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**A Dugong Research Strategy for the
Great Barrier Reef World Heritage Area
and Hervey Bay**

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On 17 May 1999 the Great Barrier Reef Ministerial Council, comprising the Commonwealth and Queensland Ministers for the Environment and for Tourism, accepted this Research Strategy as a guide for setting priorities, allocating funds and assessing performance of dugong recovery and conservation actions in the Great Barrier Reef and Hervey Bay–Great Sandy regions.

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EXECUTIVE SUMMARY

A coordinated research strategy was developed in response to a request from a task force set up to implement decisions of the Great Barrier Reef Ministerial Council in relation to the conservation of dugongs in the Great Barrier Reef Region from Cooktown south.

The aim of this strategy is to advise research providers and managers of the priorities for information that will assist in the recovery and maintenance of dugong populations in the Great Barrier Reef World Heritage Area and Hervey Bay regions. It was developed through an extensive consultation process involving research providers, management agencies, potential funding agencies and representatives of key stakeholder groups including commercial fishers, indigenous groups and conservation groups. This strategy includes a prioritised list of research projects divided into four categories according to areas of management need. These categories and the research projects deemed most urgent are:

1. *Maintaining or enhancing dugong numbers*
 - a. Long-term trends in dugong numbers
 - b. Productivity of seagrass habitats
 - c. Protocol for use of indigenous knowledge to complement scientific knowledge
 - d. Improving the estimates of absolute abundance of dugongs
 - e. Research for effective management of seagrass resources
 - f. Causes of dugong mortality in carcass strandings
2. *Minimise impacts of management decisions on affected groups*
 - a. Development of alternative fishing methods to mesh netting
 - b. Local information and socio-economic impacts of Dugong Protection Areas (DPAs) on commercial fishers
3. *Development of cooperative management arrangements*
 - a. Needs/constraints for developing indigenous management plans for dugongs
 - b. Cooperative management of dugongs with indigenous groups
4. *Enhancing the effectiveness of dugong protection measures*
 - a. Seasonal changes in dugong distribution
 - b. Acoustic characteristics of underwater explosions in Shoalwater Bay
 - c. Response of dugongs to underwater explosions
 - d. Effect of changes in net fishery operations on dugong recovery
 - e. Monitoring compliance and vessel use in the Hinchinbrook DPA

In conjunction with developing a list of priority research projects, a list of performance criteria was developed to assess the effectiveness of DPAs. These criteria involve both short-term (5 years) and long-term (> 5 years) measures of DPA success. Research projects are referenced to performance criteria and vice versa.

PREAMBLE

The development of the program for the conservation of dugongs between Cooktown and Hervey Bay took place between 1997 and 1998. During this time the Great Barrier Reef Ministerial Council, made up of Commonwealth and Queensland Government Ministers, sought information on habitat loss, appropriate management-related research into seagrass habitat issues, and advice on specific actions that may be taken to halt the decline in dugongs in these regions. At the 24th Ministerial Council meeting on 14 August 1997, the Council established a taskforce of Commonwealth and Queensland officials to oversee the implementation of the Council's decisions. The taskforce directed agencies to report on:

1. proposals for (a) monitoring trends in dugong populations and habitat and (b) performance standards and priority data needs; and
2. mechanisms to improve the coordination of relevant research with and between organisations.

At subsequent meetings the taskforce undertook to consider the prioritised list of research and monitoring projects needed for presentation to the next Ministerial Council meeting.

This research strategy was developed to address the directive of the taskforce. It was developed through a consultative process involving management agencies, research providers, groups affected by management decisions, and conservation groups.

The overarching goal of this research strategy is to advise research providers and managers of the priorities for information that will assist in the recovery and maintenance of dugong populations in the Great Barrier Reef World Heritage Area and Hervey Bay regions.

In developing a graded list of potential research projects, it is acknowledged that not all projects will be equally relevant to the Great Barrier Reef Marine Park Authority. The research priorities presented in this document reflect the wide range of priorities among managers, researchers and stakeholders with interests in dugongs. The intent of this document is to make it as relevant as possible to a range of management and funding agencies with interests in dugong conservation. This was done by dividing projects into categories or 'Topics', then assigning broad priorities within each 'Topic'. It was felt that by doing so the research priority list would retain flexibility for agencies wishing to fund projects of particular interest to them. In some circumstances, some independence from the Great Barrier Reef Marine Park Authority may be desirable and funding agencies such as the Cooperative Research Centre for Ecologically Sustainable Development of the Great Barrier Reef (CRC Reef Research Centre) may be better placed to undertake and/or coordinate research projects with some sensitivity.

