissue under investigation. This difference between two similar studies has been explained by the fact that Renn's (1934) investigations were based upon damp slide chambers with limited plant tissue available for the invasion of *Labyrinthula*, and the normal invasion of the pathogen is via plant cells (Muehlstein, 1992). The organism under investigation during the 1934 experiments by Renn was thought to be a mycetozoan similar to the *Labyrinthula* described by Cienkowski in 1876 (Renn, 1934). The *Labyrinthula*-like organism investigated forms a network of aggregated terminal, often branching with tenuous pseudopods (Renn, 1934).

The symptoms displayed by recent outbreaks, which are described below, were first recognised in the Great Bay Estuary on the Maine-New Hampshire Border in 1984 (Short *et al.*, 1987; Short *et al.*, 1988; Short *et al.*, 1993; Muehlstein *et al.*, 1988). During the years between 1985-1987 infected plants were found along the Atlantic coast of North America and there have been reported findings along the coast of Nova Scotia (Canada), Roscoff (France), Devon(England), and Kaikoura (New Zealand) (Armiger, 1964; Short *et al.*, 1988; Muehlstein *et al.*, 1988; Ramage, pers.comm., 1996)

3.2 : The Species Of Seagrass Affected By *Labyrinthula*

Marine slime moulds belonging to the genus *Labyrinthula* have been shown to infect a numbers of seagrass species under laboratory conditions (Short *et al.*, 1993; Vergeer & Den Hartog, 1991; 1994).

Wasting disease has recently been successfully isolated from not only *Zostera* species, but from 15 seagrass species belonging to nine genera (Vergeer & Den Hartog, 1991;

1994). The 15 species of seagrass from which *Labyrinthula* was successfully isolated are listed in Appendix One.

Thus, *Labyrinthula*, not only affects *Z. marina*, but also a deeper growing species in Japan and Korea; *Zostera caulescens* Miki. L. zosterea also causes necrotic lesions on *Zostera japonica* Ascherson et Graebner, a species of seagrass growing in sheltered tidal flats on the coast from Vietnam to Sakhalin.(Vergeer & Den Hartog, 1991).

Material collected from the middle of the 19th century onwards and held by the Rijksherbarium, indicated that *Z. noltii* Hornem (also referred to in the literature as *Zostera nana* Roth) is also a host of *Labyrinthula*. Recent field observations conducted in England, Wales, France, the Netherlands and Germany also indicated the presence of the *Labyrinthula* on Z. noltii species, although the rate of infection is slow (generally below 1%) (Vergeer & Den Hartog 1991; Philippart & Dijkema, 1995).

Thus, the range of hosts that L. marina affects extends beyond a single host as previously thought and the geographical distribution of the disease extends into the western North Pacific (Short *et al.*, 1993).

3.3 : The Symptoms Associated With Wasting Disease

Labyrinthula initially infects healthy leaves of seagrass causing dark patches increasing to 3-4 cm long after the first week. The presence of *Labyrinthula* cells are usually along the margins of the necrotic tissue, and in green leaf tissue *Labyrinthula* cells are commonly within 1-3 mm from visible necrotic areas (Muehlstein, 1992).

The dark necrotic lesions that develop on both young and old seagrass leaves spread longitudinally to cover large areas of the leaf surface and other leaves after two weeks

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(Short *et al.*, 1988; Short *et al.*, 1987). After three weeks several of the infected leaves turned completely brown and died, while on other shoots the spread of *Labyrinthula* had stopped. This indicates that the occurrence of the disease does not always lead to the death of the macrophyte (Short *et al.*, 1993), yet repeated defoliation may cause stress to the plant and this coupled with the discolouring of the roots or rhizomes may lead to the death of the plant (Den Hartog, 1989).

The growth rate of all infected plants is dramatically reduced due the effects of the pathogen (Short *et al.*, 1988). The lesions reduce the photosynthetic ability of the plant by decreasing pigment levels on the leaves (Durako & Kuss, 1994; Whelan & Cullinane, 1987; Short *et al.*, 1988). Cells in the necrotic areas loose their photosynthetic capability due to the destruction of the chloroplasts by the pathogen, resulting in the death of the plants if new leaves are not produced (Muehlstein, 1992). Experiments conducted on *Thallassia* spp. indicated that these lesions increased the respiratory oxygen demand of the *Thallassia* leaves (Durako & Kuss, 1994). Oxygen conductance to the root / rhizome system is also dramatically reduced resulting in net respiration regardless of the intensity of light. This also causes the macrophyte to be more susceptible to hypoxia and sulfide toxicity which may cause the death of seagrasses in waters with high sediment sulphide levels. The die-off of *Thalassia* seems to be density-dependant affecting dense patches of various sizes, from 1 metre diameter to almost 2 kilometres. Experiments revealed the pathogen spread quite slowly and all seedlings inoculated with *Labyrinthula* developed necrotic lesions within one week but did not die, perhaps due to stored seed reserve (Durako & Kuss, 1994).

Whilst the symptoms of the disease appear similar over the range of seagrass species affected, the rate of disappearance appears greatest for *Z. marina* (Short *et al.*, 1987;

27 (p.16)

Short *et al.*, 1988; Durako & Kuss, 1994). It has been suggested by Tutin (1938) that the rate of disappearance of *Z. marina* is related to the ecology of the plant itself.

Zostera marina has developed two life history strategies in response to different environmental conditions (Keddy, 1987). *Zostera* exposed to high summer water temperatures and large fluctuations in salinity have an annual growth pattern with plants growing during the winter months and die-off during summer (Harrison, 1979; Keddy, 1987). These plants tend to grow in the upper intertidal areas and recruitment is achieved entirely through the germination of seeds during the following spring (Harrison, 1982). *Zostera marina* growing in relatively stable environments allocate biomass to the elongation of perennial rhizomes during summer, following a die-back during winter (Tomlinson, 1974; Robertson & Mann, 1984). The perennial form of this species are more abundant in the low intertidal exposed briefly at low tide (Harrison, 1979; Keddy, 1987). Seeds produced by the perennial species probably do not play an important role in the year-to-year survival of the population and propagation of the plant is almost entirely by vegetative growth (Hootsman, Vermaat & Van Vierssen, 1987).

There is no evidence that the presence of *Labyrinthula* on seagrass under optimal growing conditions cause any harm to the plant. However, light intensity is the limiting factor for vigorous vegetative growth of the perennial form of *Z. marina* (Tutin, 1938). Reduced sunlight may cause a slight decrease to the growth of the plant increasing the susceptibility of the seagrass to infection by the pathogen.(Tutin, 1938;

27 (P17)

Vergeer & Den Hartog, 1994). The survival of other annual species of segrasses may in many instances depend heavily upon the abundance of seeds that are produced in the previous year (seedset) (Den Hartog, 1987).

3.4 : Characteristics Of *Labyrinthula*

The family Labyrinthulidae Haeckel (14) consists of a small group of primarily marine protists, saprophytes and pathogens of a number of different marine vascular plants such as *Zostera* spp. *Thalassia testudinium* and *Ruppia maritima* (L.), and marine algae such as *Cladophora* spp. and *Laminaria saccharina* (L). Lamour (Muehlstein, 1992; Pokorny, 1967).

Labyrinthula spp. are characterised by fusiform cells that exhibit a gliding mobility through an ectoplasmic network. The ectoplasm, which is concerned primarily with cell movement, also provides a source of nutrition, adhesion and intercellular communication (Muehlstein et.al., 1988). Extensive branching and anastomosing of hyaline slime filaments forms a distinctive colony linking the cells (Pokorny, 1967). The lack of the taxonomic classification of the genus *Labyrinthula*, due to a number of different morphological forms exhibited by this pathogen, has lead to the confusion over the classification to species level (Muehlstein, 1992).

Only one of four species of *Labyrinthula*, which were used to inoculate *Z. marina*, produced the characteristic wasting disease symptoms, suggesting that *Labyrinthula* sp. is the primary biotic agent of the wasting disease. This species has been referred to as *Labyrinthula zostera* (Muehlstein *et al.*, 1988; Muehlstein, 1992).

Labyrinthula penetrates the leaves of seagrasses using two methods. The first is by small wounds created by the epiphytic community which colonize the seagrass, and the

second is by enzymatic degradation of the outer epidermal cell walls by *Labyrinthula* (Muehlstein, 1992). However, investigations conducted by Muehlstein (1992) found that no *Labyrinthula* cells were present on the outer surfaces of epidermal cells, in epidermal cells, or in the lacunae. The cells of the pathogen remain in the mesophyll cells of the leaf, perhaps for nutritional purposes as well as the ease of penetration. *Labyrinthula* cells move through the mesophyll cell walls by enzymatic degradation and progress in the leaf cells to eventually invade cells of vascular tissue and epidermis.

3.5 : The Effects Of Wasting Disease At An Ecosystem Level

The reduction of the seagrass community during the 1930's due to die-back dramatically effected coastal and near shore ecosystems, having an effect on commercial fishing throughout the North Atlantic (Short, *et al.*, 1987). There was a reduction in the population of migratory waterfowl, as well as the closure of the scallop fishery in the mid-Atlantic coast of the United States. The loss of seagrass severely effected the geese and duck population within the United States and swans were being artificially fed at Abbotsbury and in the Yealm, near Plymouth due to the loss of seagrass seeds and rhizomes which form the staple food for these animals (Cotton, 1933).

The loss of the seagrasses causes the resuspension of sediments which reduces light penetration to the ocean floor making the recolonization of seagrasses difficult due to the decrease in water clarity (Walker & McComb, 1992). Alteration in the topography and physiography of estuaries and bays may result due to the decline of the main sand and mud binding component of this aquatic ecosystem (Cotton, 1933). A decline in the abundance of seagrasses to the level experienced in Western Australia during the

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1960's may cause a 40 % reduction in fish, macro-crustaceans and benthic invertebrates due to the seagrass habitat being replaced by bare sand (Walker & McComb, 1992).

3.6 : Environmental And Other Factors Associated With Outbreaks Of Wasting Disease

Many hypotheses have been suggested to explain the cause of the wasting disease of the 1930's but due to insufficient technology and knowledge, investigations during that era were limited. Detailed studies were not conducted until the rapid decline of Z. marina was noticed throughout the Great Bay Estuary on the Maine-New Hampshire border. Prior to this, the nature of environmental factors and the status of the seagrass beds leading up to a decline were unknown or speculated (Short *et al.*, 1988).

The hypotheses offered may be divided into two broad groups. Those of one group suggests that death is caused by a microorganism infecting otherwise healthy (but possible stressed) plants. Those of the other group suggest that the pathogenic microorganism is naturally present within healthy seagrasses, and only causes morbidity and mortality in plants that have been subject to some unrelated stressor (Den Hartog, 1989; Short *et al.*, 1987). Bacterial and fungal infection, changes in solar radiation, extremes in precipitation, reduced light, temperature increase, long-term lunar cycle that influences ocean circulation or tidal effects, and oil spills have all be suggested as possible stressors (Whelan & Cullinane, 1987; Den Hartog, 1987).

Discrepancies exist with a number of these hypotheses. The environmental conditions associated with the onset of wasting disease are reported to vary significantly. However, if 'stress' predisposes seagrass communities to infection then a range of

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causal factors may achieve the same result, and many causal factors may be shown to be inter-related (such as low precipitation and high water temperature, salinity, and solar radiation) (Den Hartog, 1987). Whilst wasting disease affected *Z. marina* meadows simultaneously over the whole North Atlantic, differing local influences may have resulted in the coincidental onset of disease (Den Hartog, 1987). Environmental factors may influence the timing of an outbreak of wasting disease or they may increase the susceptibility of the seagrass to the pathogen (Vergeer & Den Hartog, 1994).

The consideration of possible ways by which the disease may spread lends increasing support to the hypotheses that are based upon the constant presence of the pathogen *Labyrinthula* within seagrass plants. If outbreaks of the disease are the result of location-specific infection, then a mechanism which enables the disease to rapidly spread from an epicentre must exist. Evidence of such a mechanism; one which could transport the pathogen across the Atlantic within a short space of time, is lacking (Short *et al.*, 1988). However, if the pathogen is present, even as a mutation of a pathogenic form, then simultaneous geographically remote outbreaks of the disease would not be unexpected (Short *et al.*, 1988).

If the latter scenario is correct, then the pathogen must exist within seagrass communities in a non-aggressive form for long periods of time until an external factor triggers an outbreak (Short *et al.*, 1988). The pathogen may change from a non-aggressive secondary decomposer to a pathogenic form, or perhaps the pathogen has a long-term cycle which includes the formation of a resistant structure (cyst). Slime-moulds other than *Labyrinthula* exists in algae and seagrass meadows of the Pacific as secondary decomposers of aged plant material. Alternatively, *Labyrinthula* may exist

as an obligate parasite at naturally low population densities, its rapid increase triggered off by external conditions, possible on a global scale (Short *et al.*, 1988).

The influences of a range of environmental factors are discussed below:

3.6.1 : The Effects Of Increased Salinity On Wasting Disease

It was noted in the 1930's that the seagrass destroyed by wasting disease in North American was greater in areas with higher salinity levels (Pokorny, 1967 In: Short *et al.*, 1987; Vergeer and Den Hartog, 1991). Altering salinity levels in laboratory tests from <10 %, in which infection did not spread to new plant material, to between 15 and 30% in which the entire plant was infected with the disease, demonstrated how salinity levels controlled the disease (Short *et al.*, 1987).

Evidence from several sites has shown that the infection of *Z. marina* by *Labyrinthula* is greater the seaward ends of estuaries, eg. the Great Bay Estuary on the Maine-New Hampshire border, as well as in England, France and the Netherlands where eulittorial and brackish water populations of *Z. marina* have not been affected (Short *et al.*, 1988). Investigations in the Netherlands indicated that most of the surviving seagrasses growing in the eulittorial zone or in brackish water, had an 'annual strategy' with a higher seedset (Den Hartog, 1987). The wide-leaved perennial subtidal species of *Zostera* were not affected by the wasting disease that destroyed *Zostera* beds between 1932 and 1934 in Ireland but the narrow-leaved perennial form of *Z. marina* was affected (Whelan & Cullinane, 1986).

Investigations based upon the effects of salinity on seagrass infection suggests that at salinities below 10 % the infection of *Zostera marina* is rare, indicating that the activity

of the pathogen is greatly reduced or stopped at lower salinities (Muehlstein *et al.*, 1988).

3.6.2 : The Effects Of Temperature & Light On Wasting Disease

During the warmer seasons, lesions expand rapidly, whereas during the winter months growth of the disease is slower (Short *et al.*, 1988). The pathogen affects the plants' physiological processes as well as its metabolic balance by reducing photosynthesis. This reduction in photosynthesis is important during the late summer months as the hours of available light reduce while water temperatures remain relatively high. The result is a reduction in photosynthesis while respiration remains constant causing a subsequent decline in seagrass growth rates. This in turn may create a further metabolic stress on the plant, making it increasingly susceptible to diseases (Short *et al.*, 1988).

