



THE GREAT BARRIER REEF MARINE PARK AUTHORITY



RESEARCH REPORT
1976/82

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1976-1982**

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cover photograph:

Bushy Island on Redbill Reef, located northeast of Mackay. This is an unusual reef due to its high exposure at low tide and terraced reef edge. The well-vegetated cay is a Queensland National Park.

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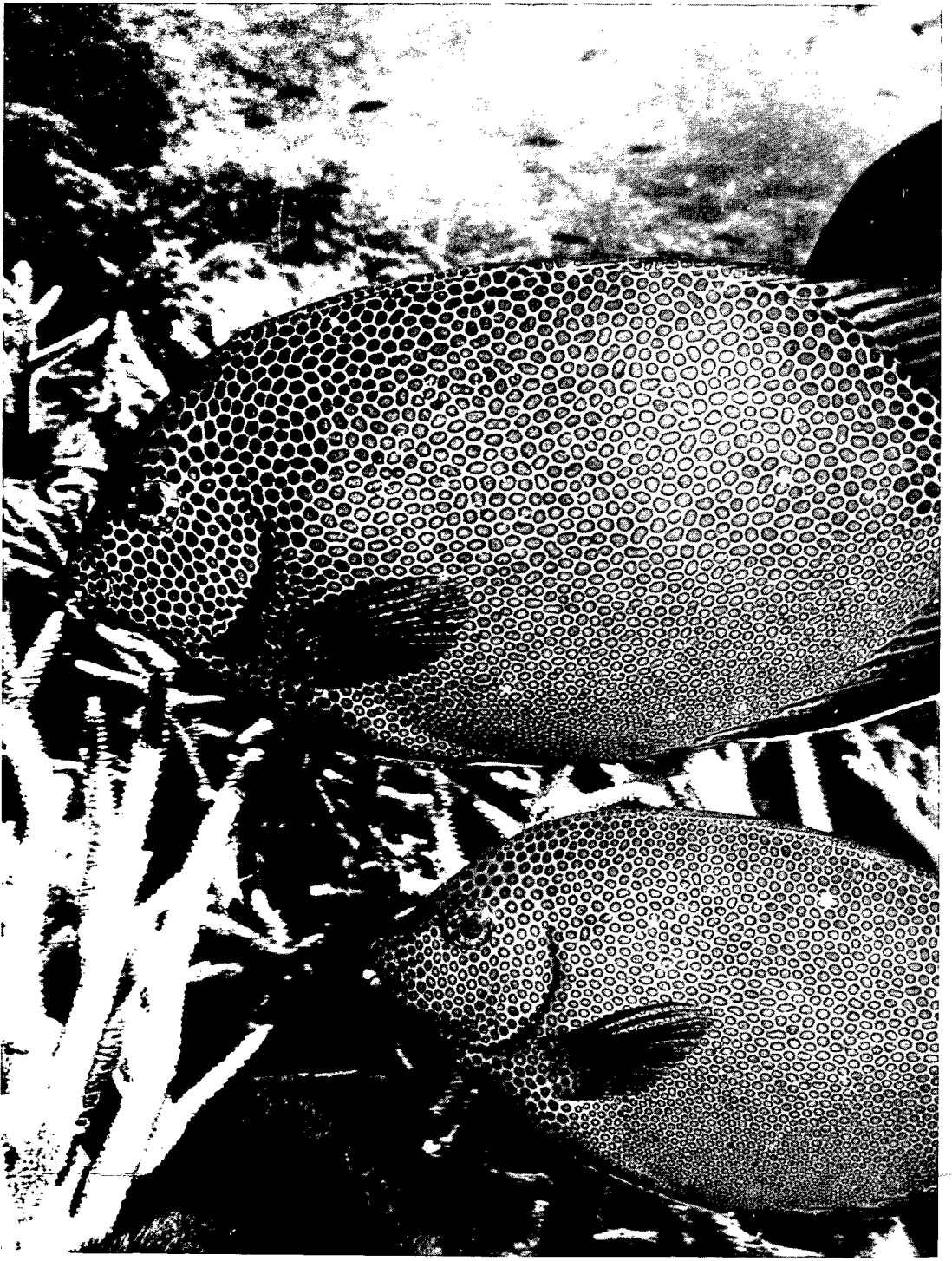
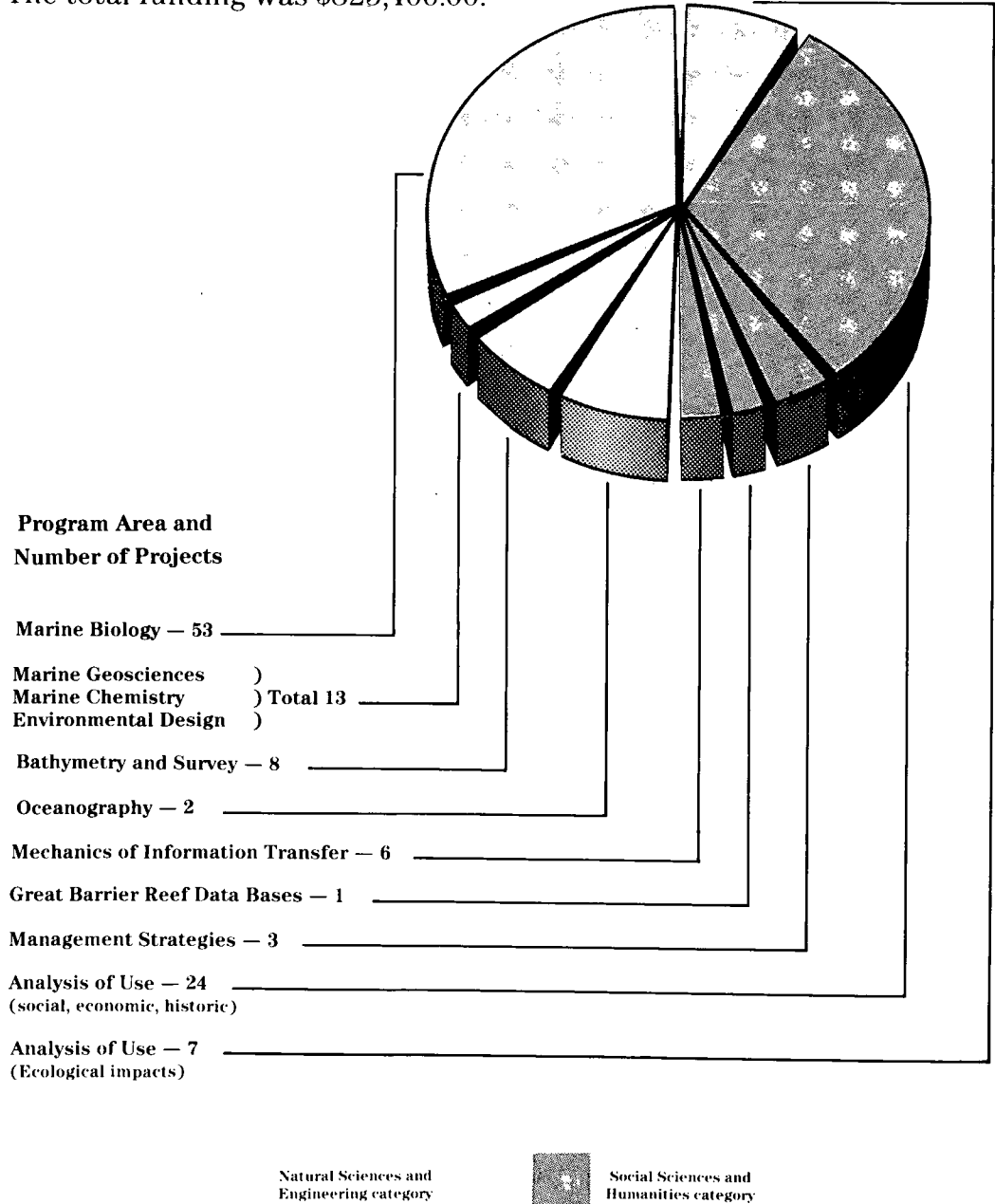


Figure One

DISTRIBUTION OF FUNDING

The pie diagram shows the percentage of funds for each research program area, over the period 1976/77 to 1981/82.

The total funding was \$825,400.00.





INTRODUCTION

The Great Barrier Reef Marine Park Authority is not primarily a research organisation but it may commission, or if necessary conduct itself, research relevant to the Great Barrier Reef Marine Park. Wherever feasible the Authority seeks to obtain such information through projects within the research programs of other institutions. However, where this is not practicable the Authority can use its powers under Section 7(1)(b) of the *Great Barrier Reef Marine Park Act 1975* to arrange for the research to be carried out.

In the period 1976-1982 the Authority provided funds totalling \$825,400 for 118 research and investigatory projects. Eighty-six per cent of the projects have been undertaken by other agencies, either especially commissioned by the Authority (26 per cent) or assisted by a grant from the Authority for a submitted research proposal relevant to the planning and management of the Marine Park (60 per cent).

This document is intended to summarise research funded by the Great Barrier Reef Marine Park Authority. The Authority has identified ten research program areas in which research relevant to the Marine Park may be conducted. These are listed in the Contents. The distribution of funds between the ten research program areas is shown in Figure One (page i).

The ten areas can be grouped into the two broad categories used by the Department of Science and Technology for the Science and Technology Statement 1982-83. Fifty per cent of funds fall into the *Natural Sciences and Engineering* (NSE) category; 40 per cent into *Social Sciences and Humanities* (SSH). Ten per cent of funds for projects in Analysis of Use (ecological impacts) fall between the two groups.

Research Projects include:

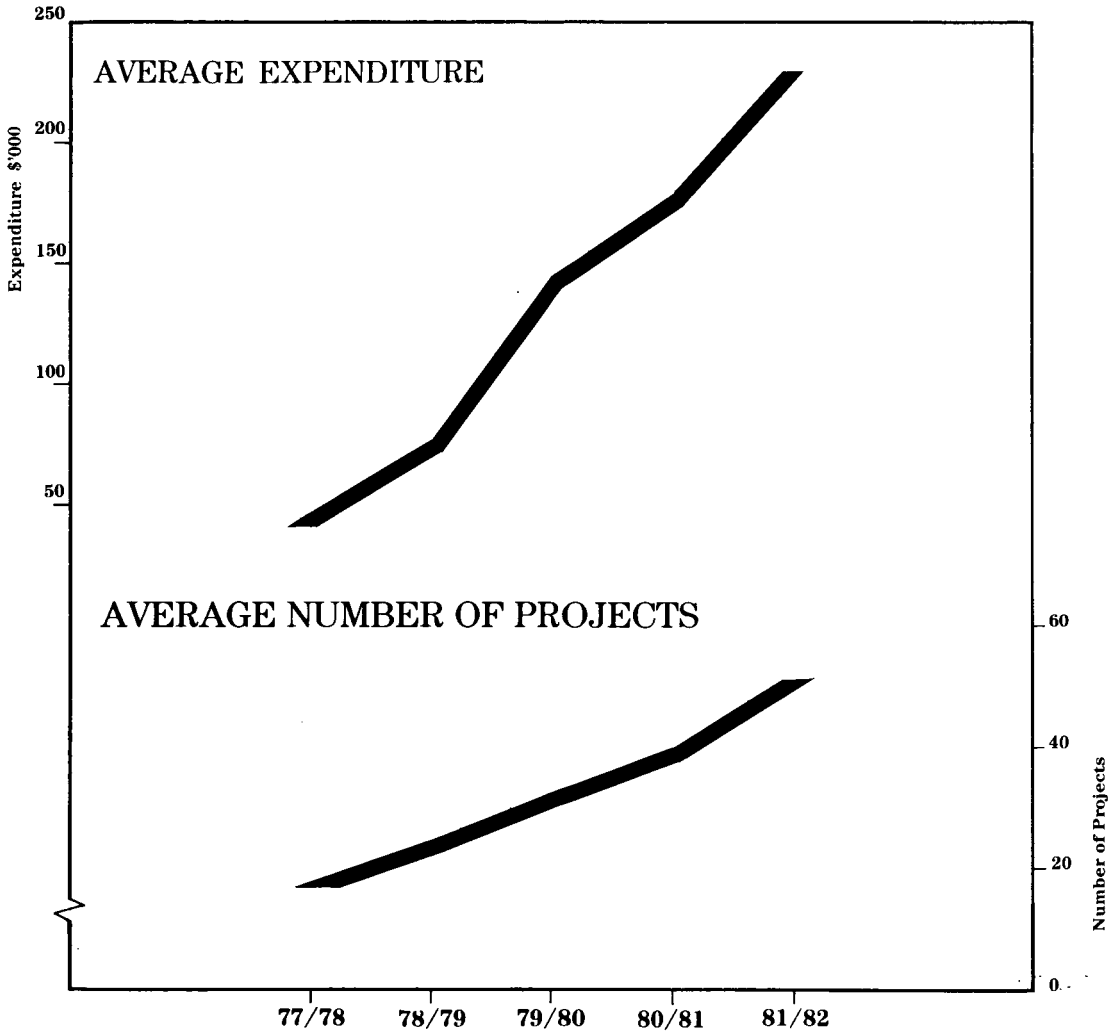
1. Consultancies in which projects proposed by GBRMPA were competitively contracted out (26% of the 118 projects).
2. Research grant projects in which proposals were referred by other agencies or were submitted unsolicited and funds were granted to the research (22%). A special section of research grant projects is the Augmentative Research Support Scheme in which the Authority awards supplementary grants to graduate and post graduate students (38%).
3. Joint studies — GBRMPA with other agencies (4%).
4. Research by GBRMPA staff (6%).
5. Workshops funded/organised by GBRMPA (4%).

The increase in research effort over the period is indicated in Figure Two (page iv) which shows the number of projects in progress and expenditure on research each year.

In future years the summaries of research projects will be presented as an Appendix to the Authority's Annual Report.

(Graeme Kelleher)
Chairman

Figure Two



THREE-YEAR MOVING AVERAGE OF EXPENDITURE ON RESEARCH AND NUMBER OF PROJECTS IN PROGRESS — 1977/78 TO 1981/82.

Source for Expenditure: Financial Statements presented in Annual Reports of The Great Barrier Reef Marine Park Authority 1976/77 to 1982/83.

FORMAT AND DEFINITIONS

Projects are presented under the ten research areas in chronological order.

The format for reporting each project is based on the format of *Australian Marine Research in Progress*. Some of the headings used are defined below; others are self-explanatory.

Organisations are the consultants, or the institutions with which the Project Leaders are affiliated.

Project Leaders are the principal investigators for the Projects.

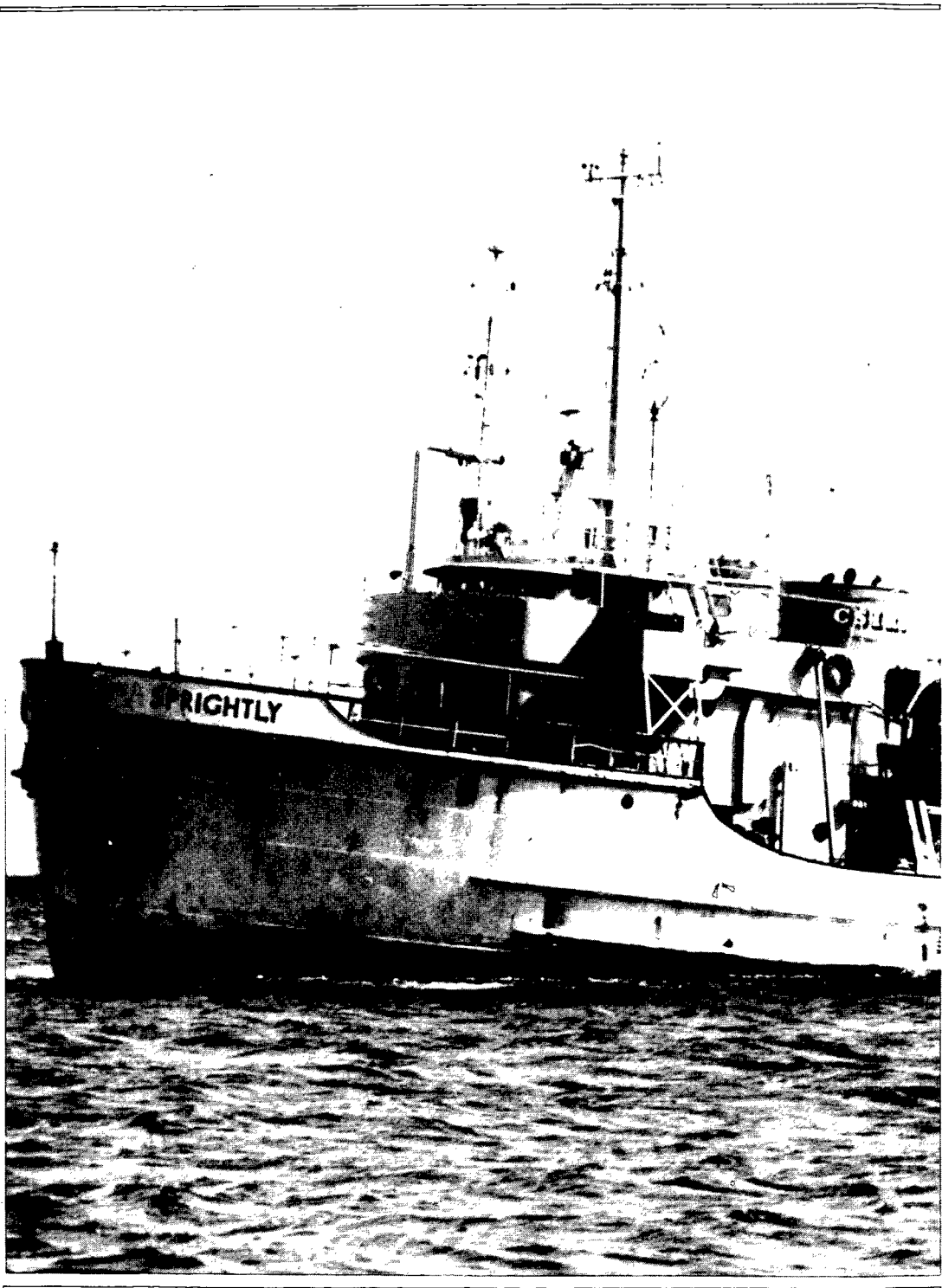
Project Officer is an officer employed by the Authority who has the responsibility of definition, control and interpretation of research projects.

Supervisor is an Assistant Executive Officer or the Executive Officer of the Authority, except for projects of the Augmentative Research Support Grant Scheme. For these projects the *Supervisor* is one appointed for the student's work at the institution concerned.

Period in general shows commencement date (month and year) to completion date or planned completion date (that is when the final report of the project has been accepted by the Authority). In some cases only the years are given. This is the case for all projects in the Augmentative Grants category. The year refers to the year the award was granted.

Implications/Management Needs: In this section the way in which the project will contribute to information required by the Authority for marine park planning and management in the Great Barrier Reef Region is described.

Locality names can be found on the accompanying map.



OCEANOGRAPHY

1

Sedimentation between the Herbert River Delta and Orpheus Island

PERIOD: Jan 1981 - Dec 1982

ORGANIZATIONS: James Cook University, Department of Geology
Australian Institute of Marine Science

PROJECT LEADERS: Dr D. Johnson
Dr M. Risk

CONSULTATION AND LIAISON: Dr C. Cuff, Geology, JCU
Mr N.C. Davidson, Honours Student, JCU

SUPERVISOR: Mr. R. Kenchington

FINANCIAL SUPPORT: GBRMPA - \$5,150

OBJECTIVES

To detail the terrigenous-carbonate transition between the Herbert River Delta and fringing reefs at Orpheus Island. To quantify sediment inputs to the reef. To investigate the geochemical record in coral skeletons.

IMPLICATIONS/MANAGEMENT NEEDS

This study will indicate the extent of the effects of terrigenous impacts to the Great Barrier Reef lagoon and enable gradients of effects to be described. Such information is needed as background to monitoring activities and also to evaluate extreme inputs to the Great Barrier Reef lagoon from the land.

METHODOLOGY

Fringing reefs were investigated using a small boat to collect samples. Sediment traps were set on the reef. Bottom samples and push cores were taken between the delta and the reefs, and results integrated with earlier shallow seismic profiling studies.

STATUS

Field work has been completed. Final report is being prepared.

LOCALITY: Herbert River Delta - Orpheus Island

Drift Card Study of Great Barrier Reef Surface Currents

PERIOD: Jan 1981 - July 1983

ORGANIZATION: James Cook University, Department of Marine Biology

PROJECT LEADERS: Dr J.D. Collins

CONSULTATION AND LIAISON: Australian Coastal Surveillance Organisation
Mr. T. Walker, QNPWS

PROJECT OFFICER: Mr R. Kenchington

SUPERVISOR: Mr R. Kenchington

FINANCIAL SUPPORT: GBRMPA - \$70,040

OBJECTIVES

To produce an integrated picture of drift over the Great Barrier Reef lagoon. To establish correlations between drift and wind patterns.

IMPLICATIONS/MANAGEMENT NEEDS

This project will provide data which is important to understanding surface water movements in the Great Barrier Reef. It will enable production of predictive models for oil slick dispersal and dispersal of larvae. It will also provide a set of data upon which to base hypotheses for more refined studies of water movement in the Great Barrier Reef Region.

METHODOLOGY

80,000 drift cards will be released regularly over an 18 month period by Coastal Surveillance aircraft at 14 sites in the Great Barrier Reef Region. Computer analysis of data from returned drift cards will be undertaken and related to wind data throughout the Region.

STATUS

A report on the pilot study drops has been prepared for GBRMPA.

Walker, T.A. and Collins, J.D. 1981. A drift card study in the central region of the Great Barrier Reef Lagoon.

Drops of drift cards did not start until November 1981. The initial period of the project was spent on optimum card studies and gathering meteorological data.

A paper of relevance to the project was published earlier:

Walker, Terry and Collins, John. 1980. Surface currents of the central Great Barrier Reef studied. *Australian Fisheries* 39(12) 8-9.

MARINE GEOSCIENCES

3

Geological Studies in the Capricorn and Bunker Reefs

PERIOD: 1978

ORGANIZATION: Bureau of Mineral Resources, Geology and Geophysics

PROJECT LEADER: Dr P. Davies

FINANCIAL SUPPORT: GBRMPA - \$4,000

OBJECTIVES

To understand processes affecting past and present growth of reefs and islands.

IMPLICATIONS/MANAGEMENT NEEDS

An age classification of reefs could assist in management: juvenile reefs and senile reefs may not be able to withstand sedimentation to the same extent as mature reefs; mature reefs may cope more easily with sedimentation compared with senile reefs which are choked with sediment.

METHODOLOGY

Multidisciplinary geological/hydrological/geobiological studies were conducted in Capricornia between 1975 and 1978 by scientists of the Bureau of Mineral Resources and collaborating institutions. Four reefs were studied in detail (One Tree, Fitzroy, Wreck and Fairfax) and reconnaissance studies were also carried out on most of the other reefs of the Capricorn and Bunker Groups. Effective comparisons with the reefs studied in detail can therefore be made.

STATUS

The project has been completed.

A classification of reefs from juvenile (Llewellyn Reef), mature (One Tree Reef, Fitzroy Reef) through to senile reefs (Wreck, Fairfax Reefs) was determined based on lagoon, particle size, margins, reef top, island progradation characteristics etc.

LOCALITY: Capricornia Section

Circulation and Sediment in Platform Reef Lagoons, using One Tree as an Example

PERIOD: 1979

ORGANIZATION: University of Sydney, Department of Geography

PROJECT LEADER: Ms C. Ludington

PROJECT OFFICER: Dr W. Craik

SUPERVISOR: Dr A. Short

FINANCIAL SUPPORT: GBRMPA Augmentative Research Grant - \$750

OBJECTIVES

To define and investigate the major factors influencing water circulation in platform reef lagoons.

To investigate the relationships between circulation, reef morphology and sediments distribution on a small scale.

IMPLICATIONS/MANAGEMENT NEEDS

This study is designed to provide a greater understanding of the effects of natural phenomena on the reef. It will provide greater information on small scale circulation.

METHODOLOGY

Field work involved: (i) the continuous recording of current over a four week period; (ii) the release of drogues over 20 tide cycles; (iii) two major dye releases traced for 3 days each; (iv) eight weeks recording of tidal fluctuations; (v) several small scale dye releases; and (vi) in-situ current measurements over 5 tide cycles.

Sediment samples were analysed at the Bureau of Mineral Resources in Canberra.

STATUS

The project has been completed.

Wind speed and direction and swell direction are the most important variables influencing circulation, except in the critical stages of the tide when the outside tide is just rising above or falling below the crest.

Total lagoon flushing is achieved in approximately 5 to 6 tides (2.5 to 3 days), but surface water can be exchanged in a single tide.

Papers on this research have been published:

Ludington, C.A. 1979. Tidal modifications and associated circulation in a platform reef lagoon. *Aust. J. Mar. Freshwater Res.*, 30: 425-430.

Ludington, C.A. 1981. A study of flushing and exchange in reef lagoons, using fluorescent dye. Proceedings of 3rd Conference on Environmental Engineering, Townsville, July 1981. The Institution of Engineers, a National Conference Publ. No. 81/6. pp 102-106.

Frith (nee Ludington), C.A. In press. Lagoon Circulation, One Tree Reef, Southern Great Barrier Reef. Proceedings of 4th International Coral Reef Symposium, Manila, May 1981.

Hatcher, A. and Frith, C.A. In prep. The control and maintenance of the standing stock of dissolved inorganic Nitrogen in a coral reef lagoon.

Frith, C.A. and Mason, L. In prep. A depth-integrated model of circulation, One Tree Reef, Southern Great Barrier Reef.

LOCALITY: Capricornia Section - One Tree Island Reef

Paleoclimate and Dating Studies: The Development of Sand Cays in the Capricorn and Bunker Groups

PERIOD: 1979

ORGANIZATION: University of Queensland, Department of Geology

PROJECT LEADER: Dr P. Flood

PROJECT OFFICER: Dr W. Craik

FINANCIAL SUPPORT: GBRMPA Augmentative Research Grant - \$675

OBJECTIVES

To explain the development of sand cays in terms of changing sea levels and temperatures, changing climatic patterns, relationships between islands on reefs, and the effects of lunar interference.

IMPLICATIONS/MANAGEMENT NEEDS

This study is designed to determine changes in island shape due to natural phenomena.

METHODOLOGY

Beach profiles were measured to determine seasonal and long term fluctuations in island shape.

Samples of *Tridacna* (clam) were collected from lithified beach ridges for radiocarbon dating and determination of paleotemperatures of seawater at the time of skeletal deposition.

STATUS

The project has been completed.

It was apparent from radiocarbon dating and isotope analysis that sea level was slightly higher than the present level at 4850 years ago. Sea level fell from above its present level between 3050 to 2750 years. A fall of slightly less than 1 metre is indicated.

Lithification of the cay sediment has been occurring at least up to 520 years ago. Subsequent to about 500 years ago the sea level appears to have remained at about present level except perhaps for a relatively recent rise of the order of a few centimetres which has been occurring during the past 40-50 years.

The following publications report on aspects of this study:

Flood, P.G., Harjanto, S., and Orme, G.R. 1979. Carbon-14 dates, Lady Elliot Reef, Great Barrier Reef. *Queensland Government Mining Journal* 80(935):444-447.

Flood, P.G. 1980. Geomorphology of Tryon Island and Reef. *Queensland Nat.* 23, 113-126.

Orme, G.R. & Flood, P.G. 1980. Sedimentation in the Great Barrier Reef Province, Adjacent Bays and Estuaries; in Henderson, R.A. & Stephenson, P.J. (eds), *The Geology and Geophysics of Northeastern Australia*. Geol. Soc. Aust. Qld. Div. Brisbane, 419-434.

Gourlay, M.R. & Flood, P.G. 1981. Impact on coastal engineering works upon a coral cay: Heron Island. *Confr. on Environmental Engineering*, Townsville, 159-163.

Flood, P.G. 1979. Heron Island Erosion Problems. *Reflections* 3, 4.

_____. 1980. Cyclone "Simon" Changes Cays. *Reflections* 3, 4.

_____. 1981. Coral Cays and Cyclones. *Beach Conservation* 42, 6.

_____. 1981. Bioclastic Carbonate Facies of the Great Barrier Reef, Australia. *Amer. Assoc. Petrol. Geol.* 65(5), 926.

_____. 1981. A record of the shoreline changes to 1980 on cays of the Capricorn Group, Southern Great Barrier Reef, Australia. Dept. Geology, University of New England, 50 p.

_____. 1981. Bioclastic Carbonate Sediments of the Great Barrier Reef, Australia. Fifth Australian Geological Convention - Sediments Through the Ages. Abstract, 46.

Flood, P.G. 1981. Geological Guide to Lady Elliot Reef. Prepared in conjunction with the Great Barrier Reef Committee and Royal Society of Queensland Symposium: the Capricornia Section of the Great Barrier Reef Marine Park - Past, Present and Future. 17 p.

———. In press. The variability of shoreline position on five uninhabited islands of the Capricorn Group, southern Great Barrier Reef, Symposium organized by Great Barrier Reef Committee and Royal Society of Queensland, Brisbane, September 1981.

———. In press. Holocene Sea Level Data from the Southern Great Barrier Reef and Southeastern Queensland: A review in HOPLEY, D. *Australian Sea Levels in the Last 15,000 Years*. A Report for International Geological Correlation Program 61.

LOCALITY: Capricornia Section

6 Study of Reef Top Sediments on Wreck Reef

PERIOD: 1981
ORGANIZATION: University of New England, Department of Geology
PROJECT LEADER: Mr G. Brown
PROJECT OFFICER: Dr W. Craik
SUPERVISOR: Dr P. Flood
FINANCIAL SUPPORT: GBRMPA Augmentative Research Grant - \$600

OBJECTIVES

To determine relationships of reef sediments to reef maturity.
To relate findings to hypothetical schemes on reef evolution.

IMPLICATIONS/MANAGEMENT NEEDS

Information is required about the distribution of sediments of the Region to establish baseline distributions for monitoring and to decide what changes are natural.

METHODOLOGY

Approximately 150 surface sediment samples were collected in transects across Wreck Island Reef. These were analysed for the proportions of coral material, etc.

STATUS

The project has been completed.

The typical component composition of the reef flat sediments was:

	coral	coralline algae	molluscs	benthic foraminiferans
av. %	25	42	9	23
range %	8-75	5-50	1-16	14-32

The beach sediments had a similar composition. The dune sediments on the cay varied only with slightly higher proportions of coral material. The various textural parameters (mean size, modal size, sorting, skewness and kurtosis) displayed a marked correspondence to the physiographic zonation.

There is an obvious relationship between the increase in the percentage of foraminiferids in the sediments of Wreck Reef when compared to their distribution in sediments of Heron and Lady Musgrave Reefs. Obviously the time that a reef has to interact with the prevailing physical environment at the sea/air interface the more pronounced is the physiographic zonation which is developed. A consequence of this is that the organisms on the reef top progressively change from frame building organisms such as corals to either calcareous algae which cement over the reef top or to soft tissue organisms such as algae, sponges etc. which support an abundant epiphytic fauna of foraminiferids etc.

The implication for management is that a reef such as Wreck is not static; it is in dynamic equilibrium with the prevailing physical forces and given adequate time (hundreds or perhaps thousands of years) it will gradually change.

In the short term, however, little change is likely to occur. The reef has experienced several major cyclones during the past decade. These have done little to change the physiography of the reef or island. The distribution of sediment on the reef flat has remained static other than that it appears to be gradually coarsening.

