



GREAT BARRIER REEF
MARINE PARK AUTHORITY



Audit of the Management of the Queensland East Coast Trawl Fishery in the Great Barrier Reef Marine Park

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let's keep it great

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Foreword

It is important for the conservation of the natural resources of the Great Barrier Reef Marine Park and for the long-term viability of the fishing industry that all fisheries in the Marine Park are ecologically sustainable.

This audit of the management of the trawl fishery in the Great Barrier Reef Marine Park was undertaken at the request of the Great Barrier Reef Ministerial Council.

In preparing the audit, the responsibilities and obligations of the Great Barrier Reef Marine Park Authority under the *Great Barrier Reef Marine Park Act 1975* provided the foundation.

Recognising the significant improvements in the management of the trawl fishery in the Great Barrier Reef Marine Park in recent years, the intention of the audit is to contribute in a positive and constructive way to the process of continuous improvement.

The audit has been prepared in the interest of progressing the ecological sustainability of the trawl fishery, thereby achieving the stated objectives of fishers, fishery managers and the Great Barrier Reef Marine Park Authority.

A handwritten signature in black ink, appearing to read 'Virginia Chadwick', with a large, stylized initial 'V'.

Hon Virginia Chadwick
Chair
Great Barrier Reef Marine Park Authority

Key Findings of the Audit Report

The trawl fishery in the Great Barrier Reef Marine Park is a highly diverse and complex fishery with demanding management challenges. Major improvements, which have been achieved in the fishery through the introduction of revised management arrangements over the past two years, are acknowledged. There has been a significant reduction of fishing effort and the introduction of effort units has (at least nominally) capped fishing effort in the fishery. The implementation of a satellite-based vessel monitoring system has enabled closer monitoring of the fleet's activity, which has major compliance benefits and may assist with stock assessment of the fishery in the longer term. Additional closures in areas where trawling had not occurred previously were introduced under the revised Trawl Plan.

Many key target species are regarded as “fully exploited”. However, there are only limited assessments on the amount of product that can be harvested sustainably. Currently, there is no stock assessment of bycatch species. The adoption of the precautionary principle requires that uncertainties be factored into the assessment process. The level and quality of monitoring and research work in the fishery need to be improved as a matter of priority. The importance of data quality in stock assessment is stressed. There are dangers in unadjusted catch rates being used as an indicator of the fishery's “well being“. Improvements in the gathering of data and stock assessment processes are required for there to be public confidence that stocks are not being over-fished and the environmental impacts of trawling are being mitigated by proper management.

Tightening of the legal requirement for trawlers to carry prescribed turtle excluder devices is welcomed. A similar revision to the specifications for bycatch reduction devices is needed.

Of primary interest to the Great Barrier Reef Marine Park Authority is the broader impact of the fishery on the GBR ecosystem. Research has demonstrated that bottom trawling has a major impact on seabed biodiversity. There has been limited monitoring of the impact of the fishery on bycatch species and the wider ecosystem. Monitoring and research efforts have been focussed primarily on key target species. The adoption of the precautionary principle requires that a risk assessment be undertaken to identify those bycatch species most vulnerable to trawling.

The effort reductions achieved through the structural adjustment scheme and subsequent restructure of the fishery are acknowledged. However, it is noted that fishing activity in the Great Barrier Reef World Heritage Area is nearing the effort cap set under the Trawl Plan. It is of concern that the effort reductions achieved under the plan can be undermined through efficiency increases by the trawl fleet (referred to as “effort creep”). Unless this is factored into stock assessments, catch rates may appear to be stable in the fishery when in fact they are declining. Current management measures for reducing fishing effort are likely to be only partially successful.

Performance measures in the Trawl Plan to alert managers of overfishing and environmental impacts are unlikely to achieve their purpose and management intervention (in response to a review event being triggered) therefore is likely to be delayed. The review of performance indicators and review events begun by Queensland is supported. Improved performance measures should be used in any future assessments of the fishery's ecological sustainability.

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Acronyms used in the Audit Report

AFFS	Agency for Food and Fibre Sciences
AIMS	Australian Institute of Marine Sciences
AGVP	Average Gross Value of Production
ANAO	Australian National Audit Office
BRDs	Bycatch Reduction Devices
CFISH	Commercial Fisheries Information System
CPUE	Catch per Unit Effort
CRC	Cooperative Research Centre
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DGPS	Differential Geographical Positioning System
EA	Environment Australia
ECERS	Electronic Catch and Effort Recording System
ECTF	East Coast Trawl Fishery
ECOTF	East Coast Otter Trawl Fishery
EPBC Act	Environment Protection and Biodiversity Conservation Act 1999
ESD	Ecologically Sustainable Development
FAO	Food and Agricultural Organization
FRDC	Fisheries Research and Development Corporation
FIDC	Fishing Industry Development Council
GBR	Great Barrier Reef
GBRMP Act	Great Barrier Reef Marine Park Act 1975
GBRMPA	Great Barrier Reef Marine Park Authority
GPS	Geographical Positioning System
JCU	James Cook University
LOA	Length Overall
LTMP(s)	Long Term Monitoring Program(s)
MAC(s)	Management Advisory Committee(s)
MSE	Management Strategy Evaluation
MSY	Maximum Sustainable Yield
NFC	Northern Fisheries Centre
NPF	Northern Prawn Fishery
OT07	Otter Trawl Logbook (Version 7)
QBFP	Queensland Boating and Fisheries Patrol
QDPI	Queensland Department of Primary Industries
QEPA	Queensland Environmental Protection Agency
QFMA	Queensland Fisheries Management Authority

QFISH	Queensland Fisheries Information System
QFIRAC	Queensland Fishing Industry Research Advisory Board
QFS	Queensland Fisheries Service
QPWS	Queensland Parks and Wildlife Services
QSIA	Queensland Seafood Industry Association
R & D	Research and Development
Reef CRC	Cooperative Research Centre for the GBR World Heritage Area
RFISH	Recreational Fisheries Information System
RIS	Regulatory Impact Statement
SAG	Scientific Advisory Group
SFC	Southern Fisheries Centre
TAE	Total Allowable Effort
TEDs	Turtle excluder devices
TSPF	Torres Strait Prawn Fisheries
TWG	Technical Working Group
UNCED	United Nations Convention on the Environment and Development
UNCLOS	United Nations Convention of the Law of the Sea
VMS	Vessel Monitoring System
WHA	World Heritage Area

1. Executive Summary

- ◆ In October 1999, the Great Barrier Reef (GBR) Ministerial Council requested that the Great Barrier Reef Marine Park Authority (GBRMPA) conduct an annual audit on the progress of the East Coast Trawl Fishery (ECTF) in achieving the objectives of its Management Plan. The findings of the audit are contained in this report, hereafter referred to as the “Audit Report”.
- ◆ The amended *Fisheries (East Coast Trawl) Management Plan 1999*, hereafter referred to as the “Trawl Plan”, was introduced in December 2000, with most of the new provisions coming into effect on or after 1 January 2001. Since that time the fishery has undergone a major restructure with the removal of nearly 250 vessels.
- ◆ The Australian National Audit Office (ANAO), in its 1998 performance audit of the GBRMPA, listed amongst its key findings that “*the Authority (i.e. GBRMPA) does not have adequate data to determine whether it is achieving its primary objective of protecting, conserving and allowing for reasonable use of the Great Barrier Reef Marine Park*”. The Audit Report on the performance of the ECTF addresses this shortcoming for this fishery by identifying the data sources available for the management of the ECTF and examining the quality of these.
- ◆ Major improvements have been achieved in the fishery through the introduction of revised management arrangements over the past two years. There has been a significant reduction of fishing effort and the introduction of effort units has (at least nominally) capped fishing effort in the fishery. The implementation of a satellite-based Vessel Monitoring System (VMS) has enabled closer monitoring of the fleet’s activity, which has major compliance benefits and may assist with stock assessment in the longer term through better temporal and spatial analysis of catch and effort data. An additional 96,000 square kilometres of the GBR Marine Park, where trawling had not occurred previously, were closed to trawling under the revised Trawl Plan.
- ◆ The Audit Report appraises the revised management arrangements under the Trawl Plan and identifies issues that need to be addressed if there is to be confidence that the fishery is managed in an ecologically sustainable manner. Short-term and medium-term management actions are recommended to ensure the ecological sustainability of the fishery and that of the impacted ecosystems.
- ◆ In preparing this report, account has been taken of the GBRMPA’s obligations under the *Great Barrier Reef Marine Park (GBRMP) Act 1975* and the “*Guidelines for the Ecologically Sustainable Management of Fisheries*” developed by Environment Australia (EA), hereafter referred to as the “Commonwealth ESM Guidelines”. The latter ensures consistency with nationally adopted benchmarks in fisheries assessment. The audit by GBRMPA is a separate process from the fishery assessment of the ECTF by EA under the *Environment Protection and Biodiversity Conservation (EPBC) Act 1999*. However, there has been close co-ordination between the GBRMPA and EA to ensure a consistent approach.
- ◆ The Audit Report has adopted a broad interpretation in its assessment of the fishery’s performance against the objectives of the Trawl Plan. It examined how well the prescribed achievements, performance measures and review events of the Trawl Plan were met since the introduction of the revised management arrangements. The Audit Report also examined the current administrative and management processes to determine whether they are appropriate for ensuring the ecological sustainability of the fishery.

- ◆ The GBR Ministerial Council requested that the audit be done on an annual basis. Since the Council did not meet in 2001, the Audit Report has commented on the performance of the fishery over the last two years. This was considered to be a more useful approach in this instance because several of the initiatives that were commenced in 2001 were not completed until 2002. Also, several public reports on the status of the ECTF were released by the QFS during 2002 and the findings of these reports have been taken into account in the preparation of the Audit Report.
- ◆ The performance of the fishery is examined only with respect to its occurrence in the GBR Marine Park and not the fishery in its entirety (as is the case with the EA process). Accordingly, some sectors of the fishery, which lie outside the Marine Park, are not considered by the audit. While reference is made to the “ECTF” throughout this report, technically it refers only to the East Coast Otter Trawl Fishery (ECOTF), because inshore beam trawling has been omitted.
- ◆ Given the occurrence of the majority of the ECTF in the GBR Marine Park, the ecological sensitivity of the region and the high conservation status of the Great Barrier Reef, the Audit Report sets a high assessment standard and advocates the adoption of the precautionary principle in managing the region’s resources and the impacts of the fishery.
- ◆ The Trawl Plan specifies “ecological sustainability of the trawl fishery” and “sustainability of the fishery’s ecological systems” as key management objectives. Without wishing to diminish the achievements of the revised Trawl Plan, the Audit Report highlights shortcomings in certain key areas of monitoring and research, fishery assessment, environmental impact and management, which detract from achieving these objectives.
- ◆ The Audit Report acknowledges that several management issues identified in this report have been identified already by the Queensland Department of Primary Industries (QDPI) through the Queensland Fisheries Service (QFS), which manages the fishery. In some instances, processes have been set in place to address the situation. Where appropriate, the audit endorses these processes through its recommendations.
- ◆ Given the diverse nature of the ECTF and hence the complexity of its management arrangements, the 40 recommendations of Audit Report deal with some fairly technical and specific issues.

Monitoring and Research in the ECTF

- ◆ Significant improvements have been made to the information base underpinning the management of the ECTF. Sequential enhancements to the trawl logbook and the introduction of fishery-independent monitoring and research have improved knowledge about the principal (i.e. target) species over time. Previous information shortfalls (such as the recording of trawl interactions with species of conservation interest and byproduct) gradually are being addressed. However, given management’s reliance on monitoring and research data for fishery assessment, the Audit Report has identified several areas where further improvements to the information systems would be beneficial.
- ◆ Long-term security of funding for monitoring and research activities is a key issue. Much of the current funding is derived from external sources such as the Fisheries Research and Development Corporation (FRDC). This includes core activities in the management of the fishery. It is of concern that, given the current competitive funding environment, “routine monitoring and research” underpinning stock assessment is not funded as readily as new, groundbreaking research.

Recommendation 1

- ***That the QFS identifies the “true” management costs for the ECTF in terms of the monitoring and research costs and continues to pursue adequate funding for its fisheries as a matter of priority.***
- ◆ Although no precise figures were available for the audit, monitoring and research expenditure for the ECTF appears to be well below the accepted benchmark of 5 –10% of the average gross value of production of the fishery. With a growing demand to demonstrate the ecological sustainability of fisheries and a general tightening of external funding sources, it is unclear how the QDPI will manage to undertake the necessary monitoring and research in the future.

Recommendation 2

- ***That the QFS, via Trawl MAC, identifies the core monitoring and research activities for the ECTF and considers strategies through which these can be met on a continued basis.***
- ◆ The Audit Report advocates greater transparency in the research process through a formal peer review of the monitoring and research results. The regular and timely publication of research results in the scientific literature would ensure that this work is of the high standard required for public confidence.

Recommendation 3

- ***That a formalised process of regular peer review of monitoring and research results be developed for the ECTF through Trawl MAC.***
- ◆ The Audit Report recommends that a strategic Research and Development (R&D) Plan be developed for the ECTF to ensure that the monitoring and research programs remain focused on priority areas and address identified information gaps. This will assist in obtaining external funding for important research.

Recommendation 4

- ***That a strategic R&D Plan, which identifies and prioritises the information gaps for monitoring and research in the ECTF and which provides input into external R&D processes, be developed through Trawl MAC.***
- ◆ The Audit Report has examined the information systems in place for the ECTF. The importance of the VMS in providing real-time, high-resolution, spatial information is recognised. More improvements are expected as researchers develop techniques to analyse trawl tracks for fishery assessment purposes. The Audit Report advocates that the feasibility of introducing gear monitors to supplement the VMS be investigated further.

Recommendation 5

- ***That the development of gear monitors in the ECTF be pursued to a prototype stage and that a cost-benefit analysis be undertaken on the use of this system as a fisheries management and monitoring tool.***
- ◆ Commercial ECTF logbooks are a key information source for fishery assessment and they have improved significantly since early 2001. Whilst relatively “cheap” and readily available, such fishery-dependent data have limitations. They provide information only on those parts of the fishery where there is commercial activity (generally on a broad geographical scale). Given the multi-species nature of the ECTF, catch composition often is recorded inaccurately and there is no reliable information on targeting. Logbooks only

record target and by-product species. The uncertainty over the accuracy of these data is of concern. The Audit Report advocates the implementation of fishery-wide monitoring programs as a secondary and independent source of fishery information to overcome these limitations.

Recommendation 6

➤ *That the QFS determines and implements specific and statistically well-designed fishery-wide monitoring programs, which supplement the existing programs and provide essential fishery assessment information currently not provided through the trawl logbook.*

- ◆ In early 2003, the requirement to record interactions with species of conservation interest was introduced. Whilst the onus is on the licence holders to report to EA any interaction with environmentally listed wildlife, the QFS is now in a position to assess the impact of the fishery on species of conservation concern.

Recommendation 7

➤ *That the interaction of trawl operations with species of conservation interest (as listed under the EPBC Act) be reported annually in the Status Report for the ECTF.*

- ◆ The Audit Report recommends the integration of VMS and logbook data, once the interpretation of VMS tracks has been resolved. This would allow for a fine-scale spatial analysis of the fishing activity recorded in logbooks.

Recommendation 8

➤ *That, as the results of the VMS interpretation study become available, a fine-scale analysis of VMS data be integrated with the logbook data analysis in the fishery assessment process.*

- ◆ The Audit Report anticipates further (and possibly significant) effort creep in the fishery, following the structural adjustment of early 2001. Gear information has been collected by the logbooks since their introduction. The report advocates that this information be used as a baseline to investigate effort creep in the fishery post-2001.

Recommendation 9

➤ *That the information provided on the logbook gear sheets be reviewed annually as part of the fishery assessment process and that this information be used in the planning of on-going assessments of effort creep.*

- ◆ A key issue in using logbook data for fishery assessment purposes relates to the accuracy of reported information. The Audit Report cites examples where the veracity of logbook information is questioned. It is recommended that the logbook data be validated independently, such as through at-sea observer programs or the auditing of processor records of landed catch.

Recommendation 10

➤ *That the QFS determines and implements an at-sea observer program, which validates the information provided in the trawl logbooks.*

- ◆ The Audit Report recognises the potential benefits of the electronic catch effort recording system (ECERS) in terms of its ability to monitor fishing activity on a real-time basis. The report argues that in an input-managed fishery such a tool is essential to ensure that effort limitations are not exceeded.

Recommendation 11

➤ *That a feasibility study be undertaken on the introduction of an ECERS throughout the ECTF, specifically with a view to monitoring the level of fishing activity in the GBR World Heritage Area on a real-time basis.*

- ◆ The continuation of annual, fishery-independent, long term monitoring programs (LTMPs), such as are conducted in the scallop and tiger/endeavour prawn fishery in North Queensland, is supported. The LTMPs address information gaps in the logbook data. However, a limitation is that these surveys are conducted only in areas of major commercial fishing activity. A review of the LTMPs is recommended to ensure that maximum benefit is derived from this costly (but essential) research. The review should consider the information demands now and in the future.

Recommendation 12

➤ *That a peer review be conducted on the design of the current ECTF LTMPs, with a view to:*

- (a) identifying the bias in sampling established trawl grounds;*
- (b) assessing the use of the data in current and future stock assessments; and*
- (c) extending the spatial coverage of the surveys.*

- ◆ The Audit Report notes that ECTF-associated researchers have adopted (through necessity) an “opportunistic” approach, making use of a range of research providers and funding sources. However, there is a danger that research may become “interest driven”. A more structured approach to meeting the information gaps in the fishery is advocated.

Fishery Assessment in the ECTF

- ◆ The Audit Report acknowledges that stock assessment in the ECTF is a challenging and resource intensive task, given the wide geographical range of the fishery and its extensive species mix. Most target species are short lived (1 to 2 years) and there are high inter-annual and seasonal variations in catches and catch rates. Notwithstanding these constraints, the methodology used in the ECTF assessment process has several limitations.
- ◆ To date, assessments for the fishery have been based primarily on Catch per Unit Effort (CPUE) analysis. Stock assessment has been confined to some principal (target) species. Permitted species generally have not been addressed. The QFS has concluded in several status reports on the ECTF that while many of the key species appear to be “fully exploited”, their CPUE has remained relatively stable.
- ◆ The predominant use of fishery-dependant data in the stock assessment process may have introduced a bias about species distribution and abundance, which is difficult to quantify. Furthermore, historical data (where available) lack resolution in terms of species composition and fine-scale spatial effort patterns. This situation, together with concerns about the accuracy of unvalidated logbook data, raises concern over the reliability of the information used in the stock assessment process.
- ◆ Logbook data in the ECTF have been collected only since 1988. There is some historical information available from early processor records, voluntary logbooks and other studies, but it is incomplete and unchecked at this stage. The Audit Report stresses the need to conduct assessments over the life of the fishery in order to obtain the necessary contrast in the data to show the impact of the fishery on virgin biomass and to determine the relationship between equilibrium yield and fishing effort or stock size.

Recommendation 13

- ***That, notwithstanding data quality and compatibility issues, an attempt be made to analyse historical (i.e. pre-1988) ECTF data and to assess the level of catch and effort since the fishery's inception.***
- ◆ In input-managed fisheries, changes in the effective fishing power of the fleet need to be monitored closely. This phenomenon, known as “effort creep”, has the potential to undermine any effort reductions imposed by management. If such changes are not factored into the assessment process, catch rates may appear to be steady when in fact they are declining. Interim results show that changes in fishing power in the ECTF are variable and fishery specific. In the scallop fishery it was calculated at 0.2% per year, whereas in the shallow-water eastern king prawn fishery it was calculated to be 1.6% per year. The Audit Report notes that these results refer only to the 1989-1999 period. They do not capture the technological changes in the fishery's early history, nor any recent changes since the 2001 restructure.

Recommendation 14

- ***That there be a review of the estimated changes in fishing power in the ECTF from the fishery's inception in the 1960s till today, using both historical (pre-1988) and recent (1988 – today) data.***
- ◆ There is considerable spatial variability amongst the ECTF species, including a latitudinal trend in catch composition, aggregating behaviour, habitat preference and lifecycle-dependent distribution. Also, fishing effort is highly aggregated, with less than 31% of the available area in the GBR Marine Park being trawled in 2001. Without fishery-wide, independent surveys, it is difficult to assess species abundance in areas outside trawl grounds. Spatial variability complicates the interpretation of commercial CPUE data, because it is unknown if observed trends are a reflection of species abundance or fleet behaviour.

Recommendation 15

- ***That, as part of the fishery assessment process, there be a fine-scale spatial analysis of the fishery in terms of species abundance and fishing effort over time, and that appropriate stratifications be applied to the CPUE data to account for the fishery's spatial variability.***
- ◆ Temporal variability can be high in tropical penaeid prawn fisheries. Species that depend on environmental conditions (such as rainfall in the case of banana prawns) may show highly variable catches and catch rates from year to year. Species with succinct spawning and recruitment events may show strong seasonal abundance. Lunar periodicity is common in most ECTF prawn species. The Audit Report stresses the need to recognise these patterns and to account for them in the assessment process.

Recommendation 16

- ***That, as part of the fishery assessment process, there be a temporal analysis of the fishery in terms of known species abundance and fishing effort over time and that appropriate stratifications be applied to the CPUE data to account for the fishery's temporal variability.***
- ◆ The multi-species nature of the ECTF introduces a further level of complexity in the assessment process. Certain species are taken as by-product either regularly or occasionally. It cannot be assumed that CPUE is a good indicator of stock abundance for species not targeted specifically. For example, Moreton Bay bugs are listed as a principal species under the Trawl Plan. Except for areas off Townsville and Gladstone, where they

appear to be abundant, generally they are taken as by-product only. In assessing the long-term CPUE trends for Moreton Bay bugs, scientists have compared catch rates from these regions rather than the whole fishery.

Recommendation 17

➤ *That, based on all available data (i.e. logbook, LTMPs and research data), there be an assessment of the spatial distribution of commercial by-product species in the ECTF.*

- ◆ In light of the data uncertainties identified in the fishery assessment process and the limitations in the use of CPUE as a performance indicator, it is of concern that sole reliance on nominal CPUE trends may fail to warn of overfishing in the ECTF in a timely manner.

Recommendation 18

➤ *That there be a peer review of the use and limitations of using CPUE as an indicator of abundance for all principal and permitted ECTF species.*

- ◆ Assessment models are being developed for the major commercial species (scallops, tiger prawns, endeavour prawns and bugs). The Audit Report supports the development of alternative assessment techniques, but acknowledges that this may take time as relevant population parameters are tested and sensitivity analyses are conducted to determine the impact of data uncertainty on the assessments.

Recommendation 19

➤ *That the development of assessment models for the principal ECTF species be progressed as a matter of priority and that they be used in the recommended annual fishery assessment process as the input data become available.*

- ◆ The Audit Report provides an appraisal of the stock assessment findings of each of the principal species, as reported in various fishery status reports (Table 1).

Table 1: Key findings of the Audit Report on the assessment status of the principal ECTF species.

Species Grouping	Commercial Value	Reported CPUE Trend	CPUE as Performance Indicator	Alternative Assessment Methods	Population Status	Estimated Sustainable Catch	Life Cycle & Biology Knowledge
Tiger Prawns *	High	Slightly decreasing	Adequate	Surplus Production Model	Fully exploited	1,227-1,400 t/yr for FNQ	Good - Adequate
Endeavour Prawns	High	Slightly decreasing	Adequate	Surplus Production Model	Fully exploited	1,053 t/yr.	Good - Adequate
Northern King Prawns *	Medium	Decreasing	Adequate - Poor	Nil	Possibly over-exploited	Unknown	Adequate
Banana Prawns	Low	Decreasing	Poor	Nil	Unknown but likely to be sustainable	Unknown	Adequate - Poor
Eastern King Prawns *	High (outside Marine Park)	Decreasing	Adequate - Poor	Age structured model	Possibly over-exploited	Unknown	Good - Adequate
Scallops *	High	Decreasing	Poor	Age	Heavily	Unknown	Good -

Species Grouping	Commercial Value	Reported CPUE Trend	CPUE as Performance Indicator	Alternative Assessment Methods	Population Status	Estimated Sustainable Catch	Life Cycle & Biology Knowledge
				structured model	exploited		Adequate
Bugs *	Low	Decreasing	Poor	Nil	Possibly fully exploited	Unknown	Adequate - Poor
Squid	Low	Decreasing	Poor	Nil	Unknown	Unknown	Poor

*Note: 1. * denotes there are demonstrated cases of overfishing for these species within Australia.
2. FNQ refers to Far North Queensland.*

- ◆ The Audit Report recommends the formalisation of the ECTF assessment process. It is suggested that there be an expertise-based, annual research review and fishery assessment process, with appropriate information feedback to management, researchers, Trawl MAC and external funding bodies. Publication and dissemination of results should occur so that the most current fishery assessment information can be considered in the formulation of fisheries policy. This would focus and optimise the monitoring, research and fishery assessment work.

Recommendation 20

- *That a formalised fishery assessment process be developed for the ECTF, through Trawl MAC, which involves an expertise-based team reviewing research results and conducting the fishery and stock assessment process.*

Recommendation 21

- *That the proposed assessment process be extended to include consideration of by-product and bycatch species taken in the ECTF.*

Recommendation 22

- *That, where there are stocks of species with distributions which extend outside Queensland, the ECTF assessment process take account of the research and stock assessment work done by other jurisdictions and that there be collaboration in the stock assessment.*

Environmental Impact of the ECTF

- ◆ Research has shown that benthic prawn trawling can have a significant environmental impact on the benthos and benthic communities. Bottom trawling is an indiscriminate method of capture, as indicated by high bycatch to catch ratios. Tropical prawn fisheries in particular are marked by high species diversity, the majority of which are bycatch.
- ◆ Monitoring and research work on the environmental impact of trawling in the ECTF has been, by necessity, opportunistic and *ad hoc*. Several studies have yielded detailed information on specific aspects of the fishery, but there has not been a systematic approach across the entire fishery. Until recently, only limited information had been collected on the bycatch composition of the various sectors of the ECTF.

Recommendation 23

- *That the proposed at-sea observer program collects detailed information on the composition, size and the condition of the bycatch taken in the ECTF and that this*

information be analysed regularly as part of the proposed annual fishery assessment process.

- ◆ Much of the ECTF bycatch in the GBR Marine Park appears to be made up of highly fecund, short-lived species, which are believed to be at a lower risk from overfishing than longer-lived species. However, trawling also has an impact on a range of species of conservation concern, including marine turtles, sea snakes, seahorses and pipefish and many shark species.

Recommendation 24

- *That there be further monitoring and research on the incidental bycatch of sea snakes in the ECTF.*

Recommendation 25

- *That there be further monitoring and research on the incidental bycatch of syngnathids and solenostomids in the ECTF, specifically with respect to their distribution within the area of the fishery.*
- ◆ The Audit Report notes the findings of the five-year study into the benthic impact of trawling in the Far Northern Section of the GBR Marine Park. A richness of biodiversity was demonstrated in the lagoonal and inter-reefal seabed and five biophysical zones were identified across the continental shelf according to their sediment type and benthic communities. The study found that trawling had a major impact on the seabed, if the fishing effort was intensive and repeated. The ability of the seabed community to recover from the impact of trawling depended on the resilience of the fauna to recover from the trawl impact and the amount of fishing effort that had been applied. The study concluded that in areas of heavy trawl activity the habitat was likely to have been modified extensively.
- ◆ Various bycatch mitigation devices are deployed in the ECTF. Turtle excluder devices (TEDs) mainly exclude marine turtles and other large bycatch such as sharks, rays and big sponges. As a result of changes to the Trawl Plan in late 2002, these devices must be used in all sectors of the ECTF and must comply with certain technical design standards. Bycatch reduction devices (BRDs) are installed primarily to exclude smaller bycatch. As there are over 1,000 bycatch species, with different swimming and behavioural characteristics, there is no common design standard that can be used for all. The Audit Report reviews the various BRDs used in the ECTF and presents preliminary data on their relative effectiveness in excluding bycatch without major product loss.

Recommendation 26

- *That the further development of BRD technology be encouraged and that performance standards, which can be applied in the performance assessment of BRDs, be developed by a group of technical experts.*
- ◆ Other measures to reduce bycatch mortality and enhance bycatch survival include the use of hoppers, which are used extensively throughout the Northern Prawn Fishery (NPF). This technology is yet to be adopted in the ECTF for smaller trawlers. Also, gear restrictions and a voluntary code of conduct on trawl times and net sizes in inshore waters off Cairns have lead to the reduction of bycatch and benthic impacts.

Recommendation 27

- *That the development and adoption of hopper technology be encouraged.*

- ◆ The Audit Report recommends that a risk assessment be undertaken in the ECTF on bycatch vulnerability to trawling. While there are several models to choose from, a quantitative approach that is based on estimated vulnerability of the bycatch species, the percentage of the population exposed to trawling and the intensity of the trawl effort, is recommended.

Recommendation 28

- *With a view to developing a risk-assessment for ECTF bycatch species, that there be an expertise-based review of those species and, that based on currently available information:*
 - (a) the species (or species groupings) taken in the ECTF be identified; and*
 - (b) their vulnerability to trawling be assessed, taking into account their known distribution and the amount of fishing effort applied.*

Management Arrangements in the ECTF

- ◆ The ECTF is a complex, multi-species fishery and, for these reasons, it is difficult to monitor, assess and manage. The Audit Report acknowledges that input-based management is the most appropriate regime for the ECTF. Fisheries management needs to balance the economics of the fishery against its ecological sustainability. A precautionary approach dictates the adoption of a risk-averse management strategy, especially when dealing with uncertain fisheries data.
- ◆ Typically, fisheries management in Australia has been focussed on target species. This approach fails to encompass the wider ecosystem impacts of the fishery. The ECTF assessment and management regimes must encompass a more holistic approach as information about the ecosystem interactions in this fishery becomes available.
- ◆ If the ecological sustainability of the ECTF is threatened, recognition may come too late and management actions may be delayed. The QFS has indicated that the objectives of its fisheries legislation are to be reviewed. The Audit Report recommends a stronger focus on the objectives relating to ecological sustainability, a clear precedence of the ecological sustainability objectives over the economic objectives (if the fishery is not ecologically sustainable, it will not be economically sustainable) and the adoption of the precautionary principle.

Recommendation 29

- *That there be a review of the objectives of the Trawl Plan, with a view to ensuring the ecological sustainability of all ECTF species, maintaining biodiversity and incorporating the principles of ESD (including the adoption of the precautionary principle).*
- ◆ The lack of predetermined decision rules is of concern. Once there are signs of overfishing, an evaluation of possible management options will cause delays in taking remedial action. Such measures should be considered in advance, using a formal management strategy evaluation (MSE) approach based on simulation modelling.

Recommendation 30

- *That, as the fishery assessment process is improved, there be an expert-based review of the management measures that can be applied in situations where there is a decline in the ECTF's performance below prescribed levels and that the decision rules for such action be tested using a MSE approach.*

- ◆ The Audit Report is critical of the performance measures contained in the Trawl Plan. It is argued that these are not prescriptive enough in terms of how the assessments of the fishery's economic or ecological performances are to be conducted and the timeframe within which action must begin. The Audit Report points out that data must be available and of sufficient quality in order to be used in the prescribed surveys and studies.

Recommendation 31

- *That, as the fishery assessment process is improved, there be an expert-based review of the performance measures specified in the Trawl Plan.*

- ◆ The Audit Report is critical of the Trawl Plan's performance indicators. A detailed appraisal is provided of the biological, ecological, enforcement and fisheries performance indicators and the events that would trigger some type of review. It is noted that review events have been triggered in the past without any action being taken. There is ambiguity in the wording of most of the performance indicators, which leaves scope for interpretation. The Audit Report supports the review processes for the performance indicators initiated by the QFS.

Recommendation 32

- *That the current review of performance indicators and review events be completed by the end of 2003 and that amendments be made to the Trawl Plan by early 2004 (incorporating the recommendations of the review) and that these revised performance indicators be used in assessing the status of the ECTF by the end of 2004.*

- ◆ The Audit Report supports the use of input-based management measures because this approach is the most pragmatic for highly variable prawn fisheries. However, this approach has several limitations, which need to be recognised. Input-based management measures are not species specific. A possible decline in any one of several species taken in the fishery cannot be addressed in isolation. The application of available management measures (such as extended temporal and spatial closures) would result in restrictions on the take of species not of assessment concern.
- ◆ The effort reductions achieved through the introduction of the revised Trawl Plan and the Structural Adjustment Scheme are acknowledged. However, the Audit Report views the allocation of an additional 14 steaming days per operator in 2001 as an allocation of additional effort (8%). The reduction of steaming days to four in late 2001 is seen as an improvement, but still is in excess of what the QFS' own analysis has indicated as being required by the fleet. In this context, the implementation of gear monitors is recommended for the ECTF.
- ◆ The issues of most concern with the current ECTF management arrangements are the potential for increase in real fishing effort and the Trawl Plan's inability to reduce fishing effort directly if this becomes necessary. Under the current effort unit system, reductions can be achieved only through the penalty provisions for vessel upgrades and the transfers of licences and effort units (to compensate for effort creep in the fishery), increased temporal and spatial closures and the emergency closure and banning powers of the QFS's Chief Executive. The Audit Report points out that, based on fisheries experiences world-wide, industry usually will develop ways to compensate for these effort reductions through increased efficiency.
- ◆ The Audit Report proposes the introduction of a proper "Total Allowable Effort" (TAE) system, which allows for the adjustment of effort on an annual basis in light of the latest assessment advice. A formal fishery assessment process (which considers allowable effort levels and changes in fishing power) is a requirement for a TAE system.

Recommendation 33

- *That the QFS considers the feasibility of adopting a TAE system, in which the permitted effort level is reviewed and adjusted (if necessary) on an annual basis in light of fishery assessment advice, and which permits the across-the-board reduction of effort units if this is required for resource sustainability.*
- ◆ The Audit Report generally supports the suite of management measures contained in the Trawl Plan. The introduction of a VMS is seen as a positive step in obtaining real-time, high-resolution data on trawl activity that will have enforcement and fishery assessment benefits.
- ◆ The adequacy of the current possession and minimum size limits for principal and permitted species is addressed. The Audit Report questions both the scientific basis for setting some of these limits and their enforceability. It is suggested that greater emphasis should be placed on the management of by-product (i.e. permitted species).

Recommendation 34

- *That there be a review of the current limits on by-product (i.e. permitted species) in light of new fishery assessment advice and adopting the principles developed for adding or removing species from the “permitted species” list.*
- ◆ The Audit Report supports the initiatives by the QFS to develop a more rigorous system for the determination of species classification (as principal, permitted or bycatch) based on the best available stock assessment advice.

Recommendation 35

- *That a process be determined for adding species to and removing them from the categories of “principal species” and “permitted species” under the Trawl Plan, taking into account the status of information on the species and adopting a precautionary approach in light of any uncertainty.*
- ◆ The Audit Report is critical of the time it has taken to revise the TED and BRD provisions of the Trawl Plan in order for them to be enforceable. It is acknowledged that the technical specifications for TEDs finally were resolved in late 2002 and that now they are consistent with the standards in other prawn fisheries and the provisions of the Turtle Recovery Plan (still in draft). With respect to BRDs, there are improvements still to be made. The Audit Report acknowledges that the development of appropriate BRD technology is a lengthy, complex and resource-intensive issue. A rigorous system for developing and testing new devices is supported.

Recommendation 36

- *That the Trawl Plan be amended, as a matter of priority, to tighten the current BRD provisions, taking into account the specifications recommended by the Technical Working Group of Trawl MAC.*

Recommendation 37

- *That a process be determined for adding new or removing existing BRDs from the permitted devices listed under the Trawl Plan, taking account of proposed technical performance standards developed for such devices.*

Recommendation 38

➤ *That there be more stringent enforcement of the TED and (proposed revised) BRD provisions of the Trawl Plan and that annual statistics be provided on the level of compliance.*

- ◆ The level of compliance with the Trawl Plan's management arrangements is integral to the plan's performance. The adequacy of current enforcement and surveillance arrangements are discussed throughout the Audit Report. Penalties, which act as a disincentive for non-compliance, are important. Acknowledging the QFS' Chief Executive's discretionary powers in this regard, the Audit Report urges the adoption of more stringent administrative sanctions for "serious fisheries offences".

Recommendation 39

➤ *That there be a greater level of reporting on enforcement and compliance issues in the ECTF, including the types of offences committed, the number of inspections (where relevant) and the subsequent legal and administrative actions.*

Recommendation 40

➤ *That there be a review of the types of offences considered "Serious Fisheries Offences" under the Trawl Plan 1999, identifying the administrative actions (if any) taken by the QFS and the grounds on which action was taken or not taken.*

Summary

- ◆ An appraisal of how well the objectives of the Trawl Plan have been met in the past two years since the introduction of the revised management arrangements is presented in Table 2. The rationale for these comments is contained in Sections 4, 5, 6 and 7 of the Audit Report.
- ◆ The Audit Report notes that the performance indicators of the Trawl Plan generally have been met, as per the reports on the "*Status of the Queensland East Coast Otter Trawl Fishery after the First Effort Year (2001)*" (QFS, 2002) and the "*Ecological Assessment of the Queensland East Coast Otter Trawl Fishery*" (Zeller, 2002). However, the adequacy of the Trawl Plan's performance measures, indicators and review events in detecting issues of concern is questioned. The Audit Report supports the review of these provisions of the plan so that appropriate changes can be made and more meaningful performance measures and indicators can be used in the assessment of the ECTF's ecological sustainability by the end of 2003.
- ◆ Clearly, changes to the revised Trawl Plan have progressed the ecological sustainability of the ECTF and assisted with the mitigation of the impact of the fishery on the environment. The Audit has indicated where further improvements are required if the fishery is to be managed according to public expectations of the management of the natural resources of the Great Barrier Reef Marine Park and in line with the requirements of the Commonwealth's environmental legislation. The recommendations of this report should be therefore viewed as constructive advice on how current arrangements may be improved.

Table 2: Provisions of the Trawl Plan regarding its management objectives, achievement measures, performance measures, review events and performance indicators, and the Audit Report’s appraisal of each.

Objective (a) “Manage the fishery in a way that gives optimal, but sustainable community benefit”	
Management Plan Provisions	Audit Report’s Comments
<p>How objective is to be achieved The objective is to be achieved by providing fair fishing opportunities for commercial and recreational fishers and Aborigines and Torres Strait Islanders.</p> <p>How achievement is to be measured Achievement of the objective may be measured only by–</p> <p>(a) surveys, accepted by the chief executive, of fishing for fisheries resources taken in the fishery by commercial and recreational fishers and Aborigines and Torres Strait Islanders; and</p> <p>(b) commercial fishing catch and effort data for the fishery received by the chief executive.</p> <p>Review events The review events for the achievement of the objective are–</p> <p>(a) a survey mentioned in (a) above shows a significant decline in the catch of principal fish; or</p> <p>(b) data mentioned in (b) above shows a significant decline in the commercial catch of principal fish;</p>	<ul style="list-style-type: none"> ➤ Access is granted to all stakeholders in the ECTF (including commercial, recreational and indigenous people). “Fair fishing opportunities” has not been defined and information is limited on the participation of non-commercial fishers. The Audit Report is therefore not in a position to comment on how well this objective has been achieved. ➤ Recreational fisheries data are collected through biennial recreational fishing surveys in Queensland. Information is presented on the state-wide recreational take of “prawns”. Information on the Indigenous take of ECTF species does not appear to be available. [See Section 4.3.6.] ➤ Commercial fishing data are received by the QFS through ECTF logbooks. There are some concerns about the veracity and level of resolution of these data and, consequently, their impact on fishery assessment. [See Sections 4.3, 4.4, 5.2, 5.3, 5.5 and 7.1.] ➤ These review events relate to the economic performance of the ECTF. ➤ “Significant” is not defined. Terms of Reference for the survey are not defined. ➤ Catches may decline for reasons other than resource abundance (e.g. fewer operators, less effort, weather conditions, etc.). Stock assessment is required to determine the reasons behind declining catches of principal species. [See Sections 5.2, 5.3 and 5.5.] ➤ The review events are target species-specific. A community cost is involved if the sustainability of by-product or bycatch species becomes threatened as a result of overfishing and/or the impact of trawling.

Objective (b) “Ensuring fisheries resources taken in the fishery are taken in an ecologically sustainable way”	
Management Plan Provisions	Audit Report’s Comments
<p>How objective is to be achieved</p> <p>The objective is to be achieved by the following -</p> <ul style="list-style-type: none"> (a) the provisions of this plan about effort units; (b) the closed waters declarations under this plan; (c) the regulated fish declarations under this plan; (d) limiting, under chapters 3 and 4, the commercial fishing apparatus that may be used under the plan; (e) the boat modification and replacement restrictions under chapter 3, part 8; (f) the main engine power restrictions under chapter 3, part 8, division 2 for boat modification or replacement. <p>How achievement is to be measured</p> <p>Achievement of the objective may be measured only by the following -</p> <ul style="list-style-type: none"> (a) the level of compliance with this plan; (b) catch and effort data received by the chief executive for principal fish; (c) the abundance of principal fish; (d) how many effort units are surrendered under sections 117, 118 and 132(2); 	<ul style="list-style-type: none"> ➤ Measures (a) to (f) are primarily input-control management tools with the potential to limit expanding fishing effort. As with most input controls, increased efficiency by the fleet (i.e. effort creep) generally overcome these effort limitations. [See Sections 5.2, 7.1, 7.3 and 7.5.] ➤ With respect to (a), the number of effort units and the value of effort units cannot be altered under current Queensland fisheries legislation. [See Section 7.3.2.] ➤ With respect to (b) and (c), restrictions on the available area of the fishery and target species may result in the redistribution of effort. [See Sections 7.3.4 and 7.3.5.] ➤ With respect to (b) and (c), these restrictions partially limit the effort that may be applied in the fishery. However, other factors (not restricted) can lead to increases in effective effort by the fleet. [See Section 7.3.2.] ➤ Insufficient compliance information has been provided by the QDPI to measure achievement. [See Sections 7.2.3 and 7.3.7.] ➤ There are concerns over the unverified nature of ECTF logbook data and the appropriateness of nominal CPUE as a performance indicator for stock abundance. By the time significant declines are noticed in the nominal CPUE, the fishery may already be over-fished. [See Sections 5.2, 5.3. 5.5 and 7.1.] ➤ The Audit Report notes that current ECTF stock assessments examine primarily nominal CPUE trends. Fishery-independent stock assessments and the development of assessment models are limited in the ECTF. Also, assessment of the sustainability of the ECTF resources is restricted to principal (i.e. target) species only. [See Sections 5.2 and 5.3.] ➤ Information on effort unit holdings and transactions is monitored by the QFS. The Audit Report notes that if effort creep exceeds the effort reductions achieved through the surrender of effort units, there will be an increase in effective effort in the fishery. [See Sections 5.2.3, 7.2.4 and 7.3.2.]

<p>(e) studies or surveys accepted by the chief executive on the average size, or the main engine power, of boats in the fishery.</p> <p>Review events Each of the following is a review event for the achievement of the objective-</p> <p>(a) CPUE for the following principal fish in the following periods is less than 70% of the average CPUE for principal fish from 1988 to 1997-</p> <p>(i) for bay prawns (greasy prawns) – 1 November to the end of February;</p> <p>(ii) for eastern king prawns – 1 November to the end of February and 1 May to 31 August;</p> <p>(iii) for bugs – 1 November to the end of February or 1 May to 31 October;</p> <p>(iv) for red spot king prawns – 1 June to 30 September;</p> <p>(v) for saucer scallops – 1 November to the end of February;</p> <p>(vi) for tiger prawns – 1 March to 30 June and 1 September to 31 December;</p> <p>(b) the chief executive accepts a study of catch and effort data that show a significant decline in a principal fish;</p> <p>(c) the chief executive accepts a scientific study that show a significant decline in the abundance of a principal fish species;</p>	<p>➤ Average boat size has increased in the ECTF following the licence buy-out in early 2001. Regular collation of these data is required to monitor the situation on a continual basis.</p> <p>➤ The Audit Report is concerned about the sole reliance on nominal CPUE as a performance indicator of stock abundance and notes that the 70% reference point is based on Western Australian stock assessment findings for tiger prawns. The wording of the review period is defined poorly, leaving ambiguity as to its interpretation. Some principal species and all bycatch species are not covered by the review event. The adequacy of the review periods is questioned for some species. The Audit Report notes that a review event has been triggered potentially (depending upon definition) for 4 of the 6 listed species. There has been on subsequent management action. [See Sections 7.1.4 and 7.2.1.]</p> <p>➤ Review period coincides with fishery season and recruitment period. Review event has been triggered potentially.</p> <p>➤ Review period coincides with fishery season and recruitment period.</p> <p>➤ Review period coincides with fishery season and spawning period. Review event has been triggered potentially.</p> <p>➤ Review period coincides with fishery season and spawning period. Review event has been triggered potentially.</p> <p>➤ Review period coincides with fishery season.</p> <p>➤ Review period coincides with fishery season, spawning and recruitment period. Review event has been triggered potentially.</p> <p>➤ By the time significant declines are noticed in nominal CPUE, the fishery may be over-fished already. “Significant” is also not defined. [See Sections 5.2, 7.1 and 7.2.]</p> <p>➤ With the exception of tiger and endeavour prawns, there are no published assessment reports on the maximum sustainable yield of the ECTF species. Nominal CPUE trends are generally used as an indicator of stock abundance. Only the key principal species are assessed regularly. [See Sections 5.2 and 5.3.]</p>
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<p>(d) more than 5% of boats in the fishery in 2000 or a subsequent year are used to commit an offence under the plan;</p> <p>(e) the number of effort units has not decreased by-</p> <p>(i) 13% or more in the first effort year;</p> <p>(ii) 1% or more in any subsequent effort year; or</p> <p>(iii) 2% or more during 2 consecutive effort years for any licence;</p> <p>(f) the chief executive accepts a study or survey that shows –</p> <p>(i) a significant change in the relative distribution of boat hull units in the fishery; or</p> <p>(ii) average main engine power for boats in the fishery is increasing.</p>	<p>➤ Notwithstanding the ambiguity in the wording of this review event, the review event appears to have been triggered in 2001. [See Sections 7.2.3 and 7.3.7.]</p> <p>➤ Effort unit reductions through effort unit surrenders and penalties on transactions amounted to 3% in 2001 and accord with the outcome of the GBRMC28. The situation will need to be monitored closely and estimates of effort creep in the ECTF since 1 January 2001 are required. [See Sections 5.2.3 and 7.3.2.]</p> <p>➤ Average boat size has increased in the ECTF following the licence buy-out in early 2001. Regular collation of these data is required to monitor the situation on a continued basis.</p> <p>➤ Apart from the gear sheet information in the OT07 logbooks, this information is not collected routinely. The last comprehensive survey on fleet profile was conducted prior to the structural adjustment scheme and the introduction of revised management arrangements. Increases in hull size and engine power are likely to lead to effort creep in the ECTF under the new management arrangements. [See Sections 5.2.3 and 7.2.1.]</p>
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Objective (c) “Ensuring the sustainability of the fishery’s ecological systems”	
Management Plan Provisions	Audit Report’s Comments
<p>How objective is to be achieved The objective is to be achieved by -</p> <p>(a) the closed waters declarations under this plan; and</p> <p>(b) limiting, under chapters 3 and 4, the commercial fishing apparatus that may be used under this plan; and</p> <p>(c) the requirements under this plan for using a BRD or TED</p> <p>How achievement is to be measured Achievement of the objective may be measured only by surveys or studies, accepted by the chief executive, of commercial fishing for principal fish by trawling in the fishery.</p> <p>Review events Each of the following is a review event for the achievement of the objective-</p> <p>(a) a scientific study, showing levels accepted by the chief executive, shows the amount for any of the following is not, by 1 January 2005, reduced by the following percentage compared with an amount reported in a scientific study showing the levels before the notification day-</p> <p>(i) benthos-25%;</p>	<p>➤ Seasonal closures to protect parts of the life cycle may assist certain susceptible bycatch species. Similarly, spatial closures may assist susceptible bycatch species that demonstrate a strong habitat preference. Closures also would limit the impact of trawling on fragile benthic habitats. However, little is known about the biology of most bycatch species and ecosystems to make such assessments. [See Section 6.1.3.]</p> <p>➤ Limitations on fishing apparatus may assist, but requires knowledge of how trawling impacts on bycatch species, benthic communities and habitat. [See Section 6.2.4.]</p> <p>➤ The requirement for minimum design standards for TEDs was revised under the Trawl Plan in December 2002, making the permitted TED designs more stringent to ensure effective deployment. The provisions for BRDs still are to be revised to maximise their effectiveness. Further research and development also is required into BRD designs. [See Sections 6.2.1 and 7.3.6.]</p> <p>➤ The health and sustainability of the fishery’s ecological systems cannot be measured by the population dynamics of the target species. There are no regular surveys or studies to assess the impact of trawling or changes in bycatch species composition. There is no formal ecological assessment process. [See Sections 4.3.4 , 6.3.3 and 6.3.5.]</p> <p>➤ In order to measure comparative reductions, knowledge is required of the “baseline“. There are no systematic surveys or studies, which quantify the benthic impact and bycatch for the entire ECTF prior to 1 January 2001. The Terms of Reference for a scientific study have not been specified. [See Section 7.2.2.]</p> <p>➤ The 25% figure is not justified in terms of ecological sustainability, nor is it specified how it will be calculated.</p>

<p>(ii) the amount of fish taken other than principal fish-40%;</p> <p>(b) more than 5% of boats in the fishery in 2000 or a subsequent year are used to commit an offence under the plan;</p> <p>(c) turtle capture or mortality for any of the following species is in any year more than 5% of the average level of turtle capture or mortality for species in the Robins report-</p> <ul style="list-style-type: none"> (i) flatback turtle; (ii) green turtle; (iii) hawksbill turtle; (iv) leatherback turtle; (v) loggerhead turtle; (vi) olive ridley turtle; <p>(d) the chief executive receives a logbook return for the fishery that shows trawling has happened in an area represented on a grid stated in the logbook where trawling has not previously been recorded in a logbook return;</p> <p>(e) the chief executive accepts a scientific study or survey that shows the level of winter whiting by-catch between 1 April and 1 June has not significantly declined in the area mentioned in schedule 3, section 72(1), before 2003.</p>	<ul style="list-style-type: none"> ➤ The 40% figure is not justified in terms of ecological sustainability, nor is it specified how it will be calculated. ➤ Notwithstanding the ambiguity in the wording of this review event, the review event appears to have been triggered in 2001. [See Sections 7.2.3 and 7.3.7.] ➤ With an amendment to the minimum TED design specifications in the Management Plan, the likelihood of turtle capture should have been significantly reduced. There is no independent verification of logbook reports of turtle interactions. [See Sections 6.1.2, 6.2.1. and 7.2.2.] ➤ The Audit Report is unaware of any data to ascertain if the review event has been triggered. This review event presumably refers to fishery expansion rather than illegal fishing in closed zones. Onus should be on the regular monitoring of spatial fishery-wide trends (in terms of expansion and contraction) rather than on individual logbook records. [See Section 7.2.2.] ➤ The Audit Report does not comment because winter whiting are taken outside the Great Barrier Reef Marine Park.
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Objective (d) “Providing an economically viable, but ecologically sustainable, trawl fishery”	
Management Plan Provisions	Audit Report’s Comments
<p>How the objective is to be achieved The objective is to be achieved by -</p> <p>(a) providing commercial fishers with fair access to permitted fish in the fishery; and</p> <p>(b) minimising restrictions, on a sustainable basis, on trawling; and</p> <p>(c) the provisions of this plan about effort units.</p> <p>How achievement is to be measured Achievement of the objective may be measured only by -</p> <p>(a) studies or surveys accepted by the chief executive on economic aspects of the fishery, and</p> <p>(a) how many effort units are surrendered under sections 117, 118 and 132(2).</p> <p>Review events Each of the following is a review event for the achievement of the objective-</p> <p>(a) the chief executive’s acceptance of an economic study of the fishery that shows a significant decline in the fishery’s economic efficiency;</p> <p>(b) the number of effort units decreases by-</p> <p>(i) 4% or more in each of 3 consecutive years; or</p> <p>(ii) 5% or more in each of 2 consecutive years; or</p> <p>(iii) 6% or more in an effort year after the second effort year;</p>	<p>➤ Following a Trawl Plan Review (August 2002), trip limits have been set for by-product species. These limits were based on the average take of permitted species by ECTF operators and not on estimates of stock sustainability. [See Section 7.3.5.]</p> <p>➤ Input controls by definition aim to restrict the operational efficiency of the fleet. [See Sections 7.3.1 and 7.3.2.]</p> <p>➤ The introduction of tradable effort units has led to an autonomous fishery restructure after the completion of the Structural Adjustment Scheme. [See Section 7.2.4.]</p> <p>➤ The Audit Report is unaware of any study or survey into the economic aspects of the fishery since 1 January 2001.</p> <p>➤ This information has been monitored and reported on by the QFS since 1 January 2001. [See Section 7.2.4.]</p> <p>➤ Information was not made available to determine if this review event has been triggered. However, given the achievements of the Structural Adjustment Scheme and subsequent effort reductions, it is unlikely that the economic efficiency of the ECTF would have decreased since 1 January 2001.</p> <p>➤ The GBRMC 28 outcome required an effort reduction of 3% per annum to compensate for effort creep in the fishery. This was achieved in 2001. [See Section 7.2.4.]</p>

<p>(c) the chief executive’s acceptance of a study that shows effort units consistently can not be obtained by transfer;</p>	<p>➤ The Audit Report is unaware of any study into the trading of effort units. The ability to acquire effort units is subject to normal supply and demand considerations. The type of management intervention that might be triggered by this review event is questioned.</p>
<p>(d) the chief executive accepts a study or survey that shows a total of more than 15,000 fishing days under “M1” and “M2” licences in a year.</p>	<p>➤ The Audit Report does not address this review event as it refers to the fishery outside the Great Barrier Reef Marine Park.</p>

Objective (e) “Ensuring fair access to fisheries resources on a sustainable basis”	
Management Plan Provisions	Audit Report’s Comments
<p>How objective is to be achieved The objective is to be achieved by regulating commercial fishers to ensure fair access to and use of fisheries resources taken in the fishery by persons other than commercial fishers.</p> <p>How achievement is to be measured Achievement of the objective may be measured only by –</p> <p>(a) surveys, accepted by the chief executive, of fishing for fisheries resources taken in the fishery by commercial and recreational fishers and Aborigines and Torres Strait islanders; and</p> <p>(b) commercial fishing catch and effort data for the fishery received by the chief executive.</p> <p>Review events It is a review event for the achievement of the objective if-</p> <p>(a) a survey mentioned in (a) above shows a significant decline in the catch of principal fish; or</p> <p>(b) data mentioned in (b) above show a significant decline in the commercial catch of principal fish.</p>	<ul style="list-style-type: none"> ➤ This objective deals with resource allocation. According to the biennial recreational fishing survey, the usage of ECTF resources by non-commercial fishers appears to be low. [See Section 4.3.6.] ➤ Recreational fisheries data are collected through biennial recreational fishing surveys in Queensland. Information is presented on the state-wide recreational take of “prawns”. Information on the Indigenous take of ECTF species does not appear to be available. [See Section 4.3.6.] ➤ Commercial fishing data are received by the QFS through ECTF logbooks. There are some concerns about the veracity and level of resolution of these data and, consequently, their impact on fishery assessment. [See Sections 4.3, 4.4, 5.2, 5.3, 5.5 and 7.1.] ➤ “Significant” is not defined. Terms of Reference for the survey are not defined. ➤ Catches may decline for reasons other than resource abundance (e.g. fewer operators, less effort, weather conditions, etc.). Stock assessment is required to determine the reasons behind declining catches of principal species. [See Sections 5.2, 5.3 and 5.5.] ➤ The review events are target species-specific. A community cost is involved if the sustainability of by-product or bycatch species becomes threatened as a result of overfishing and/or the impact of trawling.

2. Background to the Audit Report

Australia's Great Barrier Reef is the largest complex of reefs and islands in the world and it supports the most diverse ecosystem known to man. Because of its unique status, the Great Barrier Reef was included on the World Heritage List in 1981.

The GBRMPA is responsible for the management of the Great Barrier Reef Marine Park, which lies within the World Heritage Area. The Authority operates under the GBRMP Act 1975 and is responsible to the Commonwealth Minister for Environment and Heritage.

The Authority's goal is to provide for the protection, wise use, understanding and enjoyment of the Great Barrier Reef in perpetuity through the care and development of the Great Barrier Reef Marine Park. In a multi-use environment, the Authority's primary responsibility is the conservation of the resources of the Great Barrier Reef.

A number of commercial fisheries operate within the Great Barrier Reef Marine Park. The ECTF is the largest of these fisheries, with some 530 vessels accessing the General Use (light blue) Zones of the Marine Park. Historically, about 70% of all trawl activity in the fishery occurred in the World Heritage Area. The Fishery is managed under Queensland jurisdiction. However, as a result of the Great Barrier Reef Marine Park Authority's obligation under the GBRMP Act 1975, the Authority views itself as a co-manager of fisheries, where they occur in Marine Park waters.

The management arrangements for the ECTF had been under review by the administrators of the fishery and its key stakeholders since the mid-1990s, due to increasing fishing effort and decreasing viability of the industry. The Trawl Plan was introduced in November 1999. After extensive consultation, a revised Trawl Management Plan was introduced in December 2000, although the majority of the new provisions did not take effect until after 31 December 2000. The GBRMPA was party to the discussions culminating in the introduction of the revised management arrangements.

The GBR Ministerial Council, established in 1979, coordinates the Commonwealth and Queensland Government policy on reef matters at Ministerial level. At the Council's 28th meeting in October 1999, the Ministers agreed on a list of principles in relation to the draft Trawl Plan (see Section 3.7.1). Among other issues, it was agreed that the GBRMPA and the then Queensland Fisheries Management Authority (QFMA), now superseded by the QFS, would work co-operatively to develop an adequate reporting relationship so as to enable the Authority to report effectively to Council on an annual basis. This agreement was reflected in the Special Commonwealth Gazette of 26 September 2001, which states that "*the Authority will conduct an annual audit on the progress of the East Coast Trawl Fishery in achieving the objectives of the Fisheries (East Coast Trawl) Management Plan 1999 (as amended)*" (See Appendix 1 for the gazettal notice and Appendix 2 for the objectives of the Trawl Plan).

A secondary requirement for the assessment of fisheries in the GBR Marine Park lies in the key findings of the Australian National Audit Office. The ANAO, in its 1998 performance audit of the GBRMPA, listed amongst its key findings that "*the Authority (i.e. GBRMPA) does not have adequate data to determine whether it is achieving its primary objective of protecting, conserving and allowing for reasonable use of the Great Barrier Reef Marine Park*". The Audit Report on the performance of the ECTF addresses this shortcoming for this fishery by identifying the data sources available for the management of the ECTF and examining the quality of these.

The preparation of this Audit Report by the GBRMPA is a separate process to the ecological assessment by EA under the EPBC Act 1999 of all Commonwealth and State fisheries with an export component. However, in order to ensure consistency in the assessment process, the audit

has applied the “*Guidelines for the Ecologically Sustainable Management of Fisheries*” developed by the Commonwealth (see Appendix 3). It is understood that the QFS took account of the issues raised in the draft Audit Report when finalising the ecological assessment of the ECTF. Similarly, EA considered the draft Audit Report during its public consultation on the ECOTF Assessment Report. Under the EPBC Act 1999, fishery assessments need to occur before the end of 2003.