Although this research strategy sets the basic framework and core areas for research in the next 3–5 years, this strategy is best considered as a 'living document'. New or altered research ideas and opportunities may develop as a result of both the dynamic nature of research itself as well as the social and political environment in which dugongs are managed.

The expected uses of this document are: (a) researchers wishing to develop relevant project proposals for funding and (b) management/funding agencies who need to be aware of major research priorities relevant to the conservation of dugongs in eastern Australia.

INTRODUCTION

The Great Barrier Reef World Heritage Area contains an estimated 15% of Australia's known populations of dugongs (*Dugong dugon*). Although the dugong is listed on the IUCN Red List as 'Vulnerable to Extinction', the status of its populations around the Australian coast appears to vary from relatively secure to under threat of disappearing from some regions. The first data indicating a significant decrease in dugong population numbers in the Great Barrier Reef World Heritage Area was in 1992. Dedicated aerial surveys of dugong populations showed that dugong numbers south of Cooktown in 1992 were less than half of those recorded in 1986–87. A follow-up survey in 1994 confirmed this trend, suggesting that the decline was real and not a result of temporary movement of dugongs out of the Great Barrier Reef World Heritage Area. North of Cooktown however, populations remained stable over three separate surveys in 1985, 1990 and 1995.

Sources of pressure on dugong populations are thought to come from habitat degradation and loss, mesh-nets, shark nets set for bather protection, hunting, boat strikes and defence activities.

Concern over the decline in dugong numbers south of Cooktown has led to a voluntary moratorium on hunting of dugongs by a number of traditional owners and other Aboriginal and Torres Strait Islander groups south of Cooktown. Shark nets, which have killed at least 486 dugongs in this region between 1960 and 1996, have also been reduced in number, being replaced by baited hooks in most locations. At the time of writing, shark nets are deployed at eleven locations in the Great Barrier Reef World Heritage Area (near Cairns, Townsville and Mackay).

The most recent management action to protect dugongs from further decline has been the introduction of Dugong Protection Areas (DPAs). In total 16 DPAs were declared in January 1998 (figure 1). The DPAs include seven 'Zone A' areas where most forms of mesh netting are not be permitted and nine 'Zone B' areas where specialised netting practices can continue with modification.

Selection of the DPAs and the determination of their boundaries were on the basis of advice from the Scientific Working Group: an advisory group to the Great Barrier Reef Ministerial Council. The criteria used by the Scientific Working Group to determine these boundaries included the following.

1. Dugong abundance — an area was considered suitable as a DPA if it correlated positively with present high dugong abundance.
2. Seagrass status — the suitability of lower density dugong areas was elevated if it contained seagrass species known to be favoured by dugongs (especially *Halophila* and *Halodule*).
3. Size of DPA — the area of DPAs were intended to include most, if not all, of a typical home range as identified in dugong tracking studies at that time.
4. Spacing or regional issues — DPAs were to be spaced so that they could facilitate gene flow, recolonisation of depleted areas and access to remote food sources in the event of local fluctuations.

In providing its recommendations, the Scientific Working Group noted the difficulty it faced in formulating its advice due to the paucity of relevant scientific information. This research strategy arose from the need to: (a) ensure that future management decisions can be made on the basis of better scientific information, (b) assess the effectiveness of the DPAs and dugong management in general, and (c) assist the dugong in its recovery.