It has been suggested that the loss of 400 ha of T. testudinum meadows in Florida Bay since 1987 is due to either; high salinity, reduced frequency of hurricanes, high water temperatures, chronic hypoxia of *Thalassia* roots and rhizomes or *Labyrinthula* (Robbiee, Barber, Carlson, Durako, Fourqurean, Muehlstein, Porter, Yarbro, Zieman, & Zieman, 1991). The recurring patchy die-off is concentrated in protected basins to a depth of 1.5 metres below mean sea level and occurs most rapidly during autumn and spring (Robbiee *et al.*, 1991). The decline of the seagrass meadows has had dramatic effects on the species composition within Florida Bay thus effecting both the shellfish and finfish industries (Robbiee *et al.*, 1991).

The decline of *Z. marina* has been suggested by Stevens (1936 In: Short *et al.*, 1988) to be triggered by a long-term lunar cycle which influences oceanic current patterns.

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This may be considered as a global effect that would alter environmental conditions and perhaps cause the expansion of the pathogen over a very large area (Short *et al.*, 1988).

However, the factor or series of factors that initiate the disease-related declines is not yet known and is still being investigated in light of the above information (Short *et al.*, 1988). Environmental factors may influence the timing of an outbreak of the wasting disease or they may increase the seagrass susceptibility to the pathogen (Vergeer & Den Hartog, 1994). Perhaps prolonged periods of cloud cover which reduces ambient light levels while heating the surface waters, or dry summer and autumn months causing the increase in coastal water temperatures, would further stress infected plants at a time when they are more vulnerable (Short *et al.*, 1988).

3.7 : Wasting Disease Investigations Conducted In The Great Sandy Strait In 1995

Seagrass growing within the Great Sandy Strait, Queensland, are located along tidal flats adjacent to mainland towns which include Tin Can Bay, Maaroom and Hervey Bay. The majority of land bordering the Great Sandy Strait in the Tin Can Bay district is prohibited to access due to the location of the Wide Bay Military Reserve. Land use north of Tin Can Bay is predominantly forestry with sparse residential development. Hervey Bay has undergone recent urban development and subsequently a rapid increase in population. There has been an increase in infrastructure such as sewage treatment plants, community rubbish disposal sites, and industrial estates along the coastal strip within Hervey Bay. Pollutants associated with the increases in population and development of infrastructure have undoubtably had a negative impact on the

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nearby coastal aquatic ecosystems. The initial die-off of seagrass meadows within Hervey Bay coincides with township development and increases in population.

The most predominant species of seagrass growing within the Great Sandy Strait include : *Zostera capricorni*; *Halodule uninervis*; *Halophila spinulosa*; *Halophila ovalis*; and *Cymodocea serrulata*. These seagrass species have undergone periodic decline over the past three years and the symptoms associated with wasting disease were noticed (McLeod pers.comm). Many areas once covered with a diverse array of seagrass have been transformed into barren areas of tidal flats (Wnuczynski, Unpublished). There has been a significant decline in dugong and turtle sightings within the Bay as well as a decrease in locally exploited fish stocks (McLeod pers.comm.).

Investigations conducted during the winter of 1995 were aimed at isolating *Labyrinthula* from *Z. capricorni* meadows exhibiting wasting disease symptoms. *Z. capricorni* meadows were sampled at eleven sites throughout Tin Can Bay and the location of sites where *Labyrinthula* was successfully isolated are listed in Table 1. Information regarding environmental factors which may predispose seagrass to infection by *Labyrinthula* was not collected during this investigation as the aim was initially to isolate the pathogen.

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Table 1: The location of sampling sites within Tin Can Bay, Great Sandy Straits, showing the sites where *Labyrinthula* was successfully isolated from *Z. capricorni* collected during investigations conducted in 1995.

Sampling site within the Great Sandy Strait	Isolation of *Labyrinthula*
Pelican Bay	NO
Bullock Point	YES
East of Bullock Point	YES
Pannikin Island	NO
Wide of Pannikin Island	NO
Teebar Creek	NO
Carlo Creek	NO
Wabbies Creek	YES
Norman Point	NO
Snapper Creek	NO

The successfully isolation of *Labyrinthula* from *Z. capricorni* initiated the current study to test the hypothesis that changes in water quality may predispose seagrass to infection by *Labyrinthula*. *Z. capricorni* is the only species of seagrass that was assessed during this investigation due to the successful isolation of *Labyrinthula* from this species in the previous study. Moreover, the majority of literature pertaining to wasting disease originates from the Northern Hemisphere where *Z. marina* is the predominant seagrass. The strap-like leaves of *Z. capricorni* are similar in structure to those of *Z. marina* enabling results of other wasting disease investigations to be compared with the results obtained from this investigation due to the morphological similarities between the two species.

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3.8 : The Morphology & Habit Of *Zostera capricorni*

Zostera capricorni has an herbaceous rhizome system with a short lateral shoot at each node, each of which bearing up to six leaves (Figure One). The linear leaf blade is thin, long and translucent. Five main longitudinal veins are present along the length of the leaf blade with three very distinct dark green intramarginal veins. Cross veins, if present, run across the leaf at right angles to the longitudinal veins.

Figure 1: A diagrammatic representation of *Zostera capricorni* showing the herbaceous rhizome system and the thin linear leaf blades.



The width of the leaves range from 2-5mm wide and vary in length from several centimetres to over half a metre. The leaf tip is blunt and the leaf margin is generally smooth and rarely denticulate. A ligule is present. The characteristic feature *of Z. capricorni* is a single leaf originating from the rhizome rather than from the vertical leafbearing shoot.

Z. capricorni grows both intertidally and subtidally and is the most extensive seagrass growing within the Great Sandy Strait. Dawson and Dennison (1996) state that *Z. capricorni* appears to acclimatise very rapidly to adverse environmental conditions and the leaf morphology of this species provides adequate protection against ultra violet radiation when exposed at low tides.

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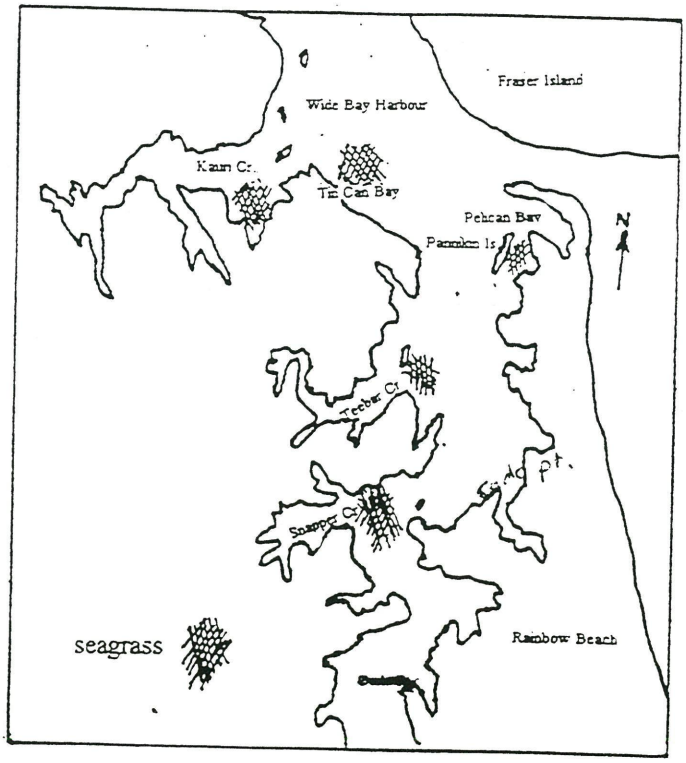
4.0 : MATERIALS & METHODS

4.1 : Site Selection & Sampling Design

Based upon the success of isolating *Labyrinthula* from *Z. capricorni* in Tin Can Bay during investigations conducted in 1995, it was envisaged that these sites would form the basis for seagrass collection for the current study. Initially five sampling areas were chosen at Tin Can Bay based upon extremities in water quality in relation to salinity and nutrients (Figure Two).

Figure 2: A map of Tin Can Bay, Great Sandy Strait, Showing the location of *Zostera capricorni* meadows sampled during 1995 and the location of envisaged sampling areas for the current investigation



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Zostera capricorni meadows growing in Snapper Creek and adjacent to Pannikin Island were chosen as high nutrients sampling areas. This is due to the Tin Can Bay sewage treatment plant located inland from Snapper Creek and the Rainbow Beach sewage treatment plant located north of Carlo Point. Low salinity sampling areas were chosen at the mouth of Teebar Creek and Kauri Creek. A standard salinity (33%) sampling area was chosen directly opposite the entrance of Wide Bay Harbour. This sampling areas was considered as the control as it is less likely to be influenced by fluctuations in salinity and nutrient due to the relatively high tidal exchange. However, due to the dramatic loss of *Z. capricorni* within Tin Can Bay since previous investigations, the sampling regime outlined above had to be altered. A second sampling location, Hervey Bay, was chosen to enable sampling areas to be compared.

Two sampling areas, varying in salinity levels, were chosen within both Tin Can Bay and Harvey Bay. Five sampling sites were randomly chosen along a standard tidal height within each of the sampling areas to ensure that seagrass collected experienced similar environmental conditions in relation to exposure, wave action, and turbidity.

Sampling areas within Tin Can Bay were located towards the southern end of the Great Sandy Strait: Seagrass collected from the mouth of Kauri Creek were considered to be a low salinity sample with recorded salinity measurements of 29.5‰. Seagrass growing on the tidal flats directly opposite the entrance to Wide Bay Harbour was collected and this was considered to be the 'control' sampling area (referred to as standard salinity sampling area, salinity measurement of 32.3‰).

Similarly, in Hervey Bay a *Z. capricorni* meadow growing near the entrance of Pulgul Creek was chosen as the second low salinity sampling area (salinity measurement of

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30.6‰), while a tidal flat south of Pulgul Creek away from its discharge was chosen as the second 'control' or standard salinity sampling area (salinity measurement of 33.2‰).

The collection of seagrass material was undertaken one hour prior to low tide to ensure that seagrass being investigated experienced with tidal exposure. Ten *Z. capricorni* tillers were collected by hand from each of the five sampling sites and placed in medium sized plastic bags. The seagrass was then transported to the laboratory in a large container cooled with ice. Care was taken throughout the collection and transportation process to minimise mechanical damage to the plants.

4.2 : Vigour Of Seagrass Sampled

Once transported to the laboratory the seagarass was rinsed in fresh water and the total number of leaves per seagrass tiller was measured. To assess the condition of the seagrass population at the time of sampling the third leaf from the apex of each *Z. capricorni* tiller was removed and measured according to Burdick *et al.*,(1993). The width of the seagrass frond was also measured and an average width value was derived.

The multiplication of the number of leaves per seagarass tiller by the area of seagrass leaves (length by width) gave a value referred to as Leaf Area Index (LAI). The LAI is a measurement of the total area of leaf material available for photosynthesis by the seagrass plant, an indicator of the health status of the plant (Burdick *et al.*, 1993).

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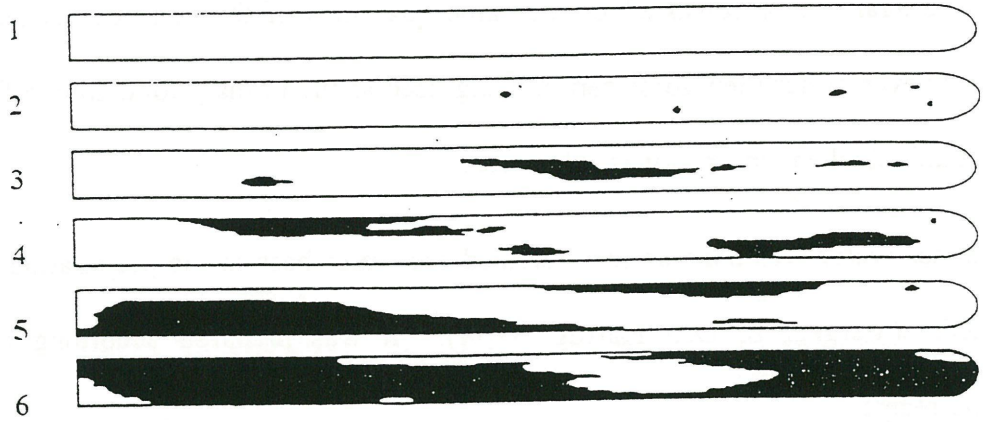
4.3 : Assessment of Wasting Disease Severity

Following the assessment of the physical condition of the collected seagrass, the third leaf from each of the 200 seagrass plants collected were visually inspected with the naked eye to determine the severity of necrosis caused by wasting disease. A score ranging from one to six was assigned to each of the leaves according to a 'wasting disease index key' (Figure 3). Seagrass fronds receiving high scores exhibited greater necrotic lesions associated with wasting disease (Den Hartog, 1989).

Figure 3: The wasting index key used to quantify the severity of disease symptoms on the leaves of *Zostera capricorni*.



4.4 : Isolation of *Labyrinthula*

Each seagrass leaf was surface sterilised by agitation in 0.5% sodium hypochlorite for 2 minutes, followed by agitation in distilled water and then in artificial sea-water for two minutes (Muehlstein, Porter & Short, 1988). Each leaf was cut into segments approximately 1-2 cm long. Each segment cut from seagrass under 10 cm in length

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was plated and every second seagrass segment was plated for leaves greater than 10 cm in length.

The plating medium initially used to isolate *Labyrinthula* was prepared according to Porter 1990 (Short, *et al.*, 1993; Muehistein *et al.*,1988) as follows:

1.2% agar on a sterilised sea-water base;

1% horse serum; and

250 mg1-1 of streptomycin and penicillin.

A second agar medium was prepared according to Vergeer & Den Hartog (1994) to determine if the frequency of isolation of *Labyrinthula* varied with the agar media used. The agar media consisted of the same quantities of the constituents outlined above, however rather then horse serum being used as the primary food source for the slime mould, chicken albumen was substituted.

Artificial sea-water was used as the sterilised sea-water base in the preparation of all agar media (Vergeer & Den Hartog, 1994). It was prepared according to the following recipe :

NaCl	49.4 g/L
KCl	1.4 g/L
MgSo4.7H2O	12.6 g/L
MgCl2.6H2O	9.2 g/L
CaCl2	0.2 g/L

The segments of the seagrass leaves were placed on the semi-solid agar media approximately 2-3mm thick, in petri dishes (Vergeer & Den Hartog, 1994). The petri dishes were sealed with thin wrapping plastic and stored in the dark at 25 degrees

Celsius (Vergeer & Den Hartog, 1994). The petri dishes were examined daily for a period of 20 days for the presence of *Labyrinthula*. The number of seagrass segments infected by *Labyrinthula* were recorded per leaf.

4.5 : Isolation Of Fungi

Any other filamentous fungi were also isolated from the seagrass segments plated on the agar media. The fungi were sub-cultured by removing square blocks of infected agar, approximately 50mm by 50mm, and transferring the blocks onto a Potato Dextrose Agar (PDA) medium.

The petri dishes were sealed and placed under a dark light near ultraviolet wavelength to promote fungal sporalation for identification. Once spores were visible with the naked eye pieces of sticky-tape were brushed over the fungi to attract spores for transfer onto microscopic slides. The spores were stained with lactophenol cotton blue and observed using light microscopy for classification.