The Audit Report only relates to the activity of the ECTF under the Authority’s jurisdiction (i.e. trawl activity within the Marine Park). Beam trawling, which occurs mainly in estuaries and inshore coastal waters outside the Marine Park, has been excluded from this report. The scallop fishery, which also occurs mainly outside the Marine Park, has been included, as the northern scallop beds lie within the southern part of the Marine Park. The Audit Report notes that the EA assessment of the fishery provides a full assessment of the ECTF, covering all sectors of activity (with the exception of beam trawling).

As the fishery occurs in the GBR Marine Park and given the World Heritage status of the GBR region, the Authority has been rigorous in its assessment of the performance of the ECTF after the introduction of the revised Trawl Plan. The audit has applied the world’s best management practices as a benchmark for the ECTF’s performance.

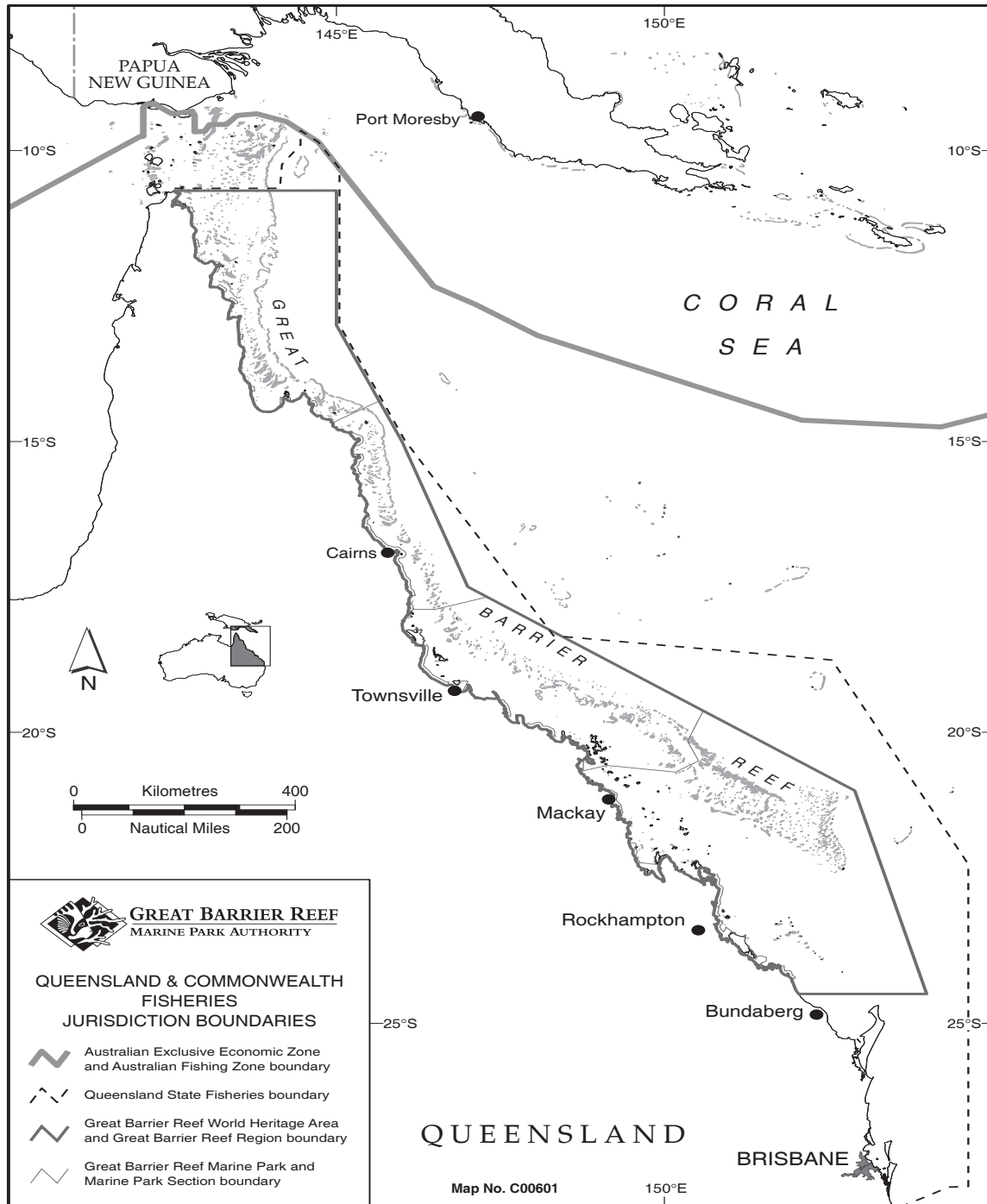
The Audit Report contains a series of recommendations, which, in the view of the audit, should be adopted by the QFS in order to meet best management standards. The recommendations are confined to the management of the ECTF within the Great Barrier Reef Marine Park. However, application of these to the wider fishery may assist in the overall management process. It should be noted that many of the issues identified by the GBRMPA have been recognised by the QFS as requiring remedial action and, in several instances, processes have been implemented to deal with these issues. Where appropriate, the audit endorses these processes through its recommendations.

The Audit Report has utilised a wide range of information, including the draft and final reports on the “*Status of the Queensland East Coast Otter Trawl Fishery after the First Effort Year (2001)*” (hereafter referred to as the “ECOTF Status Report – 2001”), the “*Ecological Assessment of the Queensland East Coast Otter Trawl Fishery*” (hereafter referred to as the “ECOTF Ecological Assessment Report”) and the “*Queensland Fisheries Resources – Current Condition and Recent Trends 1988 – 2000*” (hereafter referred to as the “Condition and Trends Report”). These documents were prepared by the QFS and have since been released publicly. In addition, relevant published literature was reviewed. Discussions were held between Queensland research and stock assessment staff, ECTF management staff and GBRMPA staff. Prior to the finalisation of the audit, the QFS was given an opportunity to provide comments on the draft Audit Report. This feedback, together with comments from two external referees, was considered in the finalisation of the Audit Report.

3. Overview of the Fishery

The ECTF is Queensland's largest commercial fishery in terms of value, production and geographical distribution. It extends from the tip of Cape York (about 10.5°S) along the eastern seaboard to the New South Wales / Queensland border (about 28.5°S).

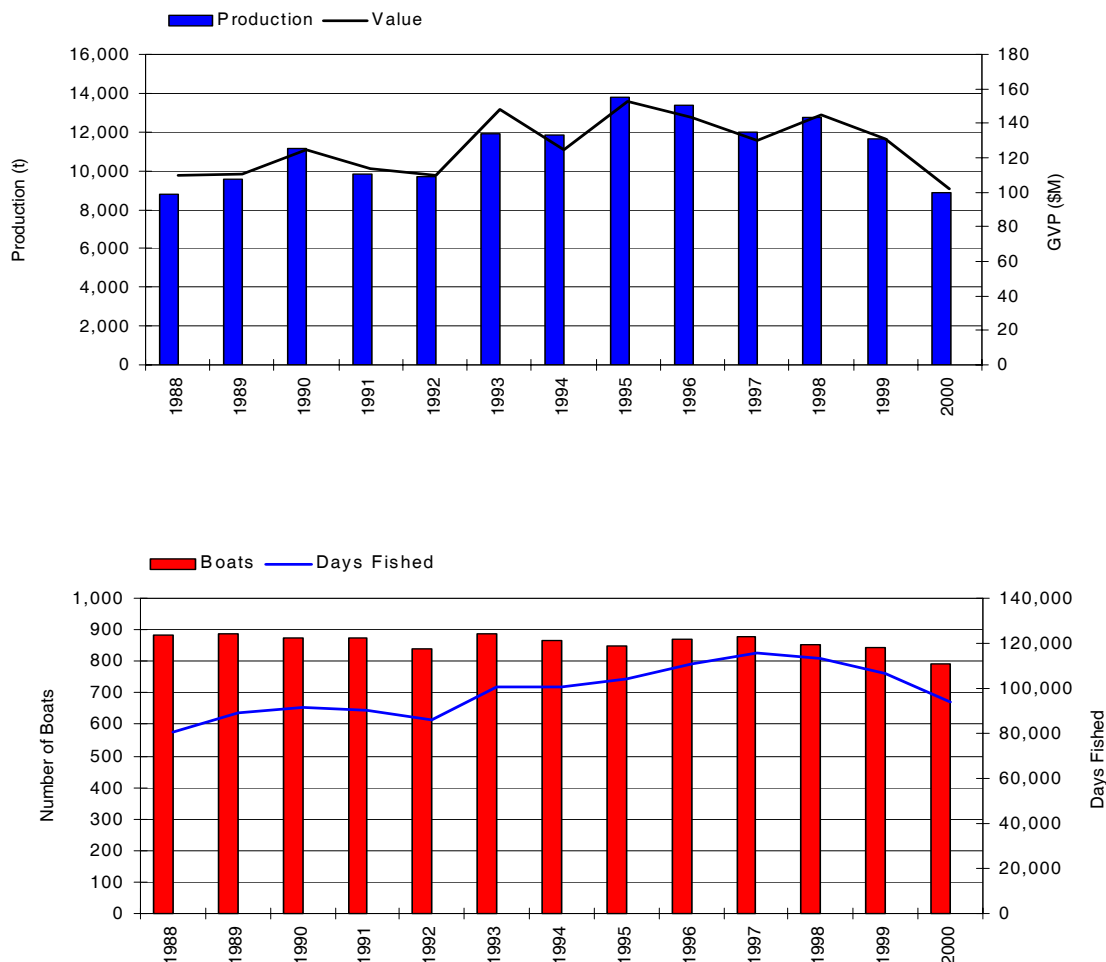
Figure 1: The Great Barrier Reef region, showing the jurisdictional boundaries between the Commonwealth and Queensland.



Until the restructure in early 2001, the fishery had an average annual production of around 11,000 tonnes and an average annual estimated value of nearly \$130 Million (Williams, 2002). Some 850 boats fished about 100,000 days per year. Following a licence buyback under a structural adjustment scheme upon the introduction of the revised Trawl Plan, the fleet size decreased to about 530 boats. This resulted in a lowering of annual production and GVP for the fishery in 2001 to 7,500 tonnes and \$95.5 million respectively.

The ECTF predominantly is a commercial fishery and, in general, there is limited overlap with other fisheries. The exception is blue swimmer crab; a commercial pot fishery takes 183t per annum and a further 200t are estimated to be taken annually by the recreational sector (Zeller, 2002). Bay Prawns (more fully described under Section 3.2.1.) are also taken recreationally in the inshore and near shore areas. The take by Indigenous fishers is unknown but is believed to be restricted to inshore prawn species only.

Figure 2: Historical commercial production, value and effort in the ECTF from 1988 to 2000

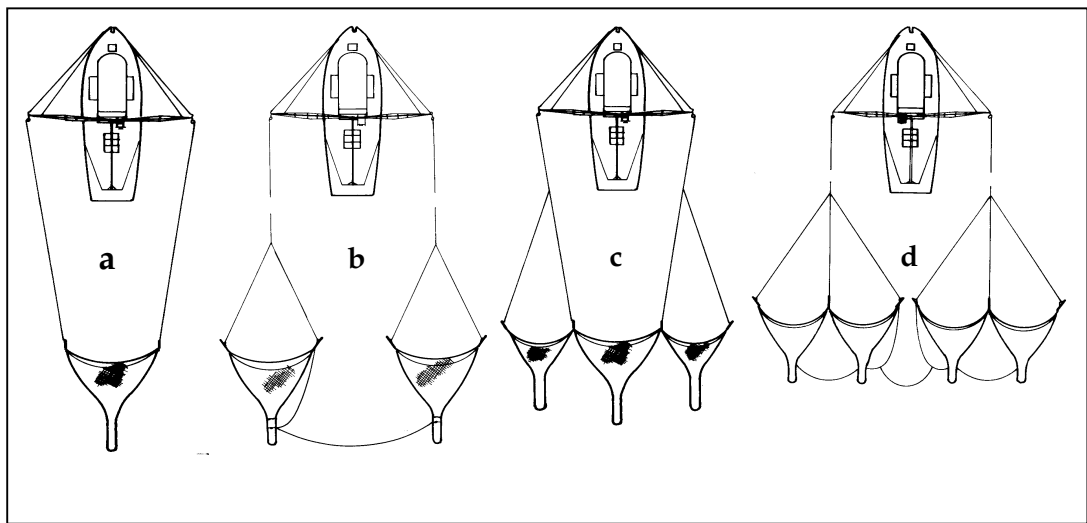


3.1 Commercial Fishing Methods

The fleet consists predominantly of demersal otter trawlers, but there are also a small number of vessels permitted to take prawns from inshore and estuarine waters using beam trawl gear. Beam trawling is not considered in this report, as it occurs generally outside the Marine Park.

Most demersal otter trawlers are purpose built vessels ranging in size from about 10m to 20m. They use variations around a standard trawl net (as permitted under the Trawl Plan) to target prawns, scallops, bugs and squid. The precise gear arrangement (such as sweep length and headrope height) depends on the targeted species. Trawlers in the ECTF typically use a triple or quad net arrangement. Try nets are permitted in the search for prawns.

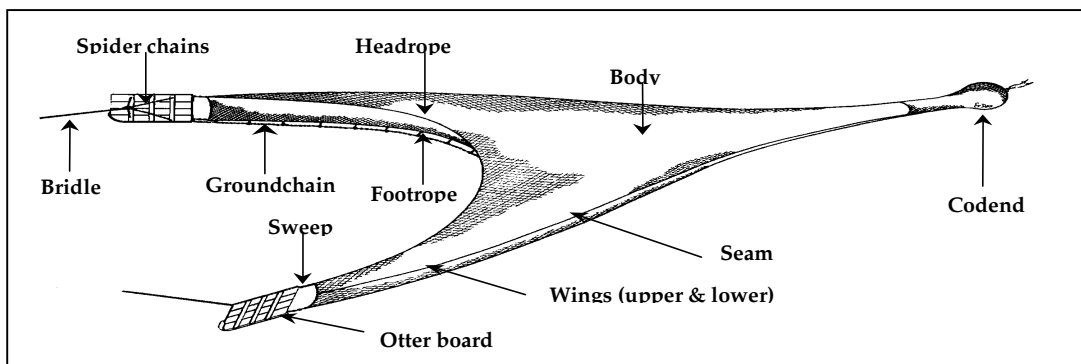
Figure 3: Trawl configurations used throughout Australian prawn trawl fisheries.
(Illustration provided courtesy of Gary Day, former Australian Maritime College.)



Note: a) depicts a single rig, b) a dual rig, c) a triple rig and d) a quad rig.

Figure 4: The typical components of a prawn trawl.

(Illustration provided courtesy of Gary Day, former Australian Maritime College.)

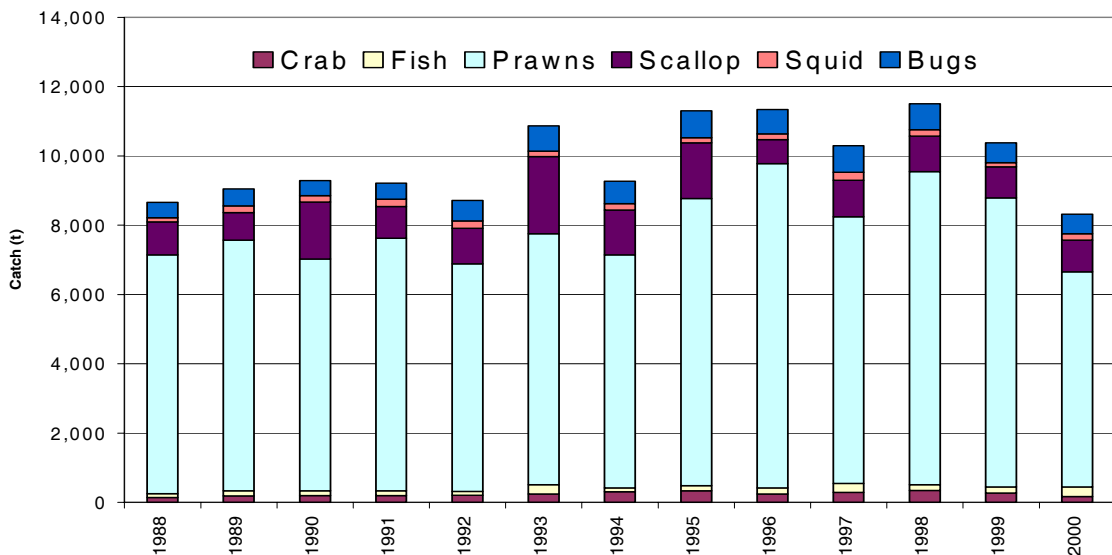


3.2 Distribution and Catch Composition of Commercial Catch

The ECTF is a complex fishery in terms of its fleet dynamics, geographical distribution, catch composition and the seasonal/temporal distribution of species. The trawl fleet is characterised by a high degree of mobility and boats frequently operate in more than one fishery. The ECTF is marked by a high inter-annual variability in catches and species composition. The data in Section 3.2 are based primarily on information presented in the Condition and Trends Report (Williams, 2002). The reader is referred to this report for further details of the ECTF and its sectors.

Several hundred species of crustaceans, finfish and molluscs are taken throughout the fishery. More than 60 species are retained as commercial catch. The otter trawl fishery primarily targets prawns, which dominate the catch (~ 70%), followed by scallops (~12%) and bugs (~6%). The remainder of the catch is made up of fish, cephalopods, crabs and crayfish. An overview of the catch of the major species grouping is provided for the 1988-2000 period in Figure 5.

Figure 5: Catch Composition in the ECTF from 1988 to 2000.
(Data Source: ECTF Logbooks; Information Source: Williams, 2002.)



Note: The stout whiting fishery, which occurs outside the GBRMP, is not shown.

3.2.1 Target Species

The amended Trawl Plan permits the targeting of certain defined species, referred to as “principal fish” under the plan (hereafter called “target species”). These include prawns, scallops, bugs and squid. There are several recognisable sectors within the ECTF (these are sometimes referred to as distinct “fisheries”) based on target species composition and geographical location. Some examples of the major relevant sectors, which occur within the Great Barrier Reef Marine Park, are outlined below. More detailed information on the stock status of these species and the other fisheries is presented in Sections 5.1.1 and 5.3.

Table 3: Commercial harvest, gross value of production, number of vessels and fishing effort for landed principal ECTF species in 2001 (Data Source: ECTF Logbooks; Information Source: QFS, *pers. comm.*).

Common Name	Species	Commercial Harvest (t)	Gross Value of Product (\$M)	Number of Vessels	Effort (days fished)
Tiger Prawns	<i>Penaeus esculentus</i> <i>Penaeus semisulcatus</i> <i>Penaeus monodon</i>	1,436	21.5	450	28,675
Eastern King Prawns	<i>Penaeus plebejus</i>	2,486	29.1	295	26,585
Scallops	<i>Amusium japonicum</i> <i>balloti</i> <i>Amusium pleuronectes</i>	938	18.3	331	13,016
Endeavour Prawns	<i>Metapenaeus</i> <i>endeavouri</i> <i>Metapenaeus ensis</i>	1,072	12.9	329	20,634
Northern King Prawns	<i>Penaeus longistylus</i> <i>Penaeus laticulatus</i>	636	7.5	276	13,807
Bugs	<i>Thenus</i> spp <i>Ibacus</i> spp <i>Scyllaroides</i> spp	379	3.3	482	30,747
Banana Prawns	<i>Penaeus merguensis</i>	330	3.0	238	6,409
Bay Prawns	<i>Metapenaeus bennettiae</i> Other species	278	1.5	112	6,412
Squid	<i>Photololigo</i> spp <i>Sepioteuthis lessoniana</i> Other species	118	0.6	360	15,687
Total		8,504	105.4	682	75,351

Note: The figure of 682 vessels does not accord with the post-restructure fleet size of around 530 vessels because some vessels fish in more than one sector.

3.2.1.1 Tiger and Endeavour Prawn Fishery

A major coastal night-time fishery exists for tiger and endeavour prawns in the GBR Marine Park. The fishery operates predominantly in waters north of Shoalwater Bay (22°S) in depths of less than 20m. As adult tiger and endeavour prawns have a preference for sandy and muddy bottoms, about 90% of the fishery occurs within the Great Barrier Reef Lagoon. The fishery falls into three broad areas: the Far Northern Region (from Cape York to Cape Flattery); the Northern Wet Region (from Cape Flattery to Paluma River) and the Northern Dry Region (from Paluma River to Cape Conway). The percentage composition of tiger and endeavour prawns in the overall catch decreases with increasing latitude. In the southern part of the fishery more species are retained as by-product than in the northern part, where the catch is made up predominantly of target prawn species. The Far Northern Region contributes about 50% of the annual tiger/endeavour prawn production, the Northern Wet Region around 20% and the Northern Dry Region about 17%. The remaining 13% of the catch is taken from the southern area of the fishery, which includes the Swains and Capricorn groups.

The tiger prawn catch consists of three species – the brown tiger prawn (*Penaeus esculentus*), the grooved tiger prawn (*Penaeus semisulcatus*) and, occasionally, the giant tiger (or leader) prawn

(*Penaeus monodon*)¹. Queensland produces about 33% of Australia's tiger prawns. Production in the fishery for the 1988 to 2000 period has ranged from as low as 1,660t (in 1992) to as high as 2,711t (in 1996). The average production over the past 13 years has been around 2,088t per annum. According to unpublished QFS figures, the production and value of tiger prawn fishery in 2001 was estimated at 1,436t and \$21.5M respectively. Until the end of 2000, 579 vessels targeted tiger prawns. Following the introduction of revised management arrangements and the structural adjustment scheme in the ECTF in early 2001, the number dropped to 450.

The endeavour prawn catch consists of two species – the true (or blue) endeavour prawn (*Metapenaeus endeavouri*) and the false (or red) endeavour prawn (*Metapenaeus ensis*). Queensland produces about 35% of Australia's endeavour prawns. Production in the fishery over the past 13 years has ranged from 1035t (in 1992) to 1566t (in 1989). The average production over this period has been about 1400t per annum. According to unpublished QFS figures, the production and value of endeavour prawn fishery in 2001 was estimated at 1,072t and \$12.9M respectively. Until the end of 2000, approximately 453 vessels targeted endeavour prawns. Following the introduction of revised management arrangements and the structural adjustment scheme in the ECTF in early 2001, the number dropped to 329.

3.2.1.2 Northern King Prawn Fishery

A second major night-time prawn fishery exists within the Great Barrier Reef Lagoon in waters north of Shoalwater Bay (22°S). Two species of northern king prawns, the red spot king prawn (*Penaeus longistylus*) and the blue-legged king prawn (*Penaeus latisulcatus*), are taken predominantly between 18°S and 21°S. The red spot king prawn is the more abundant of the two species and is associated generally with white coralline sand sediments in near-reef areas or inter-reef gutters. There are four major regions of the North Queensland king prawn fishery: the Northern Dry region (between 40 –50 % of landed catch) and the Far North, Northern Wet and Swains regions (about 17% of landed catch each). The take of these species can range from being a targeted harvest (such in the Swains region) to being a by-product of the tiger/endeavour prawn fishery (such as in areas where there are extensive inshore reefs or the lagoon narrows).

The North Queensland king prawn fishery has shown high inter-annual variability, with production over the past 13 years ranging from 502t (in 1990) to 1317t (in 1996). The average production over this period has been around 840t per annum. According to as yet unpublished QFS figures, the production and value of North Queensland king prawn fishery in 2001 was estimated at 636t and \$7.5M respectively. Approximately 400 boats fished in this fishery between 1989 and 1999. This subsequently declined to 356 in 2000 and to 276 in 2001, following the introduction of revised management arrangements and the structural adjustment scheme.

3.2.1.3 Banana Prawn Fishery

Banana prawns (*Penaeus merguensis*) are found along the entire east coast of Queensland. However, the fishery on the east coast occurs predominantly in seven major grounds between Cape Flattery (15°S) in the north and Moreton Bay (27.5°S) in the south. Banana prawns are an inshore species, with an estuarine juvenile phase and an inshore coastal adult phase. Otter trawlers in fishing grounds adjacent to river mouths harvest the species commercially. The species is harvested also from estuaries and rivers by beam trawlers and set pocket nets and recreationally by cast nets. The inshore fleet takes approximately 90% of the annual commercial catch of banana prawns. The fishery occurs during the day in water depths of less than 25m (generally within a few kilometres from shore).

¹ The giant tiger prawn is relatively rare and live specimens are sought by broodstock collectors for the prawn aquaculture industry.

Due to the schooling behaviour of banana prawns, considerable search time is spent locating schools. However, the east coast banana prawns do not school to the same degree as the ones in the Northern Prawn Fishery, where spotter planes are used to locate schools. Until the end of 2000, about 350 vessels reported banana prawn catches. This number subsequently dropped to 238 following the introduction of revised management arrangements and the structural adjustment scheme in the ECTF in early 2001.

Because of their inshore distribution, banana prawns are more available to recreational fishers. The biennial recreational fisheries survey by the QFS specifically mentions the take of banana prawns (Higgs & McInnes, 2001). The report estimates that prawns (which are made up primarily of banana prawns) constitute 1.2% of all saltwater species taken by recreational fishers.

The banana prawn fishery is highly seasonal, with the bulk of the catch being taken between March and May each year. The abundances of banana prawns in their juvenile and sub-adult phases are strongly correlated with climatic events (such as rainfall) and consequent river discharge. As a result, the fishery is highly variable from year to year depending on the strength of these events. Production in the fishery over the past 13 years has ranged from 372t (in 2000) to 1084t (in 1991). The average production over this period has been around 600t per annum. According to unpublished QFS figures, the production and value of banana prawn fishery in 2001 was estimated at 330t and \$3.0M respectively. The QFS reported that there were 238 vessels fishing for banana prawns in 2001 (compared to an average of 209 boats over the past 13 years).

3.2.2 By-product Species

In addition to the above principal (i.e. target) species, operators supplement their income with a range of by-product species. This is referred to as “permitted fish” under the Trawl Plan (hereafter called “by-product species”). These include bugs (or slipper lobsters), blue swimmer crabs, squid, octopus, cuttlefish and finfish. More detailed information on the stock status of these species is presented also in Section 5.1.2.

Diversification into by-product is more frequent amongst those operators, who show lower prawn catches and catch rates. It is prevalent particularly amongst the southern operators outside the Marine Park (especially in the Moreton Bay region).

Table 4: The commercial harvest, gross value of production and number of vessels taking permitted ECTF species in 2000 (Data Source: ECTF Logbooks; Information Source: “*Fisheries (East Coast Trawl) Management Plan 1999 Plan Review Paper*”, August 2001).

Common Name	Species	Commercial Harvest (t)	Gross Value of Product (\$M)	Vessels
Blue Swimmer Crabs	<i>Portunus pelagicus</i>	150	~1.00	410
Pipefish and Seahorses	<i>Solegnathus hardwickii</i> <i>Solegnathus dunckeri</i> Other species	7,067 (individuals)	NA	95
Balmain Bugs	<i>Ibacus</i> spp (5)	73	0.75	268
Barking Crayfish	<i>Linuparus trigonus</i>	<1	?	5
Cuttlefish	<i>Sepia</i> spp (15) <i>Metasepia pfefferi</i>	57	0.30	325
Goatfish*	<i>Mullidae</i> (55)	<3	<0.01	33
Mantis Shrimp	<i>Squillaidea</i> (8)	3	<0.01	28
Octopus	<i>Octopus</i> spp (8 –10)	20	0.10	158

Common Name	Species	Commercial Harvest (t)	Gross Value of Product (\$M)	Vessels
Pinkies	<i>Nemipterus</i> spp (5)	13	0.04	54
Red Spot Crab	<i>Portunus sanguinolentus</i>	21	0.10	143
Sharks*	<i>Carcharhinuss</i> spp	34	0.20	196
Whiptails*	<i>Pentapodus</i> spp	<1	<0.1	12
Total		> 375	~3	~600

- Note:
- * denotes species (i.e. shark, whiptail and goatfish) no longer permitted to be taken as by-product since the Trawl Plan amendment in December 2001.
 - Effort figures are not provided, as these species are not targeted.

3.2.3 Bycatch Species

Prawn trawling is a highly non-selective form of fishing and, as a result, there is a large bycatch of unwanted (and hence discarded) species. Tropical penaeid fisheries in particular are noted for their high species diversity. More than 1000 species have been recorded for the ECTF. The majority of these (about 70%) are regarded as “uncommon” or “rare”, which makes it difficult to monitor and assess their distribution and abundance.

While ratios of commercially retained species to bycatch species vary considerably (depending on a number of factors), estimates range from 2 to 15 times that of the retained product (Poiner *et al.*, 1999; Robins & Courtney, 1999; Pitcher *et al.*, 2000; Stobutzki *et al.*, 1997). The types of bycatch species that are taken typically in the ECTF are described more fully in Section 6 of the Audit Report.

3.3 Legislative Framework

As a result of the ECTF’s occurrence in waters under Commonwealth jurisdiction and governance under Queensland law, several Commonwealth and State Acts apply in the management of the ECTF. These are outlined below.

3.3.1 The Offshore Constitutional Settlement

The Offshore Constitutional Settlement (OCS) is an inter-government agreement concluded at the Premiers Conference in 1979 dealing with a range of offshore issues. Amongst other issues, it was agreed to give each State and the Northern Territory the power to manage fisheries outside its territorial sea, provided this is done in accordance with the laws of the State/Territory concerned and has the Commonwealth’s agreement. The OCS was given effect under Commonwealth and State/Territory legislation. Under the OCS, Queensland has responsibility for the management of all fish stocks (except for tuna and tuna-like species, and species taken as part of the Commonwealth-managed Coral Sea Fishery) in waters adjacent to its east coast (Figure 1). However, this arrangement is subject to the provisions of the GBRMP Act 1975 and its subsidiary legislation.

3.3.2 Great Barrier Reef Marine Park Legislation

The GBR Marine Park is administered under the *Great Barrier Reef Marine Park Act 1975* (also known as the “GBRMP Act”) and its subsidiary legislation, the *Great Barrier Reef Marine Park Regulations 1983*. These are the primary legislative instruments by which activities in the Marine Park are managed. The types of activity that may be carried out within a given area of the Marine

Park are specified through area-specific Zoning Plans. Also, Plans of Management govern specific activities (such as tourism) within certain areas (like the Whitsundays).

3.3.3 Queensland Fisheries Legislation

The East Coast Trawl Fishery is managed by the QFS (part of the QDPI) under the *Fisheries Act 1994* and its enabling legislation, the *Fisheries Regulation 1995*. The Fisheries Act provides for the general direction of fisheries management in Queensland. Fisheries specific Management Plans (where implemented) provide for specific management measures. The *Fisheries (East Coast Trawl) Management Plan 1999*, which specifies management arrangements for the ECTF, was introduced in November that year. The Trawl Plan was significantly amended in late 2000 to reflect revised arrangements. There have been two subsequent minor amendments. The title of the Trawl Plan remained unchanged with each amendment.

3.3.4 Commonwealth Environmental Legislation

New Commonwealth environmental legislation came into effect on 16 July 2000 with the implementation of the “*Environment Protection and Biodiversity Conservation (EPBC) Act 1999*”. The new Act encapsulated the principles of *Australia’s Oceans Policy*, which require the ecologically sustainable management of fisheries. In particular, blanket exemptions were removed for marine species from wildlife export controls². Fishing operations involved in the capture of marine species that are exported, must be assessed to determine if they are demonstrably ecologically sustainable. Such an assessment must be conducted by 1 December 2003.

The assessment process requires the drafting of an ecological assessment report by the managing fisheries agency. This report is made available to the public by EA and comments are sought from stakeholders and other interested parties. In light of the assessment report and comments received, EA assesses the fishery against the Commonwealth ESM Guidelines (Appendix 2). These guidelines are consistent with similar international guidelines, which Australia is a signatory (Section 3.4.1).

In order to continue the export of marine species past 1 December 2003, the management arrangements for export fisheries need to be approved under Part 13A of the EPBC Act. The Minister for Environment and Heritage may determine conditions, which may apply to the fishery in order to export approval. These conditions are designed to bring the management framework in line with the Commonwealth ESM Guidelines. The aim is to improve management arrangements to a point where the fishery is considered “demonstrably sustainable”. By endorsing arrangements as an “approved management program” under Part 13 of the Act, authorities may be granted to export species from that fishery.

In late November 2002, the QFS submitted a report entitled “*Ecological Assessment of the Queensland East Coast Otter Trawl Fishery*” (Zeller, 2002). EA called for public comments on the document by mid January 2003³, before beginning the ecological assessment of the ECOTF against the Commonwealth ESM Guidelines. At the time of writing, this process is still to be completed. The Minister for Environment and Heritage was yet to consider the report and make a determination about any conditions for approval.

² Australian fisheries had been exempted from regulation under the *Wildlife Protection (Regulation of Exports and Imports) Act 1982*.

³ A copy of the report can be found on “<http://www.ea.gov.au/coasts/fisheries/assessment/current.html>”.

3.4 Policy Framework

A policy framework at both the Commonwealth and State level underpins the management of the ECTF. This framework gives effect to many national and international agreements that the Commonwealth and the State of Queensland are party to.

3.4.1 International Conventions and Agreements

As a result of its unique value as the world's largest coral reef ecosystem, the Great Barrier Reef area was included in 1981 in the World Heritage List under the "United Nations Convention Concerning the Protection of the World Cultural and Natural Heritage" (known as the "World Heritage Convention"). The Great Barrier Reef satisfied all four criteria of outstanding universal value, as set out in Article 2 of the Convention⁴. In accepting inscription on this list, the Australian Government accepted an obligation to ensure "the protection, conservation and presentation of the Great Barrier Reef World Heritage Area and its transmission to future generations".

Australia is a signatory to the "United Nations Convention of the Law of the Sea" (UNCLOS), the "United Nations Convention on the Environment and Development" (UNCED) and the Code of Conduct for Responsible Fisheries by the Food and Agricultural Organization (FAO) of the United Nations. These are international agreements, which prescribe the application of the "precautionary principle"⁵ and have implications for how Australia manages its fisheries. UNCLOS, in particular, states that Parties to the Convention should not fish their stocks beyond their maximum sustainable yield (MSY) and should adopt best scientific evidence in its management and conservation actions. While MSY is one of a number of reference points (and not necessarily the best), which can be used in fisheries management, the Convention requires that precautionary reference points be set in fisheries management.

Finally, the Convention for the Conservation of Migratory Species of Wild Animals (CMS), the Convention on Biological Diversity and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) acknowledge the global decline of marine turtles by listing these species in their appendices. These listings provide for the protection of marine turtles by countries that are party to each convention.

3.4.2 National Policies

Australia's commitment to its obligations under international agreements is reflected in several national policies. The Council of Australian Governments endorsed a "*National Strategy for Ecologically Sustainable Development*" in December 1992. This strategy lists as one of its three core objectives the protection of biological diversity and the maintenance of essential ecological processes and life support systems. It adopts the precautionary approach as one of its guiding principles.

By implementing "*Australia's Oceans Policy*" in 1998, the Commonwealth Government has set in place a framework for the integrated and ecosystem-based planning and management of Australia's marine jurisdictions. The policy aims to "meet Australia's international obligations under UNCLOS and other international treaties" and "to understand and protect Australia's marine biological diversity, the ocean environment and its resources, and ensure ocean uses are sustainable". A commitment to the ecologically sustainable development of marine resources is at the core of this policy and, listed

⁴ The Great Barrier Reef is (a) an example of a major stage in the earth's evolutionary history, (b) an outstanding example of geological processes, biological evolution and people's interaction with the natural environment, (c) a place with unique, rare and superlative natural phenomena and (d) a place which provides habitats for rare and endangered species of plants and animals.

⁵ The "precautionary principle" requires that "where there are threats of serious or irreversible damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation".

amongst its specific actions, is an “improved understanding of the marine environment, including environmental baseline surveys and sustainability indicators, monitoring and improved assessment of the impacts of commercial and recreational activities”.

The Commonwealth Policy on Fisheries Bycatch, released in 1999, builds on the national framework set out under the Ocean’s Policy. Amongst other things, the policy advocates the use of robust and practical reference points to make decisions on by-catch management and, where such reference points are not feasible, the adoption of the precautionary principle. Whilst the policy applies only to Commonwealth-managed fisheries, many State and Territory governments in the management of their fisheries have adopted its guiding principles.

3.4.3 Specific Action Plans

The EPBC Act identifies the need to prepare a recovery plan for threatened species listed under the Act and it specifies the content of such a plan. Marine turtles have been included on this threatened species list. A “*Draft Turtle Recovery Plan*” has been prepared by EA. The draft plan identifies trawling as an activity impacting on marine turtles and specifies recovery actions designed to protect marine turtles. Representatives from the Commonwealth, each of the States and Northern Territory were involved in drafting the plan. Since the revision of the technical specifications for the turtle excluder devices in trawl nets, the Trawl Plan has been consistent with the provisions of the Draft Turtle Recovery Plan.

3.5 Institutional Arrangements

Because of the cross-jurisdictional nature of the ECTF, several agencies are involved in the management of this fishery. This results in a complex set of institutional arrangements.

3.5.1 Queensland Department of Primary Industries

The Queensland QDPI has three sections, which deal with fisheries issues. The QFS is the lead agency for the management, research and enforcement of the State’s marine and freshwater fisheries. It has primary responsibility for the day-to-day management and monitoring of the ECTF. The Agency for Food and Fibre Sciences (AFFS) is responsible for the fisheries research undertaken by the Department. The Queensland Boating and Fisheries Patrol (QBFP) provide enforcement services.

3.5.2 The Great Barrier Reef Marine Park Authority

The GBRMPA is responsible for the management of the Marine Park and the impact of activities that affect it. Since trawling is the major commercial fishing activity within these waters, the Authority has (as with all fisheries activities) a co-management role. This entails being a member on all relevant Management Advisory Committees (and their subcommittees) and promoting the GBRMPA’s management priorities in such fora. The Authority also responds to any calls for public comment on fisheries issues impacting on the Marine Park, such as Regulatory Impact Statements (RIS) and discussion papers.

Although within its regulatory powers, the GBRMPA generally avoids involvement in the direct management of commercial fisheries. However, fisheries management needs to occur in a manner consistent with World Heritage values and the Authority’s legislative objectives. A failure to do so may result in regulatory measures being introduced by the GBRMPA to supplement any inadequacy in existing (State-based) management regimes.

3.5.3 Environment Australia

EA is responsible for implementing the provisions of the Federal environmental legislation. Within the Marine Conservation Branch, the Sustainable Fisheries Section deals with the ecological assessment of fisheries under the EPBC Act, and the Marine Species Section deals with the listing and management of protected species, including turtles, dugong, cetaceans, seasnakes and syngnathids.

3.5.4 Cooperative Arrangements on Marine Park Matters

The Queensland Parks and Wildlife Service (QPWS), which is part of the Queensland Environmental Protection Agency (QEPA), is responsible for the management of Queensland's national parks, including marine parks situated within the World Heritage Area.

A Day-to-Day Management (DDM) Coordination Unit, set up by the GBRMPA and the QEPA, is responsible for field activities within the Marine Park, including compliance, monitoring, education and infrastructure maintenance. Much of the enforcement work is supported by cooperative arrangements between the GBRMPA and other agencies, including Coastwatch, Customs, the Australian Federal Police, QBFP, QPWS and the Queensland Water Police.

The Fisheries Issues Group within the GBRMPA works closely with the Sustainable Fisheries Section of EA, in assessing fisheries that occur in or adjacent to the GBR Marine Park. The Fisheries Issues Group has an auditing role in assessing the performance of fisheries within the Great Barrier Reef Marine Park, whereas the Sustainable Fisheries Section carries out the of all export fisheries. In order to ensure a commonality of approach in fisheries assessment, fishery-specific project teams have been formed between the relevant officers in the GBRMPA and EA.

3.6 Advisory and Consultative Framework

There are a number of advisory and consultative Committees at both the Commonwealth and State level, which comment and advise on policy matters regarding the ECTF.

3.6.1 Great Barrier Reef Ministerial Council

The Great Barrier Reef (GBR) Ministerial Council, was established in June 1979. It coordinates, at the highest political level, Commonwealth and State government policy on reef matters. The Commonwealth Minister for the Environment and Heritage convenes the meetings. The Commonwealth Minister for Tourism and the Queensland Ministers responsible for Environment and Heritage and for Tourism, Racing and Fair Trading, also are Council members. The Queensland Minister for Primary Industries generally attends as an observer. This Audit Report has been prepared at the request of the Ministerial Council.

3.6.2 Advisory Committees to QDPI

The QFS has adopted a consultative framework for the management of its fisheries. Fishery-specific Management Advisory Committees (MACs) provide policy advice, which are considered by the Chief Executive of the QFS before management decisions are made.

3.6.2.1 Trawl MAC

In the case of the ECTF, the responsible committee is the Trawl MAC. This Committee is made up of an independent Chair, the manager of the fishery, four commercial fishers, one recreational fisher, one processor, two scientists and representatives from the QBFP, the GBRMPA, the QPWS and the

Queensland Conservation Council (an environmental non-government organisation). A representative from EA attends Trawl MAC meetings as an observer. MAC members are selected on an expertise basis.

Some of the issues considered by Trawl MAC are highly technical or require an on-going commitment by the members. Consequently, Trawl MAC has formed three subcommittees.

3.6.2.2 The Scientific Advisory Committee

The Scientific Advisory Committee (SAG) primarily deals with ECTF research and stock assessment issues. However, it does not conduct actual stock assessments for the fishery, nor does it review stock assessment and research results critically. Its role is limited mainly to noting the status of relevant ECTF research and fishery surveys and to provide advice on research projects and research priorities. From time to time the group is tasked by Trawl MAC to provide advice from a research perspective on certain issues (such as the review of the current performance indicators and triggering events contained in the Trawl Plan).

The SAG is made up of an independent scientific chair, two QDPI-based scientists, the QFS manager of the fishery and a representative each from the GBRMPA, industry and a conservation group. Frequently, observers with an interest in special issues attend SAG meetings. The group usually meets between half and one day prior to each Trawl MAC meeting and presents a verbal report on its deliberations to the Committee.

3.6.2.3 The Technical Working Group

The Technical Working Group (TWG), as its name implies, deals with technical issues referred to it by Trawl MAC. Examples of the type of work carried out by the TWG are the reviews of the specifications for TEDs and BRDs required under the current Trawl Plan. Also, it has provided advice on broodstock collection issues for the aquaculture sector.

The TWG is comprised of a core group of members referred to as the “Steering Committee” and a panel of technical experts that are consulted on a subject-specific basis. Membership on the group typically encompasses three to four representatives from industry (including the Chair), several scientific representatives from the QDPI, QFS management and a representative from the GBRMPA. The group meets on an “as-needs” basis and reports verbally to Trawl MAC.

3.6.2.4 The Scallop Working Group

The Scallop Working Group (SWG) deals specifically with scallop issues. Its principal role is to provide advice on management, enforcement and research issues pertaining to the scallop fishery. From time to time, it may also respond to specific requests from Trawl MAC, including, for example, the issue of allocation of seeding grounds for sea ranched scallops.

SWG membership consists of the Chair, a management representative, a scientific or technical advisor, a QBFP officer and six industry members (three from the harvesting and three from the processing sectors). Additional expertise can be brought in at the discretion of the Chair.

3.7 Fishery History and Management Framework

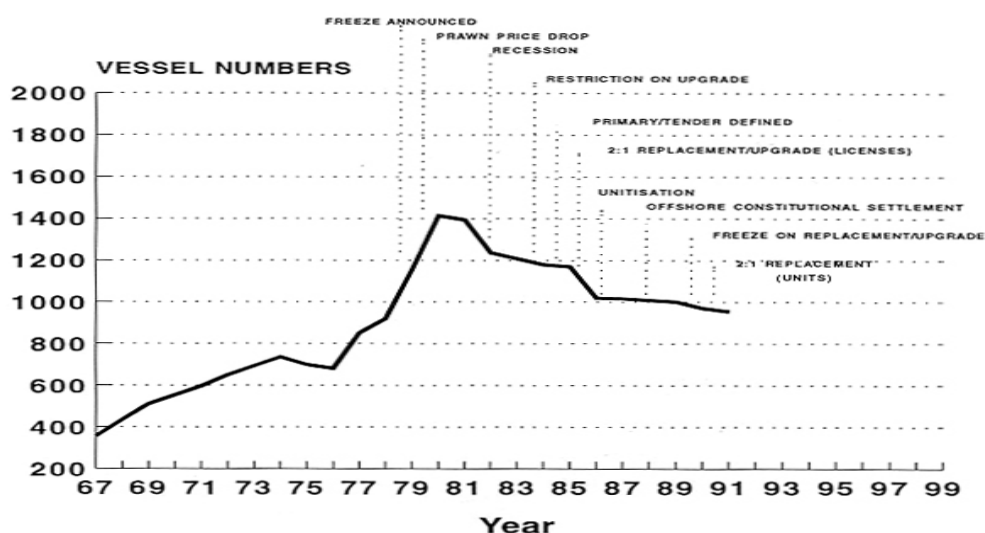
This section provides a brief outline of the history and management framework of the ECTF. Section 7 provides an appraisal of the current management arrangements of the fishery and Appendix 4 lists the chronology of key events in the ECTF since 1976.

3.7.1 History of the East Coast Trawl Fishery

Prawn fishing began in Queensland in the mid 1880s, but was carried out initially through manually-operated seine and stripe nets and set pocket nets in inshore waters. These operations were replaced eventually by towed trawl nets. By the 1950s, a prawn fishery using otter trawl had developed in Moreton Bay and it continued to expand northwards along the coast with sequential discoveries of fishing grounds off Bundaberg, Gladstone, Yeppoon, Mackay, Bowen and Townsville. Since the fleet was targeting mainly banana prawns, it was possibly the schooling behaviour of the species that led to the discovery of these grounds. Records of the earliest signs of temporary localised stock depletion date back to the late 1950s, when fishing declined significantly off Bundaberg after a few good seasons⁶. However, it is likely that the high inter-annual variations in banana prawn numbers and major impediments to river flows may also have contributed to this phenomenon. Diversification commenced in the fishery in the mid-1950s, with the discovery of scallop grounds off Bundaberg. This was followed by a further offshore expansion because of the discovery of Eastern King Prawn grounds in deeper water.

From the mid-1950s to 1979, the ECTF fleet continued to expand until it reached some 1,400 vessels. This expansion was driven by the emergence of lucrative export markets for prawns and scallops into Asia and greater offshore capabilities through technological advances. In September 1979, the Queensland Government announced a limitation to any further entry into the fishery and moved to reduce the total number of vessels in the fleet. The Commonwealth continued to license new vessels for operations in Commonwealth waters (i.e. outside 3nm from the Territorial Sea Baseline) until December 1984. From the late 1970s to 1999, Queensland managed the ECTF through a range of input controls⁷ under fisheries policy. In June 1987, Queensland took over responsibility for the management of the ECTF under the OCS.

Figure 6: History of vessel numbers in the ECTF and measures taken to reduce effort.
(Graph provided courtesy of Dr. Glaister, former QDPI)



Note: The above figure appeared in "Framework for Management for the East Coast Trawl Fishery" by Glaister et al. (1993)

⁶ "Report to Premier and Cabinet" on the ECTF by Dr Glaister (March 2000).

⁷ Input controls included restrictions on vessel upgrades, boat size restrictions on areas of operation, unitisation of hull size and the "2 for 1" licence replacement scheme.

Despite the cap on vessel numbers and other input measures, fishing effort in the ECTF continued to increase. In particular, there was a dramatic increase during 1986 – 1988 when the “2:1” boat replacement policy resulted in smaller vessels being replaced with larger, more efficient vessels. The catching power of the fleet also increased through technological improvements in engine design⁸. By 1996, effort in the ECTF had peaked at around 108,000 fishing days. The fishery showed signs of being “fully exploited” (if not over-exploited) with declining catch rates for some species (such as scallops) and the serial depletion of fishing grounds⁹. There was also a significant over-capitalisation of the fleet and declining profitability of operators in the fishery¹⁰. Despite these signs, and calls from some quarters (such as the GBRMPA) for major reductions in fleet size and fishing capacity, a Management Plan was introduced for the ECTF in November 1999, which consolidated the then management arrangements without any effort cuts. At the time, there was reluctance to implement measures that were needed to reduce effort.

Following major criticism of the Trawl Plan by the GBRMPA and intercession by the then Commonwealth Minister for Environment and Heritage, Senator the Hon Robert Hill, Queensland re-examined options for effort reductions. During early to mid 2000, future management arrangements (including the feasibility of a structural adjustment scheme for the fishery) were assessed and a stakeholder working group was established by the Queensland Premier, the Hon Peter Beattie. The group’s task was to consider ways to give effect to the agreements reached at the 28th GBR Ministerial Council in 1999. Subsequently, agreement was reached between the Commonwealth and Queensland about essential changes to the ECTF management arrangements.

Agreements reached on the elements to be included in the revised Trawl Plan:

- introduction of tradable effort units;
- capping of fishing effort at the 1996 level;
- forfeiture of effort units as penalties upon trading to compensate for effort creep in the fishery due to technology improvements;
- introduction of a Vessel Monitoring System;
- closure of additional 96,000 sq. km of untrawled area in the GBR Marine Park;
- introduction of turtle excluder and bycatch reduction devices throughout the Great Barrier Reef World Heritage Area by end of 2001;
- restrictions that only species defined under the Trawl Plan may be targeted; and
- introduction of sustainability indicators and review events.

Note: terms like “tradable effort units”, “penalties” and “target restrictions” are more fully explained in Section 3.7.3. and their impact on effort reductions in the ECTF is examined further in Section 7.

⁸ “Report to Premier and Cabinet” on the ECTF by Dr. John Glaister (March 2000).

⁹ “A report to the Chair of the GBRMPA on the Draft Management Plan for the Queensland East Coast Trawl Fishery” prepared by Hussey *et al* (July 1999).

¹⁰ Based on QDPI surveys and reported to the Commonwealth Minister for Environment and Heritage in the “ACIL Assessment of the Proposed Structural Adjustment Scheme for the Queensland East Coast Trawl Fishery” by ACIL Consulting (July 2000).

By capping fishing effort at the 1996 level, the effort reduction sought by the GBRMPA was not being achieved. There was concern that the effort reductions through the proposed penalties on trading would take too long to become effective. Because of these concerns, the Commonwealth agreed to contribute \$10M to a tripartite structural adjustment scheme for the ECTF designed to remove 15% of effort up-front from the fishery before the introduction of an amended Trawl Plan. Initially, it was proposed that Queensland, industry and the Commonwealth would pay \$10M each towards the scheme. Following legal advice by Queensland that industry could not be levied by the QFS for the payment of loans for such a scheme, industry agreed to a 5% across-the-board reduction in effort in lieu of their contribution to the scheme. The revised arrangements, which contained all the elements of the agreement, became effective on 1 January 2001.

Following the introduction of the amended Trawl Plan, a further seven months of negotiations ensued between Queensland and the Commonwealth over the implementation of an assurance sought by the Commonwealth, which would guarantee that the effort removed from the fishery under the structural adjustment scheme would not be resumed in the Marine Park. By August 2001, agreement was reached on this outstanding issue and Queensland implemented an effort cap for the World Heritage Area based on historical fishing effort in the Marine Park¹¹. Based on ECTF logbooks, effort in the World Heritage Area was about 70% of the total effort in the fishery. In September 2001, the GBRMPA accredited the Management Plan as “*ensuring an ecologically sustainable fishery for trawling in the Far Northern Section of the Great Barrier Reef Marine Park*”.

3.7.2 Current Management Arrangements

The ECTF is managed primarily through a range of input controls (i.e. effort units, gear and fishing capacity provisions, closures and restrictions on which species may be targeted), which means that fishing effort (rather than catch) is regulated. However, some output controls also apply (i.e. possession limits in terms of size, sex and amount of certain species that may be taken). An appraisal of the adequacies of current management arrangements is provided in Section 7. The following is a brief overview of the major restrictions that apply under the revised Trawl Plan.

3.7.2.1 Unitisation of Effort

With the introduction of the revised Trawl Plan in December 2000, the amount of fishing effort that could be expended in the fishery became limited for the first time through the unitisation of effort. This was a necessary step in order to cap and reduce effort. “Effort Units” are based on an allocation formula, which is prescribed in Part 6 of the Trawl Plan. Essentially, the allocated effort units are the product of allocated fishing days multiplied by an effort unit conversion factor.

Allocated fishing days were based on an operator’s history in the ECTF. The conversion factor, prescribed in Schedule 5 of the Trawl Plan, was determined by the vessel’s size (as measured by under deck hull units) to account for fishing power. The rationale for this adjustment was that larger (i.e. more powerful) vessels were more efficient than smaller (i.e. less powerful) vessels. Thus, the conversion factor effectively advantaged smaller boats by giving them a slightly higher proportional allocation than larger boats. For example, a 10 hull unit vessel with an allocated fishing history of 100 days received 1400 effort units instead of 1000, which would have been the allocation if the conversion factor had not provided a slight advantage.

Since vessel size is fixed (until such time as a boat is upgraded or replaced), each effort unit holding will allow the operator a certain amount of fishing days. Each day recorded as “fished” is deducted from the annual fishing day allocation and cannot be “used” again until the following year. Effort units are tradable, which means that effort unit holdings can be increased or decreased through

¹¹ Since operators need to indicate the location of their fishing operations, a spatial analysis of the logbook data indicated the historic levels of trawling in the Marine Park.

transfers. This allowed for the self-adjustment and rationalisation of the fleet after the fishery restructure.

3.7.2.2 Effort Capping and Reductions

The revised Trawl Plan set a maximum number of fishing days to be allocated in the ECTF, which was equivalent to the 1996 level of fishing. The implementation of the voluntary structural adjustment scheme resulted in the removal of nearly 100 licences from the ECTF. This amounted to an effort reduction of nearly 11% of the allocated fishing days. In addition, industry had agreed to a mandatory 5% fishing day reduction across-the-board in lieu of its contribution to the structural adjustment scheme. Thus, there was an up-front reduction of nearly 16% of fishing days at the start of the revised Trawl Plan.

With a reduction in the number of ECTF operators and greater profitability for those that remained in the fishery, it was anticipated that the fleet would be upgraded over time. Mechanisms were built into the Trawl Plan to address effort creep, which was estimated to be on average 3% per annum. Operators are required to surrender 10% of their transferred effort units upon trading. Similarly, a 5% penalty on effort units applies to the transfer of a licence (except for a transfer from a deceased estate). Under the third mechanism, operators need to surrender effort units upon boat replacement. The amount of effort units that are forfeited depends on the size of the replacement vessel, as specified in Schedule 5 of the Trawl Plan. The QFS has indicated that 3% of effort was removed in 2001 by these three mechanisms. The Audit Report notes that while effort creep occurs across the fleet through enhanced technology, only those operators wishing to trade or upgrade vessels pay the associated penalties. As a result, this arrangement may act as a disincentive to an autonomous fleet restructure.

3.7.2.3 Species Restrictions

The Trawl Plan defines species that may be targeted as “principal fish”, which are restricted to prawns, scallops, bugs and squid. Species, that may be taken as by-product (but not targeted), are defined as “permitted fish”. All other species (i.e. bycatch) must be returned to the water.

Following a Trawl Plan review and amendment in late 2001, sharks, whiptail and goatfish may no longer be taken. Permitted species are now restricted to barking crayfish, Balmain bugs, cuttlefish, mantis shrimp, octopus, three spot crab, pinkies, two species of pipefish and blue swimmer crabs. As discussed in Section 7.3.5, limits on possession (i.e. the number or quantity and the sex or sexual status of species that may be retained) and minimum legal size apply to permitted species.

3.7.2.4 Gear Provisions and Limitations to Fishing Capacity

The major limitations to fishing capacity in the ECTF are applied through the maximum engine power provisions and vessel size. The Trawl Plan specifies the maximum engine size of a vessel in the fishery at 300 continuous brake kW¹². Whilst there are large vessels in the ECTF¹³, the Trawl Plan did not recognise vessels in excess of 70 hull units for the purpose of effort unit allocation. For example, an 80-hull-unit vessel received the same effort unit allocation as a 70-hull-unit vessel. A limit of 20 m Length Overall (LOA) applies to vessels wishing to enter the ECTF.

A range of gear-specific restrictions, which limit net length and mesh size, apply across the ECTF. The aim of these restrictions is to mitigate the impact of the trawl gear on the seabed. In addition, sweep length must not exceed 10m, in order to reduce finfish bycatch (see Figure 4).

Under the revised trawl plan, restrictions were introduced for the first time on ground chain dimensions. Operators may not use chains with a diameter larger than 10 mm in inshore waters and

¹² 1 kW is approximately 0.75 brake horse power.

¹³ These are mostly vessel endorsed to fish in the Northern Prawn Fishery, as well as in the ECTF.

larger than 12 mm in offshore waters. Restrictions, which are designed to minimise the benthic impact, also apply to the configuration of the ground chain.

Try nets are permitted in the ECTF to locate prawns and scallops. However, restrictions apply to the net's dimension and the duration of each shot. The head rope length of a try net must not exceed 10m and a try shot must not exceed 25 minutes.

3.7.2.5 Closures

Several closures, which limit total effort in the fishery on a seasonal and year-round basis, apply in the ECTF. Approximately 32% (i.e. 176,133 km²) of the area of the east coast under Queensland fisheries jurisdiction is closed to trawling. In the case of the GBR Marine Park, spatial closures amount to about 50% (i.e. 173,904 km²) of the area. These closures have been declared under either GBRMPA's zoning provisions or Queensland's Fisheries legislation. In addition to the permanent closures, there are also several seasonal closures under the Trawl Plan.

The major reason for the implementation of the seasonal closures was economic. The northern closure allows the tiger and endeavour prawns to grow to an optimum size before harvest. The southern closure was introduced to optimise the yield from scallops and prevent the transfer of effort from northern Queensland during the north's traditionally quiet period. The sequential nature of each of the closures ensures further regulation of access.

In addition to these major closures, there is a complex system of rotational closures in place for the scallop fishery. The purpose of these closures is to protect replenishment areas of high scallop abundance (which contribute to subsequent recruitment), whilst allowing periodic commercial access to these beds. Under the rotational closures, some scallop beds are protected fully at any one time, whereas access is allowed to others.

A range of other closures applies on a smaller geographical scale. Some have been implemented for habitat protection, such as the permanent inshore closures between Cairns and Cape York to protect seagrass habitats or the temporary closure near Bundaberg to protect turtle nesting sites. Other closures have been introduced to remove trawling (and its associated wash-up of bycatch onto adjacent beaches) from major tourist centres. A further group comprises the daylight closures (6 am to 6pm), such as those applying to the far northern area and to the scallop grounds, which are designed to limit effort.

3.7.2.6 Carriage of Prescribed Gear

In order to mitigate the environmental impact of the ECTF, the Trawl Plan requires the use of TEDs and BRDs in all parts of the fishery. A VMS was also introduced with the revised Trawl Plan. By extrapolating vessel speed from the distance travelled between successive polls, the QFS can determine if a vessel is fishing or steaming and adjust the fishing day balance accordingly. Being able to trace the activities of the fleet enhances the enforcement of closures.

4. Monitoring and Research in the East Coast Trawl Fishery

The Commonwealth “**Guidelines for the Ecologically Sustainable Management of Fisheries**” require that:

1. for assessing the impact of the fishery on the stock levels of target and by-product species, “*there is a reliable information collection system in place appropriate to the scale of the fishery*” and that “*the level of data collection should be based upon an appropriate mix of fishery independent and dependent research and monitoring*” [**Guideline 1.1.1**]; and
2. for the assessment of the impact of the fishery on the wider ecosystem, “*reliable information appropriate to the scale of the fishery, is collected on the composition and abundance of bycatch*” [**Guideline 2.1.1**], that “*reliable information is collected on the interaction with endangered, threatened or protected species and threatened ecological communities*” [**Guideline 2.2.1**] and that “*information ... is collated and/or collected covering the fisheries [sic] impact on the ecosystem and environment generally*” [**Guideline 2.3.1**].