Flood, P.G. 1981. Skeletal component and grain size composition of sediments on Wreck Reef, Capricornia Section, Great Barrier Reef Marine Park. Report to the Great Barrier Reef Marine Park Authority.

LOCALITY: Capricornia Section - Wreck Island Reef

Lagoonal Sedimentation: One Tree Island Reef

PERIOD: 1981

ORGANIZATION: University of Sydney,
Department of Geology and Geophysics

PROJECT LEADER: Mr W. Kiene

PROJECT OFFICER: Dr W. Craik

SUPERVISOR: Dr E. Frankel

FINANCIAL SUPPORT: GBRMPA Augmentative Research Grant - \$600

OBJECTIVES

To define the 3-D facies geometry of lagoonal sediments at One Tree Island Reef.

To develop relationship between temporal variations in flora and fauna remains in sediment and variations in environmental and ecological parameters.

To determine estimates of patch reef sediment contribution to lagoonal infill.

IMPLICATIONS/MANAGEMENT NEEDS

Information is required about the distribution of sediments to establish baseline data for monitoring, to quantify the contributions of terrigenous and reefal sediments to the Great Barrier Reef lagoon, and to decide whether changes in sedimentary facies are natural or forced by impacts.

IMPLICATIONS/MANAGEMENT NEEDS

The coarse fractions of skeletal sediments were sampled, using an air lift, throughout the lagoon at various levels in the subsurface.

STATUS

The project has been completed.

Findings show the concentration of gravel size material is related to dominant sediment source. Areas dominated by autochthonous sedimentation show higher concentrations of gravel in air lifted samples. In areas dominated by allochthonous sedimentation, samples show less gravel.

Allochthonous sedimentation is seen to dominate on windward sand sheets. Vertical sampling shows a temporal progradation of these sand sheets over lagoonal sediments. Skeletal constituents of finer sizes show the decrease of *Halimeda* and foraminifera debris away from the windward margin. This distribution of constituents suggests transportation from a source to a sink under a hydrodynamic regime of energy dissipation.

Extensive patch reef development provides local sources for autochthonous gravel. Coralline algae dominates on linear reticulate patch reefs in windward lagoonal areas. This coralline algae dominance may reflect higher energy and sedimentation in windward areas. *Acropora* coral growth is not well developed in windward lagoonal areas but is extensive in leeward areas. *Acropora* rubble was found in the subsurface in an area that does not support the growth today. This temporal change may result from exclusion of *Acropora* in windward lagoonal areas by unfavorable environmental conditions. These unfavorable conditions may be created by the zone of allochthonous sedimentation moving into the lagoon.

LOCALITY: Capricornia Section - One Tree Island Reef

8 Study of the Fringing Reef at Orpheus Island

PERIOD: 1981

ORGANIZATION: James Cook University, Department of Geography

PROJECT LEADER: Ms A. Slocombe

PROJECT OFFICER: Dr W. Craik

SUPERVISOR: Assoc. Prof. D. Hopley

FINANCIAL SUPPORT: GBRMPA Augmentative Research Grant - \$640

OBJECTIVES

To determine the nature and depth of reef foundations, growth rates of the reef, geochemical change in the fossil reef which may indicate environmental alterations, and if any alterations are due to European settlement in the last 100 years.

IMPLICATIONS/MANAGEMENT NEEDS

This study is designed to examine physical and geochemical parameters which may be useful in monitoring the health of a reef system.

METHODOLOGY

Field work involved obtaining cores for use in geochemistry and absolute dating, sampling live corals for the establishment of modern growth rates, echosounding on the reef front and seismic profiling of the reef flat. Laboratory work included the use of x-ray diffraction, atomic absorption spectrophotometric analysis, and colorimetric techniques.

STATUS

The project has been completed.

Dating of cores has revealed that the reef began growth close to shore about 7,000 years B.P., once sea level had begun to stabilise. Rapid growth of the reef followed its initiation with rates of up to 16.7mm/yr being attained. Rates slowed down to 1.1mm/yr once it reached sea level. The inner reef reached modern sea level about 5,000 years B.P., and the outer reef about 1,000 years B.P. Early diagenesis of the reef is suggested by a depletion of Sr in the cores with respect to the modern corals.

Suggestions of salinity variations and a temperature increase are supported by climatic data obtained using pollen analysis of sediment cores from North East Queensland (Kershaw, 1978, 1980), but there has been no significant variation in terrigenous input on the reef.

No changes in terrigenous input resulting from land use on the adjacent mainland were detected. It was concluded that either (i) no changes had occurred in the waters around the reef; (ii) the techniques used could not identify small changes; or (iii) the reef studied may not have been fully affected by mainland run-off.

All three possibilities may be correct. In view of the increasing pressure on coastal lands in North Queensland, it is recommended that further experimental work of this type be carried out to identify easily available physical and geochemical parameters which reflect the health of a reef system.

There is nothing in the evidence provided by this research to suggest that Pioneer Bay fringing reef has been affected by any changes on the mainland brought by European settlement over the last 100 years or so. However, the monitoring of reefs, especially fringing reefs, must become increasingly important in future research if we are to minimise the effects on reefs of pollution, and increased sediment and fresh water input resulting from clearing of land. Only this will ensure that flourishing reefs, such as in Pioneer Bay, are not destroyed.

Slocombe, A.M. 1981. The structure and development of the fringing reef in Pioneer Bay, Orpheus Island. Honours thesis, James Cook University of North Queensland.

LOCALITY: Orpheus Island Reef (Pioneer Bay)

9

Sea-water Interpretation from Modern and Holocene Corals of the Central Great Barrier Reef: a Spatial and Temporal Perspective

PERIOD: May 1982 - Aug 1983

ORGANIZATION: James Cook University, Geography Department

PROJECT LEADER: Mr F. Muir

PROJECT OFFICER: Dr W. Craik

SUPERVISOR: Assoc. Prof. D. Hopley; Mr R. Kenchington

FINANCIAL SUPPORT: GBRMPA - \$2,500; Augmentative Research Grant: \$200

OBJECTIVES

To predict from present-day and Holocene corals the annual and seasonal ambient sea-water temperatures at the time of coral growth.

To provide a possible interpretation of Holocene sea-water temperatures as they relate to Holocene sea-level variations.

This study is designed to provide an indication of environmental factors influencing coral growth in the Holocene. Temporal variations may be explained by changing climatic and oceanographic factors. Differences between nearshore fringing reef corals and offshore may be evident.

METHODOLOGY

Corals will be collected from present-day living reefs to establish modern thermometry standards against which the corals from submerged Holocene reefs can be compared.

Geochemical analysis and sclerochronology of the modern coral and fossil coral cores will be undertaken. Geochemical analysis will involve interpretation of Sr/Ca ratio levels. These ratios will be related to the sclerochronology density bands and C14 dates.

STATUS

Report to GBRMPA due August 1983.

Radiocarbon Dating of Fantome Island Fringing Reef Corals

PERIOD: May 1982 - Dec 1982
ORGANIZATIONS: James Cook University, Department of Geology
McMaster University, Ontario, Canada

PROJECT LEADERS: Dr D. Johnson
Dr M. Risk (formerly with Australian Institute of Marine
Science)

PROJECT OFFICER: Dr W. Craik
SUPERVISOR: Mr R. Kenchington
FINANCIAL SUPPORT: GBRMPA - \$4,000

OBJECTIVES

To use radiocarbon dating of fringing reef corals to show the pattern of growth over last 5000 years.

IMPLICATIONS/MANAGEMENT NEEDS

This reef has been growing for the past 5000 years over a mud substrate. Growth and maintenance of a viable coral reef may be dependent on sustaining associated detrital deposits.

METHODOLOGY

Radiocarbon dating of 3 cores taken in May 1981 off the northern end of Fantome Reef (in a joint AIMS-Army project) is involved.

STATUS

Report to GBRMPA received and under consideration.

LOCALITY: Fantome Island Fringing Reef (in the Palm Island Group off Ingham)



MARINE CHEMISTRY

11 Accumulation and Transfer of Naturally Occurring Heavy Metals in Coral Reef Food Webs

PERIOD: 1979
ORGANIZATION: Griffith University,
School of Australian Environmental Studies

PROJECT LEADER: Mr T. Pear

PROJECT OFFICER: Dr W. Craik
SUPERVISORS: Dr D. Connell, Dr G. Miller
FINANCIAL SUPPORT: GBRMPA Augmentative Research Grant - \$542

OBJECTIVES

To measure the levels of mercury and zinc in a coral reef fish community at Heron Island Reef to test the 'trophic level theory' for the behaviour of pollutants in food webs.

IMPLICATIONS/MANAGEMENT NEEDS

Various theories have examined the behaviour of pollutants in food webs. One widely accepted theory is the trophic level theory. This theory implicates the food chain as being responsible for increasing pollutant concentrations in successively higher trophic levels. This research will examine the trophic behaviour of zinc and mercury in a coral reef fish community.

METHODOLOGY

Fish from 30 species were collected by spearing and hook and line fishing in April 1979. The species were categorised into trophic levels by relating the findings from analysis of the gut cavity with data in the literature. Samples of tissue were removed from the fish and analysed for mercury and zinc by atomic absorption methods.

STATUS

The project has been completed.

Levels of mercury and zinc found in fish of the Heron Island/Wistari Reef community were generally low but variable.

Conclusions were made regarding the possible effects of a number of ecological, physiological and biochemical variables on the trophic behaviour of mercury and zinc:

Habitat and feeding behaviour may influence levels of mercury in benthic dwelling species (*Chaetodons*, *Scarus* sp. and herbivores). Weight influenced mercury concentrations. However this variable could not account for total variation in mercury content between species and trophic level.

Trophic level had only a limited influence upon mercury content and none upon zinc content.

Biochemical regulation is suggested as the major control mechanism for zinc concentrations.

Since the total variation of mercury content could not be attributed to any one variable and because the nature of the pathway for mercury uptake is complicated an alternative theory to the trophic level theory was proposed. It is likely the alternative approach will still provide only part of the answer to mercury food web behaviour.

Pear, A.G. 1979. Mercury and zinc in a coral reef fish community from Heron Island, Great Barrier Reef, Queensland. Honours dissertation, Griffith University.

LOCALITY: Capricornia Section - Heron Island, Wistari Reefs

Hydrocarbons in Heron Island Boat Harbour

PERIOD: 1981

ORGANIZATION: Griffith University,
School of Australian Environmental Studies

PROJECT LEADER: Mr P. Bishop

PROJECT OFFICER: Dr W. Craik

SUPERVISOR: Dr D. Connell, Dr G. Miller

FINANCIAL SUPPORT: GBRMPA Augmentative Research Grant - \$683

OBJECTIVES

To establish the background concentrations of hydrocarbons in the Heron Island boat harbour and the surrounding reef flats. To investigate the use of a holothurian species (*Holothuria atra*) as a biological indicator of petroleum hydrocarbons.

IMPLICATIONS/MANAGEMENT NEEDS

The background concentrations of hydrocarbons in Great Barrier Reef waters is essential information for monitoring and assessing impacts.

METHODOLOGY

To determine the distribution and concentration of hydrocarbons, samples of sediments and holothurians were collected from two sites on the reef flat and from three sites in the boat harbour. Hydrocarbons were extracted from the sediments and holothurians using techniques developed at Griffith University. The extracts were analysed using gas chromatography and gravimetric techniques.

An uptake experiment was conducted at another site on the reef flat where holothurians were not present. An experimental group of holothurians (in a cage) and a control group were transferred to the site. Dry sediment contaminated with light diesel oil was spread over the floor of the cage. Holothurians and sediment samples were collected from the treated cage and from the control area and all samples were analysed for hydrocarbon content using the methods of the baseline study.

STATUS

The project has been completed.

Sediment samples contained no trace of oil contamination, although petroleum hydrocarbons were tentatively identified in sediments from one site sampled in the boat harbour.

H. atra sampled from the boat harbour and one site on the reef flat contained an array of hydrocarbons with characteristics similar to those of degraded diesel oil. *H. atra* sampled at the site furthest from the boat harbour contained hydrocarbons which displayed no characteristics of petroleum, and were thus assumed to represent ambient hydrocarbons.

Baseline levels of hydrocarbons in sediments and *H. atra* from this site on the reef flat were 100 ug/kg (wet wt) and 3,390 ug/kg (wet wt) respectively. These results compared favourably with other baseline studies.

Results from the baseline study indicated that *H. atra* may possibly bioaccumulate petroleum hydrocarbons, suggesting their use as a possible indicator of oil pollution. However, *H. atra* did not take up petroleum hydrocarbons during the uptake study. Further investigation is therefore required to demonstrate the usefulness of *H. atra* as a biological indicator.

Bishop, P.J. 1982. Hydrocarbons in holothurians, *Holothuria atra*, and surface sediments from Heron Island boat harbour and reef flat. Honours dissertation, Griffith University.

LOCALITY: Capricornia Section - Heron Island Reef

Evaluation of the Gastropod *Strombus luhuanus* as an Indicator for Petroleum Hydrocarbons in a Coral Reef System

PERIOD: 1982
ORGANIZATION: Griffith University,
School of Australian Environmental Studies

PROJECT LEADER: Ms H. Chapman

PROJECT OFFICER: Dr W. Craik
SUPERVISOR: Dr D. Connell, Dr C. Catterall
FINANCIAL SUPPORT: GBRMPA Augmentative Research Grant - \$460

OBJECTIVES

To test the suitability of *Strombus luhuanus* as a bio-indicator for petroleum hydrocarbons in coral reef systems.

IMPLICATIONS/MANAGEMENT NEEDS

This study is designed to test the suitability of a biological parameter to monitor background levels in the entire Great Barrier Reef and to measure the impacts of a spill.

METHODOLOGY

In situ tests will be made of the rate of uptake, retention and depuration of petroleum hydrocarbons. Low levels of a range of hydrocarbons will be used.

Compounds will be analysed by gas chromatography and gas chromatograph mass spectrometry. Fieldwork will be undertaken in May 1982.

STATUS

Report to GBRMPA due June, 1983.

LOCALITY: Capricornia Section - Heron Island Reef

Lipids in sediments and Holothurian Grazing**PERIOD:** 1982**ORGANIZATION:** University of Melbourne,
Department of Organic Chemistry**PROJECT LEADER:** Ms M. Peters**PROJECT OFFICER:** Dr W. Craik**SUPERVISOR:** Dr R. Johns**FINANCIAL SUPPORT:** GBRMPA Augmentative Research Grant - \$757**OBJECTIVES**

To undertake a baseline study of lipids in sediments.

To determine marker compounds to identify different types of micro-organisms in sediment.

To assess the effect of holothurian grazing on micro-organisms in sediment.

IMPLICATIONS/MANAGEMENT NEEDS

This study is designed to provide reference data for comparison of lipids in sediment in the future and to provide baseline data for the evaluation of possible future effects on holothurians.

METHODOLOGY

The lipids being studied are pigments, fatty acids, sterols, alcohols and hydrocarbons.

A baseline lipid study carried out at Lizard Island Reef will provide data for later comparisons.

The detrimental effects on bacteria and other micro-organisms from e.g. hydrocarbons derived from other than natural sources will have an effect on the whole system.

STATUS

The project has been completed.

With respect to micro-organisms in the sediment, it was found that bacteria, meiofauna, and algae are all grazed by holothurians and few survive the passage through the gut intact. However, the algae and bacteria grow faster in the heavily grazed areas. This suggests that the holothurians assist in the release and recycling of nutrients from within the sediment. Meiofauna populations are continuously decreased by holothurian grazing, but there was a greater decrease in meiofaunal numbers in the sediments from which holothurians were excluded. Holothurians therefore appear to be providing nutrients for the growth of other components of the coral reef, including their own food, and ensuring that the bacteria can continue in their role as the primary decomposers of dead and detrital material on the reef.

The techniques used in this study can define base line levels of natural biogeolipids and thereby allow changes in the natural components of the reef to be determined and to distinguish allochthonous inputs.

LOCALITY: Cairns Section - Lizard Island Reef

BATHYMETRY AND SURVEY

15

Great Barrier Reef Aerial Photography

PERIOD: 1977
ORGANIZATIONS: GBRMPA
James Cook University, Geography Department
Australian Institute of Marine Science

PROJECT OFFICER: Mr G. Hawley
FINANCIAL SUPPORT: GBRMPA - \$350. Matching funds by AIMS and ARGC

OBJECTIVES

To complete the aerial photographic coverage of the reef in the Townsville to Mackay region.

IMPLICATIONS/MANAGEMENT NEEDS

This survey will enable a useful photographic coverage to be obtained, for a relatively small cost. This photographic coverage can be used to update maps of the area.

STATUS

The project has been completed.

Eight hours aerial photography of reef using water penetrating film was undertaken. Colour photographic coverage of reefs between Townsville and Mackay was completed.

LOCALITY: Great Barrier Reef between Townsville and Mackay

16

Map of Cairns Reefs. Reef and Island Classification Map at a Scale of 1:300,000. Latitudes 14°S to 17°S as per Admiralty Chart 2344.

PERIOD: Jan 1978 - May 1978

ORGANIZATION: James Cook University, Geography Department

PROJECT LEADER: Mr N. Harvey

PROJECT OFFICER: Mr G. Hawley

SUPERVISOR: Mr R. Kenchington

FINANCIAL SUPPORT: GBRMPA - \$1,500

OBJECTIVES

To classify reefs and islands in the specified area and compile the map using the detail obtained from aerial photography. To present a map with increased resolution of reef shapes (i.e. greater resolution than Admiralty or Reconnaissance maps) including an original geomorphological classification of reefs and islands; and a comprehensive reef and island nomenclature.

IMPLICATIONS/MANAGEMENT NEEDS

This project was designed to develop working maps relating to the Cairns area to be researched in preparation for declaration and zoning. It also enabled the Authority to provide geomorphological maps to research institutions and to the general public.

METHODOLOGY

Using Admiralty Chart 2744 as a basis and available reference data (the most recent rectified satellite imagery, aerial photography, the Reconnaissance map series and field data) a reef and island map of the area 14°S to 17°S was produced. In addition, all reefs and islands etc. were "classified" geomorphologically and the classification listed and discussed as a separate report.

STATUS

The project has been completed.

The map of Cairns reefs and a report were prepared for and accepted by GBRMPA.

LOCALITY: Cairns Section

Assessment of Aerial Photographs and LANDSAT Imagery for Coral Reef Data Collection

PERIOD: 1979 - Dec 1983

ORGANIZATION: James Cook University, Geography Department

PROJECT LEADER: Ms D. Kuchler

CONSULTATION AND LIAISON: Dr D. Jupp, CSIRO, Division of Land and Water Resources
Dr A. Hobbs, Jet Propulsion Lab, Pasadena, California
Dr R. Bina, Natural Resources Management Centre,
Philippines

PROJECT OFFICER: Mr J. O'Dwyer, Mr D. van Claasen

SUPERVISORS: Assoc Prof. D. Hopley and Dr D. Jupp

FINANCIAL SUPPORT: GBRMPA - \$21,590; Augmentative Research Grants: \$1,184

OBJECTIVES

To test the accuracy of LANDSAT imagery and colour aerial photographs for recording inventory and monitoring data on coral reefs.

IMPLICATIONS/MANAGEMENT NEEDS

The Authority needs an efficient and economically viable means of acquiring up-to-date information on conditions of the Great Barrier Reef at any point in time. Collection of data by remote sensing on periodic overflights has been proposed as an alternative to ground data collection. This project is designed to provide basic facts about remotely sensed data (quality, quantity, cost) and to answer the following questions: What are the costs of using the competing data collection systems? Will all of GBRMPA's information needs be met by aerial photographs and LANDSAT imagery? If not, what part will be met and is it worth the effort?

METHODOLOGY

Use of the various inventory and resource-matrix analysis options in the Barrier Reef Image Analysis (BRIAN) Software Package (see Project 18) resulted in a cross-tabulation relationship between interpreted aerial photographs and interpreted LANDSAT imagery and ground data.

Use of multiple acquisitions of LANDSAT imagery and aerial photographs together with the Layered or Multiple Image and Digital Change Detection (e.g. ratio and difference images) Techniques available in the BRIAN Software Package will result in an assessment of the capability of these remote sensing techniques for identifying and locating changes in the coral reef environment. A distinction will be made between the ability of LANDSAT and aerial photographs as monitoring techniques to realize that a change in the recorded data has taken place and the interpreter's ability to decide from the imagery what the change means in terms of reef cover.

STATUS

Ground data collection from Green Island, Heron Island, Williamson and Ribbon No.5 reefs has been completed. The accuracy of LANDSAT imagery and color aerial photographs for recording inventory data on coral reefs has been completed. A study testing the monitoring ability of these remote sensing techniques commenced in October 1982.

The following reports have been published:

Kuchler, D.A. Submitted. Geomorphological nomenclature: reef cover and zonation, Great Barrier Reef, Australia. GBRMPA - Technical Memorandum.

Kuchler, D.A. Submitted. Classification system: reef cover and zonation, for use with remotely sensed data, Great Barrier Reef, Australia. GBRMPA - Technical Memorandum.

Jupp, D.L., Mayo, K.K., Kuchler, D., Heggen, S.J., and Kendall, S.W. In press. Remote Sensing by Landsat as Support for Management of the Great Barrier Reef. LANDSAT 81. Proceedings of the Second Australasian Remote Sensing Conference, Canberra, September 1981.

Jupp, D.L., Mayo, K.K., Kuchler, D., Heggen, S.J., and Kendall, S.W. In press. The BRIAN Method for Large Area Inventory and Monitoring. LANDSAT 81. Proceedings of the Second Australasian Remote Sensing Conference, Canberra, September 1981.

Jupp, D.L., Mayo, K.K., Kuchler, D.A., Heggen, S.J., and Kendall, S.W. In prep.
Landsat Based Multidate Information System for the Cairns Section of the Great Barrier Reef Marine Park. Report 1:
Image Base and Index System. CSIRO, Technical Report, Canberra, Australia.

Jupp, D.L., Mayo, K.K., Kuchler, D.A., Heggen, S.J., and Kendall, S.W. In prep.
An Interpretation and Mapping of Landsat Satellite Data: Southern Part of the Cairns Section of the Great Barrier
Reef Marine Park, Australia. CSIRO, Technical Report, Canberra, Australia.

Jupp, D.L., Mayo, K.K., Kuchler, D.A., Heggen, S.J., and Kendall, S.W. In prep.
An Interpretation and Mapping of Landsat Satellite Data: Central Part, Cairns Section, Great Barrier Reef Marine
Park, Australia. CSIRO, Technical Report, Canberra, Australia.

LOCALITY: Capricornia Section - Heron Island;
Cairns Section - Green Island, Williamson and Ribbon No. 5 reefs.

BRIAN (Barrier Reef Image Analysis) and Experienced Reef Interpreters**PERIOD:** June 1981 - October 1982**ORGANIZATION:** CSIRO, Division of Land Use Research**PROJECT LEADER:** Dr D. Jupp**CONSULTATION & LIAISON:** GBRMPA
Australian Institute of Marine Science
James Cook University**PROJECT OFFICER:** Mr J. O'Dwyer; Mr. D. van Claasen**SUPERVISOR:** Mr R. Kenchington**FINANCIAL SUPPORT:** GBRMPA - \$1,900**OBJECTIVES**

To refine a computer program to analyse LANDSAT imagery of reefs (BRIAN).

IMPLICATIONS/MANAGEMENT NEEDS

This project will ensure that training sets are generated by interaction of experts with knowledge of reef areas of primary interest to the Authority. It will also ensure that classificatory phenomena generated via BRIAN are subjected to discussion within the Authority prior to succeeding training visits.

METHODOLOGY

Reef experts will apply their detailed knowledge of specific reef areas to assist in interpretation of the satellite imagery.

During 1981 three skilled observers worked on three occasions with Dr Jupp and team on LANDSAT imagery in an iterative process of refining training sets.

STATUS

The current stage of the methodology has been realised as the BRIAN-I package. This set of programs is being fixed and documented as a stable package. The advanced options under development, and future research findings, are to be written into a separate BRIAN-II system. Part-I of the "BRIAN Handbook" (introduction, description and methodology) has been completed, and Part II (step by step guide to using the program) is being written.

The BRIAN system has been described in the paper:

Jupp, D.L., Mayo, K.K., Kuchler, D., Heggen, S.J., and Kendall, S.W. 1981. The BRIAN Method for Large Area Inventory and Monitoring. LANDSAT 81. Proceedings of the Second Australian Remote Sensing Conference, Canberra, September 1981.

A second paper was presented at the Conference:

Jupp, D.L., Mayo, K.K., Kuchler, D., Heggen, S.J., and Kendall, S.W. 1981. Remote Sensing by Landsat as Support for Management of the Great Barrier Reef. LANDSAT 81. Proceedings of the Second Australian Remote Sensing Conference, Canberra, September 1981.

Final report to GBRMPA is being prepared.

BRIAN Extension Exercise on the Great Barrier Reef**PERIOD:** July 1981 - October 1982**ORGANIZATION:** CSIRO, Division of Land Use Research**PROJECT LEADER:** Dr D. Jupp**PROJECT OFFICER:** Mr J. O'Dwyer; Mr. D. van Claasen**SUPERVISOR:** Mr R. Kenchington**FINANCIAL SUPPORT:** GBRMPA - \$12,000**OBJECTIVES**

To apply the computer program, BRIAN, to: (1) the northern reefs between Lizard Island and Cairns; and (2) the Capricorn-Bunker Group, to produce colour-write products for both areas showing LANDSAT classes mapped over raw data.

IMPLICATIONS/MANAGEMENT NEEDS

This project will provide an inventory of LANDSAT classes for the Cairns Section which may be used in the preparation of a zoning plan. It will also provide pre-survey stratification and design constraints for interpretive activities concerned with the marine park.

METHODOLOGY

The training sets developed in the previous BRIAN project (18) will be applied to the reefs of the Cairns-Lizard Island area and the Capricorn-Bunker Group. The knowledge of reef experts will again be used to analyse the results obtained from the application of the training sets.

STATUS

The inventory of the two Sections of the Park has been completed.

Final report to GBRMPA is being prepared.

LOCALITY: Cairns Section, Capricornia Section

20 **Reef and Island Classification Map and Gazetteer**

PERIOD: March 1982 - Dec.1982
ORGANIZATION: James Cook University, Geography Department
PROJECT LEADER: Professor J. Oliver
PROJECT OFFICER: Dr J. Dunn
SUPERVISOR: Mr R. Kenchington
FINANCIAL SUPPORT: GBRMPA - \$9,765 (Stage I)

OBJECTIVES

To provide a series of maps at a uniform scale of 1:250,000 showing location, the shape and morphology and other specified characteristics of reefs and islands within the Great Barrier Reef Region, and a gazetteer of reefs. (Stage 1: three maps; Stage 2: two maps and gazetteer)

IMPLICATIONS/MANAGEMENT NEEDS

These maps would show greater resolution of reef shapes, location and orientation, and an up-to-date classification of reefs and islands that is not available on any existing series of maps or charts, and provide an aid for declaration, zoning, management, and information/education.

METHODOLOGY

Dyeline transparencies of reef and island classification maps will be prepared using as reference data the most recent rectified satellite imagery, photographs, Commonwealth reconnaissance maps, Queensland cadastral maps (for fringing reefs), photography by the Beach Protection Authority, charts and field data.

STATUS

Maps of the Cairns Section, Pompeys to Lady Elliott Island and Dunk Island to Whitsundays have been produced with complete cartographic presentation of reefs, showing morphological zones, islands, reef names etc. Two additional maps (Whitsundays to Swain Reefs) and (Cape York to Cape Melville) and gazetteer remain to be produced (Stage II).

Maps received and under consideration.

21

Inkjet Maps for the Cairns and Cormorant Pass Sections of the Great Barrier Reef Marine Park

PERIOD: Dec 1981 - Feb 1982

ORGANIZATION: CSIRO, Division of Land Use Research

PROJECT LEADER: Dr D. Jupp

PROJECT OFFICER: Mr J. O'Dwyer

SUPERVISOR: Mr R. Kenchington

FINANCIAL SUPPORT: GBRMPA - \$2,000

OBJECTIVES

To provide ink-jet maps of the Cairns and Cormorant Pass Sections.

IMPLICATIONS/MANAGEMENT NEEDS

This project is designed to provide a cheap and readily available data base for future broad scale monitoring of reef changes in the Sections. It will update the Authority's knowledge on the reefs in the Cairns Section. It will provide a visual map for public displays. It could also be the basis for extension to whole Reef Region thus providing a Region-wide monitoring base.

METHODOLOGY

Classification results from the Landsat projects are produced in good hard-copy cheaply using the Applicon ink-jet plotter. A set of routines produces Landsat images, with or without classes and themes painted over them, at scales of 1:93,000 and 1:46,500. This process also produces a library of rectified tapes which would be useful for future reference.

STATUS

The project has been completed.

Maps have been supplied to GBRMPA. They are at an approximate scale of 1:160,000 which makes them roughly comparable to the AUS Hydrographic Charts series. They are not directly comparable as the charts are on a graticule base, whereas the inkjet plots are a planimetric projection. The maps are rectified to enable locations to be identified.

The data tapes are currently being held by CSIRO in their tape library.

LOCALITY: Cairns Section, Cormorant Pass Section

Remote Sensing Workshop

PERIOD: May 1982

ORGANIZATION: GBRMPA

PROJECT LEADER: Mr R. Kenchington

SUPERVISOR: Mr R. Kenchington

FINANCIAL SUPPORT: GBRMPA:\$3,500

OBJECTIVES

To assess the current state of the art of remote sensing for management of the Great Barrier Reef Marine Park and to indicate future directions for research.

IMPLICATIONS/MANAGEMENT NEEDS

Research on the application of Landsat images is intended to benefit users of the Reef by making available more accurate information which will improve safety, increase understanding of the resource potential of the Reef, assist in reef monitoring, and assist in the Authority's long term function of conserving the Great Barrier Reef as a living resource.

METHODOLOGY

A Workshop was held at James Cook University from 5 to 7 May, 1982. More than 50 experts from overseas and interstate in the field of remote sensing via satellite attended.

A number of "state of the art" papers were presented, followed by workshop discussion sessions to consider future research needs.

STATUS

The papers presented to the workshop have been accepted by the Authority and will be published in the GBRMPA Workshop Series.

Remote sensing by satellite and aerial techniques offers a means of resource assessment and study of the Great Barrier Reef Region on a range of scales which cannot be otherwise achieved without unacceptable levels of expenditure and manpower. Therefore, the establishment and maintenance of the ability to make use of the benefits of remote sensing techniques should be a matter of priority for the Great Barrier Reef Marine Park Authority. To this end, ten specific recommendations have been made.

Great Barrier Reef Marine Park Authority. In prep. Report of Remote Sensing Workshop, Townsville, May 5-7, 1982.



MARINE BIOLOGY

23

Endo-cryptolithic Fauna of Lizard Island

PERIOD: 1976

ORGANIZATION: Australian Museum

PROJECT LEADER: Dr P. Hutchings

FINANCIAL SUPPORT: ARGC - \$45,815. GBRMPA - \$600 (shared with project 56)

OBJECTIVES

To study the recruitment of polychaetes to coral substrates at two sites at Lizard Island over several years.

IMPLICATIONS/MANAGEMENT NEEDS

Polychaetes are a major component of endo-cryptolithic fauna of coral substrates both in terms of numbers of species and individuals. Endo-cryptolithic fauna (worms and other burrowing organisms) are important in several ways: they act as a food source, possibly a major food source of the more obvious fauna such as the pomacentrid fishes; they also may be important in recycling much of the detritus and mucus produced by the corals and other reef organisms; and many species of polychaetes actively bore into the substrate, breaking down the coral substrate. Fine sediment often accumulates in the burrows and cementation occurs. This project will provide a greater understanding of the yearly variation in recruitment success, differences between recruitment at two sites on the same reef, and elucidation of the role of the endo-cryptolithic fauna in the reef ecosystem.