4.6 : Statistical Analysis Of Data Collected

A generalised linear model procedure in SAS was used for the analysis of deviance using the logit function, and Pearson Chi-square for frequency of recovery of fungal isolates from *Z. capricorni* leaves. Output corresponds to Chi squared frequency distribution analysis. These techniques analyse trends in the incidence of the four fungi based on differences within and between sampling sites. Bionomially distributed data was entered for frequency of isolation of the fungi as a function of the total number of leaf segments plated.

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Measurements of individual plant characteristics, including leaf length, width and number of leaves per tiller, were compared between sites to identify indicators of plant health/stress.

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5.0 : RESULTS

5.1 : Physical Condition Of Seagrass Collected

The mean number of leaves per tiller was lower from seagrass collected from sampling areas in low salinity. Seagrass collected from standard salinity water in both Tin Can Bay and Hervey Bay had approximately 4.5 and 4.1 leaves per tiller respectively. Whereas seagrass collected from Kauri Creek and Pulgul Creek had approximately 4.3 and 3.8 leaves per tiller respectively.

Statistical analysis of the data relating to the length of each representative seagrass frond indicated that leaf length significantly varied according to salinity (Figure 4). The size of seagrass fronds collected from Tin Can Bay tended to range from 4 to 8 cm long in lower salinity areas whereas the fronds of seagrass collected from the standard salinity sampling area tended to be larger ranging from 8 to 12 cm.

Similarly, in Hervey Bay approximately 80% of seagrass fronds collected from Pulgul Creek had leaf lengths ranging between 4 to 6 cm. The majority of seagrass fronds collected from the standard salinity sampling area at Hervey Bay were larger with leaf lengths between 8 to 10 cm (Figure 4).

The LAI also derived for each sampling area indicates that seagrass collected from low salinity areas in both Tin Can Bay and Hervey Bay have a LAI value ranging between 10 to 20 (Figure 5). Whereas seagrass collected from standard salinity sampling areas tend to have a larger leaf area available for photosynthesis with LAI values ranging between 30 to 50. This result may be expected due to seagrass collected from lower salinity sampling areas having smaller fronds and less leaves per tiller.

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Figure 4 : The length of *Zostera capricorni* leaves collected from Tin Can Bay (Top) and Hervey Bay indicating the influence of lower salinity on seagrass size.

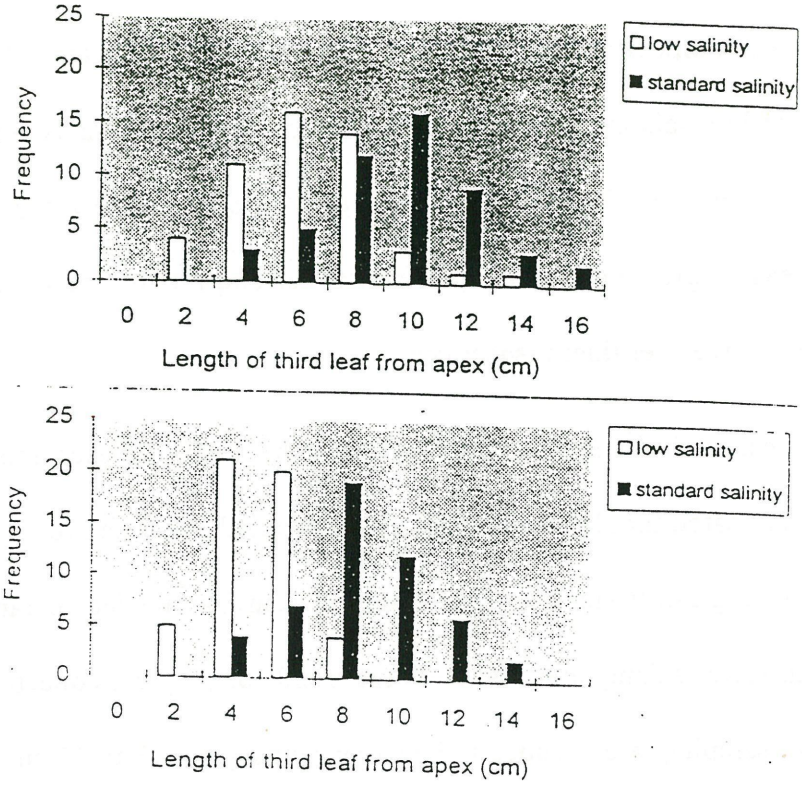
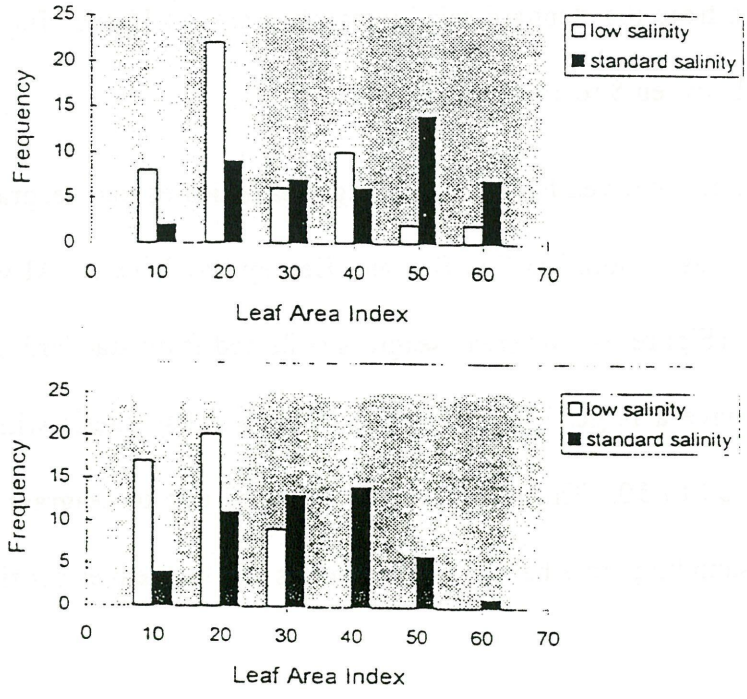


Figure 5: The influence of lower salinity on the LAI values for *Zostera capricorni* collected at two sampling locations at Tin Can Bay (Top) and Hervey Bay.

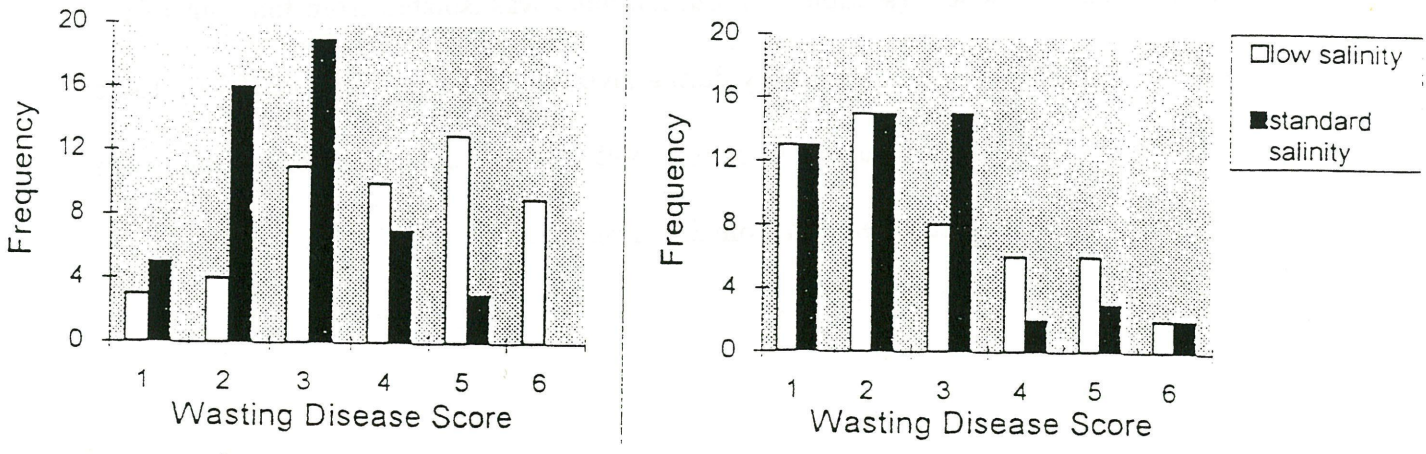


5.2 : Severity Of Wasting Disease Symptoms On *Z. capricorni*

Seagrass collected from the low salinity sampling area in Tin Can Bay exhibited a higher frequency of symptoms associated with wasting disease, reflected in the significantly higher wasting disease scores assigned to each frond assessed (Figure 6). Eighty percent of the seagrass collected from the standard salinity sampling area in Tin Can Bay had necrotic lesions covering 10% or less of the seagrass frond (ie received a wasting disease score of 3 or below).

Seagrass collected from both sampling areas in Hervey Bay appeared healthier than that at Tin Can Bay with approximately 60% of seagrass having necrotic lesions cover 1% or less of the frond (Figure 6). However, a greater proportion of seagrass collected from Pulgul Creek received higher wasting disease scores in comparison to seagrass collected from the standard salinity sampling area. Although this trend is not statistically significant it does indicate the associated that exists between wasting disease symptoms and salinity.

Figure 6: The association that exists between wasting disease symptoms exhibited by *Zostera capricorni* growing within Tin Can Bay (Left) and Hervey Bay (Right) and salinity.



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5.3 : The Frequency Of Isolation Of *Labyrinthula* From *Z. capricorni*

Despite a large proportion *Z. capricorni* assessed exhibiting a relatively high degree of wasting disease symptoms, the frequency of isolation of *Labyrinthula* from collected samples was minimal (Table 2). From the 200 seagrass fronds plated on the semi-solid agar media, *Labyrinthula* was isolated five times. The slime mould was successfully isolated three times from seagrass collected from Tin Can Bay and twice from seagrass collected in Hervey Bay. The use of the alternative medium, chicken albumen, had no effect on the frequency of isolation of *Labyrinthula*.

Table 2: The frequency of isolation of *Labyrinthula* from *Zostera capricorni* collected from sampling areas varying in salinity within the Great Sandy Strait

Sampling area	Number of fronds sampled	Isolation of *Labyrinthula*
T.C.B * Kauri Creek	50	0
T.C.B. Std.Salinity	50	3
H.B.** Pulgul Creek	50	1
H.B. Std. Salinity	50	1

*T.C.B. : Tin Can Bay
** H.B. : Hervey Bay

As is evident in Table 1 (section 3.7), *Labyrinthula* was isolated from four out of the eleven sampling areas in Tin Can Bay during investigations conducted in 1995. Table 3 compares the results obtained from the 1995 and the current investigations with reference to isolating *Labyrinthula* from *Z. capricorni*.

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Table 3: A comparison of the success of isolating *Labyrinthula* from *Zostera capricorni* meadows growing in the Great Sandy Strait during two investigations conducted in 1995 and 1996.

Sampling Location	Year	% isolation
Tin Can Bay	1996	6
Hervey Bay	"	4
Pelican Bay	1995	0
Bullock Point	"	25
East of Bullock Point	"	20
Panican Island	"	0
Inskip Hole	"	40
Wide of Panikin Is.	"	0
Teebar Creek	"	0
Carlo Creek	"	0
Wabbies Creek	"	60
Norman Point	"	0
Snapper Creek	"	0

5.4 : The Frequency Of Isolation Of Filamentous Fungi From *Z. capricorni*

Four species of fungi were consistently isolated from both Tin Can Bay and Hervey Bay sampling locations. The fungi have been referred to as Type 1 (T1), Type 2 (T2), Type 3 (T3), and Type 4 (T4). The frequency of isolation of the fungi seagrass sampled at both sampling locations within the Great Sandy Strait is listed in Table 4.

Table 4: The frequency of isolation of four species of fungi from *Zostera capricorni* collected from the two sampling locations within the Great Sandy Strait.

Sampling Location	Fungi Type	Frequency Isolation (%)*
Tin Can Bay	T1	11
	T2	50
	T3	14
	T4	7
Hervey Bay	T1	15
	T2	39
	T3	9
	T4	9

* The frequency of isolation of the fungus has been expressed as the number of seagrass fronds from which the fungus was isolated over the total number of seagrass fronds plated on agar media.

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As can be seen from Table 4 the most frequently isolated fungus is T2 which has been classified into the *Penicillium* genus.

Statistical analysis of the data collected from the frequency of isolation of each fungi from seagrass collected in Tin Can Bay and Hervey Bay indicates that there is no significant difference in the isolation of T1, T3, and T4 fungus between sampling areas (Table 5). Changes in salinity had no effect of the frequency of isolation of these fungi but did have a significant effect on the isolation of T2 fungi. There is also a significant statistical difference in the isolation of the four species of fungi within sampling sites (Table 5). The five sampling sites chosen in each of the four sampling areas were all located along a standard tidal height and from personal observations during sampling appeared to be uniform in seagrass cover.

Table 5: .Results of statistical analysis of the frequency of isolation of the four species of fungi from *Zostera capricorni* indicating significant differences between and within sampling areas in the Great Sandy Strait.($X_{2\ [8.0.05]} = 15.507$)

Sampling Location	Significance Within (Chi-Squared Deviance)	Significance Between (Pr>Chi)
Tin Can Bay		
T1	16.689 (p>0.05)	ns
T2	35.962 (p>0.05)	0.0448 (p>0.05)
T3	ns	ns-
T4	ns	ns
Hervey Bay		
T1	26.498 (p>0.05)	ns
T2	34.185 (p>0.05)	0.000 (p>0.001)
T3	ns	ns
T4	ns	ns

As there is a significant difference in the isolation of T2 fungus between sampling areas at both locations further analysis of the data collected was undertaken. From this

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analysis it was found that the frequency of isolation of T2 fungus was significantly higher ($p>0.05$) in seagrass collected from low salinity waters in both Tin Can Bay and Hervey Bay (Table 6). Within the standard salinity sampling area of Hervey Bay, the isolation of T2 fungus was less frequent in comparison to seagrass collected from the standard salinity sampling area of Tin Can Bay.

Thus, the frequency of isolating T2 fungus is positively correlated with the severity disease symptoms expressed by *Z. capricorni*, which is greatest at low salinity sampling areas within the Great Sandy Strait. The data collected and analysed during this investigation has been summarised in Table 6.

Table 6: A summary of data collected and analysed during this investigation on *Zostera capricorni* growing within the Great Sandy Strait.

Attribute Measured	TCB Sampling Location		HB Sampling Location	
	Low Salinity	Std. Salinity	Low Salinity	Std. Salinity
LAI	10-20	40-50	10-20	30-40
Disease Severity Score	4-5	2-3	1-2	2-3
Labyrinthula Isolation (%)*	-	6	-	4
Isolation of T2 fungus**	60%	40%	42%	6%

*The number of leaves from which *Labyrinthula* was isolated out of a total of 100 leaves plated per sampling location.
**The number of leaves from which T2 fungus was isolated out of the total number of leaves plated.