Adopting an ecosystem-based management approach requires that an information system is implemented to allow for the collection of baseline data to detect changes in a fishery at an appropriate level of resolution. These data then need to be reviewed and analysed to determine how well the management arrangements meet the performance indicators specified for the fishery. The following section of the Audit Report is an appraisal of the ECTF monitoring and research processes, which provide these data.

4.1 Monitoring and Research Providers and Funding

The QDPI has primary responsibility for obtaining the information needed for the assessment of its fisheries. However, several research organisations (described below) contribute to the necessary monitoring and research work. While it is beyond the scope of this report to comment on the institutional and funding arrangements of each of these contributors, a few are mentioned because of their particular relevance to the ECTF and the collaborative nature of their research.

4.1.1 The Queensland Department of Primary Industries

Research within the QDPI is carried out primarily by the AFFS. The two marine fisheries research centres are based at Deception Bay (the Southern Fisheries Centre - SFC) and Cairns (the Northern Fisheries Centre - NFC). Fisheries monitoring and assessment are done primarily by the QFS. Notwithstanding this demarcation of responsibilities, scientists from both the AFFS and QFS are situated at the SFC and NFC. There is a degree of overlap in fisheries research and stock assessment between the two groups but duplication of work does not occur.

In 2001/02, the AFFS annual fisheries research and monitoring budget was some \$2 million. Of this, about 51% was sourced from State government funds and 49% was sourced from what is termed “soft” funds or research grants (Mike Potter, QDPI AFFS, *pers. comm.*). Of the AFFS professional and technical staff, 62% are funded through short-term research grants. In 2001/02, trawl-related research by AFFS depended heavily on external (i.e. non-government) revenue, which was used to fund about eight full time staff¹⁴ and a significant proportion of the operational costs of the research projects. The Queensland Government supported the positions of four full-time scientists at about \$300,000 per annum on ECTF-related research.

¹⁴ These figures relate to November 2001. Some of the temporary staff have left AFFS employment with the completion of their externally-funded projects.

Recognising the need for fisheries stock assessment, AFFS was granted, on a once-off basis, an additional \$250,000 in 2001/02. In the case of the ECTF, this amounted to about \$50,000 of additional fishery assessment funds. These funds were renewed in 2002/03. However, the funds are granted on a year-to-year basis and there is no guarantee of their future availability.

In 2001/02, the QFS committed about \$375,000 of consolidated revenue and industry funding to fisheries monitoring and assessment work, employing about five full time staff. Its Logbook Section is responsible for maintaining the Queensland Fisheries Information System (QFISH) and the Assessment and Monitoring Unit produces regular fishery status reports, as required by legislation. This includes publication of the Condition and Trends Report, the ecological assessment of Queensland's export fisheries for EA under EPBC legislation¹⁵, annual surveys of North Queensland prawns and scallops through the LTMPs and various reports required under the Queensland Environmental Protection Act and the Queensland Fisheries Act. These reports provide information to the public on how Queensland fisheries are managed.

4.1.2 The Fisheries Research and Development Corporation

The FRDC is a rural research and development corporation within the portfolio of the Commonwealth Minister for Agriculture, Fisheries and Forestry. It is the leading agency concerned with planning, funding and managing fisheries research and development in Australia. The FRDC is a major contributor to fisheries research in Queensland and much of the ECTF research conducted in the past has been funded (at least in part) by the Corporation (and its predecessor).

The corporation has three funding programs, entitled "Natural Resources Sustainability", "Industry Development" and "Human Capital Development". Most of the ECTF research has been funded from the first of these programs and several stock assessment workshops have been financed from the last of the programs.

The FRDC's revenue base is made up of three primary sources. Firstly, the Commonwealth Government provides unmatched funds to the value of 0.5% of the average gross value of production (AGVP) of Australian fisheries¹⁶. Secondly, each State, the Northern Territory and Commonwealth provide contributions of at least 0.25% of AGVP of their respective fisheries¹⁷. Thirdly, the Commonwealth Government matches each of the State, Northern Territory and Commonwealth contributions up to a maximum of 0.25% of AGVP. Therefore, industry may expect a 3:1 return on any research contributions made on their behalf to FRDC.

In 2001/02, the FRDC had a revenue base of around \$22.9 million, which was made up primarily from unmatched Commonwealth Government funds (\$11.4 million), industry contributions (\$4.5 million) and matched Commonwealth Government funds (\$4.4 million). The remainder of the revenue was derived from sources such as investments, royalties and sales¹⁸.

In 2000/01, the Gross Value of Production (GVP) of Queensland's wild fisheries was estimated at around \$302 million¹⁹. In 2000/01 and 2001/02, Queensland contributed to FRDC some \$530,000 per annum. This figure was well short of 0.25% of the AGVP and, consequently, Queensland did not attract the maximum matchable sum from the Commonwealth. With respect to the ECTF, the Queensland contribution amounted to about \$270,000 per annum. Notwithstanding the general

¹⁵ AFFS staff also provide significant input into the condition and trend reports.

¹⁶ The average gross value of Australian fisheries production is calculated on a three-year average.

¹⁷ However, this level of contribution has not always been met by the contributors.

¹⁸ See the Fisheries Research and Development Corporation's Annual Report 2000-2001.

¹⁹ This figure was cited in the 2000/01 "Australian Fisheries Statistics" produced annually by the Australian Bureau of Agriculture and Resource Economics (ABARE). The 2001/02 GVP were not available at the finalisation of the Audit Report.

funding situation, ECTF research in recent years has been relatively well supported by the FRDC at a 4:1 return ratio²⁰.

There has been a change in the type of fisheries research supported by the FRDC in recent years. Historically, the Corporation (and its predecessors) have funded fishery monitoring and stock assessment work throughout Australia. However, the FRDC now has adopted a more strategic research direction and focus. Routine types of fishery monitoring and stock assessment work generally does not attract research funding. The FRDC aims to concentrate the research efforts that it funds towards environmental, economic and social components of nationally significant issues.

4.1.3 The Cooperative Research Centre for the Great Barrier Reef World Heritage Area

The Cooperative Research Centre (CRC) for the Great Barrier Reef World Heritage Area (hereafter referred to as “CRC Reef”) is a company limited by guarantee, supported by its members²¹ and the Commonwealth Government’s CRC Program. The Centre undertakes an integrated program of applied research and development, training and extension, which promotes the ecologically sustainable development of the Reef’s resources. The Reef CRC manages four major research programs²² and an education and communication program, aimed at achieving practical outcomes.

The total Reef CRC budget in 2001/02 was about \$11.5 million, of which \$5.912 million was cash-based and \$5.583 million was in-kind contributions from the members. In 2001/02, the Centre undertook 105 research projects²³. Of these, two were of direct relevance to the ECTF at a cost of \$118,771²⁴.

4.1.4 Other Relevant Research Providers

In addition to the QDPI, FRDC and Reef CRC, other research institutions provide research and monitoring information for Queensland fisheries (including the ECTF). Amongst these are the Australian Institute of Marine Sciences (AIMS), the Commonwealth Scientific and Industrial Research Organisation (CSIRO), James Cook University, Griffith University and State/Territory-based fisheries institutes. Much of the research carried out by these institutions is done under FRDC or Reef CRC funding and may be undertaken cooperatively with other research organisations. Where the funding is external, there is usually an “in-kind” contribution from the institutes conducting the research.

4.1.5 Comments on the Funding Environment

It is difficult to determine the precise level of financial commitment to research and monitoring in the ECTF because these functions are spread across several fisheries and carried out by several agencies using a diverse range of funds. In any case, it could be misleading to review such expenditure for one fiscal year only. Most research projects are conducted over a three to five year period and research expenditure needs to be reviewed over such a period to get a realistic funding picture. An accepted benchmark for research and monitoring expenditure in a developed fishery is about 5 - 10% of the AGVP. Although the average monitoring and research expenditure for the ECTF was not available for this audit, it appears to be well below 5-10% of the AGVP (more like 1%).

²⁰ *Pers com* from the FRDC.

²¹ The Reef CRC members are the Association of Marine Park Tourism Operators (AMPTO), the Australian Institute of Marine Sciences (AIMS), the Great Barrier Reef Marine Park Authority (GBRMPA), the Queensland Seafood Industry Association (QSIA), the State of Queensland through its Department of Primary Industries (QDPI), SUNFISH Queensland and the Great Barrier Reef Research Foundation.

²² The CRC Reef’s four research programs are: Conserving World Heritage Values; Sustainable Industries; Maintaining Ecosystem Quality and Reef Futures

²³ Of these 105 projects, the GBRMPA had direct involvement in 57 by being defined as “task associate “.

²⁴ “A Conceptual and Operational Understanding of Resource Dependency” by Ms Nadine Marshall and “Coastal Fisheries Resource Monitoring in the GBRWHA” by Mr R. Garrett.

As with other Queensland-managed fisheries, a major impediment to funding research and monitoring in the ECTF at a level appropriate for the scale of the fishery is the current lack of recovery of the fisheries management costs from industry. For example, in Commonwealth-managed fisheries all management costs (including those for research and monitoring) are levied to industry as part of the annual licence fee. For most licence types, this amounts to several thousand dollars per licence.

Recommendation 1

- ***That the QFS identifies the “true” management costs for the ECTF in terms of the monitoring and research costs and continues to pursue adequate funding for its fisheries as a matter of priority.***

In light of a greater public awareness of environmental issues, the call for fisheries management agencies to demonstrate that fisheries activities are ecologically sustainable is increasing in Australia. However, this requirement generates a growing demand on research and monitoring funds. In an environment of increased competition for research dollars and a general tightening of criteria under which such research is funded, research expenditure based largely on external funding is a high-risk strategy for any fisheries management agency to adopt. Firstly, there is a risk that high priority or essential projects will not receive funding. Secondly, the control over such projects, if they are externally funded, rests primarily with the funding body.

Much of the ECTF research to date has been at least part-funded through external (primarily FRDC) monies. A reliance on external funding to conduct core activities generates funding uncertainty from year to year. The move by FRDC away from supporting routine research and stock assessment work increases the chances that some essential activities will not be funded. It is anticipated that information demands in the ECTF will increase in light of increasing scrutiny of the ecological sustainability of the fishery. Therefore, it is crucial that alternative funding sources are identified for routine monitoring and assessment work.

Recommendation 2

- ***That the QFS, via Trawl MAC, identifies the core monitoring and research activities for the ECTF and considers strategies through which these can be met on a continued basis.***

4.2 Monitoring and Research Processes

Research and monitoring are crucial information sources for the assessment and management of the ECTF. This section of the Audit Report discusses the monitoring and research processes for the fishery.

4.2.1 Queensland Fishing Industry Research Advisory Committee

The Queensland Fishing Industry Research Advisory Committee (QFIRAC) provides advice on research for Queensland’s fisheries to the FRDC. The Committee meets regularly to review its strategic research and development (R&D) plan for Queensland’s fisheries and aquaculture, call for research proposals in line with the research plan, evaluate research applications and make recommendations to FRDC on the funding of these projects. All ECTF-related research applications seeking FRDC funding are considered by the QFIRAC.

The QFIRAC has a secondary role as the research advisory committee to the Fishing Industry Development Council (FIDC), which provides advice on fisheries policy to the Minister for Primary Industries and Development.

4.2.2 Trawl MAC and its Scientific Advisory Committee

At the fishery level, Trawl MAC is responsible for making ECTF-related research recommendations to the QFS' Chief Executive. Research issues are dealt with in more detail by Trawl MAC's SAG (Section 3.6.2.2), which meets about three times a year to consider research and stock assessment issues.

Trawl MAC and its subcommittees were suspended for nearly 15 months during 2000 and 2001, while the revised Trawl Management Plan was being developed. This suspension has created a delay in the work program of the SAG.

The involvement of Trawl MAC and its SAG in the research review process is limited to receiving intermittent verbal reports on current research projects and being provided with written reports as they become available. The committees also comment on the fisheries status and stock assessment reports, review performance indicators in the Trawl Plan and respond to *ad-hoc* research requests on ECTF matters.

Given a limited budget and the infrequency and short duration (usually half a day) of SAG meetings, it is not surprising that the committee has only a cursory role in ECTF-related research. In contrast, several other Australian fisheries at both Commonwealth and State levels, have scientific subcommittees which meet regularly to peer review research on a real-time basis and provide in-depth advice on its implications to management²⁵. A number of ECTF research projects are guided by project steering committees made up of stakeholder representatives. This approach ensures greater acceptance of research results and wider stakeholder input. The costs of these steering committees are funded by the individual projects.

4.2.3 Comments on the Monitoring and Research Process

As described earlier, several agencies conduct research on the ECTF. It is acknowledged that funding agencies generally evaluate research results and subsequent publications to varying degrees, as part of their own internal processes. However, there is no formal, peer-reviewed process for the monitoring and research work at an ECTF-wide level. Specifically, there are no structured, regular workshops with suitably qualified scientists and other relevant experts to synthesise research and monitoring results and assess their implications for management. The last systematic research review on species of major commercial importance (including some ECTF species) occurred in August 1998.

There are numerous published articles by the QDPI scientists on ECTF-related research in well-established fisheries journals (see bibliography). However, information is not always readily available in a published format for those Trawl MAC and SAG members involved in research and assessment. A significant portion of the research information remains unpublished or recorded only in the grey literature. For example, there are several final FRDC reports, which have not been published yet in the scientific literature²⁶. Similarly, much of the fishery monitoring work undertaken by the QDPI has not been documented formally.

In advocating a better scientific publications record, it is not suggested that the scientists concerned are producing low-quality research, which is not acceptable for publication in the scientific literature. It is recognised that some research (such as the long-term survey work) has only 3 - 4 years of data and may not show any long-term trends, which can be published in the scientific literature. However, the absence of a formalised research review process, together with a lack of publication of some current relevant research, casts doubt on the quality of the research results. Publication in peer-reviewed journals ensures that research is of a standard that is accepted by other scientists as being at an

²⁵ Examples of fisheries where scientific advisory committees play an integral role in research review are the Commonwealth-managed Northern Prawn Fishery and the Western Australian prawn trawl fisheries.

²⁶ Final FRD reports are considered "grey literature" even though they have been internally reviewed.

appropriate level. This requires that the research work is reviewed critically to ensure that it meets this standard. The endorsement of other scientists is achieved by such publication. Results published in the grey literature carry only a limited endorsement and are viewed with some scepticism by other scientists.

Recommendation 3

- *That a formalised process of regular peer review of monitoring and research results be developed for the ECTF through Trawl MAC.*

In an era of limited research funding and greater public accountability, it is essential that strategic research plans be developed for fisheries. Ideally, such plans need to be specific and adopt a medium-term (3–5 year) approach. This would ensure that monitoring and research work remains focussed on priority areas and that information gaps are addressed. Also, it would create greater transparency in the decision-making process underpinning funding decisions.

At present, there is only a brief list of key research areas identified for the ECTF. The SAG, through Trawl MAC, aims to formalise these into research priorities and develop a longer-term strategic research plan for the ECTF. It is expected that this process will provide input into QFIRAC's annual review of its R&D Plan, thereby ensuring that only research identified as high priority by Trawl MAC will be recommended for FRDC funding in 2003/2004. It is recognised, that frequently strategic or innovative projects are not regarded as "high priority" because of their long-term benefits and pioneering approach.

The immediate development of a strategic research plan for the ECTF is strongly supported. Given the several research providers and funding sources, it is essential that research is coordinated through such a plan. Specific issues and interests have driven past ECTF research. Greater coordination and transparency in the decision making process is needed.

Recommendation 4

- *That a strategic R&D Plan, which identifies and prioritises the information gaps for monitoring and research in the ECTF and which provides input into external R&D processes, be developed through Trawl MAC.*

4.3 Information Systems

Having described how research and monitoring are provided and funded and how they are conducted within an institutional framework, in this section a critique is provided on the information systems in place for the ECTF.

4.3.1 The Vessel Monitoring System

The revised Trawl Plan requires otter trawl operators to carry a functioning automatic location communicator aboard their vessels whilst fishing in the ECTF²⁷. This VMS reports the precise GPS location of a vessel at specific time and, therefore, is an important monitoring and compliance tool. Section 7 considers the use of the VMS as a management tool. This section of the report discusses the system's limitations as a data source.

When the VMS was first introduced, there were a number of technical difficulties with the operation of the system. These problems included shadow areas for satellite reception, errors in the extrapolation of speed and problems due to faulty power supplies. The incidence of technical malfunctioning is reported to have decreased substantially after the first year of operation. The GBRMPA did not gain access to the VMS data until early 2003 and, therefore, was not in a position to verify these reports.

²⁷ The Trawl Plan exempts Moreton Bay and inshore beam trawl operators from the use of VMS.

The value of the VMS data clearly lies in its spatial and real-time information. In this regard, the system provides a level of detail that is not available from logbooks. However, a major limitation is the system's inability to determine whether a vessel is steaming or trawling. Decision rules have been built into the VMS software that assume a vessel is steaming if its estimated travelling speed is at or above 5 knots. If the VMS detects a drop below this speed, the vessel is assumed to be trawling. As has been demonstrated by the review into steaming days in August 2001²⁸, this assumption is not always correct. Smaller vessels have difficulty attaining a travelling speed of 5 knots during rough seas.

A three-year FRDC-funded project (No. 2002/056) entitled "*Innovative stock assessment and effort mapping using VMS and electronic logbooks*", hereafter referred to as "the VMS Mapping Study", was started in January 2003 by Hoyle (QDPI, AFFS). This project's aim is to develop precise maps of trawl tracks and trawl effort distribution by examining VMS-generated trawl tracks and then to develop trawl signatures, trawl tracks and catch distribution functions for each sector of the ECTF. It is hoped the results of this study will enable a more precise analysis of trawl effort and catch distribution in the fishery and when a vessel is actually trawling.

Notwithstanding the outcomes of this FRDC project, it is noted that the benefits of the VMS could be augmented with the introduction of gear sensors, which could record the length and time of each trawl shot. Accurate information on fishing time in turn allows scientists to calculate the area swept by the net for fishery assessments purposes. The importance of accurate effort analysis in an input-managed fishery is discussed further in Section 5.

It is acknowledged that gear monitors in the ECTF are untested. However, a feasibility study by Terravision on possible gear sensors, entitled "*Scoping study to determine a method to remotely monitor trawler operations*"²⁹, was presented to the GBRMPA and QFS in June 2002. The study concluded that while there are some operational difficulties to overcome, gear sensors in the ECTF would be both feasible and of benefit. To date, the QFS and industry have been reluctant to consider the development of this technology.

Recommendation 5

- *That the development of gear monitors in the ECTF be pursued to a prototype stage and that a cost-benefit analysis be undertaken on the use of this system as a fisheries management and monitoring tool.*

4.3.2 Commercial Fisheries Logbook Program

A legal requirement for commercial fishers to fill in logbooks has been in place in Queensland since the beginning of 1989. In order to process the information derived from these commercial logbooks, a database called the "*Commercial Fisheries Information System*" (CFISH) was implemented in 1992 by the then QFMA. The "*East Coast Trawl Fishery (ECTF) Logbook*", and the information derived from it, is part of this commercial fishery-wide information system.

The ECTF logbook format has been revised several times since 1988. The logbook in use for the period of the audit was the seventh version (i.e. the OT07). This version was in force from March 2000 to December 2002 and subsequently was replaced by the OT08. The latest logbook has addressed several of the shortfalls identified in the OT07 throughout this audit.

As a general observation, information fields in the ECTF logbook have become more detailed over time. Earlier logbooks requested only basic catch and effort information on major product groups (i.e.

²⁸ "Fisheries (East Coast Trawl) Management Plan 1999 Review Paper - Permitted Fish (other than principal fish) and Steaming Day Review", prepared by QFS (August 2001).

²⁹ The Terravision study was jointly funded by the GBRMPA and the QFS.

primarily prawns). No information was collected on either minor target species or by-product. While this shortfall had been rectified in the OT07 (and its successor), time series records on by-product spanned only two years at the writing of the Audit Report. Such a lack of historical information on the take of by-product was a major limitation in reviewing possession limits for permitted species (other than principal species) in late 2001³⁰.

As outlined in Section 3, the ECTF is a multi-species fishery, with different sectors targeting different species mixes throughout the fishery. In an attempt to keep the logbook user-friendly and to ensure compliance by industry with the information demands, certain species were grouped together in the OT07³¹. However, from a stock assessment perspective it is important to have more detailed information on species composition (this is discussed further in Section 5). The OT08 now provides separate columns for each of the permitted species, but given that catch frequently is not separated at a species level, the accuracy of this information is questionable.

In the ECTF, several target species may co-occur in one trawl habitat type (such as tiger and endeavour prawns in the Great Barrier Reef lagoon). The ECTF logbooks have not recorded targeting information. Arguably, targeting data are of limited value, as such information frequently is entered after the shot has been completed and the catch has been sorted. However, from a stock assessment perspective, it is important to record fully all details of the attributes of the fishing operation and the location of capture, which contribute (together with the abundance of the species) to the species composition of the catch. With these data, statistical analysis may permit a determination of the way in which the various factors influence the catch composition of the different species (this is discussed further in Section 5).

As outlined in Section 6, the level of bycatch in trawl fisheries is of major concern both to the general public and to the GBRMPA. Although generally high, the amount of bycatch in the ECTF varies with season, location and target species composition. No trawl logbooks to date have recorded information on the amounts, species composition and status (live/dead) of discards. From a logistical point of view, this is understandable. If such information is required, it would add to the complexity of logbook design and, in any case, the data provided could not be verified. However, this highlights the need for bycatch information being derived through an alternative source.

Having outlined the major areas where the trawl logbook cannot provide adequate information on the fishing operations to enable more detailed fishery assessment, greater use of specific, statistically well-designed, monitoring programs (such as at-sea observer programs or fishery-wide surveys) is advocated. It is recognised that annual surveys are being conducted in the ECTF for certain key species (see Section 4.3.4). However, it is recommended that these programs be extended to provide fishery-wide coverage.

Surveys and observer programs are frequently the only way to obtain accurate and detailed fishing information. For example, such monitoring would provide data on the entire catch composition (including bycatch). Detailed operational information for the analysis of species abundance also can be obtained, as well as relevant biological data such as size composition data for age and growth analysis.

The strength of an at-sea observer program is that it allows for the verification of commercial logbook data. However, it is recognised that in order to obtain a statistically representative coverage of commercial activity, such a program would need to be extensive and hence be quite costly. As current work by Courtney *et al.* (FRDC Project No. 2000/170) has shown, there can considerable variation in

³⁰ “Fisheries (East Coast Trawl) Management Plan 1999 Review Paper - Permitted Fish (other than principal fish) and Steaming Day Review”, prepared by QFS (August 2001).

³¹ Species assemblages that are grouped for the principal and permitted species included Grooved/Brown Tiger Prawns, Blue/Red Endeavour Prawns, Saucer/Mud Scallops, Greasy/Bay/Coral/ School/ Other Prawns, Reef/Mud Bugs, Squid, Octopus, Cuttlefish, Whiptails, Pinkies and Goatfish.

the performance of fishing gear between boats. This leads to uncertainty in the analysis of the monitoring data (see Table 21).

These fishery-wide monitoring programs should be designed in a way that can detect changes in species abundance or fishing practices, should these occur. Estimates of the uncertainty or precision should be available for the amount of catch and bycatch taken and for the biological data that are collected, if the information is to be assessed appropriately.

Recommendation 6

- ***That the QFS determines and implements specific and statistically well-designed fishery-wide monitoring programs, which supplement the existing programs and provide essential fishery assessment information currently not provided through the trawl logbook.***

Once the Trawl Plan is accredited under Sections 208A, 222A, 245 and 265 of the *EPBC Act*, licence holders must report all interactions with listed marine species, migratory species, threatened species and cetaceans³². The onus clearly is on the operator to report to EA on this matter. The OT07 requested information on incidental turtle captures by trawlers, but was silent on the other species listed under environmental legislation, such as seahorses and pipefish, sea snakes, listed sharks (great white, grey nurse and whale shark), dolphins, whales and dugong. This inconsistency has now been addressed, with the QFS providing a separate logbook for the recording of interactions with species of conservation interest. In terms of assessing the impact of the ECTF on associated species, it would be of assistance to have this information monitored and made available on a regular basis.

Recommendation 7

- ***that the interaction of trawl operations with species of conservation interest (as listed under the EPBC Act) be reported annually in the Status Report for the ECTF.***

Earlier versions of the trawl logbook permitted operators to nominate fishing activity within a 30'x30' grid. The OT07 improved the geographical information on the fishery by requiring that the location of fishing operations be recorded to the nearest 6' x 6' grid or by precise latitude and longitude. Due to the highly localised nature of trawl operations, this change is a significant improvement in the spatial resolution of trawl data. As outlined in Section 5, detailed spatial analysis is important from a stock assessment point of view, especially with respect to assessing localised depletion or determining habitat-associated abundance of species (such as syngnathids) within the area of the fishery.

As was shown by a preliminary analysis of VMS data, even within a 6nm square area, fishing is likely to be restricted to only a small portion of that grid (Williams, 2002). A comparison of the logbook data with the finer-scale VMS data would provide a more spatially resolved picture of the extent of trawling. The VMS Mapping Study by the Hoyle (QDPI AFFS) has begun integrating VMS and logbook data. At this stage, there were only two years of VMS data available at the end of 2002 and the pattern of operation by the fleet after the fishery restructure may not be indicative of its longer-term pattern. However, the project will determine a process for monitoring fishing effort changes, which can be applied to future trawl data.

Recommendation 8

- ***That, as the results of the VMS interpretation study become available, a fine-scale analysis of VMS data be integrated with the logbook data analysis in the fishery assessment process.***

As in other prawn fisheries, there have been significant improvements in gear and vessel performance over time. This is due to the introduction of improved fishing and navigation technology. O'Neil *et al.* (QDPI, AFFS) have documented "effort creep" in the ECTF in a three-year FRDC-funded study

³² The requirement for the reporting of these species technically does not begin until EA assesses the ECTF and accredits the management arrangements by issuing a Wildlife Trade Operation Approval under Section 303FN of the *EPBC Act*.

entitled “*Reference point management and the role of catch-per-unit effort in prawn and scallop fisheries* (FRDC Project No. 1999/120), hereafter referred to as the “Effort Creep Study” (See Section 5.2.3).

With the introduction of the revised Trawl Plan in early 2001 (and in particular with the easing of vessel upgrade restrictions), further (and potentially significant) changes are expected in effort creep across the fleet. The OT07 and its successor record gear information on an annual basis. However, the accuracy of these data and the compliance with the reporting requirement are unknown. As demonstrated in the Northern Prawn Fishery, the determination of effort creep in a fishery generally warrants a separate and well-designed study, which can determine the often confounding effects of miscellaneous technological factors. The type of data collected through logbooks can serve as a valuable basis to plan such a study.

Recommendation 9

- ***That the information provided on the logbook gear sheets be reviewed annually as part of the fishery assessment process and that this information be used in the planning of on-going assessments of effort creep.***

Having described the limitations of the ECTF logbook data in terms of coverage, the audit also questions the general accuracy of the information provided. The QFS conducts a number of checks during data entry to test the logbook information for “normality”. However, there are no processes in place to validate the logbook data. Anecdotal reports suggest that there is some justification for concern over this matter.

The effort unit allocation process in 2000 highlighted numerous disputes over recorded fishing history and daily activity records, highlighting the fact that the historical logbook information is open to challenge. Furthermore, a three-year FRDC-funded study by Connolly *et al.* on “*Trawl bycatch of syngnathids in Queensland: catch rates, distribution and population biology of Solegnathus pipehorses (seadragons)*” (FRDC Project No. 1999/124), hereafter referred to as the “Syngnathid Study”, indicated a significant under-reporting of syngnathids by operators when compared to processor records.

The impact of this uncertainty over the quality of the logbook data is discussed further in Section 5. However, it is noted that the assessment of the ECTF relies predominantly on the catch and effort data derived from the trawl logbook. Therefore, it is of concern that the assessment of the fishery is based on non-validated data. The audit recommends that there be a “ground-truthing” of the logbook data through an at-sea observer program aboard the commercial fleet. Validation of the logbook data through secondary sources (such as processor records and at-sea boarding reports by compliance officers) would also assist.

An added advantage of such an observer program is that it would not only validate, but also supplement, the logbook data. As outlined above, there are major gaps in the information provided in the logbooks. Observers aboard the commercial fleet could fill in these gaps, thus providing base line data that assist in the planning of such fishery-wide monitoring programs.

Recommendation 10

- ***That the QFS determines and implements an at-sea observer program, which validates the information provided in the trawl logbooks.***

4.3.3 Electronic Catch and Effort Recording System

An Electronic Catch and Effort Recording System (ECERS) has been developed for the ECTF, which allows operators to transmit their logbook data electronically. This is a voluntary arrangement at

present. Operators, who avail themselves of this service, need on-board computers and C-plot software. According to QFS reports, ECERS is used only by the larger vessels, which operate in the northern part of the fishery. Some 50 operators currently forward logbook information electronically. This number is expected to increase with the development of more user-friendly software.

The obvious advantage of ECERS is the speedy transmission of catch and effort data, allowing real-time monitoring of the fishery. It may also reduce some of the management costs associated with the processing of hard copy returns, thereby freeing up valuable resources. However, no cost-benefit analysis has been done to date on the introduction of the ECERS in the ECTF.

During the period of the audit, there was a six-month delay in summarising the logbook data³³. This delay was in part caused by late and erroneous logbook returns. Such delays are of concern with respect to the fishery in the GBR World Heritage Area. As outlined in Section 3, an effort cap applies to the number of days that may be fished in this area. Once that level is reached, the fishery is closed in the GBR World Heritage Area. In 2001, fishing effort was well below the effort cap. However, in 2002 it came close to the cap. This demonstrated the need for real-time data in the ECTF. It is recognised that the VMS could be used as a tool to monitor fishing days on a real-time basis, but the ability of operators to apply for the reinstatement of fishing days (see Section 7.3.2.) introduces uncertainty in the effort data.

Recommendation 11

- ***That a feasibility study be undertaken on the introduction of an ECERS throughout the ECTF, specifically with a view to monitoring the level of fishing activity in the GBR World Heritage Area on a real-time basis.***

4.3.4 Fishery-independent Surveys

Section 4.3.2. of the Audit Report argues for fishery independent-surveys in the ECTF, because of the information gaps contained by the logbook data. This section discusses the fishery-independent surveys currently in place for the ECTF. These surveys are known as Long Term Monitoring Programs (LTMPs) and have been conducted by the QFS on a number of key fisheries. With respect to the ECTF, LTMPs are carried out for the scallop and North Queensland prawn fisheries.

4.3.4.1 The North Queensland Prawn LTMP

The North Queensland prawn LTMP operates in the northern part of the ECTF, between Torres Strait and Cape Flattery. Tiger, endeavour and northern king prawns are the dominant catch in this region. The need for this monitoring program was first suggested at a stock assessment workshop in August 1998, when tiger prawns were identified as a species that should be monitored using fishery-independent data because of their vulnerability to overfishing.

The aim of the North Queensland Prawn LTMP is to monitor recruitment of juveniles into the fishery and to determine (if possible) the relationship between stock and recruitment.

The survey is carried out in February, prior to the opening of the Northern Closure on 1 March each year. With the inclusions of the Cairns to Townsville sector, more than 70 sites are sampled regularly in the Far Northern Section of the Marine Park. Five years of data have now been collected for the North Queensland Prawn Fishery.

³³ The 2001 ECTF Status Report was not released until September 2002, although the data had been finalised by mid 2002.

4.3.4.2 The Scallop LTMP

The Scallop LTMP operates in the southern part of the ECTF, on the major scallop grounds between Yeppoon and Bundaberg. Following concerns over poor recruitment and low catch rates in 1996/97, spatial closures were implemented to protect broodstock in areas of high density. A scallop LTMP was implemented in 1997 to provide monitoring information for stock protection and fishery analysis.

The aim of the scallop LTMP is to assess recruitment levels, size structure and population densities in areas of high fishing activity and in the rotational area closures.

The survey is conducted around the neap tides following the October new moon each year, during the southern seasonal closure. Originally, about 400 sites were sampled within the area of the scallop fishery, using prawn trawl gear and 20-minute shots. The number of sites was reduced to 150 in 2001. The DPI has 5 years of scallop survey data, which will be built into the stock assessment, modelling and predictive assessments as the data base builds over time.

4.3.4.3 General Comments about the LTMPs

The LTMPs in the ECTF are designed to provide annual snapshots of species abundance and recruitment to the fishery. However, one of the limitations of the current ECTF LTMPs is that they are conducted only in major commercial grounds (i.e. areas of highest commercial value because of high species abundance). Due to the cost of surveys and the difficulties in obtaining access to previously untrawled (i.e. generally closed) areas, coverage is not provided for the species' entire range of distribution. This introduces a bias into the results and makes it difficult to extrapolate about species abundance outside the major trawl grounds. The implications of this are discussed further in Section 5.

The design of fishery-independent surveys is crucial in terms of the future use of the data for fishery analysis. The surveys should be robust to changes that are likely to occur in the fishery and the (as yet unidentified) data that may be required for future analyses. Most importantly, the data need to be accurate and sufficiently precise to enable their use in stock assessment. The Audit Report does not advocate that information is obtained for the sake of "data collection". It is important that the data are analysed and used in integrated assessments as they become available, rather than waiting until a sufficiently long time series of data becomes available.

In addition to collecting information on the target species, each LTMP collects information on the by-product and bycatch of these fisheries. For example, data on the size composition and abundance of a number of other species (including blue swimmer crabs, Moreton Bay bugs and pipefish) are collected during the scallop LTMP. However, as these data are collected on an opportunistic basis, they are not statistically robust and are hence of limited fishery assessment use. It is noted that the LTMP-generated bycatch information may provide a basis for planning future specific bycatch studies.

The value of data from any well-designed fishery-independent survey increases with time, as it allows for the determination of long-term fishery trends. Ideally, data should be collected over many years before stock trends can be assessed with any degree of accuracy and proper stock-recruitment relationships can be modelled. At the time of the preparation of the Audit Report, five years of data had been collected from the scallop and North Queensland Prawn LTMPs. The continuation of this work is supported. However, given the funding concerns discussed in Section 4.1.5, there is uncertainty over the scale of future monitoring work. Any changes to the programs should be evaluated carefully in terms of their impact on the existing data sets.

It is acknowledged that, within the GBR Marine Park, the scallop and North Queensland Prawn LTMPs cover the species of highest commercial value. Species of lesser commercial value (like banana prawns, bugs and bay prawns) and eastern king prawns (which occur predominantly outside the Marine Park) are not targeted by the surveys. It is recognised that fishery-independent surveys are

costly, but if they are properly designed they can yield valuable data generally not provided by logbooks. The extension of the current surveys to cover the entire ECTF on a periodic basis should be considered.

Recommendation 12

- *That a peer review be conducted on the design of the current ECTF LTMPs, with a view to:*
 - (a) identifying the bias in sampling established trawl grounds;*
 - (b) assessing the use of the data in current and future stock assessments; and*
 - (c) extending the spatial coverage of the surveys.*

4.3.5 ECTF-Related Research

Research is a crucial source of fishery-independent information for the assessment and management of fisheries. Sections 4.1 and 4.2 have described the institutional arrangements and processes for ECTF-related research in general terms. This section specifically discusses the type of research conducted in this fishery.

A list of ECTF-related research in 2001/2002 is provided in Appendix 5. Information on relevant past research is included in the bibliography (Section 8). Historically, research has concentrated on establishing biological parameters for the key target species, developing TED technology and quantifying the environmental effects of trawling (including the composition and spatial distribution of bycatch). In recent times, funding has been sought for projects focusing on reducing environmental impact (such as the assessment of bycatch in trawling and development of bycatch reduction technologies) and projects to supplement the monitoring and assessment function of the managing agency (such as stock assessments based on reference points and risk assessment).

Tables 5 to 8 summarise the research to date on the species taken in the ECTF or its wider ecosystem. As outlined below, some information is available on the principal species (Table 5), but information is more limited on the permitted species (Table 6). As described in a “*Literature Review: The biology and population dynamics of permitted fish species in the Queensland East Coast Trawl Fishery*” (Haddy, 2002), research on permitted species generally is limited to basic biological studies on taxonomy, growth and reproduction. Information is even more scant for bycatch taken in the ECTF (Table 8).

Table 5: Research on the principal species listed under the Trawl Plan (Information Source: Literature Review).

Common Name	Species	Research Studies
Tiger Prawns	<i>Penaeus esculentus</i> <i>Penaeus semisulcatus</i> <i>Penaeus monodon</i>	<ul style="list-style-type: none"> ➤ Studies on spawning and recruitment (Courtney <i>et al.</i>, 1991; Courtney, 1995) ➤ Studies on reproductive biology (Die <i>et al.</i>, 1995) ➤ Effects of closures (Gribble & Dredge, 1992; Gribble & Dredge, 1994; Gribble & Turnbull, 1996) ➤ Stock assessment work (Gribble & Turnbull, 2002);
Eastern King Prawn	<i>Penaeus plebejus</i>	<ul style="list-style-type: none"> ➤ Studies on spawning and recruitment (Courtney, 1995)

Common Name	Species	Research Studies
		<ul style="list-style-type: none"> ➤ Studies on distribution and abundance (Montgomery <i>et al.</i>, 1995) ➤ Studies on periodicity and reproductive condition (Courtney <i>et al.</i>, 1991; Courtney <i>et al.</i>, 1995) ➤ Stock assessment workshop (Dichmont <i>et al.</i>, 1999)
Scallops	<i>Amusium japonicum balloti</i> <i>Amusium pleuronectes</i>	<ul style="list-style-type: none"> ➤ Studies on reproductive biology (Dredge, 1981; Williams & Dredge, 1981; Sumpton & Dredge, 1990; Robins-Troeger & Dredge, 1993) ➤ Stock assessment work (Dredge, 1985; Dredge, 1988; Dredge 1989; Dredge 1992; Dichmont <i>et al.</i>, 1999) ➤ Scallop survey results (Dichmont <i>et al.</i>, 2000)
Endeavour Prawns	<i>Metapenaeus endeavouri</i> <i>Metapenaeus ensis</i>	<ul style="list-style-type: none"> ➤ Studies on reproductive biology (Courtney <i>et al.</i>, 1995; Courtney & Dredge, 1988)
Northern King Prawn	<i>Penaeus longistylus</i> <i>Penaeus latisculatus</i>	<ul style="list-style-type: none"> ➤ Studies on reproductive biology (Courtney & Dredge, 1988) ➤ Studies on biological parameters (Dredge, 1990)
Bugs	<i>Thenus</i> spp <i>Ibacus</i> spp <i>Scyllaroides</i> spp	<ul style="list-style-type: none"> ➤ Studies on biological parameters and yield optimisation (Courtney, 1995)
Banana Prawns	<i>Penaeus merguensis</i>	<ul style="list-style-type: none"> ➤ Studies on reproductive biology (Dredge, 1985)
Squid	<i>Photololigo</i> spp <i>Sepioteuthis lessoniana</i> Other species	<ul style="list-style-type: none"> ➤ Squid fishery review (Dunning <i>et al.</i>, 2000)

Note: 1 The above literature review was compiled during the writing of the Audit Report. It may not include all relevant references to research publications and workshop proceedings.

2 Bay Prawns were excluded from Table 5 as they are generally taken outside the GBR Marine Park.

Table 6: Research on the permitted species listed under the Trawl Plan.

Common Name	Species	Research Studies
Pipehorses	<i>Solegnathus hardwickii</i> <i>Solegnathus dunckeri</i>	<ul style="list-style-type: none"> ➤ The two commercial pipehorses in the ECTF were part of a major study, but there is limited information on the other (non-commercial) species (Connolly <i>et al.</i>, 1999)
Balmain Bugs	<i>Ibacus</i> spp (5)	<ul style="list-style-type: none"> ➤ Little information is available on the species' distribution and biology in Queensland ➤ Some research has been conducted on the species' distribution and biology in NSW (Stewart & Kennelly, 1998 and Stewart & Kennelly, 2000)
Barking Crayfish	<i>Linuparus trigonus</i>	<ul style="list-style-type: none"> ➤ Little information is available on the species'

Common Name	Species	Research Studies
		<p>distribution and biology in Queensland</p> <ul style="list-style-type: none"> ➤ Some research has been done on the reproductive capacity and biology of Australian barking crays (Wassenberg & Hill, 1989)
Cuttlefish	<i>Sepia</i> spp (15) <i>Metasepia pfefferi</i>	<ul style="list-style-type: none"> ➤ Information on the species' taxonomy and biology is generally poor, but some research has been conducted on the identification of Australian cuttlefish (Norman & Reid, 2000)
Mantis Shrimp	<i>Squillaidea</i> (8)	<ul style="list-style-type: none"> ➤ Given their Indo-West Pacific-wide distribution, international research has been conducted on Mantis Shrimps (principally in India and Japan) ➤ Some research has been done on the taxonomy of the Australian stomatopod fauna (Ahyong, 2001) their biology and reproduction (Ruppert & Barnes, 1994)
Octopus	<i>Octopus</i> spp (8 –10)	<ul style="list-style-type: none"> ➤ Information on the species' taxonomy and biology is generally very poor, but some taxonomic descriptions and biogeographical data are available for Queensland (Norman, 1998)
Pinkies	<i>Nemipterus</i> spp (5)	<ul style="list-style-type: none"> ➤ Given their wider distribution throughout South East Asia, there is some international research conducted on nemipterids ➤ Several Australian studies have examined their reproductive biology and diet (Eggleston, 1972, Sainsbury & Whitelaw, 1984 and Samuel, 1990)
Red Spot Crab	<i>Portunus sanguinolentus</i>	<ul style="list-style-type: none"> ➤ Given the wide global distribution of Portunid crabs, information is known about their bycatch throughout the Indo-West Pacific region ➤ Some information is also available on their role in ECTF bycatch (Wassenberg & Hill, 1982) and reproductive biology (Sumpton <i>et al.</i>, 1989 and Campbell & Fielder, 1986)

Note: 1 The above literature review was cited in the QFS' review of permitted species (Haddy, 2000). It may not include all relevant references to research publications and workshop proceedings.

2 No information was presented on goatfish and sharks, as both species groups have been removed from the list of permitted species under the amended Trawl Plan.

Table 7: Research on species of conservation interest as listed under the EPBC Act (Information Source: Literature Review).

Common Name	Species	Research Studies
Turtles	<i>Chelonia mydas</i> <i>Caretta caretta</i> <i>Natator depressus</i> <i>Eretmochelys imbricata</i> <i>Lepidochelys olivacea</i> <i>Dermochelys coriacea</i>	<ul style="list-style-type: none"> ➤ Voluntary turtle logbook program conducted by QDPI in mid 1990's; ➤ Extensive work on TED technology (Robins <i>et al.</i>, 2000), turtle interaction with trawl gear in the NPF (Brewer <i>et al.</i>, 1997) and in the ECTF (Robins, 1995; Robins & Mayer, 1993)

Common Name	Species	Research Studies
		(Robins, 1995; Robins & Mayer, 1993)
Sea Snakes	Miscellaneous spp of the Families Hydrophiidae and Laticaudidae	➤ Susceptibility of sea snakes to trawling (Ward, 2000; Ward, 2001; Wassenberg <i>et al.</i> , 2001, Milton, 2001)
Seahorses & Pipefish	Miscellaneous spp of the Family Syngnathidae, including <i>Solegnathus dunckeri</i> and <i>Solegnathus hardwickii</i>	➤ Population parameters and distribution of syngnathids in trawl bycatch (Connolly <i>et al.</i> , 1999)

Table 8: Research on species taken as bycatch and wider ecosystem impact studies in the ECTF.

Area of Research	Research Studies
Effects of trawling	<ul style="list-style-type: none"> ➤ Studies on the benthic impact of trawling (Poiner <i>et al.</i>, 1999; Pitcher <i>et al.</i>, 2000) ➤ Studies on trawl bycatch species and ecological communities of prawn trawl grounds (Cannon <i>et al.</i>, 1987; Watson <i>et al.</i>, 1989; Watson <i>et al.</i>, 1990; Blaber <i>et al.</i>, 1997; Robins <i>et al.</i>, 1998; Stobutzki <i>et al.</i>, 1997; Robins & Courtney, 1999; Stobutzki <i>et al.</i>, 2001) ➤ Studies on the impact of trawling on scallops (Jones & Derbyshire, 1988; Dredge, 1989; Jenkins <i>et al.</i>, 2001)
Trophic Interactions	<ul style="list-style-type: none"> ➤ Studies on the provisioning from trawlers (Blaber & Wassenberg, 1989; Blaber & Milton, 1994; Hill & Wassenberg, 1992) ➤ Studies on the demersal fish predators of prawns (Blaber <i>et al.</i>, 1990)
Alternatives to Trawling	<ul style="list-style-type: none"> ➤ Feasibility of prawn trapping (Buckworth, 1992)

Note: 1 The above literature review was compiled during the writing of the Audit Report. It may not include all relevant references to research publications and workshop proceedings.

Much of the ECTF research is carried out on an "opportunistic basis". Research on trawl-related species is sometimes the subject of a PhD study (such as Robins' work on turtles and TEDs) or part of a wider institutional research program spanning several fisheries and jurisdictions (such as Stobutzki's work on the ecological sustainability of bycatch and biodiversity in prawn trawl fisheries). Given the large number of ECTF species and limitations on research funding, these approaches clearly maximise research opportunities.

However, an opportunistic approach lends itself to becoming "interest driven" and lacking overall cohesion in the absence of strong research direction through a well-published R&D Plan. The Trawl MAC³⁴ (through its SAG) identified bay prawns, red spot king prawns, squid and barking crays as "key research issues"³⁵. Clearly, these are species (like many others) where there is limited information available to assess the impact of the fishery on their sustainability. It is recommended that

³⁴ Trawl MAC 2/2002 (2 December 2002);

³⁵ Stout whiting was also included under the key issues, but since this species occurs outside the Marine Park it is not listed;

Trawl MAC carry out an in-depth analysis of the outcomes of past and current research and, in light of this, identify research priorities for the fishery.

4.3.6 Non-commercial Fisheries Information

As with the commercial fisheries data, the QFS has implemented an ongoing Recreational Fisheries Information System (RFISH) based on a number of State-wide telephone surveys³⁶ and a diary program³⁷. As mentioned in Section 3.2.1.3, the QDPI conducts a biennial recreational fishing survey. However, the information on the take of ECTF species is limited. All prawn species are listed under the category of “prawns/banana prawns” and there is no geographical or temporal analysis of catches (Higgs & McInnes, 2001).

With respect to the Indigenous take of ECTF species, the ECOTF Assessment Report states that “*the National Recreational and Indigenous Fishing Survey undertaken during 2000/2001 will provide a snap-shot of indigenous take in selected communities of North Queensland. It is anticipated that results will be available in late 2002.*” (Zeller, 2002). This information was not available at the writing of the Audit Report.

4.4. The Audit Report’s Assessment against the Commonwealth Guidelines

With respect to Guideline 1.1.1

The information systems in place for the ECTF incorporate a mix of fishery-dependent and fishery-independent research and monitoring. However, due to limited funding, the ECTF logbook data have become the primary source of information. Given the reliance on CPUE data for stock assessment in this fishery, it is of concern that the logbook data are not validated. This introduces uncertainty regarding the reliability of these data and, consequently, the validity of any resultant stock assessments is suspect. Furthermore, as there are constraints in the manner with which information is collected for target and by-product species (such as species grouping and a lack of targeting information), sound stock assessment is jeopardised further.

Fishery-independent surveys and research could overcome the limitations of the logbook data. However, because current surveys are spatially and species restricted, they provide an incomplete picture of the fishery. An at-sea observer program for the ECTF would be a useful step to address the question of accuracy of the logbook data and would provide additional fishing information that generally is not recorded by operators.

With respect to Guidelines 2.1.1, 2.2.1 and 2.3.1

Aside from collecting unverified information on the interaction of prawn trawlers with marine turtles, no other information was collected on the impact of the ECTF on listed marine species, migratory species, threatened species and cetaceans until the end of 2002. The introduction of a separate logbook for the interaction of trawlers with species of conservation concern has provided a basis on which to compare reported interaction data with at-sea observer programs. Consequently, the QFS will be in a better position to monitor and report on the impact of the ECTF.

Reliable information on the impact of the ECTF on ecological communities and the wider ecosystem can be collected only through fishery-independent surveys and specific research programs. While some of this work is or has been conducted (especially with respect to trawl bycatch and the environmental effects of benthic trawling), it does not cover the entire ECTF and needs to be expanded to obtain a comprehensive picture.

³⁶ These phone surveys were conducted in 1986, 1996, 1998 and 2000;

³⁷ The diary programs were run in 1997 and 1999;

5. Assessments in the East Coast Trawl Fishery

The Commonwealth “**Guidelines for the Ecologically Sustainable Management of Fisheries**” require that for assessing the impact of the fishery on the stock levels of target and by-product species:

- *“there is a robust assessment of the dynamics and status of the species/fishery and periodic review of the process and the data collected. Assessment should include a process to identify any reduction in biological diversity and /or reproductive capacity. Review should take place at regular intervals but at least every three years.” [Guideline 1.1.2];*
- *“the distribution and spatial structure of the stock(s) has been established and factored into management responses” [Guideline 1.1.3];*
- *“there are reliable estimates of all removals, including commercial (landings and discards), recreational and indigenous, from the fished stock. These estimates have been factored into stock assessments and target species catch levels” [Guideline 1.1.4]; and*
- *“there is a sound estimate of the potential productivity of the fished stock/s and the proportion that could be harvested” [Guideline 1.1.5].*

This section of the Audit Report discusses fishery assessment in the ECTF (as distinct from monitoring and research). These processes deal with the same data sources. Monitoring and research generate data, whereas fishery assessment uses these data. There is some commonality between the comments made in Sections 4 and 5 with respect to data quality and process.

The ECTF is a multi-species fishery, with at least 14 target species, some 50 by-product species and over a thousand species of bycatch. The fishery spans over 2,500 km of coastline and fishing operations vary according to the targeted species. ECTF stock assessment is a challenging task, given the fishery’s geographical spread, its species diversity, high inter-annual variability and the complexity of habitat types encountered.

Before providing a critical appraisal of the ECTF assessment process, it is noted that there are few fisheries (if any) in Australia, which meet the Commonwealth Guidelines for fishery assessment adequately at all levels. In general, even those fisheries with sophisticated stock assessment models and a high degree of real-time monitoring of resource trends fail to assess adequately the impact of the fishery on non-target species and the ecosystem.

5.1 Reported Resource Status and Fishery Trends

This section provides an outline of the status of the ECTF species and the resource trends as reported by the QDPI. The Audit Report makes no comments at this point about the veracity of the reported data and trends. However, an appraisal of the assessment methodology and its findings is provided in Sections 5.2. and 5.3. respectively. It should be noted that the status and trend reports only refer to the commercial catch (i.e. target and by-product species). There is no formal assessment of the status of bycatch species or the environmental impact of the fishery. Bycatch issues are considered in Section 7.

Until recently the primary assessment method used by the QDPI for determining the status of principal ECTF species is an analysis of the catch rate using nominal CPUE data (i.e. the total recorded catch is divided by the total recorded fishing days). These data have not been adjusted (i.e. standardised) for changes in fishing power or the temporal and spatial distributions of fishing effort. Assessment of the “health” of the key species is based on the slope of the CPUE graphs. For example, if there is a general incline in the slope of the graph, the catch rate is interpreted as increasing and this is seen as a

positive trend in the fishery. Similarly, if there is a general decline in the slope of the graph, the catch rate is interpreted as decreasing and this is seen as a negative trend in the fishery. The recent development by AFFS of fishing power curves has enabled the inclusion of standardised CPUE data in future stock assessments.

Generally, commercial ECTF species are short-lived and highly fecund. A characteristic of such species is that their recruitment and abundance tends to be highly variable from year to year. For example, in “good seasons” (i.e. when conditions are favourable) a large number of recruits may enter the fishery and these strong recruitment pulses generally result in a higher number of individuals available to be caught and hence higher catch rates compared to “normal seasons”. If amalgamated historical data are presented graphically, such year-to-year variability should be reflected through error bars on the graph, indicating the statistical confidence limits of the data. The graphs provided by the QDPI depicting long-term CPUE trends in the ECTF do not show such confidence limits.

5.1.1 Target Species

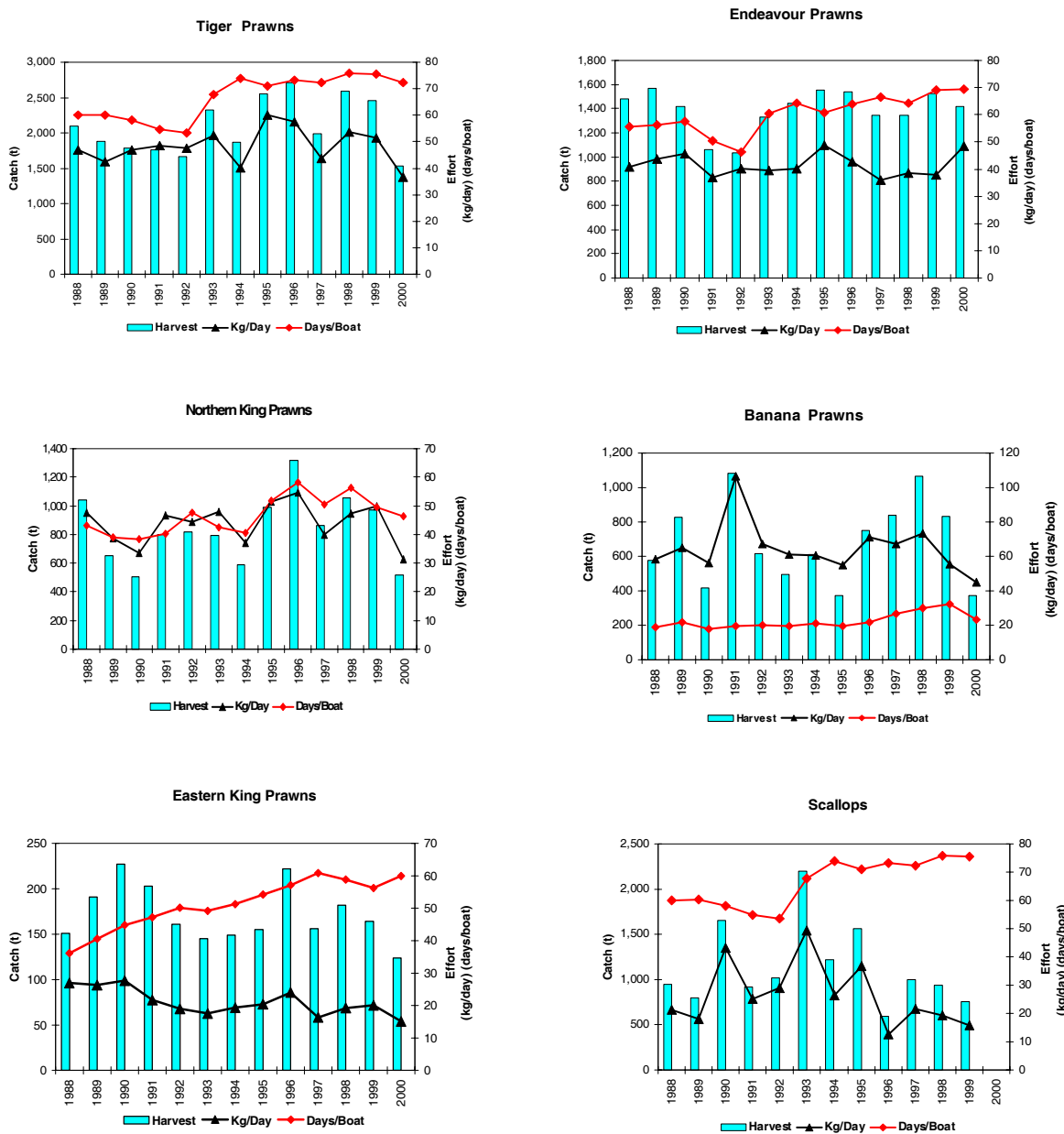
The most recent “Condition and Trends Report” makes the following comments about the target species taken in the ECTF.

Table 9: Harvest trends for the principal (i.e. target) species in the ECTF, as reported by the QDPI.

Common Name	Species	Harvest Trends
Tiger Prawns	<i>Penaeus esculentus</i> <i>Penaeus semisulcatus</i> <i>Penaeus monodon</i>	<ul style="list-style-type: none"> ➤ long-term trend generally is stable, but wide annual variation with volatility increasing over the last 5 years ➤ possible decrease in CPUE due to increasing effective effort
Endeavour Prawns	<i>Metapenaeus endeavouri</i> <i>Metapenaeus ensis</i>	<ul style="list-style-type: none"> ➤ considerable annual variation but no consistent increases or declines ➤ possible decrease in daily boat harvest due to increasing effective effort
Northern King Prawn	<i>Penaeus longistylus</i> <i>Penaeus laticulatus</i>	<ul style="list-style-type: none"> ➤ long-term trend generally is stable, but with wide annual variation; ➤ possible decrease in fleet mean daily catch due to increasing effective effort
Banana Prawns	<i>Penaeus merguensis</i>	<ul style="list-style-type: none"> ➤ highly variable ➤ harvests related to rainfall and climatic events
Scallops	<i>Amusium japonicum balloti</i> <i>Amusium pleuronectes</i>	<ul style="list-style-type: none"> ➤ stable harvest and harvest rate since 1997
Eastern King Prawn	<i>Penaeus plebejus</i>	<ul style="list-style-type: none"> ➤ stable harvest rate reported state-wide since early 1990s, but with increased harvest
Bay Prawns	<i>Metapenaeus bennettiae</i> Other species	<ul style="list-style-type: none"> ➤ harvest has shown considerable variability over the past 12 years, with 2000 harvest being one of the lowest
Bugs	<i>Thenus</i> spp <i>Ibacus</i> spp <i>Scyllaroides</i> spp	<ul style="list-style-type: none"> ➤ declined from a maximum in 1997 and 1998 ➤ mean daily catch per boat declined from a peak in 1992

Squid	<i>Photololigo spp</i> <i>Sepioteuthis lessoniana</i> Other species	<ul style="list-style-type: none"> ➤ variable, with between 125 and 225t reported annually from trawl and inshore net fisheries ➤ declining trend since 1991 in the Moreton Bay trawl harvest and in the small net fishery harvest since 1998
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Figure 7: Time series of catch and effort trends for the major ECTF target species - 1988 to 2000. (Data Source: ECTF Logbooks; Information Source: Condition and Trends Report (Williams, 2002).)



- Note: 1. The above figures were prepared from the catch effort statistics reported in the “Condition and Trends Report” and are based on nominal CPUE data (standardised CPUE data were not available).
2. Bay Prawns have been excluded from the figure, as they are a species mix and generally taken outside the GBR Marine Park.

The report provides data on the catch, effort and nominal CPUE for the key commercial species. This information is presented in Figure 6, which shows several important trends. Firstly, there is

considerable inter-annual variability in the reported catch of target species. This is pronounced particularly with banana prawns and scallops. Secondly, for most sectors (tiger, endeavour, northern king and eastern king prawns) recorded catches peaked around 1996, which is the year nominated in the revised Trawl Plan as the benchmark for effort unit allocation. Thirdly, the graphs show a general decrease in nominal CPUE (reported as kg/day) and a general increase in fishing effort (reported as days/boat) by the fleet. The QFS has reported that nominal CPUE for scallops, endeavour prawns and tiger prawns were stable from 1995 to 2000. In contrast, nominal CPUE for banana prawns and northern king prawns decreased over the same period. Following the implementation of the Trawl Plan, fishing effort has decreased for some of the main target species (tiger, northern king and banana prawns).