METHODOLOGY

Experiments were set up in 1976 to test a technique for determining the biomass and number of species of endo-cryptolithic fauna. Blocks of live coral *Porites* were collected and any living material was allowed to rot away. The blocks were then cleaned and shaped roughly into square blocks using a hammer and chisel. These blocks were then laid on a steel grid which was bolted to the reef floor on the windward and leeward fringing reefs of Lizard Island for 3, 6, 9 and 12 months. The blocks were then removed from the grid and dissolved in dilute acid to collect all the fauna, which was then sorted to species level.

The technique proved to be feasible but variation in weight, volume and surface area ratio of the hand cut blocks was a source of variability which needed to be eliminated before the experiments could be repeated over a longer term (up to 5 years). The only method of cutting uniformly regular blocks is by using a slab saw with a diamond blade. The saw could also be used to cut transverse sections through samples of reef rock to study the spatial distribution of the fauna within the rock and to look at the burrow requirements of some of the common cryptolithic species.

STATUS

The funds allocated by GBRMPA were used to purchase an automatic power feed 12" saw unit for use at the Lizard Island Research Station by Dr Hutchings. No cutting facilities previously existed at the Research Station and coral samples were cut and filed by hand.

LOCALITY: Cairns Section - Lizard Island

Capricorn-Bunker Shrimp Fauna**PERIOD:** 1977 - 1980**ORGANIZATION:** Heron Island Research Station**PROJECT LEADER:** Dr A. Bruce**FINANCIAL SUPPORT:** GBRMPA - \$4,980**OBJECTIVES**

To survey the biology of the shrimp fauna of the southern region of the Great Barrier Reef. To compare the fauna of this part with that of the northern region based on collections made from Lizard Island.

IMPLICATIONS/MANAGEMENT NEEDS

The shrimp fauna are an integral part of the reef biocoenosis. This research will assist in the understanding of this very complex reef ecosystem.

METHODOLOGY

Specimens of small shrimps were collected by scuba diving from the Hercules dory (purchased with the GBRMPA grant). The boat was also used for nocturnal plankton tows to obtain the larval and post larval stages of shrimps, as well as some planktonic adults. The specimens were examined under microscope (also purchased with this grant) for identification and further study.

STATUS

Detailed information is available only for the Pontoniinae so far. The Alpheidae, Hippolytidae and other families are still being studied. Results have been reported in:

Bruce, A.J. 1981. Pontoniine Shrimps of Heron Island. *Atoll Res. Bull.* 245:1-33

and updated in:

Bruce, A.J. In press. The Pontoniine shrimp fauna of Australia. *Records of the Australian Museum.*

LOCALITY: Capricornia Section

Role of Recruitment in Determining Species Composition of Reef Fish Populations

PERIOD: 1977 - 1979

ORGANIZATION: University of Sydney, School of Biological Sciences

PROJECT LEADER: Dr P. Sale

SUPERVISOR: Mr R. Kenchington

FINANCIAL SUPPORT: GBRMPA - \$3,674

OBJECTIVES

To establish:-

- (i) the degree of spatial and temporal homogeneity of distribution of larval fishes and of newly settled recruits to adult habitats in the One Tree Lagoon
- (ii) the duration of larval life for the commoner species of fish
- (iii) the degree of seasonality of recruitment
- (iv) the extent of habitat preferences of fishes when settling from the plankton
- (v) the effect of resident adult and juvenile fishes on the rate and pattern of recruitment of juveniles of their own and other species.

IMPLICATIONS/MANAGEMENT NEEDS

This project will lead to a greater understanding of population dynamics of reef fish communities.

METHODOLOGY

Twelve patch reefs of similar size and appearance were selected. Each of the following treatments was made on three reefs:

- (i) removal of all adult pomacentrids
- (ii) removal of all juvenile pomacentrids
- (iii) removal of all pomacentrids
- (iv) undisturbed control.

Sets of four replicate colonies of each of three species of coral were set out, 2m apart in a square grid pattern in open sandy sites at four locations in the One Tree Lagoon.

Coral heads were searched for fish on a number of occasions during two years, and on a daily, or near-daily basis during the peak recruitment period each summer. All recruited fish were removed. Some, for which it was definite that recruitment had occurred within 24 hours of collection, were preserved in alcohol for subsequent aging using circuli on otoliths.

STATUS

Results of the study have been published.

Recruitment was monitored and showed a high degree of spatial and temporal heterogeneity of newly settled recruits with strong seasonal recruitment in most species. Larval age was directly determined for 9 families. Habitat preferences were species specific and may play an important role in determining kinds of species recruiting to different sites. Removal of residents had no effect on growth, recruitment or survivorship of planktivorous pomacentrids but affected growth of territorial pomacentrids.

Williams, D.McB. and Sale, P.F. 1981. Spatial and temporal patterns of recruitment of juvenile coral reef fishes to coral habitats within "One Tree Lagoon", Great Barrier Reef. *Marine Biology* 65: 245-253.

LOCALITY: Capricornia Section - One Tree Island Lagoon

Survey of Swain Reefs

PERIOD: Oct 1977 - Nov 1977
ORGANIZATIONS: Queensland Fisheries Service
GBRMPA

PROJECT LEADER: Mr R. Pearson

PROJECT OFFICER: Mr G. Hawley

SUPERVISOR: Mr R. Kenchington

FINANCIAL SUPPORT: GBRMPA - \$6,000

OBJECTIVES

To determine the present status of crown of thorns starfish aggregations and coral assemblages on reefs in the Swain Reefs complex.

To determine if and by what means the starfish aggregations previously encountered in July 1975 are spreading.

IMPLICATIONS/MANAGEMENT NEEDS

Aggregations of crown of thorns starfish were encountered during a survey of 85 reefs in the Swain Reefs in 1975. Extensive coral mortality was noted on 15 reefs. These aggregations and the associated coral damage may have spread to other reefs in the Swains over the following few years.

METHODOLOGY

102 reefs were surveyed in 19 days in which 1721 one-minute spot checks were made for crown of thorns presence and coral mortality.

STATUS

The project has been completed.

No starfish were found at 55 reefs (54%) at 825 spot checks; 796 starfish were observed on the remaining 47 reefs.

Starfish aggregations were still active in the north-east section of the Swain Reefs complex, in the same area surveyed in July 1975 (Pearson and Garrett ms.). Smaller aggregations were active on reefs in the south-eastern section of the Swains complex, but as this region was not visited in July 1975 nothing is known of their previous occurrence in the area. The central section of the eastern Swain Reefs was relatively free of starfish and associated coral damage. It was predicted (Pearson and Garrett ms.) that infestations encountered in July 1975 would spread rapidly southwards through the Swain Reefs from the north-east section by adult migration. This does not appear to have happened in the intervening two years.

Pearson, R.G. 1977. 1977 Swain Reefs Survey. Preliminary report on *Acanthaster* distribution and abundance. Report to the Great Barrier Reef Marine Park Authority.

LOCALITY: Swain Reefs

Study for Development and Refinement of Coral Baseline and Monitoring Methodology

PERIOD: 1978 - March 1980

ORGANIZATION: James Cook University, Department of Marine Biology

PROJECT LEADER: Dr T. Done

PROJECT OFFICER: Mr L. Zell

SUPERVISOR: Mr R. Kenchington

FINANCIAL SUPPORT: GBRMPA - \$32,200

OBJECTIVES

To develop a "benthos reconnaissance methodology and program", the function of which is to provide a broad picture of the range and condition of coral communities to be found on particular reefs, at the time management decisions are to be made.

IMPLICATIONS/MANAGEMENT NEEDS

It is necessary to possess knowledge of the current status of coral communities if decisions regarding the management of such temporally variable entities are to be made. "Reference" data on reef conditions against which future changes can be monitored are also provided.

METHODOLOGY

This project tested and refined techniques for surveying reefs.

STATUS

The project has been completed. The Authority plans to publish the report in 1983.

The reconnaissance program aims to characterize "entire" reefs on the basis of

- (a) the types of communities present
- (b) the percentage cover of living and dead coral in each community.

A technique involving divers towed behind small boats was developed. Divers note slope depth, coral cover, algal cover, aesthetics, and visually dominant organisms and are debriefed after 20 minute tows. Data are computer plotted for each characteristic for each reef. Additionally, a photogrammetric monitoring technique using a stereoscopic camera system was developed. This allows monitoring of a permanently marked site in which precise locations of corals can be identified.

- Done, T.J. 1980. Part I. Reconnaissance of Reef Benthos as an Aid to Management.
Part II. Close Range Photogrammetry for Time Series Studies of Reef
Part II. Coral Communities.

LOCALITY: Capricornia Section. Cairns Section.

Amateur Fishing Study**PERIOD:** April 1978 - Aug 1979**ORGANIZATION:** GBRMPA**PROJECT LEADER:** Dr W. Craik**CONSULTATION AND LIAISON:** Deep Sea Fishing Clubs**PROJECT OFFICER:** Dr W. Craik**SUPERVISOR:** Mr R. Kenchington**FINANCIAL SUPPORT:** GBRMPA - \$3,000**OBJECTIVES**

To assess the population fluctuations of reef fish stocks and the possible impact of fishing on these stocks.

IMPLICATIONS/MANAGEMENT NEEDS

There has been no attempt at collection and analysis of catch and effort statistics to determine the state of the demersal reef fishery on the Great Barrier Reef. As fishing is probably the major activity on the Great Barrier Reef, the necessity of managing reef stocks so that it may continue to be a major reef activity is evident.

METHODOLOGY

Catch records from deep sea amateur fishing clubs and charter boat operators using the Great Barrier Reef were analysed.

STATUS

Results of the study have been published.

Findings for demersal reef fishes:

- where reefs are a range of distances from shore, catches increase with increasing distance from port (e.g. Cairns, Innisfail)
- off Townsville, the same number of fish are being caught as 15 years ago, but the average fish size is smaller
- off Innisfail, catches are smaller but the fish have got larger in the last 5 years
- in the Capricorn-Bunker area, catches and average fish size have remained fairly steady over the last 20 years
- many smaller fish are caught in the Capricorn-Bunker area but these figures change with latitude and by Cairns fewer but larger fish are caught
- large red emperor and coral trout are caught less frequently
- small boats catch more fish than larger boats.

Craik, W. 1979. Amateur Fishing on the Great Barrier Reef. Technical Memorandum GBRMPA-TM-4. Great Barrier Reef Marine Park Authority, Townsville, Queensland.

Craik, W. 1979. Survey identifies trend in reef fish catches. *Australian Fisheries* 38(12): 29-32.

Survey of Wheeler Reef

PERIOD: Sept 1977
ORGANIZATIONS: James Cook University
Queensland Fisheries Service
GBRMPA

PROJECT LEADERS: Dr T. Done
Mr R. Pearson
Mr R. Kenchington

SUPERVISOR: Mr R. Kenchington
FINANCIAL SUPPORT: GBRMPA - \$1,360

OBJECTIVES

To characterize Wheeler Reef biologically, including the estimation of populations of selected commercial and recreational fish stocks. To assess survey techniques for use in further such studies.

IMPLICATIONS/MANAGEMENT NEEDS

Biological maps of reefs are required by GBRMPA to assist in decision making for zoning and management of the Marine Park.

METHODOLOGY

A system based on visually predominant organisms was developed to provide an impression of the reef benthos. Data were numerically coded on field data sheets in a form for computer processing to optimise both the field work and interpretation. Two reconnaissance methods were used: manta-board tow and spot checks.

In addition, manta-board survey techniques were used to survey recreationally and commercially important fish stocks.

The survey of Wheeler Reef was carried out over a six-day period, September 10-15, 1977.

STATUS

The project has been completed.

Maps and sets of histograms relating to benthos were produced for the reef. Each histogram set provides a characterization of the reef as a whole in terms of gross attributes. Two types of data were recorded - cover and qualitative. Generally, histograms and maps produced for cover data recorded by different observers showed satisfactory concurrence. Qualitative data (diversity, aesthetics, and community type) were less consistent - probably due largely to observer variation and differences in reconnaissance method.

Refinements of the field techniques, descriptive master sheet, and data analysis are planned for future surveys. The approach used in this study may then be useful in characterizing reefs relatively rapidly and only requiring a short period of observer training.

In terms of selected commercial and recreational reef fish species the Wheeler Reef ichthyofauna could be characterised as a moderately exploited community. However, the data collected should be considered as an indicator of the reef fish community status only at the time of sampling (a reef fish community being a dynamic system).

LOCALITY: Wheeler Reef (90km east of Townsville).

Fish Survey Methodology Workshop I**PERIOD:** Nov 1978 - May 1979**ORGANIZATION:** Sponsored by GBRMPA**CONSULTATION AND LIAISON:** Fish biologists from Universities, State Fisheries, research institutions**PROJECT OFFICER:** Mr S. Summerhays**SUPERVISOR:** Mr R. Kenchington**FINANCIAL SUPPORT:** GBRMPA - \$4,000**OBJECTIVES**

To define simple techniques to identify reef fish community types and assess population levels of commercially and recreationally important species of fish.

IMPLICATIONS/MANAGEMENT NEEDS

The Authority considers that the single most important impact in the Great Barrier Reef Region is the effect of fishing, and that one of the most important recreational activities for reef visitors is "fish watching", thus it is essential to develop techniques to assess these populations.

METHODOLOGY

A workshop of fish biologists was held at Heron Island from 18-28 November 1978 to examine the feasibility of developing survey and monitoring techniques for fish communities - "lookers" and fished species - "cookers".

STATUS

The project has been completed.

A report of the workshop has been published by GBRMPA.

After comparison of a range of tow and diving survey strategies, survey dives over fairly limited areas of reef were regarded as the most appropriate approach. The "lookers" survey technique involved replicate dives by divers armed with a species list. The divers recorded species and abundance. The "cookers" technique involved two divers covering a fixed area of reef scoring coral trout observed into 10cm size classes.

Great Barrier Reef Marine Park Authority. 1978. Workshop on Reef Fish Assessment and Monitoring held at Heron Island, 18-28 November 1978.

LOCALITY: Capricornia Section - Heron Island Reef

Fish Survey Methodology Workshop II**PERIOD:** April 1979 - Nov 1979**ORGANIZATION:** Sponsored by GBRMPA**CONSULTATION AND LIAISON:** Dr D. Pollard)
Mr J. Bell) NSW State Fisheries
Mr B. Russell, Macquarie University**PROJECT OFFICER:** Dr W. Craik**SUPERVISOR:** Mr R. Kenchington**FINANCIAL SUPPORT:** GBRMPA - \$6,000**OBJECTIVES**

To refine the intensive fish survey techniques developed at the Fish Survey Methodology Workshop I for the estimation of recreationally and commercially important populations of fishes, with particular reference to coral trout.

IMPLICATIONS/MANAGEMENT NEEDS

The intensive scuba search technique was found to be the only feasible technique for realistic estimates of populations of commercially and recreationally important species of bottom reef fish. Thus refinement and evaluation of this technique are essential in aiding management of the reef fish resource.

METHODOLOGY

The workshop was conducted for 2 weeks at Heron Island and was attended by 4 fish biologists to refine the coral trout survey technique.

STATUS

The project has been completed.

Work undertaken included:

- Underwater length estimation: variability in underwater length estimation was examined and standard techniques for improving accuracy and reducing variability were developed and employed.
- Coral trout censusing: this involved diving censuses to determine the required transect time/length, required number of replicates and observers, tidal and time variability factors, usefulness of the method, differences between areas and the relationship of results found in this study to other studies.
- Proposed action and recommendations were developed.

Great Barrier Reef Marine Park Authority. 1979. Workshop on Coral Trout Assessment Techniques held at Heron Island 21 April-4 May, 1979.

LOCALITY: Capricornia Section - Heron Island Reef

Manta-tow Survey of Capricorn-Bunker Reefs

PERIOD: 1978 - Aug. 1980
ORGANIZATION: GBRMPA

PROJECT LEADER: Mr L. Zell

PROJECT OFFICER: Mr L. Zell

SUPERVISOR: Mr R. Kenchington

FINANCIAL SUPPORT: GBRMPA - \$25,000

OBJECTIVES

To survey the reefs in the Capricornia Section to provide a broad picture of the range and condition of coral communities to be found on particular reefs.

IMPLICATIONS/MANAGEMENT NEEDS

It is hoped that this survey will develop and refine baseline and monitoring techniques for coral community and cover assessment, and provide baseline data for this part of the reef.

METHODOLOGY

Reconnaissance of 21 reefs in the Capricornia Section of the Great Barrier Reef was undertaken during 8 separate visits to the area during 1978 and 1979.

Reconnaissance was undertaken by snorkellers towed along reef margins behind a small boat using a manta board for manoeuvrability.

For details of the method, see "Study for development and refinement of coral baseline and monitoring methodology" (Project 27).

STATUS

A report was prepared for and accepted by GBRMPA. The Authority plans to publish the report in 1983.

Standard data presentation are tables and computer-printed maps of reef tops and slopes showing relevant characteristics.

Done, T.J. 1980. Reconnaissance of Reef Benthos as an Aid to Management. Part I.

LOCALITY: Capricornia Section

Larval Fish Ecology at Lizard Island**PERIOD:** 1979 and 1980**ORGANIZATION:** Australian Museum**PROJECT LEADER:** Dr J. Leis**PROJECT OFFICER:** Dr W. Craik**FINANCIAL SUPPORT:** GBRMPA Augmentative Research Grants - \$1,175**OBJECTIVES**

To identify fish larvae in the Lizard Island area. To determine the spatial and temporal distribution of fish larvae around Lizard Island.

IMPLICATIONS/MANAGEMENT NEEDS

More knowledge is needed of the biology of fish larvae to aid our understanding of coral reef fishes. This will prove beneficial to scientific investigations of the population biology of reef fish and for resource management.

METHODOLOGY

Plankton tows were made for fish larvae and currents were measured at a number of sites by drogues.

STATUS

The project has been completed.

Few fish larvae completed their development within the midwaters of the Lizard lagoon. Relatively few larvae completed their development in midwaters immediately surrounding Lizard Island. Of those that did few were of recreational or commercial importance. Larvae of a few families of recreational and commercial importance spent some time in midwaters around Lizard only in young stages.

These findings have relevance from a management sense in that they indicate many common reef fish do not complete their planktonic development in the vicinity of their mid-Barrier Reef Lagoon reefs of origin. It appears mid-Barrier Reef Lagoon reefs may depend on recruits from elsewhere to maintain the populations of some fishes. This is relevant to management decisions because a reef which is not self-maintaining cannot be treated as an isolate in decisions regarding fishing closures, zoning e.g. the location and size of replenishment areas, or the like.

Results of the study are being published:

Leis, J.M. In press. Distribution of fish larvae around Lizard Island, Great Barrier Reef: Coral reef lagoon as refuge? Proceedings 4th International Coral Reef Symposium, Manila, May 1981.

Leis, J.M. and Rennis, D.S. In press. The larvae of Indo-Pacific coral reef fishes: A guide to identification. New South Wales University Press.

LOCALITY: Cairns Section - Lizard Island

Food and Feeding of Loggerhead Turtles

PERIOD: 1979

ORGANIZATION: James Cook University, Department of Zoology

PROJECT LEADER: Ms E. Moodie

PROJECT OFFICER: Dr W. Craik

SUPERVISOR: Prof. R. Kenny

FINANCIAL SUPPORT: GBRMPA Augmentative Research Grant - \$648

OBJECTIVES

To establish food preferences and feeding patterns of loggerhead turtles in the southern Great Barrier Reef. To investigate ecological and/or seasonal or age (size) class differences in diet. To investigate the bioenergetics and usage of food taken.

IMPLICATIONS/MANAGEMENT NEEDS

This study will provide a greater understanding of the coral reef food web.

METHODOLOGY

Faeces samples were analysed. Molluscs were sampled. Gut contents and principal prey species were analysed for nitrogen, phosphorus, organic matter, caloric value and pH.

STATUS

The project has been completed.

The loggerhead turtle *Caretta caretta* at Heron Island and Wistari Reefs was feeding primarily on molluscs. Faecal samples of turtles collected from different zones of the reef were dominated by different molluscan species.

No significant temporal, age/size or sexual differences in the composition of the diet were detected. Some regional variations were noticed. The size ranges of prey taken were investigated and feeding behaviour and possible foraging strategies discussed. Examination of the morphological features of loggerhead turtles associated with feeding indicated that the species is carnivorous and feeds mainly on hard-shelled food items.

The minimum energy intake of a population of 250 *C. caretta* at Heron Island was estimated as 3.435×10^7 kcal/yr and the energy equivalent of the minimum amount of organic debris made available to other trophic levels by the egestion of wastes by the *C. caretta* population was calculated as 1.450×10^7 kcal/yr. Minimum annual mortality rates of the principal prey species due to predation by *C. caretta* were calculated.

Moodie, E.G. 1979. Aspects of the feeding biology of the loggerhead turtle (*Caretta caretta*). Honours thesis, James Cook University of North Queensland.

LOCALITY: Capricornia Section - Heron Island, Wistari Reefs

PERIOD: 1979
ORGANIZATION: University of Sydney, School of Biological Sciences
PROJECT LEADER: Mr B. Hatcher
PROJECT OFFICER: Dr W. Craik
SUPERVISOR: Dr A. Larkum
FINANCIAL SUPPORT: GBRMPA Augmentative Research Grant - \$468

OBJECTIVES

To examine the interaction between benthic algae and herbivores on a coral reef, and to quantify the trophic exchange due to grazing.

IMPLICATIONS/MANAGEMENT NEEDS

This study will provide a greater understanding of the influence of grazing species of reef fish on coral reef community structure.

METHODOLOGY

At One Tree Reef the standing stocks of the epilithic algal community (EAC) and of grazing organisms were monitored in 7 habitats over 14 months at 2 month intervals. The feeding rates of the dominant grazers were also monitored, and ingestion rates calculated. Synchronous measurements of the yield from the EAC to the grazers were made using short term, low impact caging treatments of dead coral blocks. Thus, two independent measures of the trophic transfer were obtained.

STATUS

The project has been completed.

The major grazer groups present were scraping, cropping and sucking fish. Group diversity and standing stock did not vary significantly with season. However, the between-habitat differences in these parameters, as well as the EAC standing crop and yield were significant. The general picture is one of consistently low EAC biomass with high yield to a high, itinerant grazer biomass on the reef slopes, and the opposite situation inside the lagoon. The intertidal reef crest is unique in having the largest EAC biomass and a high yield as well. The proportion of EAC production entering grazing food chains ranged from 10 to 80%, with a whole reef value of approximately 50%. Grazing fish feeding rates were highly seasonal, and correlated with water temperature.

The two measures showed good agreement. Calculated ingestion rates accounted for 52 to 290% of the measured yield, but were almost an order of magnitude higher than the estimated respiratory carbon requirement, suggesting that herbivorous fish populations are not energy-limited.

Hatcher, B. 1981. The interaction between algae and grazers on a coral reef. Ph.D. thesis, University of Sydney.

Papers on this research have been published:

Hatcher, B.G. 1982. Grazing in coral reef ecosystems. In: D. Barnes (Ed.), *Perspectives on Coral Reefs*. Australian Institute of Marine Science, Townsville.

Hatcher, B.G. In press. The interaction between grazing organisms and the epilithic algal community of a coral reef: A quantitative assessment. Proceedings 4th International Coral Reef Symposium, Manila, May 1981.

LOCALITY: Capricornia Section - One Tree Island Reef

Ecology of Territorial Pomacentrids**PERIOD:** 1979**ORGANIZATION:** University of Sydney, School of Biological Sciences**PROJECT LEADER:** Mr P. Doherty**PROJECT OFFICER:** Dr W. Craik**SUPERVISOR:** Dr P. Sale**FINANCIAL SUPPORT:** GBRMPA Augmentative Research Grant - \$398**OBJECTIVES**

To investigate mechanisms permitting coexistence of similar species in view of their potentially intense competition.

IMPLICATIONS/MANAGEMENT NEEDS

This study is designed to provide a greater understanding of population dynamics of reef fish communities.

METHODOLOGY

Data was gathered on longevity, age composition, fecundity, spawning frequency, breeding season length, pattern of larval recruitment in time and across habitats and competitive interactions between adults and juveniles among and within species.

STATUS

The project has been completed.

The production of eggs and larvae is highly synchronised with lunar and tidal cycles, suggesting that newly hatched larvae are flushed to the open sea and transported, probably elsewhere. Larval recruitment is highly variable and uncorrelated with the current population density. Post-settlement survival does not appear to be density dependent, though juvenile growth is density dependent.

Inadequate recruitment frequently limits population densities to low levels where resource competition is unimportant.

Papers on this research have been published:

Doherty, P.J. In press. Coral reef fishes: recruitment - limited assemblages?
Proceedings 4th International Coral Reef Symposium, Manila, May 1981.

Doherty, P.J. In press. Tropical territorial damselfishes: are densities limited by aggression or recruitment? *Ecology*

Doherty, P.J. In press. Some effects of density on the juveniles of two tropical territorial damselfishes. *J. Exp. Mar. Biol. Ecol.*

LOCALITY: Capricornia Section - One Tree Island Reef

PERIOD: 1979

ORGANIZATION: James Cook University, Department of Zoology

PROJECT LEADER: Dr G. Heinsohn

PROJECT OFFICER: Dr W. Craik

FINANCIAL SUPPORT: GBRMPA Augmentative Research Grant - \$440

OBJECTIVES

To document the species of small cetaceans found in North Queensland waters with regard to occurrence and distribution, habitat preferences, feeding, biology and reproduction, and life histories.

IMPLICATIONS/MANAGEMENT NEEDS

Cetaceans are migratory and nomadic species that move in and out of reef areas. The recording of cetacean species, their distributions, and their movements is very important in terms of their conservation and management in the Great Barrier Reef waters.

The long term aim is to produce a guide to the marine mammals of the region. This will serve as an educational information source on this subject.

METHODOLOGY

Aerial survey data was analysed and maps drawn to show the distributions of small cetaceans as seen on some surveys. Stomach contents were analysed to examine feeding behaviour. Teeth were sectioned, decalcified and stained, and dentinal growth layer groups were counted to estimate age.

STATUS

The project has been completed.

Six known species and one unidentified specimen have been collected in North Queensland. The known species are the Indo-Pacific hump-backed dolphin (*Sousa chinensis*), the Irrawaddy dolphin (*Orcaella brevirostris*), the Melon-headed whale or Electra dolphin (*Peponocephala electra*), the Short-finned pilot whale (*Globicephala macrorhynchus*), the Bottlenose dolphin (*Tursiops truncatus*) and the Spinner dolphin (*Stenella longirostris*).

Analysis of stomach contents showed *Orcaella* fed on crustaceans, cephalopods and a variety of bony fish, probably taking the most readily available foods. *Sousa* and *Tursiops* both appeared to feed predominantly on fish (insufficient stomach content data for these species).

Age determination studies showed that *Orcaella* may live to more than 28 years and *Sousa* to more than 20 years.

Some species, particularly *Tursiops truncatus*, were observed to use a wide range of habitats from inshore to outer reef waters. *Orcaella* and *Sousa* seemed to be primarily inshore species.

Seasonal Use of Heron Island Beach Rock by Browsing Fish particularly of the Genus *Siganus*

PERIOD: 1979

ORGANIZATION: University of Queensland, Department Of Zoology

PROJECT LEADER: Mr N. Quinn

PROJECT OFFICER: Dr W. Craik

SUPERVISOR: Prof. J.M. Thomson

FINANCIAL SUPPORT: GBRMPA Augmentative Research Grant - \$384

OBJECTIVES

To determine seasonal usage of the beach rock at Heron Island by browsing fish.

To examine feeding preferences, reproduction, toxicology, growth, population size and parasites of *Siganus* species.

IMPLICATIONS/MANAGEMENT NEEDS

Herbivores are an important influence in coral reef community structure. Foraging activities of tropical marine herbivores may affect the distribution and abundance of algae and contribute to the development of coral reef structure and the fish assemblage associated with reef structure.

METHODOLOGY

375 *Siganus rivulatus* and 480 *S. lineatus* were tagged using floy tags and plastic pricing tags. Regular censusing of fish monitored the presence of tagged fish while recaptures allowed growth to be measured and individual movement to be observed. Food preference experiments were undertaken.

STATUS

The project has been completed.

Siganus rivulatus is a seasonal species making wide migrations. It restricts movements to a localised area during short periods, feeds on *Enteromorpha* on beach rock, and tends to form schools. Reproduction occurs in November, average fecundity is 5.1×10^5 eggs ovary. It cannot survive outside salinities of 25‰ to 38‰ and has a narrow temperature tolerance.

S. lineatus resides around Heron all year. It has a greater tolerance to temperature and salinity extremes than *S. rivulatus* and is a more selective feeder than *S. rivulatus*.

LOCALITY: Capricornia Section - Heron Island

39 **Reproduction in some Scleractinian Corals.**

PERIOD: 1979 and 1982
ORGANIZATION: University of Queensland, Department of Zoology
PROJECT LEADER: Ms B. Kojis
PROJECT OFFICER: Dr W. Craik
SUPERVISOR: Dr R. Endean
FINANCIAL SUPPORT: GBRMPA Augmentative Research Grants - \$1,149

OBJECTIVES

To determine the timing and manner of reproduction, fecundity, and age/size at sexual maturity for species of corals from 3 major taxonomic groups (Faviidae, *Porites*, *Acropora*).
To determine the reproductive strategies of the species.

IMPLICATIONS/MANAGEMENT NEEDS

This study is designed to provide important biological information relevant to recovery after perturbation: seasonality of spawning and larval release, fecundity, growth and natural mortality.

METHODOLOGY

The field work in 1982 involved: (i) observations to determine the fecundity in aquaria of *Goniastrea*; (ii) completion of the experiment to test whether size of whole colony determines the proportion of energy going into gametes; (iii) continuation of the annual recording of tagged colonies of *G. favulus*; (iv) determination of lunar and diurnal periodicity of larval release in *Acropora cuneata*; and (v) observations of the mode and timing of spawning of other corals.

STATUS

The project has been completed.

Observations of Favid corals and *Porites* indicate that external fertilisation may be common among hermatypic corals. For example, *Goniastrea favulus* is an hermaphrodite with eggs and sperm intermingled. It releases eggs and sperm and external fertilisation occurs.

There are two distinct reproductive cycles in *Acropora palifera/cuneata* with a single colony reproducing according to one or the other cycle.

In 1982 there were cases of partial or no spawning in the *Goniastrea* colonies observed and generally low larval release in *A. cuneata* colonies. Also peak larval production occurred later in the lunar cycle than in previous years. The seas were rough at the time.

This study indicates that a large number of coral species may spawn only once a year over a relatively short period and a disturbance during spawning or settlement may largely destroy that year's recruitment. It also indicates that certain species may be better pollution indicators than others - ideally a larval releasing (short-lived) one that recruits to shallow water (easy monitoring).

Papers on this research have been published:

Kojis, Barbara L. and Quinn, Norman J. 1981. Aspects of sexual reproduction and larval development in the shallow water hermatypic coral *Goniastrea australensis* (Edwards and Haime, 1857) (*Goniastrea* cf. *favulus* (Dana, 1846) (Veron, et al. 1977). Identified by M. Pichon.) *Bulletin of Marine Science* 31:558-573.