6.0 : DISCUSSION

Dark necrotic lesions growing along the length of *Z. capricorni* leaves were noticed during investigations conducted in 1995. During this time seagrass meadows were declining at an alarming rate with no apparent expatiation (McLeod pers.comm. 1995). The isolation of *Labyrinthula* from *Zostera* growing in a number of locations in the Great Sandy Strait implicated the pathogen as the primary cause of the seagrass die-off.

However, Short *et al.* (1988) and Vergeer *et al.* (1994) suggest that *Labyrinthula*, being isolated from 11 seagrass species belonging to nine genera, may be of no detriment to seagrass optimal growing conditions. The isolation of *Labyrinthula* from healthy seagrass suggests that it may play an important role in the senescence of seagrass leaves.

Environmental factors may influence an outbreak of wasting disease, either by increasing the susceptibility of seagrass to infection by the pathogen or by stimulating the growth of *Labyrinthula* and other fungi (Short *et al.*, 1988; Vergeer *et al.*, 1994). In warmer latitudes seasonal variation in seagrass distribution is less common and fungal diseases, flooding and industrialization have been suggested as major factors causing a decline in seagrass (Talbot, Dnoop & Bate, 1990). The relatively rapid decline in seagrass within the Great Sandy Strait during the six month period between sampling is comparable to other reported cases of seagrass die-off throughout the Atlantic cost of North America during 1985-1987 (Short *et al.*, 1988; Muehlstein *et al.*, 1988). Sampling areas where *Labyrinthula* was isolated during initial

investigations in Tin Can Bay, Bullock Point, East of Bullock Point Jetty, and Wabbies Creek, were barren and no seagrass could be found for investigative purposes.

Salinity, as well as other environmental parameters, has been proposed as a factor influencing disease-related die-off of seagrass meadows throughout the world. *Labyrinthula* was not frequently isolated during this investigation despite alternative plating medium being used. However, previous studies conducted on seagrass growing in mesocosm tanks by Short *et al.*, (1987) and Burdick *et al.*, (1993) demonstrated that at lower salinities (<10%) the rate of seagrass infection by *Labyrinthula* was reduced and at higher salinities (between 15 and 30%) entire seagrass tillers were infected resulting in die-off.

Labyrinthula was only isolated from five seagrass plants out of 200 plants plated despite a high proportion of plants exhibiting symptoms associated with wasting disease. Two plating mediums were used ensure that the frequency of isolating *Labyrinthula* was not influenced by agar media used (Muehlstein *et al.*, 1988; Short *et al.*, 1993; Vergeer & Den Hartog, 1994).

Investigations conducted by Burdick *et al.*, (1993)on seagrass growing in mesocosm tanks found that as the rate of infection by *Labyrinthula* increased seagrass tended to dihisce the outer diseased leaves resulting in lower leaf area indices. These findings correspond to the physical condition of seagrass growing in the Great Sandy Strait in relation to the frequency of isolation of T2 fungi.

Seagrass sampled from the entrance of Pulgul Creek and Kauri Creek had shorter leaf lengths and less leaves per tiller resulting in lower leaf area indices. These findings are comparable to those of Talbot *et al.*, (1990) who demonstrated that following an

increase in freshwater due to major rainfall events there is a reduction in the length of seagrass leaves. The average maximum blade length of seagrass fronds decreased from 41.2 cm prior to major rainfall to 19.6 cm ten months latter.

The influence that creek systems have on surrounding seagrass meadows is not restricted to altering salinity concentrations. The input of freshwater derived from land based sources can also influence nutrient concentrations within the water column as well as the marine benthos, alter turbidity, and during times of high flow may cause a decrease in light penetration. The re-establishment of seagrass may be limited due to the decrease in water clarity associated with lower light penetration and rises in suspended solids within the water column (Bulthuis, *et al.*, 1984).

Following high rainfall events towards the end of 1995 the large quantities of freshwater input into the Great Sandy Strait increased the suspended solids within the water column causing a reduction in light penetration. Investigations conducted by Abal & Dennison (1996) indicated that *Z. capricorni* displays a variety of adaptive responses to decreases in light intensities. *Zostera* growing under low light intensities had lower biomass and productivity per m2, and larger shoots.

Although the seagrass sampled at the mouth of creek, areas expected to have higher quantities of suspended solids, had shorter leaves, the input of freshwater and associated sediments may have caused a smothering of seagrass meadows. Following moderate fresh water input into the Dwelera and Nahoon estuaries, South Africa, the sudden influx of freshwater and sediment temporarily impaired the growth of seagrass (Talbot, *et al.*, 1990). This placed a major stress on *Zostera capensis* Setchell, resulting in a significant reduction in leaf length.

The seagrass sampled from both standard salinity areas tended to appear more healthy displaying less necrotic lesions, thus receiving lower wasting index scores then seagrass collected from low salinity sampling areas. However, the use of the wasting index key (Burdick, *et al.*, 1993) it is a subjective method of determining disease severity. Video image analysis would provide a more objective method of quantifying the severity of disease symptoms while providing appropriate data for statistical analysis.

The wasting index scores assigned to seagrass fronds tended to reflect the success of isolating T2 fungi rather than *Labyrinthula* and the other three types of fungi. This suggests that the symptoms produced by T2 fungi may be similar to that of *Labyrinthula* or, T2 fungi is a secondary infection which invades seagrass fronds following infection by *Labyrinthula*. The absence of isolating both *Labyrinthula* and T2 fungi from the same seagrass frond suggests that similar symptoms are produced by both pathogens.

Despite attempts being made to ensure that sampling sites were uniform (ie. seagrass was collected at random from a uniform tidal height at similar tide times), there was a significant statistical difference in the isolation of the four fungi within sampling sites. This indicates variation in the susceptibility of individual plants within seagrass meadows to disease.

There is no significant statistical difference in the isolation of T1, T3, and T4 fungus between sampling areas indicating that the influencing factors associated with freshwater creek systems have no affect on the presence of the fungus within seagrass meadows. As a significant difference did exist in the frequency in isolation of T2 Fungi a correlation may be made between low and standard salinity sampling areas. The

frequency of isolation of T2 fungi was higher in the low salinity sampling areas of Tin Can Bay and Hervey Bay. This suggests that the presence of T2 fungi within *Z. capricorni* meadows is influenced by an environmental factor or series of factors associated with freshwater input. This factor, or combination of factors, may predispose seagrass to infection by diseases including T2 fungi or *Labyrinthula* and have a detrimental affect on the productivity *Z. capricorni*.

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7.0 : ACKNOWLEDGEMENTS

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As well, I wish to thank Mr Joe McLeod and other members of the Queensland Commercial Fishermans Organisation for providing invaluable knowledge of the Great Sandy Strait region and the use of boating facilities during seagrass collections.

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9.0 : APPENDIX ONE

A list of the eleven species of seagrass from which *Labyrinthula* was isolated from during investigations conducted by Vergeer & Den Hartog (1994).

Zostera marina (L.)

Zostera mucronata (Den Hartog)

Heterozostera tasmanica (Martens ex Aschers)

Posidonia oceanica (L.)

Haodule uninervis (Forssk.)

Cymodocea nodosa (Ueria)

Syringodium isoetifolium (Aschers.)

Thalassiodendron ciliatum (Forssk.)

Ruppia cirrhosa (Petagana)

Thalassia testudinum (Banks ex Konnig)

Halophila ovalis (R.Br.)

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A Part Resurvey of Long-Term Seagrass Monitoring Sites within the Great Sandy Strait and Tin Can Inlet

November 1996

FRC Coastal Resource & Environmental

Marine, Freshwater & Terrestrial Ecologists



FRC Ref: 96.09.01

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A Part Resurvey of Long-Term Seagrass Monitoring Sites within the Great Sandy Strait and Tin Can Inlet

November 1996

Conducted on behalf of:

Cooloola Fishermans Festival Association Inc.

By:

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FRC Ref: 96.09.01

January, 1996

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Appendix A - Morphological and density data for processed seagrass samples

Introduction

This report presents the findings of the November 1996 part-resurvey of long-term seagrass monitoring transects established within the Great Sandy Strait in June 1994 (Fisheries Research Consultants, 1994).

Financial constraints limited the resurvey to three of the nine established transects: Transect 4B - Boonooroo; Transect 6A - Kauri Creek and Transect 7A - Bullock Point. These transects provided an assessment of regions in Great Sandy Strait where seagrass loss had been reported

Methodology

Kauri Creek was reached, transects surveyed and samples collected using a boat provided by Mr Joe McLeod. The other two transects were surveyed and sampled on foot. Transects were resurveyed using an automatic level, staff and stadia (as was used in establishing each transect).

Along each transect, the qualitative character of surface sediments, and the distribution and abundance of seagrass and algae was recorded with seagrass samples collected from a number of points along each transect, to provide a quantitative comparison with samples taken in June 1994 and March 1995.

Seagrass sampling methodology was based upon collecting all living vegetative matter from within a 0.04 m^2 quadrat. For each sample, species composition was determined by careful sorting; the number of shoots of each species were counted to provide a measure of density; five randomly selected shoots from each species were measured to describe morphology; and plants of each species were divided into above (shoots) and below (roots and rhizomes) ground components, oven dried to total desiccation, and weighed to provide a measure of above and below ground biomass.

Seagrass at each site was described in-situ in the accompanying field notes. The benefit of 'laboratory processing' of samples is to provide a detailed characterisation of each sample that may be statistically compared with samples taken over the past three years, and with the data bases of other organisations (e.g. CSIRO Fisheries, QDPI Fisheries).

In addition an aerial over-flight from Tin Can Inlet over Maroom, over Garry's Anchorage, and over Bullock Point was conducted to assess broad-scale patterns in seagrass and macroalgae distribution.

Results

The following pages contain a characterisation of each transect.

Glossary of abbreviations used in the following tables

When following a species of seagrass, (sml) refers to the small or fine morphology; (med) to the medium or transitionary morphology, and (lge) to the large or broad morphology.

Under ' Samples ' - Sg refers to seagrass.

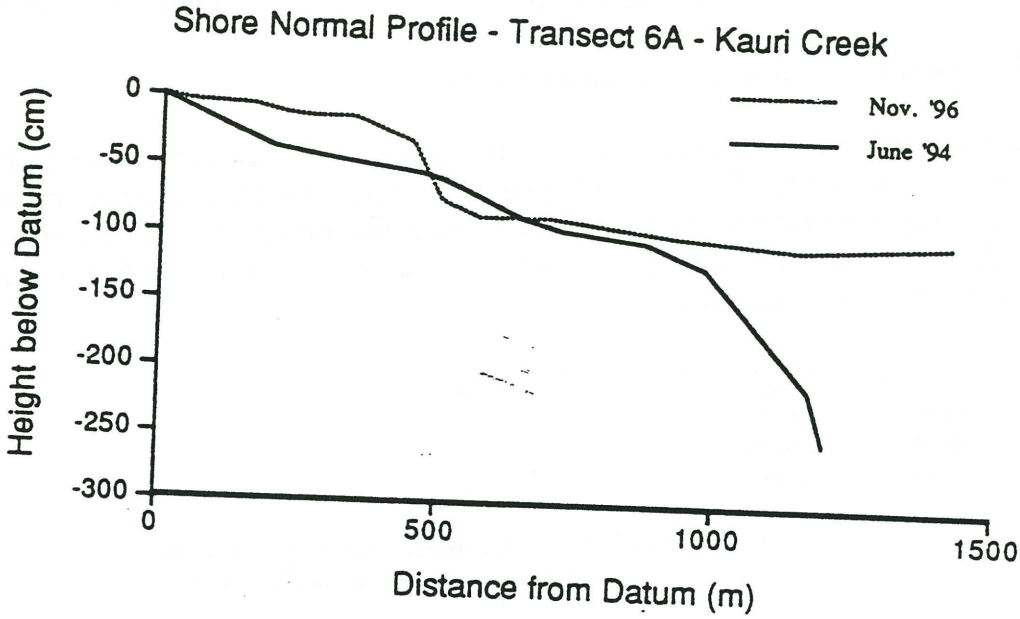
NB. Seagrass and sediment dominance is presented as: most dominant/next dominant.

Transect : 6A **Bearing :** 50° **Date :** 24 Nov. 1996

Location character : Mainland, undeveloped

Location description : Running east from the small bay immediately to the north of the mouth of Kauri Creek. The peg is located within the roots of the dense fringing mangrove forest. The transect crosses the broad intertidal flat comprised of soft silts, firm sands heavily worked by crabs and fine sands / silts supporting moderate seagrass meadows.

Point	Distance from datum (m)	Height below datum (cm)	Time	Description	Samples
0	0	0	13:45	Lone *Avicennia marina* tree 3m tall, pneumatophores, v. muddy sand.	
1	50	4		<2% *Zostera capricorni* (patch), low epiphyte cover, mud/sand.	
2	165	6		Bare, sand (anoxic beneath surface)	
3	221	12		<1% *Z. capricorni* and *Halophila ovalis* (patchy and sml) sand.	Sg
4	266	14		<1% *Z. capricorni* and *H. ovalis* (patchy and sml), sand.	
5	347	15		<<1% *Z. capricorni*, hard sand.	
6	453	33	14:08	10% *Cymodocea serrulata* , <1% *H. ovalis*, muddy sand.	Sg
7	504	75		10-15% *H. ovalis*, sandy mud.	Sg
8	571	86		15-20% *H. ovalis*, , stronger rhizome, sandy mud.	
9	701	86	14:35	20-25% *H. ovalis* / *C. serrulata*, sand.	Sg
10	926	99	14:56	10% *Z. capricorni* / *H. ovalis* . Red bands on *Z. capricorni* and red pigment on *H. ovalis* leaves. Sand.	Sg
11	1154	106	15:05	15% *C. serrulata*, sand	Sg
12	1434	101	15:14	<5% *Halodule uninervis*, 5cm long, 3mm wide, Very hard sand ridge, with pebbles and shell	


Shore Normal Profile - Transect 6A - Kauri Creek
Height below Datum (cm)
0
-50
-100
-150
-200
-250
-300
0
500
1000
1500
Distance from Datum (m)
Nov. '96
June '94

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Transect : 4B **Bearing : 80°** **Date :** 26 Nov. 1996

Transect character : Mainland, small unsewered village

Location description : Approx. 800 m south of Boonooroo boat ramp, 50 m to the south of the prominent two storey house with the green roof. The row of houses visible from the water front an extensive claypan. At the seaward edge of the claypan stunted *Avicennia marina* trees occur in small clumps. The 'peg' is located immediately seaward of a clump of *Avicennia*. Intertidal flats extend several hundred meters into the Great Sandy Strait.