5.1.2 By-product Species

Until recently the status of by-product species has not been the subject of focussed research and monitoring efforts in the ECTF. In fact, by-product information was not collected until the introduction of the amended OT07 logbook in July 1999. The following reported harvest trends are excerpts from the “*F(ECT) Management Plan Review Paper – Permitted Fish (other than principal fish) and Steaming Day Review*”, hereafter referred to as the “Trawl Plan Review”, released by the QFS in August 2001. In reviewing the take of permitted species, the QFS collated the catch/effort information available at the time.

Table 10: Harvest trends for the permitted (i.e. by-product) species in the ECTF
(Data Source: ECTF Logbooks; Information Source: Trawl Plan Review)

Common Name	Species	Resource Comments
Blue Swimmer Crabs	<i>Portunus pelagicus</i>	<ul style="list-style-type: none"> ➤ mortality rates and stock recruitment have not been estimated ➤ no concerns about ability to withstand current fishing pressures (800 t/yr overall, 150 t/yr trawl) ➤ very high fecundity and rapid growth rate ➤ recruitment is likely to be a function of environmental and hydrological conditions ➤ high catchability and low discard mortality
Pipefish and Seahorses	<i>Solegnathus hardwickii</i> <i>Solegnathus dunckeri</i> Other species**	<ul style="list-style-type: none"> ➤ strong habitat preference ➤ low fecundity ➤ susceptible to overfishing and listed as “vulnerable” under IUCN ➤ recruitment, stock size and the impact of trawling is poorly understood ➤ high catchability and high discard mortality
Barking Crayfish	<i>Linuparus trigonus</i>	<ul style="list-style-type: none"> ➤ no information on species’ biology ➤ unknown catchability or discard mortality
Balmain Bugs	<i>Ibacus</i> spp (5)	<ul style="list-style-type: none"> ➤ long-lived species (up to 10 yrs) ➤ two species commonly taken (<i>I. peroni</i> and <i>I. spp</i>) have very similar morphology but different life histories and behaviour ➤ have the potential to be sequentially depleted

Common Name	Species	Resource Comments
		➤ high catchability and unknown discard mortality
Cuttlefish	<i>Sepia</i> spp (15) <i>Metasepia pfefferi</i>	➤ no information on species' biology ➤ habitat preference for at least part of the life cycle ➤ high catchability and high discard mortality
Goatfish*	<i>Mullidae</i> (55)	➤ appear to be abundant ➤ display schooling behaviour ➤ pelagic spawners ➤ some species display habitat preference ➤ high catchability and medium discard mortality
Mantis Shrimp	<i>Squillaidea</i> (8)	➤ no information on species' biology ➤ appear to have low discard mortality
Octopus	<i>Octopus</i> spp (8 –10)	➤ little information on species' biology ➤ appear to be short-lived species ➤ display habitat preference and territorial behaviour ➤ high catchability but low discard mortality
Pinkies	<i>Nemipterus</i> spp (5)	➤ appear to be abundant ➤ may display schooling behaviour ➤ pelagic spawners ➤ high catchability and medium discard mortality
Red Spot Crab	<i>Portunus sanguinolentus</i>	➤ little information on species' biology ➤ high catchability and low discard mortality
Sharks*	<i>Charcharhinus</i> spp	➤ little information on species' biology ➤ concerns about the sustainability of some shark stocks, both nationally and internationally ➤ low catchability (post TED introduction) and low discard mortality
Whiptails*	<i>Pentapodus</i> spp	➤ high catchability and high discard mortality

Note: Species groups denoted by * were removed from the permitted species list following the August 2001 review.

Mantis shrimp are taken only in significant quantities in Moreton Bay (outside the GBR Marine Park).

5.2 General Comments about the Assessment Methodology

5.2.1 Reliability of Information Sources

As outlined in Section 4.3.2, there are several (at times major) limitations to data collection in the ECTF. This may impact considerably on the reliability of assessment results. Firstly, the data collected are mainly fishery dependent. Even when there are fishery-independent surveys, such as in the scallop and North Queensland prawn LTMPs, the areas surveyed are restricted generally to major commercial grounds. This is done because of constraints on funding but it introduces a fishery bias to

the data, which is difficult to quantify. Information gaps exist on species distribution and abundance outside the area of commercial activity.

Secondly, there is uncertainty over the quality of commercial logbook data, which are the dominant information source for ECTF assessment. These data are not validated and it is of concern that the veracity of the key estimator of stock abundance (i.e. CPUE) remains unknown.

A third important source of uncertainty concerns the species reported. As a result of prawns being graded by size and the natural co-occurrence of certain species, there is evidence of inadequate reporting. For example, the category of “bay prawns” is known to contain unsorted catches of small eastern king prawns, greasy back prawns, school prawns and red-spot king prawns. Such practices are a major source of uncertainty in the assessment process, although it is more of a problem in inshore and enclosed waters like Moreton Bay and Hervey Bay than in the GBR Marine Park.

Section 4.3 contains recommendations on how data reliability and information gaps can be addressed. Principally, it is recommended that, following a review of its statistical design, the fishery-wide monitoring program should be expanded spatially and in terms of the species covered. This would provide fishery-independent data at a high level of resolution. It is recommended that the logbook data provided by industry be validated through an at-sea observer program and other mechanisms. This would give greater confidence in the reliability of the logbook data and, again, give a higher level of data resolution. Technology that monitors vessel and gear movement (such as the VMS and gear sensors) would also verify the spatial and effort information provided by industry.

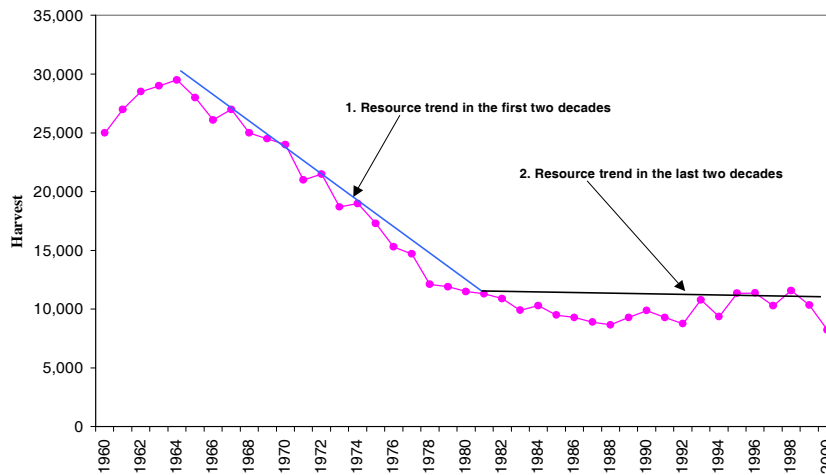
5.2.2 Time Series of Fishery Data

A major limitation of the ECTF assessment process is its chronological coverage. The fishery began in the 1950s in Moreton Bay and expanded sequentially in a northerly direction. Yet, despite five decades of commercial fishing, current fishery assessments have taken account of the last two decades of data only. The QFS’s CFISH database covers the period from when logbooks first became mandatory (i.e. 1988) to the present. This means that the assessment provides only a snapshot of the data that relate to a period that represents less than half of the fishery’s existence.

As outlined in Section 5.1.1, the QDPI interprets the catch and effort trends for major target species as being “relatively stable”, despite considerable inter-annual variations. However, the proceedings of the “South-East Queensland Stock Assessment Review Workshop (August 1998)” note that “*the CFISH data tends to have little year to year contrast. Within the years there is a marked seasonal pattern. Historical data from voluntary logbook programs and other studies would extend the data to about 1970, but is [sic] unavailable for analysis because the database entry is incomplete and unchecked. Data resides with (the then) QFMA. There is an urgent need to have the data developed and made available.*” (Dichmont *et al.*, 1999)

Whilst it is acknowledged that there may be quality issues with the pre-1988 data, the Audit Report supports the need to assess the fishery against the background of its entire history. To illustrate the point, Figure 7 depicts a hypothetical harvest trend, which assumes an annual harvest of between 25,000 to 30,000 tonnes of virgin biomass when the fishery began in the 1960s. The graph, based on hypothetical values, shows a different harvest trend in the first two decades compared to the last two decades of the fishery. The first period would be indicative of the “fish down” of a virgin biomass, whereas the second period would be indicative of a “plateauing out” of catch rates.

Figure 8: Hypothetical Harvest Trend 1960 – 2000.



A decline in catch is to be expected as a virgin biomass is fished down, even with species that are relatively short lived and highly fecund. A decline of stock abundance from virgin biomass does not present a problem, provided that appropriate decision rules are applied to provide the necessary feedback and control to ensure that the abundance of the stock is maintained at a level required for the sustainability of the stock.

By using the full dataset in the assessment, as much information as possible concerning the relationship between equilibrium yield and fishing effort or stock size may be extracted. It is noted that from a fishery analysis viewpoint, the data most useful for the calculation of MSY usually are contained in the first (“fish-down”) phase of the fishery and little information on this estimate is available if the stock assessment is confined to the data pertaining only to the second period. For example, pre-1988 data were used in scallop and Eastern king prawn stock assessments to establish a stock-recruitment relationship (Gribble *et al.*, 1995).

Recommendation 13

- *That, notwithstanding data quality and compatibility issues, an attempt be made to analyse historical (i.e. pre-1988) ECTF data and to assess the level of catch and effort since the fishery’s inception.*

5.2.3 Changes in Fishing Power

The increasing fishing power of a fleet over time, due to gear and technological advances, is referred to as “effort creep”. While some management measures³⁸ have the effect of reducing effort, advances in fishing technology frequently offset such measures.

When the ECTF first developed in Moreton Bay, operators were restricted to a maximum trip time of four days because their product was iced. Radar had not been adopted at the time and the only high-technology equipment aboard the vessel was an unsophisticated echo sounder. Nowadays, state-of-the-art equipment such as sonar, GPS and plotters allow the exact location of fishing grounds (i.e. they

³⁸ Such measures include restrictions such as night-time only fishing, limitations on vessel size and below deck capacity, the requirement for excluder devices such as TEDs and BRDs and various net restrictions.

reduce search time) and allow trawling in areas adjacent to unsuitable grounds (i.e. they allow for the expansion of the fishery into areas previously not fished).

Stock assessment experts have hypothesised that the introduction of triple and quad gear in prawn fisheries between 1976 and 1978 led to a 20% increase in efficiency. Similarly, it is estimated that the use of try gear in the mid-1980s and the introduction of GPS in 1990 resulted in an increase in effective effort of 5% and 10% respectively (Dichmont *et al.*, 1999). This represents an overall increase of 35%, without taking into account later developments such as bulbous bows, propeller nozzles differential GPS, improved otter boards, faster winches, enhanced net designs and improved communication equipment.

A further aspect of effort creep is the increase in boat size and engine power. In the ECTF, there had been an influx of larger boats from the Gulf of Carpentaria until 1984. This led to the introduction by fishery managers of a boat size limit (20 m) and hull unitisation. The revised Trawl Plan recognises the different fishing capacities between smaller and larger vessels by applying a proportional conversion factor to hull units in the calculation of effort units. In other words, larger vessels have a higher conversion factor applied, which recognises their greater fishing power.

If CPUE is a parameter in stock assessment, it is essential that an accurate estimate of effort creep is obtained³⁹. A downward trend in stock abundance may be masked if increases in fishing power are not recognised. Specifically, it may appear from the recorded logbook information that there has not been an increase in fishing effort, when in fact “effective effort” in the fishery may have increased several-fold. Thus, if the level of catch remains the same under this scenario, the fishery will have experienced a drop in CPUE, which will not be reflected in the logbook data.

Consequently, it is crucial that effort creep is quantified and accounted for in the stock assessment process. This is done through an adjustment of the nominal fishing effort. By applying an adjustment factor to the effort data to account for the increased efficiency of the fleet, the CPUE becomes “standardised” for effort creep.

In the case of the ECTF, CPUE is the major (and, in many instances, the only) input variable used in stock assessment. Recognising the importance of this, QDPI initiated the “Effort Creep Study” (FRDC Project No. 1999/120), which is nearing completion. The study examined technological changes in fishing gear through a voluntary industry survey. The results of this survey were then applied to commercial logbook data. The final report from this study is yet to be reviewed and published. Interim data derived from the study were made available for this report.

The study is based primarily on CFISH data and, therefore, relies predominantly on the period 1988-1999. The first two decades of the ECTF’s existence are not captured in the analysis. Given the fishery’s development, it would be reasonable to assume that some of the most marked changes in fishing power occurred during those first 20 years. The study would not have taken account of the earlier efficiency increases brought about by the introduction of try, triple and quad gear.

The FRDC study had a number of important objectives. Firstly, it was to describe the gear and technological improvements over time in Queensland’s tiger prawn, saucer scallop and shallow-water and deep-water eastern king prawn fisheries⁴⁰. Preliminary results indicate that increases in fishing power varied across the sectors, as did the factors influencing effort creep.

³⁹ The NPF is now in its second phase of estimating increased efficiency over time, by quantifying the relative contribution of each of the factors influencing fishing power. However, it has been difficult to establish consensus on what the level of increase has been and how this has been offset by consecutive management intervention.

⁴⁰ The Torres Strait tiger prawn fishery was also included in this study but is not cited in this report.

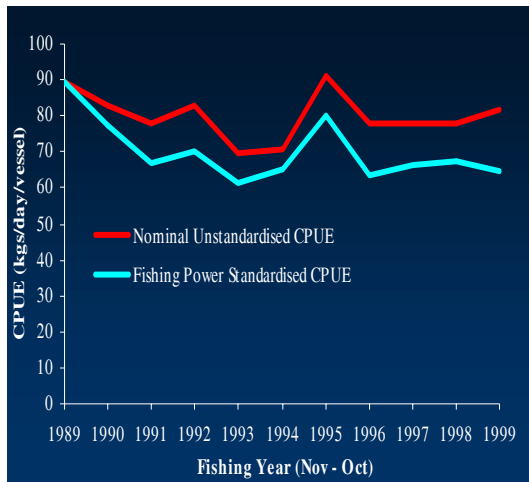
Table 11: Preliminary results on effort creep in the ECTF
(Information source: Voluntary Industry Survey).

Sector	Estimated Fishing Power		Important Factors
	% Increase/Year	Range	
Eastern King Prawn – Shallow	1.6	0.6 to 2.7	<ul style="list-style-type: none"> ➤ vessel length ➤ engine power
Eastern King Prawn – Deep	0.3	-0.1 to 0.7	<ul style="list-style-type: none"> ➤ net size ➤ otter board size ➤ fuel capacity
Tiger Prawn	0.6	-0.2 to 1.5	<ul style="list-style-type: none"> ➤ GPS /DGPS
Scallop	0.2	-0.7 to 1.1	<ul style="list-style-type: none"> ➤ engine power ➤ use of try gear

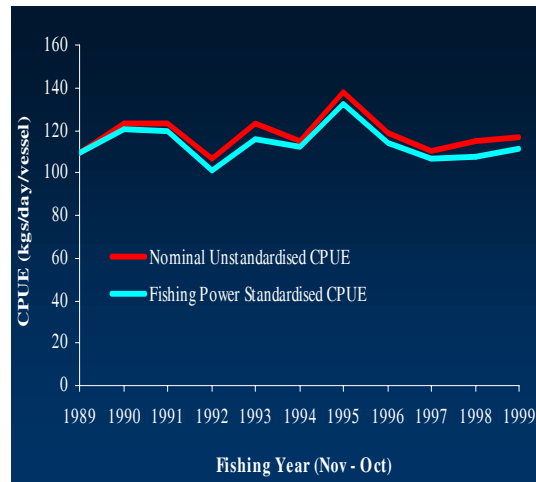
Note: The above preliminary results were provided courtesy of Mick O’Neil (QDPI, AFFS) and relate to information to be published in the Final Report on FRDC Project No. 1999/120.

Figure 9: Nominal versus standardised CPUE for four major ECTF sectors.

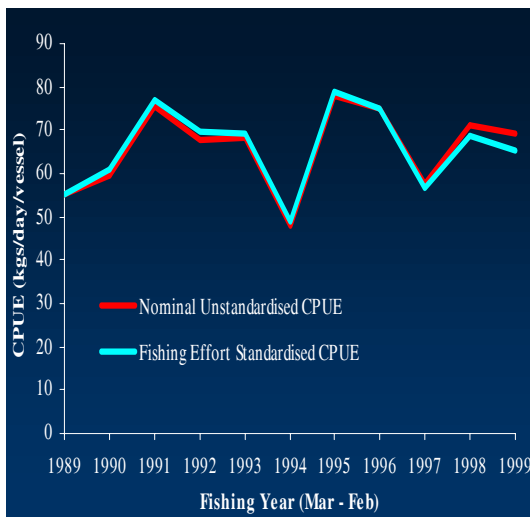
(i) Easter King Prawn – Shallow



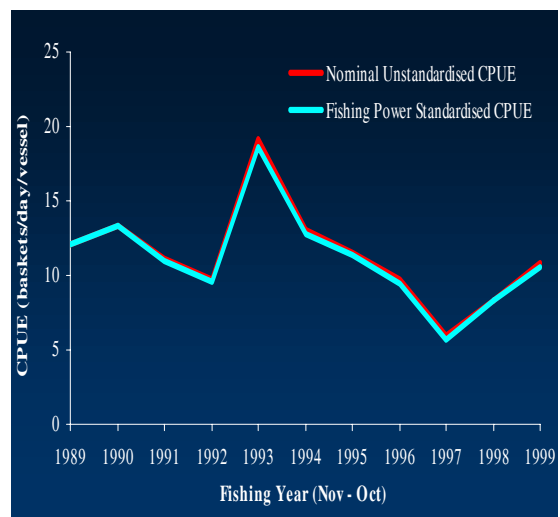
(ii) Eastern King Prawns - Deep



(iii) Tiger Prawns



(iv) Scallops



Note: The above figures were provided also courtesy of Mick O'Neil (QDPI, AFFS) and relate to information to be published in the Final Report on FRDC Project No. 1999/120.

The second objective of the study was to standardise CPUE in light of the fishing power analysis. Because effort creep was estimated to be low in the deep-water eastern king prawn, tiger prawn and scallop sectors, there did not appear to be a significant difference between the nominal and standardised CPUE graphs. However, in the case of the shallow-water eastern king prawn sector, there appears to be a significant difference between the two. These results of CPUE standardisation are presented in Figure 9.

The third objective of the study was to compare current management reference points with standardised and nominal CPUE and investigate possible alternatives. The results of this part of the study are not yet available.

The estimates of effort creep in the study are surprisingly low compared to the estimated effort creep in the NPF, which is calculated at an average 5% per annum and is the subject of continued (and highly contested) research. It could be argued that, historically, the ECTF has had more effort constraints imposed on it than the NPF and that this would have reduced effort creep significantly⁴¹. However, technological advances in satellite navigation and improvements in the performance of fishing gear/vessels would have been adopted equally in both fisheries and would have improved fishing efficiency and fishing power significantly. Intuitively, it seems unlikely that industry would invest in improved and costly fishing technology without benefiting from increased efficiency. In the case of the NPF, it was found that knowledge accumulation and improved operational practices by industry contributed considerably to increased fishing efficiency. The study by O'Neil *et al.* included such factors as skipper experience.

The FRDC study was undertaken just prior to the restructure of the ECTF. The dynamics of the fishery have been altered fundamentally since the introduction of revised management arrangements. It would be erroneous to attempt to extrapolate past effort creep estimates to the current situation. With the freeing up of the boat replacement policy and greater economic viability of the remaining fleet, it is expected that effort creep in the fishery would have increased substantially since January 2001.

This contention is supported by the ECOTF Status Report 2001, which states that, due to the fishery's structural adjustment, there has been a shift to larger vessels and greater average engine power. The report explains that the buy-back scheme bought out proportionally more smaller vessels than larger vessels. With the removal of the "2 for 1" boat replacement policy, it is anticipated that, over time, fewer but larger trawlers will be fishing in the GBR Marine Park. Furthermore, under the new effort system, operators will be fishing fewer days but (because of this limitation) they will do so more efficiently by spending more hours actually fishing during any allocated fishing day. Prior to the plan, there was an incentive to continue fishing in less productive times if there was a marginal cost benefit. The new limitation on the number of days that each boat is entitled to fish will cause operators to be more selective about the days on which they actually fish, so as to maximise the catch from their time allocation.

It is important that effort creep continues to be monitored in the ECTF, as it is likely to have increased since 1 January 2001. Substantial changes in the fleet's efficiency could effectively undermine the effort reductions achieved by the revised management plan. In trying to quantify changes in fishing power under the revised system, it is important to account for efficiency decreases brought about any product loss through excluder devices such as TEDs and BRDs.

⁴¹ Before the introduction of the revised Trawl Plan, constraints, which may have impeded effort creep, included high penalties on boat replacement (2 for 1) and a maximum permitted number of hull unit of 40.

Recommendation 14

- *That there be a review of the estimated changes in fishing power in the ECTF from the fishery's inception in the 1960s till today, using both historical (pre-1988) and recent (1988 – today) data.*

5.2.4 Spatial Distribution and Variability of the Fishery

Due to the large geographical area covered by the ECTF, there are spatial variations in species distribution and abundance. Firstly, there is a latitudinal trend in species distribution across the fishery, ranging from the tropical penaeid fishery made up primarily of tiger and endeavour prawns in the far north to the more temperate eastern king prawn fishery in the south. Secondly, there can be considerable variation in abundance on a smaller spatial scale within the known area of a species' distribution. This is particularly pronounced in species that are known to aggregate, like banana prawns and tiger prawns. As outlined in the Trawl Plan Review, habitat preferences have been noted for cuttlefish, octopus, pipefish and seahorses. Thirdly, there can be spatial variation in species abundance depending on their life-cycle stage. For example, juveniles of many prawn species are found in shallow inshore nursery areas and then migrate into deeper waters as adults. The eastern king prawn in particular is known for its offshore movement as recruiting adults, but also undertakes a longitudinal migration during its life cycle.

Logbook data indicate that trawling is not distributed uniformly across the fishery but is highly aggregated spatially. Over time, as successive closures were introduced, there has been a reduction in the area available to the fishery. Anecdotal reports from industry suggest that there has been a contraction of fishing effort into well-established grounds, especially since the removal of effort through the ECTF Structural Adjustment Scheme.

Table 12: Trawled area in the fishery and the GBR Marine Park.
(Information Source: ECOTF Status Report – 2001)

	Total Fishery		GBRMP	
	Area (km ²)	%	Area (km ²)	%
Total area of fishery	546267	100	345848	100
Total area of permanent closures ¹	176133	32	173904	50
Total area available to be fished	370134	68	171944	50
Area fished	143110	26	106519	31
Area not fished	227023	42	65425	19
Area of major seasonal closures	312654	57	255798	74
Area with some restriction on trawling ²	324469	59	262073	76

Note:1 – Under Queensland fisheries legislation and GBRMP zoning

2 – Restriction may be in the form of permanent or temporal closures

The “ECOTF Status Report 2001” notes that only 26% of the total area of the fishery is trawled or 31% of the GBR Marine Park (Table 12). If permanent closures are not included in the calculation, this equates to about 39% of the total available area being fished in the overall fishery or 62% in the case of the GBR Marine Park. However, the trawl area information is based on 6' x 6' grids and within each grid fishing activity is even more aggregated. The “Condition and Trends Report” states that trawling occurs in “concentrated areas of the fishery and boats frequently operate within one square kilometre during the course of a night” (Williams, 2002).

This spatial pattern in fleet behaviour is reflected in the frequency of trawl usage. Most of the fishery area (about 90%) is fished at low (i.e. less than 21 boat days per year) to moderate (i.e. less than 99

boat days per year) levels of effort, with 10% (or 8% in the case of the GBR Marine Park) fished heavily at more than 100 boat days per year (Table 13).

Table 13 Level of activity in the area of the ECTF and the GBR Marine Park.
(Information Source: ECTF Status Report – 2001)

	Total Fishery		GBRMP	
	Area	%	Area	%
Area fished less than 21 boat days per year	89451	63	67942	64
Area fished between 21 and 99 boat days per year	39343	27	29734	28
Area fished between 100 and 199 boat days per year	9710	7	6841	6
Area fished more than 200 boat days per year	4607	3	2003	2
Total	143110	100	106519	100

From a stock assessment perspective, it is crucial that the causes underlying the spatial patterns of a fishery are understood fully. For example, about half of all the bugs taken in the ECTF come from two distinct areas (off Townsville and Gladstone). It is important to know if bugs are “naturally” more abundant in these areas, if the fishers target bugs more heavily off Townsville and Gladstone than elsewhere in the fishery or if the numbers of bugs have been reduced in the other areas due to heavy fishing in the past. The way in which the fishery area data are stratified and analysed during stock assessment depends on which scenario reflects reality. A failure to recognise the underlying causes may lead to a misinterpretation of the status of the fishery.

A case in point is the tiger prawn sector of the NPF. Fishing has contracted in its area of operation since the 1980s. It was found that “*between 20% and 40% of the catch was coming from (6nm x 6nm) grids that are no longer being fished today*” (Die *et al.*, 1995). As noted in a stock assessment review by an external consultant “*such contractions have caused assessments of fish stocks in other parts of the world to make a downward revision of their abundance indices to account for the contraction. The downward revision depends on the extent to which animal density in the non-fished areas is below the average animal density in the fished areas.*” (Deriso, 2001). The reviewer concluded that a fishery-independent survey was required for non-fished areas to improve the assessment advice in the NPF. Subsequently, this recommendation was implemented.

In the absence of long-term fishery-independent surveys across the entire ECTF, it is uncertain if the spatial patterns observed are a natural habitat-associated phenomenon of the species caught, a reflection of fleet behaviour or the sequential impact of fishing. It is of concern that there could be a spatial contraction of fishing due to reduced species abundance, but that this may go unnoticed. In particular, assessments of CPUE trends at a fishery-wide level may not detect spatial depletion, because catch rates may remain unaltered in a contracting fishery.

A more detailed spatial analysis of the CPUE data is required and this information should be used in the stratification of fisheries data to account for the spatial variability of the fishery. The investigation of trawl track signatures will assist in the future spatial analysis of the fisheries data and provide a finer resolution of the fishing pattern. However, long-term fishery-independent surveys across the ECTF are required to obtain information on species abundance in areas where the commercial fleet does not operate. Such information is required for biomass estimates and to determine the impact of area closures on species abundance and recruitment. AFFS has sought to initiate a research program focused on evaluating current management systems for the main target species; however, to date this has not received funding from FRDC.

It would be useful to conduct a fine-scale spatial analysis of the fishing patterns in the ECTF over time. This would show the extent to which the reduction in the area fished is a reflection of the decrease in the number of operators over time, the introduction of closures or regional stock depletion and decreasing catch rates. In undertaking such an analysis, the historical (i.e. pre-1988) data should

be included. This would show how fishing effort has shifted geographically over time since the fishery began.

Recommendation 15

- *That, as part of the fishery assessment process, there be a fine-scale spatial analysis of the fishery in terms of species abundance and fishing effort over time, and that appropriate stratifications be applied to the CPUE data to account for the fishery's spatial variability.*

Most of the species taken in this fishery are also taken in other State and Territory jurisdictions. While there may be distinct stocks off the Queensland coast with little mixing between populations for some species, others have an extremely large geographical distribution and a high degree of genetic mixing. The eastern king prawn fishery is a good example, which spans three jurisdictions (Queensland, New South Wales and Victoria) and the sub-adults and adults undertake longitudinal migrations of over 1,000km. Where species are shared between jurisdictions, it is essential that available assessment data are analysed over the species' entire geographical range. It is acknowledged that under such circumstances data access can present a problem and that it requires collaboration with other fisheries management agencies to achieve a comprehensive stock assessment.

5.2.5 Temporal Distribution and Variability of the Fishery

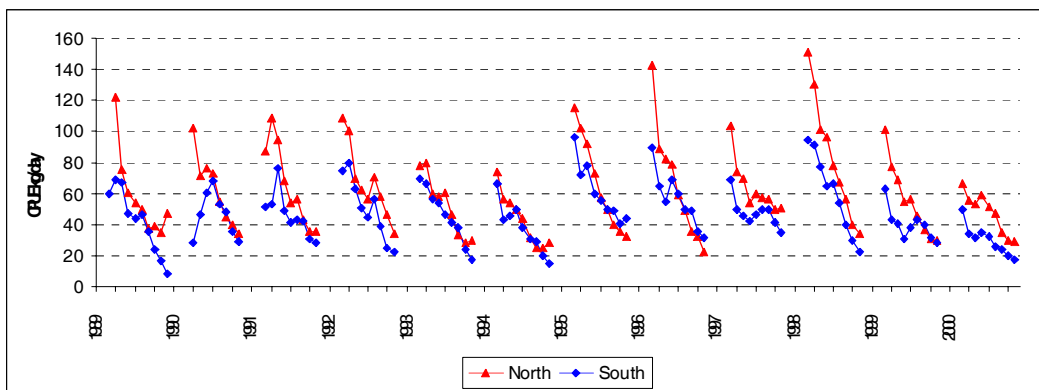
Temporal variation in species abundance is common in many tropical penaeid prawn fisheries. Firstly, there can be high inter-annual variability, particularly when recruitment is affected by environmental conditions such as rainfall and discharge from rivers. In the case of the ECTF, the most variable fishery is the banana prawn fishery, where annual catches have ranged from a couple of hundred tonnes to over a thousand tonnes. It is noted that all the stock assessment trends reported in the various QDPI publications cited in Section 5.3 are prefaced with comments about the large variability in catches and catch rates between years.

Secondly, many prawn species have distinct spawning periods and the recruitment of adults to the fishery occurs after the juvenile phase has been completed. In many prawn fisheries, there is a strong recruitment pulse, which may disappear over time as the adults are fished down or become less available to the commercial fishery for behavioural reasons. The changing CPUE in the Torres Strait Prawn Fishery on a seasonal basis between 1989 and 2000 illustrates this point (Figure 10). The trend in the Torres Strait Prawn Fishery of declining CPUE within each season and within each region appears to be relatively consistent from year to year. Such clear trends would not be observed in fisheries where spawning is continuous throughout the year. For example, endeavour prawns spawn all year, with a peak during summer.

A third example of temporal variability is the lunar periodicity of many prawn fisheries. With the exception of the red spot king prawn, all other ECTF prawn species appear to become unavailable to the commercial fishery at the time of the full moon. What is ultimately a behavioural phenomenon may appear as a periodic decrease in abundance from a stock assessment and industry perspective.

To compare CPUE in a meaningful manner across years and on a seasonal basis, stock assessments need to take account of these temporal variations. As with spatial variations, data need to be standardised for this type of variability. For example, in prawn fisheries that have a single clear recruitment pulse, it would be meaningless to compare catch rates at the beginning of the season in one year with the catch rates at the end of a season in another year.

Figure 10: Seasonal declines in tiger prawn CPUE in the Torres Strait Prawn Fishery (1989 to 2001).
(Data Source: QDPI survey data)



Note: The above graph was supplied courtesy of Clive Turnbull (QDPI) and represents the results from fishery surveys in the Torres Straits.

Similarly, annual catch rates (i.e. total annual catch divided by total annual effort) may not detect seasonal peaks and troughs in abundance or availability because the CPUE is averaged over the entire year. Assessments need to take account of these variations.

The importance of the comparison periods is examined further in Section 7.3.1, where the performance of the fishery against the stated performance indicators is discussed. The strong temporal variability of the ECTF needs to be factored into the design of any LTMPs and the logbook and monitoring data need to be stratified accordingly.

Recommendation 16

- *That, as part of the fishery assessment process, there be a temporal analysis of the fishery in terms of known species abundance and fishing effort over time and that appropriate stratifications be applied to the CPUE data to account for the fishery's temporal variability.*

5.2.6 Multi-Species Catch Composition and Targeting

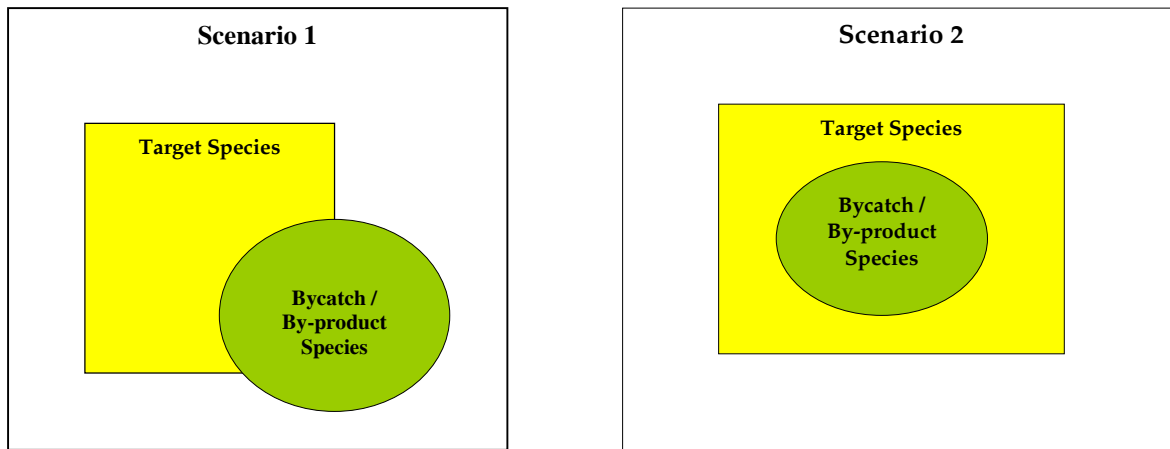
“Targeting behaviour” in a multi-species fishery, such as the ECTF, adds another level of complexity to the stock assessment process and can undermine the usefulness of CPUE as an indicator of stock abundance. If species are taken incidentally to target species, inferences concerning the abundance of this by-product or bycatch cannot necessarily be drawn from the recorded CPUE data. A hypothetical example (Figure 11) demonstrates this point.

Under Scenario 1, the area of distribution of bycatch partly overlaps the area of distribution of the target species. In other words, there are areas of the fishery where the bycatch species is found, but which are not fished commercially because they fall outside the area of the target species abundance. The degree of overlap is the critical issue. Under this scenario it could be misleading to extrapolate from the bycatch CPUE in the fished area to other parts of the fishery. In contrast, such an extrapolation would be appropriate under Scenario 2, where the area of distribution of bycatch occurs entirely within that of the target species.

Consequently, it is important to understand the population biology of bycatch species and, in particular, their distribution and abundance. Such knowledge is crucial in determining whether a decline in catch rates (should this occur) is an indicator of decreased bycatch abundance (i.e. scenario

2) or a localised phenomenon with the species being protected in the non-fished parts of the fishery (i.e. scenario 1).

Figure11: Hypothetical scenarios of bycatch and target species distributions.



Recommendation 17

- *That, based on all available data (i.e. logbook, LTMP and research data), there be an assessment of the spatial distribution of commercial by-product species in the ECTF;*

Recommendation 18

- *That there be a peer review of the use and limitations of CPUE as an indicator of abundance for all principal and permitted ECTF species.*

5.2.7 Development of Assessment Models

Having outlined the limitations of CPUE as an indicator of stock abundance, it is noted that alternative assessment methods currently are being investigated by the AFFS. Specifically, assessment models, which predict stock abundance, are being developed for tiger prawns, endeavour prawns, eastern king prawns and scallops. These models will cover about 80% of the stock taken in the ECTF. The results from this work are not yet available.

Table 14: Stock assessment models being developed by the QDPI
(Information Source: the ECOTF Ecological Assessment Report (Zeller, 2002)).

Fishery	Assessment Type	Status
Bugs	➤ Yield-per-Recruit model	➤ Completed internal report being peer-reviewed
Eastern King Prawns	➤ Age structured model	➤ Completed report to FRDC due mid 2003
Scallops	➤ Age structured model	➤ Completed report to FRDC due mid 2003
Northern Tiger and Endeavour Prawns	➤ Surplus production model	➤ Completed internal report being peer-reviewed
Blue Swimmer Crab	➤ Biomass model	➤ Completed report to FRDC

The development of such models is a considerable improvement in the ECTF stock assessment process. However, for these models to predict population size adequately, two conditions must be met. Firstly, assessment models are used to estimate population parameters such as natural mortality, catchability, virgin biomass and spawner/recruitment relationships. If the data are non-informative with respect to estimating the relevant population parameters, information needs to be sought from other studies and the results applied to the stock assessment model. Under such circumstances, the accuracy of the assessment results will depend on the appropriateness of the parameters used. Secondly (and in line with the previous consideration), the uncertainty associated with the parameter estimate and the impact of such uncertainty on the results needs to be explored using the model. In other words, a sensitivity or bayesian analysis should be carried out to test the results of the model under a range of parameter estimates. Again, any historical (i.e. pre-1988) ECTF data would provide an important contrast in the dataset.

The data used in the models are from 1988 only, when logbooks were introduced for target species, despite the fact that catch information has been collected since the fishery's inception in the 1950s. In order to estimate virgin biomass and to analyse fishery trends over the life of the fishery, pre-1988 data should be used in stock assessments.

The underlying assumption in the models being developed is that CPUE is a good estimator of biomass. As outlined in Section 5.3.4, there are concerns about the adequacy of CPUE as a population parameter. Also, it is uncertain to what degree the CPUE data used in these models have been standardised for changes in fishing power, geographical area and season (as discussed in Section 5.3.3.).

Based on percentage composition of catch, logbook data used in the tiger/endeavour prawn assessment model are filtered for targeting. In a mixed-species fishery, there is an inherent risk in adopting such an approach. The filter may screen out data as non-target catch, when in fact there has been a decline in percentage catch composition due to declines in stock abundance. Thus, overfishing of one species in a multi-species fishery may not be detected.

Recommendation 19

- ***That the development of assessment models for the principal ECTF species be progressed as a matter of priority and that they be used in the recommended annual fishery assessment process as the input data become available***

5.3 Specific Comments about the Assessment Findings

There are no periodic assessment reports that summarise the status of stocks in the ECTF in light of the most recent monitoring and research findings. The proceedings of the last stock assessment workshop held by the QDPI, while highly valuable at the time, are now dated and only address the status of saucer scallops and eastern king prawns in the ECTF. As outlined in Section 5.2, there is uncertainty associated with the CPUE trends reported for the ECTF species, which limit their usefulness as an assessment tool. Only now are assessment models beginning to be developed for some of the major target species.

The most current assessment on the status of stocks by QDPI is reported in the "ECOTF Status Report - 2001" (Zeller, 2002) and the "Condition and Trends Report" (Williams, 2002). Useful information on species distribution, stock structure and life history is also contained in the BRS Atlas on "Australian Fisheries Resources" (Kailola *et al.*, 1993), hereafter referred to as the "BRS Atlas". The following sections contain excerpts from these and other relevant sources on stock assessments of the principal ECTF species and a critique of these findings. A summary table of the information in this section is provided in Appendix 6. It is noted that "Bay Prawns" are not considered in this report, as

these include the juveniles of species considered separately (i.e. tiger prawns, endeavour prawns, king prawns and banana prawns). Furthermore, greasyback prawns and school prawns occur mostly outside the GBR Marine Park.

5.3.1 Tiger Prawns

Tiger prawns are the major commercial species caught in the GBR Marine Park and, together with endeavour prawns, form the most valuable sector of the ECTF. Estimates of the MSY for the northern region (Cape Tribulation to Cape York) suggest an annual catch of between 1,227 and 1,400 tonnes. The average annual catch for that region in the 1988-2001 period was 1,167 tonnes (Gribble and Turnbull, 2003).

The tiger prawn is one of the few ECTF species for which additional assessment work (apart from the routine nominal CPUE analysis) is being done, reflecting its commercial importance. The “ECOTF Ecological Assessment Report ” notes that “*from 1988 to 2000 there are no consistent trends in the catch*” and that “*annual variability was high*”. It is acknowledged that the “*adoption of advanced navigation aids, such as GPS and differential GPS, may have increased fishing efficiency*” and therefore “*resulting in decreases in CPUE*” (Zeller, 2002).

The same report makes the following statement about the status of tiger prawns: “Yearly catch rate data for tiger prawns in the northern part of the fishery (Cape York to Cape Tribulation; 16°S) have been fitted to a Schaefer non-equilibrium surplus production model, with effort creep scenarios factored into the model. This model indicated that although the stock is exploited fully, catch rates (and stocks) have not declined over the last ten years. A number of caveats need to be applied to this assessment however: the data time-series is relatively short and does not contain the developmental stage of the fishery; the logbook categories used are suites of species and consequently may mask stock changes in individual species; and these prawns aggregate, which may make CPUE a poor indicator of underlying abundance”.

The uncertainty surrounding the status of tiger prawns is of concern. Recruitment overfishing has been demonstrated for these species in other parts of Australia (Western Australia and the Gulf of Carpentaria). As outlined in Section 5.2, it is likely that the three assumptions underlying the surplus production model are being violated. A sensitivity analysis is required to determine how robust the results are if the assumptions are not being met.

There are two species of tiger prawns; the brown tiger prawn (*Penaeus esculentus*) and the grooved tiger prawn (*Penaeus semisulcatus*), which are taken in commercial quantities in the ECTF⁴². There has been no separation of these two species in the ECTF logbooks to date. Tiger prawns form part of the multi-species mix of tropical penaeid prawn fisheries, which includes other species such as endeavour prawns and northern king prawns. As discussed in Section 5.2.6, a decline in one of the species may be masked by the higher abundance of one or more of the other species and remain undetected in a CPUE analysis (Deriso, 2001). The “Condition and Trends Report” notes that endeavour prawns “*appear to be opportunistic in their habitat requirements, and have increased in trawl areas that were previously dominated by tiger prawns*” (Williams, 2002). Spatial stratification of logbook data and an analysis of historical data from fishery-independent surveys in the far north are required to determine if there has been a contraction of the tiger prawn fishery similar to that experienced in the NPF.

5.3.2 Endeavour Prawns

The endeavour prawn stock assessment situation is similar to that for tiger prawns. Estimates of the MSY for the northern region suggest an annual catch of 1,053t. The average annual catch of endeavour prawns for the region is 1,039t (Gribble and Turnbull, 2003).

⁴² The giant tiger or leader prawn is taken only in small quantities.

The high inter-annual variability does not indicate any clear CPUE trends (Williams, 2002). The “ECOTF Assessment Report” suggests that *“the adoption of improved navigational aids such as GPS by the fleet may have increased the fishing efficiency. The resulting increasing effective effort may give a slightly decreasing mean daily boat harvest”* (Zeller, 2002).

Because of their commercial value, additional stock assessment is being done on endeavour prawns. A Schaefer non-equilibrium surplus production model has been fitted to the yearly catch rate data for endeavour prawns in the northern part of the fishery and possible effort creep scenarios have been factored in. It is presumed that the same caveats that apply to the tiger prawn assessment model also apply to that for endeavour prawns. The “ECOTF Assessment Report ” states that *“the results indicate that the stock is fully exploited, however there have not been any apparent detrimental trends in the logbook catch and effort data indicative of sustainability concerns at current levels of harvest”* (Zeller, 2002). The robustness of this assessment in light of the assumptions in the model being violated is questioned.

As with tiger prawns, there has been no separation of the two species of endeavour prawns – the true endeavour prawn (*Metapenaeus endeavouri*) and the false endeavour prawn (*Metapenaeus ensis*), in the ECTF logbooks to date. They are part of the multi-species tropical penaeid fishery complex, which may mask a decline in any one of the species. The “Condition and Trends Report” comments on the product status of these species by noting that *“endeavour prawns are now retained in their own right, rather than kept only if the harvest of tigers is poor, as was the case in the past when only local markets were available. Markets and price can affect the proportion of retained (reported) harvest of endeavour prawns – a factor that must be taken into account when using commercial logbook information to assess the status of stocks”* (Williams, 2002). The Audit Report questions if the reported “opportunistic behaviour” of endeavour prawns taken over the tiger prawn grounds (Section 5.3.1) could be a reflection of endeavour prawns being retained now when previously they were discarded in favour of tiger prawns.

Endeavour prawns show a complex movement between the shallower inshore juvenile habitat and the deeper offshore adult habitat. This offshore movement is not consistent across the fishery and depends on latitude (Kailola *et al.*, 1993), thereby highlighting the need for spatial stratification of the fishery assessment data. Endeavour prawns spawn throughout the year (with peak activity in summer) and there is no clear recruitment pulse within the fishery.

5.3.3 Northern King Prawns

There is no other assessment of the status of northern king prawns apart from the nominal CPUE analysis. As with the other penaeid fisheries in northern Queensland, high inter-annual variability of catch has been reported. The “Condition and Trends Report” states that *“there are no long-term signals in the harvest and effort data that suggest the population of red spot kings is overexploited, but more detailed assessment and monitoring is needed to strengthen this observation”* (Williams, 2002). This report does not refer to the status of the blue-legged king prawn. The ECOTF Ecological Assessment Report, while noting a decrease in the fleet CPUE (possibly due to *“increasing effective effort”*), supports the contention that there are no clear long-term trends in the CPUE data (Zeller, 2002).

Two species constitute the northern king prawn catch, with red spot king prawns (*Penaeus longistylus*) being more abundant than blue-legged king prawns (*Penaeus latisculcatus*). Unlike the situation for tiger prawns, the logbook requires the two species of northern king prawns to be identified. The degree to which these species are targeted depends on latitude. In the far north of the GBR Marine Park they form part of the tropical penaeid prawn complex, whereas in the southern part they are the subject of directed effort.

Less seems to be known about blue-legged king prawns than about red spot king prawns. Yet, based on their longevity (up to 4 years), this species has been reported as “overfished” in areas of high fishing activity like the Gulf of St. Vincent in South Australia (Kailola *et al.*, 1993).

5.3.4 Banana Prawns

No stock assessment of any kind is conducted on the banana prawn fishery. It is regarded as a minor seasonal fishery on a relatively short-lived species (about one year). In any event, stock assessment is made difficult by the species’ strong schooling behaviour and the pronounced (albeit poorly understood) relationship between recruitment and rainfall (Vance, 1985). It is noted that in the NPF, where banana prawns (*Penaeus merguensis*) are a major sector of the fishery, stock assessment also has not been undertaken for these reasons.

5.3.5 Eastern King Prawns

Eastern king prawns (*Penaeus plebejus*) are harvested predominantly outside the GBR Marine Park, as they generally occur south of 22°S. Consequently, a detailed consideration of the assessment of the status of this species is beyond the scope of the Audit Report. However, a couple of points are worth noting, as they reflect concerns about the current assessment methodology in the ECTF.

The “ECOTF Ecological Assessment Report” noted that “*assessment of fishery-independent survey data collected in 1971-73 and 1989-90 indicates that there has been some decline in the recruitment of juvenile prawns to the ocean fishery, with a significant decrease in juvenile king prawn numbers on inshore nursery grounds*” (Zeller, 2002). However, the “Condition and Trends Report” stated that “*the mean daily harvest (of Eastern king prawns) has remained relatively stable with a slight upwards trend*” (Williams, 2002). It is recognised that these comments relate to different periods and that juvenile recruitment may have “recovered” in the last decade. Clearly this demonstrates the need to use long-term data sets (as discussed in Section 5.2.2.) and justifies further fishery-independent surveys. Also, it may indicate that CPUE is not a good indicator of stock abundance for Eastern king prawns because of their complex life cycle (involving offshore and latitudinal migration).

The 1998 stock assessment workshop conducted by the QDPI noted that Eastern king prawns are vulnerable to recruitment and growth overfishing. Simulation models demonstrated that the yearly recruitment index was declining over time. Given the species’ susceptibility to overfishing and the downward trends, the adoption of a precautionary approach in interpreting assessment results and setting limit reference points is warranted.

5.3.6 Scallops

Two species of scallops are harvested in the GBR Marine Park – saucer scallops (*Amusium japonicum balloti*) and mud scallops (*Amusium pleuronectes*). The saucer scallop (the larger of the two) has been the subject of considerable research and stock assessment because of its economic importance as a major target species in the southern part of the ECTF. The smaller mud scallop is a by-product of the northern, multi-species trawl fishery. It has been less well studied but is “*assumed to have the same general lifecycle as saucer scallops*” (Williams, 2002).

The “Condition and Trends Report” comments that the “*the total scallop harvest from Queensland is relatively more stable compared to other scallop fisheries around the world. Harvest and mean daily boat harvest, after falling by an order of magnitude between the late 1970s and early 1980s, have remained at generally stable levels during the past 13 years*” (Williams, 2002). However, the report acknowledges that there have been huge fluctuations in the harvest between 1988 and 2000, ranging from 600t to 2200t. Having estimated the mean harvest to be around 1100t per year, the report states

that “effort applied to the fishery peaked in 1995 and 1997” and that “the trend in harvest appears downward with the last five years’ harvest being below the mean”.

The use of CPUE trends as an indicator for scallop fisheries is questioned, given the aggregating behaviour of scallops once they settle into beds as adults. The “ECOTF Ecological Assessment Report” noted that more advanced assessment work had begun for saucer scallops. In particular, it stated that the “*biomass dynamics model [sic] which relates annual catch and effort to estimate optimum effort levels, sustainable yield and potential biomass levels*” (Zeller, 2002). However, assessment results from this work are not yet available.

Despite high inter-annual fluctuations in abundance (based on variable recruitment), scallop fisheries can be overfished through recruitment overfishing. The “BRS Atlas” notes that “*saucer scallop densities in many Queensland beds have been reduced from about 1 animal per m² to 1 per 150m². This reduction has probably been caused by intense fishing, which also removes large numbers of young, pre-spawning scallops and their occurrence in discrete beds also make stocks vulnerable to depletion under heavy fishing pressure.*” (Kailola *et al.*, 1993). The “Condition and Trends Report” appears cognisant of this concern in stating that “*the saucer scallop resource appears to be heavily exploited. There is sufficient fishing effort being directed towards saucer scallops to cover all available fishing grounds annually*” and that “*some grounds are heavily fished, and trawled repeatedly within a year.*”. The report speculates that “*it is quite possible that low-density areas of scallops between fished beds constitute an appreciable proportion of the breeding population.*” The report concludes that “*should a major increase in effort be directed towards the scallop stock, the risk of overfishing should not be ignored.*” (Williams, 2002).

5.3.7 Moreton Bay Bugs

Of the several species of bugs harvested in the ECTF, only the two species of Moreton Bay bugs are discussed in this section. Balmain Bugs are taken as a by-product of the eastern king prawn fishery and occur mostly outside the GBR Marine Park.

Of the Moreton Bay bugs, the reef bug (*Thenus orientalis*) is the larger of the two. It is found mainly at depths of 25-60 m and is taken predominantly as a by-product of the red spot king prawn fishery. The mud bug (*Thenus indicus*) is found in shallower waters (less than 25 m) and is taken predominantly as a by-product in the tiger/endeavour prawn and (to a lesser degree) banana prawn fisheries. Both species have been commercially important by-products of their respective fisheries. The introduction of TEDs and BRDs is reported to have reduced their take as by-product (Zeller, 2002).

The ECOTF Ecological Assessment Report notes a decline in the catches of the two bug species since 2000, but links this primarily to a decrease in fishing effort and the introduction of bycatch mitigation devices (Zeller, 2002). The recent “Condition and Trend Report 1988-2000” notes that the “*mean daily catch per boat shows a decline from 1992 to 2000, when State wide data is [sic] used. Regional analysis of bug catch rates also shows a decline, especially in 1999 – 2000 in some major producing regions.*”

This report also acknowledges that “*bugs typically display a low fecundity and low density, meaning they face some risk of over-exploitation*” (Zeller, 2002). The “BRS Atlas” notes that these species “*are heavily exploited where prawns are targeted and evidence of overfishing comes from reduced catch rates and average size of caught individuals.*” However, it adds “*there are extensive areas that are not suitable for prawn fishing (due to rough grounds and/or low prawn densities) which do not support bay lobster (i.e. name used for Moreton Bay bugs) stocks.*” (Kailola *et al.*, 1993). This suggests that these areas may act as potential refuge/ replenishment areas.

As outlined in Section 5.2, the bug fishery has many characteristics, which make CPUE a poor indicator of stock abundance⁴³. It is acknowledged that the decline in catch rates may be a reflection of changing fleet behaviour and greater escapement of bugs through TEDs and BRDs. However, this needs to be confirmed through research and stock assessment.

5.3.8 Squid

Several species of squid of the families Omnastrephidae (arrow squids of deeper oceanic waters) and Loliginidae (the pencil squids of the continental shelf and upper slope) are taken in the ECTF. The inshore pencil squids and calamarys are the predominant species, usually as by-product. Most squid are taken outside the GBR Marine Park.⁴⁴

Little is known about the biology and life history of the various squid species. However, it appears that they have certain population characteristics that make them vulnerable to demersal trawling. Firstly, they deposit their eggs in clusters on the seabed, which increases the likelihood of them being damaged by trawling. Secondly, they aggregate for feeding and breeding and, consequently, can be targeted readily. The “BRS Atlas” states that “*Jigging is the only method that specifically targets calamary and squid. In fisheries using other methods calamary are taken as part of mixed species catch, although they may be targeted at certain times of the year (eg when spawning aggregations occur)*” (Kailola *et. al.*, 1993).

Using CPUE data as an indication of stock abundance and to assess the population trends of the ECTF squid species would be inappropriate, given their aggregating behaviour and their usual status as by-product species. The “Condition and Trend Report” acknowledges that there may be “*possible under-reporting in commercial logbooks*”. The retention of squid is driven strongly by market forces. Little is also known about stock structure and population sizes of these squid.

5.3.9 Summary of the Stock Status of the Principal Species taken in the ECTF

Table 15 summarises the key issues discussed in section 5.3.1-5.3.8. This table has also been presented in the Executive Summary as Table 1.

Table 15: Key findings of the Audit Report on the assessment status of the principal ECTF species.

Species Grouping	Commercial Value	Reported CPUE Trend	CPUE as Performance Indicator	Alternative Assessment Methods	Population Status	Estimated Sustainable Catch	Life Cycle & Biology Knowledge
Tiger Prawns *	High	Slightly decreasing	Adequate	Surplus Production Model	Fully exploited	1,227-1,400 t/yr for FNQ	Good - Adequate
Endeavour Prawns	High	Slightly decreasing	Adequate	Surplus Production Model	Fully exploited	1,053 t/yr.	Good - Adequate
Northern King Prawns *	Medium	Decreasing	Adequate - Poor	Nil	Possibly over-exploited	Unknown	Adequate
Banana Prawns	Low	Decreasing	Poor	Nil	Unknown but likely to be sustainable	Unknown	Adequate - Poor

⁴³ High spatial variability, by-product (rather than target species) and lack of species separation.

⁴⁴ 80% of the reported squid catches in the ECTF are taken south of Caloundra and trawl operators appear to target these species in Moreton Bay and the Great Sandy Strait between April and October (Kailola *et.al*, 1993).

Species Grouping	Commercial Value	Reported CPUE Trend	CPUE as Performance Indicator	Alternative Assessment Methods	Population Status	Estimated Sustainable Catch	Life Cycle & Biology Knowledge
Eastern King Prawns *	High (outside Marine Park)	Decreasing	Adequate - Poor	Age structured model	Possibly over-exploited	Unknown	Good - Adequate
Scallops *	High	Decreasing	Poor	Age structured model	Heavily exploited	Unknown	Good - Adequate
Bugs *	Low	Decreasing	Poor	Nil	Possibly fully exploited	Unknown	Adequate - Poor
Squid	Low	Decreasing	Poor	Nil	Unknown	Unknown	Poor

*Note: 1. * Denotes there are demonstrated cases of overfishing for these species within Australia.
2. FNQ refers to Far North Queensland.*

The limitations of CPUE as an indicator of stock abundance and resource trends, particularly where highly aggregated and by-product species are concerned, were highlighted in section 5.3. In light of the high inter-annual variability in the catches of most ECTF species and the high degree of spatial and temporal variations in this fishery, caution needs to be exercised when using CPUE data. The development of alternative assessment methods is recommended as a matter of priority.

Fisheries managers and stock assessment scientists are generally aware of the limitations of CPUE for stock assessment. A lack of resources and data frequently slow down the development of alternative assessment methods. However, there is concern that the reporting of “stable” nominal CPUE trends in public reports may create a false sense of confidence about the status of the resource.

This section highlights the need for fishery-independent surveys and at-sea observer programs. With such additional monitoring and research, information could be collected on the size composition of the catch. Provided there is adequate stratification of the data, this would assist with the development of alternative assessment models. Furthermore, changes in the size composition of the catch can be an indicator of changes in population structure. Provided there is wide coverage, fishery-independent surveys can provide valuable information on resource abundance in areas not fished by the commercial fleet. This could provide a quantitative indication of the importance of unfished areas to recruitment.

This section also has highlighted the wide geographical distribution of many ECTF species, ranging across Northern Australia from Western Australia into New South Wales. For most species, there is limited understanding of underlying stock structure and the degree of genetic mixing. Such issues can be resolved only through collaborative research and assessment work between the responsible management agencies.

It is noted that the degree of stock knowledge and assessment is determined by the economic importance of the fishery. Thus, for the less important target species, which are essentially taken as by-product (northern king prawns, squid and bugs), there is limited information available on which to base stock assessment. No stock assessments for any of the permitted species under the Trawl Plan have been conducted to date. Acknowledging the current information and resource constraints, it is recommended that assessment gaps be addressed in a systematic manner within a defined timeframe. The processes recommended in Section 4.2.3 and 5.3.4 (if adopted) should assist in this regard.

5.4 Formalisation of the Assessment Process

It is recognised that in such a biologically diverse fishery as the ECTF not all information gathering and assessment demands can be met at once and within a short timeframe. An information base needs to be built gradually over time. However, fisheries assessment and its supporting monitoring and research work need to be strategically targeted and designed to yield optimum results within a limited budget.

The stock assessment process for fisheries managed by Queensland is described in Dunning (1998). There is no formal or structured assessment process in place to assess the status of stocks in the ECTF on a regular basis. Assessment is frequently driven by the specific interests of researchers and subject to available monitoring and research funding. The SAG generally is provided with a broad, verbal summary of the outcomes of LTMPs and other relevant research and is invited to comment on the drafts of stock trend reports. However, given the infrequency with which the SAG meets and the duration of its meetings (usually half days), there is limited scope for any in-depth review of the results of monitoring, research and stock assessment.

ECTF-specific publications are limited and many of the more recent research and survey results have not been disseminated or formally published (see Section 4.2.3). The “Condition and Trends Report” report had a production time of almost five years between successive editions. Whilst it is a useful summary of catch/effort trends in Queensland’s commercial fisheries, it should not be seen as a substitute for sound fishery or stock assessment work.