Kojis, Barbara L. and Quinn, Norman J. 1981. Factors to consider when transplanting hermatypic coral to accelerate regeneration of damaged coral reefs. Conference on Environmental Engineering, Townsville, 8-10 July, pp. 183-187.

Kojis, Barbara L. and Quinn, Norman J. 1982. Reproductive ecology of two faviid corals (Coelenterata: Scleractinia) *Mar. Ecol. Prog. Ser.* 8(3): 251-256.

Kojis, Barbara L. and Quinn, Norman J. In press. Reproductive strategies in two species of *Porites* (Scleractinia). Proceedings of 4th International Coral Reef Symposium, Manila, Philippines, May 1981.

LOCALITY: Capricornia Section - Heron Island Reef

PERIOD: 1979

ORGANIZATION: University of Sydney, School of Biological Sciences

PROJECT LEADER: Mr M. Sutton

PROJECT OFFICER: Dr W. Craik

SUPERVISOR: Dr P. Sale

FINANCIAL SUPPORT: GBRMPA Augmentative Research Grant - \$260

OBJECTIVES

To determine the distribution and abundance of several species of chaetodontid fish at One Tree. To test some of the factors which determine their occurrence.

IMPLICATIONS/MANAGEMENT NEEDS

This study is designed to provide a greater understanding of population dynamics of reef fish communities.

METHODOLOGY

Five widely separated study areas in the first lagoon at One Tree Reef were chosen and three 100-metre transects were sampled in each area to examine the structure of communities, emphasising habitat requirements, recruitment pattern, recruitment sites, longevity, breeding, fecundity and social structure.

STATUS

The project has been completed.

There was no relationship between the abundance of a particular butterfly fish and the cover of live corals or any other substratum type. It was hypothesized that patterns of juvenile recruitment probably play a more important role in determining adult population levels than does any particular feature of the environment.

Compression of territory size appears to be the mechanism by which high population densities are maintained in some habitats, although this remains to be verified experimentally.

Social behaviour investigations revealed a strong intra-specific response, including vigorous displays and attacks by the residents against the cased intruder. Interspecific response, however, was in all cases minimal and restricted to a mild curiosity at the activity of the fish in the perspex case.

The species do not seem to be partitioning the space resources of the reef. Similarly, no obvious differential food preferences nor temporal partitioning of feeding activity have been found after many hours of observation of feeding fishes. However, the partitioning of food resources remains a possible explanation for the occurrence of any guild member within a habitat and continues to be investigated.

Members of this family are midwater spawners releasing planktonic eggs. Populations of coral-feeding butterfly fishes in the One Tree lagoon did not breed at any time of the year. On the outer slopes, breeding activities followed a seasonal pattern, with breeding apparently at its height in December. In addition to this dichotomy, *Chaetodon plebius* may not be breeding in any habitat at One Tree reef.

LOCALITY: Capricornia Section - One Tree Island Reef

Coral Trout Survey

PERIOD: Oct/Nov 1979
ORGANIZATIONS: (1) NSW State Fisheries
(2) Macquarie University
(3) GBRMPA
(4) Sydney University

PROJECT LEADERS: (1) Dr D. Pollard, Mr J. Bell
(2) Mr B. Russell
(3) Dr W. Craik
(4) Mr M. Sutton

PROJECT OFFICER: Dr W. Craik
SUPERVISOR: Mr R. Kenchington
FINANCIAL SUPPORT: GBRMPA - \$10,000

OBJECTIVES

To conduct a survey of coral trout in the Capricorn and Bunker group of reefs.

IMPLICATIONS/MANAGEMENT NEEDS

This program should permit evaluation of the survey technique as a feasible field operation as well as providing data on the state of coral trout stocks at a number of habitats at particular reefs of the Capricorn and Bunker groups.

METHODOLOGY

All the emergent reefs in the Capricorn-Bunker groups were surveyed for coral trout in at least one area of each reef.

STATUS

Results of the study are being prepared for publication.

Results showed coral trout at the Heron Island "unfished" area to be 10-20 cm larger and up to 10 times as numerous as at any other reef surveyed. Surveys over extended periods of time at the same site showed little variation within a week, but considerable variation when surveys were far apart.

Craik, G.J.S., Pollard, D.A., Russell B.C. and Bell J.D. In prep. Estimation of demersal reef fish population density and size structure in the Great Barrier Reef Marine Park using an underwater census technique. I. Development of the technique.

Craik, G.J.S., Pollard, D.A., Russell B.C. and Bell J.D. In prep. Estimation of demersal reef fish population density and size structure in the Great Barrier Reef Marine Park using an underwater census technique. II. Surveys of coral trout in the Capricornia Section.

LOCALITY: Capricornia Section

Manta-tow Survey of Benthos and Crown of Thorns at Reefs in the Proposed Cairns Section of the Marine Park

PERIOD: March 1980 - August 1982
ORGANIZATION: GBRMPA

PROJECT LEADER: Mr W. Nash

PROJECT OFFICER: Mr L. Zell

SUPERVISOR: Mr R. Kenchington

FINANCIAL SUPPORT: GBRMPA - \$40,000

OBJECTIVES

To survey the reefs in the proposed Cairns Section to provide a broad picture of the range and condition of coral communities to be found on particular reefs.

To document occurrence of crown of thorns.

IMPLICATIONS/MANAGEMENT NEEDS

This study will provide valuable baseline data prior to the development of the zoning plan for this section. It will also provide information on crown of thorns distribution.

METHODOLOGY

The manta-tow technique was used to survey 61 reefs.

For details of the manta-tow method, see "Study for the development and refinement of coral baseline and monitoring methodology" (Project 27).

STATUS

Five transects covering 61 reefs, islands and shoals were visited during five ten-day expeditions on the TSMV "Hero". In all, 586 reef survey tows were recorded for the purpose of data analysis.

Some 50 scuba dives were undertaken for the purposes of training (for manta tows), data recording, specimen collection, coral trout survey and photography. Reefs where crown of thorns were found were listed, and starfish were collected for size measurement, sexing and electrophoretic studies of the pyloric caeca.

The survey data are being prepared for publication - see Project 49 "Manta - tow Survey Analysis for Capricornia and Cairns Sections.

LOCALITY: Cairns Section (Innisfail to Lizard Island)

A survey of Arginine Decarboxylase Amongst Reef-building Scleractinian Corals

PERIOD: 1980 and 1981

ORGANIZATION: James Cook University,
Department of Chemistry and Biochemistry

PROJECT LEADER: Dr M. Streamer

PROJECT OFFICER: Dr W. Craik

FINANCIAL SUPPORT: GBRMPA Augmentative Research Grants - \$865

OBJECTIVES

To study the activity of the enzyme arginine decarboxylase in hard corals and to determine whether its presence is related to active growth.

To study differences in activity of the enzyme in *Acropora formosa*.

IMPLICATIONS/MANAGEMENT NEEDS

If the level of activity exhibited by arginine decarboxylase in hard corals can be correlated with growth of the corals, it could provide a rapid and sensitive indicator of stress.

METHODOLOGY

Scleractinian corals were collected and the animal tissue and zooxanthellae analysed for the level of activity of arginine decarboxylase.

STATUS

The project has been completed.

In 1980, Scleractinian corals from 13 families were collected. Other than Pocilloporidae and some Faviidae all corals showed unambiguous evidence of arginine decarboxylase. Zooxanthellae were also examined from the corals but only *Goniastrea aspera* showed significant arginine decarboxylase levels.

In the 1981 survey, arginine decarboxylase was found in some samples of *Pocillopora*, *Seriatopora* and *Stylophora* at levels comparable to levels found in other corals during 1980 survey. However, enzyme activity was more frequently absent than present and its occurrence showed no discernible correlation with any of the imposed variables.

Arginine decarboxylase was consistently found in the animal tissue of *Goniastrea* and it was concluded that the activity found in 1980 in the zooxanthellae was due to contamination by the former.

For *Acropora formosa* the data suggested that the enzyme activity reflects the growth of the corals, though a correlation of enzyme activity with an increase in physical size of the corals is not possible because of small changes in coral size.

Experiments are underway to correlate enzyme activity with DNA synthesis to relate arginine decarboxylase activity to cellular growth and thus instantly assess the growth status of coral sampled by this enzymatic method.

LOCALITY: Cairns Section - Lizard Island, Carter Reef, Davies Reef

Coral Trout Species Identification

PERIOD: 1980
ORGANIZATION: Australian Museum, Fish Department
PROJECT LEADER: Dr D. Hoese
PROJECT OFFICER: Dr W. Craik
FINANCIAL SUPPORT: GBRMPA Augmentative Research Grant - \$500

OBJECTIVES

To determine the number of species referred to as coral trout in a systematic examination of specimens in the Australian Museum.

IMPLICATIONS/MANAGEMENT NEEDS

The project will give a key to Australian species, give the correct scientific name(s), synonyms and previously used names, and give the presently known distributions.

METHODOLOGY

Preserved specimens of the 6 species of *Plectropomus* were examined to provide standard point to point measurements and counts of fin rays, enlarged teeth, gill rakers (divided into 3 types). The internal anatomy was not studied. Radiographs of the six species were examined.

STATUS

The project has been completed.

Six species of *Plectropomus* from Australia were recognized. Two species, *P. oligacanthus* and *P. truncatus*, are probably not common. Most records of coral trout refer to the following four species - *P. maculatus*, *P. leopardus*, *P. melanoleucus* and a *P. sp.* separable from *P. melanoleucus* only on the basis of colouration.

A key and illustrations have been provided for identification and a set of 35mm slides have been provided. The distributions of the 4 common species were given.

For ecological studies and management of the Great Barrier Reef, it is recommended that each species be treated separately, since each seems to have different ecological requirements, differs in abundance, and grows to a different size. Caution should be used in interpreting angling and fish market data, since at least four and possibly all six species of *Plectropomus* and *Variola louti* are commonly referred to as coral trout. For example, average larger sizes of fishes would be expected from northern areas, if *Plectropomus sp.* enters into the fishery. There is some evidence that juveniles may occur over a much broader habitat range than that preferred by adults. For example, young of *Plectropomus maculatus* have been trawled from weedy areas between inner reefs.

Hoese, D.F., Bowling, J., Russell, B., and Randall, J.E. 1981. A preliminary revision of Australian species of coral trout of the genus *Plectropomus*. *Aust. Mus. Tech. Report No.12*.

Coral Trout Populations in Fished and Unfished Areas of French Polynesia**PERIOD:** 1980**ORGANIZATION:** NSW State Fisheries**PROJECT LEADER:** Mr J. Bell**PROJECT OFFICER:** Dr W. Craik**FINANCIAL SUPPORT:** GBRMPA Augmentative Research Grant - \$558**OBJECTIVES**

To compare the populations of coral trout in heavily fished and unfished areas within French Polynesia and the populations of Polynesia with those of the Great Barrier Reef.

IMPLICATIONS/MANAGEMENT NEEDS

This study is designed to establish the degree to which fishing has affected the natural population level of coral trout. This study can help direct the location of reserves to help build up population levels.

METHODOLOGY

Observations were made using the visual intensive scuba search technique developed at GBRMPA workshops and using general observation during diving.

STATUS

The project has been completed.

No *Plectropomus leopardus* (or *P. maculatus*) were observed during 40 hours observation at various populated localities in French Polynesia. Other serranids were present at very low densities. The fish were small and skittish in behaviour - believed to be the result of intense fishing activity. No coral trout were evident at the Papeete fish market nor among the catch from permanent fish traps.

Coral trout are potentially a conspicuous part of the Polynesian fish fauna. Tahitian researchers have found them to be relatively common (16-20 per pass) in ocean-lagoon passes of remote uninhabited (therefore unfished) atolls. It seems that long-term sustained fishing by the islanders has eliminated *Plectropomus* populations or reduced them to the point where reproductive success is adversely affected. At Mataiva Atoll intensive fishing could have done this in less than 35 years. Recruitment (which is presumed to occur through pelagic larval dispersal) from unfished areas has not been able to maintain the species at exploitable levels.

It has therefore been recommended that, where coral trout are vulnerable to fishing pressure on the Great Barrier Reef, reserves should be located at spawning sites so that recruitment to the reserve is enhanced. Research on identifying spawning sites and on the existence and extent of larval dispersal of coral trout may need to be funded by the Authority.

It appears that the Capricorn-Bunker Groups may support uniquely high numbers of serranids - another reason why the Authority should consider creating reserves to maintain densities of breeding serranids at their natural levels.

Coral Cay Vegetation Analysis in Capricorn-Bunker Groups**PERIOD:** 1980**ORGANIZATION:** University of Queensland, Department of Geography**PROJECT LEADER:** Ms P. Sales**PROJECT OFFICER:** Dr W. Craik**SUPERVISOR:** Dr R. Dick**FINANCIAL SUPPORT:** GBRMPA Augmentative Research Grant - \$610**OBJECTIVES**

To examine the pattern and character of vegetation on 14 coral cays in the Bunker and Capricorn groups. To consider the extent to which floristic and other vegetation differences are related to variations in land surface, soil properties and other features.

IMPLICATIONS/MANAGEMENT NEEDS

This study is designed to increase knowledge of the vegetation systems established on cays in the Capricornia Section and to improve understanding of the successional status of plant communities. This information is of basic relevance to the management of coral cays in the Great Barrier Reef Region.

METHODOLOGY

Field surveys will be undertaken to determine plant distributions and vegetation types which will be then mapped.

STATUS

Project not completed. Report not provided.

LOCALITY: Capricornia Section

Recruitment Rates and Availability of Potential Recruits in Plankton; Biology of Baitfish *Hypoatherina tropicalis*.**PERIOD:** 1980, 1981 and 1982**ORGANIZATION:** University of Sydney, School of Biological Sciences**PROJECT LEADER:** Ms P. Schmitt**PROJECT OFFICER:** Dr W. Craik**SUPERVISOR:** Dr P. Sale**FINANCIAL SUPPORT:** GBRMPA Augmentative Research Grants - \$2084**OBJECTIVES**

To examine the temporal changes in the abundance of ichthyoplankton within One Tree Reef lagoon. To examine breeding seasonality, fecundity and larval biology of a tropical baitfish, *Hypoatherina tropicalis*.

IMPLICATIONS/MANAGEMENT NEEDS

Valuable information on larval availability in different habitats will be provided by this study and investigation of life history parameters of an important baitfish could be particularly useful as it makes up the prey of many bird and fish species.

METHODOLOGY

Replicated underwater and surface samples were taken in the lagoon for subsequent analysis of plankton. Life history stages of the baitfish were investigated using a variety of techniques.

STATUS

Analyses should be completed in late 1983. The main results to date are listed.

Larval availability is quite low in lagoonal waters - mean numbers of larvae were 16.8/1000m³ in January/February and 40.8/1000m³ in April-May compared with tows outside the reef giving 294.5/1000m³. Larvae taken outside the reef were about 50% older. Only 3 species complete entire larval development within the lagoon - *Hypoatherina tropicalis*, *Spratelloides delicatulus* and a new species of atherinid.

Reproductive seasonality in *H. tropicalis*: spawning occurs all year round with peaks in spring and autumn; well defined cohorts appear every two weeks in spring and autumn.

S. delicatulus appears to be a spring to autumn breeder. Larvae were almost absent from winter samples.

Larval growth rate: daily growth increments have been identified in *H. tropicalis* otoliths using tetracycline. There are significant differences in growth rate between seasons and in the seasonal pattern between years. In 1981, spring and autumn showed the highest growth rates. In 1982, summer was higher than spring. Data for *S. delicatulus* show a spring growth rate of more than twice that of winter larvae.

Larval mortality rates for spring 1980 and autumn 1981 were estimated to be 16.1% and 19.4% per day respectively.

Adult reproductive parameters: females apparently must be greater than 50mm standard length before 50% are ripe. Samples have been collected for length frequency analysis and otoliths will be aged. Fecundity appears low.

Some data on food and feeding in *H. tropicalis* larvae have been obtained and also on size when larvae are able to feed at night.

LOCALITY: Capricornia Section - One Tree Island lagoon

Coral Trout Monitoring at Escape Reef**PERIOD:** Nov 1980 - Oct 1982**ORGANIZATION:** Marine Research Foundation**PROJECT LEADER:** Dr A. Ayling**PROJECT OFFICER:** Dr W. Craik**SUPERVISOR:** Mr R. Kenchington**FINANCIAL SUPPORT:** GBRMPA - \$1,800**OBJECTIVES**

To determine the degree of natural variation in coral trout population size structures in different habitats over a year at one reef in the northern area of the Great Barrier Reef Region.

IMPLICATIONS/MANAGEMENT NEEDS

The project will give information relevant to the monitoring of coral trout on the following aspects:

- the natural variation of coral trout numbers
- the natural movement of coral trout.

METHODOLOGY

Monthly surveys of coral trout population size structures were undertaken in predetermined transects on the leeward and windward sides of Escape Reef.

The surveys involved use of the intensive search survey technique developed in the coral trout workshops.

STATUS

The project has been completed.

Monthly surveys beginning in November 1980 were interrupted and were resumed in October 1981 to run for a 12 month period. Considerable variation between months is evident in surveys in the November to January period.

LOCALITY: Cairns Section - Escape Reef

Manta-tow Survey Analysis for Capricornia and Cairns Sections**PERIOD:** Nov 1980 - August 1982**ORGANIZATION:** James Cook University, Department of Marine Biology**PROJECT LEADERS:** Mr J. Robertson
Mr M. Haywood**CONSULTATION AND LIAISON:** Dr T. Done (AIMS)**PROJECT OFFICER:** Mr R. Kenchington**SUPERVISORS:** Prof. M. Pichon

Mr R. Kenchington

FINANCIAL SUPPORT: GBRMPA - \$13,819**OBJECTIVES**

To complete the analysis and presentation of manta tow data in two phases: (1) debugging reef data; (2) presenting as much data as possible for plotting.

IMPLICATIONS/MANAGEMENT NEEDS

Will enable production of resources handbook for Capricornia and Cairns Sections.

METHODOLOGY

All the coral data were debugged. The data were organised for plotting and then plotted.

STATUS

Data for all reefs have been debugged and plotted for each of the seven physiographic features recorded: (i) aesthetics; (ii) hard coral cover; (iii) soft coral cover; (iv) dead coral cover; (v) macroscopic algae; (vi) colony size; and (vii) diversity. These data will be published in 1983.

Data on visually dominant organisms have still to be plotted and analysed.

LOCALITY: Capricornia and Cairns Sections

Crown of Thorns Starfish Clearance from Green Island Reef**PERIOD:** April 1980 - April 1981**ORGANIZATIONS:** Queensland Fisheries Service
GBRMPA**PROJECT LEADER:** Mr J. Hicks**SUPERVISOR:** Mr R. Kenchington**FINANCIAL SUPPORT:** GBRMPA - \$4,996; QFS - \$5,000**OBJECTIVES**

To establish the most effective, economically feasible method of eradicating crown of thorns starfish by means other than biological control.

IMPLICATIONS/MANAGEMENT NEEDS

A lack of information in the literature dealing with the dose rates and concentrations of killing agents used previously in *A. planci* control programs has prompted this research which is primarily undertaking chemical injection experiments. This research will reveal the most successful method of eradicating crown of thorns.

METHODOLOGY

The injection experiments involved injecting the starfish with chemicals grouped into categories based on their physiological effects: (i) fixatives (e.g. concentrated formalin); (ii) toxic agents (e.g. copper sulphate, aqua ammonia); (iii) pH disruption agents (e.g. concentrated sodium hydroxide); (iv) osmotic abuse agents (e.g. saturated sodium chloride).

Other methods tested were air inflation of starfish and spreading granulated quicklime over the aboral surfaces of the starfish.

STATUS

The project has been completed.

Saturated copper sulphate solution proved to be the outstanding killing agent of the injection chemicals tested at a rate of 124 starfish per man hour.

Air inflation of starfish was approximately twice as efficient as hand collection. The technique has potential for application in a beche-de-mer fishery.

Direct application of granulated quicklime to crown of thorns starfish caused mortality in doses as low as 25 g dry weight CaO. The direction of further experimental work was discussed.

Research efforts into identification of a possible bacterial pathogen are worthy of further funding.

Hicks, J. and Blackford, B. 1981. Report on injection experiments and other field experiments on *Acanthaster planci* conducted at Q.F.S. Green Island Field Station, April - December, 1980. Report to the Great Barrier Reef Marine Park Authority.

LOCALITY: Cairns Section - Green Island Reef

Coral Trout Tagging in Capricornia**PERIOD:** Dec 1980 - June 1982**ORGANIZATIONS:** (1) GBRMPA
(2) Queensland National Parks and Wildlife Service (QNPWS)**PROJECT LEADER:** (1) Dr W. Craik
(2) Mr G. Mercer**PROJECT OFFICER:** Dr W. Craik**SUPERVISOR:** Mr R. Kenchington**FINANCIAL SUPPORT:** GBRMPA - \$15,000; QFS/QNPWS - \$15,000**OBJECTIVES**

To determine the extent of movement of reef fish, especially coral trout: (a) around a reef; and (b) between reefs. To obtain catch effort data. To obtain growth data.

IMPLICATIONS/MANAGEMENT NEEDS

The results will be significant with respect to the effects of replenishment areas and their closure. They will provide input for coral trout monitoring programs. Additional life history information in areas relevant to management will be gathered for both coral trout and other species.

METHODOLOGY

Reef fish are caught on hook and line at most reefs in Capricornia by anglers from QFS, QNPWS and invited local anglers from deep sea clubs. The fish are tagged with numbered lock-on spaghetti tags. Data on species, length, location, angler, bait, tide, time etc. are recorded for each fish. Some double tagging has been undertaken to look at tag loss.

STATUS

The effect of replenishment areas on reef stocks is yet to be determined. The degree of movement of reef fish is significant in this respect. To date, 4,300 reef fish have been tagged. Recaptures are being made at the rate of about 2%. The majority of recaptures have been made in the vicinity of the tagging sites.

LOCALITY: Capricornia Section

Handbook: Algal Flora of Heron Island and Adjacent Reefs**PERIOD:** Jan 1981 - Dec 1982**ORGANIZATION:** University of Queensland, Department of Botany**PROJECT LEADER:** Dr A.B. Cribb**PROJECT OFFICER:** Mr R. Kenchington**SUPERVISOR:** Mr R. Kenchington**FINANCIAL SUPPORT:** GBRMPA - \$1,157**OBJECTIVES**

To produce a handbook of the algal flora of Heron Island.

IMPLICATIONS/MANAGEMENT NEEDS

The handbook will provide a research and communication guide to the intertidal algae of Heron Island. Such information is required for (a) interpretive activities in the marine park and (b) as a precursor to the isolation of indicators of condition and impact.

METHODOLOGY

The field work involves collection of specimens and observations on variability.

STATUS

Specimens of over 200 species were collected. These included five species not previously collected from the area (one previously undescribed) and numerous specimens which furnished information on morphology or reproduction which had not previously been available.

Compared with the reef at Heron Island, that at Lady Elliott Island (examined only a fortnight later) supported only a depauperate algal vegetation. The bird population of Lady Elliott Island is also small compared with that of Heron Island. These differences between the two reefs support the suggestion made previously by Cribb that nutrients derived from birds on the cay may be one factor responsible for the relatively rich algal vegetation of the inner reef flat compared with the outer reef flat on Heron Island Reef.

Part I (Rhodophyta) of the handbook of the algae of the Capricornia Section has been completed and submitted for publication to the Great Barrier Reef Committee.

LOCALITY: Capricornia Section - Heron Island Reef, Lady Elliott Island Reef

53 **Seabird Colonies of the Capricorn and Bunker Reefs**

PERIOD: Jan 1981 - July 1981
ORGANIZATION: Griffith University
School of Australian Environmental Studies

PROJECT LEADER: Dr K. Hulsman

CONSULTATION AND LIAISON: Dr J. Kikkawa (University of Queensland)

PROJECT OFFICER: Mr R. Kenchington
SUPERVISOR: Mr R. Kenchington
FINANCIAL SUPPORT: GBRMPA - \$345

OBJECTIVES

To survey breeding colonies of seabirds in the Capricorn and Bunker Groups by analysing aerial photographs.

IMPLICATIONS/MANAGEMENT NEEDS

This study is designed to provide descriptive distributional data that: (a) may be used for interpretive activities in the marine park; (b) will produce a measure of impacts upon marine food chains in the Great Barrier Reef Region; and (c) will identify breeding and feeding areas susceptible to impact for strategic planning and risk mapping.

METHODOLOGY

Calculations were restricted to five species of seabird because the sizes of the colonies of other species were not known. Sizes of colonies of five species of seabird were estimated using the amount of vegetation type in which a species nests and its nesting density. No species occupied more than 31 per cent of the habitat that was assumed to be suitable and available. All the area covered by any vegetation type in which a species nested was assumed to be both suitable and available.

STATUS

The project has been completed.

The sizes of colonies of each species were overestimated. More colonies need to be censused to determine if constant correction factors can be found to provide accurate estimates of the sizes of colonies.

The scale of aerial photographs may have to be larger to provide greater accuracy. A scale of 1:10 000 has an error of $\pm 50 \text{ m}^2$ which could be the size of a colony of black-naped or roseate terns. A scale of 1:5 000 with an error of $\pm 25 \text{ m}^2$ would be more suitable for compiling maps of vegetation types and assessing the area potentially suitable as a nesting area.

LOCALITY: Capricornia Section

Systematics and Ecology of the Phytobenthos of Swain Reefs**PERIOD:** Jan 1981 - Feb 1983**ORGANIZATION:** Private Consultant**PROJECT LEADER:** Dr P.G. Saenger**PROJECT OFFICER:** Mr R. Kenchington**SUPERVISOR:** Mr R. Kenchington**FINANCIAL SUPPORT:** GBRMPA - \$10,570**OBJECTIVES**

To document the phytobenthos of the Swain Reefs. To observe the functional role of phytobenthos in a southern reef ecosystem.

IMPLICATIONS/MANAGEMENT NEEDS

Identification of algal components of reef systems is important for interpretation and extension activities in the marine park. An algal flora which contains species of importance as indicators of pollutants or of the well being of reef systems may be identified.

METHODOLOGY

Systematic collection at various depths, habitats, etc. is being made to complete taxonomic studies already undertaken.

Quantitative studies on the phytobenthos are to be carried out by means of SCUBA diving techniques.

Marked study sites will be revisited at various intervals to determine seasonal and long term changes in species composition, standing crop, growth rates and reproductive development.

STATUS

The field work has been completed.

The quantitative data collected in each 1m² quadrat for each species are height of tallest plant, total cover of that species in the quadrat, maximum cover of the biggest plant of each species and a canopy rating for each species - i.e. low, average and dense.

LOCALITY: Swain Reefs

Checklist of Fishes in Capricornia Section

PERIOD: July 1980 - December 1982
ORGANIZATION: Australian Museum

PROJECT LEADER: Dr B. Russell

PROJECT OFFICER: Dr W. Craik
SUPERVISOR: Mr R. Kenchington
FINANCIAL SUPPORT: GBRMPA - \$15,090

OBJECTIVES

To compile and provide GBRMPA with existing information on the fishes of the Capricornia Section, in the form of an historical account of work done in the area, an annotated checklist of the fishes, a discussion of the ecological and zoogeographic relationships of the fishes, and a bibliography.

IMPLICATIONS/MANAGEMENT NEEDS

This information is not otherwise available, and will be extremely useful to workers and reef users, librarians etc.

METHODOLOGY

Examinations of fish specimens from the Capricornia Section of the Marine Park, and any other necessary specimens held in the Australian Museum or Queensland Museum, were made to provide information pertinent to the compilation of the checklist.

An historical account of biological investigatory work conducted in the Capricornia Section has been based on appropriate primary reference material. A complete bibliography of all this work as well as the references abbreviated in the checklist has been compiled.

STATUS

The checklist is ready for publication.

LOCALITY: Capricornia Section

Bioerosion of Coral Substrates**PERIOD:** 1980-81**ORGANIZATION:** Australian Museum
Bureau of Mineral Resources, Canberra**PROJECT LEADERS:** Dr P.A. Hutchings
Dr P.J. Davies**FINANCIAL SUPPORT:** AMSTAC (for technical assistance)
GBRMPA - \$600 (shared with project 23)**OBJECTIVES**

To investigate the initial stages of bioerosion of newly available coral substrates at various sites at Lizard Island. Incidentally rates of bioaccretion and sedimentation will also be measured.

IMPLICATIONS/MANAGEMENT NEEDS

Data on rates of bioerosion and causal agents are virtually non-existent for the Great Barrier Reef, yet bioerosion is one of the major destructive forces operating on a coral reef, as evidenced by boulder tracts, eroded reef flats, cay sediments and lagoonal sediments. No data exists on the seasonal variations between reef environments. [This was a pilot study to test the feasibility of the method and has been expanded in to a long-term project, investigating a greater number of environments (AMSTAC supported research to Dr P. Hutchings)].

METHODOLOGY

Blocks of live coral *Porites* were collected and dried. Thin slices of coral were prepared using the diamond saw, measured, washed and dried. Blocks were attached to a steel grid firmly attached to the reef floor in three environments for 3, 6, 9, 12 and 15 months. After exposure, half the blocks were dissolved in dilute acid, and the fauna extracted, identified, counted, measured and divided into boring, nestling and encrusting organisms. The other blocks were dried, the organic matter dissolved and the blocks impregnated with epoxy resin and thin sections cut. Estimates of rates of bioerosion and bioaccretion were made and the major causal organisms identified during the experimental period at the three sites.

STATUS

The funds allocated by GBRMPA were used to purchase an automatic power feed 12" saw unit for use at the Lizard Island Research Station by Dr Hutchings. No cutting facilities previously existed at the Research Station and coral samples were cut and filed by hand.

A paper has been submitted for publication:

Davies, P.J. and Hutchings, P.A. Submitted. Bioerosion of coral substrate at Lizard Island, Great Barrier Reef - an experimental approach. *Coral Reefs*.

LOCALITY: Cairns Section - Lizard Island

Population Biology of *Montipora ramosa***PERIOD:** 1981**ORGANIZATION:** James Cook University, Department of Marine Biology**PROJECT LEADER:** Mr A. Heyward**PROJECT OFFICER:** Dr W. Craik**SUPERVISOR:** Dr J. Collins**FINANCIAL SUPPORT:** GBRMPA Augmentative Research Grant - \$255**OBJECTIVES**

To evaluate the vegetative reproduction rate, sexual reproduction and encrustment of *M. ramosa*.

IMPLICATIONS/MANAGEMENT NEEDS

This study is designed to provide greater understanding of the effects of human use on coral populations. *M. ramosa* is the dominant coral of the reef flat at Geoffrey Bay, Magnetic Island, an area well used by the people of nearby Townsville.

METHODOLOGY

At two mapped sites on the reef flat the following work was undertaken: (i) growth measurements using a skeletal stain to set a base mark; (ii) grafting experiments; (iii) determination of the size distribution of colonies; (iv) fragmentation experiments involving trampling; and (v) sexual reproduction studies involving the sampling of branches at monthly or weekly intervals.

STATUS

The project has been completed.

Both sexual reproduction (recorded for the first time in this species) and asexual colony multiplication contributed to the population of *Montipora ramosa*, a simultaneous hermaphrodite. Asexual reproduction may be of more importance in colonizing the loose substrata of the inner and middle reef flat. Sexual reproduction may be critical for re-establishing the population after cyclones.

A high frequency of intercolony grafts indicated that asexual colony multiplication had occurred extensively. Breakage of the fragile skeletal structure of *M. ramosa* generates many fragments which grow rapidly on rubble substrata to re-establish themselves as individual colonies which may be extremely long lived.