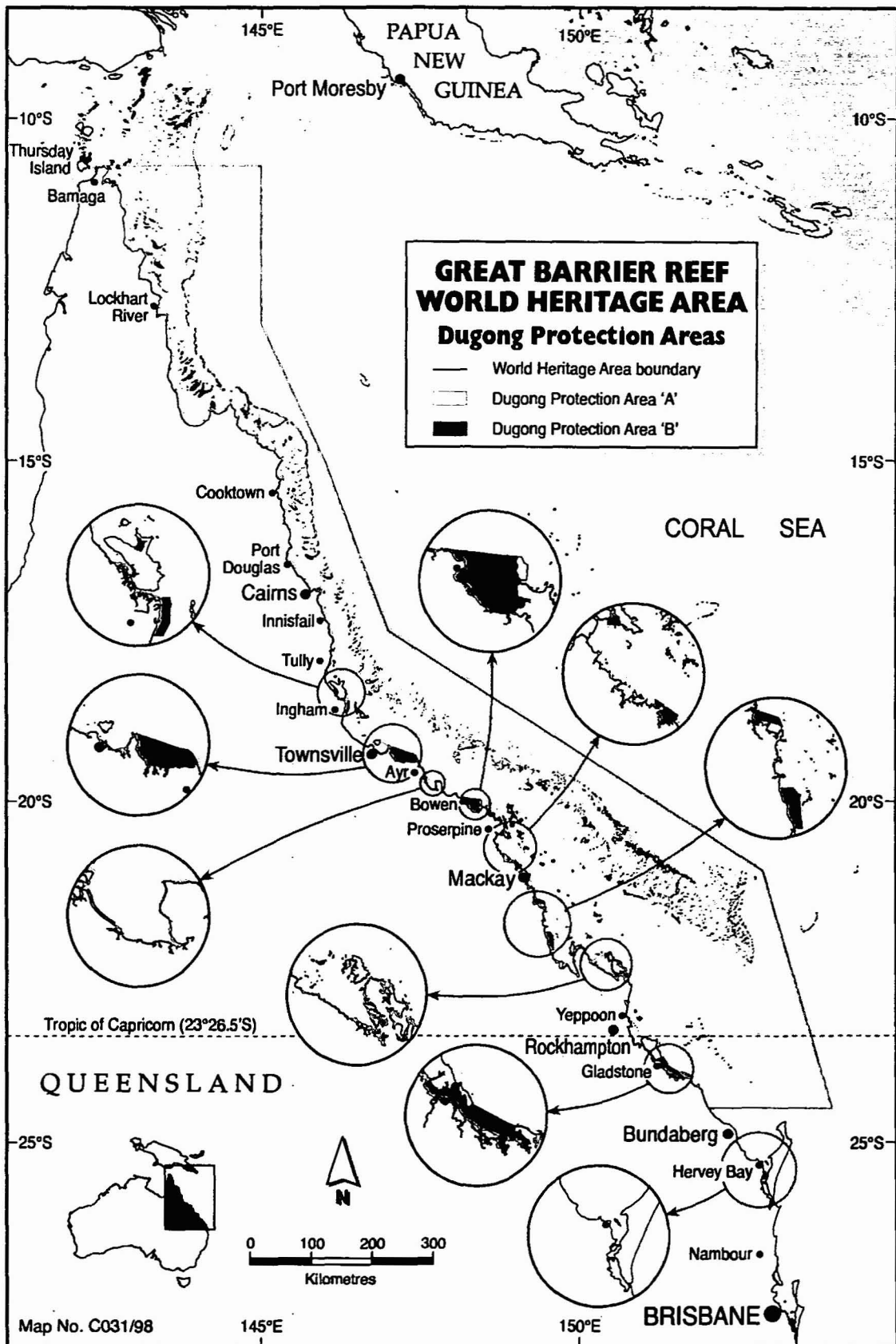


Figure 1. Dugong Protection Areas in the Great Barrier Reef World Heritage Area

RESEARCH STRATEGY DEVELOPMENT PROCESS

The process used in developing this dugong research strategy was firstly to host a one-day workshop of key stakeholders and interest groups. The aim of the workshop was to obtain broad input on the most urgent research needs for the conservation of dugongs and to develop a process by which research needs could be scoped into achievable and cost-effective research projects and then objectively prioritised.

The workshop was held on 30 October 1997 and involved researchers from James Cook University, Queensland Departments of Primary Industries and Environment and Heritage; representatives from potential funding agencies, including the Great Barrier Reef Marine Park Authority, CRC Reef Research Centre, Department of Defence and Queensland Department Of Primary Industries; reef managers from the Great Barrier Reef Marine Park Authority, the (then) Queensland Departments of Environment and Heritage and Primary Industries; and representatives of key stakeholder agencies, including the Queensland Commercial Fishermen's Organisation, Cape York Land Council, Aboriginal and Torres Strait Islander Commission, Central Queensland Land Council, Friends of Hinchinbrook and the North Queensland Conservation Council.

Delegates at the workshop were invited to develop scoping papers which would provide an overview of how research needs could be synthesised into research projects. The purpose of the scoping papers was to detail the objectives of the proposed project, its relevance to dugong conservation, an outline of methodologies which could be employed, the feasibility of the project, an approximate budget and time required to carry out the project.

Forty areas of research need were identified in the workshop and individuals with interests in these areas were invited to submit scoping papers. A total of 25 scoping papers were received. The total amount of funds needed to undertake the nominated projects amounted to \$4.4m. These scoping papers were circulated to all workshop delegates and other interested parties. They were asked to comment on the proposed projects and score them along draft criteria formulated in the workshop (appendix 1).