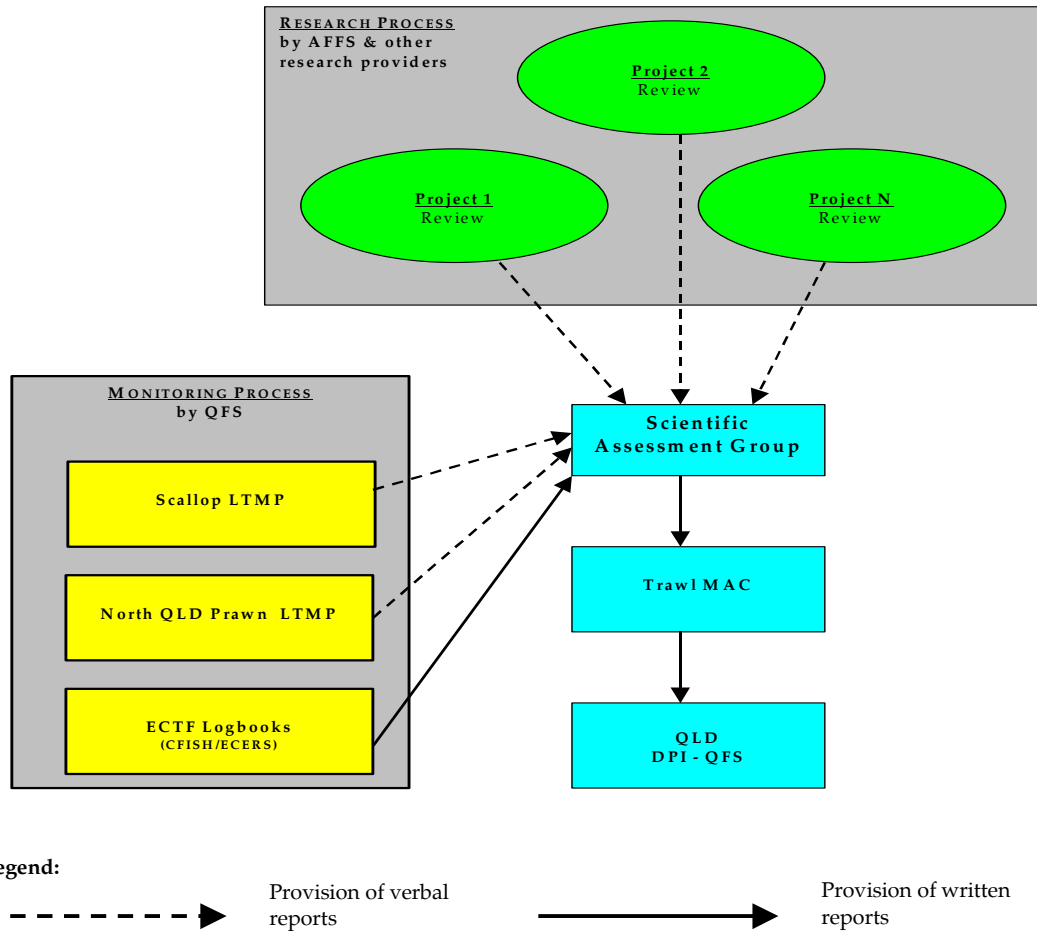
The QFS agreed in 2002 to produce annual status reports on the ECTF, which will outline basic catch and effort trends in the fishery from year to year. The first report “ECOTF Status Report - 2001” was finalised in September 2002. This document presents an important overview of the fishery on a more timely basis, but lacks sufficiently detailed resolution of data and analysis to be of significant fishery assessment benefit.

There needs to be an expertise-based group to review the monitoring and research results and to conduct assessments of the status of the fishery and stocks. Increasingly, such teams include population modellers, scientists, managers, industry experts, environmentalists and economists. Such a multi-disciplinary approach reflects a more holistic evaluation of the impacts of fishing on the ecosystem. An expertise-based group assists in examining the interpretation of the data and the appropriateness of the modelling assumptions.

Figure 12 represents the current research and stock assessment process and Figure 13 illustrates how this process could be improved in order to introduce greater scientific rigour and enhanced transparency. The proposed model is consistent with the assessment framework for many Australian fisheries at both the Commonwealth and State level.

In the current ECTF monitoring, research and fishery assessment approach, research reviews frequently are internal (i.e. between the research provider and the funding agency) and publication of research in peer-reviewed scientific journals is frequently delayed. Monitoring results from the scallop and North Queensland Prawn LTMPs generally are provided as verbal reports to the SAG, Trawl MAC and management. Logbook data are reported in Condition and Trend reports, frequently after some lengthy delays. The feedback to QFIRAC on the fishery’s monitoring and research needs generally only occurs at a broad level.

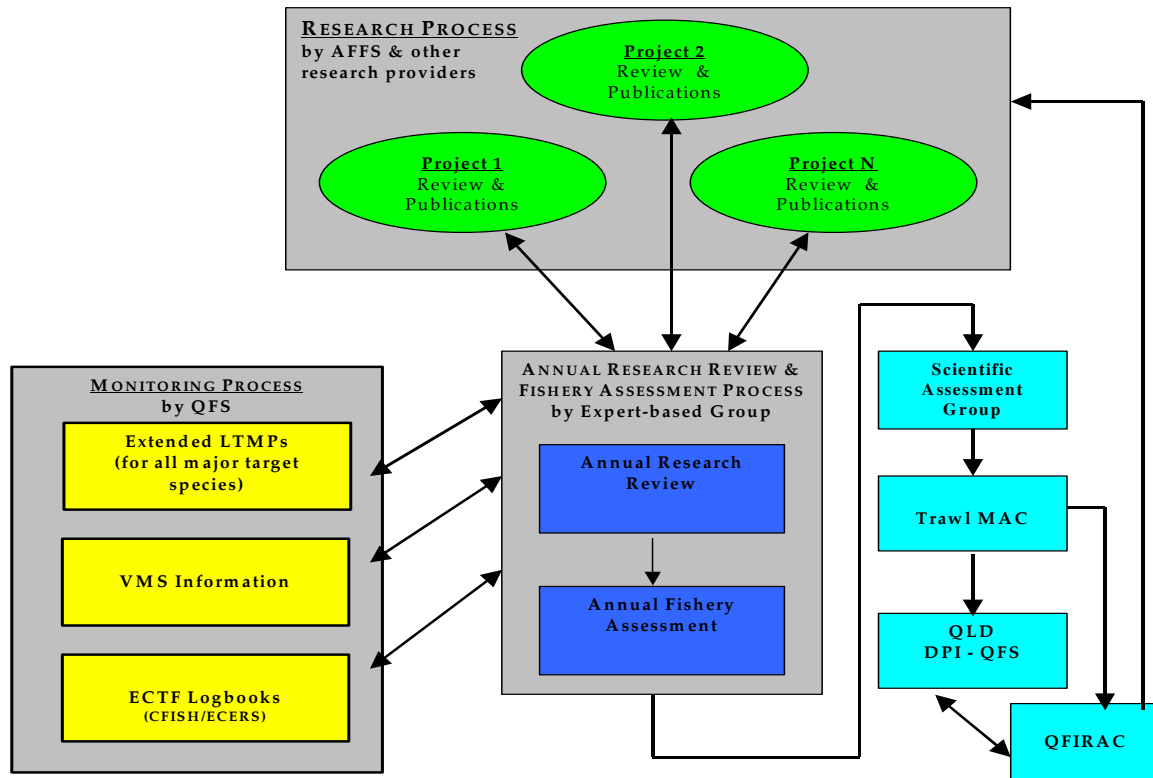
Figure 12: Current process for monitoring, research and fishery assessment in the ECTF.



To overcome these problems, the creation of an annual research review and fishery assessment process conducted by an expert-based group is recommended. The SAG and Trawl MAC would not be expected to carry out the review and assessments. The model proposes that the monitoring process be expanded to include the analysis of VMS information and LTMP data for the major target species. It is proposed that written reports be provided for the annual assessment process and that there be two-way communication between the data gathering and data assessment processes. Where possible, researchers should aim to publish their findings in the scientific literature or otherwise have their research independently peer reviewed in a timely manner. It is recommended that the QFIRAC be more closely linked to research prioritisation at the Trawl MAC and research provider level.

The benefits of adopting such an approach have been seen in past stock assessment workshops held by the QDPI for several major commercial species. The most recent one, in August 1998, examined (amongst other species) the status of eastern king prawns and saucer scallop stocks. The workshop was successful in bringing together biologists, stock assessment specialists, fishers and managers from Queensland and interstate. All available information on each of the species was collated and analysed. Shortfalls in the data were identified and accounted for in the simulation models. The workshop considered the evidence for overfishing and recommended priorities with respect to monitoring and research. It is recommended that such a structured process, involving a wide range of experts, be implemented on a regular basis in the ECTF to cover all major target/by-product species. It would be useful to link this process with the research review process (see Section 4.2.3).

Figure 13: Proposed process for improved monitoring, research and fishery assessment in the ECTF



Recommendation 20

- *That a formalised fishery assessment process be developed for the ECTF, through Trawl MAC, which involves an expertise-based team reviewing research results and conducting the fishery and stock assessment process.*

The assessment process for the ECTF is focussed almost entirely on the major commercial target species. Minor commercial target species and by-product species receive little or no research attention and are not included in any regular stock assessments. Furthermore, bycatch in the ECTF is monitored and assessed only on an opportunistic basis, if external research grants become available. Regular review of the impact of the fishery on bycatch in terms of species composition and abundance does not occur. Although believed to be small, there are no detailed estimates of the recreational and Indigenous take of ECTF species.

Recommendation 21

- *That the proposed assessment process be extended to include consideration of by-product and bycatch species taken in the ECTF.*

In relation to shared ECTF stocks, it is noted that, while joint research and assessments have been conducted on occasion, generally these have been project specific. Currently, there are no routine procedures in place for collaborative assessments.

Recommendation 22

- *That, where there are stocks of species with distributions which extend outside Queensland, the ECTF assessment process take account of the research and stock assessment work done by other jurisdictions and that there be collaboration in the stock assessment.*

5.5 The Audit Report's Assessment against the Commonwealth Guidelines

With respect to Guideline 1.1.2

There are some serious deficiencies in the ECTF assessment process. Apart from the uncertainty over how stock assessments (and associated research) are funded each year, there are no clear strategic priorities and processes that address stock assessment shortfalls over time. The process lacks rigour in terms of regular peer review, and the publication/dissemination of stock assessment results is poor. The uncertainty over the reliability of the information used for stock assessment further undermines the robustness of the fishery assessment process.

Stock assessment efforts to date have been focussed on major commercial species (tiger prawns, endeavour prawns, eastern king prawns and scallops). There are several target species (defined as principal species under the Management Plan) that have received little or no research/stock assessment attention (bugs, banana prawns and squid). Also, there is no regular assessment of by-product species. The Trawl Plan Review had suggested that some species (such as the barking crayfish) were quite heavily fished by some operators.

The major performance indicator (and the only one published regularly) for stock abundance is the nominal CPUE. The potential problems associated with the sole use of commercial catch rates in stock assessments are outlined in this Audit Report. Given that the ECTF began in the 1950s, it is surprising that the development of biomass assessment models has not progressed further. Similarly, there is a paucity of historic (pre-1988) data available for the assessment process, which may distort current assessments of the status of the various stocks exploited in the fishery.

Assessment in the ECTF needs to move beyond basic CPUE analyses and aim to develop research data and models, which allow for a more accurate assessment of stock abundance. Estimates of the reproductive capacity of the major commercial species are needed. It is unlikely that the current stock assessment approach would detect any downturn in resource abundance as a result of overfishing. Similarly, the usefulness of the current performance indicators specified in the Management Plan is questionable.

With respect to Guideline 1.1.3

Given the large geographical area covered by the fishery and its multi-species nature, assessment of the distribution and spatial structure of ECTF stocks is difficult. There needs to be more research and fishery-independent surveys to obtain sufficient data for such assessments. The risks entailed in not taking proper account of the geographical distribution and spatial structure of stocks are highlighted in the Audit Report. As a useful first step, there would be great benefit in collaborative research and stock assessment for species that have distributions that extend beyond the ECTF (such as eastern king prawns and bugs). A precautionary approach should be adopted in setting harvest limits for by-product species, particularly for species such as syngnathids, Balmain bugs, barking crayfish and cuttlefish, which are likely to be susceptible to localised stock depletion.

With respect to Guideline 1.1.4

Catch data collected for the ECTF are derived only from the commercial sector. There are no estimates of the recreational and Indigenous take, although these are believed to be relatively small. Of greater concern is the reliability of the estimates of the commercial catch, since the information is derived solely from unverified logbook data.

With respect to Guideline 1.1.5

Biomass abundance models for the key commercial species are still in the preliminary stages of development. As with all such models, it will take a while (and several refinements) before there can be an accurate prediction of the potential productivity of the fished stocks.

6. Environmental Impact of the East Coast Trawl Fishery

The Commonwealth “**Guidelines for the Ecologically Sustainable Management of Fisheries**” require, as overarching principles, that the fishery is conducted in a manner that:

1. “*does not threaten bycatch species*”
[**Principle2; Objective 1**];
2. “*avoids mortality of, or injuries to, endangered, threatened or protected species and avoids or minimises impacts on threatened biological communities*”
[**Principle2; Objective 2**]; and
3. “*minimises the impact of fishing operations on the ecosystem generally*”
[**Principle2; Objective 3**].

Recapitulating on the obligations for assessing the impact of a fishery on the wider ecosystem, the guidelines require that:

- “*there is a risk analysis of the bycatch with respect to its vulnerability to fishing*” [**Guideline 2.1.2**];
- “*there is an assessment of the impact of the fishery on endangered, threatened or protected species*” [**Guideline 2.2.2**];
- “*there is an assessment of the impact of the fishery on threatened ecological communities*” [**Guideline 2.2.3**]; and
- “*information is collected and a risk analysis, appropriate to the scale of the fishery and its potential impacts, is conducted into the susceptibility of 1. impacts on ecological communities 2. impacts on food chains 3. impacts on the physical environment*” [**Guideline 2.3.2**].

The guidelines also require that a number of management measures be in place to avoid:

1. “*capture and/or mortality of endangered, threatened or protected species*” [**Guideline 2.2.4**];
2. “*impact on threatened ecological communities*” [**Guideline 2.2.5**];
3. “*significant damage to ecosystems*” [**Guideline 2.3.3**]

This section of the Audit Report deals specifically with the impact of trawling on the environment. Specific actions in relation to environmental impact management are discussed further in Section 7. There are no listed threatened ecological communities in the ECTF and, therefore, Guideline 2.2.3 does not apply.

Benthic trawling is one of the least selective fishing methods and, as a result, the amount of discarded bycatch far outweighs the amount of retained product. The FAO has estimated that about 27 million tonnes of bycatch are discarded globally each year (Alverson *et al.*, 1994), with prawn trawling estimated to contribute more than one third of this total (Pascoe, 1997).

Australia is signatory to several international agreements, which prescribe the management of fisheries resources. Both the UNCLOS and FAO Code of Conduct for Responsible Fisheries require that fishing is conducted in a manner which does not undermine the sustainability of bycatch species. As a result of the increasing global awareness of the effects of trawling on marine ecosystems, the bycatch

and benthic impact of fishing in the ECTF is of major concern in the management of the GBR Marine Park.

The impact of fishing gear on the environment generally is the least investigated area of fisheries management. In most cases, there is little information on the biology of the bycatch (i.e. impacted non-commercial) species and on the physical and ecological impacts of fishing. Much of the available information is anecdotal, with limited quantitative research on which to base an assessment. Even in simple, single-species, spatially-limited trawl fisheries, such research can be difficult, since the impact cannot be assessed fully by studying the retained catch in a commercial trawl net. Specific research is required. As fisheries become larger in terms of species diversity and geographical spread, research costs increase accordingly.

6.1 Description of Environmental Impacts

There are no unequivocal estimates of the bycatch or the impact of trawling in the ECTF. As described in Section 5.2, there is large temporal and spatial variability in the fishery, which is reflected in a wide range of benthic habitat types and bycatch composition. Some monitoring and research work has been undertaken on environmental impacts and bycatch composition, but this has been opportunistic in terms of funding and areas studied. It is also noted that every sampling method for collecting bycatch species will have an inherent bias (due to gear selectivity) and results may differ significantly between day and night shots depending on the diurnal activity of the species (Wassenberg *et al.*, 1997).

As far as volume is concerned, estimates of bycatch range from 2 to 15 times that of the retained product. Poiner *et al.* (1999) calculated a 6 to 10 : 1 ratio for by-product versus prawn catch in the Far Northern Section of the GBR Marine Park. Preliminary data from an ECTF bycatch project in the southern part of the GBR Marine Park, currently underway, suggests that some 25,000t of bycatch is discarded for an annual production of about 10,000t of commercial product (Dr Courtney, QDPI, AFFS, *pers. comm.*). This figure is considerably lower than the figures reported by Poiner *et al.* (1999) for the northern part of the Marine Park.

As is common with all tropical penaeid fisheries, there is a large diversity of species in the bycatch. It is estimated that between 500 and 1000 species are taken as bycatch in the ECTF, of which about 30% are regarded as common. The remaining 70% are uncommon and usually taken in low numbers. This situation presents difficulties from a monitoring perspective, because “rare” organisms caught in trawls generally occur too infrequently to detect changes in abundance at a statistically significant level. Bycatch has been examined and classified for some sectors of the fishery, but there is no bycatch profile for the ECTF in its entirety.

There have been several studies on bycatch in the ECTF and in other prawn fisheries. Robins and Courtney (1999) provide a bycatch profile for each of the ECTF sectors prior to its recent restructure (Table 16). Given that the number of effort units has reduced by about 14% since 1 January 2001, it is expected that there has been a drop in the overall bycatch produced by the fleet. There has been a significant reduction in the number of turtles caught, following the requirement to use TEDs.

A three-year FRDC-funded study (No. 2000/170) entitled “*Bycatch weight, composition and preliminary estimates of the impact of bycatch reduction devices in Queensland’s trawl fishery*”, hereafter referred to as the “BRD Evaluation Study”, is scheduled for completion by mid 2003. This study will provide updated information on bycatch composition in the various sectors of the ECTF and preliminary results have been available for the writing of the Audit Report (Dr Courtney, QDPI AFFS, *pers. comm.*). However, the primary aim of this project is the comparative evaluation of BRDs in each of the major fisheries of the ECTF. It is not designed to provide a statistically robust assessment of bycatch in the fishery as a whole.

Table 16: Bycatch trends reported for the ECTF by Robins and Courtney (1999).

Sector	Turtle Catch/Year (Pre TED)	Prelim. Estimates Bycatch/Year (t)	Bycatch Characterisation
Tiger /Endeavour Prawn	1,600	10,260 to 19,2000	<ul style="list-style-type: none"> ➤ fish dominate bycatch (75%) ➤ BCR not available, but bycatch catch rate 38kg/hr ➤ bycatch variable depending on location
Red Spot King Prawn	65	~8,000	<ul style="list-style-type: none"> ➤ high species diversity ➤ fish dominate bycatch ➤ BCR not available, but bycatch catch rate 55kg/hr ➤ bycatch variable depending on location
Banana Prawns	350	Unknown	<ul style="list-style-type: none"> ➤ 8 species constituted 50% of catch ➤ BCR: 5 to 1
Eastern King Prawn	250	Unknown	<ul style="list-style-type: none"> ➤ fish dominate bycatch (66-86%) ➤ BCR 11.2 : 1 (inshore) ➤ bycatch highly variable depending on location (highest inshore)
Scallop	200	Unknown	<ul style="list-style-type: none"> ➤ no quantification of bycatch

Note: “BCR” stands for bycatch to catch ratio.

6.1.1. Bycatch Composition in the ECTF

As a result of its vast geographical spread, its cross-shelf operations and the multitude of target species, there is no uniform bycatch profile for the ECTF. For example, the bycatch species in the far northern tiger/endeavour prawn fishery are considerably different in terms of volume, species composition and diversity to those found in the fishery in the southern GBR Marine Park.

A project entitled “*Ecological sustainability of bycatch and biodiversity in prawn trawl fisheries*” (FRDC Project No. 1996/257) by Stobutzki *et al.*, hereafter referred to as the “Bycatch Sustainability Study”, examined bycatch in the NPF, TSPF and ECTF banana prawn fisheries. The study demonstrated that bycatch in tropical penaeid fisheries is characterised by a high species diversity, but a low numerical abundance of most species. The catches appear to be dominated (up to 82%) by teleosts (bony fish) and elasmobranchs (sharks and rays), which show a high trawl mortality (about 90%). Crustaceans make up about 20% of the total bycatch biomass (Stobutzki *et al.*, 1997).

In contrast, the temperate-water trawl fisheries show a lower species diversity. Crustaceans, such as crabs and bugs, dominate the catch (around 80%). These have a higher trawl survival rate than teleosts and elasmobranchs, which constitute around 20% of the bycatch (Hill and Wassenberg, 1992).

Most teleost bycatch in northern waters is made up of small benthic species, which include the Bothidae (flounders), Paralichthyidae, Mullidae (goatfish), Monacanthidae (leatherjackets), Synodontidae (lizardfishes) and Nemipteridae (threadfin and monocle breams). Juvenile Lutjanidae (snappers), Lethrinidae (emperors and breams) and Serranidae (gropers), which are important in other commercial and recreational fisheries, are taken also.

The elasmobranch bycatch in tropical penaeid fisheries warrants special mention. Until the introduction of TEDs and the more recent ban on the taking of sharks in the ECTF, there was a significant bycatch of elasmobranchs in prawn trawls. Unfortunately, there are no reliable historical estimates of this type of bycatch, because the ECTF logbooks (as for other by-product) were completed poorly. By way of comparison, Pender *et al.* (1992) estimated that the shark bycatch of the Family Carcharinidae alone was about 12% in the western NPF in 1988. Because of their biological characteristics, elasmobranchs are particularly vulnerable to overfishing. Many species are relatively long lived, have a low fecundity and are ovoviviparous (i.e. giving birth to live young). There is growing national and international concern about the possible overexploitation of sharks. Sawfish (Family Pristidae) have been nominated recently as “endangered” under the EBPC Act. Under the auspices of the FAO, an “International Plan of Action (IPOA) for the Conservation and Management of Sharks” has been implemented, to which Australia is a signatory.

In the Far Northern Section surveys, Poiner *et al.* (1999) noted a similar bycatch ratio to that reported by Stobutzki *et al.* (1997). They reported a ratio of 6 to 10 tonnes of bycatch for every 1 tonne of prawns harvested. Extrapolating this to the fleet, they calculated a bycatch rate of 3-7 kg of discards per hectare of trawled ground per year⁴⁵. About two-thirds of the bycatch were teleosts and elasmobranchs and about one-third were crustaceans. It was noted that nearly all of the fish were dead and that about half were floating and half were sinking.

Recommendation 23

- *That the proposed at-sea observer program collects detailed information on the composition, size and life-history status of the bycatch taken in the ECTF and that this information be analysed regularly as part of the proposed annual fishery assessment process.*

6.1.2 Take of Listed Species

Three groups of species taken in the ECTF are “Listed Marine Species” under Section 248 of the EBPC Act. These include all species of marine turtles, sea snakes, seahorses, seadragons and pipefish.

6.1.2 Marine Turtles

Turtles are listed internationally as either endangered or threatened (Table 17). Due to their longevity, slow maturity, low fecundity, vulnerability whilst breeding and lack of parental care, they are highly susceptible to over-exploitation and have a low capacity to recover.

Table 17: Conservation status of marine turtles found in the ECTF and Australia.

Common Name	Scientific Name	Conservation Status		
		IUCN ¹	C'Wealth ²	Queensland ³
Green Turtle	<i>Chelonia mydas</i>	endangered	vulnerable	vulnerable
Loggerhead Turtle	<i>Caretta caretta</i>	endangered	endangered	endangered
Flatback Turtle	<i>Natator depressus</i>	vulnerable	not listed	vulnerable
Hawksbill Turtle	<i>Eretmochelys imbricata</i>	critically endangered	vulnerable	vulnerable
Pacific Ridley Turtle	<i>Lepidochelys olivacea</i>	endangered	vulnerable	endangered

⁴⁵ This calculation was subject to the distribution of fishing effort.

		Conservation Status		
		endangered	vulnerable	endangered
Leatherback Turtle	<i>Dermochelys coriacea</i>	endangered	vulnerable	endangered

Note: In addition to an Appendix 1 CITES listing, turtles are also listed under the following:

- ¹ the IUCN Red List of Threatened Animals 1996
- ² a national list of threatened species provided for under the EPBC Act; and
- ³ the Queensland Nature Conservation Act 1994

Prior to the introduction of TEDs, trawling was seen as a major cause of turtle mortality through drowning. Robins (1995) calculated that some 5295 (\pm 1231) turtles were caught annually in the ECTF⁴⁶ and that mortality ranged between 1.1 and 7.8% of those caught. This estimate was lower than the 6 – 10.1% mortality calculated for the NPF (Poiner *et al.* 1990 and Poiner & Harris, 1994). This difference is believed to be due to the shorter duration of ECTF shots (average < 80 minutes) compared to the NPF (average 3 hours). Since the introduction of TEDs, turtle capture and mortality has declined dramatically (Table 18).

Table 18: Turtle interactions in the ECTF.

(Data Source: Trawl Logbooks; Information Source: “ECOTF Status Report – 2001”.)

Common Name	Scientific Name	No. Caught	No. Released	Fatalities
Green Turtle	<i>Chelonia mydas</i>	4	4	0
Loggerhead Turtle	<i>Caretta caretta</i>	5	4	1
Flatback Turtle	<i>Natator depressus</i>	2	2	0
Hawksbill Turtle	<i>Eretmochelys imbricata</i>	1	1	0
Pacific Ridley Turtle	<i>Lepidochelys olivacea</i>	1	1	0
Leatherback Turtle	<i>Dermochelys coriacea</i>	0	0	0
Great Barrier Reef World Heritage Area Total		13	12	1
ECTF Total		14	13	1

However, it is noted that the logbook information on turtle interaction is unverified data. Given the lengthy delay in the deployment of prescribed TEDs by many ECTF operators (see Table 20), the figures provided by the QFS seem surprisingly low⁴⁷. The effectiveness of TED design and the legislation providing for its use, are discussed in Section 7.3.6.

6.1.2.2 Sea Snakes

Sea snakes of the families Hydrophiidae and Laticaudidae are “Listed Marine Species” under the EPBC Act, but they are not listed internationally under CITES or the IUCN. About 30 species of sea snakes are found in northern Australia and about 50% of these are endemic (Stobutzki *et al.*, 1997). Sea snakes are susceptible to overexploitation because of their longevity (5 to 10 years), low fecundity and ovoviviparity. Studies in the NPF indicate that the ability of some sea snakes to recover from trawling is low, with 33% estimated to die from trawl-associated injuries such as drowning or physical damage (Wassenberg *et al.*, 2001). However, these results cannot be extrapolated to the ECTF, as trawl shots generally are shorter on the east coast.

⁴⁶ Annual effort was estimated at the time to be about 80,500 fishing days.

⁴⁷ Although outside the scope of this report, the figures for turtle interaction outside the GBR Marine Park seem particularly low.

There is little published information on the impact of trawling on sea snakes. Several projects (Ward, 2000; Wassenberg *et al.*, 2000; Ward, 2001 and Milton, 2001) have examined the occurrence of sea snakes in tropical penaeid fisheries. Primarily, these studies have investigated temporal and spatial distributions and no quantitative assessments have been made of the impact of trawling on sea snake abundance and distributions. These studies were conducted mostly in the NPF.

Recommendation 24

- *That there be further monitoring and research on the incidental bycatch of sea snakes in the ECTF.*

6.1.2.3 Seahorses, Seadragons and Pipefish

Species of the families Syngnathidae (seahorses, seadragons and pipefish) and Solenostomidae (ghost pipefish) are “Marine Listed Species” under the EPBC Act. Seahorses also are listed on the 2000 IUCN Red List. The genus *Hippocampus* currently is being considered for CITES listing under Appendix II.

Until the late-2001 amendments to the Trawl Plan, there were no restrictions on the take of any seahorses, seadragons or pipefish (about 56 species). The “Trawl Plan Review” indicated that about 20 operators were landing more than 200 seahorses per year, at an average estimated market value of \$1,300/kg. However, the “Syngnathid Study” noted that there was considerable underreporting of syngnathids bycatch in the ECTF⁴⁸ (Connolly *et al.*, 1999) and the reported logbook figures should therefore be treated with caution. Following the legislative amendments, only *Solegnathus hardwickii* and *Solegnathus dunckeri* may be retained and landed by commercial fishers. The others must be discarded.

As demonstrated by Connolly *et al.* (1999), seahorses, seadragons and pipefish show a highly variable catch rate in the ECTF. Notwithstanding concern over data quality with trawl logbooks, these species demonstrate a strong habitat preference for rocky reefs and sponge beds, which are areas generally avoided by trawlers. Syngnathids and solenostomids are vulnerable to trawling because they are highly susceptible to capture and have a high trawl-associated mortality. Based on their biological characteristics, they have a low capacity to recover from overfishing. However, they receive some degree of protection from trawling because their distribution is believed to only partly overlap with commercial trawl grounds.

Recommendation 25

- *That there be further monitoring and research on the incidental bycatch of syngnathids and solenostomids in the ECTF, specifically with respect to their distribution within the area of the fishery.*

6.1.3 Benthic Habitat Impacts

There are numerous publications on the benthic impacts of trawling overseas. Two major studies were conducted into the effects of prawn trawling in the GBR Marine Park. The first, carried out over five years by Poiner *et al.* (1999), examined the “*Environmental Effects of Prawn Trawling in the Far Northern Section of the Great Barrier Reef Marine Park: 1991–1996*”, hereafter referred to as the “Effects of Prawn Trawling Study”. The second study by Pitcher *et al.* (2000), a continuation of the

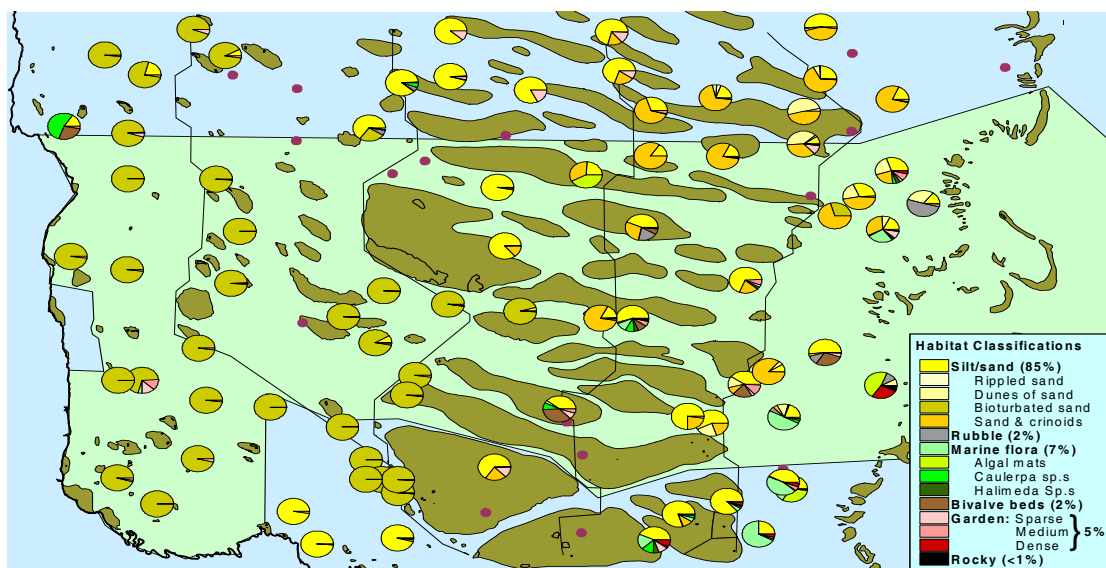
⁴⁸ Connolly *et al.* state that “logbook fishing effort recording syngnathids bycatch presented only a small fraction of the total fishing effort” and that “the use of logbooks to quantify (syngnathids) bycatch is a ... potentially unreliable method.”

first, is monitoring “Recovery of Seabed Habitat from the Impact of Prawn Trawling in the Far Northern Section of the Great Barrier Reef Marine Park”, hereafter referred to as the “Recovery Study”.

The studies examined the biological communities of the lagoonal and inter-reefal areas, which make up 95% of the GBR Marine Park. More than 1000 species were recorded over an area of about 10,000km². The Far Northern Section contains a large “Green Zone”, which was closed to trawling in 1985. The aim of this work was to compare differences in marine life between the trawled and untrawled areas. Prior to the closure there had been trawling in some of these areas. However, because of the highly aggregated nature of trawling, much of the area open to trawling (both pre and post closure) had not been fished commercially. Furthermore, the study found evidence that illegal trawling had occurred in closed areas. These two factors led to some confounding results.

The first study found a richness of biodiversity in the lagoonal and inter-reefal seabed. Habitats included bare muddy/sandy flats, seagrass and algal meadows, highly diverse sponge and coral gardens and deeper hard coral reefs (Poiner *et al.*, 1999). Five biophysical zones were identified across the continental shelf, which were characterised by the sediment type and plant/animal communities. The study found that muddier areas tended to be least diverse, whereas sandy or hard bottom areas showed more diverse and abundant seabed life. The study also noted that large epibenthos, which forms the living structural habitat of the seabed, generally was found in rocky or rubble patches.

Figure 14: Habitat types of the Far Northern Section of the GBR Marine Park.
(Data: benthic surveys).



Note: The above figure was provided courtesy of Dr Pitcher (CSIRO) and appeared in Poiner *et al.*, 1999.

One component of the study, the repeat trawl depletion experiment, aimed to simulate commercial trawl operations. When productive grounds containing aggregations of prawns are located, the fleet trawls them repeatedly until catch rates drop off. The study simulated this behaviour and concluded that each pass of the trawl net removed between 5 and 25% of the seabed life, depending on the area and its benthic character. The research also showed that the effects of trawling are cumulative, with 7 repeated trawls removing about 50% of the seabed life and 13 repeated trawls removing between 70 and 90%. The study demonstrated that the level of trawl impact varied according to species, with large sponges and flower-pot corals being particularly susceptible and seawhips and gorgonians being

more resistant to such disturbance. The study concluded that trawling causes changes in the composition of seabed communities.

The findings of the repeat trawl depletion experiment are very relevant in assessing the impact of trawling. As discussed in Section 5.2.4, trawling is highly aggregated and numerous vessels target some productive grounds heavily. Pitcher *et al.* (2000) concluded from logbook records that about 20% of trawl effort was concentrated in less than 5% of the trawled area. This was referred to as “intensive” fishing effort. On the other hand, some 20% of effort was spread over 60% of the trawled area. This was referred to as “extensive” fishing effort. The analysis was based on logbook data reporting catches within 30’x30’ grids. Pitcher *et al.* stressed that the spatial resolution of the effort information is essential in determining the impact of trawling. The more accurately the fishing operations are reported, the greater the ability to predict trawl impact based on the biophysical characteristics of the fishing ground.

The second study, which examined the recovery of benthic communities to trawling, concluded that the amount of fauna removed each year is related to the resilience of the benthic fauna to removal, the intensity of trawl effort and the degree of aggregation of fishing. In terms of vulnerability, the study found that large sponges and flower-pot corals were particularly susceptible to trawling and that sea whips and gorgonians were the most resistant species. Also, as neither the benthic fauna nor trawl effort was distributed uniformly throughout the fishery, there were large variations in the estimated impact. Pitcher *et al.* (2000) suggest that, on average, about 4% of high-resilience fauna, 8% of medium-resilience fauna and 15% of low-resilience fauna may be removed annually in trawled areas. Extrapolating from their results, they estimated that, in heavily trawled areas, the removal of the least resilient fauna may be as high as 80%, whereas in lightly trawled areas this may be significantly lower. However, it is noted that the Far Northern Section had been fished extensively for several decades prior to the introduction of the closure. Therefore, it is likely that the habitat had been modified extensively prior to the study being undertaken.

From the work in the Far Northern Section of the GBR Marine Park it is clear that trawling has a major (and in many cases long-term) impact on the environment. Whilst acknowledging that benthic recovery rates are not well understood, the second study suggested that recovery may take up to 20 years in trawled areas (assuming trawling were to cease) for the most vulnerable species. Also, the seabed community structure may be altered permanently as less vulnerable species survive trawling better and become re-established more quickly than more vulnerable species.

The above findings relate only to the Far Northern Section of the Marine Park, which has a quite different benthic habitat structure to that of the southern fishery. The fishery also changes in terms of gear used and species targeted with increasing latitude. It is not possible, based on the northern results, to predict the impact of trawling for scallops in the southern part of the Marine Park. A three-year study entitled “*Mapping bycatch and seabed benthos assemblages in the Great Barrier Reef region for environmental risk assessment and sustainable management of the Queensland East Coast Trawl Fishery*” by a consortium of research providers is scheduled to begin in mid-2003. It will expand on the earlier “*Effects of Prawn Trawling Study*” and it is anticipated that this study will provide valuable information on areas not investigated so far.

6.1.4 Trophic Level Impact

Several studies (e.g. Blaber and Wassenberg, 1989, Blaber *et al.*, 1999 and Hill and Wassenberg, 1992) have commented on the trophic impact of trawling. The discard of bycatch provides food for scavengers (in the case of dead discard) and predators (in the case of live or injured bycatch). In combination with the removal of the landed catch, this is likely to affect the trophic dynamics of the ecosystem and may change the community structure. There is no empirical evidence or data on this type of interaction within the ECTF.

Sharks, dolphins, fish, crabs and seabirds have been identified as the main groups of scavengers in the tropical penaeid fisheries. Dolphins and sharks tend to feed on discards at the surface, whereas portunid crabs, nemipterids, lethrinids and lutjanids predominantly scavenge on the seabed. Discards that sink are usually scavenged within hours of the discard sinking to the seabed. Some researchers (Blaber and Wassenberg, 1989; Blaber and Milton, 1994) found that increased food abundance through trawler discards has increased the populations of crested terns. Poiner *et al.* (1999) report a hundred-fold increase in this species since trawling began, possibly because the fledglings are feeding on discards. The flow-on effects to other bird populations is not yet understood. The study into the environmental effects of prawn trawling in the Far Northern Section of the GBR Marine Park concluded that it was unlikely that the amount of discards by prawn trawling in that region of the Marine Park would have serious ecological consequences.

A mass-balance, trophic-based, ecosystem model (in preparation) has been developed as part of the project entitled “*Modelling ecosystem impacts of changes in fisheries management of the commercial prawn (shrimp) trawl fishery in the far northern Great Barrier Reef*”. It simulates the effects of trawling on the penaeid prawn community in the lagoonal and inter-reefal habitat and predicts trophic impacts. The data for the model were derived from the “Effects of Prawn Trawling Study”. The model predicted that the trawl fleet has little impact on the target prawn species, but a greater effect on the omnivorous fish bycatch and large turtles. Simulations showed a 59% and 64% decrease in the tiger and endeavour prawn biomass respectively, with a 50% reduction in trawl effort. The model suggests that trawling removes prawn predators and other competitors and increases the food sources for prawns through discards and predicts a 15% decrease in sea bird biomass with the halving of trawl effort (Dr Gribble, QDPI, AFFS, *pers comm.*)

6.2 Mitigation Devices

Devices, which reduce bycatch in trawl nets whilst they are being towed, are known collectively as BRDs. A subset of these devices assist in the escape of turtles and other large unwanted bycatch, such as sharks, rays and sponges (referred to as “monsters” by industry). These are commonly called TEDs. Another group of devices, which are still being developed (especially for use on small vessels), are called hoppers. This work on the principle that the cod end (once hauled) is emptied into a container filled with circulating seawater, thereby keeping bycatch alive and reducing damage to the target species.

Adopting mitigation technology has obvious benefits. Firstly, it enhances the quality of the commercial product because there is less damage from cod-end crowding. Secondly, it reduces sorting and handling time for the crew and may avoid interactions with dangerous fauna (such as seasnakes and poisonous fish). By excluding “monsters”, it also reduces damage to the trawl net and avoids the cod end becoming filled with large amounts of unwanted bycatch. However, these advantages are offset by potential product loss, which may occur if the devices are malfunctioning or improperly installed. Product loss has been reported to be heavy for certain species such as bugs. Also, mitigation devices can reduce the hydrodynamic performance of the gear, thereby adding to fuel costs and engine strain (Day, 2002).

Because of the high levels of bycatch in tropical penaeid fisheries and the impact of trawling on vulnerable species, a range of mitigation devices has been tested in the NPF, TSPF and ECTF over the last decade. In each of these fisheries, it is now a legislative requirement to deploy such devices during trawling. However, progress in the correct usage of BRDs has been slower on the ECTF than in the NPF and TSPF. The reasons for the delay are discussed further in Section 7.3.6. Also, it is noted that there are no monitoring and research funds provided in the current ECTF research budget to enable the scientific evaluation of new mitigation gear through scientific at-sea trials and observer surveys of fleet practices.

6.2.1 Turtle Excluder Devices

TEDs have been tested and developed by the QDPI for almost a decade. Initially, the driver was concern over the drowning of marine turtles in trawl nets and their subsequent population decline (especially the endangered loggerhead turtle). The avoidable deaths of threatened species were of particular concern to the GBRMPA, as they clearly did not accord with the objectives of the GBRMP Act. A U.S. embargo on the importation of prawn products from fisheries that did not use TEDs was a further driver in the implementation of TEDs.

A range of TED designs has been tested in the ECTF over the past ten years. Some of the results are summarised in Table 19.

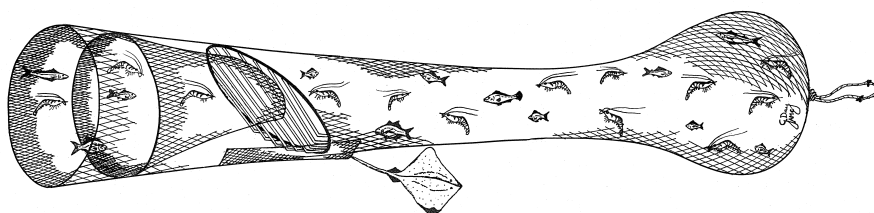
Table 19: TED designs tested in the ECTF since 1995
(Data Source: Information summarised from Robins *et al.*, 1999).

Type of TED	Description of Design	Comments on Performance
Morrison Soft TED	➤ semi-flexible grid of trawl wire	<ul style="list-style-type: none"> ➤ tended to clog with seaweed and crabs in estuarine areas ➤ tended to result in significant prawn loss (-8% to -29%)
Aus TED	➤ semi-flexible grid of trawl wire	<ul style="list-style-type: none"> ➤ tested in limited number of areas
Aus TED II	➤ semi-flexible grid of trawl wire	<ul style="list-style-type: none"> ➤ worked well on “clean grounds” but tended to clog with sponges and starfish elsewhere ➤ at times resulted in significant prawn loss (-1% to -36%)
Supershooter TED	➤ rigid grid	<ul style="list-style-type: none"> ➤ worked well at excluding sharks, rays and turtles ➤ could become clogged with starfish ➤ small prawn loss (-5% to +6%)
Seymour TED	➤ rigid grid	<ul style="list-style-type: none"> ➤ efficiently excluded large animals ➤ clogging with large rocks, sponges and starfish was a problem in certain areas ➤ small prawn loss (-3%)

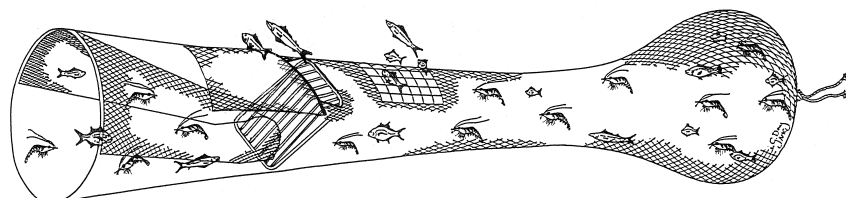
Testing of TED designs has centred primarily around variations in the position of the escape hole, the construction of the deflector grid (i.e. whether it should be flexible, semi-rigid or rigid), the angle at which the grid is installed and the size of the grid spacing. The work by Robins *et al.* (1999) demonstrated that a TED grid needs to be rigid, the bar spacing not more than 12 cm and the escape hole of a certain surface dimension in order to deflect 95% of turtles out of the net. This escape rate is the benchmark set in the draft “Recovery Plan for Marine Turtles in Australia”. Two designs, which fit these specifications, are depicted in Figure 15.

Figure 15: Two commonly used TED designs which fit the design specifications for a 95% escape rate.

(a) The “Super Shooter” (bottom opening TED)



(b) The “NAFTED” (top opening TED)



* These TED drawings were provided courtesy of Gary Day (former Australian Maritime College).

Research suggests that TEDs are highly efficient at excluding turtles and large benthic fauna if certain minimum design standards (such as a rigid or semi-rigid grid, maximum bar spacing of 12 cm and an escape section of prescribed dimensions) are met and the devices are installed properly (Robins, 1993). The adoption of such minimum design standards is essential for compliance with the Turtle Recovery Plan, once it is finalised. The Draft Plan sets a target of 95% escape upon capture by the trawl net.

Reports by QBFP inspectors and scientists working in the field suggest a high rate of non-compliance in 2001 and 2002. The trawl logbook data support this observation (Table 20), with only 63% of the fleet reporting the usage of grid-type TEDs and an unknown number within that group using a bar spacing between 12 and 15 cm.

The circumstances leading to the poor record of TED usage and its management implications are considered further in Section 7.3.6. The QFS amended the TED provisions in late 2002 to tighten the minimum design standards. Data on TED usage in 2002 are not yet available.

Table 20: TED usage reported in the trawl logbooks by the ECTF fleet in 2001
[Data source: Trawl Logbooks.]

TED Type	Vessels in 2001	% of Vessels (reported)
Usage of grid-type TED		
➤ Bar spacing 10 –15 cm	128	21%
➤ Unknown bar spacing	262	42%
Subtotal	390	63%

Usage of non- grid TED		
Subtotal	229	37%
Fleet Total	619	100%

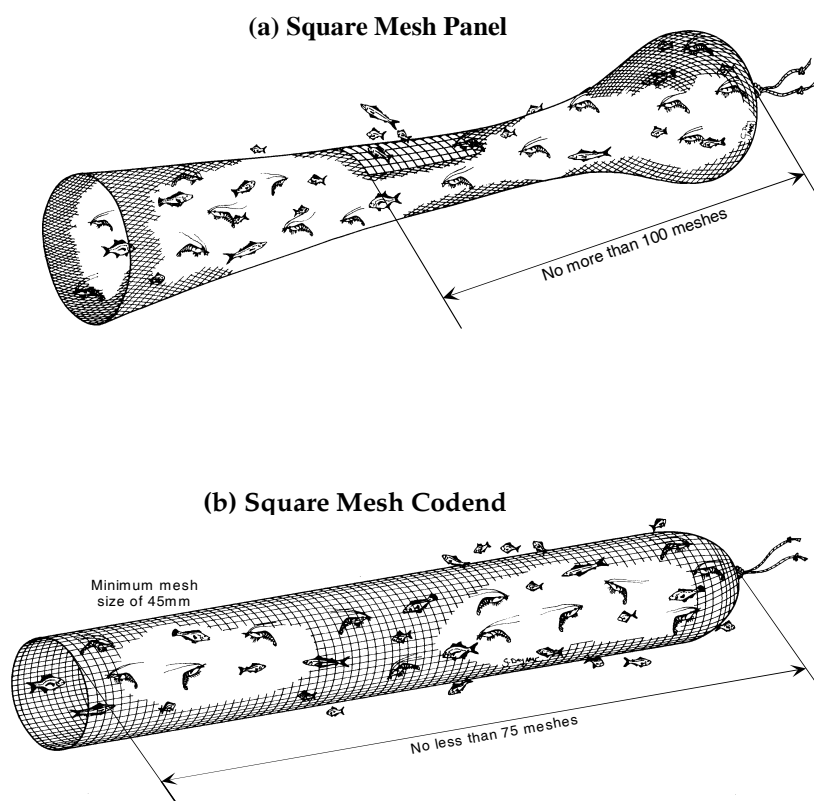
Note: There are more responses than the number of licensed operators (about 550 by the end of 2001). The QFS has indicated that, in some instances (such as upon vessel transfer or replacement) more than one gear sheet may have been received per boat.

6.2.2 Bycatch Reduction Devices

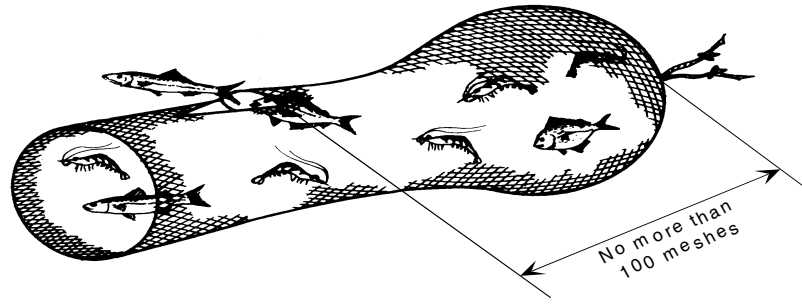
Research on BRDs in prawn fisheries has been conducted in NSW since 1989 and in the NPF, TSPF and ECTF since about mid-2000. The aim of BRDs is to provide escape opportunities for fish and other animals, which are captured in the net. To date, a range of devices has been tested (Figure 15). These devices either reduce mesh selectivity for bycatch (through altered mesh size/design) or create physical escape holes in the funnel of the net.

The Trawl Plan currently specifies five recognised BRD types, although it makes provisions for the use of alternate devices provided they meet the purpose of a BRD. The QFS, through a Technical Working Group of Trawl MAC, is in the process of reviewing and amending the BRD provisions. However, progress has been slow to date as discussed in Section 7.3.6.

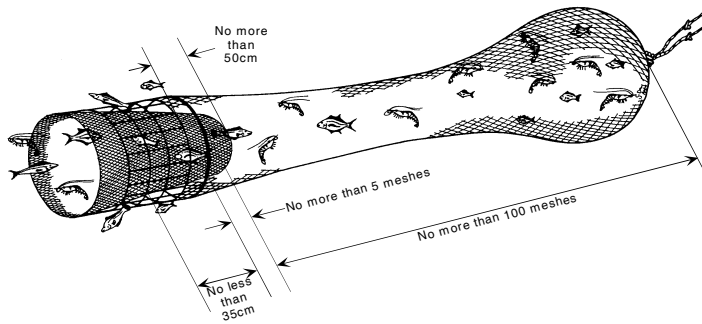
Figure 16: BRDs in use in the ECTF and other tropical penaeid fisheries.



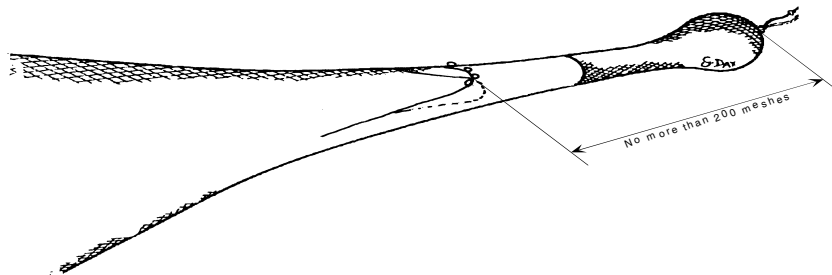
(c) Fisheye



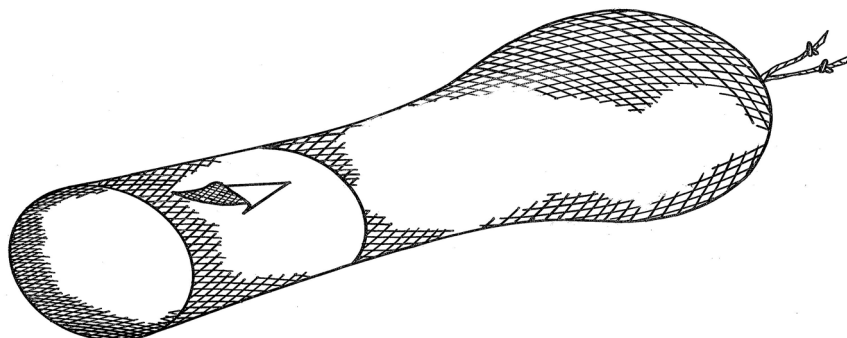
(d) Radial Escape Section



(e) Bigeye



(f) V-Cut or Flapper



These BRD drawings were provided courtesy of Gary Day (former Australian Maritime College).

- Note:**
1. The minimum mesh distances from the cod end indicated above reflect the proposals suggested by industry to improve the performance of the BRDs.
 2. All devices except for the V-Cut BRD currently are specified under the Trawl Plan.
 3. According to a QFS survey, the Bigeye is the most popular BRD design in the ETCF.

Based on BRD trials in the northern penaeid fisheries (Brewer *et al.*, 1997) and preliminary results from the “BRD Evaluation Study”, several observations can be made about BRD performance. Firstly, given the range of species that needs to be excluded from the net, one BRD type will not exclude all forms of bycatch successfully. How fish and other animals respond to a trawl net and its escape device(s) depends on their swimming ability and innate behaviour. In other words, what may be a good BRD for one bycatch species may not necessarily work for another species. Secondly, the type of terrain trawled may impact on the efficiency of BRDs. Some devices perform better on “clean grounds” than in areas containing rubble, seaweed, sponges and starfish. High product loss can result when escape openings become jammed with debris. Thirdly, the correct installation of a BRD is crucial to its performance. For example, the distance of the device from the cod end, its orientation and the design of the escape opening, all impact on a BRD’s efficiency. The incorrect “tuning” of a BRD may either render the device useless or result in severe product loss (Day, 2001).

Consequently the effectiveness of BRDs varies with net design, BRD design, bycatch profile (i.e. species types and catch composition), benthic habitat type and the time when fishing occurs. Some preliminary results from the “BRD Evaluation Study” are presented in Table 21.

Table 21: Preliminary results on bycatch reduction in the major sectors of the ECOTF
[Data Source: At-Sea Observer Coverage].

Fishery and Treatment	Effect on Target Species	Effect on Bycatch Species
Tiger/Endeavour Prawn Fishery		
1. V Slit < Standard	-17.3%	-15.4%
2. Square mesh panel < Standard	-9.0%	-7.9%
3. Modified fisheye < Standard	NS	-12.9%
4. Radial escape section + TED < Standard	-17.0%	NS
5. Modified fisheye + TED < Standard	-13.3%	-10.0%
Scallop Fishery		
7. Bigeye + TED < Bigeye	NS	-22.3%
7. TED < Standard	NS	-48.3%
8. TED 15cm < Standard	NS	-44.7%
9. Bigeye + TED < TED	NS	NS
10. Fisheye + TED < Standard	-12.4%	-62.6%
Eastern King Prawn (Shallow) Fishery		
11. Bigeye < Standard	NS	NS
12. Fisheye + TED < TED	NS	-28.1%
13. Bigeye < Standard	NS	-14.1%
14. TED + V cut + Bigeye < Standard	NS	-9.8%
15. Square mesh panel + TED < Standard	NS	NS
17. Fisheye + TED < Standard	-14.9%	-22.1%

Eastern King Prawn (Deep) Fishery		
17. Square mesh window < Standard	NS	NS
18. Square mesh panel < Standard	NS	NS
19. Bigeye + TED < Standard	NS	NS

Note:

1. Table 21 was provided courtesy of Dr Tony Courtney (QDPI, ADFS) based on the preliminary results from the “BRD Evaluation Study”.
2. The above results were derived from opportunistic observer coverage aboard ECTF trawlers and, as a result, there is no statistical design to the treatments and coverage. Each treatment refers to paired comparisons between the performances of net types. Each treatment represents the results of a trip (about 30 shots).
2. “Standard” refers to a standard net, which has no TED and no BRD.
3. “Treatment” refers to the comparison between net types, where “<” means “compared to” (e.g. “Bigeye < Standard” means that the catch from a net fitted with a Bigeye BRD is compared to the catch from a net that has neither a TED nor a BRD fitted).
4. Results were compared using a T-Test and “NS” means statistically “not significant”.

These preliminary results suggest a large variation in the performance of these devices, ranging from no discernible difference (i.e. statistically invalid results) to nearly 63% reduction in bycatch through the combined use of a fisheye and TED (Treatment 10). Also, results were not consistent between the same types of treatment (e.g. Treatments 11 and 13). Courtney (*pers. comm.*) indicated that this might relate to operational differences between vessels, such as the BRD position on the net and the hydrodynamic performance of the trawl nets and doors.

The preliminary results also show that prawn loss can be higher than bycatch reduction, which is of concern to operators and acts as a disincentive to the proper deployment of BRDs. Of the six treatments that showed statistically significant reductions for both the target and bycatch species, only two showed a higher reduction in bycatch than in prawns. Courtney (*pers. comm.*) reports widespread use of the Bigeye as the preferred BRD in late 2001 and 2002. This preference is not reflected in the QFS’ reports (see Tables 22 and 23), although it is noted that these data refer to early 2001. Courtney expressed concern about the effectiveness of the Bigeye, particularly in the manner with which it appears to be deployed.

It will be interesting to compare the final data from the bycatch reduction study with earlier information on the relative bycatch reduction through BRDs. Stobutzki *et al.* (1996) estimated a 33% bycatch reduction for the ECTF banana prawn sector and 55% reduction for the NPF banana prawn sector. Broadhurst and Kennelly (1996) reported about a 30% reduction using a square mesh net. Based on observations in the NPF, Brewer (CSIRO, *pers. comm.*) indicated that square mesh panels may achieve a 50% escape rate of seasnakes.

There is no verified information on current BRD usage by the ECTF fleet. Two data sources have been examined by the QFS. The first is reported BRD usage in the trawl logbooks in 2001 (Table 22) and the second is the result of a voluntary survey by the QFS in early 2002 (Table 23).

Table 22: BRD usage reported in trawl logbooks by the ECTF fleet in 2001
[Data Source: Trawl Logbooks.]

BRD Type	Vessels in 2001	% of Vessels	Ranking
Bigeye	33	5%	5
Fisheye	69	11%	3
Radial Escape Section	2	0%	6

BRD Type	Vessels in 2001	% of Vessels	Ranking
Square Mesh Codend	58	9%	4
Square Mesh Panel	277	46%	1
Others	180	29%	2
Total	619	100%	

Note: The logbook data indicate a higher level of BRD usage than there were operators in the ECTF at the time (about 550). This is because some operators reported using more than one BRD.

Table 23: BRD usage reported in a QFS survey by the ECTF fleet in 2002
[Data Source: Voluntary Survey by QFS.]

BRD Type	% of Vessels	Ranking
Bigeye	25%	2
Fisheye	10%	4
Radial Escape Section	8%	5
Square Mesh Codend	5%	6
Square Mesh Panel	28%	1
Others	24%	3
Total	100%	NA

Note: The above is based on 88 responses received (of a possible 550), which represents only 16% of the fleet.

There is a considerable difference in reported BRD usage between the two data sources. However, it is not clear to what degree this is a reflection of changing preferences in BRD design or a reflection of sampling bias. It is noted that the popularity of the Bigeye (as reported in the survey) appears to accord with field observations by researchers (Courtney, *pers. comm.*). Also, about one quarter of the fleet reported the usage of devices not specified in the Trawl Plan.

Recommendation 26

- *That the further development of BRD technology be encouraged and that performance standards, which can be applied in the performance assessment of BRDs, be developed by a group of technical experts.*

6.2.3 Hoppers

Hoppers can assist in enhancing the survival of bycatch once landed on board the vessel and are most useful for species that do not suffer damage (i.e. barometric trauma) to their swim bladders as a result of being hauled from deep waters. They have been found to work well for shallow inshore fisheries where trawl shots are of short duration.

Many operators in the NPF have adopted hoppers voluntarily because they increase significantly the value of the commercial product and reduce handling time. However, current hopper designs are

suited only for larger trawlers and many of the smaller ECTF vessels would not be able to carry such devices. An FRDC-funded project (No. 2001/098), entitled “*Evaluation of ‘hoppers’ for reduction on bycatch mortality in the Queensland East Coast Trawl Fishery*” by Gribble (QDPI, AFFS), has begun into the feasibility of adapting hopper technology for the banana prawn sector of the ECTF. The emphasis is on modifying the design of hoppers to make them more suitable for small boats. The results from this study are expected in mid-2003.