Point	Distance from datum (m)	Height below datum (cm)	Time	Description	Samples
0	0	0		Peg amongst mangrove roots. Firm silt and iron stone pebbles.	
1	49	58	13:30	<5% Z. *capricorni* (sparse), few shoots, mainly rhizome, sand/pebbles.	
2	107	78		5% Z. *capricorni* / *H. ovalis*, sand/grit.	Sg
3	165	88	13:45	5%Z. *capricorni* / *H. ovalis*, sand/grit.	
4	220	96	13:50	5-10% Z. *capricorni* / *H. ovalis*, sand/grit.	Sg
5	255	110	13:55	Bare except for algae (*Dictyota*, *Chondrus*, *Hydroclathus* - attached by holdfast to shells).	
6	700	?	14:30	Bare	

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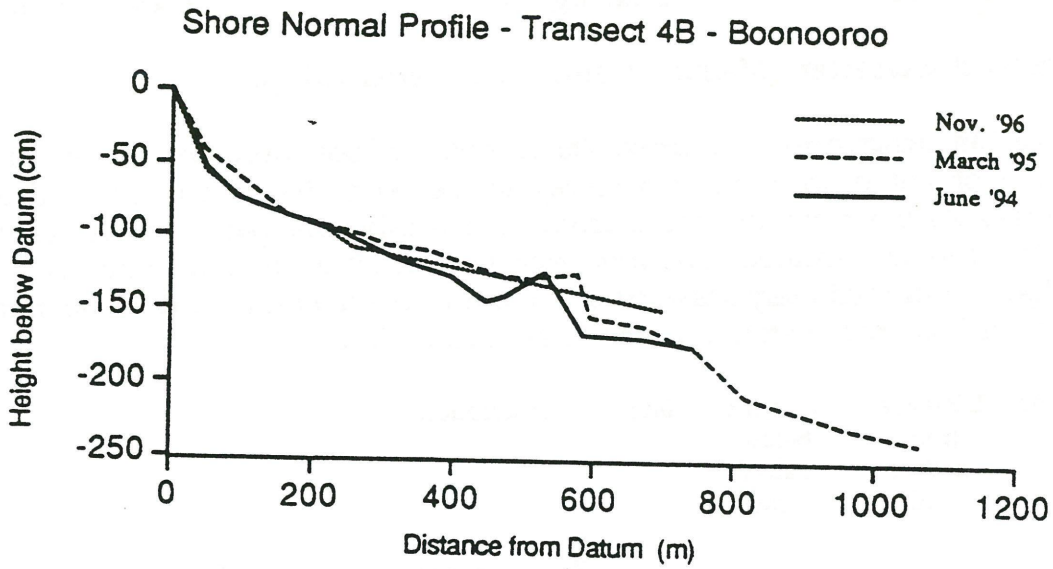
Shore Normal Profile - Transect 4B - Boonooroo
Height below Datum (cm)
0
-50
-100
-150
-200
-250
0
200
400
600
800
1000
1200
Distance from Datum (m)
Nov. '96
March '95
June '94

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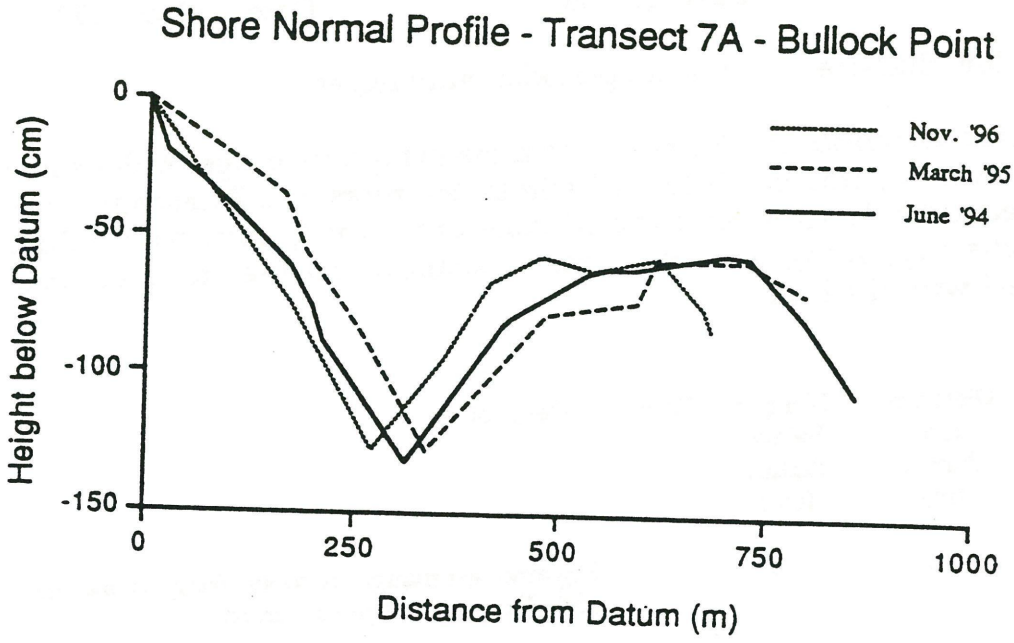
Transect : 7A **Bearing : 220°** **Date :25 Nov. 1996**

Location character : Mainland, periodic camping, etc.

Location description : Extending from the mangrove fringe of the southern side of Pelican Bay (the peg is located within the roots of a *Rhizophora stylosa*), the transect extends across an elevated zone of relatively firm bare sediment, then soft silts supporting seagrass, across a shallow channel to a silt bar running parallel with the bank.

Point	Distance from datum (m)	Height below datum (cm)	Time	Description	Samples
0	0	0		Peg amongst mangrove roots, fringe *A. marina* and *Rhizophora stylosa*, mud.	
1	178	75		Bare, mud.	
2	276	128		Bare, mud, some algae *Cladophora*	
3	361	95	14:40	*C. serrulata* (3 shoots only - very loosely rooted), mud.	
4	414	67	14:55	5-10% *Z. capricorni* (clean), mud.	Sg
5	477	57		20% *Z. capricorni* / *H. ovalis*, mud (all sites muddier where bare).	Sg
6	541	62	15:11	5% *H. ovalis*, heavy epiphyte and sediment on leaves, mud.	Sg
7	622	57	15:25	25% *Z. capricorni* (clean), mud.	
8	678	75	15:40	<5% *H. uninervis*, mud.	
9	685	83		5-10% *Z. capricorni* (patchy), mud.	



The characteristics of seagrass samples processed from each transect are presented in Appendix A.

Aerial Survey

The aerial survey showed an overall reduction in the distribution of seagrass and an increased abundance of macroalgae, compared with previous surveys.

Discussion

Changes in the shore normal profile were apparent at each resurveyed location. At Boonooroo there has been a very gradual shoaling, with ridges and channels apparent in the '94 and '95 surveys smoothed out. The channel at Bullock Point has migrated shoreward. Profile alterations were most obvious at Kauri Creek where sedimentation has infilled the offshore channel, described in June, 1994.

The gross sediment characteristics of each location appear similar to those recorded in June, 1994 and March 1995, with the exception of Kauri Creek where the grain size has increased from silt to sand with increasing distance from shore.

At Boonooroo the *Halodule uninervis* that replaced the 1994 *Zostera capricorni* has in turn, been replaced by a sparse regrowth of *Z. capricorni* and *Halophila ovalis*. The overall abundance and distribution of seagrass has been significantly reduced since March 1995. Whereas in 1995 there was a 70% cover of *H. uninervis* over the first 300 m, the sparse regrowth of *Z. capricorni* and *H. ovalis* covers only 5-10% of the substrate. In 1995 seagrass was found along the entire survey (1,066 m) to a depth below datum of 239 cm. In November 1996, despite the substrate profile and sediment grain size remaining similar to that recorded in previous years, the substrate is now devoid of seagrass 255 m from the peg at a depth below datum of about 110 cm. This section of the survey is now characterised by macroalgal species e.g. *Dictyota* and *Chondrus* attached by holdfasts to shells.

The overall abundance of seagrass has also declined at Kauri Creek. Community composition has also altered, although the overall distribution of seagrass along the transect line has changed little. *Z. capricorni* and *C. serrulata* which each covered about 70% of the substrate at 500 m and 560 m, respectively, in 1994, have been replaced by a 10-15% cover of *H. ovalis*. Inshore of 450 m the substrate is generally bare, as it was in 1994, with sparse and patchy occurrences of *Z. capricorni* and *H. ovalis*. Seagrass distribution seaward of approximately 1000 m from the peg, remains sparse and patchy with *C. serrulata* being the dominant species.

At Bullock Point the overall distribution of seagrass has decreased since March 1995, and community composition has also changed. The lush *Z. capricorni* bed fringing the channel in 1995 has been lost, with no seagrass regrowth. However the nearby beds of *C. serrulata* has been replaced by *Z. capricorni* . Seagrass distribution seaward of approximately 650 m remains sparse with *Z. capricorni* being the dominant species.

Summary

The part-resurvey indicates that no substantial change has occurred to the physical environment at Boonooroo and Bullock Point, whereas the offshore depth profile at Kauri Creek has shallowed by up to 1.5 m with the infilling of a channel. A 129 cm reduction in the vertical distribution of seagrass was evident at Boonooroo (a very significant change), whilst at Kauri Creek and Bullock Point the overall distribution has not changed significantly. All transects displayed significant reductions in seagrass abundance, especially Boonooroo, and in most cases this was concomitant with a change in species composition. Since March 1995, Boonooroo has lost moderately dense (70% cover) beds of *H. uninervis* , whilst Kauri Creek and Bullock Point have lost low to moderately dense (30 -70%) beds of *C. serrulata* and *Z. capricorni* respectively. Seagrasses at all transects were relatively free from epiphytes compared to previous surveys, however, broad-scale aerial survey indicated that macroalgal cover had increased within the study area.

At each location, samples taken from within areas of seagrass indiacted that shoot density, leaf morphology, and biomass remain within the range of measurements of these parameters made in 1993 (Fisheries Research Consultants, 1994b), 1994 (incomplete data set), and 1995 (Fisheries Research Consultants, 1995). For most samples of each species, below ground biomass exceeds above ground biomass, indicating a capacity for recovery following the loss of the above ground component (by for example grazing, or desiccation).

Whilst only a part resurvey, this study suggests a significant acceleration in the trend of declining seagrass distribution within the Great Sandy Strait, first reported by FRC in 1992 (Fisheries Research Consultants, 1993).

References

Fisheries research Consultants. 1993. A Study of the Marine and Intertidal Habitats of the Great Sandy Region. Report prepared on behalf of the Marine Parks Branch, Queensland Department of Environment and Heritage.

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Fisheries Research Consultants. 1994b. A resurvey of the Seagrasses of the Great Sandy Strait and Tin Can Estuary, November, 1993. Consultancy report prepared for the Queensland Department of Environment and Heritage, 34pp + appendices and plates.

Fisheries Research Consultants. 1995. A Part resurvey of long-term Seagrass Monitoring Sites within the Great Sandy Strait and Tin Can Inlet, March 1995. Consultancy Report prepared for Central Coast Regional Office, Queensland Department of Environment and Heritage.

Appendix A Morphological and density data for processed seagrass samples

Site	Species	Mean Leaf Length (mm)	Mean Leaf Width (mm)	Number of shoots/0.04m²	above : below ground biomass	
KC4	*Z. capricorni*	48	0.8	13	0.07	0.18
7	*C. serrulata*	52	3.5	15	0.25	0.72
8	*H. ovalis*	25.5	9.8	20	0.17	0.3
8	*C. serrulata*	47	3	1	0.005	0.01
10	*H. ovalis*	29	10	35	0.2	0.3
10	*C. serrulata*	79.5	4.5	10	0.4	0.52
11	*H. ovalis*	6.2	2.6	32	0.34	0.92
11	*Z. capricorni*	63	1.4	7	0.03	0.06
12	*C. serrulata*	57.8	4.4	8	0.5	0.73
12	*H. uninervis*	54.8	1.1	7	0.1	0.2
B 3	*H. ovalis*	15	4	13	0.01	0.01
3	*Z. capricorni*	39.3	0.8	42	0.1	0.35
5	*H. ovalis*	21	7.6	39	0.28	0.93
BP 5	*Z. capricorni*	79.2	1.9	20	0.31	0.2
6	*H. ovalis*	17	7	4	0.005	0.005
6	*Z. capricorni*	103.8	2	63	3.4	3.21
7	*H. ovalis*	18.6	7	11	0.04	0.07

KC = Kauri Creek
B = Boonooroo
BP = Bullock Point

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REPORT ON ILLEGAL TAKE OF DUGONG IN THE GREAT BARRIER REEF REGION AND IN PROPOSED DUGONG SANCTUARY AREAS

Introduction

The time frame adopted for this review has focused on the period January 1996 to February 1997, "the review period".

Overview of levels of illegal take

Northern Great Barrier Reef (i.e. north of Cooktown)

In the Hopevale Aboriginal Community there is one report of about 11 dugong carcasses being found at the mouth of the Starcke River 2 weeks before Christmas 1995. This incident was brought to the attention of DoE and GBRMPA staff by students from James Cook University and can be substantiated. This report was published in the local and State print media.

In the Lockhart River Aboriginal Community reports have been received of several dugong being taken from the Shelburne Bay area. This information comes from direct sightings by the ranger previously attached to the Heathlands National Park Base.

There appear to be no current permits under the Nature Conservation Act or State or Commonwealth Marine Park regulations for this take.

Southern Great Barrier Reef (i.e. south of Cooktown to Hervey Bay).

There is little data available to establish the level of take by either netting or traditional hunting in the southern Great Barrier Reef Region.

From information available in the DoE strandings database and similar scientific records there are records of stranded dugongs which have been mutilated and of other apparent attempts by fishers to dispose of dugong which have become entangled in fishing nets. It is understood that this matter is dealt with in other reports such as those by Tony Preen and Nina Morissette which contain discussion of possible causes of mortality in the broader context and speculation on the proportions of overall mortality which may be attributed to netting.

Prosecutions

To date there has only been one proposed prosecution by the Department of Environment of an alleged offender involving the use or take of dugong. This stems from investigations by Northern Region staff and is presently with the Crown Law Office in Brisbane.

Conclusion

In order to have any tangible success in establishing levels of illegal take either by way of netting or hunting a long term enforcement strategy needs to be developed and implemented. This strategy would need to cover both the northern and southern Great Barrier Reef as well as the Torres Straits, the Gulf of Carpentaria and also, the Moreton Bay area. A more accurate indication of the level of take by hunting in the northern Great Barrier Reef and netting in the southern Great Barrier Reef, particularly the

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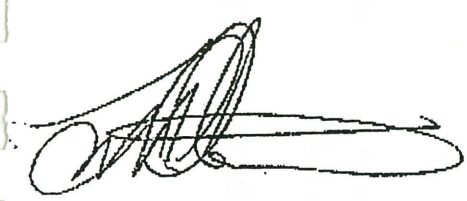
Shoalwater Bay area would be a likely outcome of this strategy. This strategy would require substantial additional resources.