Use of the reef flat by humans increases fragmentation and hence increases the number of viable colonies in the area. Furthermore, the fragmentation process enables colonies to become established in areas where planulae do not settle. One negative effect of fragmentation is an overall reduction of the average colony size (may affect fecundity).

The major physical source of mortality of *M. ramosa* is burial by sediment. Consequently activities which generate large amounts of suspended sediment (e.g. dredging) may be deleterious to the population. However, natural turbidity at Geoffrey Bay is high and contribution of sediment from human activities may be insignificant.

It is concluded that the use of the Geoffrey Bay reef flat by humans does not harm the *M. ramosa* population other than by reducing average colony size. The effects of reduced colony size do not appear to be deleterious, except if the colony becomes so small that it succumbs to sedimentation.

Heyward, A. 1981. The population biology of *Montipora ramosa*. Honours thesis, James Cook University of North Queensland.

LOCALITY: Geoffrey Bay, Magnetic Island (off Townsville)

The Interactive Biology of Plate and Encrusting *Montipora* spp.**PERIOD:** 1981**ORGANIZATION:** James Cook University, Department of Marine Biology**PROJECT LEADER:** Mr J. Robertson**PROJECT OFFICER:** Dr W. Craik**SUPERVISOR:** Dr J. Collins**FINANCIAL SUPPORT:** GBRMPA Augmentative Research Grant - \$255**OBJECTIVES**

To investigate the way in which encrusting and foliose corals maintain and hold space in the reef environment.

IMPLICATIONS/MANAGEMENT NEEDS

This study is designed to provide greater understanding of the inter-connectivity of reefal populations and of colonisation.

METHODOLOGY

Interactions in two species of *Montipora* (Scleractinia), *M. monasteriata* and *M. spumosa*, were observed and quantitatively analysed in a 20m x 2m subtidal transect in Geoffrey Bay, Magnetic Island. These two species compose nearly 90% of the total scleractinian cover in this transect. Growth and reproductive characteristics of each *Montipora* species were also assessed.

STATUS

The project has been completed.

Plate and encrusting *Montipora* spp. are very common corals on the shallow subtidal reefs of high continental islands.

The intercolony interactions of these plate corals appear to be somewhat benign, being limited to less than 4cm. If reef viewing areas were being loaded with these species then no cytotoxic interactions could be expected as long as the 4cm intercolony distance was adopted.

Non-Scleractinian competition can be significant, and the soft coral *Paverythropodium* could present overgrowth problems.

It is suggested that algal interactions may be more important than intercolony interactions with respect to colony distortion (needs further study).

Like many other corals, the growth rates of *Montipora* spp. do show considerable individual and interspecific variability. However, unlike other corals there appear to be less distinct seasonal variations in growth rates and no prolonged slow growing juvenile stages.

The sexual reproduction of these corals appears to be bimodal or at least spread over the summer months. To minimise effects on larval production the corals should only be disturbed in the spring or early summer.

Robertson, J.W.A. 1981. Intra- and inter-specific interactions of two species of *Montipora*. Honours thesis, James Cook University of North Queensland.

LOCALITY: Geoffrey Bay, Magnetic Island (off Townsville)

Assessment of the Role of Large Transient Fishes (the Fishable Resource) in Shaping Shallow Water Communities of Small Resident Coral Reef Fish

PERIOD: 1981
ORGANIZATION: Macquarie University,
Centre for Environmental Studies

PROJECT LEADER: Mr B. Lassig

PROJECT OFFICER: Dr W. Craik
SUPERVISOR: Prof. F. Talbot
FINANCIAL SUPPORT: GBRMPA Augmentative Research Grant - \$731

OBJECTIVES

To assess the role of large transient fishes (the fishable resource) in shaping shallow water assemblages of small resident coral reef fish and to describe temporal variation in fish assemblages on patch reefs.

IMPLICATIONS/MANAGEMENT NEEDS

This study is designed to provide greater understanding of the factors affecting reef fish communities which is important for monitoring and interpretative activities.

METHODOLOGY

Patch reefs were divided into three categories: 1. reef controls - undisturbed
2. caged reefs - fully enclosed
3. cage controls - partially enclosed.

All fish were censused on 30 occasions over three years. They were classified resident or transient and classified into one of four size classes.

STATUS

The project has been completed.

On the control reefs the number of species and individuals fluctuated seasonally. A two-fold difference in numbers of species and seven-fold differences in mean numbers of individuals per reef per year were recorded. Recruitment was strongly seasonal, with peak numbers settling in the spring and summer months, and varying annually. Recruitment played a major role in determining the diversity and density of assemblages. Species turnover was high and species persistence low. Cyclones had significant effects on juveniles and subadults but did not affect the density of adult fishes.

The seasonal pattern on caged reefs was similar to that on control reefs. Caged reefs consistently accommodated more transients but not residents.

Control cages over flat sandy substrate attracted a variety of planktivorous fishes using the mesh as temporary shelter and herbivores feeding on algae. Cages were effective in excluding large transient piscivores and herbivores. Caging effects can be explained in terms of the physical presence of mesh and the exclusion of large grazers.

LOCALITY: Cairns Section - Lizard Island Reef

Ecology of the Sharpnose Pufferfish, *Canthigaster valentini***PERIOD:** 1981 and 1982**ORGANIZATION:** Macquarie University, Centre for Environmental Studies**PROJECT LEADER:** Mr W. Gladstone**PROJECT OFFICER:** Dr W. Craik**SUPERVISOR:** Prof F. Talbot**FINANCIAL SUPPORT:** GBRMPA Augmentative Research Grants - \$1,518**OBJECTIVES**

To determine what factors control the distribution and abundance of the toxic fish *C. valentini* in particular, reproduction, development and growth in separate populations and correlations between behaviour and habitat.

IMPLICATIONS/MANAGEMENT NEEDS

This study is designed to examine the role of toxicity in life history strategies and the differences in growth and ethology of one species in different areas.

METHODOLOGY

Reproduction, growth and population dynamics were examined at two sites, Palfrey Island and Mermaid Cove, Lizard Island Reef. In addition, social behaviour was described at each site as well as at several other areas around Lizard Island representing different habitat types. Toxicology was investigated at all life stages (egg, larval, juvenile and adult) and in two other *Canthigaster* species.

STATUS

The project has been completed.

Analysis of the data revealed significant differences between the two populations in mean size of fish, size at first spawning, growth rates, areas of territory and social dynamics. At the Mermaid Cove site (a leeward rubble slope where *C. valentini* is present at a low population density) *C. valentini* have a slower growth rate, spawn at a later age, are significantly larger, occupy significantly larger territories and display different degrees of social behaviour compared with fish at the Palfrey Island site (a lagoon rubble slope with a high population density of *C. valentini*). These differences have arisen in response to differences in environment at each site and possibly differences in substrate structure.

Three social systems were identified: harems, pairs and hierarchies. At Lizard Island, *C. valentini* were most commonly found in male-dominated harems. Occasionally male-female pairs occurred together with harems in the same area and habitat type. It is hypothesized that the presence of two social systems in the same area is the product of a low and unpredictable recruitment of new juveniles, female territoriality and the presence of mobile bachelor males. Long term studies of several sites around Lizard have shown that juvenile recruitment varies between sites.

The results emphasise that for *C. valentini*, and many other reef fish, hypotheses proposed to explain and predict distribution, abundance and life history strategies, may not be applicable over the entire range of the animal. Moreover, significant local differences may be found across the range of habitat types of a single reef.

LOCALITY: Cairns Section - Palfrey Island; Mermaid Cove, Lizard Island Reef

Genetic Variability in *Acanthaster planci***PERIOD:** 1981**ORGANIZATION:** James Cook University, Department of Marine Biology**PROJECT LEADER:** Mr W. Nash**PROJECT OFFICER:** Dr W. Craik**SUPERVISOR:** Dr J. Lucas, Dr M. Goddard**FINANCIAL SUPPORT:** GBRMPA Augmentative Research Grant - \$500**OBJECTIVES**

To measure the genetic distance between populations of *Acanthaster*.

METHODOLOGY

Starfish were collected from Lizard Island, Eyrle, Yonge, Green Island, Broadhurst and One Tree Island Reefs. Pyloric caeca were removed from each animal for electrophoretic analysis and various morphometric characteristics were measured. 13 enzyme loci were routinely analysed, of which 10 were polymorphic.

STATUS

The project has been completed.

Morphometric comparisons revealed arm spine length (ASL): body diameter (D) was the best index of *A. planci* growth rate. ASL:D ratios were different for Yonge Reef and Granite Bluff (Lizard) populations, and for Yonge Reef and One Tree populations; but similar for the populations of Yonge Reef and Broadhurst.

Electrophoretic analysis revealed little difference in allelic composition at most general localities examined, which suggests one large Great Barrier Reef population. Major differences in allele frequencies at the MDH-1 Locus occurred between the Green Island population and all other populations. The likely explanation for this is that selection for or against particular alleles was occurring.

The Green Island population was the only population sampled in a post plague phase which suggests that a factor related to high starfish numbers may induce allele frequency changes.

Species with pelagic larval phase have potential for widespread dispersal. This appears to be the case for *A. planci* - the species being represented by a genetically continuous population.

LOCALITY: Cairns Section - Lizard Island, Eyrle, Yonge, Green Island;
Capricornia Section - Broadhurst and One Tree Island Reefs

Coral Trout Monitoring at Lizard Island Reef

PERIOD: Sept 1981 - Sept 1982
ORGANIZATION: Macquarie University, Centre for Environmental Studies

PROJECT LEADERS: Mr H. Sweatman
Mr W. Gladstone

PROJECT OFFICER: Dr W. Craik
SUPERVISOR: Mr R. Kenchington
FINANCIAL SUPPORT: GBRMPA - \$2,340

OBJECTIVES

To collect and provide data at monthly intervals on coral trout populations to provide a numerical indication of the natural variability in such populations on both the leeward and windward sides of Lizard Island Reef.

IMPLICATIONS/MANAGEMENT NEEDS

This project will provide information on natural monthly variation in coral trout numbers at Lizard. It will be useful with respect to management programs introduced after declaration and zoning. It is important to know population parameters of coral trout (as an indicator of other large predatory fish) in the northern area.

METHODOLOGY

Surveys will be made of coral trout using the intensive scuba search technique, developed by GBRMPA. Surveys will be undertaken on leeward and windward sides of the reef at monthly intervals for twelve months.

STATUS

The monthly surveys have been completed. They show considerable variation between months with the windward side generally having a higher population density of coral trout than the leeward side.

LOCALITY: Cairns Section - Lizard Island Reef

Co-ordinated Study of Events surrounding Seasonal Synchronised Spawning in Three Species of Hard Corals

PERIOD: Oct 1981 - Aug 1982
ORGANIZATION: James Cook University, Department of Marine Biology

PROJECT LEADERS: Mr J. Oliver
 Ms B. Willis
 Mr P. Harrison
 Mr R. Babcock
 Dr C. Wallace

CONSULTATION AND LIAISON: Prof M. Pichon, Dr C. Alexander, Mr G. Bull
 James Cook University

PROJECT OFFICER: Dr W. Craik
SUPERVISOR: Mr R. Kenchington
FINANCIAL SUPPORT: GBRMPA - \$1,135

OBJECTIVES

To determine 1981 spawning dates of the three species and relate to the 1980 spawning date and environmental parameters. To determine reproductive products of corals, means and patterns of dispersal, date of settlement, age of reproduction and relative fecundity of size classes.

IMPLICATIONS/MANAGEMENT NEEDS

This project follows on from the coral and fish monitoring workshop and the suggested use of coral reproductive information in monitoring reef health, by providing information on reproduction, dispersal and juvenile recruitment for three hard corals.

METHODOLOGY

Reproduction in selected species of three genera (*Acropora*, *Goniastrea* and *Turbinaria*) was studied at Nelly Bay, Magnetic Island during October and November, 1981.

The spawning behaviours of *A. formosa* (the study species), *A. valida*, *A. nasuta*, *A. hyacinthus*, *A. longicyathus* and *A. elseyi* were observed and documented. The spawning behaviour of *Goniastrea* was observed for the second successive year. Aspects of spawning in two other faviids, *Platygrya sinensis* and *Favia favus* were observed also. *Turbinaria* failed to spawn during the October-November study period. A more detailed study of this genus was subsequently undertaken.

Plankton hauls were made in the Nelly Bay area at regular intervals during the study month. Initially three hauls were made daily, later two and finally one.

To study recruitment patterns, settlement plates were set out at four sites at Nelly Bay over the 5-week period in October-November, and the plates were picked up in February 1982.

STATUS

The project has been completed.

Some of the corals studied (e.g. *Acropora formosa*) reproduced during two periods, namely around four days after full moon in both October and November 1981. This was contrary to the expectation that a single breeding period would be seen. On the other hand, *Turbinaria mesenterina* and five other members of this genus had not spawned by May 1982 despite the presence of both eggs and sperm in October 1981.

Three different reproductive patterns were seen in the three main study genera namely:-

Acropora: simultaneous hermaphrodite, spawning egg sperm masses, fertilization external.

Goniastrea: hermaphrodite, spawning gametes, fertilization external.

Turbinaria: dioecious, spawning products as yet undetected.

The plankton survey has yielded the first significant records of spawned coral products in surface or subsurface waters, and these should contribute to an understanding of the dispersal of coral offspring within and between reefs. Differences in the timing of the major spawning season were detected, between the study reef and the reef in the adjoining bay. This detail could also have important significance for management.

LOCALITY: Nelly Bay, Magnetic Island (off Townsville)

Biology and Management of Trochus

PERIOD: June 1981 - Sept 1984
ORGANIZATION: Queensland Department of Primary Industries
Fisheries Research Branch

PROJECT LEADERS: Mr R. Pearson
Mr W. Nash

PROJECT OFFICER: Dr W. Craik
SUPERVISOR: Mr R. Kenchington
FINANCIAL SUPPORT: GBRMPA - \$38,151; QLD DPI - \$35,000

OBJECTIVES

To determine the basic biology, reproduction, recruitment, growth population structure and the sustainable, harvestable yield of trochus and management principles for a possible collection fishery within the Great Barrier Reef Marine Park.

IMPLICATIONS/MANAGEMENT NEEDS

Considerable interest has been expressed by commercial fishermen in collecting trochus in the Great Barrier Reef Region. Present biological understanding is minimal and totally inadequate for determining the impact, sustainable harvest or reasonable extent of such a fishery. This study will enable guidelines to be drawn up for the management of a trochus fishery.

METHODOLOGY

A survey of the trochus resource in the Cairns area will be made to determine the distribution of trochus in relation to habitat, population densities, and size frequency distributions. Survey techniques involving SCUBA search along line transects (based on those used for other reef invertebrates) are being developed.

Basic biological studies will include growth rate (to be determined by size-frequency analysis and/or tagging), reproduction (breeding season, size/age at sexual maturity, fecundity), and movement (only in relation to recruitment into depleted areas).

The impact of a potential fishery on the Great Barrier Reef and on the trochus population will be investigated by (i) recording the impact of collection on other reef organisms including the effects of damage by divers; and (ii) resurveying areas at intervals after collection to record recovery of the trochus population.

STATUS

Delays were experienced in the commencement of this project. Work started in September 1982.

Final report to GBRMPA due September 1984.

Coral Trout Monitoring at Heron Island Reef

PERIOD: June 1982 - Sept 1984
ORGANIZATION: Heron Island Research Station

PROJECT LEADERS: Ms M. Preker
Dr I. Lawn

PROJECT OFFICER: Dr W. Craik
SUPERVISOR: Mr R. Kenchington
FINANCIAL SUPPORT: GBRMPA - \$1,200

OBJECTIVES

To collect and provide data on coral trout populations on a monthly basis to provide a numerical indication of the natural variability in such populations.

IMPLICATIONS/MANAGEMENT NEEDS

This study is designed to provide information on natural monthly variation in coral trout numbers at Heron. It will be useful with respect to management programs introduced after declaration and zoning. It is important to know population parameters of coral trout (as an indicator of other large predatory fish) in the southern area of the Great Barrier Reef Region.

It will assist in interpretation of monitoring survey data.

METHODOLOGY

Twelve monthly surveys will be made over a 150m transect at Heron Island Reef, previously surveyed in development of the technique.

STATUS

Surveys should commence September 1983. Delays were experienced in starting the project.

LOCALITY: Capricornia Section - Heron Island Reef

**The Determinants of Coral Reef Community Structure: Dynamics of
Communities Dominated by the Genus *Acropora***

PERIOD: Dec 1981 - Dec 1982

ORGANIZATION: James Cook University, Department of Marine Biology

PROJECT LEADERS: Prof M. Pichon
Dr C. Wallace

CONSULTATION & LIAISON: Dr T. Done, Mr W. Nash (genetic *Acanthaster planci* studies)
Dr T. Walker (*Acanthaster* growth studies)

PROJECT OFFICER: Dr W. Craik

SUPERVISOR: Mr R. Kenchington

FINANCIAL SUPPORT: GBRMPA - \$1,650; AMSTAC - \$25,668

OBJECTIVES

To investigate the dynamics of coral reef communities dominated by various species of *Acropora* involving -

- a. successional changes in communities after a typical denudation
- b. changes in population structure of selected dominant species
- c. reproductive strategy of these dominant species.

IMPLICATIONS/MANAGEMENT NEEDS

This study is designed to examine the effects of disturbance, patterns of recolonisation, seasonality of reproduction and recruitment.

The study site has been fully mapped using T. Done's stereophotography and this study will assist in the interpretation of larger-scale changes at the site.

The area has been subject to *A. planci* increase and changes have been monitored.

METHODOLOGY

The project has three parts: a recolonization experiment, coral settlement studies, and population studies on selected *Acropora* species. They are being carried out on a suitable outer reef slope on Broadhurst Reef.

For the recolonization experiment portions of the reef were cleared of corals, then after an initial eleven month waiting period assessment of re-growth commenced. Settlement studies are being made by collecting data on recruitment to settlement plates which were set up in June 1981. For the population studies, large (25m²) quadrat plots are being studied for changes in tagged populations of several *Acropora* species. Reproduction in the these tagged populations is also being followed.

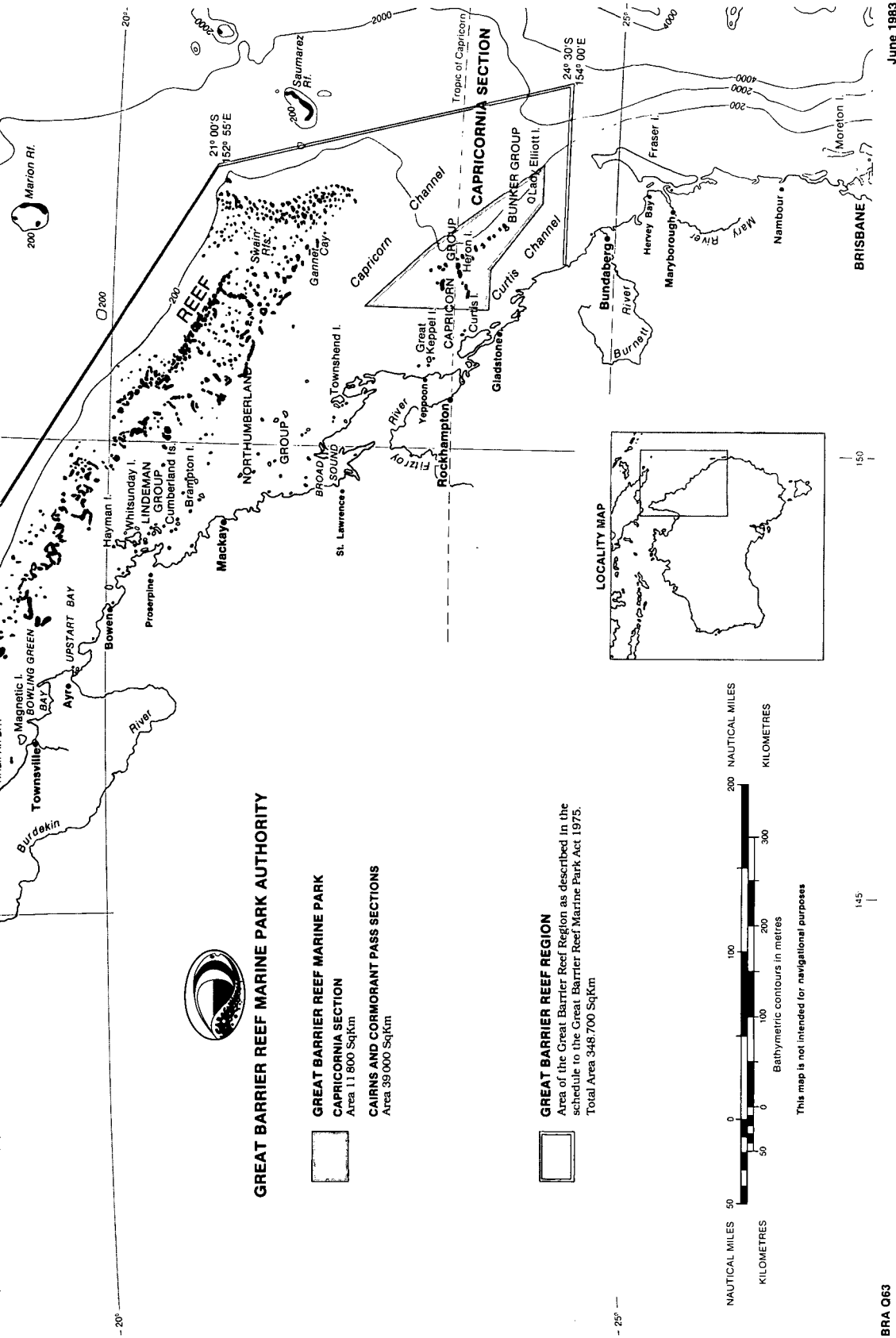
STATUS

The project has been completed.

There has been one publication from the project so far:

Wallace, C.C. and Bull, G.D. In press. Patterns of juvenile coral recruitment on a reef front during a spring-summer spawning period. Proceedings of the 4th International Coral Reef Symposium, Manila, May 1981.

LOCALITY: Broadhurst Reef (90km east of Townsville)



GREAT BARRIER REEF MARINE PARK AUTHORITY

GREAT BARRIER REEF MARINE PARK

CAPRICORNIA SECTION

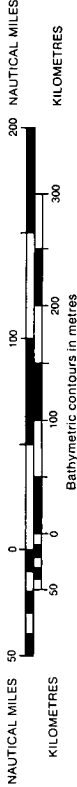
Area 11 800 Sqkm

CAIRNS AND CORMORANT PASS SECTIONS

Area 39 000 Sqkm

GREAT BARRIER REEF REGION

Area of the Great Barrier Reef Region as described in the schedule to the Great Barrier Reef Marine Park Act 1975.
Total Area 348 700 Sqkm



This map is not intended for navigational purposes

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**Distribution of Fish Larvae and Current Flow in the Vicinity of a Coral Reef,
Northern Great Barrier Reef****PERIOD:** Dec 1981 - Dec 1982**ORGANIZATION:** Australian Museum**PROJECT LEADERS:** Dr B. Goldman
Dr J. Leis**CONSULTATION & LIAISON:** Dr J. Middleton (University of NSW)**PROJECT OFFICER:** Dr W. Craik**SUPERVISOR:** Mr R. Kenchington**FINANCIAL SUPPORT:** GBRMPA - \$2,400; AMSTAC-FAP - \$25,950**OBJECTIVES**

To determine fine scale distribution of fish larvae and current pattern in vicinity of an outer ribbon reef and the Great Barrier Reef lagoon behind it.

IMPLICATIONS/MANAGEMENT NEEDS

This study will assist in understanding distributions of adult populations. It will determine species with "local" populations (i.e. larvae remaining near their spawning sites) and species with "widespread" populations (i.e. larvae which disperse from their spawning sites).

METHODOLOGY

Larval fish were sampled by plankton net, sorted under a dissection scope, larvae identified and quantified to values per m² or m³. Samples were taken along a multi-station transect near Lizard Island. Current meters were placed in the same area (mid-way in the water column). Replicate samples were taken and sampling was increased during the October-April spawning season.

Developmental staging of larvae will discriminate spawning or development sites.

STATUS

The project has been completed.

A paper on the preliminary work was presented to a meeting of the Australian Marine Science Association. An abstract of this has been published:

Leis, J.M. 1982. Distribution of fish larvae around Carter Reef, Great Barrier Reef: a preliminary study. *Aust. Mar. Sci. Bull.* 79:21

LOCALITY: Cairns Section - Ribbon Reefs; Lizard Island

**The Ecological Distribution of Hermatypic Corals and Crustose Coralline Algae
on the Fringing Reefs in the Great Barrier Reef Region**

PERIOD: 1982

ORGANIZATION: James Cook University, Department of Marine Biology

PROJECT LEADER: Mr K. Fujiwhara

PROJECT OFFICER: Dr W. Craik

SUPERVISOR: Prof M. Pichon

FINANCIAL SUPPORT: GBRMPA Augmentative Research Grant - \$484

OBJECTIVES

To describe the structure of a coral and crustose coralline algal community.

IMPLICATIONS/MANAGEMENT NEEDS

This study is designed to provide greater understanding of coral-coraline algal community structure.

METHODOLOGY

A coral and crustose coralline algal community will be described in terms of distribution, arrangement and abundance of species examined with respect to reef topography, sedimentation and light intensity.

At three research sites at Lizard Island, surveys will be made over line transects set along a depth contour parallel to shore at fixed intervals of 2m on the reef flat.

STATUS

A report to GBRMPA is in preparation.

LOCALITY: Cairns Section - Lizard Island Reef

The Algal Bearing Ascidians of the Great Barrier Reef

PERIOD: 1982

ORGANIZATION: University of Queensland, Department of Chemistry

PROJECT LEADER: Mr D. Parry

PROJECT OFFICER: Dr W. Craik

SUPERVISOR: Prof C. Hawkins, Dr P. Mather

FINANCIAL SUPPORT: GBRMPA Augmentative Research Grant - \$272

OBJECTIVES

To establish a catalogue of species of algal-bearing Ascidians at Heron Island.

To provide a chemotaxonomic method for identifying species.

To investigate the symbiotic relationship.

To investigate the ability of these ascidians to concentrate trace metals (e.g. Fe, V) and heavy metals (e.g. Cd, Zn and Hg).

IMPLICATIONS/MANAGEMENT NEEDS

This study is designed to provide information on the photosynthetic rate of algal-bearing ascidians in relation to oxygen levels on reef flats.

The Ascidiacea are fixed benthic organisms that are important components of the coral reef ecosystem. Within the Ascidiacea there are a number of species from the families Didemnidae, Polycitoridae and Polyclinidae which have been found to contain plant cells. The relationship between the plant cells and ascidian host appears to be a symbiotic one.

METHODOLOGY

The objectives of the project will be pursued by:

- (1) Observation
- (2) Isolation and identification of pigments from algae, together with the isolation and identification of compounds from the ascidian host. This may ultimately provide a chemotaxonomic method for the identification of species within this group which are otherwise extremely difficult to identify.
- (3) A study of metabolic pathways of the algal cells and the ascidian and more important a study of photosynthesis and respiration of these animals in the field.
- (4) Determination of the concentration of trace and heavy metals in these ascidians.

STATUS

Thirty-two species of algal-bearing ascidians, including 4 new species, have been found at Heron Island Reef. In 30 out of the 32 species the algal cells are all Prochloron. The occurrence and relative abundance of ascidians are being plotted on a map of Heron and Wistari Reefs.

Three different criteria have been tried to develop a chemotaxonomic method of identification: (i) chlorophyll a/b ratios of the algae (Prochloron); (ii) vanadium content and oxidation state; (iii) intracellular acidity.

The symbiotic relationship has been investigated by measurements of photosynthetic and respiration rates in vivo and in situ. Both measurements of P/R agree very closely for species so far investigated and there is a range from 1.0 to 3.2 (cf. corals P/R range from 1.7 to 5.0). The Prochloron associated with ascidians are producing amounts of organic matter sufficient to, or to more than, compensate for respiratory activity of both the algae and the host. They appear to be important producers on the reef.

LOCALITY: Capricornia Section - Heron Island Reef

Some aspects of Community Dynamics and Biology of Scleractinian Corals on the Heron Island Reef Crest

PERIOD: 1982

ORGANIZATION: University of Queensland, Department of Zoology

PROJECT LEADER: Ms A. Bothwell

PROJECT OFFICER: Dr W. Craik

SUPERVISOR: Dr R. Endean, Professor J. Kikkawa

FINANCIAL SUPPORT: GBRMPA Augmentative Research Grant - \$843

OBJECTIVES

To continue monitoring parts of a coral community in quadrats established in 1976-1977 to allow interpretation of community structure in terms of:

- (i) recruitment from planular settlements,
- (ii) recruitment through asexually produced fragments,
- (iii) 'recruitment' through colony fission,
- (iv) variations in predominance of particular growth forms,
- (v) variations in predominance of particular species,
- (vi) reversals in the life-phase of corals from sexual to asexual,
- (vii) comparative rates of 'constancy' and 'turnover' of colonies of different *Acropora* and *Montipora* species,
- (viii) growth rates,
- (ix) interference competition between established or resident corals and between residents and recruits.

IMPLICATIONS/MANAGEMENT NEEDS

This study is designed to catalogue the long-term changes in reef crest communities.

METHODOLOGY

A basic census is taken each year and supplemented with shorter term observations whenever possible.

The 1982 census will be based upon single instance recordings and include a photographic catalogue of 40 X 1m² quadrats marked permanently on the reef. This will complement records made of these same areas in previous years, and hopefully will continue into the future.

The quadrats are distributed in three groups, two in back reef locations and one to windward. The back reef quadrats were established in 1976-77 and the windward quadrats were established in 1979-80.

STATUS

Estimates from the 1981 census have been finalised. Some of the 1982 census of quadrats remains to be completed.

Analysis of the observations on community structure from 1978 to 1981 revealed that both the number and diversity of scleractinian colonies were highest at the least wave exposed of the 3 sampling stations on the reef crest. The percentage of living coral was also highest at this location until cyclone Paul in January 1980.

Overall, the number of colonies changed little over the observation years. However, the community patches were dynamic with high colony mortality and colony recruitment being recorded.

Recruitment was largely from vegetative (asexual) processes at each of the sampling stations, with fission of established colonies being the most common means of recruitment.

Continued monitoring combined with investigation by closure experiments could determine whether recruitment by fragments is enhanced by trampling at the station closest to the tourist resort and research station.

LOCALITY: Capricornia Section - Heron Island Reef

PERIOD: 1982**ORGANIZATION:** James Cook University, Department of Zoology**PROJECT LEADER:** Mr J. Gilmore**PROJECT OFFICER:** Dr W. Craik**SUPERVISOR:** Dr N. Milward**FINANCIAL SUPPORT:** GBRMPA Augmentative Research Grant - \$744**OBJECTIVES**

To evaluate three fish tags (lock-on spaghetti tag, internal anchor tag and opercular strap tag) in tropical conditions. To compare tagged and untagged fish.

IMPLICATIONS/MANAGEMENT NEEDS

This study is designed to provide more information on the effect of different kinds of tag, and the effects of tags on fish, all relevant to the GBRMPA/QNPWS tagging program.

METHODOLOGY

A mark/recapture program was conducted to compare the tags under field conditions and a laboratory study on the physical effects of the tags was undertaken using a flow tank.

STATUS

The project has been completed.