There are questions about the usefulness of hoppers in reducing bycatch mortality. Observations by researchers in the field (Brewer (CSIRO) and Dr Gribble (QDPI, AFFS) *pers. comm.*) suggest that long-term mortality may be high for several of the less robust fish because of scale damage incurred during trawling. However, these observations are yet to be supported empirically.

Recommendation 27

➤ *That the development and adoption of hopper technology be encouraged.*

6.2.4 Other Measures

Several gear provisions under the Trawl Plan potentially reduce bycatch. For example, restrictions on the length of the sweeps that may be used on a trawl net can reduce the amount of fish bycatch. “Sweeps” refers to the trawl wire connecting the wings of the trawl net with the otter boards (see Figure 4). The vibration of these wires, as the net is dragged along the bottom, has a herding effect upon fish. In the area of the GBR Marine Park, sweep length is restricted to less than 10 m.

Limits apply to the number and size of ground and tickler chains that may be used during trawling. Operators are restricted to using only one of each chain type. Furthermore, the diameter in the links of the ground chain may not exceed 12 mm in the deepwater fishery and 10 mm in other waters. The diameter of the tickler chain must not exceed 6 mm if a ground chain is used or 10mm if the tickler chain is suspended below the bottom rope. The use of weights or attachments on the ground and tickler chains is prohibited. It is believed that these gear restrictions reduce the impact of the trawl gear on the benthic habitat, but this has not been quantified.

A further measure involves restricting the use of covering nets (or “skirts”). These are used to protect the codend from chaffing and damage due to shark attacks. However, the presence of a covering net can impede escape of bycatch. Provisions within the Trawl Plan restrict the use of a covering on the codend (i.e. within 150 rows of mesh from the drawstring).

In addition to these legislative measures to reduce bycatch, some sectors of the industry have adopted a voluntary code of conduct to reduce bycatch in the inshore fishery. For example, a voluntary ban on the use of large vessels and the length of time that may be trawled has been adopted for the Cairns region. These measures are designed to reduce the wash-up of dead fish on major tourist beaches. While these bans are voluntary (and therefore cannot be enforced legally), they represent positive steps towards the reduction of bycatch.

6.3 Future Research, Monitoring and Assessment Needs

As has been described earlier in this section, there is little information on the biological and population characteristics of ECTF bycatch and its vulnerability to benthic trawling. Detailed research has been undertaken only in the Far Northern Section of the GBR Marine Park and it would be misleading to extrapolate these findings to other parts of the Marine Park.

There is a need for further research in the remainder of the Marine Park and a better understanding is required of how bycatch species and benthic communities are affected by trawling. The planned

collaborative study on bycatch and benthos mapping should assist greatly in addressing these shortfalls.

Until these research results become available, bycatch in the ECTF needs to be assessed and managed in a risk adverse manner. The current situation of little or no monitoring and assessment needs to be improved.

6.3.1 Risk Assessment of Bycatch Vulnerability to Trawling

It would not be possible to conduct a full stock assessment on all ECTF bycatch species, since over a thousand species are taken. Most of these are taken rarely and there is insufficient knowledge about them and the historical trawl effort applied to estimate the impact of trawling. However, ecologically sustainable management of fisheries resources requires that an ecosystem is managed in its entirety and that bycatch species are not threatened by the fishing activity.

Consequently, a risk assessment needs to be conducted on the vulnerability of bycatch species in the ECTF. Several approaches may be adopted in carrying out such a risk assessment. For example, Western Australia (WA) Fisheries has provided assessment reports on its wild capture fisheries to EA for WTO consideration. WA Fisheries used the component tree analysis developed by the Standing Committee on Fisheries and Aquaculture (SCFA) to detail the risks and management responses for each of the issues identified for the fishery (Chessan and Clayton, 1992).

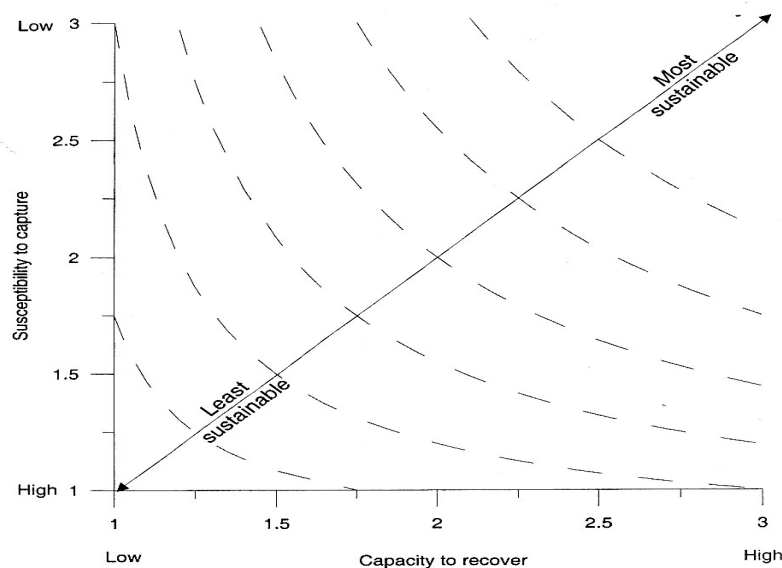
An approach developed for the NPF (Stobutzki *et al.*, 2001) can be applied to the ECTF. Despite the limitations discussed below, this approach offers a useful method of classifying bycatch information as it becomes available. The first stage in managing bycatch is to identify bycatch species and determine any temporal and spatial variations in distribution. Based on an IUCN system of classification for endangered species, Stobutzki *et al.* developed a matrix for the classification of bycatch in the NPF. Some 400 species were examined in terms of their “susceptibility to capture” and their “ability to recover” from the effects of trawling. Factors which were considered in determining a species’ susceptibility included position in the water column, preferred habitat, survival, range, day/night catchability, diet and depth range. Factors considered in determining capacity to recover included the probability of breeding, maximum size, removal rate, reproductive strategy, hermaphroditism and mortality index⁴⁹. An overall score was given to each species according to these two main sets of criteria and the outcome was presented in the form of a two-dimensional graph (Figure 17).

Those species that appeared in the bottom left hand side of the graph were the least sustainable species. They included the Apogonidae (cardinalfish), Arridae, Bathysauridae, Callionymidae (dragonets), Congridae (conger eels), Diodontidae (porcupinefish), Labridae (wrasses), Opsithognathidae (jawfishes), Plotosidae (catfish), Synodontidae (lizardfish) and Tetradontidae (pufferfish). Stobutzki *et al.* found these species to be highly susceptible to capture by trawl, as they were benthic or demersal, their primary habitat was in soft sediment and their diet included prawns.

Species that appeared in the top right hand side of the graph were the most sustainable species. These included the Carangidae (scads and trevallies), Clupeidae (herrings and sardines), Ephippidae (batfish), Scombridae (tunas and mackerels), Sphyrnaeidae (barracudas) and Terapontidae (trumpeters). These species generally were pelagic, their primary habitat was non-trawl grounds and they had a broad distribution in terms of depth and spatial range.

⁴⁹ The mortality index relates to the fishing mortality of the population caught. It is determined by how close the average size of the individuals in the population caught, is to the minimum or maximum size of the species caught in the fishery. The closer the average length of the species caught is to its maximum size in the fishery, the lower the mortality index.

Figure 17: Classification system for quantifying the susceptibility of bycatch species.



Note: The above figure provided courtesy of Dr Stobutzki (former CSIRO) has appeared in several publications, including Stobutzki *et al.* (2001).

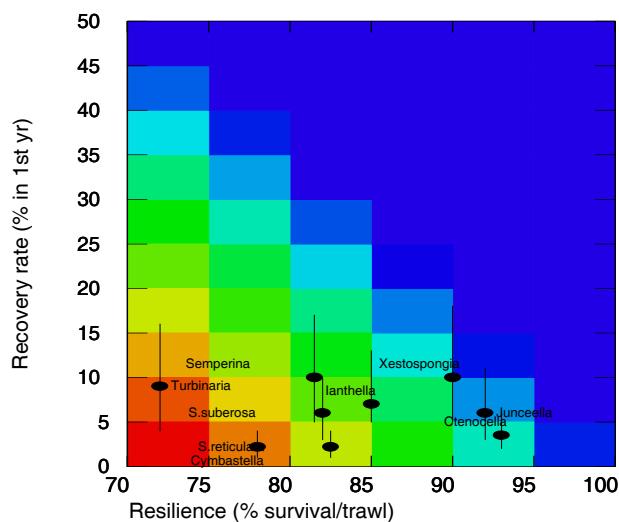
While such a classification is a useful first step in recognising species most at risk, several limitations to this classification approach have been identified. Firstly, the scientific information on the recovery and sustainability of many of the bycatch species is very poor. This forces the assessor to make a judgement on what the “x” or “y” value should be on the graph. Secondly, the approach does not take account of the amount of fishing effort applied to each of these species. As demonstrated by the Far Northern Section study (Poiner *et al.*, 1998), the intensity of trawling has a major impact on the species removed and their recovery. Thirdly, susceptibility to trawl capture is a function of the percentage abundance of the species within trawlable grounds.

Pitcher (CSIRO, *pers. comm.*) is in the process of developing an approach, which builds on the work of Stobutzki *et al.*(2001), but also addresses its limitations. As shown in Figure 18, vulnerability indicators for megabenthos are being developed, which take account of species resilience (expressed as percentage survival after trawl) and ability to recover (expressed as recovery rate in the first year after impact).

Quantitative risks can be calculated for these species using information on their estimated vulnerability, the percentage of the population exposed to trawling and the intensity of trawl effort applied. For example, the red species shown in the bottom left hand corner of the graph would be highly vulnerable to trawling if regularly exposed to it.

Such an approach requires some understanding of species biology and fine-scale information on species distribution and abundance and the area of applied trawl effort. To illustrate the point, a species may be highly vulnerable to trawling, but if 98% of its distribution falls outside trawlable grounds, it would be of little management concern. Conversely, a species may be quite robust in withstanding trawl impacts. However, if 98% of this species is found on heavily trawled grounds, it may need to be monitored closely to assess the impact of trawling on its abundance.

Figure 18: Showing the vulnerability indicators for certain megabenthos in the Far Northern Section of the GBR Marine Park, using a combination of removal and recovery rates.



- Note: 1. The above figure, provided courtesy of Dr Pitcher (CSIRO), will be published in FRDC Project No. 97/205 “Dynamics of large sessile seabed fauna important for structural fisheries habitat and biodiversity of marine ecosystems, and use of these habitats by key finfish species”.
2. The above figure is a draft and has not yet been reviewed. FRDC is awaiting the results of an external review process prior to approving this research for publication.

Given the large number of bycatch species taken in the ECTF, it is not feasible to conduct a quantitative risk assessment on each of them. A more practical approach would be to select indicator species within a risk spectrum (ranging from the most vulnerable species to the most resilient species) and assess these against the known risks (based on their distribution and abundance with respect to trawl effort). Such an approach will provide boundaries within which the ECTF should operate in order to manage the bycatch in an ecologically sustainable manner.

Recommendation 28

- *With a view to developing a risk-assessment for ECTF bycatch species, that there be an expertise-based review of those species and that based on currently available information: (a) the species (or species groupings) taken in the ECTF be identified; and (b) their vulnerability to trawling be assessed, taking into account their known distribution and the amount of fishing effort applied.*

6.3.2 Representative Areas Program

The GBRMPA currently is in the process of preparing a Draft Zoning Plan for the GBR Marine Park, which aims to achieve about 25% protection of all bioregions. Under current Marine Park zoning arrangements, many reefal habitats are well protected from extractive use. However, the same situation does not apply to lagoonal and inter-reefal areas. The creation of additional no-take areas will act as a further safeguard to ensure that the ECTF bycatch species and benthic communities will not be

altered irreversibly by trawling. How much these areas contribute to the recruitment and abundance of species outside the protected areas is the subject of further research

It is recognised that the aggregating behaviour of trawl operations has ensured that some areas remain unaffected by trawling (Pitcher *et al.*, 1997; Poiner *et al.*, 1999; Stobutzki *et al.*, 1997; Pitcher *et al.*, 2000; BurrIDGE *et al.*, 2003). For example, of the area of the fishery open to trawling, only 60% was fished in 2001 (Zeller, 2002). It is believed that the untrawled areas act as refugia for many benthic bycatch species, although the degree to which protection is provided has not been quantified.

6.3.3 Fishery-Independent Monitoring and At-Sea Observer Programs

As mentioned previously, fishers are not required to record in their logbooks any information on bycatch quantities, species composition or survival status. An at-sea observer program would augment the information currently collected opportunistically through applied research on bycatch composition in each of the major sectors of the ECTF. Provided there is a statistically significant level of coverage, such a program could provide useful information over time and may detect changes in bycatch composition, which can be an indicator of changed species abundance. With an extensive coverage of the fleet, the presence of rare species stands a greater chance of detection. However, with very rare species it is unlikely that this would occur at a statistically significant levels and proxy organisms should be monitored instead. An at-sea observer programs would provide an opportunity for verification of logbook information on listed marine species. Low reported catches of sea snakes and syngnathids suggests that this information is not always being provided.

There is an on-going need for regular fishery-independent bycatch monitoring to quantify the impact of the ECTF over time and to indicate any possible changes in biodiversity. As shown by Stobutzki *et al.* (1997), there are significant spatial and temporal variations in bycatch in the NPF and TSPF. A similar situation undoubtedly applies in the ECTF. Consequently, fishery-independent survey designs need to be stratified, taking account of these variations, to reduce variance in catch estimates and increase the ability of the survey to detect changes in catch rates of bycatch.

6.3.4 Continued Research into Gear Technology

Further research and development need to be done on bycatch mitigation devices. Knowledge of the performance of BRDs still is limited. There needs to be a program of continued development and testing of new and existing BRDs. It is likely that, in future, the use of several BRDs will provide the optimum bycatch exclusion. To date, the performance of only a few devices has been tested scientifically.

In developing a process for the continued testing of BRD technology, standards will need to be set about the acceptable levels of bycatch exclusion that would warrant a new device being included on the recognised BRD list under the plan. Also, it is important that the gear is tested in situations that simulate commercial fishing operations without sacrificing the scientific integrity of the investigations.

6.3.5 Regular Bycatch Assessments

There is a fair amount of information available on bycatch in tropical penaeid fisheries and the effects of mitigation devices. There is also some ECTF-specific information, which will increase over time as the results of further research and monitoring work become available. It is important to bring all relevant information together from time to time in an appropriate forum (such as a workshop) to discuss what is known, analyse available data and identify future monitoring and research needs for bycatch. Such workshops would be ideal fora for reviewing the status of mitigation technology.

It is important that an assessment process firstly addresses how bycatch is measured in the ECTF. For example, a mixture of performance indicators has been specified in the literature, ranging from product : bycatch ratios (by weight or number), total amount (by weight or number) to catch rates (kg/hr or kg/area swept). It is important that the relative advantages and disadvantages of each indicator are discussed and that appropriate indicators are agreed upon to detect future changes in the bycatch profile. Equally important is the need to estimate the precision of the bycatch assessment.

Once it is determined how bycatch is to be measured, there needs to be agreement on the appropriate reference points for bycatch management and the scientific basis for selecting these particular reference points. The Trawl Plan currently specifies a target of a 40% reduction in bycatch and a 25% reduction in benthos. These figures are neither defined nor justified. While benthic and bycatch performance indicators are discussed further in Section 7, it is noted that bycatch reduction targets should arise from fishery assessment considerations and that the assessment process should also evaluate how well the fishery meets these targets.

6.4 The Audit Report's Assessment against the Commonwealth Guidelines

With respect to Principle 2

It is difficult to comment on the impact of trawling on threatened species, biological communities and the ecosystem in a quantitative manner, because there is insufficient knowledge about the impact of trawling and about the biology of many of the affected (and frequently rare) species.

There has been progress in adopting mitigation devices in the ECTF to reduce the amount of bycatch taken. However, this progress has been slow compared with other Australian prawn trawl fisheries (e.g. the NPF and New South Wales). Bycatch data are now being collected for the major sectors of the ECTF, through the "BRD Evaluation Study" (Courtney et al., FRDC Project No. 2000/170). While this is a major improvement, more reliable information needs to be collected on BRD usage by operators in order to assess their effectiveness on a fleet-wide basis.

It is noted that there are no threatened biological communities nominated under EPBC legislation in the ECTF. However, there are three groups of species that appear as "Listed Marine Species" under Section 248 of the Act. Of these, the marine turtles are most in danger of extinction, with a conservation status generally of "vulnerable" or "endangered" under domestic and international listings. There are also concerns about the sustainability of sea snakes (50% of which are endemic to Australia) and seahorses, sea-dragons and pipefish (which are threatened by over-exploitation in other parts of the world). Whilst not yet formalised, saw sharks were nominated recently as "endangered" and an international action plan applies to their management and conservation.

In terms of mitigating the impact of trawling on these listed species, the introduction of TEDs would have reduced the trawl mortality of marine turtles. Almost 100% exclusion can be achieved if the devices meet the minimum design standards and are installed correctly. Also, TEDs have reduced significantly the bycatch of sharks and rays. With respect to sea snakes, BRD trials in the NPF indicate that square-mesh netting enhances their ability to escape. Significant bycatch reductions also were observed with the use of square mesh panels and square mesh cod ends, which are devices commonly used in the ECTF according to logbook information.

With respect to Guideline 2.1.2

With the exception of the banana prawn fishery, there has been no formal or structured risk analysis of bycatch with respect to its vulnerability to trawling. The research undertaken by Stobutzki *et al.* (1997) in quantifying the susceptibility of bycatch species to trawling has been a useful first step in trying to quantify relative risk in bycatch management. This should be extended to the other major sectors of the ECTF, where sufficient information is known about bycatch composition, to inform

managers about which bycatch species need close monitoring for changes in abundance and biodiversity.

The work currently being done by Pitcher *et al.* (FRDC Project 1997/205) paves the way for a more comprehensive risk analysis. However, an extension of the information base is required to make this assessment framework more precise. Fine-scale resolution of trawl effort (through VMS records) is essential to determine the precise location and frequency of trawl operations. The collection of information on the biophysical habitat of the ECTF also needs to be continued. It is anticipated that the planned study on bycatch and benthos mapping will assist greatly in this regard.

With respect to Guideline 2.2.2

In the past, there has been inadequate monitoring of the impact of the ECTF on endangered, threatened or protected species on a fishery-wide basis. Logbooks for the recording of interactions with species of special conservation interest were introduced only in early 2003. While the EPBC Act places the onus for such reporting on individual operators, the impact of the fishery on all species (included those listed under environmental legislation) needs to be part of the regular fishery assessment process.

However, two intrinsic problems are associated with the use of such logbook data. Firstly, they are fishery dependent and thus do not provide an overview of species abundance in areas not trawled. Secondly, they are unverified in terms of accuracy. To overcome this, fishery-independent surveys are required, together with at-sea observer programs aboard the commercial trawl fleet. Information collected from these sources should be analysed regularly at a workshop or in some other formal assessment process. Advantages could be gained by collaborating with bycatch specialists engaged in other tropical penaeid fisheries.

Based on the work by Robins (1995), research information is available on the historical interaction of the ECTFC fleet with marine turtles. However, with the requirement for the use of TEDs in all parts of the fishery under the revised Trawl Plan and the fishery restructure in the early 2001, these data (while very valuable) are of limited application in the current fishery.

With respect to Guideline 2.2.3

This guideline is not applicable in the ECTF because there are no formally-listed, threatened, ecological communities.

With respect to Guideline 2.3.2

A significant start in addressing the question of the benthic impacts of trawling, and its wider ecological flow-on effects, has been made with the initial five-year study on the “Environmental Effects of Prawn Trawling in the Far Northern Section of the Great Barrier Reef Marine Park: 1991 – 1996” and the subsequent study to monitor recovery. This has enabled the biophysical mapping of the lagoonal and inter-reefal seabed and provided the first quantitative assessments of the impact of trawling.

However, given the changes in bycatch with increasing latitude, inferences cannot be drawn from the Far Northern Section results to other parts of the fishery. For example, the community structure in the southern part of the GBR Marine Park (which supports a scallop fishery) is quite different to the northern part (which supports a tiger/endeavour prawn fishery). The difference in the configuration of the trawl gear also affects its benthic impact.

It is acknowledged that the gathering of such benthic impact information is costly and needs to be conducted over long periods to detect benthic community changes. However, in order to obtain a comprehensive picture, research similar to that conducted in the north of the fishery is required for the remainder of the fishery. Again, it is stressed that the planned study on mapping bycatch and seabed benthos will prove invaluable in this regard.

With respect to Guidelines 2.2.4 and 2.2.5

The adequacies of existing arrangements in the ECTF for managing environmental impact are discussed in detail in Sections 7.3.6. Mitigation devices, which can reduce the impact of trawling, have been developed. Refinement of this technology needs to be ongoing and tested scientifically. Management arrangements need to reflect such progress in terms of how the mitigation devices are prescribed under legislation.

7. Management Arrangements in the East Coast Trawl Fishery

The Commonwealth “**Guidelines for the Ecologically Sustainable Management of Fisheries**” require that:

1. in order to ensure and assess the adequacy of management responses with respect to target and by-product species, that:
 - “*there are reference points (target and/or limit), that trigger management actions including a biological bottom line and/or catch or effort upper limit beyond which stock should not be taken*” [**Guideline 1.1.6**];
 - “*there are management strategies in place capable of controlling the level of take*” [**Guideline 1.1.7**];
 - “*fishing is conducted in a manner that does not threaten stocks of by-product species*” [**Guideline 1.1.8**]; and
 - “*the management responses, considering uncertainties in the assessment and precautionary management actions, has [sic] a high chance of achieving the (Commonwealth Guideline) objective*” [**Guideline 1.1.9**];
2. in order to assess and ensure the adequacy of management responses with respect to the impact of the fishery on the environment, bycatch species and ecologically related communities, that:
 - “*measures are in place to avoid capture and mortality of bycatch species unless it is determined that the level of catch is sustainable (except in relation to endangered, threatened or protected species). Steps must be taken to develop suitable technology if none is available*” [**Guideline 2.1.3**];
 - “*an indicator group of bycatch species is monitored*” [**Guideline 2.1.4**] and “*there are decision rules that trigger additional management measures when there are significant perturbations in the indicator species numbers*” [**Guideline 2.1.5**];
 - “*the management response, considering uncertainties in the assessment and precautionary management actions, has a high chance of achieving Objective 1 of Principle 2*” [**Guideline 2.1.6**].
3. in order to address overfishing of stocks below ecologically viable levels, that:
 - “*a precautionary recovery strategy is in place specifying management actions, or staged management responses, which are linked to reference points. The recovery strategy should apply until the stock recovers, and should aim for recovery within a specific time period appropriate to the biology of the stock*”; [**Guideline 1.2.1**]; and
 - “*if the stock is estimated as being at or below the biological and / or effort bottom line, management responses such as a zero targeted catch, temporary fishery closure or a ‘whole of fishery’ effort or quota reduction are implemented*” [**Guideline 1.2.2**].
4. in order to conduct the fishery in a manner which is consistent with Objectives 2 and 3 of Principle 2, that:

- “the management response, considering uncertainties in the assessment and precautionary management actions, has a high chance of achieving the objective”; [Guideline 2.2.6];
- “management actions are in place to ensure significant damage to ecosystems does not arise from the impacts described in 2.3.1”; [Guideline 2.3.4]; and
- “there are decision rules that trigger further management responses when monitoring detects impacts on selected ecosystem indicators beyond a predetermined level, or where action is indicated by application of the precautionary approach”; [Guideline 2.3.5].

Following amendment to the Trawl Plan in late 2000 and the removal of nearly 16% of effort through a structural adjustment scheme and an across-the-board industry effort reduction, management arrangements in the ECTF improved significantly⁵⁰. The reduction of fishing effort and the introduction of effort units has capped effort in the fishery, at least nominally. The implementation of a VMS has enabled closer monitoring of the fleet’s activity, which has major compliance benefits and may assist with stock assessment in the longer term through better temporal and spatial analysis of catch and effort data. An additional 96,000 square kilometres of the GBRMP, where trawling had not occurred previously, were closed to trawling under the revised Trawl Plan.

The ECTF essentially is managed under an input control regime, which means that the amount of fishing effort (rather than the catch) is limited on an annual basis. This management approach is common in prawn fisheries world-wide, because it is difficult to predict the strength of annual recruitment (and hence the likely abundance of trawlable adults) with any degree of accuracy⁵¹. Also, the ECTF is a multi-species fishery. Catch restrictions applicable to one species are unlikely to be appropriate for other species. Under an input-controlled management system, high grading and discarding of commercial by-product is not as big a problem as in many multi-species quota fisheries, because operators generally retain their lesser-value catch.

7.1 General Comments about the Legislated Management Objectives of the Trawl Plan

The management objectives for the ECTF are subject to the overarching fisheries management objectives contained in the *Queensland Fisheries Act 1994*, which aim for the ecologically sustainable use of fisheries resources, optimum community, economic and other benefits from these resources and fair resource access. The specific objectives for the fishery, which expand on the objectives of the Act, are detailed in Part 2 and Schedule 2 of the Trawl Plan (see Appendix 3).

This section provides a brief consideration of the legislated management objectives of the Trawl Plan, the processes to achieve these objectives, measurements of how well they have been achieved, and review events, which are triggered if certain points are reached. Table 2 accompanying the Executive Summary lists the Schedule 2 provisions and comments on how well the Trawl Plan has performed against each provision. Section 7.2 provides specific comments about these objectives. In particular, it examines the adequacy of the biological, environmental and fishery performance indicators and the review events currently listed in the Trawl Plan.

⁵⁰ Details of the Trawl Plan negotiations and key events in the recent history of the ECTF are provided in Appendix 4.

⁵¹ For some prawn fisheries which show distinct periods of spawning, pre-recruit surveys can give an indication of the strength of the cohort about to enter the fishery.

7.1.1 Specific Management Objectives

Schedule 2 of the Trawl Plan explicitly mentions the “ecological sustainability” of the ECTF and the “sustainability of the fishery’s ecological systems” in three of its five objectives, (viz. objectives (b), (c) and (d). Ecological sustainability is implied also in objectives (a) and (e), which respectively state that a “sustainable community benefit” is to be derived from the resource and that there is to be a “sustainable basis” for fisheries access. The economic aims for the fishery are specified in objectives (a), (d) and (e) and refer to “community benefit” and “economic viability”.

It is noted that the Trawl Plan does not state that ecological sustainability should take precedence over the attainment of economic objectives, if ecological sustainability is threatened. It is recognised that fisheries managers must balance the various legislative objectives when dealing with uncertain data and, in particular, the need for caution must be weighed against the economic impacts. However, there are numerous examples world-wide and within Australia, which demonstrate that economic considerations frequently delay remedial action in response to threats to fisheries resources. It is only when issues become critical (often too late), that ecological sustainability takes precedence. Of even greater concern in a multi-species fishery like the ECTF is the fact that some species will be considerably less resilient to trawling than others, and overfishing of some species may be considered to be of relatively little significance when compared with the value of the catches obtained from the more resilient species.

The objectives of the Act and Trawl Plan broadly are consistent with the Commonwealth Guidelines for the Ecologically Sustainable Management of Fisheries and accord with sound fisheries management principles. The way in which these objectives are interpreted and made operational is apparent from the plan’s provisions on “how (the) objective is to be achieved” and “how achievement is to be measured”. It is clear from these provisions, that the Management Plan takes a narrow definition of the fishery and focuses primarily on the economics and sustainability of the principal (i.e. target) species. Although implied in the objectives and addressed in certain review events, there is no “explicitly stated” focus on the fishery’s by-product and bycatch resources or the benthic communities impacted by trawling.

Recommendation 29

- *That there be a review of the objectives of the Trawl Plan, with a view to ensuring the ecological sustainability of all ECTF species, maintaining biodiversity and incorporating the principles of ESD (including the adoption of the precautionary principle).*

7.1.2 Achievement of Objectives

The measures listed in Schedule 2 for achieving the objectives of the Trawl Plan are broad and refer to the input-based management tools available under the plan. Section 7.3 provides an evaluation of these tools. However, the availability of management tools does not necessarily imply action. For example, a range of measures (such as area closures, gear and effort restrictions) is cited as possible means to achieve the ecological sustainability of the ECTF (i.e. objective (b)). However, the plan is silent on when these measures would be used or the process that would be adopted in applying those measures. In other words, there are no pre-agreed management actions that would be adopted if there was an imminent risk of the objective not being met and the ecological sustainability of one or more species was threatened.

Managers frequently argue that such a situation should be assessed and appropriate management action should be taken if (and when) the need arises. They state that “flexibility” is required in dealing with a dynamic fishery and that specified action should not be prescribed under legislation. It is agreed that legally-prescribed action can be limiting. However, having no pre-agreed and publicly-stated actions (even in the form of a policy statement) frequently results in lengthy delays in introducing

appropriate management measures because of the protracted consultative processes associated with revised management arrangements. Such delays generally are to the detriment of the resource.

As has been demonstrated in fisheries world-wide, the chances of managing fisheries sustainably are optimised if there are clear and predetermined decision rules on what measures will be applied if stock concerns arise. The effectiveness of such decision rules can be tested using a formal Management Strategy Evaluation (MSE) approach, which is based on exhaustive computer simulation that explores the various likely outcomes from the application of the decision rules and determine the probability that the objectives are likely to be achieved through their application.

Furthermore, the ECTF is a multi-species fishery, which discards its bycatch and, sometimes, its by-product species. The decision rules need to specify the action that is to be applied when the stock abundance of each of the various species decreases to a specified level, and it may need to specify also the action that is to be applied when the species composition of the catch or the bycatch changes beyond a specific point. Currently the concern for multi-species fisheries is that their management is likely to be inadequate if single-species stock assessments and management rules are used. A holistic management strategy is required that takes the technological and biological interactions in a multi-species fishery into consideration.

Recommendation 30

- *That, as the fishery assessment process is improved, there be an expert-based review of the management measures that can be applied in situations where there is a decline in the ECTF's performance below prescribed levels and that the decision rules for such action be tested using a MSE approach.*

7.1.3 Performance Measures

Schedule 2 of the Trawl Plan contains performance measures that prescribe how the achievement of the plan's objectives is measured. These measures generally refer to data sources such as logbooks, surveys and studies. If the QFS' Chief Executive accepts these findings, they provide a measure of how well the management objectives are being met. There are several limitations with respect to these performance measures.

Firstly, the plan refers to the Chief Executive's powers to commission scientific studies and surveys that examine the fishery's performance. The plan does not specify any processes that need to be followed in commissioning such work, any terms of reference, the competence of the parties undertaking research, the timeframe within which this should occur or the basis on which the Chief Executive may accept or reject the findings. Whilst a prescribed process may be seen as fettering the Chief Executive's administrative powers, nevertheless it would increase the transparency of the management process and provide clear guidance on the legislative background against which policy decisions are framed.

Secondly, the studies and surveys commissioned generally are investigations about the economic performance of the fishery, the allocation and use of effort units and the sustainability of the target species. With respect to the sustainability assessments, it is noted that data on the abundance of the various non-target and bycatch species do not exist. In the absence of this information, it is questioned how the impact of trawling on these species, or on the community structure of the ecosystem, can be identified. The ability to compare the variables against specific reference points or to develop assessment models is not possible if data are not collected.

Thirdly, it is of concern that the collection of catch and effort data is seen as an appropriate information source against which to measure the ecological performance of the fishery. As has been demonstrated in Section 5.2 and is discussed further in Section 7.2, non-standardised nominal CPUE can be a misleading performance indicator, especially if used for non-target or aggregating species.

Especially within the development of stock assessment models, any review of the biological status of the ETCF should not rely entirely on reported CPUE trends. It is noted that the evaluation of the accuracy and precision of such fishery-dependent data requires that the processes that are used for the collection, validation and analysis of these data should be stated explicitly. The impact of changes to these methods should also be carefully assessed to determine whether the consistency of the time series has been affected.

Recommendation 31

- *That, as the fishery assessment process is improved, there be an expert-based review of the performance measures specified in the Trawl Plan.*

7.1.4 Review Events and Performance Indicators

Schedule 2 of the Trawl Plan specifies several review events for the ECTF, which may be triggered if a certain pre-agreed performance measure is reached. It includes a suite of biological, ecological and fisheries performance-based review events. The incorporation of such review events in a Management Plan is an important first step in adopting a more precautionary management approach. Section 7.2 provides a detailed appraisal of the review events and the appropriateness of their associated performance indicators. This section presents a broad overview of the issues of major concern.

The management action (if any) that will follow when a review event is triggered is not specified in the Trawl Plan or through appropriate policy statements by the QFS. This lack of commitment to introduce more stringent management measures immediately and in a prescribed manner is of concern. Section 7.2 describes how review events have been triggered previously, with no management action being taken to date.

Once a review event is triggered, one of the difficulties in responding lies in the ambiguity of the wording of the current legislation. There is considerable flexibility in the interpretation of the current performance measures, which would lead to a review event being triggered. To date, the focus of discussions at the scientific and MAC level has been more on how to interpret the performance indicators and less on the type of management action that would follow if a resource concern is triggered or on more appropriate performance indicators.

The limitations of the current review events have been recognised by the QFS and a review of the performance indicators and associated review events has begun. Through the MAC process, two expert-based workshops were held in mid-2002 and early 2003 to interpret and improve the biological and ecological performance indicators respectively. This review process is on-going and it is anticipated that recommendations for improvements will be made by the end of 2003. There is a need to introduce better-defined and more precautionary performance indicators. It is recommended that these revised performance indicators should be used to assess the future status of the ECTF, in particular for the major ecological assessment of the ECTF before 1 January 2004 (as specified in the Trawl Plan)⁵². However, it is recognised that this requires amendment to the Trawl Plan.

As performance indicators become a more commonly used tool to gauge the performance of a fishery against its stated management objectives, many fisheries management agencies are adopting a tiered approach. Two types of reference points may be set for a fishery. A “target reference point” (TRP) represents the desirable status of the fishery. This is mostly the achievement of maximum economic yield in combination with ecological sustainability of the resources. A “limit reference point” (LRP) should not be exceeded, if sustainability is to be ensured. Typically, this may take the form of a

⁵² The “before 2004, the chief executive must review the Trawl Plan before 2004 to decide whether fishing effort in the fishery is ecologically sustainable” (Part 2, Division 1, Provision 227).

percentage of a biomass that may be harvested before there is a significant risk that recruitment overfishing is likely to occur.

The TRP should always be set at a more conservative level than the LRP, as the LRP refers to the “biological bottom line”. The Audit Report warns against making both equivalent, as this increases the likelihood of the LRP being exceeded. In other words, the TRP should be set sufficiently conservatively, so that the risk of exceeding the LRP does not exceed a specified probability (say a 5% risk). In the case of the ECTF, only one type of reference point is specified in the Trawl Plan and it is not stated explicitly if this refers to a TRP or LRP.

Recommendation 32

- *That the current review of performance indicators and review events be completed by the end of 2003 and that amendments be made to the Trawl Plan by early 2004 (incorporating the recommendations of the review) and that these revised performance indicators be used in assessing the status of the ECTF by the end of 2004.*

7.2 Specific Comments about the Legislated Review Events and Performance Indicators of the Trawl Plan

Section 7.1.4 outlined some of the generic problems with the current review events and performance indicators of the Trawl Plan. To assist with the proposed review, this section provides some specific comments about the adequacy of the current biological, ecological, enforcement and fisheries performance review events.

7.2.1 Biological Review Events and Performance Indicators

There are several biological review events, which relate to resource sustainability, contained in Schedule 2 of the Trawl Plan. However, these review events relate to the sustainability of the principal (i.e. target) species only. There are several inadequacies with the current biological review events and performance indicators. The QFS and Trawl MAC have acknowledged these. A review has begun, based on the available stock information, to identify suitable alternatives.

7.2.1.1 Specific Biological Review Events and Performance Indicators

This type of review event sets a reference point based on the average historical CPUE for a given species and states that this point must not be exceeded by a certain margin. With respect to greasy back prawns⁵³, eastern king prawns, bugs, red spot king prawns, saucer scallops and tiger prawns the review events⁵⁴ in the Trawl Plan state that the “*CPUE for the following principal fish in the following periods is less than 70% of the average CPUE for principal fish from 1988 to 1997*”. The review event lists specific periods (as detailed in Table 24) for each of the categories of principal fish for which the review applies.

Table 24: Review Events for principal species specified in the Trawl Plan

Common Name	Species	Review Period
Tiger Prawns	<i>Penaeus esculentus</i> <i>Penaeus semisulcatus</i> <i>Penaeus monodon</i>	➤ 1 March to 30 June; and ➤ 1 September to 31 December

⁵³ The Trawl Plan refers to “greasyback prawns” as “greasy prawns”, which are a component of the “bay prawn” mix of species.

⁵⁴ Review events under objective (b) under Schedule 2 of the Trawl Plan.

Common Name	Species	Review Period
Endeavour Prawns	<i>Metapenaeus endeavouri</i> <i>Metapenaeus ensis</i>	➤ Review Event not specified
Red Spot King Prawn	<i>Penaeus longistylus</i>	➤ 1 June to 30 September
Blue-legged King Prawn	<i>Penaeus latisculatus</i>	➤ Review Event not specified
Banana Prawns	<i>Penaeus merguensis</i>	➤ Review Event not specified
Saucer Scallops	<i>Amusium japonicum</i> <i>balloti</i>	➤ 1 November to end February
Mud Scallops	<i>Amusium pleuronectes</i>	➤ Review Event not specified
Eastern King Prawn	<i>Penaeus plebejus</i>	➤ 1 November to end February; and ➤ 1 May to 31 August
Bay Prawns (Greasybacks)	<i>Metapenaeus bennettiae</i>	➤ 1 November to end February
Bugs	<i>Thenus</i> spp <i>Ibacus</i> spp <i>Scyllaroides</i> spp	➤ 1 November to end February; or ➤ 1 May to 31 October
Squid	<i>Photololigo</i> spp <i>Sepioteuthis lessoniana</i> Other species	➤ Review Event not specified

Note: A review event has been specified if the (nominal) CPUE drops below “70% of the average CPUE for principal fish from 1988 to 1997” for the specified period.

Several principal species are not covered by prescribed review events. These include species abundant in the GBR Marine Park, such as endeavour prawns, blue-legged king prawns, banana prawns and mud scallops. Importantly, there are no review events for the 50-odd species of permitted (i.e. by-product) species taken in the fishery. Also, it is noted that of the species with a prescribed review event, “tiger prawns” and “bugs” each represent a species group. As outlined in Section 5.2, the treatment of a species group as a single species can mask the decline in any one of the species in the group and, consequently, the CPUE may not be a good indicator of stock abundance.

Specific reference points for species sustainability often are selected subjectively. In making this choice, managers are guided by the history of the fishery, experiences in other fisheries and the limited information available on the species biology and ecosystem. Verbal reports from scientists involved in the ECTF assessment process (Mike Dredge, QDPI, AFFS, *pers. comm.*) have suggested that the justification for the “70% average CPUE” performance indicator was based on experiences in the Exmouth Gulf (WA) tiger prawn fishery, which showed recruitment overfishing at this catch rate. However, it is questioned why the WA situation should be applicable in the ECTF, especially with respect to species other than tiger prawns. Furthermore, the WA stock assessment process used standardised CPUE and data derived from research. In contrast, the ECTF assessment process uses nominal CPUE from commercial logbook data.

The working group set up to review the biological reference points considered the limitations of the current assessment models and how these are likely to affect the biological performance indicators and review events. It was acknowledged that the relationship between spawning stock size and subsequent recruitment was poorly understood in the ECTF and that the assessment models may be very sensitive

to this. This is supported by Mace (1994), who found that density dependence in a spawning-recruitment relationship had a strong bearing on the suitability of various biological reference points.

A major difficulty in reporting against the “70% average CPUE” performance indicator lies in its interpretation. The Trawl Plan does not specify how the “average CPUE” is to be calculated. One interpretation is that catch rates of each of the species are averaged over the specified review period and compared against the 70% mark of average CPUE from 1988 to 1997. Under this interpretation, single average figures are compared without any temporal (i.e. seasonal) stratification. Adopting this approach, the QFS reports the outcomes summarised in Table 25.

Table 25: Assessment against biological performance indicators, comparing the average CPUE for specified principal species during the prescribed review period against the 70% historical average for that species (Information Source: ECOTF Status Report - 2001).

Species	CPUE (kg/day)				
	Reference Point 1988 -1997	Review Event Period 1		Review Event Period 2	
		CPUE	% of Ref	CPUE	% of Ref
Bay Prawns	42	45	107%	NA	NA
Eastern King Prawns	67	91	136%	103	154%
Bugs	17	11	63%	14	82%
Bugs (alternate method)	17	12	71%	14	80%
Red Spot King Prawns	46	33	73%		NA
Scallops	50	89	178%		NA
Tiger Prawns	50	62	124%	31	62%

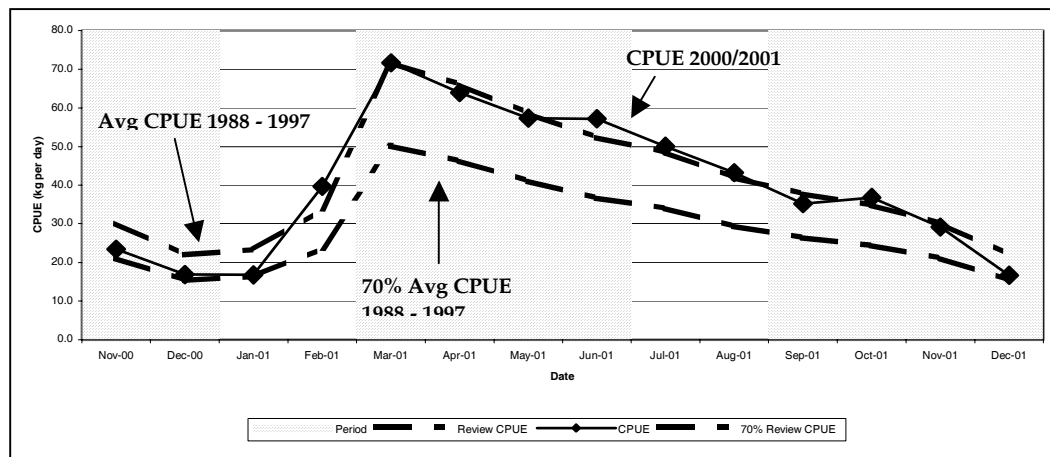
Note: The reference point CPUE is calculated by dividing the total catch by the total effort for the 1988 to 1997 period.

Under this approach, a review event appears to have been triggered for tiger prawns and bugs in 2001, with the CPUE figures for both species groups dropping below the 70% threshold. As discussed previously, this approach has limitations. The SAG considered the interpretation of this performance indicator and agreed that it would be more meaningful to make a seasonal comparison, particularly since the review periods have been based on the “peak catching periods” for each of these species.

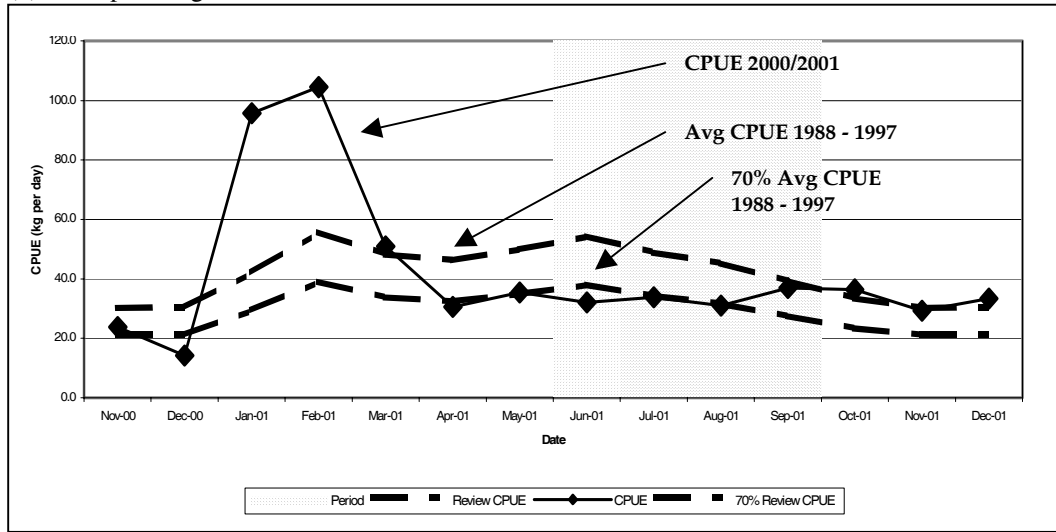
The QFS has carried out another analysis of the performance of the species against the indicator, but made the comparison on a monthly basis (Figure 18). In other words, the monthly CPUE of the review species was compared against the average monthly CPUE for that species between 1988 and 1997 during the review period. The review periods were based on the peak fishing periods.

Figure 19: Assessment of species performance against the biological performance indicator, using seasonal stratification of data (Information Source - ECOTF Status Report - 2001).

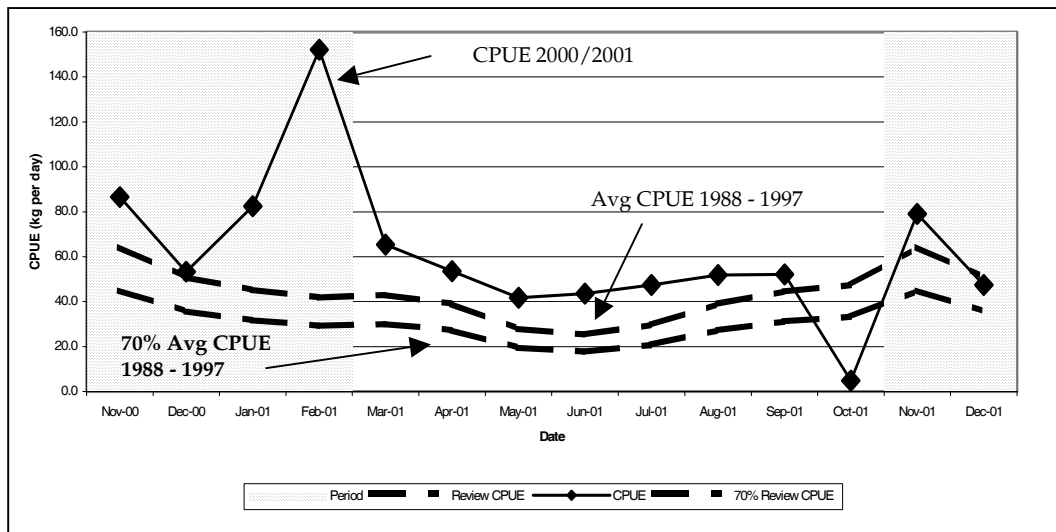
(a) Tiger Prawns



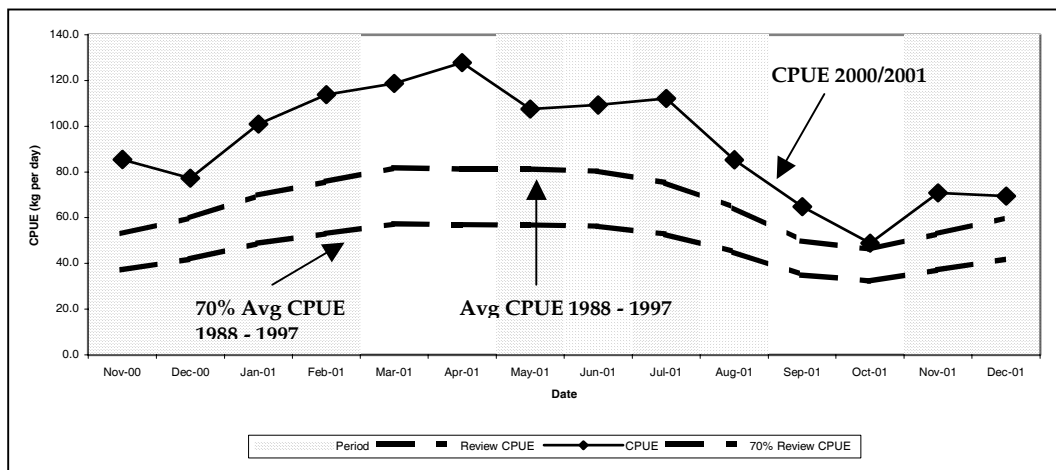
(b) Red Spot King Prawns



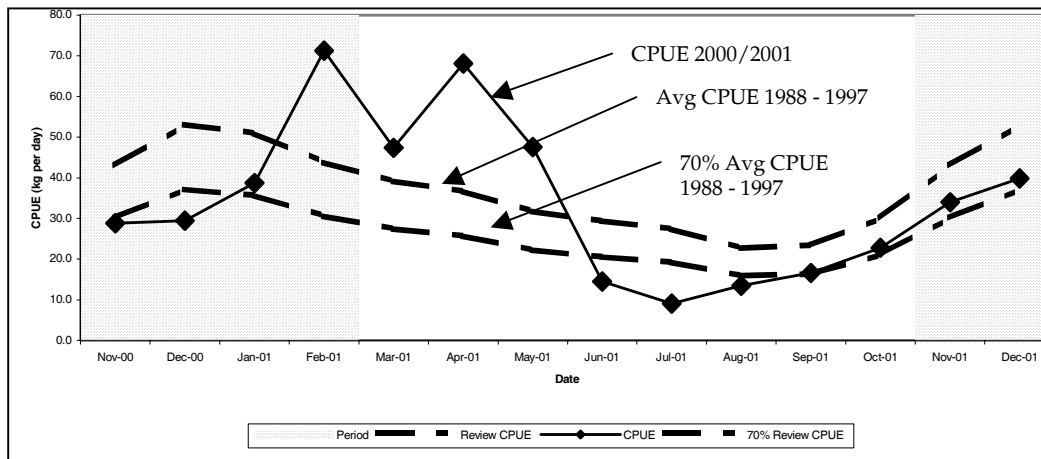
(c) Saucer Scallops



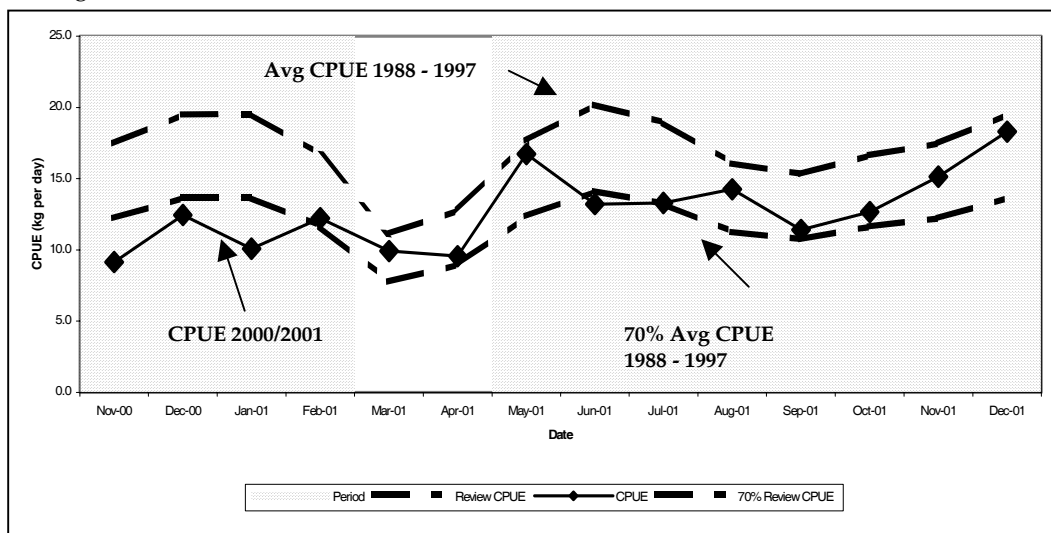
(d) Eastern King Prawns



(e) Bay Prawns



(f) Bugs



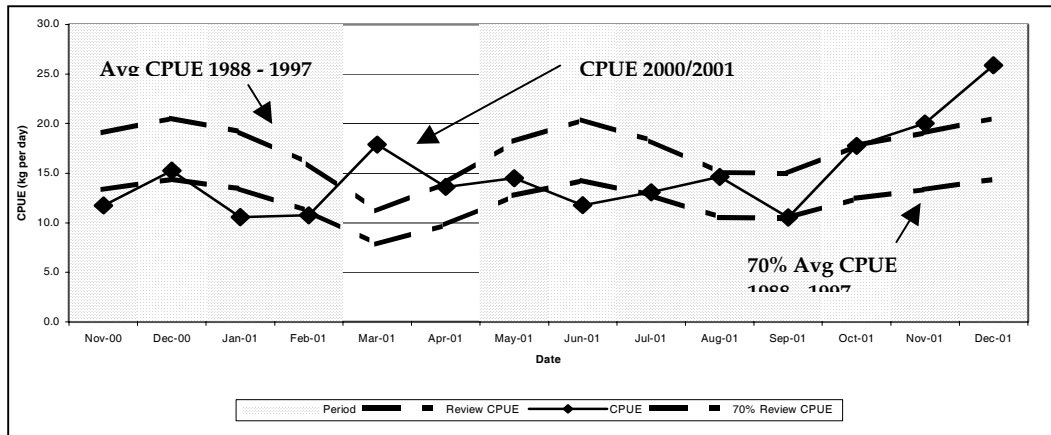
Note: 1 The above graphs were provided courtesy of Wez Norris and appear in the ECOTF Status Report – 2001.

- 2 In the above graphs the average CPUE during the prescribed review period is compared with the historical average for that species for the review period.

By adopting the second interpretation as the basis for comparison, a different picture emerges. The CPUE for tiger prawns no longer falls below the 70% reference line. However, red spot king prawns and bay prawns appear to have triggered a review event because their average CPUE fell below the reference line for one and two month respectively. Bugs are well below the reference line for most months.

The performance of bugs against the legislated performance indicators is of concern. Based on a FRDC-funded study into “*The biological parameters associated with yield optimisation of Moreton Bay Bugs, Thenus spp*” (FRDC Project No. 92/102), the SAG adopted another approach to assessing the performance of bugs against their performance indicator. It was recognised that bugs are prolific only off Townsville and Gladstone, with 50% of the entire catch being derived from those areas. It was agreed to calculate the average CPUE for those two areas only and compare them with the performance indicator. Figure 19 shows the outcome of this analysis.

Figure 20: Assessment of bugs against the biological performance indicator, using seasonal and spatial stratification of data (Information Source - ECOTF Status Report - 2001).



- Note:** 1 The above graph was provided courtesy of Wez Norris and appear in the ECOTF Status Report – 2001.
- 2 In the above graph the average CPUE during the prescribed review period in areas of major abundance (off Townsville and Gladstone) is compared with the historical average for the review period.

The results still show that the CPUE dropped below the 70% reference line, but the overall performance appeared improved. Based on the concerns about the usefulness of CPUE as a performance indicator for species that are taken as bycatch in the ECTF, it is questioned if this legislated performance indicator is appropriate for this species. In light of this, it is unclear if the CPUE trends displayed by bugs in 2001 are an indication of a resource decline.

It is noted that conclusions about the performance of the principal species against specified performance indicators may vary significantly, depending on how the review event is defined and how performance is analysed. Thus, in the pending review of the biological performance indicators for the ECTF, close attention needs to be given to how the future performance indicators are specified. The appropriateness of each review period should be examined with respect to the species life cycle and seasonality

There is little benefit in specifying performance indicators, that managers do not trust to detect early warning signs of a decline. This will result in reanalysis of information (as above) to present a “more positive picture”, so that remedial action is unlikely if a review event is triggered.

7.2.1.2 General Biological Review Events and Performance Indicators

In the Trawl Plan, a second category of biological performance indicators refers to studies or surveys demonstrating a “significant decline in the commercial catch”⁵⁵, “catch effort data”⁵⁶ or “the abundance”⁵⁷ of principal species. No definitions are given of what constitutes “significant” or over what period such declines need to be observed. Also, it is unclear if this refers to each of the principal species or to all principal species.

The reference to commercial catch and the limitation to principal species highlight the Audit Report’s earlier comment that economic priorities appear to outweigh ecological and sustainability priorities.

⁵⁵ Review event (a) under objective (a) and review events (a) and (b) under objective (e) of Schedule 2 of the Trawl Plan.

⁵⁶ Review event (b) under objective (b) of Schedule 2 of the Trawl Plan.

⁵⁷ Review event (b) under objective (a) and review event (c) under objective (b) of Schedule 2 of the Trawl Plan.

There needs to be a broader approach with respect to ensuring that the ecological sustainability of the ECTF is maintained in its entirety. Furthermore, a single-species approach fails to take account of the interactions between species (including by-product and bycatch).

It is noted that commercial catches may decline for a range of reasons, including overfishing, fewer operators in the fishery since the restructure, strong inter-annual variability or changes in targeting behaviour by the fleet. Only the first reason is of resource concern.

As pointed out in Section 5.2, there are major concerns with relying solely on CPUE data as an indicator of resource abundance. There are also too many environmental variables and uncertainties in the data to determine CPUE trends with confidence.

With respect to abundance, it is noted that assessments predicting available biomass (using either appropriate biomass or surplus production models) for any of the principle species are not available publicly. Once the assessment process reaches a point where such estimates can be made, it would be useful to have “abundance” defined (such as the level of recruitment or the biomass of adult spawners).

7.2.2 Ecological Review Events and Performance Indicators

Objective (c) in Schedule 2 of the Trawl Plan specifically relates to the “sustainability of the fishery’s ecological systems”. It contains performance indicators with respect to the impact of trawling on benthos, bycatch, turtles and bottom habitat.

7.2.2.1 Review Event and Performance Indicator for Benthic Impact

A review event is triggered under the Trawl Plan if there is not a 25% reduction in the amount of benthos taken in the ECTF by 1 January 2005. This has to be documented through a scientific study, showing “*levels accepted by the chief executive*”. The starting date for the review period is some unspecified time “*before the notification day*” of the Trawl Plan (i.e. 19 November 1999)⁵⁸.

The plan gives no guidance on how this reduction is defined or calculated. As indicated in the Section 6, there has been no comprehensive study on habitat types and associated seabed life throughout the entire fishery. Apart from the “Effects of Prawn Trawling Study” in the Far North Section of the GBRMP (Poiner *et al.*, 1999), benthic impact data generally have been collected on an opportunistic basis. Furthermore, historical information on the spatial distribution of the fishery was reported at a broad scale (30’x30’ grids) until early 2000.

Undoubtedly, the reduction of fleet activity (brought about by the industry restructure and reduction in the number of fishing platforms) would have had an impact on the amount of benthos taken. However, without comprehensive and spatially structured “before and after” data, it is impossible to quantify this reduction with any degree of certainty. Some major assumptions would need to be made about the areas fished, the gear used, the amount of time trawled and the biophysical habitat impacted.

Currently, a working group established by the QFS is reviewing the ecological performance indicators and review events. It is expected that the group will recommend a broad methodology for the calculation of the reduction in the amount of benthos taken in the ECTF and, more importantly, recommend improved benthic performance indicators for future incorporation in the Trawl Plan.

⁵⁸ The notification day refers to the date when the Trawl Plan was first gazetted (as opposed to any subsequent dates when amendments were gazetted).

7.2.2.2 Review Events and Performance Indicators for Bycatch

A review event is triggered under the Trawl Plan if there is not a 40% reduction in bycatch by 1 January 2005. This has to be documented through a scientific study, showing “*levels accepted by the chief executive*”. The starting date for the review period is the same as that for the performance indicator for benthic impact.