T M Christensen
Enforcement Co-ordinator
Marine Parks Section, Department of Environment
Date: 14 February 1997

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Attachment 2

NUMBER OF ILLEGAL NETS RECORDED OR CONFISCATED IN tHE GREAT BARRIER REEF

DPA	SCOURCE	NO. NETS
Princess Charlotte Bay	Cairns QBFP	4
Bathurst Bay	Cairns QBFP	0
Hinchinbrook Region	Ingham QBFP	3
Cleveland Bay	T'ville QBFP	2
Upstart Bay	T'ville QBFP	2
Newry Region	Mackay QBFP	1
Ince Bay	Mackay QBFP	0
Shoalwater Bay	R'hpton QBFP	1
Port Clinton	R'hpton QBFP	0
Southern Hervey Bay	Urangan & Maryborough	0
Great Sandy Straight	QBFP	0
TOTALS		**13**

MARINE PARK	SOURCE QBFP	NO. NETS
	Cairns	1
	Ingham	5
	Mackay	9
	Port Douglas	2
		17

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PRELIMINARY REPORT

INTERAGENCY DUGONG WORKING GROUP

GREAT BARRIER REEF MINISTERIAL COUNCIL

Action arising from
decisions of the 22nd Meeting Brisbane 30 November 1996

INFORMATION ON THE CONSERVATION STATUS OF DUGONG IN THE TORRES STRAIT AREA

ISSUES

At its 22nd Meeting, the GBR Ministerial Council approved a series of emergency measures for dugong conservation in the Great Barrier Reef and Adjacent waters. While the focus of the concerns has been the major declines in surveyed areas of the Southern Great Barrier Reef and more southerly areas in which dugong have been abundant, the Ministerial Council noted that

> *Agenda Item 2 (e)*
> *The Council also had brought to its attention major loss of dugong in the Torres Strait and whilst beyond the jurisdiction of GBRMPA the Commonwealth Minister for the Environment undertook to investigate such losses and review appropriate strategies to advance conservation.*

Hunting, capture, distribution and consumption of dugong and turtles are very important in the culture of Torres Strait Island peoples and coastal communities in Cape York and PNG and the fisheries continue to be a major source of protein in those communities. There is considerable community interest in long-term maintenance of the traditional activities and concern that the resources are becoming less abundant.

BACKGROUND

Current effects on dugong population status: In the Torres Strait region, the major direct anthropogenic source of mortality is traditional hunting. Illegal hunting of dugong for sale has been reported but does not now appear to be prevalent. The limited mortality that may occur in gillnet bycatch of dugong in the region is considered to come primarily from illegal shark fishing by Indonesian vessels during the monsoon season. With activity by Australian fisheries patrols in the Australian sector, this impact is now likely to occur primarily in PNG waters. There has been no incidental catch of dugong reported from the important prawn trawl fishery in the Strait.

Major changes in seagrass distribution and abundance have occurred in the Torres Strait area, some associated with exceptional rainfall, flooding and increased turbidity. Associated with such changes have been changes in condition of dugong, movement and changes in local abundance, but the relationships are not yet understood.

Biological status

It is not clear what information the Ministerial Council had available to it on the conservation status of dugong in the Torres Strait area on which they based their comment. The following are the main points that arise from recent assessments:

- There is a anecdotal evidence that dugong densities in areas that are favoured hunting grounds in Torres Strait are possibly very much lower that they once were. Some hunters report that they cannot achieve the catch rates of the past for dugong, while turtle catches can be maintained with similar effort;

- aerial surveys carried out in 1983 (partial) 1987 and 1991 indicate that the Torres Strait remains the single-most important area of dugong abundance in Australian waters, with estimates of 13,319± SE 2136 (reanalysis of 1987 survey) and 24,225 (±SE 3,276) for the 1991 survey; (Marsh and Lawler 1992, Marsh 1996, TPZJA 93-94);
  - results of the most recent survey, completed in November - December 1996, are not yet available;
- the most likely explanation for the increase in the estimate of dugong density in the 1991 survey, most marked in the Papuan coastal, western Torres Strait and Southern Strait blocks, is immigration of dugong from adjacent waters, rather than variable bias in the survey methods or an increase in the resident population (Marsh et al in press);
- preliminary assessments of population structure in the region indicate that dugong in the SE Asian (Indonesia/Philippines) region are distinct from Australian populations, in which at least three genetic groups occur on the east coast (Torres Strait, GBR and SE Queensland groups, Tikel, cited in Marsh, 1997);
  - it is thus extremely unlikely that the increase in the 1991 abundance estimate reflects migration from areas in the GBR in which there have been marked declines;
- dugong hunting is carried out at differing intensities within the TSPZ, with more recent activity in the Top Western and Western Islands, less in the Central Islands and little in the Eastern Islands, where turtle catches continue to be most important;
  - estimated wet weight of dugong landings between June 1991 and May 1993, was higher than landings for any other component of the traditional fisheries catch in the TSPZ, with significant inter-annual variability in catches;
- the estimated annual catch of 1226 (±SE 204) for 1991-93 for the Australian Sector was higher than estimates for catches in the mid-70s and 80s, with an estimate for 1994 of 860 (±SE 241);
- dugong may respond to food shortages by decreased fecundity, increases in the pre-reproductive period or calving interval, with evidence of significant changes in the Torres Strait region which may have been associated with seagrass dieback and recovery;

Additional causes for concern are:

- possible selective taking of adult females;
- estimates of high per-capita consumption of dugong meat in some areas that may reflect over-estimation of catches, inter-community trade or wastage of dugong meat beyond that required to meet immediate needs;
- combined hunting of turtles and dugong may maintain effective effort even at low dugong densities;
- lack of information on levels of recent catches in PNG waters and those to the south of the TSPZ;

While the most recent aerial surveys of the TSPZ will provide an improved basis for an assessment, even if the 1991 estimate of abundance is taken as the reference point, there are real concerns that, recent catch levels in the Torres Strait dugong fishery may not be sustainable. Essential for an assessment of the conservation status of the dugong of the Torres Strait are:

- more accurate estimate of the absolute abundance of dugong in the area
- catch statistics for PNG and in the adjacent waters to the south;
- current life history parameters for dugong from the TSPZ and region;
- improved understanding of population structure and seasonal and other movements.

CURRENT MANAGEMENT OF THE TORRES STRAIT DUGONG HUNT IN THE AUSTRALIAN SECTOR

The Torres Strait Treaty, entered into by Australia and Papua New Guinea in 1985, deals with sovereignty and maritime boundaries in the area, and provides for protection of the way of life and

livelihood of traditional inhabitants and the marine environment (TSPZJA report 1993/94). The Treaty establishes the Seabed Jurisdiction and Fisheries Jurisdiction lines, with Australian sovereignty recognised by PNG of fifteen islands or cays north of that line, including the inhabited islands of Boigu, Saibai and Dauan (Laffan 1991, TSPZJA 1995). Where part of a fisheries stock under joint management by Australia and PNG extends beyond the Protected Zone, the Treaty allows the provisions of joint management plans to be extended to what are termed "outside but near areas" (see attached figure from TSPZJA 1995 for dugong and turtle areas).

Management objectives adopted for the dugong and turtle fisheries of the TSPZ and adjacent areas (TSPZJA 1995) are:

- to promote he conservation of turtle and dugong stocks; and
- to restrict the taking of dugong and turtle to traditional inhabitants fishing for traditional purposes.

The sale of dugong and turtle meat is prohibited, with a recognition by most communities of the status of the species globally and the need for conservation action within the Torres Strait region. The TSPZJA reports recognition by Torres Strait communities that dugong hunting should be restricted to those needed for weddings, funerals and other special occasions. Dugong do continue to form, however, an important component of the normal diet of communities on some islands.

The Torres Strait Dugong Sanctuary: After consultation with Torres Strait communities, a large segment of the TSPZ and adjacent area to the east and SE was designated as a dugong sanctuary, in which all hunting of dugong was nominally banned from 1985. Limited capacity for surveillance and enforcement, the isolation of much of the area and incorporation of extensive areas of lower dugong density identified in the more recent aerial survey series have raised questions about the efficacy of the sanctuary as a component of management for dugong in the region. There have been suggestions that its boundaries should be renegotiated, or that additional protected areas are considered for establishment in areas of higher density of dugong (Marsh and Saalfield 1981, Marsh, Harris and Lawler 1997 in press).

Other management-related activities:

Dugong hunting in the TSPZ and adjacent areas is limited to traditional inhabitants only, using the traditional wap or spear. Aluminium dinghies with outboards are used, rather than canoes. There are currently other no limits for hunting effort, numbers of hunters or catch for dugong or turtles in the TSPZ and adjacent areas, with the conservation effort directed at surveys and catch monitoring and school and community education.

Since the closure of a monitoring program in Daru market in the late 1970s-early 1980s and a ban on commercial sale of meat, , there has been no systematic recording of dugong takes in PNG, although the Maza wildlife Authority continues to monitor dugong passing through Daru market.

In the Australian sector, monitoring of marine fisheries catches in 1991-1993 under a CSIRO project was continued in 1994 as a joint CSIRO/AFMA project and was re-established in late 1995 by AFMA. It has provided the basis for estimates of the traditional take of dugong in the Australian Sector of the TSPZ.

A Schools Program has also been conducted by AFMA in schools in the Australian Sector, with the duel objectives of educating and informing the school community, and future hunters, about turtle and dugong conservation and management issues, and collection of catch data. There have been modifications to the data collection methods to increase reliability and estimates of catches and recording effort. Appointment of part-time time community rangers under the CEPANCRM program and development of cooperative programs with the Island Coordinating Council (ICC) provide an important base from which further community involvement and participation in the development of management programs for the traditional hunts can develop. It is essential that such inititives are coordinated with those of the ICC and the MaSTERS initiative, with support for parallel developments in the PNG sector.

PLANNING FOR THE FUTURE

Marsh and others (1986,1996, 1997) have argued that successful conservation of dugong in the Torres Strait area will depend on recognition of the special significance of dugong to Torres Strait Islanders and the Aboriginal communities of the area and the cooperation and direct involvement of indigenous hunters and communities in management and habitat protection. They have argued strongly that the area is too large and remote for management based on external surveillance and enforcement and that such an approach is inappropriate. In addition to a range of proposed research projects related to management, specific suggestions for further community-level action include:

- maintenance and expansion of the schools monitoring program;
- development of wider community information program in cooperation with the ICC;
- cooperative development of community-based management plans for the major hunting communities of Boigu, Mabuiag and Badu;
- fostering wider community involvement in development of all aspects of dugong management and research in the region and a recognition of a formal role and responsibility for management;
- a community role in determining priorities and direction for dugong conservation action in the region.
- development of longer-term strategy for training and the provision of resources of indigenous community rangers to develop the capacity for effective and sustained involvement in dugong management and research..

Community consultation and workshop

Recognising the broad interest in the region and the range of communities involved, a suggestion has been made that a workshop should be held of the Torres Strait Island communities, at which the major issues and priorities could be addressed from a community perspective. The workshop would provide an opportunity for information on current status to be provided to a broader section of the communities and could examine and provide its views on:

- priorities for conservation action, including revision of the current Dugong Sanctuary and other possible sanctuary areas;
- development of community-based management plans and a regional context;
- community ranger programs and support required for effective operation.
- research and research priorities;
- information and education programs;
- cooperation with PNG agencies in developing complementary actions;
- information from adjacent areas on the east and west coasts of Cape York.

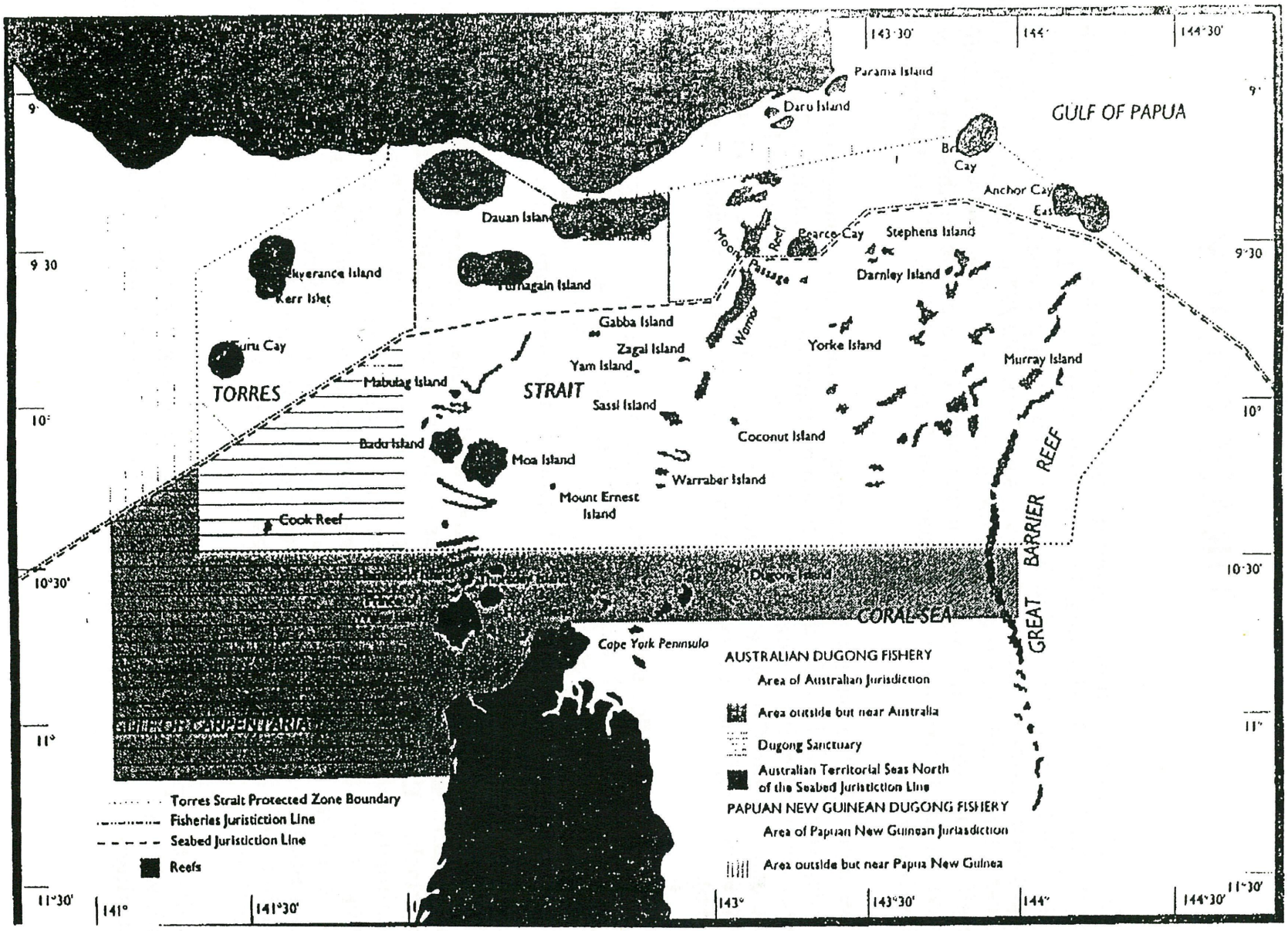
Biodiversity Group
February 1997

Action Officer Gordon Anderson
Marine Policy and Coordination 2500237

ACKNOWLEDGMENTS

REFERENCES

Dugong fisheries



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INTERIM POLICY - TRADITIONAL HUNTING
DUGONG

A1
MPA 161
Item 3(d)

DRAFT POLICY

June 1996

The Authority has now received the final report on the "status of dugong in the southern Great Barrier Reef Marine Park"(Marsh et al 1995). The report states that " dugongs in the Region have declined by approximately 50% over the past eight years from an estimated 3479 ± s.e. 459 in 1986/87 to 1682 ± s.e. 236 in 1994. Over a large section of the region this decline is over 80%."(Marsh et al 1995) All staff should read and become familiar with the contents of this report, copies have been distributed to Regional and District Offices of the Department of Environment.