One hundred and nineteen fish, comprising eight species, were tagged at Middle Reef, near Townsville, but no recaptures have been reported to date from this site. At Barramundi Creek, south of Townsville, 219 fish, comprising six species, were tagged, including 34 *Pomadasys hasta* that were double tagged with anchor and strap tags. Strap tags were found to have a shedding rate of over 60% and the internal anchor tag had a mechanical breakdown rate of over 5%. The overall recapture rate at Barramundi Creek was nearly 8%. The total internal anchor tag recapture rate was 6% but for *Pomadasys hasta* alone, the internal anchor tag recapture rate was 13%. No recaptures were reported for fishes tagged with lock-on spaghetti tags.

Drag characteristics on tagged fish were studied in a flow tank consisting of a vertical recirculating flume. For tagged fish (species *Pomadasys hasta*) the average percentage increase in drag (tag effect) was over 22% for spaghetti tags, over 8% for strap tags and over 5% for internal anchor tags. Water speed and fish length had significant relationships with tag effect.

The results of this study have shown that for the three tags studied, in particular, and all tags, in general, any conclusions drawn from fish tagging programs must be critically evaluated and used cautiously as a basis for any management strategy. For example, estimates of recruitment to coral reef fish communities would be significantly affected by tag loss rates of the magnitude recorded.

LOCALITY: Middle Reef and Barramundi Creek, Townsville

An Investigation into the Biology of the Parrot Fish (Scaridae) with Particular Reference to Factors Influencing their Distribution

PERIOD: 1982

ORGANIZATION: James Cook University, Department of Zoology

PROJECT LEADER: Mr D. Bellwood

PROJECT OFFICER: Dr W. Craik

SUPERVISOR: Dr N. Milward

FINANCIAL SUPPORT: GBRMPA Augmentative Research Grant - \$481

OBJECTIVES

To study the post settlement development of juvenile scarids and the biology of adult scarids especially feeding.

IMPLICATIONS/MANAGEMENT NEEDS

The parrot fish family is one of the most important reef fish families in biomass and numbers and are major contributors to reef bio-erosion.

METHODOLOGY

In studying the post-settlement development of juvenile scarids, selected individuals and populations were followed in a marked area through a year for data on growth, mortality, feeding biology, indication of factors governing juvenile distribution and relationship to adult distribution.

For the study of feeding biology of adult scarids, detailed observations were made on feeding and distribution in relation to structure and behaviour. Further work will involve quantitative morphological analysis, detailed intestinal analysis and tank feeding experiments.

STATUS

Between December 1981 and December 1982 studies of juvenile scarids of four common species and adults of the same four species were undertaken at two representative areas on Lizard Island - one in the lagoon on a growing reef edge; and the other on an exposed reef slope at North Reef.

Brief descriptions have been prepared which will assist in the identification of juvenile scarids.

An important finding is the difference between the distribution of juveniles and adults of some species. For example, *S. frenatus* and *S. niger* appear to be relatively immobile for long periods throughout their lives. Other species (*S. sordidus* and *S. rivulatus globiceps*) may, however, use 'nursery area' (e.g. the growing edge of lagoon reef flats) which are distinct from adult feeding areas.

Preliminary data suggest considerable variation between the juveniles of the four species of scarid studied in detail. There appears to be no fixed relationship between morphology and feeding abilities of juveniles. The main differences arise from behavioural variability.

Field work in early 1983 should provide more details on movement, growth, mortality and behaviour of juveniles.

LOCALITY: Cairns Section - Lizard Island Reef

Genetic Variability among Geographically Isolated Nesting Populations of the Sea Turtle *Caretta caretta*

PERIOD: 1982

ORGANIZATION: Monash University, Zoology Department

PROJECT LEADER: Ms E. Gyuris

CONSULTATION & LIAISON: C. Limpus, QNPWS

PROJECT OFFICER: Dr W. Craik

SUPERVISOR: Dr J. Baldwin

FINANCIAL SUPPORT: GBRMPA Augmentative Research Grant - \$379

OBJECTIVES

To determine whether two distinct populations of *C. caretta* can be distinguished on the basis of protein polymorphisms.

IMPLICATIONS/MANAGEMENT NEEDS

This study is designed to provide a greater understanding of population interactions and the relative importance of breeding sites in maintaining the Queensland populations.

METHODOLOGY

In 1982, specimens of plasma, serum and erythrocytes were collected from turtles at Bundaberg (beaches between Mon Repos and Round Hill Head) and Capricornia rookeries. The specimens were analysed electrophoretically.

STATUS

During the 1982 breeding season samples were collected from 165 animals. One set of serological tests revealed a significant difference in agglutination reactions between the mainland rookeries and the island rookeries of the Capricorn-Bunker Islands. These tests will be repeated in the 1982/83 season in an attempt to establish the significance of the differences observed.

In the studies of enzyme polymorphisms about 100 animals have been screened for six protein classes, representing at least seven presumptive loci. One of the enzymatic proteins showed variability but polymorphisms at this locus do not appear to be helpful in deriving any estimate of the extent of gene flow between the two presumed populations. Methodologies for surveying an additional 15 proteins were established during 1982.

Further work is needed to confirm or reject the hypothesis that geographically isolated nesting populations of the loggerhead turtle are also distinct genetically.

LOCALITY: Bundaberg; Capricornia Section

The Population Dynamics of a Species of Fish in a Large Continuous Area and Interactions Between Two Species of Damsel Fish

PERIOD: 1982

ORGANIZATION: Macquarie University, Centre for Environmental Studies

PROJECT LEADER: Mr H. Sweatman

PROJECT OFFICER: Dr W. Craik

SUPERVISOR: Prof F. Talbot

FINANCIAL SUPPORT: GBRMPA Augmentative Research Grant - \$787

OBJECTIVES

To follow the population of a site-attached species in an area of continuous habitat. To study recruitment in Pomacentrids.

IMPLICATIONS/MANAGEMENT NEEDS

This study is designed to provide a greater understanding of dynamics of reef fish populations and communities. Given the conflicting theories on reef fish populations, more studies will clarify the situation.

METHODOLOGY

The monitoring of trigger fish populations over a 500 m² area will be continued to get two years data on recruitment. A long term experiment will be set up on survivorship and settlement in *Dascyllus* spp. at different densities.

STATUS

The project has been completed.

Observations of the population of the small triggerfish *Hemibalistes chrysopterus* in the 500 m² area of reef slope suggest that mortality is low and social structures are stable, which contrasts with the findings of some studies of assemblages of smaller fish species at small isolated reefs.

In the 1981-82 settlement season an experiment showed that recruits of each of two *Dascyllus* spp. (*D. aruanus* and *D. reticulatus*) tended to settle with conspecifics, and further, coral heads supporting higher densities of adults received higher numbers of conspecific recruits. This contrasts with predictions of a negative relationship between number of residents and recruitment. Two experiments were set up in winter 1982 to investigate two possible advantages for recruits to settle with established conspecifics. The findings suggest that the presence of adult conspecifics does not have a large effect on survivorship or growth of juveniles. It may be that the habitat selection shown by these species has its evolutionary basis in the mating systems of the species.

Overall, and of importance for management, these studies show that some published hypotheses on population dynamics of reef fish are not generally applicable.

LOCALITY: Cairns Section - Lizard Island Reef

Sex Reversal and Recruitment of *Thalassoma lunare* and other Common Wrasses**PERIOD:** 1982**ORGANIZATION:** University of Sydney, School of Biological Sciences**PROJECT LEADER:** Ms G. Eckert**PROJECT OFFICER:** Dr W. Craik**SUPERVISOR:** Dr P. Sale**FINANCIAL SUPPORT:** GBRMPA Augmentative Research Grant - \$783**OBJECTIVES**

To collect data on movements, fecundity, social structure, and sex reversal for *Thalassoma lunare* with further studies of population dynamics and spatial and temporal variations in recruitment for several common wrasses.

IMPLICATIONS/MANAGEMENT NEEDS

Wrasses are suitable aquarium fishes. This study is designed to provide some useful data on *T. lunare* and other common species of wrasses.

METHODOLOGY

Data for *T. lunare* and other labrid species were collected on four field trips to One Tree Island Reef. Social organisation and sex-reversal, in *T. lunare*, were investigated through manipulative experiments. Spatial and temporal population variations for all species were studied by censuses of adults and recruits in the lagoon and on the reef slope. A manipulative experiment was set up to test for small-scale habitat preferences in newly settling labrids.

STATUS

The 1982 field work found that *T. lunare* spawned daily at high water from September to April. All drab fish on small reefs are female and these pair spawn with one brightly coloured "Terminal Phase" male. On larger reefs some drab fish are "Initial Phase" males and these spawn with females in large groups. Removal of the dominant "Terminal Phase" male in any group leads to sex (and colour) change in the largest female.

Thalassoma lunare were found to be essentially site-attached. Home ranges varied however, from about 25 m² for a 6 cm female, to 1600 m² for a 30 cm male on continuous reef.

It was possible to visually identify all common species of newly settling labrids. Labrid larvae seem to have strong preferences for the habitat in which they settle, especially with regard to depth and coral type. No evidence was found to suggest that larvae settle everywhere and are subsequently eliminated from certain habitats. Mortality in the first six months preceding settlement varied between species from 5 to 80% but was generally low in the lagoon.

LOCALITY: Capricornia Section - One Tree Island Reef

ANALYSIS OF USE

76 **Review of Selected Recreational and Professional Activities on the Great Barrier Reef**

PERIOD: Nov 1976 - June 1977
ORGANIZATION: Private Consultant

PROJECT LEADER: Ms A. Domm

PROJECT OFFICER: Mr R. Williams
SUPERVISOR: Dr D. McMichael
FINANCIAL SUPPORT: GBRMPA - \$6,500

OBJECTIVES

To establish an inventory of current scientific research, local advisory organisations and groups (shell collectors, boat owners, etc.) using the Great Barrier Reef Region. To produce a report describing the informal network of communication and liaison, the above inventory, and a geographical description of uses and areas of interest to the organisations and people mentioned.

IMPLICATIONS/MANAGEMENT NEEDS

The development and zoning of a Marine Park requires a detailed knowledge of both current research activities and less formal uses and activities in the Reef Region.

METHODOLOGY

Likely Reef users were identified by several different means and a directory of addresses was developed. Questionnaires were developed and circulated by mail to the various clubs, individuals, professionals and charter boat owners on the directory. The questionnaires were designed to provide general information about their activities, which reefs they were using and how many trips they had made over the last three years. Information was sought about possible conflicts that might arise between different reef users and about their attitudes to conservation. The postal survey was followed up by discussions with various individuals, clubs, professionals and charter boat owners in each of the major coastal towns.

STATUS

The project has been completed.

Recreational and professional users of the Great Barrier Reef Region were identified. The groups contacted in the survey were diving groups, line fishing clubs, shell clubs, boating and sailing clubs, conservation clubs, charter boat owners, professional marine collectors and photographers, and scientists. The activities, areas of use, and attitudes of these groups are presented in the first section of the report.

The second section deals with areas of the Great Barrier reef Region and the ways in which the reefs in each particular area were being used. The areas given separate treatment are the Capricorn-Bunker Reefs, the Keppel Bay area, the Swain and Coral Sea Reefs, the reefs in the Mackay, Whitsunday and Bowen region, the Reefs from Ayr to Cardwell and the reefs in the Cairns district.

Domm, A. 1977. Review of selected recreational and professional activities on the Great Barrier Reef. Report to the Great Barrier Reef Marine Park Authority.

Scientific Advice on Three Areas of the Great Barrier Reef**PERIOD:** March 1978 - Dec 1978**ORGANIZATION:** Great Barrier Reef Committee (GBRC)**PROJECT OFFICER:** Mr R. Kenchington**SUPERVISOR:** Dr D. McMichael**FINANCIAL SUPPORT:** GBRMPA - \$10,000**OBJECTIVES**

To provide 3 scientifically-based reports on the following areas:

- (i) the area off Cairns between Lizard Island and Innisfail
- (ii) the reefs off Townsville
- (iii) the Swain Reefs.

To focus on the physical and biological resources of the reefs and should identify human activities, levels of usage, and their impacts.

IMPLICATIONS/MANAGEMENT NEEDS

The zoning and development of the Marine Park requires a comprehensive understanding of the biological and physical nature of the Reef. The Great Barrier Reef Committee can provide through its diversity of membership and expertise, informed, scientifically-based advice on this aspect of the Great Barrier Reef Region.

METHODOLOGY

A review was made of the information available on the respective areas set out in the objectives. Papers representing up-to-date assessments of knowledge in the various fields were provided by many authors.

STATUS

Reports were prepared for GBRMPA on the history, geology, biology and exploitation of the three reefal areas defined above. The scientific information in the reports was accepted by the Authority. In preparing the reports, an attempt was made to review the information available on the respective areas set out above, to identify impacts that have resulted from uses, and to recommend on management criteria and neglected research areas where investigations could have direct relevance to management.

Great Barrier Reef Committee. 1979. An Account of the Present Knowledge and Use of the Great Barrier Reef from Lizard Island to Bowen. Report to the Great Barrier Reef Marine Park Authority.

LOCALITY: Cairns Section, Reefs off Townsville, Swain Reefs

OECD Case Study: The Impact of Tourism on the Environment: Heron Island

PERIOD: April 1978 - Nov 1978
ORGANIZATION: GBRMPA
PROJECT LEADER: Mr G. Hawley
PROJECT OFFICER: Mr G. Hawley
SUPERVISOR: Mr R. Kenchington
FINANCIAL SUPPORT: GBRMPA - \$500

OBJECTIVES

To determine how the quality of the environment can be preserved, while at the same time maintaining a profitable level of tourism.

IMPLICATIONS/MANAGEMENT NEEDS

If the effects of tourism and the capacity of natural areas to absorb recreational pursuits are recognised and assessed, then effective management and control measures can be implemented to avoid environmental damage.

METHODOLOGY

Using detailed personal interviews of both the resort and research station personnel at Heron Island, information was collected on the economic dimensions of the tourist industry, institutional and legal information and the impact of tourism on the environment.

STATUS

A Case Study has been prepared by the Great Barrier Reef Marine Park Authority for the OECD Environment Committee Group of Experts on the Environment and Tourism.

Great Barrier Reef Marine Park Authority. 1978. OECD Case Study - The Impact of Tourism on the Environment: Heron Island.

LOCALITY: Capricornia Section - Heron Island

Workshop on the Northern Sector of the Great Barrier Reef

PERIOD: April 1978 - Nov 1978

ORGANIZATION: Sponsored by GBRMPA

PROJECT OFFICER: Mr S. Summerhays

SUPERVISOR: Dr J. Baker

FINANCIAL SUPPORT: GBRMPA - \$8,025

OBJECTIVES

To bring together scientists and other individuals with an interest in the Great Barrier Reef Region north of Lizard Island:

- (i) to report on and analyse current knowledge and utilization of the area
- (ii) to identify activities and areas of particular interest that will assist the Authority in a declaration proposal
- (iii) to establish research needs and recommendations for an integrated research program for the area.

IMPLICATIONS/MANAGEMENT NEEDS

The northern sector is an area less influenced by human utilization than any other area in the Great Barrier Reef Region and therefore it is suitable for a detailed comparative study and for study prior to major development.

METHODOLOGY

A workshop was held in Townsville from 20-21 April 1978. In a series of presented papers and group discussions the following areas were covered:

- Description of the area
- Natural features
- Surveillance and management
- Identification of gaps in knowledge and establishment of priority programs for research
- Criteria and categories for zoning and methods of regulation
- Development of guidelines to assist the Authority in declaring and zoning a Marine Park in the area.

STATUS

The proceedings have been published:

Great Barrier Reef Marine Park Authority 1978. Workshop on the Northern Sector of the Great Barrier Reef. Papers and proceedings of a workshop held in Townsville, Australia, April 20-21, 1978. GBRMPA Workshop Series No. 1.

LOCALITY: Far Northern area of the Great Barrier Reef Region.

Economic and Social Research Program

PERIOD: July 1978 - Dec 1978
ORGANIZATION: James Cook University,
Department of Commerce

PROJECT LEADER: Professor S.J. Rogers

PROJECT OFFICER: Mr T. Hundloe

SUPERVISOR: Mr R. Kenchington

FINANCIAL SUPPORT: GBRMPA - \$4,985

OBJECTIVES

To identify the perceptions of the economic and social research needs of GBRMPA, and to identify a set of research projects which would meet these perceived needs.

IMPLICATIONS/MANAGEMENT NEEDS

Two major benefits should be forthcoming from this project:

- a framework will be provided within which the Authority could develop its research planning and control strategies
- the report should provide guidelines to the Authority in planning its short-run economic and social research program.

METHODOLOGY

Socio-economic research projects to be undertaken by the Authority were to be identified with a review of alternative methods, and assessment of data required.

STATUS

The project has been completed.

The report concluded that virtually no socio-economic research of direct relevance to the Authority had been undertaken. A cautious and pragmatic approach to undertaking this research was recommended. Four specific recommendations were made:

1. institution of a formal mechanism to co-ordinate research
2. establishment of an information bank
3. consideration be given to research in the area of conflict resolution
4. research into the tourism recreation industry in the Capricorn-Bunker area begin immediately

James Cook University of North Queensland. 1978. Economic and Social Research Program Report. Report to the Great Barrier Reef Marine Park Authority.

PERIOD: March 1979 - June 1979

ORGANIZATION: University of Queensland, Department of Economics

PROJECT LEADER: Mr M.J. Gibbings

PROJECT OFFICER: Mr T. Hundloe

SUPERVISOR: Mr R. Kenchington

FINANCIAL SUPPORT: GBRMPA - \$3,500

OBJECTIVES

To produce a report on the likely future of Great Barrier Reef tourism, given some probable future scenarios which will be developed by predicting changes in the important socio-economic variables affecting tourism.

IMPLICATIONS/MANAGEMENT NEEDS

The report was designed to guide the Authority's future planning in the area of tourism research and to identify areas for further study.

METHODOLOGY

Available information was reviewed and updated after consultation with the Australian Tourist Commission and TAA

STATUS

The project has been completed.

Available evidence indicates that, while tourism in the region near the Reef has been growing, that growth has failed to keep pace with the expansion of tourism over the whole State and Australia. At the same time the accommodation sector has experienced a relative shift away from the hotel, motel type accommodation and toward caravan parks. Though some operations have had notable successes in attracting increased numbers of overseas visitors, overall it seems that they still represent as little as 6% of total customers. The exception to this appears to be the island resorts where, though the trend is in the same direction, a large majority of visitors still come from interstate or overseas. The predominant mode of transport for domestic holiday visitors to the Region is still the motor car - used by 84.2% of visitors in 1977/78 - and in fact its use has increased relatively throughout the seventies. Analyses of the age distributions of adult respondents to the 1969/70 and 1977/78 surveys reveals an increase in the proportions of holiday visitors in the younger age groups.

Not surprisingly the potential market for tourism generally is expanding, though the future impact of some market determinants will be less than in the recent past. Movements in transport costs will seriously weaken the competitive position of Reef tourism. Recent movements in the relative cost of domestic and international air travel have further reduced the Region's competitiveness.

The major contention of this report is that, with some few exceptions, the Reef as a resource for tourism has been barely tapped. Responses to visitor surveys reveal that the Reef has served as little more than a backdrop for most tourism. In a sense it would be correct to say that there is an almost completely new area of Reef tourism awaiting development.

Gibbings, M.J. 1979. Tourism and the Great Barrier Reef. Report to the Great Barrier Reef Marine Park Authority.

82 **Economic Impact of Activities in Capricornia**

PERIOD: March 1979 - June 1979
ORGANIZATION: University of Queensland, Department of Economics

PROJECT LEADER: Dr R.C. Jensen

PROJECT OFFICER: Mr T. Hundloe
SUPERVISOR: Mr R. Kenchington
FINANCIAL SUPPORT: GBRMPA - \$7,500

OBJECTIVES

To assess, for the main categories of activity centred on the Capricorn/Bunker Groups, the ultimate location of the beneficiaries of each dollar spent and hence the extent and location of income and employment arising from the existence of this part of the Great Barrier Reef Region and its usage pattern. To undertake this assessment by using economic models known as input-output models.

IMPLICATIONS/MANAGEMENT NEEDS

An assessment of the economic impact of the usage of the Capricorn/Bunker Reef area is essential for the Authority's planning for the area. This study will also indicate the value of using input-output modelling for other Great Barrier Reef areas.

METHODOLOGY

Input-output modelling was used to estimate the importance of selected Reef activities in the Capricorn/Bunker area on the output, income and employment of the coastal regions of Queensland and on the economy of the whole state.

STATUS

The project has been completed.

Four sectors were defined: commercial fishing, research activity, resort-based activity, other recreation. Regarding output effects, induced effects are dominant in the commercial fishing and research sectors and indirect effects are relatively insignificant. Direct income effects are dominant and virtually confined to the region as are direct employment effects. In the commercial fishing and research sectors direct employment effects are dominant.

Jensen, R.C. 1979. An Assessment of the Economic Impact of Selected Activities Associated with the Capricornia Section of the Reef, on the Coastal Regions and the State of Queensland. Report to the Great Barrier Reef Marine Park Authority.

LOCALITY: Capricornia Section

Tourism and the Great Barrier Reef Workshop, Mackay 1979

PERIOD: April 1979 - August 1981

ORGANIZATION: (1) Queensland Dept of Tourism)
 (2) GBRMPA) Joint Sponsors

PROJECT LEADERS: (1) Ms J. Deakin
 (2) Mr G. Hawley

PROJECT OFFICER: Mr G. Hawley

SUPERVISOR: Mr R. Kenchington

FINANCIAL SUPPORT: .GBRMPA - \$9,825

OBJECTIVES

To bring together a cross-section of representatives associated with tourism in the Great Barrier Reef Region, enabling them to:

- discuss marketing, conservation and research needs for Great Barrier Reef tourism
- review by open forum, the roles of government agencies which have a public responsibility towards the reasonable use of the Great Barrier Reef.

IMPLICATIONS/MANAGEMENT NEEDS

To advise the tourist operators connected with the Great Barrier Reef Region of the Great Barrier Reef Marine Park Authority's aims, objectives and possible areas of assistance to the industry, and for the industry to advise the Authority and government of its requirements and needs etc.

METHODOLOGY

The workshop was held at the Mackay City Council Chambers from the 9 to 11 April 1979.

One hundred and twenty-one delegates attended and participated actively in the program, which featured five workshop sessions with discussion periods, forum panels and a reef flight excursion. Keynote and panel speakers were selected for their expertise and ability to communicate their particular topic. Each workshop session was chaired by a recognised industry specialist.

STATUS

The proceedings of the workshop have been published.

The proceedings were recorded in full; papers and delegates' deliberations have been edited to give a broad representation of the discussions. The proceedings and recommendations demonstrate the tremendous potential for tourism in the Great Barrier Reef Region. A major result of the workshop was the establishment of a steering committee composed of tourist industry representatives.

Papers and proceedings of the workshop "Tourism and the Great Barrier Reef" held in Mackay, Australia on 9th, 10th, 11th April 1979. Sponsored by the Great Barrier Reef Marine Park Authority and the Queensland Department of Tourism. 1981.

Post-impact Survey: Oil on the Great Barrier Reef - Ruby Reef

PERIOD: July 1979 - Jan 1980
ORGANIZATION: GBRMPA

CONSULTATION AND LIAISON: Department of Transport
RAN

PROJECT OFFICER: Mr L. Zell
SUPERVISOR: Mr R. Kenchington
FINANCIAL SUPPORT: GBRMPA - \$5,200

OBJECTIVES

To assess the impact on coral reef fauna of a diesel oil spill from the Taiwanese vessel *Hui Ju Hup* disabled at Ruby Reef, and the practicability of salvage in an oil spill situation.

IMPLICATIONS/MANAGEMENT NEEDS

The management of oil on the Great Barrier Reef is an area of Authority responsibility. Involvement in minor spill situations will permit assessment of techniques in the event of a major spill.

METHODOLOGY

Sample collection and analysis. Photography and visual assessment.

STATUS

The project has been completed.

GBRMPA personnel participated in the *Hui Ju Hup* follow-up survey and field training. Sample surveys and photographs were taken at Escape and Ruby Reefs. Irene and Emily Reefs were also surveyed. The samples taken were sent to the Victorian Institute of Marine Sciences Laboratories for hydrocarbon analysis.

LOCALITY: Cairns Section - Escape, Ruby, Irene and Emily Reefs

Effect of Tourists on the Ecology of the Great Barrier Reef

PERIOD: 1979
ORGANIZATION: Griffith University,
School of Australian Environmental Studies

PROJECT LEADER: Dr M. Liddle

PROJECT OFFICER: Dr W. Craik
FINANCIAL SUPPORT: GBRMPA Augmentative Research Grant - \$342

OBJECTIVES

To define some tourist usage problems on the Great Barrier Reef. (This was intended as a pilot study for a larger research proposal)

IMPLICATIONS/MANAGEMENT NEEDS

This study is designed to identify areas for further study in the field of tourism research regarding tourist impacts on coral reefs.

METHODOLOGY

This was a pilot study for the preparation of a research program to (a) develop methods of determining the amount and rate of damage caused by tourists, and (b) develop management techniques and appropriate regulations to minimise damage.

STATUS

The project has been completed.

The pilot study observed possible change around the Heron Island sewage outlet. It suggested a need for experimentation on breaking/regeneration of common corals and a need for more information on the effects of trampling. A research proposal was subsequently prepared and submitted under the MSTGS.

Green Island Reef Economic Study

PERIOD: June 1979 - Oct 1979
ORGANIZATION: Economic Associates (Aust) Pty. Ltd.

PROJECT LEADERS: Mr R.J. O'Hara
Mr M.J. Gibbings

PROJECT OFFICER: Mr T. Hundloe
SUPERVISOR: Mr R. Kenchington
FINANCIAL SUPPORT: GBRMPA - \$22,025

OBJECTIVES

To undertake an economic evaluation of the existing and alternative uses of Green Island and its reef as a tourist/recreational resource.

IMPLICATIONS/MANAGEMENT NEEDS

The Cairns area has been selected for investigation as the second section of the Marine Park. Green Island with its reef is a key attraction on the Great Barrier Reef. It is heavily used by local and international tourists and hence economically important as a resource.

METHODOLOGY

Operators of commercial facilities on Green Island were interviewed, publications and documents were examined and the information collected was analysed. Two field surveys of tourists were conducted to supplement other data sources: one on board the ferries serving Green Island and the other in accommodation establishments in Cairns.

STATUS

The project has been completed. The report will be published in 1983.

The assessment showed that options for major changes in use are very limited, due to many constraints, including policies aimed at preservation of the ecosystem, the small size of the island, perceptions of crowding and the position of commercial operators who face growing competition, tight lease conditions and limited areas for expansion. Three alternatives were proposed for future use of the island:

- (1) "No resort" where resort accommodation on the island is assumed eliminated.
- (2) "expand resort"
- (3) "camping" alternative.

The camping alternative appeared the best solution in economic terms. The activities/attractions most closely related to the Reef provide greatest net benefit. The other man-made attractions either attract few visitors or provide little or no benefit to those who visit them.

Economic Associates Australia. 1979. Green Island Economic Study.

LOCALITY: Cairns Section - Green Island (and its reef)

Boat Ramp Surveys in the Capricornia Section of the Great Barrier Reef Marine Park**PERIOD:** July/Aug 1979**ORGANIZATION:** GBRMPA**PROJECT LEADER:** Dr W. Craik**CONSULTATION AND LIAISON:** Institute of Applied Social Research,
Griffith University**PROJECT OFFICER:** Dr W. Craik**SUPERVISOR:** Mr R. Kenchington**FINANCIAL SUPPORT:** GBRMPA - \$2,555**OBJECTIVES**

To determine catch, effort and economic information about reef fishing by people using their own boats to get to the reef.

IMPLICATIONS/MANAGEMENT NEEDS

This information will be of assistance in assessing usage by small boat owners of the Capricornia Section and will permit assessment of catch and economic investment in recreational fishing for comparison with the mail survey data collected by the Institute of Applied Social Research in their project (Number 90).

METHODOLOGY

Surveys were conducted at boat ramps adjacent to the Capricornia Section of the Great Barrier Reef Marine Park, i.e. Bundaberg, 1770, Gladstone, Rockhampton, Turkey and Yeppoon. Each ramp was surveyed several times during the 3 week survey. Data were collected by interviewing speedboat users about catch and catch per unit effort to compare with values for amateur fishermen using charter boats. Economic data were also collected.

STATUS

The project has been completed.

The data were used in the study: The Economic Characteristics of Fishing in the Capricornia Section (Project 90).

LOCALITY: Capricornia Section

Research and Planning of Information Facilities on the Great Barrier Reef**PERIOD:** April 1980 - Dec 1981**ORGANIZATION:** Cameron, McNamara and Partners Ltd.**PROJECT LEADERS:** Mr R. O'Hara
Mr A. Chenoweth**PROJECT OFFICER:** Mr G. Hawley
SUPERVISOR: Mr R. Kenchington**FINANCIAL SUPPORT:** GBRMPA - \$17,600**OBJECTIVES**

To assess the type of programs and facilities required in the Great Barrier Reef Region using the Whitsunday area as an example. To assess the role which various public and private organisations should play in an integrated information/education facility.

IMPLICATIONS/MANAGEMENT NEEDS

The Authority's role in any information/education facility in the Great Barrier Reef Region requires careful evaluation and planning. This workshop is designed to initiate that planning.

METHODOLOGY

A workshop was held at Lindeman Island from 5-8 August, 1980 to discuss planning for Reef visitor Information/Education facilities on the Great Barrier Reef.

STATUS

The project has been completed.

The consultant prepared a review paper for use at the Workshop. This provided a summary of relevant background material, with particular emphasis on the Whitsunday area. Available information on present and future demand for and supply of such facilities was reviewed, and a possible methodology outlined for planning and integrating future facilities.

A number of other papers were presented at the workshop, discussions were conducted and a report containing presented papers and a record of discussions was prepared.

Cameron McNamara. 1981. Research and Planning of Information Facilities on the Great Barrier Reef. Volume 1 - Review and Workshop Papers. Volume 2 - Workshop Report and Executive Summary. Report to the Great Barrier Reef Marine Park Authority.

LOCALITY: Whitsunday area.

Reef Tourism Data Base Review 1946-1980

PERIOD: June 1980 - April 1982
ORGANIZATION: Australian Travel Industry Association

PROJECT LEADER: Mr R. Claringbould

PROJECT OFFICER: Mr G. Hawley

SUPERVISOR:

FINANCIAL SUPPORT: GBRMPA - \$9,000

OBJECTIVES

To review the growth of the tourism industry sector servicing the Great Barrier Reef Region for the period 1946-1980.

IMPLICATIONS/MANAGEMENT NEEDS

The collected data will be analysed to provide a review of the trends since 1946 illustrating various factors consequent to the growth of tourism. This data will assist in future reef tourism planning and management.

METHODOLOGY

The project was designed to analyse and determine changes including increases or decreases in tourism plant and services, the economic base of Reef-related tourism, the institutional legal structures of tourism, significant aspects of change, for future study or consideration.

STATUS

The project has been completed. The report will be published in 1983.

Results from this study showed:

- (1) There has been a tremendous growth in Reef-related tourism over the period 1946-1980. The number of overseas visitors to the Region continues to keep pace with overseas visitor traffic into Australia which has increased by 50% over the past 10 years.
- (2) The peak visitor periods for the Great Barrier Reef Region are the months of May to September, and also the month of January.
- (3) About 85% of the trips to the Great Barrier Reef Region are of a duration between one and seven nights, although visits to Cairns and the Island Resorts show a greater proportion of visitors stay for seven to fourteen nights.
- (4) Employment in the industry is subject to seasonal fluctuations. The increase in overall employment does not appear to have kept pace with increase in visitor traffic.
- (5) There has been a strong growth in the provision of accommodation over recent years, involving substantial amounts of capital investment in larger-scale developments.
- (6) Transport by air has shown a period of sustained and significant growth over the period 1965-80. The motor car accounts for over 75% of the visitor trips to the Region.