Similar arguments to those for the performance indicator for benthic impact can be made about the difficulties in calculating bycatch reductions in a data-poor environment. Apart from uncertainties about bycatch composition throughout the area of the fishery, there is little reliable information about industry’s past pattern of TED and BRD usage. The work by Courtney et al. (FRDC Project No. 2000/170) on the relative effectiveness of BRDs provides useful insights on expected reductions for each of the permitted devices. Again, major assumptions would need to be made if these findings are to be extrapolated to past activity.

The above-mentioned working group also is examining the bycatch-reduction review event specified in the plan. How to measure bycatch reductions has been one of the major issues identified. Typically-used measures such as the total amount of bycatch per area swept, percentage of catch composition, product to bycatch ratio and actual numbers all have disadvantages associated with them.

7.2.2.3 Review Events and Performance Indicators for Incidental Turtle Captures

With respect to the ECTF’s impact on turtles, the number of captures or kills before a review event is triggered is linked to figures reported by Robins (1995). Table 26 shows how these figures equate to actual numbers, taking into account the lower and upper confidence intervals of the assessment.

Table 26: Numbers of turtles that may be captured or killed before a review event is triggered.

Common Name	Scientific Name	Permitted Turtle Numbers for compliance with 95% limit under Draft Turtle Recovery Plan Robins (1995)		
		5% of Mean Catch	5% of Lower CI	5% of Upper CI
Green Turtle	<i>Chelonia mydas</i>	80	43	116
Loggerhead Turtle	<i>Caretta caretta</i>	80	43	116
Flatback Turtle	<i>Natator depressus</i>	29	16	42
Hawksbill Turtle	<i>Eretmochelys imbricata</i>	4	2	6
Pacific Ridley Turtle	<i>Lepidochelys olivacea</i>	14	8	21
Leatherback Turtle	<i>Dermochelys coriacea</i>	NA	NA	NA

Note: 1. The figures were provided courtesy of Dr. Robins (AFFS). These figures appear in Robins (1995), which is referred to as the “Robins Report” under the Trawl Plan. The calculations have been based on 1991/1992 data.

2. “CI” refers to the 5% confidence interval.

3. No leatherback turtles were caught during the study and the “Robins Report” therefore provides no limits for this species.

In relation to these numbers, the working group on environmental performance indicators considered whether this indication should be based on the number of turtles killed or the number of turtles captured since the Trawl Plan gives an option. It was noted that as a result of the installation of TEDs, turtles generally are not caught in the codend and, consequently, are not emptied onto the sorting tray.

There is likely to be a difference between the number of turtles landed (lower figure) and the number of turtles observed (higher figure). Identification is difficult when a turtle is trapped in a suspended trawl net compared to when it is examined on a sorting tray. Again, there is a problem with the definition of the performance indicator in terms of how turtle numbers are measured.

It is noted that if TEDs are deployed properly there should be very few turtles caught. However, it is apparent that some operators either inadvertently or purposely reduce TED efficiency through incorrect installation. A performance indicator on the level of TED compliance is required. Also, an at-sea observer program would assist in validating the number of turtle captures reported in logbooks.

7.2.2.4 Review Events and Performance Indicators for Fishery Expansion

The Trawl Plan refers to a review event being triggered if the “*chief executive receives a logbook return for the fishery that shows trawling has happened in an area represented on a grid stated in the logbook where trawling has not previously been recorded in a logbook return.*”

Presumably, this performance indicator refers to the potential expansion of the fishery into new (i.e. as yet untrawled but open to trawling) areas. Anecdotal reports suggest that there has been a reduction in the area of the fishery actively trawled because of the industry restructure and accompanying effort reductions. However, a spatial analysis of trawl effort is required to substantiate these reports.

While supporting the intent of this review event, the practicality of this performance indicator is questioned. It would seem more feasible to conduct a spatial analysis of the fishery, as part of an annual assessment process (see Recommendation 15), to determine if there has been a reduction or expansion of the area trawled. There should be a defined threshold, at which the fishery is considered to be expanding and, therefore, impacting on previously untrawled grounds. For example, the movement of one operator into a previously untrawled but open area (defined by a logbook grid) for one fishing day should not trigger a review event. However, if 50% of operators reported fishing in new grounds for most of their allocated fishing time, this would be of concern.

7.2.3 Enforcement Review Event and Performance Indicator

The importance of compliance is recognised in objectives (b) and (c) of Schedule 2 of the Trawl Plan, which relate to sustainability of the fisheries resources and the fishery’s ecological systems. A review event is triggered if “*more than 5% of boats in the fishery in 2000 or a subsequent year are used to commit an offence under this plan.*”

Table 27: Convictions in the ECTF under the Trawl Plan in 2001
(Information Source: ECOTF Status Report - 2001).

Type of Offence	Number of Convictions		
	Serious Fisheries Offences	Other Offences	Total
Closed Waters Offence	23	16	39
VMS Incursion	5	2	7
TEDs/BRDs	0	5	5
Regulated Fish Offence	1	6	7
Total	29	29	58

Note: Serious Fisheries Offences include offences such as contravening the Great Barrier Reef Marine Park Act 1975, contravening the Marine Parks Act 1982, contravening closed waters, possessing regulated fish, obstructing inspectors, etc (see Section 235 of the Trawl Plan).

Data presented in the ECOTF Status Report 2001 suggest that a review probably was triggered in 2001, when 58 convictions were recorded (Table 27). This is twice the trigger point identified in the Trawl Plan. The Status Report notes that “*data is [sic] not readily available to confirm whether multiple convictions were recorded for individual vessels*”. This lack of data on such an important issue is of concern. Information on prosecutions involving fishing boats is a matter of public record and should be available readily. It seems *ultra vires* to ignore the legal provisions of the plan by not providing information on the performance against this objective, particularly when there is evidence that performance has been inadequate to the point of triggering a review under the Trawl Plan’s provisions.

As with some of the other review events in the plan, there is some ambiguity in the wording of this trigger. Clarification is required as to whether the 5% refers to the total number of offences or the number of vessels used in an offence. For example, a situation could arise where less than 5% of the boats have committed offences, but together these boats have amassed more than a 5% level of non-compliance. Clearly the 5% figure should refer to the number of offences (i.e. the frequency of non-compliance), irrespective of the number of boats involved.

Another difficulty in reporting against this review event becomes apparent from the compliance data presented by the QFS. According to the Management Plan, the review event is triggered if 5% of the boats are used “to commit” an offence. Table 27 provides a breakdown of “convictions” in 2001. Given the delays inherent in the judicial process, many offences committed in one year will be heard before a court during the following year. To avoid delays in obtaining and acting on information crucial to the plan, the review events should be defined more clearly as the number of operators found guilty of an offence in a year (regardless of when the offence was committed). Inevitably, this will include some offences committed in the previous calendar year, but these will be balanced by other incidents yet to go to court.

Furthermore, the number of operators “found guilty of an offence” is a more appropriate performance indicator than the “number of convictions”. It must be recognised that, in many cases, no conviction is recorded when someone is found guilty of an offence. Such a judgement is sought increasingly by persons found guilty in order to avoid the “Serious Fisheries Offences” provisions. The aim of the review event is to measure the level of non-compliance. Whether or not a conviction is recorded in such cases is irrelevant.

Notwithstanding the limitations of the “number of convictions” as a useful performance indicator to trigger a review event, such information is still of interest as a compliance statistic. It reflects the views of the judiciary and community on fisheries offences and, to a degree, the success rate of bringing fisheries cases to trial.

Other enforcement and compliance information may be useful indicators of the level of compliance in the ECTF. This may include patrol and inspection reports (e.g. number of nets inspected and proportions found to be compliant) or the number of VMS “switch-offs”. One of the traditional difficulties of using detection and prosecutions as compliance indicators is their interpretation. For example, a declining number of prosecutions may indicate an improved compliance, that offenders are getting smarter or that fewer cases make it to the legal proceedings stage. Consequently, performance indicators should not be viewed in isolation, but in conjunction with other information.

7.2.4 Fisheries Performance Review Events and Performance Indicators

Several fishery performance-based indicators have been included in Schedule 2 of the Trawl Plan, which relate to the economic performance of the fishery and the achievement of effort reductions.

7.2.4.1 Review Events and Performance Indicators for Effort Reductions

Part of the agreement between Queensland and the Commonwealth in bringing in a revised Trawl Plan was that there should be an effort reduction in the fishery of 3% per annum to compensate for anticipated effort creep. To achieve this reduction, penalties were built into the plan. Operators are required to surrender 10% of their transferred effort units upon trading. Similarly, a 5% penalty on effort units applies to the transfer of a licence (except for a transfer from a deceased estate). Under the third mechanism, operators need to surrender effort units upon boat replacement. The amount of forfeited effort units depends on the size of the replacement vessel⁵⁹.

To ensure that these effort reductions are met, the Trawl Plan specifies review events if the reduction falls below or rises above the 3% target. Specifically, the review event (e) under objective (b) states that a review event is triggered if “*the number of effort units has not decreased by - (i) 13% or more in the first effort year; (ii) 1% or more in any subsequent effort year; or (iii) 2% or more during 2 consecutive effort years of any licence*”. This provision gives greater flexibility to the required effort reductions than the requirement for an outright 3% per annum. To ensure that effort reductions do not become excessive, review event (b) under objective (d) states that a review event is triggered if “*the number of effort units decreases by - (i) 4% or more in each of 3 consecutive years; or (ii) 5% or more in each of 2 consecutive years; or (iii) 6% or more in an effort year after the first year*”.

Table 28: Allocation of effort units in 2001 and subsequent reductions.
(Information Source: ECOTF Status Report – 2001.)

	Effort Units	% of Allocation
Total Effort Units Allocated in 2001		
Initial T1 allocation	3,350,328	94.84%
Plus initial T2 allocation	69,474	1.97%
Plus supplementary T1 allocation	82,562	2.34%
Plus supplementary T2 allocation	30,429	0.86%
Total Effort Available 2001	3,532,793	100%
Total Effort Units Removed in 2001		
Transfers of T1 Effort Units	34,716 ¹	0.99%
Transfers of licences	6,794 ²	1.92%
Voluntary surrender	18	>0.00%
Surrender for M2 licence	64,882	1.84%
Surrender for boat replacement	16,984	0.48%
T1 Buyback	367,009	10.39%
T2 Buyback	2,838	0.08%
Total Effort Units Removed	493,241	13.96%
Total Effort Units Available in 2002		
T1 Effort Units 2002	2,941,460	83.24%
T2 Effort Units 2002	98,092	2.78%
Total Effort Available 2002	3,039,552	87.02%

⁵⁹ The amounts of effort units forfeited upon boat replacement are specified in Schedule 5 of the *Fisheries (East Coast Trawl) Management Plan 1999*.

Note: 1 – This is made up of approximately 210 transactions involving approximately 130 licences.

2 – There were 35 licences transferred.

The data in Table 28 show that an effort reduction of nearly 14% was achieved in 2001. This was consistent with the performance indicators specified in the Trawl Plan. The majority of the reduction (nearly 11%) was achieved through the licence buy-back scheme. The remaining 3% were achieved through the penalty provisions. Thus, in 2001, the 3% effort reduction to compensate for effort creep was met. Data for 2002 are not available yet.

7.2.4.2 Review Events and Performance Indicators for Fleet Changes

In order to detect changes in boat size composition of the ECTF, the Trawl Plan specifies review event (f) under objective (b), which states that a review event is triggered if “*the chief executive accepts a study or survey that shows (i) a significant change in the relative distribution of boat hull units in the fishery; or (ii) average main engine power for boats in the fishery is increasing.*” The review event was included because of concerns that there would be a shift to larger vessels following the industry restructure under the revised plan. However, what constitutes “significant” was not defined.

The ECOTF Status Report 2001 reports a shift towards larger vessels, which may have triggered the review event. However, the status report explains that this shift has occurred because the structural adjustment scheme bought out proportionally more smaller boats than larger boats. In addition, 38 Moreton Bay operators surrendered their T1 licences in favour of Moreton Bay only (M2) licences. These were predominantly small vessels. Any pronounced and long term shifts in the fleet profile will become apparent only in the future when the industry has “settled” following the recent major restructure.

7.3 Evaluation of the ECTF Management Arrangements

The ECTF poses some challenging management problems, given its huge species diversity, large geographical spread and differences in fishing methods depending on the targeted species. The current suite of input-based management measures aims to cover the fishery in its entirety, although some measures target specific species or species groups. As with any fishery of this magnitude and complexity, fisheries managers must strive to find a balance between management measures that are pragmatic yet effective. The following section considers the effectiveness of the management measures currently in place.

7.3.1 Input-Based Management

As with most prawn fisheries world-wide, their high inter-annual variability and the short life cycle of prawns make input-based management frequently the best (and most pragmatic) approach. Input-based management is the most appropriate regime for the ECTF. However, input controls have several limitations.

Under an input-based system, control on fishing effort is used as a proxy to control exploitation and fishing mortality, which indirectly controls catch. The problem is that the input controls, which further restrict effort (such as reduced fishing seasons or additional gear restrictions), often have an indirect effect on the nominal effort. Operators are likely to accommodate the additional constraints by further improving the efficiency of their operations. This leads to a requirement to develop a mechanism, similar to that used when setting an annual Total Allowable Catch (TAC), which allows for ongoing and regular feedback and adjustment of fishing effort.

For example, in the Kimberley trawl fishery in Western Australia, the concept is to specify a Total Allowable Effort (TAE) as the total number of days of trawling that may be applied during the season. The fishery is then monitored and closed once this limit is reached. This TAE may be adjusted on an

annual basis to accommodate changes in efficiency and is less unsettling for industry than major once-off effort reductions.

It is noted that in many fisheries, input-based management is adopted because there is insufficient knowledge about the status of stocks to set an optimal TAC (i.e. one that allows for the maximisation of economic yield without jeopardising the sustainability of the resources). However, under a stringent effort control system, a similar demand for resource knowledge exists. In other words, if the TAE is set too low, industry will forfeit valuable fishing days. Conversely, if the TAE is set too high, the fishing effort may exceed the capacity of the resource to recover and this may impact on the sustainability of the resource. During the stock assessment process, the basis for calculating a proposed TAE should be specified. As with a TAC, the basis for calculating a TAE will come under close scrutiny by industry if it limits their activity.

The effort control system adopted in the ECTF is essentially a TAE system, but without the annual stock assessment and effort adjustments underlying the WA model. How effective the current effort limitations are and the Trawl Plan's ability to reduce effort is discussed in the next section. However, it is noted that neither the basis for the initial allocation of fishing days in the ECTF nor any subsequent effort reduction targets have been justified with respect to the available biomass of the fisheries resources. Instead, the scientific justification underlying the ECTF's TAE level is that historic levels of fishing effort have not resulted in any significant resource declines and that, therefore, a lower level of effort than those in 1996 and 1997 must be sustainable.

Generally, input-based management is not species specific. For example, if there was a decline in grooved tiger prawn stocks (as has occurred in the NPF), possible management action could include extended spatial and temporal closures to protect grooved tiger prawn recruitment. However, in addition to grooved tiger prawns, the northern ECTF yields blue endeavour prawns, red endeavour prawns and brown tiger prawns. Any measures designed to reduce fishing effort on one species will have flow-on effects to the other three species. This has major economic implications for industry and any management initiatives to reduce effort are likely to be challenged.

Another problem in a multi-species fishery, in which exploitation is regulated through input controls, is the ability of fishers to refocus effort on different species. This can lead to the sequential depletion of species or species groups and this depletion may not be detected readily during stock assessment. Such changes in targeting need to be identified during stock assessment and factored into any TAE calculations, if effort controls are to remain effective.

In summary, input-based management is the most appropriate regime for the ECTF, but care needs to be taken in assessing the effective effort applied in the fishery. Input controls generally work on the principle of reducing fishing effort through gear and vessel restrictions, which in turn decreases the efficiency of fishing operations. As has been shown repeatedly in many fisheries, industry (in its attempt to maximise profitability), will generally find ways to overcome or compensate for these restrictions. For example, in the NPF, all major initiatives to reduce effort have been gradually compensated for by an accompanying increase in effective effort. A properly functioning TAE system needs to recognise these underlying forces.

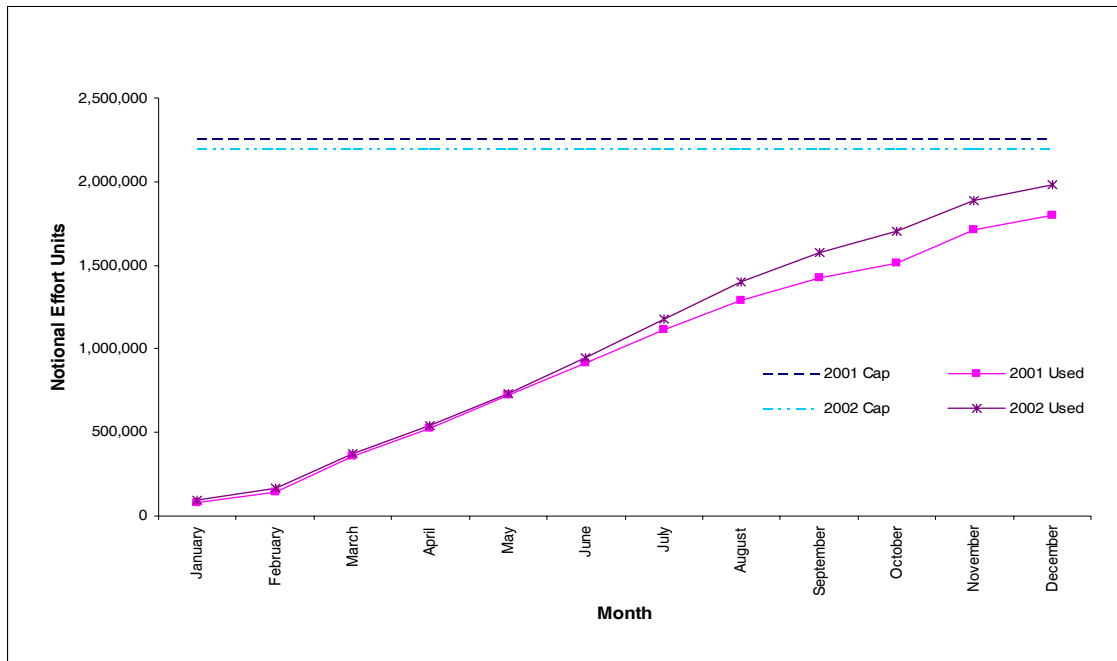
7.3.2 Effort Limitations and Reductions

Under the revised Trawl Plan for the ECTF, effort units were allocated based on the product of an individual licence's historical participation in the fishery (i.e. allocated fishing days) and the standardised hull units of the vessel (i.e. hull units x conversion factor). About 3.5 million effort units were allocated at the beginning of 2001.

In addition to the overall effort cap in the fishery, a secondary effort limitation relates to the GBR World Heritage Area. The Commonwealth contributed \$10 million to the ECTF structural adjustment scheme in late 2000 in return for an assurance from Queensland that effort would not increase in the World Heritage Area. Subsequently, fishing effort in the region was capped at about 2.4 million effort

units (referred to as “notional” effort units), which equates to about 70% of the total effort units issued for the fishery. This reflects the historical level of fishing in the GBR World Heritage Area.

Figure 21: Cumulative usage of notional effort units in the GBR World Heritage Area by the ECTF fleet in 2001 and 2002 (Information Source: VMS and Logbook).



Note: The above graph was provided courtesy of Mr Wez Norris, (QDPI, QFS)

Figure 21 demonstrates that effort increased in 2002 compared to 2001. The total effort in the GBR World Heritage Area was well below the effort cap set for the region in the first two years since the release of the revised Trawl Plan. However, if effort continues to expand in the region, a point may be reached in the future where the fishery in the GBR World Heritage Area may need to cease as the cap has been reached.

The combination of the ECTF structural adjustment scheme and the penalties associated with the trading of effort units and vessel replacement, resulted in a 14% reduction in effort units after the first year of the revised plan entering into force. This was in addition to a 5% effort surrender by industry prior to 1 January 2001 in lieu of its contribution to the adjustment scheme. The QFS has advised that 493,241 effort units were removed from the fishery in 2001. Also, this reduction in effort has brought about the removal of 237 trawlers from the ECTF fleet (i.e. 99 licences were bought out by the scheme and a further 138 operators surrendered their trawl endorsement as a result of selling their effort units).

Currently, there are no data on how the reduction in effort units equates to fishing days. It cannot be assumed that there was a corresponding 14% reduction in fishing days, as the hull size of vessels removed by the scheme would have had a bearing on the number of fishing days removed. Figures 21 and 22 illustrate the significant effort reductions on the east coast since 1999. A decrease in the number of fishing days is obvious, particularly in waters off the northern part of Cape York and between Cairns and Townsville. Other areas (such as Princess Charlotte Bay and southern parts of the GBR Marine Park) remain areas of high fishing concentration.

Figure 22: Fishing effort in the ECTF in 1999 (Information Source – Trawl Logbooks)

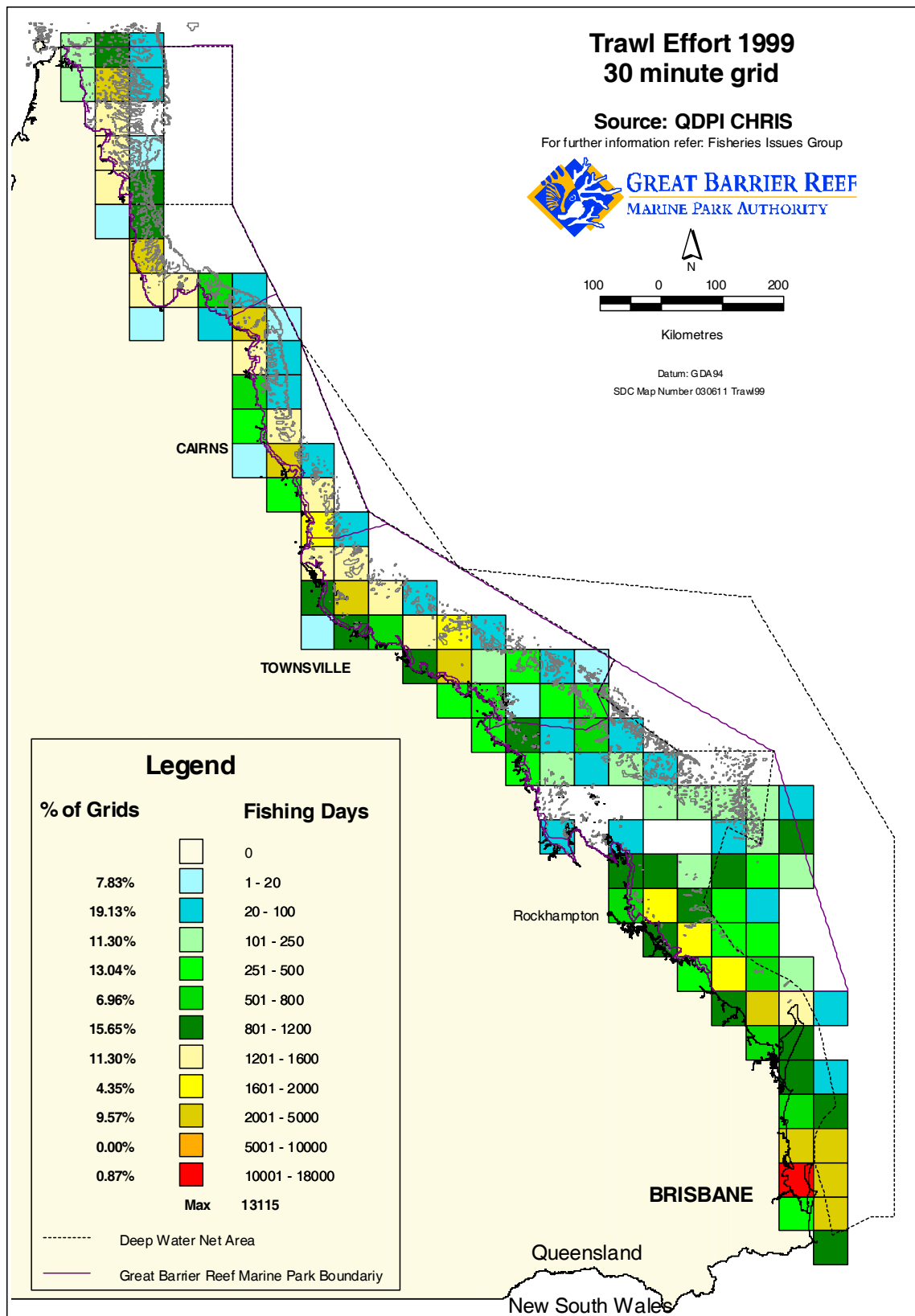
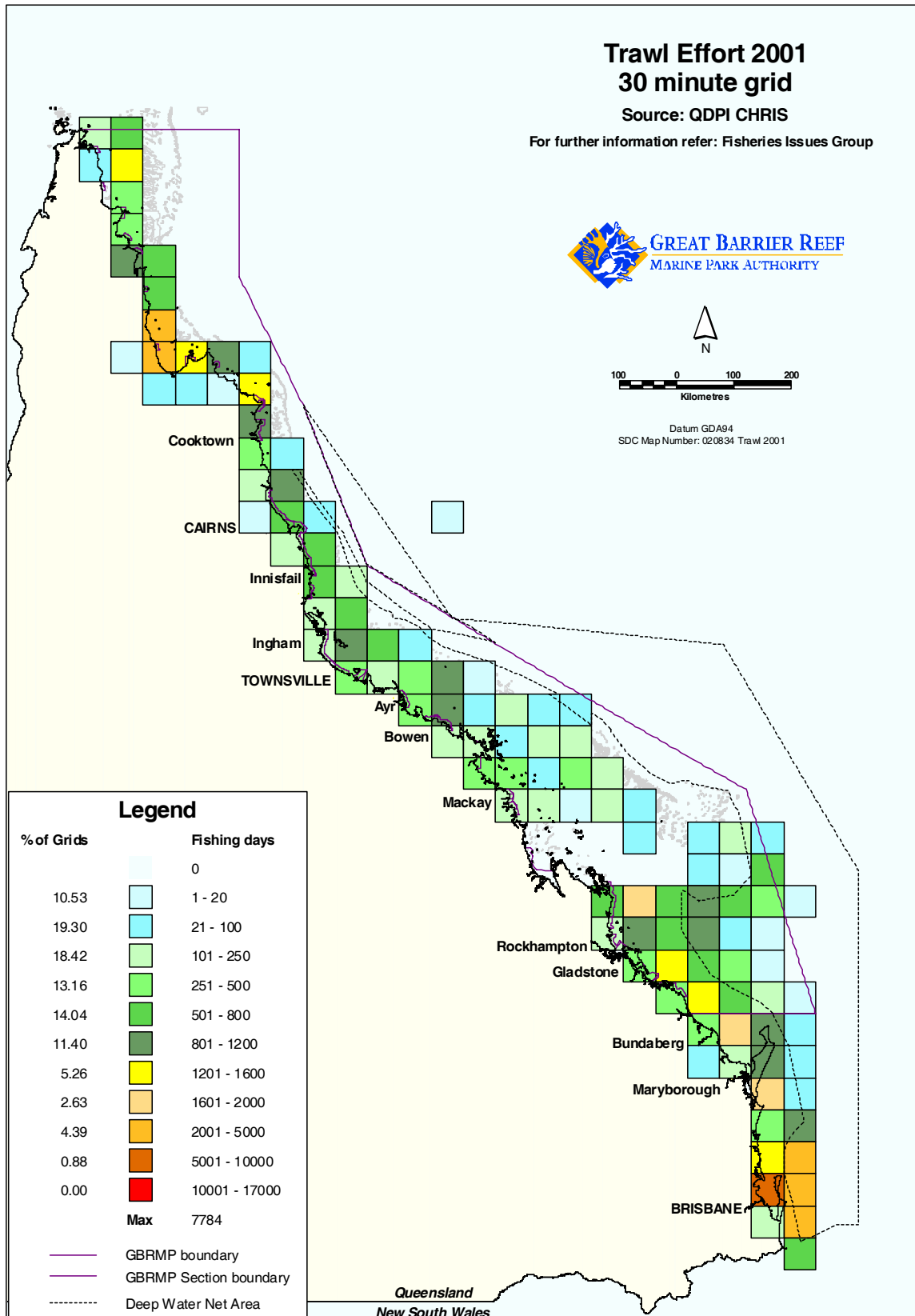


Figure 23: Fishing effort in the ECTF in 2001 (Information Source – Trawl Logbooks)



A contentious issue from the GBRMPA’s perspective was the allocation of 14 steaming days in 2001, in addition to the fishing days already allocated on the basis of past participation. Initially, steaming days had been proposed by the Premier’s Working Group to compensate operators for any days lost steaming to the grounds and searching for fish⁶⁰. However, prior to 1 January 2001, the QFS agreed to a proposal by industry that vessels would be deemed not to be trawling if, on the basis of VMS polls, they were estimated to be moving at a speed greater than 5.5 knots.

Subsequently, this provision was implemented under the Management Plan.⁶¹ It meant that operators effectively had been allocated an additional 14 days above their allocated fishing days. Furthermore, operators could apply to have their fishing day(s) reinstated if they could demonstrate to the QFS that they had not been fishing. As a result of these arrangements, few operators lost fishing days when they were steaming.

The GBRMPA was opposed to this allocation of steaming days. Its submission to the “Review on Steaming Days” stated that the “14 additional days equates to about 10% of the average number of effort days allocated for ECTF operators and this could result in an overall increase of effort of up to 8% across the fleet. Clearly this would undermine the achievements of past effort reductions under the ECTF Structural Adjustment Scheme and jeopardise the effectiveness of the 1996 effort cap.” Following the review, the QFS reduced the number of steaming days to four. In the view of the GBRMPA, this still is an over-allocation of steaming days. Given the amended speed provisions, the QFS’s own data have shown an average annual steaming day requirement of less than one day per operator.

As shown in Table 29, the amount of fishing in 2001 was considerably less than the allocated effort. Only 83% of the total effort units allocated for the fishery were used for fishing, leaving 17% unused.⁶² In the case of the effort unit allocation for the GBR World Heritage Area only 78.5% of the available effort units were used. In an appropriately allocated and well-functioning effort quota system, it would be expected that the fleet would come close to using all available effort units each year.

Table 29: Fishing effort used in the ECTF in 2001 and 2002
(Data Source: Logbook and VMS Data).

	2001	2002
Total Effort Units available (1 Jan)	3,162,946 ¹	3,045,424 ²
Total Effort Units Used	2,625,737	2,672,564
% of Available Effort Units	83%	88%
GBRMP Cap (Notional Effort Units)	2,365,200	2,193,731
Notional Effort Units Used in GBRMP	1,855,534	1,984,662
% of Available Effort Units	78.50%	90.47%

Note: 1 The above information was reported in the “ECOTF Status Report – 2001”.

2 The available effort units indicated as of 1 January may appear to be consistent with the figures cited in Table 1. However, the 2001 figure¹ has been adjusted for the effort units removed from the fishery and the 2002 figure² has been adjusted for additional units allocated through appeal.

⁶⁰ A fishing day was going to be deducted for every day that the VMS recorded the vessel as operating in the fishery.

⁶¹ The 5.5 knot provision was amended to 5.0 knots in December 2001 following a review of the steaming provisions.

⁶² The 83% does not include the 14 steaming days.

It is too early to speculate about the reasons behind the "under-usage" of allocated effort units by the fleet. This type of phenomenon has been observed in other fisheries operating under catch or effort quota system. It could be that operators were becoming familiar with the new system and were reluctant to trade their effort units until they had established a fishing pattern under the new system. Alternatively, it could be that the penalties on trading effort units acted as a disincentive. Another reason may be that there has been an over-allocation of fishing days in the first instance. In any case, the situation needs to be monitored closely over the next few years.

Despite effort being capped by the number of allocated fishing days, there is still scope for any increase in effective effort. Fishing effort in any trawl fishery is defined by the area swept, which is a product of the width of the gear, the speed of the boat and the time trawled. In the case of the ECTF, all three factors are partly fixed. The area swept is limited by net size restrictions (Table 30). The speed of the boat is fixed partly by a maximum engine power restriction of 300 kW continuous brake. However, the thrust of the boat is influenced also by factors such as the type of nozzle and the size of the propeller, which are both unrestricted. Since the ECTF is either a day or night only fishery, the third factor of time spent fishing, is partly fixed also. However, devices that reduce the handling time for the trawl net and catch between shots (such as hoppers) may increase bottom time of the net. Thus, while effort is capped nominally in the ECTF, there is still scope for increased efficiency in vessel and gear performance, which will lead to effort creep in the fishery over time. It is crucial that such effort creep is monitored on an on-going basis and is factored into the catch and effort analyses for the fishery.

Table 30: ECTF gear and vessel restrictions applicable in the GBR World Heritage Area.

Type of restriction	Application	Restriction
Boat length restriction	Otter trawl	➤ Maximum length 20 m LOA
Trawl net restrictions	Deep water otter trawl	➤ Maximum net length 184m ➤ Mesh size 38–60 mm
Trawl net restrictions	Scallop trawl	➤ Maximum net length 109 m ➤ Minimum mesh size 75 mm

As mentioned earlier, fisheries with a responsive management regime generally have the ability to reduce effort or catch across the entire fleet on a pro-rata basis (if required). For example, in many quota fisheries, the value of a quota unit in tonnes of product may change from year to year in response to scientific advice on the amount of stock that may be harvested.

There are no provisions in the current Trawl Plan to achieve effort reductions directly. In fact, an attempt by the QFS to provide its Chief Executive with such powers was abandoned following the release of a Regulatory Impact Statement in May 2002. It was argued that such powers would diminish industry's fishing rights. If there is a serious decline in the ECTF target or bycatch resources, which warrant a major management intervention, the only available remedial measures are extended closures, further gear restrictions and limitations on the species that may be taken. In other words, through increased limitations on the fishery, it is hoped that effort will be reduced sufficiently. In an extreme situation, the Chief Executive also has the power under the Fisheries Act to close the fishery temporarily. These measures are likely to be perceived as controversial and would meet industry opposition. A regularly adjusted TAE system in response to assessment advice (like the WA model) would remove much of the angst associated with major effort reductions and provide for a more adaptive management framework.

Recommendation 33

- *That the QFS adopts a proper TAE system, in which the permitted effort level is reviewed and adjusted (if necessary) on an annual basis in light of fishery assessment advice, and which permits the across-the-board reduction of effort units if this is required for resource sustainability.*

7.3.3 The Vessel Monitoring System

The requirement for ECTF operators to carry automatic location communicators as part of a VMS became mandatory on 1 January 2001. The introduction of this system greatly enhances the QFS's ability to manage the fishery. It enables the QFS to monitor fishing days used by the fleet. This is essential under the new system of effort unitisation in order to determine the use of fishing days. Also, it allows the monitoring of a vessel's activity with respect to closures, thereby assisting compliance. In this section, the current limitations in interpreting trawl tracks and extrapolating a vessel's activity from its calculated travelling speed are discussed and the frequency of VMS malfunctions considered.

The Trawl Plan "deems" a vessel to be "steaming" if it is travelling at a speed above a certain threshold. Initially, this was set at 5.5 knots. Following a review of steaming days in August 2001, the threshold speed was lowered to 5 knots. The speed is calculated from the distance covered between successive VMS polls. Since the introduction of the system, industry has argued that some operators are losing fishing days wrongly because their steaming speed had dropped below the threshold even though they had not trawled. The reasons cited for this were rough sea conditions and limited engine power.

The Trawl Plan contains provisions for operators to dispute any days that the VMS has recorded as having been fished. Following an application to QFS, operators can have their fishing days reinstated, if they can demonstrate that they had not been fishing on that day. The GBRMPA is not in a position to comment on the validity of these reinstatements, as the evidentiary requirements and decision rules for such action are not made public.

It is clear from the QFS's own data that a significant number of fishing days were reinstated in 2001. Of all the applications received for re-instatement (854) for the period from 1 January to 1 June 2001, all but 70 were successful (QFS Review Paper, 2001). This is despite operators having been granted 14 steaming days in 2001.

Some of the earlier reinstatements of fishing days were related to technical difficulties with the VMS shortly after its introduction. To a large extent these problems have been addressed. As indicated in Table 31, disputes over fishing days still remain an issue and the success rate of operators having their days reinstated is very high (Figure 24). This has the potential to undermine significantly the effort system if some of the claims are fraudulent. The QFS has provided no information to date on the degree to which claims for the reinstatement of fishing days are checked.

Table 31: Disputed fishing days under the VMS for the ECTF in 2001.
(Information Source: ECOTF Status Report – 2001.)

Month	Missing Position at Sea ¹	Missing Position in Port ²	Sleep Mode ³	Speed ⁴	System Error ⁵	Other ⁶
Jan	1	242	49	59	1	3
Feb	0	196	64	53	0	0
Mar	0	151	44	56	5	0
Apr	0	83	8	63	2	0
May	0	67	1	50	1	0
Jun	0	95	0	45	12	0

Jul	4	141	0	22	0	0
Aug	0	83	1	26	0	0
Sep	1	107	0	23	0	0
Oct	0	58	0	5	0	0
Nov	0	11	0	5	0	0
Dec	0	1	0	2	0	0
Total	6	1235	167	409	21	3

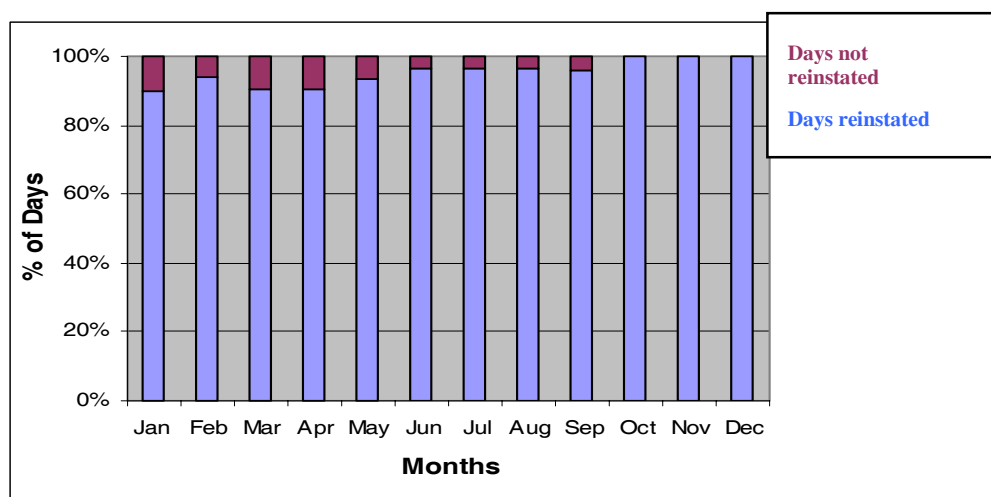
Note:

- 1 “Missing position at sea” refers to non-reporting of position while at sea. This may be due to faulty batteries, KVA and alternator problems, VMS malfunctioning (including switch offs).
- 2 “Missing position in port” refers to non-reporting of position while in port. This may be due to faulty batteries, KVA and alternator problems, VMS malfunctioning (including switch offs, transmission black spots in port and expired exemptions).
- 3 “Sleepmode” refers to the vessel operating in sleepmode function while in port.
- 4 “Speed” refers to a vessel’s speed dropping below 5.5 knots without fishing.
- 5 “System Error” refers to a wrong accrual of fishing days by the VMS software.
- 6 “Other” refers to a boat having moved more than 250m from anchorage without fishing.

The current “VMS Mapping Study” (FRDC Project No. 2002/056) should assist in gaining a better understanding of trawl signatures. However, the point is made again that gear monitors would provide a far more accurate indication of fishing activity than travelling speed determined from the VMS.

There is a secondary advantage to introducing gear monitors in the ECTF. From a stock assessment perspective, “fishing days” are a poor proxy for actual fishing effort. Hours trawled would be a more precise effort indicator. Operators are asked to provide information on bottom time in their logbooks, but these data are unverified and currently not analysed in the stock assessment. Gear monitors would address this problem, by allowing a direct comparison between the bottom time data provided through the logbooks with those recorded by the gear monitors. This would provide better temporal resolution of the catch effort data, which would improve assessment considerably.

Figure 24: Disputed fishing days versus reinstated days under the VMS for the ECTF in 2001
(Information Source: ECOTF Status Report 2001)



7.3.4 Spatial Management of the Fishery and Fishery Closures

Based on the targeted product, there are several fisheries contained within the ECTF. For example, the saucer scallop fishery in the southern part of the GBR Marine Park has little similarity to the typical tropical penaeid fishery in the north. A case can be made for management measures to be focussed at a smaller spatial scale, coinciding with species distributions, rather than at a fishery-wide level.

The concern with a fishery of this size is that effort can be displaced from one part of the fishery to another quite easily. This could lead to localised and serial depletion of the resources, as the fleet moves in search of new profitable operations. Spatial closures are a means of mitigating trawl effort within a defined area.

Several closures apply in the ECTF, which limit total effort in the fishery on a seasonal and year-round basis. Approximately 32% (i.e. 176,133 km²) of the area of the east coast under Queensland fisheries jurisdiction is closed to trawling. In the case of the GBR Marine Park, spatial closures amount to about 50% (i.e. 173,904 km²) of the area. These closures have been declared under either GBRMPA's zoning provisions or Queensland's Fisheries legislation. In addition to the permanent closures, there are also several seasonal closures under the Trawl Plan (Table 32).

Table 32: Description of seasonal closures in the ECTF prescribed under the Trawl Plan.

Seasonal Closure	Area of Application	Period (each year)
First Northern Closure*	All waters north of 22°S (except deepwater trawl areas)	15 December – end February
Second Northern Closure**	All waters north of 22°S (except deepwater trawl areas)	1 March – 14 May
First Southern Closure*	All waters south of 22°S (except deepwater trawl areas and Moreton Bay)	20 September – 1 November
Second Southern Closure**	All waters south of 22°S (except deepwater trawl areas and Moreton Bay)	1 November – 12 December

Note: * The first closure in each area applies to all vessel;

** The second closure in each area applies only to those vessels, which trawl elsewhere in the fishery during the first closure.

In addition to the above closures, the QFS has emergency powers to close waters under the “emergency fisheries declarations” (Division 2, Provision 46 of the *Fisheries Act 1994*), which allows it to close waters for up to two months without prior consultation. This is a short-term measure to prevent the over-exploitation of any fishery.

The major reason for the implementation of the seasonal closures appears to be economic. The AFFS, in assessing the impact of the seasonal closures of the North Queensland prawn trawl grounds, concluded that “the current seasonal closure appears to protect the juvenile recruitment of the brown tiger prawn, most recruits of the king prawn, and the first of two pulses of grooved tiger prawn recruitment. Endeavour prawn recruits are at best only partially protected.” (Gribble, 1995). The northern closure allows the tiger and endeavour prawns to grow to an optimum size before harvest. The southern closure was introduced to optimise the yield from scallops and prevent the transfer of effort from northern Queensland during the north's traditionally quiet period. The sequential nature of each of the closures ensures further regulation of access.

In addition to these major closures, there is also a complex system of rotational closures in place for the scallop fishery. The purpose of these closures is to protect replenishment areas of high scallop abundance (which contribute to subsequent recruitment), whilst allowing periodic commercial access to these beds. Under the rotational closures, some scallop beds are fully protected at any one time, whereas access is allowed to others.

A range of other closures applies on a smaller geographic scale. Some have been implemented for habitat protection, such as the permanent inshore closure between Cairns and Cape York to protect seagrass habitats or the temporary closure near Bundaberg to protect turtle nesting sites. Other closures have been introduced to remove trawling (and its associated wash-up of bycatch onto adjacent beaches) from major tourist centres. A further group comprises the daylight closures (6 am to 6pm), such as those applying to the far northern area and to the scallop grounds, which are designed to limit effort.

7.3.5 Output-Based Management Measures

In addition to defining species as either principal or permitted species, the Trawl Plan also establishes a range of possession limits for some of the permitted species and minimum legal size limits for crustaceans and scallops. Restrictions also apply to the take of ovigerous female bugs and barking crayfish.

Table 33: Current output limits on principal and permitted species prescribed under the Trawl Plan.

Common Name	Species	Possession Limit	Minimum Legal Size Limit
<u>Principal Species:</u>			
Scallops	<i>Amusium japonicum balloti</i> <i>Amusium pleuronectes</i>	➤ No limit applies	➤ 9 cm (1 Jan – 1 May) ➤ 9.5 cm (1 May – 1 Jan)
Bugs	<i>Thenus</i> spp <i>Ibacus</i> spp	➤ Egg-bearing females prohibited	➤ 7.5 cm ➤ 10.0 cm
<u>Permitted Species:</u>			
Blue Swimmer Crabs	<i>Portunus pelagicus</i>	➤ 100 crabs inside Moreton Bay; ➤ 500 crabs outside Moreton Bay; ➤ All females prohibited	➤ 15 cm carapace
Balmain Bugs	<i>Ibacus</i> spp (5)	➤ Egg-bearing females prohibited	➤ 10cm carapace
Barking Crayfish	<i>Linuparus trigonus</i>	➤ Egg-bearing females prohibited	➤ No limit applies
Cuttlefish	<i>Sepia</i> spp (15) <i>Metasepia pfefferi</i>	➤ 66 litres	➤ No limit applies
Mantis Shrimp	<i>Squillaidea</i> (8)	➤ 15 litres (Moreton Bay only)	➤ No limit applies
Octopus	<i>Octopus</i> spp (8 –10)	➤ 66 litres	➤ No limit applies
Pinkies	<i>Nemipterus</i> spp (5)	➤ 198 litres	➤ No limit applies
Red Spot Crabs	<i>Portunus sanguinolentus</i>	➤ All females prohibited	➤ 10 cm carapace

Note: The possession and minimum size limits are specified primarily in Schedule 4 of the Trawl Plan. Part 3, Division 2, of the plan deals with the definitions of principal and permitted species and the scallop restrictions.

The above size limits for bugs appear to be based on stock assessment work, such as yield-per-recruit analysis, to optimise yield (Courtney, FRDC Project No. 1992/102). Also, the ban on the take of all egg-bearing female bugs, crabs and barking crayfish is designed to protect recruitment. Informal reports of “egg stripping” suggest that there may be enforcement problems with this provision.

The possession limits for by-product were introduced in December 2001, following a review of permitted species by QFS. This action recognised that permitted species were an incidental take to the principal species and was an attempt to stop targeting. The setting of catch limits is welcomed, but in its submission to the review the GBRMPA questioned the basis for the proposed limits. Since there had been no historical logbook data on the take of by-product in the ECTF until the introduction of the OT07, there was little information on which to base such decisions. The principle adopted by the QFS in setting bycatch limits was that the limit covered the activity of most of the fleet.

The GBRMPA had argued that bycatch limits should be small to discourage targeting of byproduct. Furthermore, it recommended that where alternative and more environmentally friendly fishing methods are available for the take of a species (like blue swimmer crabs), preference should be given to that method. It was recognised that scope may exist for the possible targeted exploitation of some of the current by-product species. The GBRMPA recommended that this should occur only under an exploratory or developmental fisheries permit and be restricted initially to a small number of operators until more was known about the status of the resource. Also, concern was expressed that permitting the retention of large amounts of permitted species would act as a disincentive for the development and proper deployment of BRDs and other mitigation technology.

Distinguishing between target and by-product species in this manner raises the question of whether there should be decision processes in place to allow for the transfer of species between the two categories. For example, if stock assessment indicated that there was scope for one of the by-product species to become a target species, by what mechanism would that species be added to the “principal fish” list. Similarly, there may be signs that one of the principal species is being overfished and bans on targeting this species may be the most appropriate management measure. To deal with this issue, the QFS (through Trawl MAC) is developing a “*Framework for Amending Principal and Permitted Species*”. This is a positive step in providing clear decision rules (based on the best available stock assessment information) in setting harvest limits for the resources of the ECTF. Finalisation of this framework is supported.

Recommendation 34

- *That there be a review of the current limits on by-product (i.e. permitted species) in light of new fishery assessment advice and adopting the principles developed for adding or removing species from the “permitted species” list.*

Recommendation 35

- *That a processes be determined for adding species to and removing them from the categories of “principal species” and “permitted species” under the Trawl Plan, taking into account the status of information on the species and adopting a precautionary approach in light of any uncertainty.*

The Trawl Plan prohibits the targeting of by-product by specifying that “*a net must not be used unless .. (b) its primary purpose is to take principal fish.*” (Section 149 (3)). Such a provision is extremely difficult to enforce, as an inspector would have to prove that an operator had “deliberately targeted” by-product.

The data presented in the QFS Review Paper on Permitted Species in August 2001 indicate that some operators had significantly higher annual catches of certain by-product species than the fleet average.

In particular, species such a barking crayfish and mantis shrimps⁶³ were taken in large numbers by a small number of operators, particularly in the southern parts of the fishery. Above average catches of by-product cannot by themselves be considered evidence of the targeting of permitted species. For such proof, statistical information would be required about the distribution of the catches of each of the by-product species, sufficient to allow an assessment of the probability associated with the unusually high catches. This information is not available.

A specific problem is the enforcement of the ban on the take of sharks by trawling. It is acknowledged that the introduction of the ban is a positive step in supporting the effective use of TEDs and recognises the vulnerability of shark stocks to over-fishing. Unfortunately, the intent of the regulation is undermined by practicality constraints associated with its enforcement. The prosecution of infringements requires proof that sharks or shark product was taken by trawling. Most ECTF operators hold a line-fishing endorsement. The crew on many trawlers take sharks by line, particularly when the sharks are feeding around the vessel during the discarding of bycatch. This fishing practice is legal provided an appropriate endorsement is held. However, it weakens significantly the trawl ban on shark. Regulations were introduced in late 2002 banning the finning of sharks. This makes a significant contribution to the sustainability of shark stocks since many operators primarily take shark for their fins.

While the by-product possession limits are necessary from a management perspective, they present enforcement problems in terms of the practicalities associated with the inspection and the counting of product, particularly when it is packaged and/or frozen. Also, there is a high risk of the product being damaged during such inspections. In other fisheries, limits on numbers, size and sex of fish product are supported by appropriate regulations on the format in which the product must be held in order to facilitate enforcement. Regulations on the labelling of packaged product could also be helpful in the ECTF.

7.3.6 Bycatch Mitigation Devices

With the introduction of the revised Trawl Plan on 1 January 2001, TEDs and BRDs became a legal requirement in most parts of the ECTF (including throughout the GBR Marine Park). However, temporary exemptions were provided for the scallop and deepwater trawl fisheries because industry had indicated that current devices were not suited (and in some cases dangerous) to their type of operation. In order to allow for further development, the plan specified an introduction date of 1 July 2001 for TEDs in all scallop nets and 31 December 2001 for TEDs in all deepwater nets. BRDs were required in all scallop and deepwater nets by 1 July 2002.

Despite the prolonged phase-in period for bycatch mitigation devices, there has been slow progress in their effective implementation (see Section 6.2.1 and Tables 20, 22 and 23). This is particularly the case with TEDs, where there is ample information from within Australia and overseas on minimum design standards for effective turtle exclusion. It is noted that TED adoption has been achieved industry-wide in some prawn trawl fisheries (like the NPF) within two seasons. In the ECTF, discussions about the need for such devices and their design have extended over several years.

Part of the reason for the poor implementation record has been ambiguity in the relevant legislative provisions. Parts 3 and 4 of the Trawl Plan deal with the requirement for licence holders to use BRDs and TEDs in their nets, and minimum design standards are stipulated for each. Until the amendment to the TED provisions in late 2002, the Trawl Plan stated that the “*use condition is taken to have been complied with if ... a recognised BRD/TED is used with the net*”. At the time, there were five recognised BRDs and one recognised TED design permitted under the plan (see Appendix 7).

⁶³ Mantis shrimp are targeted in Moreton Bay, outside the GBR Marine Park.

In order to allow for technological development, the Trawl Plan made provisions for the use of “another device with the net if the use achieves the purpose of a BRD/TED”. The plan provided even greater flexibility for the use of non-specified devices by granting the Chief Executive the power to “make guidelines for devices other than recognised BRDs/TEDs, that may be used with a trawl net to achieve the purpose of a BRD/TED”.

Towards the end of 2001, the QFS and the GBRMPA discussed the size of the bar spacing in TED grids. In an attempt to tighten the existing TED provisions and remove the scope for operators to use devices other than rigid or semi-rigid grids, the QFS sought to amend the TED guidelines. However, it was proposed that the maximum bar spacing be set at 15cm. The GBRMPA did not support this position because it would have set a significantly lower standard than that adopted in other prawn fisheries⁶⁴. Furthermore, the QFS’s own scientific advice indicated that, with a 15cm bar spacing, there is a high risk of capturing up to 16% of flatback turtles and up to 10% of other turtles found off the east coast. These potential captures rates are higher than the targets agreed to by parties to the National Draft Turtle Recovery Plan and present an unacceptably high risk of the incidental capture of an endangered marine species.

In November 2001, following discussions over the bar spacing, the QFS received legal advice, which suggested that the proposed TED guidelines were invalid. It was argued that the guidelines were inconsistent with the procedures for amending a management plan set out in Section 39 of the *Fisheries Act 1994* and that the publication and notification provisions for the guidelines were inconsistent with Section 52 of the *Statutory Instruments Act 1992 (Qld)*⁶⁵. The advice noted that the purpose of the TED, currently specified in Section 52 of the Trawl Plan (i.e. to allow turtles to escape immediately after being taken in the net) could not possibly be met because some turtle hatchlings would always pass through to the codend, even at a conservative bar spacing of 10 or 12cm. The advice also stated that the TED guidelines were “so wide to be virtually meaningless”.

In light of this advice, the GBRMPA urged the QFS to rescind the invalid guidelines and inform industry of the urgent need to meet tighter minimum design standards. Trawl MAC supported this position in March 2002 and recommended that “the implementation of rigid TEDs with a maximum of 120 mm bar spacing should become law by 1 January 2003”. The QFS has since revised the Trawl Plan to implement the tighter provisions⁶⁶. No information is available yet on how well the new provisions have been adopted by industry.

Progress also has been slow in tightening the current BRD definitions to ensure the optimal deployment of these devices. Recognising the need to address this issue, the QFS embarked on a “BRD Amendment Program” through the Technical Working Group of Trawl MAC. The first stage involved the dissemination of a questionnaire and survey form. The responses were discussed in May 2002 at a workshop on the effectiveness of the current BRDs. The meeting identified modifications and new designs, which could enhance the effectiveness and performance of BRDs. In particular, suggestions were made about the maximum distance that escape holes should be positioned from the codend.

The proceedings of the workshop were considered by Trawl MAC in mid 2002 and recommendations about revised BRD specifications were made to QFS. To date, there appears to have been no progress in implementing these changes. The QFS has indicated that the revised BRD provisions will be addressed in a Regulatory Impact Statement to be released in mid-2003.

⁶⁴ In the Commonwealth-managed prawn fisheries, such as the TSPF and NPF the minimum bar spacing is 12 cm and, in the USA, the bar spacing is 10 cm.

⁶⁵ The logic of this argument also can be applied to the BRD guidelines, making them invalid under administrative law.

⁶⁶ The QFS released a Regulatory Impact Statement in late 2002, which (amongst other things) proposed the amendment of the TED provisions. The Trawl Plan was amended in December 2002.

It is acknowledged that designs need to be developed to increase the chances of escape for unwanted bycatch, but do not result in significant product and by-product losses. This is a difficult balance to strike and the development of effective BRDs is likely to be an on-going process. It will require constant scientific review of new devices and the development of guidelines setting minimum performance standards.

Recommendation 36

- ***That the Trawl Plan be amended, as a matter of priority, to tighten the current BRD provisions, taking into account the specifications recommended by the Technical Working Group of Trawl MAC.***

Recommendation 37

- ***That a process be determined for adding new or removing existing BRDs from the permitted devices listed under the Trawl Plan, taking account of proposed technical performance standards developed for such devices.***

Verbal reports from the QFBP and the QFS' own surveys have indicated a low compliance rate with the TED and BRD requirements. Once the necessary legislative changes have been made to tighten the prescriptions for the mitigation devices, a program of education and enforcement needs to be conducted to ensure a high level of compliance.

Recommendation 38

- ***That there be more stringent enforcement of the TED and (proposed revised) BRD provisions of the Trawl Plan and that annual statistics be provided on the level of compliance.***

7.3.7 Enforcement and Surveillance

The level of compliance with the management arrangements is a fundamental issue in assessing the effectiveness of the Trawl Plan. The Audit Report has evaluated the performance of the ECTF on the assumption that the management measures are implemented and met. Any non-compliance reduces the effectiveness of the plan and introduces greater uncertainty about the status of the ECTF resources. Depending on its nature and frequency, non-compliance has the potential to undermine the plan's objectives and damage the quality of information on which the plan and fishery assessment are based.

In this section, the issue of penalties and administrative sanctions, which underpin any successful enforcement program, are addressed. The ECOTF Status Report 2001 indicates that 29 convictions were for "Serious Fisheries Offences" in 2001 (see Table 27). Under the Queensland *Fisheries Act 1994* and Trawl Plan, scope exists for the application of fishery sanctions and licence suspension. Information should be made available on the administrative sanctions imposed in each case and, if not applied, the reasons why this did not occur. It is noted that serious fisheries offences may include contravention of the *Great Barrier Reef Marine Park Act 1975*.

Penalties are a vital factor in compliance. The deterrence value of the penalty (both the maximum under the plan and the levels applied in the courts) for each offence needs to be assessed against the likely financial gain by the offenders. Acknowledging the QFS' Chief Executive's discretionary powers with regard to "Serious Fisheries Offences", the adoption of more stringent administrative sanctions is urged. The QFS has indicated that it will initiate a review of "Serious Fisheries Offences" in 2003. This review will include an analysis of the adequacy of the current penalties from a deterrent perspective and clarify the definitions of the current enforcement trigger points.

Recommendation 39

- *that there be a greater level of reporting on enforcement and compliance issues in the ECTF, including the types of offences committed, the number of inspections (where relevant) and the subsequent legal and administrative actions.*

Recommendation 40

- *That there be a review of the types of offences considered “Serious Fisheries Offences” under the Trawl Plan 1999, identifying the administrative actions (if any) taken by the QFS and the grounds on which action was taken or not taken.*

7.4 Summary of the ECTF’s performance against its legislated objectives.

Based on the information presented in Section 7.1 to 7.3, a summary has been provided on how well the ECTF performs against its legislated objectives (Table 34). Please note that this table has been presented as Table 2 in the Executive Summary.

Table 34: Provisions of the Trawl Plan regarding its management objectives, achievement measures, performance measures, review events and performance indicators, and the Audit Report’s appraisal of each.

Objective (a) “Manage the fishery in a way that gives optimal, but sustainable community benefit”	
Management Plan Provisions	Audit Report’s Comments
<p>How objective is to be achieved The objective is to be achieved by providing fair fishing opportunities for commercial and recreational fishers and Aborigines and Torres Strait Islanders.</p> <p>How achievement is to be measured Achievement of the objective may be measured only by–</p> <p>(c) surveys, accepted by the chief executive, of fishing for fisheries resources taken in the fishery by commercial and recreational fishers and Aborigines and Torres Strait Islanders; and</p> <p>(d) commercial fishing catch and effort data for the fishery received by the chief executive.</p> <p>Review events The review events for the achievement of the objective are–</p> <p>(c) a survey mentioned in (a) above shows a significant decline in the catch of principal fish; or</p> <p>(d) data mentioned in (b) above shows a significant decline in the commercial catch of principal fish;</p>	<ul style="list-style-type: none"> ➤ Access is granted to all stakeholders in the ECTF (including commercial, recreational and indigenous people). “Fair fishing opportunities” has not been defined and information is limited on the participation of non-commercial fishers. The Audit Report is therefore not in a position to comment on how well this objective has been achieved. ➤ Recreational fisheries data are collected through biennial recreational fishing surveys in Queensland. Information is presented on the state-wide recreational take of “prawns”. Information on the Indigenous take of ECTF species does not appear to be available. [See Section 4.3.6.] ➤ Commercial fishing data are received by the QFS through ECTF logbooks. There are some concerns about the veracity and level of resolution of these data and, consequently, their impact on fishery assessment. [See Sections 4.3, 4.4, 5.2, 5.3, 5.5 and 7.1.] ➤ These review events relate to the economic performance of the ECTF. ➤ “Significant” is not defined. Terms of Reference for the survey are not defined. ➤ Catches may decline for reasons other than resource abundance (e.g. fewer operators, less effort, weather conditions, etc.). Stock assessment is required to determine the reasons behind declining catches of principal species. [See Sections 5.2, 5.3 and 5.5.] ➤ The review events are target species-specific. A community cost is involved if the sustainability of by-product or bycatch species becomes threatened as a result of overfishing and/or the impact of trawling.