The report further states that "Applying the criteria of the latest IUCN Red List Categories (IUCN 1995), the population of dugongs in the southern Great Barrier Reef is Critically Endangered, the worst of the threatened categories. Inclusion in the Critically Endangered category means that a taxon is "facing an extremely high risk of extinction in the wild in the immediate future" (IUCN 1995).

The report identifies several threats to dugongs but does not identify any single threat or event which might have lead to this decline. Traditional hunting is identified as but one of many threats. It is clear however that the situation of dugongs is such that hunting of dugongs in the area from south of Cooktown is no longer ecologically sustainable.

This is a sensitive policy issue as the refusal to grant hunting permits may have a significant impact on indigenous rights and culture and could cause some backlash. Rather than making a statement banning hunting outright the Authority would prefer to work in a cooperative manner with indigenous peoples to meet both World Heritage and indigenous traditional responsibilities for survival of the species. The Authority is undertaking a program of consultation and negotiation with indigenous groups in the affected area to further develop a series of agreements and long term policy on traditional hunting.

Whilst this process is in progress the following interim measures should be followed by staff when approached by indigenous people about traditional hunting:-

INTERIM POLICY - Traditional Hunting in the GBRMP south of Cooktown

Whilst this policy specifically addresses indigenous hunting of dugong it does not blame hunting for the decline of dugong. The causes of the decline in the dugong population have not been specifically identified but potentially include loss of seagrass (habitat and food source), disturbance and strike by vessels, entrapment in mesh nets (including beach protection) and effects of pollution. These other threats will be addressed in specific policies and management plans.

- Take time to explain the seriousness of the situation for dugongs as indicated by the most recent survey report (Marsh et al 1995). This may require acknowledgment of local knowledge of apparently healthy populations of dugong. Put this population into a regional perspective which indicates that all animals need to be preserved to maintain a breeding population to ensure future recovery to a regionally healthy population.

- Acknowledge traditional rights, do not apportion blame for dugong decline to hunting. Accept comments and criticism raised about the effects of trawlers, gill nets and other threats to dugong. Advise of actions in place to begin to mitigate other threats and appeal to traditional responsibilities which require maintenance of the species for future generations. A handout brochure is available which can be used as a prompt and give away.

- If an application to hunt dugong is lodged, accept the application but advise that a permit **will not be recommended** based on a responsibility to ensure continuance of the species (Assessment Criteria 13AC(4)(c) & (d), 13AC(5)(a) Great Barrier Reef Marine Park Regulations).

- Evaluation of the current status of dugongs against assessment criteria 13AC(4) (a), (f) and (j) should indicate that hunting can no longer be recommended. During assessment local information should be sought from indigenous groups on traditional responsibilities for conservation of species and quote against criterion 13AC(4)(b). Advise the applicant of their reconsideration and appeal rights Regulation 22(2) & (5) should the permit be refused (as the assessing officer you may be recommending refusal, you are not refusing the permit). (GBRMP Regulations)

- Advise applicant that a program of consultation and negotiation is being developed to talk to indigenous people and groups about this issue. Ask for contact details if the person would like to be involved. Tell them that they will be contacted about meetings by someone from GBRMPA. Pass the contact details on to the:

  Indigenous Liaison Coordinator (Mr Ross Williams), or
  Manager, Indigenous Culture Liaison Unit (Mr Greg Smith), or in their absence:
  Assistant Planning Officer (Ms Janet Slater),
  at GBRMPA Townsville.

- If someone claims an exemption under Section 211 of the *Native Title Act 1993*, you should refer to either the:

  Legal Officer GBRMPA (077) 500867,
  Manager Indigenous Cultural Liaison Unit GBRMPA (Mr Greg Smith) (077) 500850, or
  Manager Aboriginal and Torres Strait Islander Land Interests, Department of Environment Brisbane (Mr Terry Piper) (073) 2277797.

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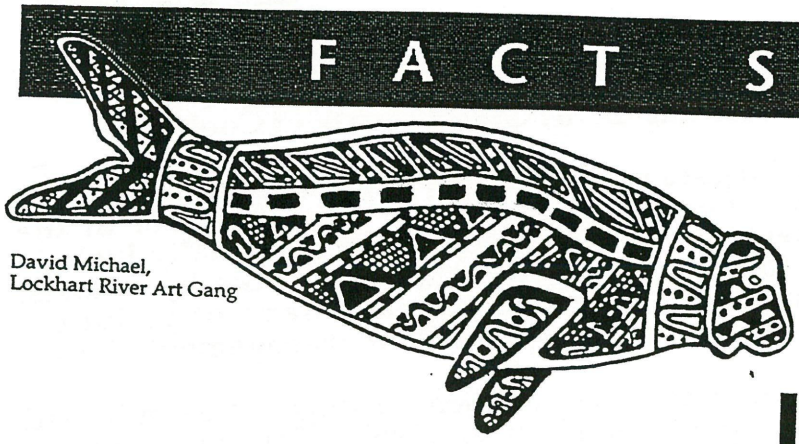
FACT SHEET

GREAT BARRIER REEF MARINE PARK AUTHORITY



David Michael,
Lockhart River Art Gang

DUGONGS IN TROUBLE

The Great Barrier Reef Marine Park Authority has run research programs to check the numbers of dugongs in the Great Barrier Reef area since 1987. In 1987, approximately 3479 dugongs were counted in the area near Cooktown south to Bundaberg. Another count of the same area in 1992 found approximately 1857 dugongs. As a result of the large decrease in numbers of dugong during these two surveys a further survey was conducted in 1995 with only approximately 1682 dugongs counted.

Dugong numbers have fallen to less than ½ since 1987

1987 Approx. **3479**

1992 Approx. **1857**

1995 Approx. **1682**

These figures show that dugong numbers have dropped to less than half since 1987. Some local populations have dropped by as much as 80% with only one local area showing an increase in dugong numbers. Unfortunately, in most of the areas, populations are so small that they cannot afford to lose any more breeding animals.

Scientists say numbers are so low, in the southern Great Barrier Reef area from near Cooktown to Bundaberg, that the population of dugongs is 'Critically' Endangered meaning dugongs in the immediate future face an extremely high risk of extinction.

Scientists think that there is a combination of many reasons which may have caused the loss in numbers, including loss of seagrass, boat strikes, pollution, trapping in nets (including protection nets for swimmers and commercial gill nets) and hunting.

The following things are now being done to try and stop the loss of animals.

- A Turtle and Dugong Management Strategy has been developed by the Great Barrier Reef Marine Park Authority.
- Aboriginal people in Bowen, Mossman and Rockhampton have voluntarily elected to stop hunting dugongs until they recover to a healthy number. In some other areas, people have agreed to very tight restrictions on hunting.
- Banning of some types of gill nets in Shoalwater Bay have been agreed to by the commercial fishers of the area.

- A management plan is being developed for other action to protect dugongs in Shoalwater Bay.
- Nets to protect swimmers from sharks have been removed from some areas of Queensland (nets now only occur off Cairns, Townsville and Mackay) and replaced with drum lines to target sharks.
- Gillnetting is a recognised problem of dugong deaths and capture. The management agencies are working together with the fishing industry to develop new management plans and ways to reduce the impacts on dugongs. Queensland has rules which restrict net size and strength and requires the fisher to be near the net at all times to stop accidental dugongs or turtles deaths.
- Work is being done by farmers and landcare groups to reduce the amount of pollution running off farms into the sea which might affect seagrass.
- Staff of management agencies must consider and comment upon the possible dangers of proposed resort developments (or other major projects) on seagrass areas and dugongs.
- Research is under way to identify important feeding and breeding areas (seagrass areas).

The Great Barrier Reef Marine Park Authority and the Queensland Department of Environment, which manage the Great Barrier Reef World Heritage Area, have national and international responsibilities for making sure that there are healthy dugong populations for the future. It is understood that indigenous peoples hold the same responsibility by traditional law and custom. Elders from several areas have recently expressed concern about the drop in dugong numbers over the past ten years, and have taken action to see that dugongs are not hunted.

We would like to seek your help and cooperation in managing this problem by not hunting dugong in the area until dugong numbers have recovered to safe numbers, which in most areas will take many years.

Staff of the Great Barrier Reef Marine Park Authority and Queensland Department of Environment will be visiting your area shortly to discuss this issue with you.
If you would like any other information before then or would like to pass on information please contact - ***Ross Williams*** **(077) 500 716** or ***Janet Slater*** **(077) 500 731**
(free call number **1800 802 251)**
at the Great Barrier Reef Marine Park Authority.

TRADITIONAL HUNTING OF DUGONGS - INTERIM POLICY

RECOMMENDATION

That the Authority:

- adopt the document "Interim Policy - Traditional Hunting Dugong" dated June 1996 as interim policy for use by staff of the Authority and the Queensland Department of Environment when assessing applications for traditional hunting of dugongs in the area from Cooktown to the southern boundary of the Great Barrier Reef Marine Park (decision MPA 91/15 on guidelines for permits for hunting of dugongs refers); and
- decide to proceed cautiously with the introduction of the interim policy, in recognition of the need for further consultation with indigenous groups and others, in order to develop a co-operative approach to managing all threats to dugongs.

BACKGROUND

James Cook University has been commissioned to conduct surveys of dugong numbers in the GBRMP since 1987. The most recent report on surveys conducted in 1994 states that dugong numbers in the area Cooktown south have declined by approximately 50% with some local areas declining by as much as 80%. The decline is so serious that researchers are now stating that dugong in the area meet IUCN criteria for being listed as "Critically Endangered".(Marsh et al 1995)

Traditional hunting has not been blamed in isolation for the loss of dugongs. It is acknowledged as being but one of many threats to dugong.

MPA 146/8 developed a draft Turtle and Dugong Management Strategy. Recent decisions by the Authority in regard to the population decline in the southern area concern:

- proposals for regulations or plan of management to deal with gill netting deaths in Shoalwater Bay (MPA 156/3),
- the setting of a course of action to address a number of probable causes (MPA 159/9), and
- commencement of management planning for dugong populations in the area (MPA 159/10).

ISSUES

The situation of dugongs in the area is so serious that loss from all means must be stopped if dugongs are to survive and recover to a healthy population.

The Authority cannot meet its international obligations for management of the World Heritage Area, or its legislative responsibilities for management of the Marine Park, unless an effective strategy is being implemented to protect dugong.

The Authority has a policy of permitting traditional activities whilst they remain ecologically sustainable. The serious decline in dugong numbers in the area south of Cooktown indicates that traditional hunting for dugongs can no longer be considered ecologically sustainable.

Banning of hunting, whilst not taking serious action to mitigate all threats to dugong, is culturally offensive to indigenous communities. The loss of the right to traditionally hunt is seen to be a serious erosion of indigenous rights as well as a serious breach of legal responsibility, by management agencies, for management of the environment.

Staff propose that the Authority work in a cooperative manner with indigenous peoples to meet both World Heritage and indigenous traditional responsibilities for survival of the species. The Authority is undertaking a program of consultation and negotiation with indigenous groups in the affected area to further develop a series of agreements and long-term policy on traditional hunting.

Whilst this process is in progress, interim measures, set out in the document "Interim Policy - Traditional Hunting Dugong" dated June 1996 (attachment A1), should be followed by staff of the Authority and the Queensland Department of Environment when approached by indigenous people about traditional hunting, and in particular when assessing applications for traditional hunting of dugongs in the area from Cooktown to the southern boundary of the Marine Park.

CONSULTATION

Comments from all Regional Offices of the Department of Environment have been incorporated.

Bowen, Ayr, Whitsunday, Shoalwater Bay and Mossman Aboriginal groups have been involved in the process through permit negotiations. All have already agreed to cease hunting until dugong numbers recover to safe levels. Work is currently proceeding with Mackay Councils of Elders who have greatest concern over stopping hunting.

RESOURCE IMPLICATIONS AND PRIORITY

Very high priority. A liaison officer will need to spend some three months of effort in the Mackay area working through issues with the two Councils of Elders. Additional liaison work will be required in the Townsville/Cairns area. Travel to be calculated into the 1996/97 budget for the Indigenous Cultural Liaison Unit.

PROPOSED IMPLEMENTATION

It is proposed to implement the interim policy immediately. Public announcements are not encouraged until the policy is finalised. However, the public will be able to access the decision and the policy as well as the paper by Professor Marsh et al.

Liaison with targeted Aboriginal and Torres Strait Islander groups to commence in July to disseminate information about the status of dugong and discuss actions being implemented to address identified issues. A final policy on hunting will be developed through this process.

Item 3(c) Day-to-day Management: First Quarterly Payment 1996-97

The Authority:

- noted that for a period commencing 1 July, 1996 there will be no approved annual program in place for day-to-day management of the GBRMP for 1996/97; and
- DECIDED to ratify the agreement reached by members through correspondence to authorise the Chairperson to approve payment of the first quarterly claim for day-to-day management for 1996/97 to cover ongoing salaries, wages and associated operating costs only in accordance with supply funding principles.

MPA 161/7

REFERRED TO QDoE (1,2,3,4,5), QDPIFF (1) AND QWP (1), FOR INFORMATION

Item 3(d) Traditional Hunting of Dugongs: Interim Policy

The Authority DECIDED to:

- adopt the document "Interim Policy - Traditional Hunting Dugong" dated June 1996 as interim policy for use by staff of the Authority and QDoE when assessing applications for traditional hunting of dugongs in the area from Cooktown to the southern boundary of the GBRMP (decision MPA 91/15 on guidelines for permits for hunting of dugongs refers); and
- proceed cautiously in the introduction of the interim policy, in recognition of the need for further consultation with indigenous groups and others, in order to develop a cooperative approach to managing all threats to dugongs.

MPA 161/8

REFERRED TO QDoE (2,3,4,5), QDPIFF (1) AND QWP (1), FOR INFORMATION

Item 4 Regulation of Ship Sourced Sewage

Noting the development of regulations to control discharges of sewage from vessels within the Queensland *Transport Operations (Marine Pollution) Act 1995*, the Authority DECIDED to recommend development of complementary legislation for the GBRMP, subject to confirmation of support from the Queensland Department of Transport.

MPA 161/9

REFERRED TO QDoE (1,2,3,4,5), QDPIFF (1) AND QWP (1), FOR INFORMATION

Item 5(a) Great Barrier Reef Consultative Committee: Report of the 55th Meeting

The Authority received formally the reports from the GBRCC on its 55th meeting and considerd the Committee's advice.

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32.

Mackay Conservation Group Inc.