Australian Travel Industry Association. 1980. Data Base Review of Reef-Related Tourism 1946-80. Report to the Great Barrier Reef Marine Park Authority.

90 **Economic Characteristics of Fishing in the Capricornia Section**

PERIOD: July 1979 - June 1981
ORGANIZATION: Institute of Applied Social Research (IASR),
Griffith University

PROJECT LEADER: Mr T. Hundloe

CONSULTATION AND LIAISON: Queensland Fisheries Service
Commonwealth Department of Primary Industry

PROJECT OFFICER: Dr W. Craik
SUPERVISOR: Mr R. Kenchington
FINANCIAL SUPPORT: GBRMPA - \$22,219

OBJECTIVES

To investigate the economic characteristics of recreational and commercial fishing in the Capricorn/Bunker Groups of Reefs.

IMPLICATIONS/MANAGEMENT NEEDS

The Authority investigated the Capricorn/Bunker reefs as the first section of the Great Barrier Reef Marine Park. The fishing industry (both commercial and recreational) is one of the most important users of these groups of reefs.

METHODOLOGY

Data were collected from both primary and secondary sources. The primary sources were field investigations, mainly personal interviews within the study area. The secondary sources were of two forms: published reports and unpublished data.

STATUS

The project has been completed.

Recreational fishing: About 800 owners of registered private motorboats fished in the Capricornia Section. They mostly lived in the adjacent coastal area, had a total investment associated with fishing of over \$7m and a total annual expenditure of about \$630,000 to fish in the Section.

Charter boats regularly engaged in fishing in the Capricornia Section were worth \$2m and collected \$330,000 annually in fees from fishermen.

Commercial fishing: Between 129 and 177 commercial fishing units of the total 269 operating from ports adjacent to the Capricornia Section, did some of their fishing in the Section. Prawn and/or scallop trawling was the activity of the majority (66%) of units. Operating costs of commercial fishing units which did some fishing in the Section was \$6m in 1978-79 (\$2.5m attributed to direct costs of fishing within the Section). The replacement value of vessels was almost \$12m. All expenditure on operating costs and vessels occurred in Queensland and 80% within the Wide Bay-Fitzroy region. The value of catch of the commercial fishery in the Capricornia Section was over \$2.5m in 1978-79 (scallops 49%, prawns 27%, pelagic fish 14%, demersal fish 9%).

Hundloe, T., Driml, S., Lack, S. and McDonald, G. 1980. Economic characteristics of fishing in the Capricornia Section of the Great Barrier Reef Marine Park.

Other reports were also prepared:

Dragun, A., Driml, S., and Lack, S. 1979. The economics of fishing in the Capricornia Section of the Great Barrier Reef. Part A: A baseline study of the activity and resources of the sector. Part B: A methodological statement of further economic investigation.

Dragun, A.K. 1979. Management issues in the fishery. IASR Research Report, October 1979.

Papers on the research have been published:

Hundloe, Tor John. 1981. Employment and income effects of a Queensland fishery. *Australian Fisheries* 40(3):6-9.

Driml, Sally. 1980. Recreational fishing in the Capricornia Section Marine Park - an input-output study. Papers of the meeting of the Australian and New Zealand Section Regional Science Association, Fifth Meeting, Tanunda, December, 1980.

LOCALITY: Capricornia Section

Excavation of Archaeological Sites on South Keppel Island

PERIOD: 1980
ORGANIZATION: University of Queensland,
Department of Anthropology and Sociology
PROJECT LEADER: Mr M. Rowland
PROJECT OFFICER: Dr W. Craik
SUPERVISOR: Prof. B. Rigsby
FINANCIAL SUPPORT: GBRMPA Augmentative Research Grant - \$440

OBJECTIVES

To interpret how a small population exploited the marine niche of the Keppel Islands in prehistoric times.

IMPLICATIONS/MANAGEMENT NEEDS

Archaeological investigation will provide an understanding of the type of locally available resources exploited at particular times over the last 5000 years, changes in availability of resources over time, and the cumulative effect of man through time. This understanding should assist in the formulation of today's management strategy.

METHODOLOGY

Eight sites were investigated on South Keppel Island. Faunal material and particularly stone material were collected and analysed. The latter is expected to provide detailed information on the islanders' technology.

STATUS

The project has been completed.

Several major finds were made: a bondi point, a jua knife, and remnants of a house or hut-like structure. These finds are significant in corroborating a northerly distribution of bondi points (backed scrapers), and in finding evidence of a hut similar to one in a photograph of a hut on South Keppel last century.

Extending the archaeological investigation to the Capricorn Bunker Group is recommended.

The work is being followed up in the Percy Islands (July 1982) and the Whitsunday Islands (September 1982).

Papers on the investigation have been published:

Rowland, M.J. 1980. The Keppel Islands - preliminary investigations. *Australian Archaeology* No 11: 1 - 17.

Rowland, M.J. 1981. Radio carbon dates for a shell fishhook and disc from Mazie Bay, North Keppel Island. *Australian Archaeology* No 12: 63 - 69.

Rowland, M.J. 1982. Keppel Islands marine specialists: an adaptation to the southern Barrier Reef Province. In *Coastal Archaeology in Eastern Australia*. Proceedings of the 1980 Valla Conference on Australian Prehistory.

LOCALITY: South Keppel Island (off Yeppoon)

Attitudes of Townsville and Cairns Inhabitants to the Great Barrier Reef

PERIOD: 1980
ORGANIZATION: James Cook University, Department of Geography
PROJECT LEADER: Mr F. Greenleaf
PROJECT OFFICER: Dr W. Craik
SUPERVISOR: Dr P. Valentine
FINANCIAL SUPPORT: GBRMPA Augmentative Research Grant - \$269

OBJECTIVES

To determine the meaning of the Great Barrier Reef for the communities of Townsville and Cairns in terms of their attitudes towards it. To compare and contrast the expressed attitudes between and within the communities. To isolate indicators which may explain why people hold certain attitudes.

IMPLICATIONS/MANAGEMENT NEEDS

Man tends to act towards his environment in accordance with the images he has of it and his relationship to it. Images play an important role in forming beliefs, attitudes and behavioural intentions. This study is designed to provide information on public attitudes and probable behaviours which can be used in the planning stage and in the management of the Marine Park.

METHODOLOGY

Likert attitude scales were employed to determine the strength and direction of attitudes expressed by sample populations toward the environmental resource. Samples of 104 Townsville and 80 Cairns residents were randomly selected. Participants were interviewed in their homes to complete a tested questionnaire.

STATUS

The project has been completed.

No significant differences were found between average community attitudes in Cairns and Townsville, in spite of very different levels of experiential contact with the Reef by the two groups. 91 percent of the Cairns sample had visited the Reef compared with 57 percent of the Townsville sample.

In both communities over 80% of the sample had a favourable attitude to maintaining the Reef as a natural environment. The same percentages wanted better observational and interpretative facilities and better access to the Reef. Around 60% in both samples wanted little structural development, while 24% favoured some development in keeping with the natural character of the Reef.

Within both communities attitudes varied and three subgroups were identified to explain the variation. The characteristics of the subgroups were similar in Cairns and Townsville.

The *Community* subgroups (Cairns -50% of sample; Townsville - 41%) could be described as reflecting the average person's attitudes to the Reef (as outlined above).

The *Development* subgroups (C - 36%; T - 49%) held neutral or unfavourable images of the Reef. They favoured activities on the reef, even those in conflict with the natural environment. They saw the Reef as having greater importance to the commerce and character of their cities than did other subgroups. They rated 'recreation' and 'socialising' as important reasons for reef visits.

The *Preservation* subgroups (C - 14%; T - 10%) tended to have frequent, extended reef visits. Most frequent motivation for visiting the reef was to study and appreciate nature, while 'socialising' was unimportant. These subgroups contained people who were active in community groups, well-educated, and middle to high income earners.

Greenleaf, F. 1980. Environmental Concern for the Great Barrier Reef - an investigation of attitudes of the Cairns and Townsville communities. Honours thesis, James Cook University of North Queensland.

LOCALITY: Cairns, Townsville

Boat Ramp Surveys in the Proposed Cairns Section of the Great Barrier Reef Marine Park**PERIOD:** Aug/Sept 1980**ORGANIZATION:** GBRMPA**PROJECT LEADER:** Dr W. Craik**CONSULTATION AND LIAISON:** Mr T. Hundloe) Institute of Applied Social Research,
Ms S. Driml) Griffith University
Mr J. Trigger)**PROJECT OFFICER:** Dr W. Craik**SUPERVISOR:** Mr R. Kenchington**FINANCIAL SUPPORT:** GBRMPA - \$2,215**OBJECTIVES**

To obtain information on reef fish catches and to determine economic characteristics of recreational fishing in the proposed Cairns Section of the Great Barrier Reef Marine Park.

IMPLICATIONS/MANAGEMENT NEEDS

The information from this survey will be of assistance in providing information on small boat usage, catch and effort and economic importance of fishing.

METHODOLOGY

The four principal points of embarkation of speedboats to the reefs in the Cairns Section are Tully, Mourilyan, Cairns and Port Douglas. Twenty-three days were spent surveying boat users at these locations. Interviews were conducted and data were gathered on catch, catch per unit effort and economic information.

STATUS

The data were used in the study: The Economic Characteristics of Fishing in the Great Barrier Reef Region, excluding Capricornia (Project 94).

LOCALITY: Cairns Section

Fisheries Economics of the Great Barrier Reef Region, excluding the Capricornia Section

PERIOD: Aug 1980 - March 1982

ORGANIZATION: Institute of Applied Social Research,
Griffith University

PROJECT LEADER: Ms S. Driml

CONSULTATION & LIAISON: Fisheries, Queensland Department of Primary Industries
Commonwealth Department of Primary Industry

PROJECT OFFICER: Dr W. Craik

SUPERVISOR: Mr R. Kenchington

FINANCIAL SUPPORT: GBRMPA - \$21,395

OBJECTIVES

To determine the economic importance and value of commercial and recreational fishing activities in the Great Barrier Reef Region, except Capricornia.

IMPLICATIONS/MANAGEMENT NEEDS

This study will provide the first "order of magnitude" figures on total catch and value for the Great Barrier Reef Region.

METHODOLOGY

Data were collected from both primary and secondary sources. The primary sources were field investigations, mainly personal interviews within the study area. The secondary sources were of two forms: published reports and unpublished data.

STATUS

The project has been completed.

Data were collected for 3 regions (based on Cairns, Townsville and Mackay). Data are presented in the reports by region and combined to give a total for the Great Barrier Region (excluding Rockhampton region which was covered in a preceding study). A summary of the combined data follows.

Recreational fishing: About 14,900 registered private motorboats were used for fishing in the Region excluding Capricornia. They made a total of 197,000 recreational fishing trips per annum. The total catch was about 6,600 tonnes. The total investment associated with recreational fishing was about \$84.5m and the total annual expenditure in 1980 was about \$37m. All expenditure occurred within Queensland and 95% within the local regions.

Charter boats: 159 charter boats (including Rockhampton region but excluding non-game charter boats from Cairns) operated in the Great Barrier Reef Region.

Commercial fishing: 361 otter trawlers (east coast only) and 395 vessels engaged in other fishing methods operated out of home ports in the three regions. They employed 1,452 people (not all full-time). They had a total annual expenditure of about \$16m (90% made within local regions). The value of catch was about \$18m. The 1981 market value of vessels (and equipment) was \$43m.

Driml, S., Hundloe, T., McGinnity, P., and Shaw S. 1981. Economic Characteristics of Fishing in the Great Barrier Reef Region (excluding the Capricornia Section). Report to the Great Barrier Reef Marine Park Authority.

Hundloe, T. and Driml, S. 1981. Summaries of recent investigations with emphasis on the structural and economic characteristics of the Australian Fishing Industry and in particular the Queensland component of the industry. A companion volume to Economic Characteristics of Fishing in the Great Barrier Reef Region (excluding the Capricornia Section).

Man-made Noise in the Ocean

PERIOD: Jan 1981 - Dec 1982
ORGANIZATION: James Cook University
Department of Electrical and Electronic Engineering

PROJECT LEADER: Dr G.H. Allen

CONSULTATION AND LIAISON: GBRMPA - provision of some boat time in conjunction with park management cruises.

PROJECT OFFICER: Mr R. Kenchington
SUPERVISOR: Mr R. Kenchington
FINANCIAL SUPPORT: GBRMPA - \$3,000

OBJECTIVES

To measure the noise spectra of vessels and relate ship noise to ambient levels in the sea at various frequencies. This is a pilot project.

IMPLICATIONS/MANAGEMENT NEEDS

This study may enable the specification of a passive surveillance network to: (a) record use of areas of the marine park; (b) test the effectiveness of zoning plans; and (c) direct officers of management agencies to areas of high level use.

METHODOLOGY

Pressure sensitive detectors are fitted to a portable spectral analyser system carried in a small craft. This will measure ambient sea noise and boat noises between the mainland and the Great Barrier Reef.

STATUS

Project underway.

Preparation of a Complementary Management Plan - Capricornia Section**PERIOD:** March 1981 - Dec 1982**ORGANIZATION:** Queensland National Parks and Wildlife Service (QNPWS)**PROJECT LEADER:** Mr T. Vollbon**PROJECT OFFICER:** Mr S. Woodley**SUPERVISOR:** Dr A. Gilmour**FINANCIAL SUPPORT:** GBRMPA - \$6,500**OBJECTIVES**

To design and specify the contents and scope of a complementary management plan for the Capricornia Section.

To identify and assign priorities to studies and research that are a necessary prerequisite to the preparation of a management plan.

IMPLICATIONS/MANAGEMENT NEEDS

A comprehensive and detailed management plan for all the islands, reefs, and waters within the outer boundaries of the Capricornia Section is essential to complement the Zoning Plan and Regulations for the Capricornia Section, and to guide all agencies with management responsibilities in the area.

METHODOLOGY

In November 1980, a working group to the Co-ordinating Committee on Day-to-Day Management comprising officers of QNPWS, QFS and GBRMPA was established to consider and report on the ambit and scope of an integrated management plan. A consultant was contracted to work with the Co-ordinating Committee on this project. Tasks included:

- (a) discussions and liaison with Queensland and Commonwealth Government Departments;
- (b) identifying special projects and studies that will need to be conducted to provide information for the preparation of a Management Plan; and
- (c) the preparation of a report on the ambit and scope of a management plan.

STATUS

A draft report has been prepared for GBRMPA.

Queensland National Parks and Wildlife Service, July 1981. A proposal to prepare a management plan for the Capricornia Section, Great Barrier Reef Marine Park and associated islands.

LOCALITY: Capricornia Section

Economic Impacts of Tourist/Recreational and Fishing Industries in the Proposed Cairns Section of the Great Barrier Reef Region

PERIOD: Sept 1980 - Dec 1981

ORGANIZATIONS: Institute of Applied Social Research, Griffith University

PROJECT LEADER: Mr T. Hundloe

CONSULTATION AND LIAISON: Dr R. Jensen, Mr G. West
Department of Economics, University of Queensland

PROJECT OFFICER: Mr G. Hawley/Dr. W. Craik

SUPERVISOR: Mr R. Kenchington

FINANCIAL SUPPORT: GBRMPA - \$9,070

OBJECTIVES

To assess the ultimate location of the beneficiaries of each dollar spent on the tourist/recreational and fishing activities of the proposed Cairns Section of the Great Barrier Reef Region, and hence to assess the extent and location of increased income and employment, arising from the current usage pattern of this area.

IMPLICATIONS/MANAGEMENT NEEDS

The information provided will prove extremely useful in the declaration, zoning and management of the Cairns Section of the Marine Park, by enabling economic impact assessment of different management strategies.

METHODOLOGY

Data were collected from both primary and secondary sources. The primary sources were field investigations, mainly personal interviews within the Cairns study area. The secondary sources were of two forms: published reports and unpublished data.

STATUS

The project has been completed. The findings are summarised in the following table:

Economic Characteristics and Multipliers	Key Activities					Total
	Commercial Fishing	Resort Recreation	Day Trips	Charter Boat Fishing	Amateur Fishing	
Value of output sales \$million (1979 prices)	11.119	4.895	2.330	4.020	6.321	28.685
Regional total output multiplier	1.772	1.571	1.600	1.371	1.412	N/A
Regional total income multiplier	.714	.456	.475	.264	.017	N/A
Regional total employment multiplier	.069	.057	.062	.033	.023	N/A

Multipliers provide a basis for assessing the relative importance of the various reef users in terms of total, uncompensated effects. They allow decision-makers to estimate readily the end result (in terms of income, output and employment generated or lost) of any actions which would affect the output of the major uses of the proposed Cairns Section of the Great Barrier Reef Marine Park, and to compare the impacts across the industries concerned.

Hundloe, T., Driml, S., Shaw, S., and Trigger, J. 1981. Proposed Cairns Section of the Great Barrier Reef Marine Park: Some Economic Characteristics and Multipliers. Report to the Great Barrier Reef Marine Park Authority.

LOCALITY: Cairns Section

Reef Tourism Attitudinal and Socio-Economic Assessment Survey

PERIOD: July 1980 - June 1982
ORGANIZATION: Unisearch Ltd.
University of New South Wales

PROJECT LEADERS: Dr I. Wilkinson
Dr S. Glaser

PROJECT OFFICER: Mr G. Hawley/Dr. J. Dunn
SUPERVISOR: Mr R. Kenchington
FINANCIAL SUPPORT: GBRMPA - \$28,500

OBJECTIVES

To determine the attractiveness of the Great Barrier Reef to holiday-makers. In particular to determine (a) Vacation histories; (b) vacation preferences and expectations; (c) expenditure patterns; (d) socio-economic backgrounds; (e) attitudes to Reef management of visitors to the Great Barrier Reef Region.

IMPLICATIONS/MANAGEMENT NEEDS

It is hoped to identify needs and expectations of vacationers to the Great Barrier Reef and incorporate these needs into management plans.

METHODOLOGY

A literature review of leisure, recreation and tourism was undertaken as the basis for the development of the survey. Data relating to the five vacation and socio-economic areas of interest mentioned above were collected over two periods using a questionnaire to interview a sample of 1015 tourists (508 in October 1980 and 507 in January 1981). A quota sampling method (taking into account location of centres for Reef tourism, sex, age, stage of holiday, and type of accommodation) was used to gain a representative sample of visitors.

STATUS

The project has been completed.

Analysis of the survey data has provided information about the five areas of interest listed in the objectives. It also helps answer questions such as: Who goes where in the Great Barrier Reef Region, when and for how long, and why? How many times have people visited the Reef Region? How long do they stay? How do they get to the Region and how many visit on package tours?

Information is also provided about the satisfaction of tourists with vacations in the Reef Region, their images of the Region as a location for vacations, and comparison of these images with their images of other vacation locations.

Three different approaches were used to segment the sample to represent a possible segmentation of the Great Barrier Reef tourist market in order that a greater understanding of the variety of groups who visit the Region might be achieved.

Glaser, S. and Wilkinson, I. 1981. Reef Tourism Attitudinal and Socio-Economic Assessment Survey. Report to the Great Barrier Reef Marine Park Authority.

Socio-Economic Research Program for the Great Barrier Reef Marine Park Authority

PERIOD: March 1981 - June 1982
ORGANIZATION: Unisearch Ltd.
University of New South Wales

PROJECT LEADER: Dr G. McColl

CONSULTATION & LIAISON: Griffith University
James Cook University

PROJECT OFFICER: Dr J. Dunn
SUPERVISOR: Dr A. Gilmour
FINANCIAL SUPPORT: GBRMPA - \$31,000

OBJECTIVES

To review and assess in the light of recent socio-economic research and the Authority's objectives, the future socio-economic research program needs of GBRMPA.

IMPLICATIONS/MANAGEMENT NEEDS

This project will ensure that the Authority has up-to-date advice and an appreciation of priorities in developing its socio-economic program.

METHODOLOGY

A draft report was prepared covering fisheries, tourism/recreation and other matters. The draft was discussed at a two-day workshop in Brisbane in November 1981 attended by academics, State and Federal Government Departmental officers, individuals from private enterprise, the consultants and GBRMPA staff. As a result of these discussions a revised draft report has been prepared.

STATUS

The revised draft report is currently under consideration by GBRMPA.

The Social and Economic Elements of a Strategic Plan for the Whitsunday Area

PERIOD: 1981
ORGANIZATION: Griffith University,
School of Australian Environmental Studies

PROJECT LEADER: Mr P. McGinnity

PROJECT OFFICER: Dr W. Craik
SUPERVISOR: Mr T. Hundloe
FINANCIAL SUPPORT: GBRMPA Augmentative Research Grant - \$600

OBJECTIVES

To undertake a detailed analysis of the economic impact of the Whitsunday Area in terms of effects on the local (Mackay Statistical Division) and Queensland State economies, for five sectors of activity.

IMPLICATIONS/MANAGEMENT NEEDS

This study shows the economic significance of the uses of the Whitsunday Area.

METHODOLOGY

Five sectors were investigated: (i) island resort tourism; (ii) charter boat operations; (iii) island camping; (iv) recreational fishing; and (v) commercial fishing. Data on income, expenditure and location of expenditure were collected for each of the five sectors. Detailed primary information was collected for resorts, charter boat operations and island camping. Data pertaining to recreational and commercial fishing were available from secondary sources.

STATUS

The project has been completed.

Economic impact was determined by applying input-output analysis techniques. Impacts pertain to the 1980/81 financial year. The major impacts of the Whitsunday Area were confined to the local economy. The total value of output for the five marine and island related activities was estimated to be \$42 million in 1980/81. Associated with this output were output flow-ons to other industries of approximately \$51 million comprising \$33.5 million to the local region and \$17.5 million to industries in other parts of Queensland.

Income to households associated with the provision of goods or services by industries from the Whitsunday Area was estimated to be \$29 million in 1980/81, comprising \$23 million to the local region and \$6 million to the rest of Queensland.

Total employment was also estimated. In 1980/81, 2513 persons were employed in Queensland either directly or indirectly as a result of industries associated with the Whitsunday Area. Of those, 2231 persons were employed in the local region.

The limitations of input-output modelling and of the data available mean the estimates of economic impact must be considered as maximum effects. It is still apparent that the Whitsunday Area has a substantial impact on the economy of the local region, an impact that extends to the economy of the state of Queensland. It is apparent that the Whitsunday area and the adjacent coastal mainland have only begun to achieve their potential as tourist destinations. However, unless adequate guidelines are provided by the appropriate management bodies the increased visitor pressure could, in the long run, lead to a degradation of the natural environment. Any such degradation can only serve to reduce the value of the Area.

McGinnity, P. 1981. Whitsunday Area economic impact study. Honours dissertation, Griffith University.

LOCALITY: Whitsunday Area

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Analysis of Present and Predicted Uses of the Natural Environment: National Parks and Proposed Cairns Section of the Great Barrier Reef Marine Park

PERIOD: 1981

ORGANIZATION: Griffith University,
School of Australian Environmental Studies

PROJECT LEADER: Mr D. Hudson

PROJECT OFFICER: Dr W. Craik

SUPERVISOR: Mr T. Hundloe

FINANCIAL SUPPORT: GBRMPA Augmentative Research Grant - \$600

OBJECTIVES

To gather and analyse data on the human uses of the terrestrial and proposed marine parks in an area centred on Cairns.

IMPLICATIONS/MANAGEMENT NEEDS

Information on visitor usage in the proposed Cairns Section is essential for the Authority's planning for the area.

METHODOLOGY

Interviews of 313 visitors to three islands (Low Isles, Dunk and Bedarra, Fitzroy) and three mainland National Parks (Cape Tribulation, Palmerston, Lake Eacham) were made on one week and one weekend day each in the peak visitor period (July-August).

STATUS

The project has been completed.

The findings can be summarized:

Visitor Origin: Queensland 23%; Interstate 59%; Overseas 18%

Attractions: (1) Great Barrier Reef and Islands; (2) climate; (3) fauna/flora, rainforest;
(4) Atherton Tableland.

Visitor Origin and attraction: Great Barrier Reef No. 1 attraction for NSW, Qld (excluding Cairns) and overseas visitors; Climate No. 1 attraction for Victorians.

Island day trippers ranked Great Barrier Reef No. 1 attraction

National Park day trippers ranked Great Barrier Reef and Climate equal No. 1 attraction.

Overseas, NSW and Victorian visitors made up the majority of day trippers to islands. Most were mobile, travelling by private car, based at Cairns or transient through the region. Most day trippers were sightseeing to a specific island or generally, except for Low Isles where most were going to see the coral and marine life. Factors contributing to enjoyment were dependent on cruise characteristics. Future research may be able to distinguish between the roles that particular day cruises play in the recreational usage of the Reef which will help identify potential conflicts with management objectives.

National Parks were included in the itineraries of most visitors. The purpose of visits was mostly to sightsee and most had short stopover times. Factors associated with enjoyment were mainly the scenic, natural, unspoilt attributes of the parks. A consistent proportion of visitors to National Parks were residents of the Cairns area.

Hudson, D. 1981. A preliminary study of island daytrippers and National Park visitors in the Cairns Region. Honours dissertation, Griffith University.

LOCALITY: Cairns Section

Tourist Impact on Reef Corals

PERIOD: Feb 1982 - Jan 1984
ORGANIZATION: Griffith University
School of Australian Environmental Studies

PROJECT LEADERS: Dr M. Liddle
Dr A. Kay

PROJECT OFFICER: Mr R. Kenchington
SUPERVISOR: Mr R. Kenchington
FINANCIAL SUPPORT: GBRMPA - \$59,849

OBJECTIVES

To determine the effects of human trampling on intertidal coral communities typically visited by reef walkers.

IMPLICATIONS/MANAGEMENT NEEDS

This study is designed to provide basic data for: (a) assessment of reef top impacts by officers of the marine park; (b) interpretive activities in the marine park.

METHODOLOGY

The amount of broken coral and the identity and abundance of sessile animal and plant species on untrampled pathways and pathways trampled to various degrees is being compared in a trampling experiment over a period of 18 months.

Cordoned-off plots designed to keep people from walking on certain areas of coral are positioned in the region visited by the guided reef walks from the Heron Island resort. Comparison of the coral breakage and composition inside and outside of these plots will be made over a period of 18 months to determine whether this area has been affected by the high numbers of people who visit it.

The ability of four common reef flat corals to survive and recover after human trampling will be assessed in a third series of experiments which will be designed to determine such things as the amount of force required to break the coral skeleton and the growth rate and survival rate of dislodged coral fragments and damaged colonies.

STATUS

The trampling experiment and the cordoned-off plots were set up in April and June 1982. Both experiments will terminate in November 1983.

An experiment to determine the survival and growth rate of variously sized and damaged fragments of three species of branching corals was set up in August and September 1982. Another experiment to record the growth rate of colony branches with and without their growing tips removed was set up in September 1982 for the same three species. These two experiments will terminate at latest in September 1983.

Final report to GBRMPA due January 1984.

LOCALITY: Capricornia Section - Heron Island Reef

History of Crown of Thorns Incidence on the Great Barrier Reef

PERIOD: June 1982 - Dec 1982

ORGANIZATION: James Cook University, History Department

PROJECT LEADERS: Prof B. Dalton
Mr H. Reynolds

CONSULTATION AND LIAISON: Dr R. Johannes (CSIRO, Perth)

PROJECT OFFICER: Dr W. Craik

SUPERVISOR: Mr R. Kenchington

FINANCIAL SUPPORT: GBRMPA - \$13,600 (Phase 1)

OBJECTIVES

To collect material related to historical use and frequency of events in the Great Barrier Reef Region, with particular reference to the incidence of crown of thorns.

IMPLICATIONS/MANAGEMENT NEEDS

This study has relevance to recent outbreaks of crown of thorns and the frequency and extent thereof. It will also meet an overdue need to collect and collate historical information (often unwritten) on the Great Barrier Reef.

METHODOLOGY

Information will be collected by (i) conducting interviews using a standard format with long-time residents of areas adjacent to the Great Barrier Reef Region (starting in Townsville); (ii) a literature search to extend contacts and collect written information; and (iii) cross checking oral information on events with timing of other events and the written record.

The information will be collated for (i) storage in a library on history of the reef and adjacent waters; (ii) separate documentation of crown of thorns incidence and frequency.

STATUS

Phase I has been completed. Phase II should commence in June 1983 and the final report to GBRMPA is due December 1983.

Economic Impact Study of the Great Barrier Reef Region**PERIOD:** April 1982 - December 1982**ORGANIZATIONS:** Institute of Applied Social Research
Griffith University**PROJECT LEADERS:** Ms S. Driml
Mr T. Hundloe**CONSULTATION AND LIAISON:** Dr R. Jensen, Mr G. West,
University of Queensland**PROJECT OFFICER:** Dr W. Craik**SUPERVISOR:** Mr R. Kenchington**FINANCIAL SUPPORT:** GBRMPA - \$9,930**OBJECTIVES**

To calculate input-output tables for selected major activities in the Great Barrier Reef Region (fishing, tourism, research, recreation) for local and State economic regions. This will lead to assessment for Marine Park Sections and the entire Great Barrier Reef Region of beneficiaries of each dollar spent on the activities and hence the extent and locations of income and employment arising from current usage of the Great Barrier Reef Region.

IMPLICATIONS/MANAGEMENT NEEDS

This study will assist the evaluation of the potential impact of management measures (made for sections of the Marine Park and for the entire Reef Region) on the local economy, the State economy, and on local and state employment.

METHODOLOGY

Existing reef-oriented uses will be categorised into groups of activities (having similar expenditure patterns) for areas of the Great Barrier Reef Region (excluding the Cairns, Capricornia and Whitsunday areas already investigated). These activities will be inserted into input-output tables, multipliers calculated, and projections made of output, income and employment for relevant areas. Multipliers for Capricornia will be updated to the same base year to make projections for the entire Region. The location of money expenditure associated with the Great Barrier Reef Region will be isolated as will the ultimate areas of the State which benefit from the expenditure.

STATUS

Report to GBRMPA received and under consideration.

**Factors Affecting Visitors Choice of Selected Reef Experience
Activities/Facilities within the Cairns Section of the Great Barrier Reef Marine
Park**

PERIOD: 1982

ORGANIZATION: James Cook University, Geography Department

PROJECT LEADER: Ms J. Muntz

PROJECT OFFICER: Dr J. Dunn

SUPERVISOR: Prof J. Oliver, Dr P. Valentine

FINANCIAL SUPPORT: GBRMPA Augmentative Research Grant - \$690

OBJECTIVES

To define factors affecting the choice of activity.

To identify factors contributing to satisfaction from the activity.

To devise a model illustrating the factors affecting choice and satisfaction.

IMPLICATIONS/MANAGEMENT NEEDS

This study is designed to provide some guidance for management re user facilities through the identification of "clusters" of visitors using facilities and the satisfaction with activities.

METHODOLOGY

Reef experience sites to be studied are:

- | | | | |
|----------|--------------------|--------|-------------------|
| Mainland | 1. Windows on reef | Island | 3. Green Island |
| | 2. Reef World | | 4. Low Isles |
| | | | 5. Lizard Island |
| | | | 6. Outer reef (?) |

Several variables expected to influence choice and satisfaction are to be examined including: (i) personal characteristics or profile variables; (ii) spatial relationships; (iii) activity orientation/planning; and (iv) satisfaction levels/likelihood of return visit.