Objective (b) “Ensuring fisheries resources taken in the fishery are taken in an ecologically sustainable way”	
Management Plan Provisions	Audit Report’s Comments
<p>How objective is to be achieved</p> <p>The objective is to be achieved by the following -</p> <ul style="list-style-type: none"> (a) the provisions of this plan about effort units; (b) the closed waters declarations under this plan; (c) the regulated fish declarations under this plan; (g) limiting, under chapters 3 and 4, the commercial fishing apparatus that may be used under the plan; (h) the boat modification and replacement restrictions under chapter 3, part 8; (i) the main engine power restrictions under chapter 3, part 8, division 2 for boat modification or replacement. 	<ul style="list-style-type: none"> ➤ Measures (a) to (f) are primarily input-control management tools with the potential to limit expanding fishing effort. As with most input controls, increased efficiency by the fleet (i.e. effort creep) generally overcome these effort limitations. [See Sections 5.2, 7.1, 7.3 and 7.4.] ➤ With respect to (a), the number of effort units and the value of effort units cannot be altered under current Queensland fisheries legislation. [See Section 7.3.2.] ➤ With respect to (b) and (c), restrictions on the available area of the fishery and target species may result in the redistribution of effort. [See Sections 7.3.4 and 7.3.5.] ➤ With respect to (b) and (c), these restrictions partially limit the effort that may be applied in the fishery. However, other factors (not restricted) can lead to increases in effective effort by the fleet. [See Section 7.3.2.]
<p>How achievement is to be measured</p> <p>Achievement of the objective may be measured only by the following -</p> <ul style="list-style-type: none"> (e) the level of compliance with this plan; (f) catch and effort data received by the chief executive for principal fish; (g) the abundance of principal fish; (h) how many effort units are surrendered under sections 117, 118 and 132(2); 	<ul style="list-style-type: none"> ➤ Insufficient compliance information has been provided by the QDPI to measure achievement. [See Sections 7.2.3 and 7.3.7.] ➤ There are concerns over the unverified nature of ECTF logbook data and the appropriateness of nominal CPUE as a performance indicator for stock abundance. By the time significant declines are noticed in the nominal CPUE, the fishery may already be over-fished. [See Sections 5.2, 5.3, 5.5 and 7.1.] ➤ The Audit Report notes that current ECTF stock assessments examine primarily nominal CPUE trends. Fishery-independent stock assessments and the development of assessment models are limited in the ECTF. Also, assessment of the sustainability of the ECTF resources is restricted to principal (i.e. target) species only. [See Sections 5.2 and 5.3.] ➤ Information on effort unit holdings and transactions is monitored by the QFS. The Audit Report notes that if effort creep exceeds the effort reductions achieved through the surrender of effort units, there will be an increase in effective effort in the fishery. [See Sections 5.2.3, 7.2.4 and 7.3.2.]

<p>(e) studies or surveys accepted by the chief executive on the average size, or the main engine power, of boats in the fishery.</p> <p>Review events Each of the following is a review event for the achievement of the objective-</p> <p>(a) CPUE for the following principal fish in the following periods is less than 70% of the average CPUE for principal fish from 1988 to 1997-</p> <p>(vii) for bay prawns (greasy prawns) – 1 November to the end of February;</p> <p>(viii) for eastern king prawns – 1 November to the end of February and 1 May to 31 August;</p> <p>(ix) for bugs – 1 November to the end of February or 1 May to 31 October;</p> <p>(x) for red spot king prawns – 1 June to 30 September;</p> <p>(xi) for saucer scallops – 1 November to the end of February;</p> <p>(xii) for tiger prawns – 1 March to 30 June and 1 September to 31 December;</p> <p>(b) the chief executive accepts a study of catch and effort data that show a significant decline in a principal fish;</p> <p>(c) the chief executive accepts a scientific study that show a significant decline in the abundance of a principal fish species;</p>	<p>➤ Average boat size has increased in the ECTF following the licence buy-out in early 2001. Regular collation of these data is required to monitor the situation on a continual basis.</p> <p>➤ The Audit Report is concerned about the sole reliance on nominal CPUE as a performance indicator of stock abundance and notes that the 70% reference point is based on Western Australian stock assessment findings for tiger prawns. The wording of the review period is defined poorly, leaving ambiguity as to its interpretation. Some principal species and all bycatch species are not covered by the review event. The adequacy of the review periods is questioned for some species. The Audit Report notes that a review event has been triggered potentially (depending upon definition) for 4 of the 6 listed species. There has been on subsequent management action. [See Sections 7.1.4 and 7.2.1.]</p> <p>➤ Review period coincides with fishery season and recruitment period. Review event has been triggered potentially.</p> <p>➤ Review period coincides with fishery season and recruitment period.</p> <p>➤ Review period coincides with fishery season and spawning period. Review event has been triggered potentially.</p> <p>➤ Review period coincides with fishery season and spawning period. Review event has been triggered potentially.</p> <p>➤ Review period coincides with fishery season.</p> <p>➤ Review period coincides with fishery season, spawning and recruitment period. Review event has been triggered potentially.</p> <p>➤ By the time significant declines are noticed in nominal CPUE, the fishery may be over-fished already. “Significant” is also not defined. [See Sections 5.2, 7.1 and 7.2.]</p> <p>➤ With the exception of tiger and endeavour prawns, there are no published assessment reports on the maximum sustainable yield of the ECTF species. Nominal CPUE trends are generally used as an indicator of stock abundance. Only the key principal species are assessed regularly. [See Sections 5.2 and 5.3.]</p>
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<p>(d) more than 5% of boats in the fishery in 2000 or a subsequent year are used to commit an offence under the plan;</p> <p>(e) the number of effort units has not decreased by-</p> <p>(iv) 13% or more in the first effort year;</p> <p>(v) 1% or more in any subsequent effort year; or</p> <p>(vi) 2% or more during 2 consecutive effort years for any licence;</p> <p>(f) the chief executive accepts a study or survey that shows –</p> <p>(iii) a significant change in the relative distribution of boat hull units in the fishery; or</p> <p>(iv) average main engine power for boats in the fishery is increasing.</p>	<p>➤ Notwithstanding the ambiguity in the wording of this review event, the review event appears to have been triggered in 2001. [See Sections 7.2.3 and 7.3.7.]</p> <p>➤ Effort unit reductions through effort unit surrenders and penalties on transactions amounted to 3% in 2001 and accord with the outcome of the GBRMC28. The situation will need to be monitored closely and estimates of effort creep in the ECTF since 1 January 2001 are required. [See Sections 5.2.3 and 7.3.2.]</p> <p>➤ Average boat size has increased in the ECTF following the licence buy-out in early 2001. Regular collation of these data is required to monitor the situation on a continued basis.</p> <p>➤ Apart from the gear sheet information in the OT07 logbooks, this information is not collected routinely. The last comprehensive survey on fleet profile was conducted prior to the structural adjustment scheme and the introduction of revised management arrangements. Increases in hull size and engine power are likely to lead to effort creep in the ECTF under the new management arrangements. [See Sections 5.2.3 and 7.2.1.]</p>
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Objective (c) “Ensuring the sustainability of the fishery’s ecological systems”	
Management Plan Provisions	Audit Report’s Comments
<p>How objective is to be achieved The objective is to be achieved by -</p> <p>(a) the closed waters declarations under this plan; and</p> <p>(b) limiting, under chapters 3 and 4, the commercial fishing apparatus that may be used under this plan; and</p> <p>(c) the requirements under this plan for using a BRD or TED</p> <p>How achievement is to be measured Achievement of the objective may be measured only by surveys or studies, accepted by the chief executive, of commercial fishing for principal fish by trawling in the fishery.</p> <p>Review events Each of the following is a review event for the achievement of the objective-</p> <p>(f) a scientific study, showing levels accepted by the chief executive, shows the amount for any of the following is not, by 1 January 2005, reduced by the following percentage compared with an amount reported in a scientific study showing the levels before the notification day-</p> <p>(iii) benthos-25%;</p>	<p>➤ Seasonal closures to protect parts of the life cycle may assist certain susceptible bycatch species. Similarly, spatial closures may assist susceptible bycatch species that demonstrate a strong habitat preference. Closures also would limit the impact of trawling on fragile benthic habitats. However, little is known about the biology of most bycatch species and ecosystems to make such assessments. [See Section 6.1.3.]</p> <p>➤ Limitations on fishing apparatus may assist, but requires knowledge of how trawling impacts on bycatch species, benthic communities and habitat. [See Section 6.2.4.]</p> <p>➤ The requirement for minimum design standards for TEDs was revised under the Trawl Plan in December 2002, making the permitted TED designs more stringent to ensure effective deployment. The provisions for BRDs still are to be revised to maximise their effectiveness. Further research and development also is required into BRD designs. [See Sections 6.2.1 and 7.3.6.]</p> <p>➤ The health and sustainability of the fishery’s ecological systems cannot be measured by the population dynamics of the target species. There are no regular surveys or studies to assess the impact of trawling or changes in bycatch species composition. There is no formal ecological assessment process. [See Sections 4.3.4 , 6.3.3 and 6.3.5.]</p> <p>➤ In order to measure comparative reductions, knowledge is required of the “baseline“. There are no systematic surveys or studies, which quantify the benthic impact and bycatch for the entire ECTF prior to 1 January 2001. The Terms of Reference for a scientific study have not been specified. [See Section 7.2.2.]</p> <p>➤ The 25% figure is not justified in terms of ecological sustainability, nor is it specified how it will be calculated.</p>

<p>(iv) the amount of fish taken other than principal fish-40%;</p> <p>(g) more than 5% of boats in the fishery in 2000 or a subsequent year are used to commit an offence under the plan;</p> <p>(h) turtle capture or mortality for any of the following species is in any year more than 5% of the average level of turtle capture or mortality for species in the Robins report-</p> <ul style="list-style-type: none"> (vii) flatback turtle; (viii) green turtle; (ix) hawksbill turtle; (x) leatherback turtle; (xi) loggerhead turtle; (xii) olive ridley turtle; <p>(i) the chief executive receives a logbook return for the fishery that shows trawling has happened in an area represented on a grid stated in the logbook where trawling has not previously been recorded in a logbook return;</p> <p>(j) the chief executive accepts a scientific study or survey that shows the level of winter whiting by-catch between 1 April and 1 June has not significantly declined in the area mentioned in schedule 3, section 72(1), before 2003.</p>	<ul style="list-style-type: none"> ➤ The 40% figure is not justified in terms of ecological sustainability, nor is it specified how it will be calculated. ➤ Notwithstanding the ambiguity in the wording of this review event, the review event appears to have been triggered in 2001. [See Sections 7.2.3 and 7.3.7.] ➤ With an amendment to the minimum TED design specifications in the Management Plan, the likelihood of turtle capture should have been significantly reduced. There is no independent verification of logbook reports of turtle interactions. [See Sections 6.1.2, 6.2.1. and 7.2.2.] ➤ The Audit Report is unaware of any data to ascertain if the review event has been triggered. This review event presumably refers to fishery expansion rather than illegal fishing in closed zones. Onus should be on the regular monitoring of spatial fishery-wide trends (in terms of expansion and contraction) rather than on individual logbook records. [See Section 7.2.2.] ➤ The Audit Report does not comment because winter whiting are taken outside the Great Barrier Reef Marine Park.
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Objective (d) “Providing an economically viable, but ecologically sustainable, trawl fishery”	
Management Plan Provisions	Audit Report’s Comments
<p>How the objective is to be achieved The objective is to be achieved by -</p> <p>(a) providing commercial fishers with fair access to permitted fish in the fishery; and</p> <p>(b) minimising restrictions, on a sustainable basis, on trawling; and</p> <p>(c) the provisions of this plan about effort units.</p> <p>How achievement is to be measured Achievement of the objective may be measured only by -</p> <p>(a) studies or surveys accepted by the chief executive on economic aspects of the fishery, and</p> <p>(b) how many effort units are surrendered under sections 117, 118 and 132(2).</p> <p>Review events Each of the following is a review event for the achievement of the objective-</p> <p>(e) the chief executive’s acceptance of an economic study of the fishery that shows a significant decline in the fishery’s economic efficiency;</p> <p>(f) the number of effort units decreases by-</p> <p>(iv) 4% or more in each of 3 consecutive years; or</p> <p>(v) 5% or more in each of 2 consecutive years; or</p> <p>(vi) 6% or more in an effort year after the second effort year;</p>	<p>➤ Following a Trawl Plan Review (August 2002), trip limits have been set for by-product species. These limits were based on the average take of permitted species by ECTF operators and not on estimates of stock sustainability. [See Section 7.3.5.]</p> <p>➤ Input controls by definition aim to restrict the operational efficiency of the fleet. [See Sections 7.3.1 and 7.3.2.]</p> <p>➤ The introduction of tradable effort units has led to an autonomous fishery restructure after the completion of the Structural Adjustment Scheme. [See Section 7.2.4.]</p> <p>➤ The Audit Report is unaware of any study or survey into the economic aspects of the fishery since 1 January 2001.</p> <p>➤ This information has been monitored and reported on by the QFS since 1 January 2001. [See Section 7.2.4.]</p> <p>➤ Information was not made available to determine if this review event has been triggered. However, given the achievements of the Structural Adjustment Scheme and subsequent effort reductions, it is unlikely that the economic efficiency of the ECTF would have decreased since 1 January 2001.</p> <p>➤ The GBRMC 28 outcome required an effort reduction of 3% per annum to compensate for effort creep in the fishery. This was achieved in 2001. [See Section 7.2.4.]</p>

<p>(g) the chief executive’s acceptance of a study that shows effort units consistently can not be obtained by transfer;</p>	<p>➤ The Audit Report is unaware of any study into the trading of effort units. The ability to acquire effort units is subject to normal supply and demand considerations. The type of management intervention that might be triggered by this review event is questioned.</p>
<p>(h) the chief executive accepts a study or survey that shows a total of more than 15,000 fishing days under “M1” and “M2” licences in a year.</p>	<p>➤ The Audit Report does not address this review event as it refers to the fishery outside the Great Barrier Reef Marine Park.</p>

Objective (e) “Ensuring fair access to fisheries resources on a sustainable basis”	
Management Plan Provisions	Audit Report’s Comments
<p>How objective is to be achieved The objective is to be achieved by regulating commercial fishers to ensure fair access to and use of fisheries resources taken in the fishery by persons other than commercial fishers.</p> <p>How achievement is to be measured Achievement of the objective may be measured only by –</p> <p>(a) surveys, accepted by the chief executive, of fishing for fisheries resources taken in the fishery by commercial and recreational fishers and Aborigines and Torres Strait islanders; and</p> <p>(b) commercial fishing catch and effort data for the fishery received by the chief executive.</p> <p>Review events It is a review event for the achievement of the objective if-</p> <p>(c) a survey mentioned in (a) above shows a significant decline in the catch of principal fish; or</p> <p>(d) data mentioned in (b) above show a significant decline in the commercial catch of principal fish.</p>	<ul style="list-style-type: none"> ➤ This objective deals with resource allocation. According to the biennial recreational fishing survey, the usage of ECTF resources by non-commercial fishers appears to be low. [See Section 4.3.6.] ➤ Recreational fisheries data are collected through biennial recreational fishing surveys in Queensland. Information is presented on the state-wide recreational take of “prawns”. Information on the Indigenous take of ECTF species does not appear to be available. [See Section 4.3.6.] ➤ Commercial fishing data are received by the QFS through ECTF logbooks. There are some concerns about the veracity and level of resolution of these data and, consequently, their impact on fishery assessment. [See Sections 4.3, 4.4, 5.2, 5.3, 5.5 and 7.1.] ➤ “Significant” is not defined. Terms of Reference for the survey are not defined. ➤ Catches may decline for reasons other than resource abundance (e.g. fewer operators, less effort, weather conditions, etc.). Stock assessment is required to determine the reasons behind declining catches of principal species. [See Sections 5.2, 5.3 and 5.5.] ➤ The review events are target species-specific. A community cost is involved if the sustainability of by-product or bycatch species becomes threatened as a result of overfishing and/or the impact of trawling.

7.5 The Audit Report's Assessment against the Commonwealth Guidelines

With respect to Guideline 1.1.6

This guideline requires that a “biological bottom line” is set for a stock, that management “action” is triggered if that line is reached, and that there is an upper effort or catch limit beyond which the stock should not be taken. The Audit Report has pointed out that it is unclear if the reference points specified in the Trawl Plan are limit or target reference points. The fact that they have been exceeded on occasion without triggering a performance review (as specified under the plan) would suggest that they are viewed more as a target reference point.

This Audit Report has questioned the appropriateness of the current stock reference points (i.e. 70% of the average CPUE and “significant declines” in catch or CPUE) as a means for the early detection of stock problems. Sharply reduced catch rates over a prolonged period usually are a good indicator that the fishery is being overfished. Precautionary fisheries management dictates that this point should not be reached. The current review to develop more appropriate biological reference points is supported. Such reference points need to be set for all species taken, including principal and permitted species.

The Trawl Plan compels the Chief Executive to take action if a review event is triggered. The Audit Report notes that this has not occurred to date and there is concern that action will be slow if stock problems arise in the fishery. There could be lengthy delays in the commissioning of a scientific study, consideration of its results, formulation of management responses and subsequent public consultation before management actions are implemented. It is noted that the Chief Executive has discretionary powers in the acceptance of the findings of a study or survey.

There is a need for the adoption of a MSE-based management approach in the ECTF. If there are stock concerns for any species, decision rules should be in place to allow speedy action to occur. This requires that such rules are developed and tested (for probability of outcome) before such stock concerns arises.

With respect to Guideline 1.1.7

Since the ECTF is an input-managed fishery, there are no direct controls on the level of take. Several management measures can be used to decrease the amount of fishing time (such as closures), reduce fishing efficiency (such as gear restrictions) or limit the take of species (such as bans on the take of certain species, sexes or lifecycle stages). The rotational scallop closures in the southern part of the fishery are an example of such a response to stock concerns.

An intrinsic problem with input-based management regimes is the difficulty in curbing increases in real effort. Effort constraints usually are matched by industry through increased operational efficiency in other areas (i.e. effort creep). A fundamental problem with the ECTF effort unit system is its inability to allow for across-the-board effort reductions (should this be necessary). The Audit Report advocates that the ECTF should move to a proper TAE system that provides for the regular adjustment of effort in light of stock assessment advice.

With respect to Guideline 1.1.8 and 1.1.9

Stock assessment of by-product species in the ECTF is limited. Commercial logbook data on bycatch have been collected only since the introduction of the OT07. In any case, even if such historical data were available, CPUE-based analysis may not be appropriate for species taken primarily as a by-product. There are no limit reference points set for the permitted species that would signal a reduction in abundances or a change in species composition.

As a precautionary measure, some form of catch limit has been set for permitted species. This limits the take to a normal range of by-product and reduces the incentive to target these species. Limits apply to the amount (numbers or volumes) that may be taken (as with pinkies, octopus, squid, mantis shrimp,

syngnathids and blue swimmer crabs). For others, a ban is placed on the take of females or berried females (as with red spot crab, barking crayfish, Balmain bugs and blue swimmer crabs). Given operational difficulties with the enforcement of by-product provisions, the Audit Report questions how well the ban on targeting and the possession limits are met.

With respect to Guideline 2.1.3

The use of TEDs and BRDs in trawl nets is a requirement in all areas of the ECTF under the revised Trawl Plan. However, progress has been slow in implementing tighter (and more effective) technical prescriptions for these devices. Also, enforcement of compliance with their usage was hampered until late 2002 by an ambiguity in the legislative provisions. The TED specifications now have been resolved and the revised design standards are consistent with other prawn fisheries in Australia.

The development of technical specifications for BRDs has been a slower process than that for TEDs. There are several design standards permitted under the Trawl Plan. Currently, these standards are being reviewed. The Audit Report advocates the early introduction of revised BRD specifications and the on-going monitoring and testing of available BRD technology.

Other measures, which enhance the survival of bycatch, include on-board hoppers and voluntary codes of conduct to minimise trawl time and the size of the gear used in some areas. However, these measures are voluntary and are not widespread in the ECTF.

With respect to Guideline 2.1.4, 2.1.5, 2.2.6, 2.3.4 and 2.3.5

Given the large species diversity, no formal assessment is done on the sustainability of bycatch species or the impact of the fishery on the wider ecosystem. Research suggests that in heavily trawled areas of the fishery significant habitat modification has already occurred. More monitoring information is required on the long-term changes to bycatch composition in the ECTF as a result of trawling. Indicators need to be developed to monitor the impact of the fishery, including the identification of indicator organisms for rare species.

Notwithstanding a lack of clear definition, the ecological performance indicators in the Trawl Plan identify a 40% reduction in the take of bycatch and a 25% reduction of benthos from the 1999 levels. The scientific basis for these figures is unclear and an agreement is yet to be reached on how the reductions are to be calculated. Undoubtedly, bycatch mitigation devices (both TEDs and BRDs) contribute significantly to an overall bycatch reduction, but there is insufficient information to calculate their quantitative impact.

With respect to Guideline 2.1.6

Apart from mitigation devices, the normal suite of input-control management measures could be applied if there are concerns about the sustainability of bycatch species. However, since bycatch is taken incidentally to permitted and principal species, many measures are of limited value and may not reduce the fishing-associated mortality of bycatch. Permanent closures are likely to be beneficial in protecting the biodiversity of bycatch species because they offer refugia from trawl activity.

With respect to Guideline 1.2.1 and 1.2.2

These guidelines relate to the recovery of overfished stocks. The assessment reports suggest a high or fully exploited status for many of the key target species in the ECTF, but do not state that there is any over-fishing. The Audit Report has outlined several concerns with the stock assessment process, which introduces uncertainty into the assessment results. Given the experiences in other prawn fisheries (especially with respect to the longer-lived species like the tiger prawns) a precautionary approach is warranted regarding the level of sustainable exploitation.

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SPECIAL

Great Barrier Reef Marine Park Act 1975

Notice Pursuant to Clause 4.3.2 of the Far Northern Section Zoning Plan

The Great Barrier Reef Marine Park Authority has, for the purposes of clause 4.3.2 of the Far Northern Section Zoning Plan tabled in both Houses of the Commonwealth Parliament on 6 March 2000, accredited the *Fisheries (East Coast Trawl) Management Plan 1999* (as amended) under the *Fisheries Act 1994* of Queensland as ensuring an ecologically sustainable fishery for trawling in the Far Northern Section of the Great Barrier Reef Marine Park.

The aforesaid Management Plan may be inspected at the Queensland Fisheries Service at 157 Ann Street, Brisbane Qld 4000 and copies may be obtained from GoPrint at 371 Vulture Street, Woolloongabba Qld 4102 or from the website of the Queensland Parliamentary Counsel at <http://www.legislation.qld.gov.au>.

Consistent with the resolutions of the Great Barrier Reef Ministerial Council at its 28th Meeting on 13 October 1999, the Great Barrier Reef Marine Park Authority ("the Authority") will conduct an annual audit on the progress of the East Coast Trawl Fishery in achieving the objectives of the *Fisheries (East Coast Trawl) Management Plan 1999* (as amended). This audit will include an assessment by the Great Barrier Reef Marine Park Authority of an annual report provided by the Queensland Fisheries Service to the Authority in respect of the East Coast Trawl Fishery. The Authority will report annually to the Great Barrier Reef Ministerial Council on the findings of this audit.

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**PART 2—OBJECTIVES OF PLAN AND THEIR
ACHIEVEMENT**

4 Objectives

The objectives of this plan are to—

- (a) manage the fishery in a way that gives optimal, but sustainable, community benefit; and
- (b) ensure fisheries resources taken in the fishery are taken in an ecologically sustainable way; and
- (c) ensure the sustainability of the fishery’s ecological systems; and
- (d) provide for an economically viable, but ecologically sustainable, trawl fishery; and
- (e) ensure fair access to fisheries resources taken in the fishery, on a sustainable basis, among the following groups and persons in the groups—
 - (i) commercial fishers;
 - (ii) recreational fishers;
 - (iii) Aboriginal and Torres Strait Islander fishers;²
 - (iv) other users of the fisheries resources.
Example of ‘other users’—
Divers who view or photograph fish, but do not take them.

5 How objectives are to be achieved—sch 2

- (1) Schedule 2 states how the objectives are to be achieved.
- (2) The achievement of each objective must be—
 - (a) measured only in the way stated in schedule 2; and
 - (b) reviewed by the chief executive under section 2303 if a review event stated in schedule 2 for the objective happens.

**SCHEDULE 2
HOW THE OBJECTIVES ARE TO BE ACHIEVED**

section 5

**PART 1—MANAGING THE FISHERY IN A WAY THAT
GIVES OPTIMAL, BUT SUSTAINABLE, COMMUNITY
BENEFIT**

1 Definition for pt 1

In this part—

“objective” means the objective of managing the fishery in a way that gives optimal, but sustainable, community benefit.

2 How objective is to be achieved

The objective is to be achieved by providing fair fishing opportunities for commercial and recreational fishers and Aborigines and Torres Strait Islanders.

3 How achievement is to be measured

Achievement of the objective may be measured only by—

- (a) surveys, accepted by the chief executive, of fishing for fisheries resources taken in the fishery by commercial and recreational fishers and Aborigines and Torres Strait Islanders; and
- (b) commercial fishing catch and effort data for the fishery received by the chief executive.

4 Review events

The review events for the achievement of the objective are—

- (a) a survey mentioned in section 3(a) shows a significant decline in the catch of principal fish; or
- (b) data mentioned in section 3(b) shows a significant decline in the commercial catch of principal fish.

**PART 2—ENSURING FISHERIES RESOURCES TAKEN
IN THE FISHERY ARE TAKEN IN AN ECOLOGICALLY
SUSTAINABLE WAY**

5 Definition for pt 2

In this part—

“objective” means the objective of ensuring fisheries resources taken in the fishery are taken in an ecologically sustainable way.

6 How objective is to be achieved

The objective is to be achieved by the following—

- (a) the provisions of this plan about effort units;
- (b) the closed waters declarations under this plan;
- (c) the regulated fish declarations under this plan;
- (d) limiting, under chapters 3 and 4, the commercial fishing

- (e) apparatus that may be used under this plan;
the boat modification and replacement restrictions under chapter 3, part 8;
- (f) the main engine power restrictions under chapter 3, part 8, division 2 for boat modification or replacement.⁴²

7 How achievement is to be measured

Achievement of the objective may be measured only by the following—

- (a) the level of compliance with this plan;
- (b) catch and effort data received by the chief executive for principal fish;
- (c) the abundance of principal fish;
- (d) how many effort units are surrendered under sections 117, 118 and 132(2);
- (e) studies or surveys accepted by the chief executive on the average size, or the main engine power, of boats in the fishery.

8 Review events

Each of the following is a review event for the achievement of the objective—

- (a) CPUE for the following principal fish in the following periods is less than 70% of the average CPUE for principal fish from 1988 to 1997—
 - (i) for bay prawns (greasy prawns)—1 November to the end of February;
 - (ii) for eastern king prawns—1 November to the end of February and 1 May to 31 August;
 - (iii) for bugs—1 November to the end of February or 1 May to 31 October;
 - (iv) for red spot king prawns—1 June to 30 September;
 - (v) for saucer scallops—1 November to the end of February;
 - (vi) for tiger prawns—1 March to 30 June and 1 September to 31 December;
- (b) the chief executive accepts a study of catch and effort data that shows a significant decline in a principal fish species;
- (c) the chief executive accepts a scientific study that shows a significant decline in the abundance of a principal fish species;
- (d) more than 5% of boats in the fishery in 2000 or a subsequent year

⁴² Chapter 3, part 8, division 2 (Restrictions on amending licence to modify or replace boat)

- are used to commit an offence under this plan;
- (e) the number of effort units has not decreased by—
 - (i) 13% or more in the first effort year; or
 - (ii) 1% or more in any subsequent effort year; or
 - (iii) 2% or more during 2 consecutive effort years for any licence;
 - (f) the chief executive accepts a study or survey that shows—
 - (i) a significant change in the relative distribution of boat hull units in the fishery; or
 - (ii) average main engine power for boats in the fishery is increasing

PART 3—ENSURING THE SUSTAINABILITY OF THE FISHERY’S ECOLOGICAL SYSTEMS

9 Definition for pt 3

In this part—

“**objective**” means the objective of ensuring the sustainability of the fishery’s ecological systems.

10 How objective is to be achieved

The objective is to be achieved by—

- (a) the closed waters declarations under this plan; and
- (b) limiting, under chapters 3 and 4, the commercial fishing apparatus that may be used under this plan; and
- (c) the requirements under this plan for using a BRD or TED.

11 How achievement is to be measured

Achievement of the objective may be measured only by surveys or studies, accepted by the chief executive, of commercial fishing for principal fish by trawling in the fishery.

12 Review events

(1) Each of the following is a review event for the achievement of the objective—

- (a) a scientific study, showing levels accepted by the chief executive, shows the amount for any of the following is not, by 1 January 2005, reduced by the following percentage compared with an amount reported in a scientific study showing the levels

before the notification day—

- (i) benthos—25%;
- (ii) the amount of fish taken other than principal fish—40%;
- (b) more than 5% of boats in the fishery in 2000 or a subsequent year are used to commit an offence under this plan;

SCHEDULE 2, part 3—Sustainability of ecological systems
(continued)

- (c) turtle capture or mortality for any of the following species is in any year more than 5% of the average level of turtle capture or mortality for the species in the Robins report—
 - (i) flatback turtle;
 - (ii) green turtle;
 - (iii) hawksbill turtle;
 - (iv) leatherback turtle;
 - (v) loggerhead turtle;
 - (vi) olive ridley turtle;
- (d) the chief executive receives a logbook return for the fishery that shows trawling has happened in an area represented on a grid stated in the logbook where trawling has not previously been recorded in a logbook return;
- (e) the chief executive accepts a scientific study or survey that shows the level of winter whiting by-catch between 1 April and 1 June has not significantly declined in the area mentioned in schedule 3, section 72(1),43 before 2003.

(2) In this section—

“**Robins report**” means Robins, J.B. 1995, ‘Estimated catch and mortality of sea turtles from the East Coast Otter Trawl Fishery of Queensland, Australia’, ‘Biological Conservation’, vol 74, pp 157–67.44

**PART 4—PROVIDING AN ECONOMICALLY VIABLE,
BUT ECOLOGICALLY SUSTAINABLE, TRAWL
FISHERY**

13 Definition for pt 4

In this part—

“**objective**” means the objective of providing an economically viable, but ecologically sustainable, trawl fishery.

14 How objective is to be achieved

The objective is to be achieved by—

- (a) providing commercial fishers with fair access to permitted fish in the fishery; and
- (b) minimising restrictions, on a sustainable basis, on trawling; and
- (c) the provisions of this plan about effort units.

15 How achievement is to be measured

Achievement of the objective may be measured only by—

- (a) studies or surveys accepted by the chief executive on economic aspects of the fishery; and
- (b) how many effort units are surrendered under sections 117, 118 and 132(2).

SCHEDULE 2, part 4—Economically viable, but ecologically sustainable etc. (continued)

16 Review events

Each of the following is a review event for the achievement of the objective—

- (a) the chief executive’s acceptance of an economic study of the fishery that shows a significant decline in the fishery’s economic efficiency;
- (b) the number of effort units decreases by—
 - (i) 4% or more in each of 3 consecutive effort years; or
 - (ii) 5% or more in each of 2 consecutive effort years; or
 - (iii) 6% or more in an effort year after the second effort year;
- (c) the chief executive’s acceptance of a study that shows effort units consistently can not be obtained by transfer;
- (d) the chief executive accepts a study or survey that shows a total of more than 15 000 fishing days under ‘M1’ and ‘M2’ licences in a year.

**PART 5—ENSURING FAIR ACCESS TO FISHERIES
RESOURCES ON A SUSTAINABLE BASIS**

17 Definition for pt 5

In this part—

“objective” means the objective of ensuring fair access to fisheries resources taken in the fishery, on a sustainable basis, among the following groups and persons in the groups—

- (a) commercial fishers;
- (b) recreational fishers;
- (c) Aboriginal and Torres Strait Islander fishers;
- (d) other users of the fisheries resources.

SCHEDULE 2, part 5—Ensuring fair access to fisheries on a sustainable basis
(continued)

18 How objective is to be achieved

The objective is to be achieved by regulating commercial fishers to ensure fair access to and use of fisheries resources taken in the fishery by persons other than commercial fishers.

19 How achievement is to be measured

Achievement of the objective may be measured only by—

- (a) surveys, accepted by the chief executive, of fishing for fisheries resources taken in the fishery by commercial and recreational fishers and Aborigines and Torres Strait Islanders; and
- (b) commercial fishing catch and effort data for the fishery received by the chief executive.

20 Review events

It is a review event for the achievement of the objective if—

- (a) a survey mentioned in section 19(a) shows a significant decline in the catch of principal fish; or
- (b) data mentioned in section 19(b) shows a significant decline in the commercial catch of principal fish.

Guidelines for the Ecologically Sustainable Management of Fisheries

To satisfy the Commonwealth Government requirements for a demonstrably ecologically sustainable fishery, the fishery or fisheries if a species is caught in more than one fishery, must operate under a management regime that meets Principles 1 and 2. The management regime must take into account arrangements in other jurisdictions, and adhere to arrangements established under Australian laws and international agreements.

The management regime does not have to be a formal statutory fishery management plan as such, and may include non-statutory management arrangements or management policies and programs. The regime should:

- be documented, publicly available and transparent;
- be developed through a consultative process providing opportunity to all interested and affected parties, including the general public;
- ensure that a range of expertise and community interests are involved in individual fishery management committees and during the stock assessment process;
- be strategic, containing objectives and performance criteria by which the effectiveness of the management arrangements are measured;
- be capable of controlling the level of harvest in the fishery using input and/or output controls;
- contain the means of enforcing critical aspects of the management arrangements;
- provide for the periodic review of the performance of the fishery management arrangements and the management strategies, objectives and criteria;
- be capable of assessing, monitoring and avoiding, remedying or mitigating any adverse impacts on the wider marine ecosystem in which the target species lives and the fishery operates; and
- require compliance with relevant threat abatement plans, recovery plans, the National Policy on Fisheries Bycatch, and bycatch action strategies developed under that policy

The management regime also must comply with any relevant international or regional management regime to which Australia is a party. Compliance with the international or regional regime does not mean Australia cannot place upon the management of the Australian component of the fishery management controls that are more stringent than those required through the international or regional regime.

PRINCIPLE 1

A fishery must be conducted in a manner that does not lead to over-fishing, or for those stocks that are over-fished, the fishery must be conducted such that there is a high degree of probability the stock(s) will recover .

Objective 1. The fishery shall be conducted at catch levels that maintain ecologically viable stock levels at an agreed point or range, with acceptable levels of probability.

Information requirements

1.1.1 There is a reliable information collection system in place appropriate to the scale of the fishery. The level of data collection should be based upon an appropriate mix of fishery independent and dependent research and monitoring.

Assessment

1.1.2 There is a robust assessment of the dynamics and status of the species/fishery and periodic review of the process and the data collected. Assessment should include a process to identify any reduction in biological diversity and /or reproductive capacity. Review should take place at regular intervals but at least every three years.⁶⁷

1.1.3 The distribution and spatial structure of the stock(s) has been established and factored into management responses.

1.1.4 There are reliable estimates of all removals, including commercial (landings and discards), recreational and indigenous, from the fished stock. These estimates have been factored into stock assessments and target species catch levels.

1.1.5 There is a sound estimate of the potential productivity of the fished stock/s and the proportion that could be harvested.

Management responses

1.1.6 There are reference points (target and/or limit), that trigger management actions including a biological bottom line and/or a catch or effort upper limit beyond which the stock should not be taken.⁶⁸

1.1.7 There are management strategies in place capable of controlling the level of take.

1.1.8 Fishing is conducted in a manner that does not threaten stocks of by-product species. (Guidelines 1.1.1 to 1.1.7 should be applied to by-product species to an appropriate level)

1.1.9 The management response, considering uncertainties in the assessment and precautionary management actions, has a high chance of achieving the objective.

Objective 2. Where the fished stock(s) are below a defined reference point, the fishery will be managed to promote recovery to ecologically viable stock levels within nominated timeframes.

⁶⁷ Review should be undertaken by the relevant management authority in a transparent way

⁶⁸ Reference points can allow for seasonal fluctuations in stock recruitment and other areas of uncertainty

Management responses

- 1.2.1** A precautionary recovery strategy is in place specifying management actions, or staged management responses, which are linked to reference points. The recovery strategy should apply until the stock recovers, and should aim for recovery within a specific time period appropriate to the biology of the stock.⁶⁹
- 1.2.2** If the stock is estimated as being at or below the biological and / or effort bottom line, management responses such as a zero targeted catch, temporary fishery closure or a ‘whole of fishery’ effort or quota reduction are implemented.

PRINCIPLE 2

Fishing operations should be managed to minimise their impact on the structure, productivity, function and biological diversity of the ecosystem.⁷⁰

Objective 1. The fishery is conducted in a manner that does not threaten bycatch species.

Information requirements

- 2.1.1** Reliable information, appropriate to the scale of the fishery, is collected on the composition and abundance of bycatch.

Assessments

- 2.1.2** There is a risk analysis of the bycatch with respect to its vulnerability to fishing.⁷¹

Management responses

- 2.1.3** Measures are in place to avoid capture and mortality of bycatch species unless it is determined that the level of catch is sustainable (except in relation to endangered, threatened or protected species). Steps must be taken to develop suitable technology if none is available.
- 2.1.4** An indicator group of bycatch species is monitored.
- 2.1.5** There are decision rules that trigger additional management measures when there are significant perturbations in the indicator species numbers.
- 2.1.6** The management response, considering uncertainties in the assessment and precautionary management actions, has a high chance of achieving the objective.

Objective 2. The fishery is conducted in a manner that avoids mortality of, or injuries to, endangered, threatened or protected species and avoids or minimises impacts on threatened ecological communities.⁷²

Information requirements

- 2.2.1** Reliable information is collected on the interaction with endangered, threatened or protected species and threatened ecological communities.

Assessments

- 2.2.2** There is an assessment of the impact of the fishery on endangered, threatened or protected species.

⁶⁹ Strategies require that recovery should take place within specified times with certain degrees of probability

⁷⁰ The issues addressed under the principle are those that define components of ecosystem integrity

⁷¹ The vulnerability of a bycatch species may be its vulnerability to fishing technology (eg its catchability), or its vulnerability in terms of ecological impact (eg loss of predators or prey)

⁷² “Protected” species are those which warrant a higher degree of conservation and for which explicit legislative or other mechanisms exist, eg they may be categorised under separate legislation as “endangered”, “threatened”, “protected”

2.2.3 There is an assessment of the impact of the fishery on threatened ecological communities.

Management responses

2.2.4 There are measures in place to avoid capture and/or mortality of endangered, threatened or protected species.

2.2.5 There are measures in place to avoid impact on threatened ecological communities.

2.2.6 The management response, considering uncertainties in the assessment and precautionary management actions, has a high chance of achieving the objective.

Objective 3. The fishery is conducted, in a manner that minimises the impact of fishing operations on the ecosystem generally.

Information requirements

2.3.3 Information appropriate for the analysis in 2.3.2 is collated and/or collected covering the fisheries [sic] impact on the ecosystem and environment generally.

Assessment

2.3.2 Information is collected and a risk analysis, appropriate to the scale of the fishery and its potential impacts, is conducted into the susceptibility of each of the following ecosystem components to the fishery.

1. Impacts on ecological communities
 - Benthic communities
 - Ecologically related, associated or dependent species
 - Water column communities
2. Impacts on food chains
 - Structure
 - Productivity/flows
3. Impacts on the physical environment
 - Physical habitat
 - Water quality

Management responses

2.3.4 Management actions are in place to ensure significant damage to ecosystems does not arise from the impacts described in 2.3.1.

2.3.5 There are decision rules that trigger further management responses when monitoring detects impacts on selected ecosystem indicators beyond a predetermined level, or where action is indicated by application of the precautionary approach.

2.3.5 The management response, considering uncertainties in the assessment and precautionary management actions, has a high chance of achieving the objective

DEFINITIONS

The following defines how certain terms will be interpreted in application of the guidelines.

Associated and/or dependent species – species associated with or dependent upon harvested species, for example species which are predator or prey of the harvested species.

Biological diversity, biodiversity – the variability among living organisms from all sources (including marine and other aquatic ecosystems and the ecological complexes of which they are part). Includes 1) diversity within species and between species; and 2) diversity of ecosystems.

Bycatch - species that are discarded from the catch or retained for scientific purposes, and that part of the “catch” that is not landed but is killed as a result of interaction with fishing gear. This includes discards of commercially valuable species.

By-product - species that are retained because they are commercially valuable but are not the main target species.

Ecologically related species – species which, while not associated with or dependent upon a harvested species, nevertheless are affected by the fishing operation.

Ecologically sustainable – use of natural resources within their capacity to sustain natural processes while maintaining the life-support systems of nature and ensuring that the benefit of the use to the present generation does not diminish the potential to meet the needs and aspirations of future generations.

Ecologically viable stock - ecological viable stock has a general rather than a specific meaning. It refers to the maintenance of the exploited population at high levels of abundance designed to maintain productivity, provide margins of safety for error and uncertainty and maintain yields over the long term in a way that conserves the stocks role and function in the ecosystem.

Ecosystem - the biotic (living) community and its abiotic (non-living) environment.

Function - relationships between components of the ecosystem, without which individuals could not survive and/or reproduce. eg protection for juveniles provided by marine plants; trophic relationships.

Management regime – In this document, refers to the policies, plans, action plans, strategic research plans, and all documentation that relates to the operations and management of the fishery.

Overfishing - can be defined in two ways which can act independently or concurrently: 1) “recruitment overfishing”, where fishing activities are causing a reduction in recruitment in succeeding years and cause the mortality of too many fish in total, too many pre-productive fish, or too many fish that have only spawned a few times. The end result is that the stock can no longer replenish itself adequately. 2) “growth overfishing”: where fishing activities lead to a reduction in the size of the individuals of a species, as a consequence of which few specimens grow to the size for optimum yield.

Precautionary approach - used to implement the precautionary principle. In the application of the precautionary principle, public and private decisions should be guided by: 1) careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment; and 2) an assessment of the risk-weighted consequences of the various options.

APPENDIX 3

Precautionary principle – the lack of full scientific certainty should not be used as a reason for postponing a measure to prevent degradation of the environment where there are threats of serious or irreversible environmental damage.

Precautionary recovery strategy - Management and operational strategy, designed to increase numbers within the stock, that incorporates the precautionary approach and includes mechanisms to avoid or mitigate adverse ecosystem effects.

Productivity - when applied to fish stocks the term productivity gives an indication of the birth, growth and death rates of a stock.

Reference point - an indicator level of fishing (or stock size) to be used as a benchmark for assessment or decision making.

Stock – In the strict sense, a distinct, reproductively isolated population. In practice, a group of individuals of a species in a defined spatial range which is regarded as having a relatively low rate of exchange with others of the species.

Chronology of Key Events in the East Coast Trawl Fishery

Date	Event
1976	Some 700 vessels licensed to fish in the ECTF.
September 1979	Queensland announced effort limitations in the ECTF for the first time, including a moratorium on the number of vessels permitted in the ECTF and a 2:1 boat replacement rule .
1981	Size of the ECTF fleet peaked at 1,413 licences.
December 1984	The Australian Fisheries Service ceased granting licences for vessels to fish in Commonwealth waters (>3nm).
July 1987	OCS between Queensland and the Commonwealth, resulting in amalgamation of the State and Commonwealth components of the ECTF and jurisdiction being passed to Queensland.
1994	Introduction of the new <i>Queensland Fisheries Act 1994</i> , which provided for the establishment of MACs and the introduction of fisheries management plans.
December 1996	Release of the “ <i>Queensland Trawl Fishery – Discussion Paper No.5</i> ” by QFMA.
March 1997	Response by GBRMPA to Discussion Paper No.5.
1998	Release of information paper entitled “ <i>Queensland Trawl Fishery - Proposed Management Arrangements (East Coast – Moreton Bay) 1998 – 2005</i> ” by QFMA.
1998	Establishment of the GBRMPA’s Fisheries Issues Group.
1999	Release of the ECTF Draft Management Plan 1999 and Regulatory Impact Statement.
1999	Submission by GBRMPA to QFMA on the Draft Management Plan for the ECTF, incorporating a GBRMPA – commissioned assessment report on the Draft Management Plan for the fishery by an independent expert panel.
July 1999	GBR Ministerial Council establishes a Trawl Task Force consisting of Commonwealth and Queensland officials to deal with the issues raised in response to the draft plan and RIS.
1999	Port meetings along the Queensland East Coast to discuss the proposed ECTF management arrangements with industry.
1999	Negotiations between the Commonwealth and Queensland over the proposed ECTF management arrangements.
1999	GBR Ministerial Council (GBRMC28) considers the recommendations of the Trawl Task Force and agreed on principles with respect to the ECTF Management Plan; recommends how to progress issues; and the requirement for an annual Audit by the

APPENDIX 4

	GBRMPA of the ECTF.
1999	Introduction of the ECTF Management Plan, which did not contain measures to address the difficult and controversial issues identified by the Trawl Task Force and agreed by the GBR Ministerial Council.
1999	“Stakeholder Working Group on the Queensland ECTF Management Plan” established to achieve industry acceptance of GBR Ministerial Council outcomes, including effort capping at 1996 levels and further reductions; closure of non fished areas and the mandatory use of TEDs and BRDs.
March 2000	Stakeholder Working group reports to Queensland Premier on recommendations for the Queensland ECTF Management Plan and a proposed timetable.
April	Report on “ <i>Proposed Structural Adjustment in the Queensland ECTF</i> ” by the QFS.
July 2000	External Review of the Queensland Vessel Monitoring System.
November– December 2000	Negotiations about the Commonwealth’s contribution of \$10 Million to the ECTF Structural Adjustment Scheme.
1 January 2001	Implementation of revised ECTF Management Plan, including significant improvements to management of the ECTF: <ul style="list-style-type: none"> - introduction of tradable effort units. - capping of fishing effort at the 1996 level. - voluntary effort reduction by industry of 5%. - effort reductions through effort unit penalties upon trading. - introduction of VMS system. - closure of additional 96,000 sq. km of GBR Marine Park. - introduction of TEDs and BRDs in all parts of the ECTF by end 2001. - only principal species to be targeted. - introduction of sustainability indicators and review events.
January – March 2001	Finalisation of the \$20 million ECTF Structural Adjustment Scheme, resulting in the voluntary buy-out of 99 licences and 10.86% of effort.
January – June 2001	Negotiations between the Commonwealth, Queensland and industry on options to cap effort in the GBR World Heritage Area.
26 April 2001	QFS issued Regulatory Impact Statement dealing with effort in WHA <ul style="list-style-type: none"> - no mandatory closure of WHA if effort cap is reached. - 3% annual reduction in effort cap. - retrieval of effort units if WHA effort is be reached.
8 June 2001	Meeting of Great Barrier Reef Ministerial Council; Queensland inclusion of steaming days in WHA effort cap.
15 June 2001	Commonwealth advised Queensland that accreditation of the ECTF Management Plan would be linked to the resolution of the WHA effort issue.
22 June 2001	Revised ECTF Management Plan enters into force:

APPENDIX 4

	<ul style="list-style-type: none"> - entire ECTF closure if WHA effort cap is reached. - no legislative guarantee of closure. - no ability to reduce effort units on ecological sustainability grounds.
9 August 2001	<p>Agreement was reached between Commonwealth and Industry on WHA effort issue, involving:</p> <ul style="list-style-type: none"> - automatic closure of WHA fishery if cap is reached. - 3% annual reduction in WHA effort cap during life of Management Plan
19 September 2001	<p>Marine Park Authority accredits the ECTF Management Plan under the Far Northern Section Zoning Plan;</p>
September 2001	<p>Regulations introduced under Queensland fisheries legislation giving effect to agreement between Commonwealth and Industry.</p>
3 September 2001	<p>QFS releases Review Paper on permitted species and steaming provisions (in line with legislative requirement under the Management Plan).</p>
29 October 2001	<p>QFS releases Regulatory Impact Statement and Draft Amendment Plan on permitted species and steaming provisions in light of comments received in response to Review Paper.</p>
26 November 2001	<p>QFS receives legal advice that the TED guidelines are inconsistent with the <i>Statutory Instruments Act 1992 (QLD)</i>.</p>
December 2001	<p>QFS proposes changes to management of permitted species and steaming provisions, for introduction by 1 January. 2002.</p>

Current research of relevance to the East Coast Trawl Fishery

Project Title	Funding source	Project duration	Overall objectives
Development of a genetic method to estimate effective spawner numbers in the NPF and Queensland tiger prawn fishery.	FRDC/AFMA	2 years (Jul 2001- June 2004)	New genetic method being developed, using tiger prawns in Moreton Bay as a model, which will indirectly determine the number of breeding adults; may lead to more accurate predictions of recruitment and improve the spatial resolution of spawning stocks; may be applicable to other heavily exploited fisheries.
Bycatch weight, composition and preliminary estimates of the impact of bycatch reduction devices in Queensland's trawl fishery.	FRDC	3 years (Jul 2000- June 2003)	Aim to measure impact of TEDs and BRDs on prawn, scallop and bycatch catch rates.
Reference point management and the role of catch-per-unit effort in prawn and scallop fisheries	FRDC	3 years (Jul 1999- June 2002)	Quantify effort creep in the eastern king prawn, scallop, tiger/endeavour and Torres Strait tiger prawn sectors. Undertake assessment of these stocks using both unstandardised and standardised catch per unit of effort data.
Environmental flows for estuaries	CRC/FRDC	5 years (July 2000- June 2005)	Link recruitment, growth and movement of banana prawns with different levels of freshwater flow to catches in the inshore beam trawl and offshore otter board trawl fisheries.
"GBRprawn" an ecosystem model of the prawn trawl fishery in the GBR world heritage area.	DPI/ Smithsonian Fellowship	1 year	Evaluate ecosystem management of the commercial fisheries in the GBR World Heritage Area.
Potential of using climate variability in predictive models for Queensland fisheries.	DPI	3 months (end June 2002)	<ul style="list-style-type: none"> Identify key relationships between catch rates and environmental conditions (eg ocean temperature, EAC strength) or pre-conditions (e.g. freshwater river discharge) Quantify long-term variability in these environmental variables, and linkages with key climatic indicators (e.g. El Niño/Southern Oscillation phenomenon, sea-surface temperatures). Use these relationships in stock assessment model for eastern king prawn, spanner crab and scallops.
Inventory and mapping of seabed biota in the GBRWHA to support	CRC Reef/ FRDC(?)	5 years	Map marine biodiversity of the GBR World Heritage Area by extensive acoustic, dredge, trawl sampling

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management for ecological sustainability of the QECTF.			
Evaluation of hoppers for reduction of bycatch mortality in the Queensland East Coast Prawn Trawl Fishery.	FRDC	1 year	Evaluate the survival of bycatch using seawater-filled hoppers compared to normal prawn sorting trays.
Recovery of the seabed environment from the impact of prawn trawling in the Far Northern Section of the Great Barrier Reef.			In final stages of writing up.
Development of manufactured attractants as a means to harvest prawns.	FRDC, AIMS	2 years (July 2000-June 2002)	Quantify the attraction and specificity of pheromones from Crustacea in experimental environments. Develop methods suitable for isolating and concentrating pheromones from crustaceans, especially penaeid prawns. Identify mechanism for manufacturing a bait incorporating these novel attractants.
Dynamics of large sessile seabed fauna, important for structural fisheries habitat and biodiversity of marine ecosystems – and use of these habitats by key finfish species.			Contact Roland Pitcher, CSIROfor details
Factors affecting the distribution of black tiger prawn <i>Penaeus monodon</i> brood stock and alternative harvest strategies.		3 years	Examine spatial distribution of black tiger prawns in north Queensland and evaluate alternative harvesting (ie., potting) methods for black tiger prawns.
Innovative stock assessment and effort mapping using VMS and electronic logbooks	FRDC	3 years (Jul 2002-June 2005)	Review VMS mapping software. Develop precise maps of trawl tracks and trawl effort in each trawl sector. Estimate the distribution and extent of trawled and untrawled areas. Map CPUEs. Use these methods to improve Trawl Fishery Review Events, and improve stock assessment approaches for scallops, eastern king prawns and tiger prawns.

Summary of Stock Assessment Findings for the Principal ECTF Species

Assessment Considerations	Tiger Prawns (Brown & Grooved)	Endeavour Prawns (Red & Blue)	Northern King Prawn (Red Spot & Blue-legged)
Distribution	Brown tigers – WA, NT, QLD, northern NSW; Grooved tigers – WA to mid-QLD; Evidence of localised populations with low levels of cross-migration; Decreasing southerly abundance	Blue endeavours - WA, NT, QLD, northern NSW; Red endeavours - WA to southern NSW; Decreasing southerly abundance	Red spot kings - WA to mid-QLD; Coral reef associated; Blue-legged kings – WA, NT, QLD, northern NSW
Population Characteristics	Highly fecund; Live up to 2 years	Highly fecund	Highly fecund; Blue-legged kings live up to 4 years
Assessment Status	Fully exploited; CPUE – fluctuating (possibly declining); MSY 1,598t/yr in the far northern region	Fully exploited; CPUE – fluctuating (possibly declining); MSY – unknown	Possibly fully exploited; CPUE – fluctuating (possibly declining); MSY – unknown
Effort Creep in Fishery	Low till 1998; More significant since	Low till 1998; More significant since	Unknown
Product Status	Target product	Previously by-product; Now mostly target product	Both target and by- product depending upon area
Species Identification	No species separation in logbooks	No species separation in logbooks	Species separated in logbooks
Catch Composition	Part of multi-species assemblage of tropical penaeid fisheries	Part of multi-species assemblage of tropical penaeid fisheries	Part of multi-species assemblage of tropical penaeid fisheries
Temporal variability - yearly variability - lunar periodicity	High Present	High Present	High No lunar periodicity in red spot king prawns
Spawning Event	Brown tigers – single spawning in summer; Grooved tigers – single spawning from summer to autumn	Continuous spawning (peaking in summer) for both species	Red spot kings – winter to spring; Blue-legged kings –single spawning in colder waters during summer; continuous spawning in tropics
Schooling behaviour	Weak schooling	Weak schooling	Weak schooling
Life History	Juvenile – inshore Adult – offshore	Juvenile – inshore Adult – offshore	Juvenile –inshore Adult – lagoonal

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Assessment Considerations	Banana Prawns (White bananas)	Eastern King Prawn	
Distribution	WA, NT, QLD, northern NSW; Decreasing southerly abundance;	From mid QLD (Mackay) to north-eastern TAS	
Population Characteristics	Highly fecund; Live up to 18 months; Recruitment strongly influenced by climatic conditions	Highly fecund; Live up to 2 years;	
Assessment Status	None	Unknown	
Effort Creep in Fishery	Low	Major effort creep in the shallow EKP Fishery; Lesser effort creep in the deeper EKP Fishery	
Product Status	Target product	Target product	
Species Identification	Species separated in logbooks	Single species	
Catch Composition	Single species fishery with fish and other species as minor by-product	Single species fishery with fish and other species as minor by-product	
Temporal variability - yearly variability; - lunar periodicity;	High Present	High Present	
Spawning Event	Continuous spawning throughout most of the year (peaking in Sep. – Nov. and Mar. – May)	Low level continuous spawning throughout the year but major spawning event May-July	
Schooling behaviour	Strong schooling	Weak schooling	
Life History	Juvenile – in freshwater swamps and rivers; Adult –inshore	Complex life history involving: - inshore nursery habitat; - offshore and longitudinal migration by sub-adults; - offshore adult grounds;	

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Assessment Considerations	Scallops (Saucer & Mud)	Bugs (Mud & Reef Bugs)	Squid (Inshore squid (2 sp.) & Calamary (2 sp.))
Distribution	Saucer scallops – from north QLD to southern NSW; Mud scallops – northern QLD	WA, NT, QLD, northern NSW;;	From WA to southern QLD (Moreton Bay);
Population Characteristics	Highly fecund; Live up to 3 years; Recruitment strongly influenced by oceanic conditions	Low fecundity; Recruitment at 1 –2 years; Live up to 6 years	High fecundity; Live up to 18 months
Assessment Status	Saucer scallops heavily (heavily) exploited	Unknown	Unknown
Effort Creep in Fishery	Unknown	Unknown	Unknown
Product Status	Saucer scallops- target product; Mud scallops - by-product in northern prawn fishery	Principal species can be targeted; usually taken as by-product only; Suggestion that there is escape through TEDs and BRDs	By-product only
Species Identification	One species only	No species separation in logbooks	No species identification in logbooks
Catch Composition	Saucer scallops is a single-species fishery with fish and other species as minor by-product	Mud bugs taken as part of the red spot king prawn fishery; Reef bugs taken as part of tiger/endeavour prawn fishery	Pencil squid are generally taken as by-product to trawling
Temporal variability - yearly variability; - lunar periodicity;	High	Unknown	High
Spawning Event	Continuous spawners throughout winter - spring (peaking in June and August); Broadcast spawners	Two spawning periods (Aug. - Sep. and Jan. – Feb.), with peak spawning in spring; minimum 3 months between spawnings	Continuous spawners throughout the year (peaking in Feb. - May and Aug. – Nov.)
Schooling behaviour	Adults settle on beds (i.e. aggregations)	Aggregations in preferred habitat types	Strong schooling (feeding and spawning aggregations)
Life History	Juvenile – short pelagic phase, settle after about 20 days; Adult – sexually mature after 1 year	Juvenile biology unknown; Adult recruitment into trawl grounds at 1 – 2 years;	Limited information available; Juveniles remain in hatching areas until recruitment where fishery at 12 months

Provisions for the use of BRDs and TEDs in Trawl Plan (prior to the Trawl Plan amendment in December 2002)

PART 4—USE OF TEDs

Division 1—Preliminary

51 Application and purpose of pt 4

This part—

- (a) applies if, under chapter 4, a TED must be used with a net used under a provision of that chapter; and
- (b) prescribes an additional condition to which the licence under which the net is used is subject.

52 Purpose of TED

The purpose of a TED is to allow turtles to escape immediately after being taken in the net.

Division 2—TED use condition

53 Requirement to achieve purpose

(1) The licence under which the net is used is subject to a condition (the “**TED use condition**”) that the use of the net must achieve the purpose of a TED.

(2) The TED use condition also applies to anyone acting under the licence.

Division 3—Compliance with TED use condition

Subdivision 1—General

54 How to comply

(1) The TED use condition is taken to have been complied with if a device that complies with section 55 (a “**recognised TED**”) is used with the net.

Provisions for the use of BRDs and TEDs in Trawl Plan (prior to the Trawl Plan amendment in December 2002)

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