PO Box 826 Mackay Q 4740
Environment Centre 156 Wood Street Mackay
Phone 530 808 Fax ~~530 808~~ 535438

→ Tony Stokes



25 February 1997

Dr Ian McPhail
Chair
Great Barrier Ref Marine Park Authority
TOWNSVILLE 4810

By facsimile: (077) 726 093

Dear Dr McPhail,

We are writing to reaffirm our support for your commitment to ensure the recovery of dugongs in the southern Great Barrier Reef region.

The best available scientific evidence shows that gill netting is ecologically unsustainable primarily because of its impact on dugong populations. Subsequently it is our position that gill netting should be prohibited throughout the dugongs range, especially in the proposed Great Barrier Reef dugong sanctuaries.

Yours sincerely,

Jacki Wirth
Coordinator

33.

→ Tony Stokes

Wildlife Queensland

Wildlife Preservation Society of Queensland
Proserpine/Whitsunday Branch Inc.

27/02/97
facsimile

Dr Ian McPhail
Chairman GBRMPA

Dear Ian,

URGENT
INTERIM DUGONG PROTECTION

I refer to the AMCS "interim dugong protection strategy", as articulated at the last GBR Advisory Committee meeting of last week:

Although our next general meeting is not until the 19/3/97, the policy has been discussed with our branch executive and as may members that I could contact.

We are all of the opinion that gill netting inside dugong sanctuaries should be prohibited, and that the branch policy should be the same as that policy taken by the QCC, NQCC and the Human Society (all represented at the Advisory meeting).

Because of the precarious state of dugong populations between Townsville and Mackay, we call on the GBRMPA to take the strongest possible measures to stop this animal becoming locally extinct.

Could you please convey the content of this letter to the State and Federal Environment ministers at tomorrows meeting (28/2/97)

Ian Sutton
Branch Coordinator
phone/fax 079 464 170

Ian Sutton

P.O. Box [illegible] PROSERPINE, Q. 4800

Recycled

34.(P.1)

→ Tony Stokes

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cairns and far north environment centre inc

Robert Hill
Minister for the Environment
C/O Parliament House
Canberra ACT 2601

25th February 1997

Regarding dugong protection

Dear Mr Hill;

As you are about to decide the future of Australia's dugong population, we wish to bring a few of our concerns to your attention.

The numbers of dugong have decreased in the southern Great Barrier Reef region by 80% from 1987 to 1994. Within years we could see this magnificent marine mammal become extinct. The urgency for protection of the dugong has been well recognised by the scientific community and even your own ministry.

We are yet to see action on this matter initiated.

The Draft Emergency Protection Measures (DEPM) which have been proposed by the state and federal governments **do not** provide necessary protection for the dugong.

In order to effectively protect the dugong from extinction, some tough decisions have to be made, some of which may have ramifications for certain industries, such as the fishing industry. Short term strategies such as those proposed by both levels of government are no longer acceptable to the community.

We therefore call on you and your government to :

- declare new marine sanctuaries for dugong protection;
- prohibit use of gill nets in dugong sanctuaries, a practice which has accounted for approximately 66% of dugong strandings between 1995 and 1996 and has been proven by the best available scientific evidence to be unsustainable;
- remove shark nets from the dugongs range in favour of replacement by drum lines which have been proven to be a viable alternative;
- prohibit trawling on all sea grass beds;
- implement a moratorium on large scale developments adjacent to critical dugong habitats;
- prohibit use of underwater explosives in all dugong habitats;

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- implement enforceable controls on vessel speeds in dugong habitat.

Only with the implementation of these significant measures will human impacts on the dugong be reduced, enabling a long term recovery of dugong numbers in the southern Great Barrier Reef region .

Present and future communities in Australia rely on you to protect these rare species from extinction and we are looking forward to see a strong implementation plan that addresses our concerns.

Regards

Jamie Machin
Marine Biologist
Cairns and Far North Environment Centre (CAFNEC)

c.c Ian McPhail
Chairman - Great Barrier Reef Marine Park Authority

c.c Brian Littleproud
Queensland minister for the environment

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Dugong management in the Northern Great Barrier Reef

Joan Phillips, Great Barrier Reef Marine Park Authority
February 1997

Dugongs in the northern Great Barrier Reef region, north of Cooktown, have not shown the widespread decline detected in the southern Great Barrier Reef. However the northern region is the most important dugong habitat in the GBR, and one of the most important in Australia. In November 1996 the Great Barrier Reef Ministerial Council considered a package of emergency measures to eliminate or substantially reduce dugong mortality in the Great Barrier Reef area. The Ministerial Council agreed to nine interim Dugong Protection Areas south of Cooktown, plus a possible two more in Bathurst Bay and Princess Charlotte Bay in the northern region.

A preliminary assessment of existing information has been made and the following approach to dugong protection in the northern Great Barrier Reef is proposed:

The following areas are recognised as significant areas for dugong north of Cooktown:

- **the Starcke coast between Lookout Point and Cape Melville**
- **Bathurst Bay**
- **Princess Charlotte Bay**
- **Port Stewart to Colmer Point (south of Chester R)**
- **Campbell Point to north of Friendly Point**
- **Temple Bay**
- **Shelburne Bay**

Lloyd Bay is a possible additional area of significance for dugong.
Although the above areas are listed as discrete units, it is likely that dugong populations move between them. For example, the Starcke coast and Bathurst Bay may be utilised by the same population. This is probably true of any two adjacent areas. Researchers have consistently rated the northern Great Barrier Reef region as a whole is the most important dugong habitat in the Great Barrier Reef (e.g. Marsh and Corkeron 1996).

It is not recommended that a formal dugong sanctuary status be placed on the above key areas, but that the areas be listed as significant and measures clearly identified to ensure protection and maintenance of populations and habitat. The management intent proposed for the Far Northern Section includes a primary objective of biodiversity protection. All of the key areas for dugong also contribute to the broader aim of biodiversity protection, and most are important to indigenous people. These values may be confused in the public's mind if the areas are identified solely or formally as dugong sanctuaries.

Existing and recommended protection measures for dugong in the northern GBR are set out below. A considerable amount of protection is afforded to dugong through the existing zoning plans. Changes proposed for the Far Northern Section through the current review will, if agreed to, provide additional protection for dugong and dugong habitat, as well as fulfilling other management objectives. Measures are also proposed for Commonwealth waters in the Cairns Section north of Cooktown, and in State waters in both the Cairns and the Far Northern Section. The processes for implementing the latter suite of measures are outside the current Far Northern Section review, and implementation should be considered along with measures in the southern GBR.

1. Starcke coast

This area straddles the Cairns and Far Northern Sections. The existing level of protection through zoning in the GBRMP is at first glance very high. North of the section boundary the area is zoned Scientific Research, Preservation and Marine National Park 'B'. South of the boundary is zoned National Park. However several factors are acting to reduce the level of protection. A State Marine Park has yet to be established adjacent to the Far Northern Section, hence waters above LWM and in estuaries are not managed in a complementary way to waters in the GBRMP. Netting takes place, for example, adjacent to the existing Preservation Zone and Scientific Research Zone. The National Park Zone in the Cairns Section has a boundary 100m offshore from LWM. Inshore of this boundary, waters (including State waters) are zoned Habitat Protection and netting is carried out. It is possible that this area is subject to considerable hunting pressure, particularly in the southern parts.

Recommendations:

- Amend the Cairns Section Zoning Plan to bring the National Park Zone inshore to LWM.
- Implement netting closures in State waters to HWM and into the mouths of estuarine streams, using the same mechanisms as for southern DPAs.
- Develop traditional hunting plans with the Hopevale community.

2. Bathurst Bay

Along with Starcke, this area is arguably the most significant for dugong in the northern Great Barrier Reef. There is a considerable amount of commercial netting in Bathurst Bay. Measures proposed by QCFO for this area are believed to be unlikely to significantly reduce incidental dugong mortality due to netting. For a number of reasons, the draft proposals for the Far Northern Section include changing the zoning for this area from GU'B' to MNP'B', with a narrow inshore strip of Marine National Park 'A' east of the Muck River mouth. This change, if implemented, will eliminate commercial netting in the GBRMP. Complementary zoning in State waters awaits the establishment of the State Marine Park. The area is not believed to be used for traditional hunting of dugong.

Recommendations:

- Retain the proposal in the Far Northern Section Draft Zoning Plan to change the zoning of Bathurst Bay to MNP'B' and MNP'A'.
- Implement netting closures in State waters to HWM and into the mouths of estuarine streams, using the same mechanisms as for southern DPAs.

3. Princess Charlotte Bay

Although Princess Charlotte Bay/Bathurst Bay was not one of the areas of highest dugong *density*, about half the total numbers of animals observed in the survey area were observed in this block (Peter Corcoran, pers. comm.). The area is also an important area for commercial fishing, in particular for netting, crabbing and trawling (in the northern part of the Bay). No changes to the zoning are proposed for the main part of the Bay, but it is proposed to rezone the area around the Cliff Islands and June Reef to MNP'B'. An important area for dugong, west of Bathurst Heads, is currently excluded from the Marine Park.

Recommendations:

- Implement netting closures in parts of the Bay e.g. W of Bathurst Heads to about the Normanby R, and N from about 14°21', using the same mechanisms as for southern DPAs.
- Retain the proposal in the Far Northern Section Draft Zoning Plan to change the zoning around the Cliff Islands and June Reef from GU'B' to MNP'B'.

4. Port Stewart to Colmer Point (south of Chester R)

This area is currently zoned GU'B'. An area adjacent to Port Stewart is currently excluded from the Marine Park. No changes to zoning are proposed for the Far Northern Section Draft Zoning Plan.

Recommendations:

- Implement netting closures using the same mechanisms as for southern DPAs.

5. Campbell Point to north of Friendly Point

In the existing Zoning Plan, this area is mostly MNP'B', but significant dugong habitat extends north of this zone. The inshore area in this vicinity was one with the highest densities of dugongs observed in the 1995 surveys. Friendly Point may be becoming a focus for hunting from the Lockhart River community.

Recommendations:

- Propose in the Far Northern Section Draft Zoning Plan to extend the boundaries of the existing MNP'B' north to the Bobardt Point exclusion area to take in significant dugong habitat.
- Develop traditional hunting plans with the Lockhart River community.

6. Temple Bay

For a number of reasons, the draft proposals for the Far Northern Section include changing the zoning for this area from GU'B' to MNP'B'.

Recommendations:

- Retain the proposal in the Far Northern Section Draft Zoning Plan to change the zoning of Temple Bay to MNP'B'.
- Implement netting closures in State waters to HWM and into the mouths of estuarine streams, using the same mechanisms as for southern DPAs.

7. Shelburne Bay

The area was observed to have one of the highest densities of dugong in the 1995 surveys. It is currently zoned MNP'B'. No changes are proposed in the Far Northern Section Draft Zoning Plan. The Margaret Bay area north of Cape Grenville is currently excluded from the Marine Park. The Wuthathi people have suggested to the Authority that this area be managed as a dugong sanctuary.

Recommendations:

- Retain the existing zoning of MNP'B'.
- Implement netting closures in State waters to HWM and into the mouths of estuarine streams, using the same mechanisms as for southern DPAs.
- Futher assess the Margaret Bay area east of Shelburne, and develop management arrangements in consultation with traditional custodians.

8. Other areas

Lloyd Bay

There is some anecdotal suggestion of a localised decline in the dugong population due to hunting pressure.

- Develop traditional hunting plans with the Lockhart River community.
- Retain proposal in the Far Northern Section Draft Zoning Plan to change zoning from GU'B' to MNP'B'.

Corbett Reef and Hedge Reef

The report of the northern deep-water seagrass survey (1995) stated that areas of deep-water seagrass habitat close to Corbett Reef and at various sites on the outer shelf should be considered for special protection as dugong and turtle habitat.

- Retain proposal in the Far Northern Section Draft Zoning Plan to change zoning of northern Corbett Reef from GU'A' to GU'B' to protect deepwater seagrass.

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QFMA - ZAC Meeting, Townsville 19th Nov 1996

Notes on seagrasses and seagrass-dugong interactions in the Hinchinbrook Region.

Warren Lee Long and Robert Coles
Northern Fisheries Centre, PO Box 5396, Cairns Q 4870.

Seagrass habitats in the Hinchinbrook region (including Dunk Island to Cape Cleveland) were ***first mapped in 1987 during a broadscale survey*** between Cairns and Bowen (see attached Map, from Coles *et al.* 1992). That survey indicated where the main areas of seagrass habitat occurred and noted that seagrasses in the Hinchinbrook Island area are important regionally (Lee Long *et al.* 1993). The nearest large areas of seagrass are to the south around Townsville, and dugong populations in Hinchinbrook Island area probably use seagrasses in a region which extends at least from Dunk Island to Cape Cleveland.

A detailed survey of Dunk Island to Cape Cleveland in October 1996 (one month ago) provides the only source of quantitative data to assess changes in seagrasses in the region since 1987 (Queensland Department of Primary Industries unpublished information). This survey included repeat checks of approximately 10% of sites from the 1987 survey (both seagrass and non-seagrass sites).

Draft maps from the recent detailed survey indicate ***significant increases in the distribution of seagrasses across the region since the 1987 broadscale survey***. Most noticeable were increases in the area of sub-tidal seagrass habitat in Missionary Bay and from Cape Pallarenda to Cape Cleveland. However, we have no measure of any other year-to-year changes in seagrass distribution and abundance for the region between 1987 and now.

Anecdotal information (eg., Mellors, pers comm. Dr John Collins, pers comm.) has indicated ***a possible decrease in seagrass distribution and abundance in the region during 1990 and 1991***. These sources only mention intertidal seagrasses, and no information exists on changes in sub-tidal seagrasses for those years. No quantitative data means we have no real measure of year-to-year losses or increases, and more importantly, no idea of the ***scale*** of any changes. Therefore we cannot make any confident comment about the likely impacts on seagrass grazers such as dugongs and green sea turtles. We require detailed annual surveys at a number of localities to reliably measure long-term variations in seagrasses across regions.

At this point it is believed that ***small-scale losses of seagrass*** are likely to affect dugong population ***movements*** and dugong population ***fecundity*** (birth rates), but ***not*** likely to be the most important cause of mortalities (Marsh, pers comm.).
Large-scale changes in seagrass distribution and abundance would more likely effect dugong ***mortality*** rates (eg., the 1992 seagrass and dugong losses in Hervey Bay, Preen, Lee Long and Coles 1995, Preen and Marsh 1995).

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Coastal seagrasses in northern Queensland are often restricted to the intertidal and immediate sub-tidal depths to less than 5 m. The relatively turbid coastal waters of northern Queensland limit light penetration and therefore inhibit seagrass photosynthesis and growth at greater depths. Thus ***the primary food source of dugongs*** in the Hinchinbrook region, as for many other parts of the Queensland coast, ***is along the relatively narrow band close to shore.*** This area overlaps with some of the main areas of gill netting in these regions, and presents immediate high risks to dugongs of capture in gill nets. If the area of subtidal seagrass habitat is small, there are few alternative feeding areas for dugong.

It is also possible that increases in day-time boat traffic may also cause dugong to retreat to offshore areas during the day and concentrate their inshore feeding activity to night time. This would increase the likelihood of encounters with gill nets.

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