At each site a random sample of the visitor population will be surveyed by on-site standardised interview procedure before the visit (to measure variables (i) to (iii) as well as to get some measure of expectations) and after (to measure (iv) satisfaction levels). It is planned to have a total of seven survey days at each site to test for expected changes in visitor types from week day to weekend. The data will then be collated.

STATUS

Status of project is under review.

LOCALITY: Cairns

106 **Evaluation of the Travel Cost Method for Estimating Recreation Use Values of Public Amenity Resources such as Sites on the Great Barrier Reef**

PERIOD: 1982
ORGANIZATION: University of New South Wales, School of Economics

PROJECT LEADER: Mr R.K. Sloan

PROJECT OFFICER: Dr J. Dunn
SUPERVISOR: Dr D. Gallagher
FINANCIAL SUPPORT: GBRMPA Augmentative Research Grant - \$729

OBJECTIVES

To assess the empirical relevance of theoretical work on the travel cost method (TCM) which indicates it may be inappropriate for establishing a site value when it is used in different ways by various visitors.

IMPLICATIONS/MANAGEMENT NEEDS

The TCM is the most widely used method for evaluating recreation sites. This study will add to the understanding of recreation site valuation procedures.

METHODOLOGY

Data on the TCM will be collected using an appropriate questionnaire distributed at a suitable site e.g. Heron Island.

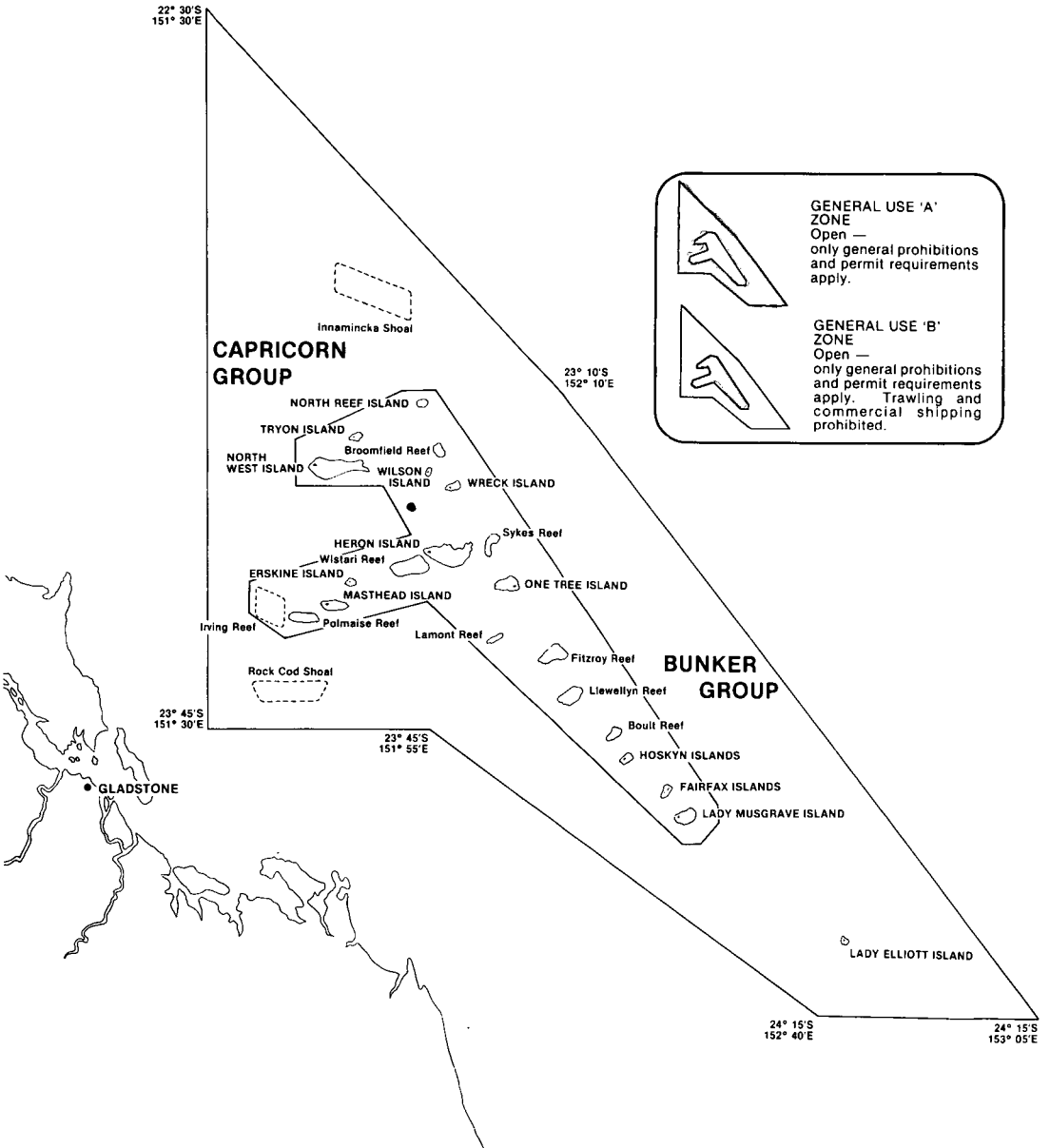
Data collected will also provide socio-economic profiles, delineation of use categories, and identification of the most valued attributes of a site.

STATUS

Report to GBRMPA due June, 1983.

LOCALITY: Capricornia Section - Heron Island

GREAT BARRIER REEF MARINE PARK CAPRICORNIA SECTION



MANAGEMENT STRATEGIES

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Zoning Strategy Study

PERIOD: Oct 1979 - March 1980
ORGANIZATION: Environment Science and Services

PROJECT LEADERS: Ms D. Anderson
Mr D. Pitts

CONSULTATION AND LIAISON: Zoning Strategy Study Group

PROJECT OFFICER: Mr J. O'Dwyer
SUPERVISOR: Mr R. Kenchington
FINANCIAL SUPPORT: GBRMPA - \$31,500

OBJECTIVES

To prepare zoning strategies for the proposed Capricornia Section of the Marine Park.
This shall include:

- an inventory of existing data, usage impacts and constraints;
- development of, and comparisons between, alternative strategies.

IMPLICATIONS/MANAGEMENT NEEDS

To facilitate development of a zoning plan for the Capricornia Section of the Great Barrier Reef Marine Park.

METHODOLOGY

The project was divided into three phases:

Phase 1 - Data Collection and Analysis

- (i) An inventory of the natural resource base and human factors within the Capricornia Section based upon currently available information.
- (ii) An appraisal of available evidence describing the impacts of various human activities within the Capricornia Section.
- (iii) Identification of existing constraints and opportunities that should influence future use and management of the Capricornia Section.

Phase 2 - Strategy Generation

Preparation of alternative strategies for future use and management of the Capricornia Section based on the output from Phase 1 and in accordance with the objects specified in Section 32(7) of the *Great Barrier Reef Marine Park Act 1975*.

Phase 3 - Strategy Evaluation

Evaluation of the alternative strategies developed in Phase 2 using recognised multi-criteria procedures.

STATUS

The project has been completed.

A report was prepared for GBRMPA by Environment Science and Services in association with the Zoning Strategy Study Group. The report will be published in 1983-84.

Environment Science and Services. 1979. Zoning Strategy Study based on the proposed Capricornia Section of the Great Barrier Reef Marine Park. Report to the Great Barrier Reef Marine Park Authority.

LOCALITY: Capricornia Section

Demonstration of SIRO-PLAN in the Cairns Section

PERIOD: Dec 1981 - April 1982
ORGANIZATION: CSIRO, Division of Land Use Research

PROJECT LEADER: Dr D. Cocks

PROJECT OFFICER: Dr W. Craik
SUPERVISOR: Mr R. Kenchington
FINANCIAL SUPPORT: GBRMPA - \$5,000

OBJECTIVES

To demonstrate the SIRO-PLAN land-use planning method in developing SIRO-PLAN draft zoning plans for the Cairns Section, to support the zoning plan development procedures normally used by GBRMPA.

IMPLICATIONS/MANAGEMENT NEEDS

This study should assist in drawing up draft zoning plans through the digestion of diverse multiple data sets. It can illustrate the effect of different strategies on the draft zoning plan.

METHODOLOGY

The steps proposed to meet the objectives are: (i) specification of zoning categories and policies; (ii) specification of policy satisfaction indicators and data needs; (iii) completion of planning base map and data acquisition; (iv) completion of the computer program and production of discussion plans.

STATUS

A demonstration of the SIRO-PLAN method applied to the Cairns Section of the Great Barrier Reef Marine Park has been made.

Final report to GBRMPA has been received and is under consideration.

LOCALITY: Cairns Section

The Terms of Reference of Information Acquisition Projects in Coastal Management

PERIOD: 1982
ORGANIZATION: Australian National University
Centre for Resource and Environmental Studies

PROJECT LEADER: Mr P. Macartney

PROJECT OFFICER: Mr J. O'Dwyer
SUPERVISOR: Mr D. Smith, Dr D. Cocks
FINANCIAL SUPPORT: GBRMPA Augmentative Research Grant - \$275

OBJECTIVES

To identify a set of guidelines for the format and for developing the content of the terms of reference of information acquisition projects. The terms of reference initiate information acquisition projects and specify procedural and substantive aspects of the same which are intimately related to the form and content of the final product/s.

IMPLICATIONS/MANAGEMENT NEEDS

This study is designed to assist an assessment of the steps involved in the Capricornia zoning plan development. It also has relevance to the planning in the Cairns area.

METHODOLOGY

Part 1 of the study is concerned with the development of a theoretical frame work and includes:

- (a) the development of a conceptual model of coastal zone management oriented to public authorities, decision making, management information systems and the role of the Australian Public Service;
- (b) the development of a set of guidelines for the format and content of theoretical ideal terms of reference for initiating information acquisition projects; and
- (c) the development of a method for assessing the guidelines.

Part 2 of the study is concerned with the maximization of the validity of the research results and includes:

- (a) the documentation of all coastal-zone-management-oriented Australian public authorities and the identification of similar authorities involved in developing resource management plans; and
- (b) the documentation of all the information acquisition projects conducted by the short listed authorities identified in the preceding step (from 1970 to 1980), and the selection of case studies from these projects.

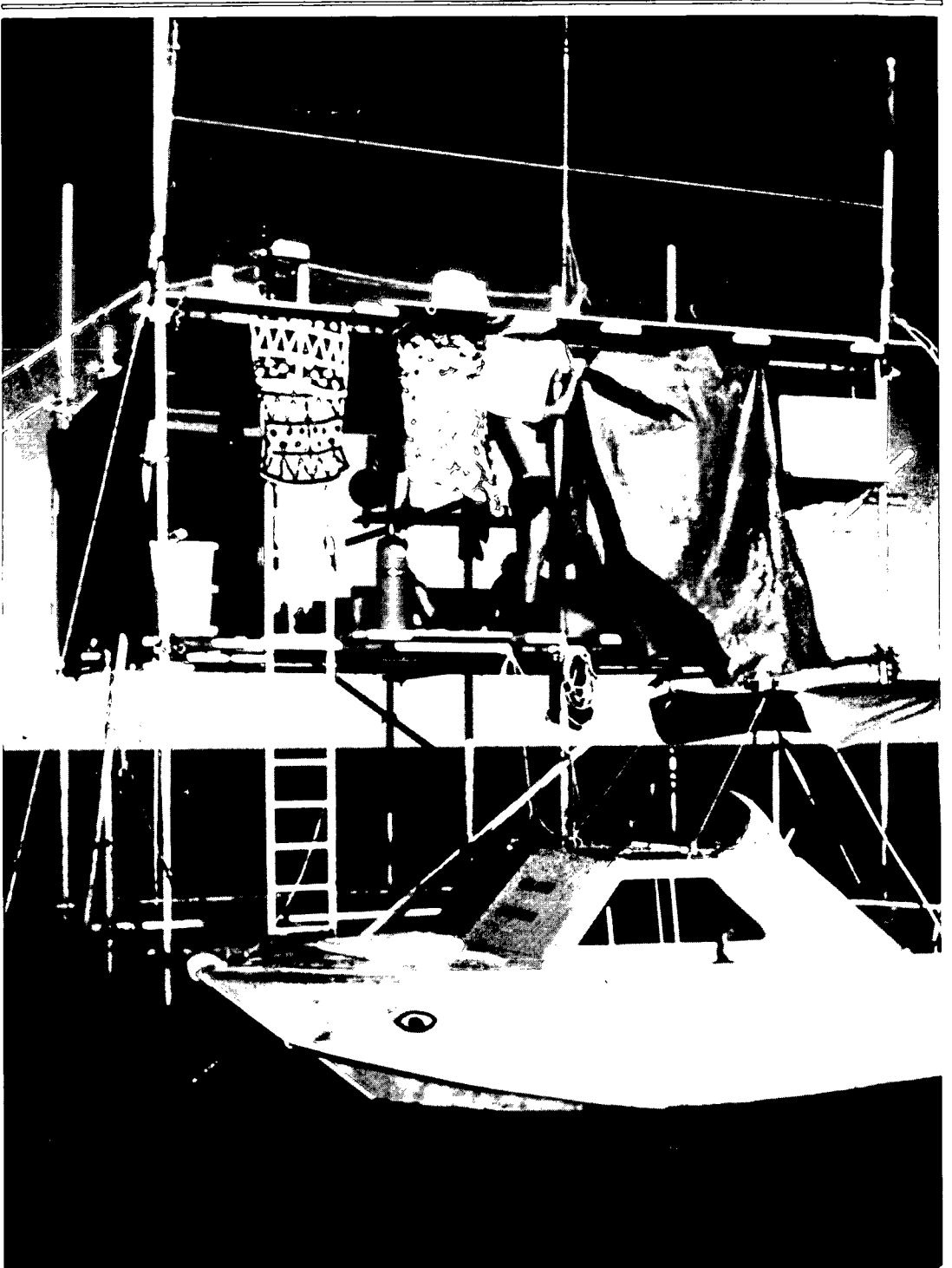
Part 3 is concerned with the implementation of four case studies, the second one to be undertaken in the Capricornia Section of the Great Barrier Reef Marine Park in November 1982. The case study involves identifying information sources, explicit and implicit terms of reference and analysing real terms of reference with the 'ideal' terms of reference. Events which affected the development of the terms of reference will be documented and the differences between the real and 'ideal' terms of reference assessed. Finally a set of guidelines will be designed for the development of terms of reference for initiating information acquisition projects.

STATUS

The field work has been completed.

A chronicle of the events leading to the Capricornia Zoning Plan has been prepared.

LOCALITY: Capricornia Section



ENVIRONMENTAL DESIGN

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Engineering Properties of Coral Reefs

PERIOD: May 1979 - Feb 1980
ORGANIZATION: James Cook University,
Department of Civil and Systems Engineering

PROJECT LEADER: Dr H. Bock

PROJECT OFFICER: Mr R. Kenchington
SUPERVISOR: Mr R. Kenchington
FINANCIAL SUPPORT: GBRMPA - \$2,600

OBJECTIVES

To increase knowledge of the near-surface geotechnical properties of coral reefs, down to a depth of about 25m. To increase knowledge on the principal distribution of the dominant geotechnical units (coral limestone, sand and cavities) over the area of an individual reef.

IMPLICATIONS/MANAGEMENT NEEDS

The project will provide valuable information for the development of a code of practice for the design of structures for erection on coral reefs. In the past, problems have been encountered when founding man-made structures such as lighthouses or research platforms on coral reefs.

METHODOLOGY

Three techniques were applied: diamond drilling, dynamic penetration and seismic refraction.

Keeper Reef (approx. 60km north-east of Townsville) was systematically investigated along a section running from the outer reef into the lagoon.

STATUS

The project has been completed.

It was found that dynamic penetration is the best method of exploring the near-surface structure of coral reefs in detail.

With respect to the second objective, it was found that there are characteristic changes in the near-surface reef structure in both horizontal and vertical directions.

Papers on the research have been published:

Bock, H. and Brown, E.T. 1980. Foundation properties of coral reefs - site investigation techniques and preliminary results. Proceedings International Conference on Structural Foundations on Rock, Sydney 7-9 May, 1980. Vol.1, pp.43-52, Rotterdam (Balkema).

Bock, H. 1981. Founding structures on coral reefs. Proceedings Environmental Engineering Conference, Townsville, pp.51-56, Barton A.C.T. (Institute of Engineers, Australia).

LOCALITY: Keeper Reef (80km north-east of Townsville).

Review of Construction and Design Principles for Man-made Structures on Coral Reefs**PERIOD:** 1979**ORGANIZATION:** James Cook University, Engineering Department**PROJECT LEADER:** Mr G. Bulgarelli**PROJECT OFFICER:** Dr W. Craik**SUPERVISOR:** Dr H. Bock**FINANCIAL SUPPORT:** GBRMPA Augmentative Research Grant - \$437**OBJECTIVES**

To present the state of the art concerning the construction of man-made structures on coral reefs and particularly the Great Barrier Reef.

IMPLICATIONS/MANAGEMENT NEEDS

This study is designed to provide important background information for the development of a code of practice for the design of structures for erection on coral reefs.

METHODOLOGY

A review of the literature on the subject was made. The information was updated by contacting relevant Government Institutions.

STATUS

The project has been completed.

When planning a major engineering structure a thorough site investigation is probably the single most important step. Of the different site investigation techniques applicable for coral reefs, penetrometer tests seem to be best.

Piles are the most suitable foundation for a structure on a coral reef. Prestressed concrete piles have application for large structures. The high cost involved in construction on a coral reef can lead to great flexibility in the foundation design. (The increased cost of driving piles deeper, for example, is negligible). Ideally, the engineer should be on site when the piles are driven so he can determine if any variations in design are necessary.

Full advantage should be taken of prefabricated sections to keep actual on-site construction to a minimum. Corrosion resistant materials should be used wherever possible.

GREAT BARRIER REEF DATA BASES

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Great Barrier Reef Bibliographic Data Base: System Specification

PERIOD: March 1981 - Feb 1982

ORGANIZATION: James Cook University, Library

PROJECT LEADER: Ms H. Penridge

CONSULTATION & LIAISON: GBRMPA
CSIRONET, AUSINET and users

PROJECT OFFICER: Ms J. Dartnall

SUPERVISOR: JCU Librarian

FINANCIAL SUPPORT: GBRMPA - \$26,000

OBJECTIVES

To specify a system for a Great Barrier Reef bibliographic data base in machine-readable form within a standard data base management system. To predict costs of establishment and maintenance of data base. To construct a test data base.

IMPLICATIONS/MANAGEMENT NEEDS

The system is required for the production and updating of bibliographies required: (i) to meet the Authority's statutory reporting obligations; (ii) to service requests for information by officers of the Authority and of Queensland instrumentalities involved in park management and interpretation; (iii) to meet requests for information about the Great Barrier Reef from the public at large; and (iv) to service the needs of the world research community with regard to the Great Barrier Reef, its ecosystems and its usage.

METHODOLOGY

Existing database systems were examined and compared. On the basis of this, specifications were developed.

STATUS

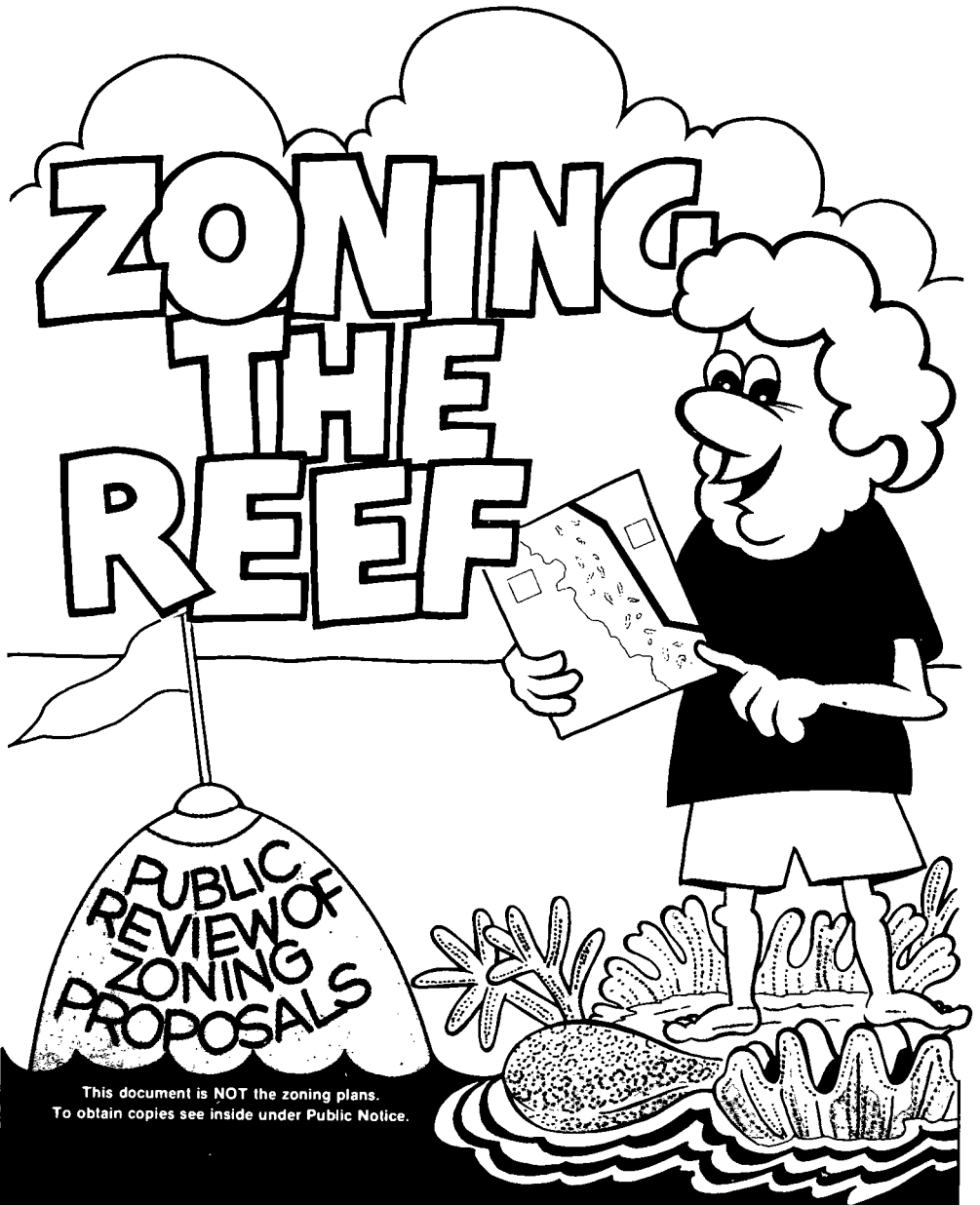
The project has been completed.

The proposal to establish a bibliographic database of Great Barrier Reef materials is discussed, and specifications proposed.

A sample database has been created and further developments are in progress.

James Cook University of North Queensland, Library. 1982. Great Barrier Reef Bibliographic Database. Report to the Great Barrier Reef Marine Park Authority.

ZONING THE REEF



This document is NOT the zoning plans.
To obtain copies see inside under Public Notice.



GREAT BARRIER REEF MARINE PARK AUTHORITY

MECHANICS OF INFORMATION TRANSFER

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Bibliography of the Great Barrier Reef Province

PERIOD: March 1977 - Sept 1977
ORGANIZATION: University of Sydney,
Department of Geology and Geophysics

PROJECT LEADER: Dr E. Frankel

SUPERVISOR: Dr D. McMichael
FINANCIAL SUPPORT: GBRMPA - \$9,000

OBJECTIVES

To compile for publication as complete a bibliography of the Great Barrier Reef Province as possible. The bibliography is to be indexed and cross-referenced and to include as many subjects and categories as is practicable.

IMPLICATIONS/MANAGEMENT NEEDS

This project will collect the widely scattered literature on the Great Barrier Reef Province into a single, reasonably accessible listing.

METHODOLOGY

A considerable amount of information had been previously collected and the immediate concern was to peruse and expand those topics in which that listing was lacking. These were principally the more popular fields (articles such as those published in "Skin Diver Magazine" for example), tourist information and literature sources, government reports and information, and the film index.

STATUS

The bibliography has been published:

Frankel, E. 1978. *Bibliography of the Great Barrier Reef Province*. 204pp.
Australian Government Publishing Service, Canberra.

Public Participation Methods and Program**PERIOD:** July 1977 - Nov 1977**ORGANIZATION:** MSJ Keys Young Planners Pty. Ltd.**PROJECT OFFICER:** Ms A. Wallace**SUPERVISOR:** Mr R. Williams**FINANCIAL SUPPORT:** GBRMPA - \$10,000**OBJECTIVES**

To undertake a study of the nature of and processes for public participation which would be appropriate for consideration by the Authority, drawing on other studies and recent experience in Australia (Stage 1).
To prepare a range of options for a co-ordinated participation program applicable to the development of zoning and management plans for the Capricorn/Bunker area (Stage 2).

IMPLICATIONS/MANAGEMENT NEEDS

The Authority feels that public participation procedures would educate and inform people about the comprehensive nature of the marine park concept and, by enabling them to understand how they can interact with the Authority, encourage their participation during several phases of the planning process.

METHODOLOGY

Steps involved in pursuing the first stage of the project were: (i) a briefing to, amongst other things, establish specific objectives and evaluation criteria and familiarize the consultant with relevant background details; and (ii) a review of participation techniques.

The work program for the second stage involved: (i) an inventory of the major resources for information gathering and distribution; (ii) identification of target groups; (iii) monitoring of current participation activities; (iv) designing a range of options for a co-ordinated participation program.

STATUS

The project has been completed.

A range of techniques that can be used in a public participation program are discussed. These are generally ordered in relation to the primary function which they serve, this being one of the following:

- (i) gathering of factual data and assessment of perceptions
- (ii) dissemination of information
- (iii) interaction with the community and evaluation of attitudes.

Included is a description of the techniques, a discussion of their appropriate uses, an assessment of their advantages and disadvantages, and the nature and levels of skills required to carry them out, as well as some indication of the likely cost.

MSJ Keys Young Planners Pty Ltd. 1977. Public Participation Program. Report to the Great Barrier Reef Marine Park Authority.

LOCALITY: Capricornia Section

Management Information Systems — Computer Needs**PERIOD:** March 1978 - April 1978**ORGANIZATION:** James Cook University, Computer Centre**PROJECT LEADER:** Mr D. Abel**CONSULTATION AND LIAISON:** CSIRO Division of Computing Research
Department of Administrative Services
Queensland Government Computer Centre
Australian Institute of Marine Science
James Cook University Library**PROJECT OFFICER:** Mr R. Kenchington**SUPERVISOR:** Mr R. Williams**FINANCIAL SUPPORT:** GBRMPA - \$1,500**OBJECTIVES**

To evaluate the needs of the Authority for computer services, information network facilities, and the options available for meeting those needs.

IMPLICATIONS/MANAGEMENT NEEDS

The Authority has substantial management information needs which are essential to the fulfilment of its functions. These needs include collection, storage, retrieval and processing of information.

METHODOLOGY

In the course of the investigation to determine the Authority's information processing requirements and to recommend options, the consultant conferred with staff of GBRMPA, computing staff of relevant Australian and Queensland government departments, organizations such as CSIRO and AIMS, JCU library, and private computer firms and consultants.

STATUS

The project has been completed.

This report includes the following:

- (1) Identification of present and future areas of management information needed by the Authority.
- (2) Identification of sources of information outside the Authority which should be integrated with the Authority's information.
- (3) Examination of methods of information collection, processing, storage and retrieval relevant to the Authority's information needs.
- (4) Identification of the options available for meeting those information needs, including the use of computer-based systems.
- (5) Recommendation of options open to the Authority including the identification of relative advantages, costs and staff requirements of the various options; each option to include estimates of time for implementation.

James Cook University of North Queensland, Computer Centre. 1978. Evaluation of information needs and computer services for the Great Barrier Reef Marine Park Authority. Report to the Great Barrier Reef Marine Park Authority.

Evaluation of Library Requirements for the Great Barrier Reef Marine Park Authority**PERIOD:** 1978**ORGANIZATION:** James Cook University, Library**PROJECT OFFICER:** Ms J. Carter**SUPERVISOR:** Mr R. Williams**FINANCIAL SUPPORT:** GBRMPA - \$1,500**OBJECTIVES**

To evaluate the library requirements of the Authority and how these requirements may be met.

IMPLICATIONS/MANAGEMENT NEEDS

This project is essential to the establishment of a library for GBRMPA.

METHODOLOGY

The study involved the collection of information on the subject nature and type of library holdings available in Townsville and on the services which other libraries in Townsville would be able to provide on a fee for service basis or for no charge to the Authority.

Information available and collected was analysed to provide guidelines and cost estimates where relevant on: (i) the subject nature and type of holdings to be purchased by the Authority; (ii) the acquisition, cataloguing and loans procedures to be used by the Authority; (iii) the financial administration of the library; (iv) the housing of the collection; (v) the hardware equipment necessary to house the collection and facilitate library operations in general; and (vi) the staffing requirement.

STATUS

The project has been completed.

James Cook University of North Queensland, Library. 1978. Evaluation of library requirements for the Great Barrier Reef Marine Park Authority. Report to the Great Barrier Reef Marine Park Authority.

Australian Marine Research in Progress**PERIOD:** Dec 1981 - Sept 1982**ORGANIZATION:** Victorian Institute of Marine Sciences**PROJECT LEADER:** Mr J. Thompson**CONSULTATION & LIAISON:** CSIRO, Central Information and Library Editorial Service
Department of Science & Technology (DOST)
Ms H. Penridge, JCU**PROJECT OFFICER:** Dr A. Gilmour**SUPERVISOR:** Dr A. Gilmour**FINANCIAL SUPPORT:** GBRMPA - \$4,000; AMSTAC-FAP - \$8,100**OBJECTIVES**

To develop a system for the computer based storage and retrieval of information on marine research projects in Australia (Australian Marine Research in Progress). To produce a first hard copy run of AMRIP.

IMPLICATIONS/MANAGEMENT NEEDS

This project is designed to produce a current summary of on-going research in the Great Barrier Reef Region (and elsewhere), which is readily accessible and readily updated.

METHODOLOGY

Nationally distributed questionnaires on Research in Progress were used in the following steps in the development of the first run of AMRIP: (i) editing and classification; (ii) data entry; (iii) drafting indexes and output format; (iv) software modifications/development; (v) printing of 1000 copies.

STATUS

The first hard copy of AMRIP has been published.

Great Barrier Reef Marine Park Authority, Victorian Institute of Marine Sciences, Department of Science and Technology, 1982 *Australian Marine Research in Progress*. 532pp.

PERIOD: May 1982 - Dec 1982

ORGANIZATION: CSIRO, Division of Computing Research
GBRMPA

PROJECT LEADER: Dr D. Abel

SUPERVISOR: Dr A. Gilmour

FINANCIAL SUPPORT: GBRMPA -\$6,000

OBJECTIVES

To produce an on-line, interactive bulletin of research-related information. This is a pilot study.

IMPLICATIONS/MANAGEMENT NEEDS

This project should eventually result in a readily accessible up-to-date source of information being available on all research activities relating to the Great Barrier Reef Region and other areas of Australia.

METHODOLOGY

The development of specifications for the bulletin was undertaken and software to produce the bulletin is being prepared. Potential users are being surveyed to evaluate potential use before implementation.

STATUS

Computing has begun and will be completed when certain CSIRONET software becomes available.

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