In March 1998, the Great Barrier Reef Marine Park Authority formed a smaller Dugong Research Focus Group to review the comments of the workshop participants and interested parties, refine proposed projects, scope new projects if required, review the prioritisation criteria and develop an overall research strategy. The Dugong Research Focus Group consisted of: Dr J Oliver (Great Barrier Reef Marine Park Authority and Chair), Mr T Stokes (Great Barrier Reef Marine Park Authority), Professor H Marsh (James Cook University), Dr R Coles (Department of Primary Industries), Mr D McPhee (Queensland Commercial Fishermen's Organisation), Professor C Crossland (CRC Reef Research Centre), Ms G Duell (Aboriginal and Torres Strait Islander Commission) and Mr J Tager (North Queensland Conservation Council).

Through several iterations, a number of projects were re-scoped and added. A total of 22 projects were finally assessed (appendix 2). The Dugong Research Focus Group conceded that there were a number of important dugong management measures for which the Group could not come up with a feasible project. For example, the Group found it difficult to scope a project to measure the effectiveness of changed attendance rules for set mesh nets, mesh sizes and net types which were introduced to reduce accidental drowning of dugongs in mesh nets in DPA Zone B areas.

When it came to reviewing project priorities, the Group noted the difficulty in applying the rigidly structured criteria developed as part of the workshop (appendix 1). In particular, they found it difficult to prioritise objectively between projects in different research areas (e.g. dugong habitat projects vs socio-economic projects). In addition, it was felt that the criteria relating to funding and timing would artificially bias the strategy towards quick, cheap projects

which were not necessarily the most important ones to carry out. Consequently, the Group adopted a process whereby research projects were categorised only within each research area; no prioritisation between research areas was attempted. The Group also agreed that project priorities should be assigned in broad terms only. It was felt that this approach would allow some flexibility to be retained by funding agencies in choosing projects to fund.

The following topics or categories of research were identified and each project was assigned to a category.

1. Projects designed to assess the effectiveness of current dugong protection measures
2. Projects likely to result in information which will directly assist in maintaining or enhancing dugong numbers
3. Projects that will assist with the development and implementation of cooperative management arrangements
4. Projects designed to minimise the impacts of management decisions on industry and other affected groups

Projects were ranked into High, Medium, and Low priorities within each research topic (refer to 'Dugong Research Priorities', page 10). These priorities are intended to assist government bodies and other funding agencies in selecting a subset of projects for funding.

PERFORMANCE INDICATORS FOR DUGONG PROTECTION MEASURES

In conjunction with developing a list of priority research projects, the Dugong Research Focus Group developed the following list of performance indicators for DPAs. The research projects scoped as part of this strategy are also designed to address the need for deciding the success of DPAs, as determined by the performance indicators below. Research projects that specifically address these performance indicators are noted in brackets after each performance indicator.

Short-term

1. Decline in the number of dugong carcasses reported (given constant or increased monitoring and public awareness) (Projects 6, 14, 18, 19, 20).
2. Reduction in illegal net fishing and hunting especially in DPAs and adjacent areas (Projects 13, 15, 16)*.
3. No increase in set and drift netting effort in DPAs and adjacent areas (Project 12).
4. All set and drift net fishermen to have completed an endangered species awareness course*.
5. An increase in awareness of, and compliance with, boating restrictions and code of practice in Hinchinbrook DPA (Projects 5, 21)*.

Long-term

6. Dugong numbers in the southern Great Barrier Reef and Hervey Bay do not decline below 1994 levels and continue to increase in the long-term to above 1986–87 levels (Projects 1, 3, 4, 9, 11, 12, 15, 16, 22).
7. Distribution patterns in the southern Great Barrier Reef and Hervey Bay are at least maintained at 1986–87 patterns and the proportion of dugongs in DPAs is maintained or increased (Projects 1, 3, 4, 7, 9, 10, 13, 15, 16, 17, 22).
8. Maintenance of community composition, productivity and distribution of seagrass beds, particularly in DPAs (Projects 2, 5).

* Note: The incidence of illegal hunting and net fishing will be addressed through a surveillance and enforcement program being developed elsewhere. Also, the endangered species awareness course and boating restrictions in the Hinchinbrook DPA will be addressed elsewhere through an education and extension program.

A list of research proposals scoped as part of this strategy and the performance indicators they address is outlined in the next section of this report. At the time of writing, some of these projects had commenced. These are noted in the 'Comments' section adjacent to the project titles.

DUGONG RESEARCH PRIORITIES — PROPOSED PROJECTS

Project No.	Project Title	Funding needed	Performance indicator	Comments
Topic 1: Maintaining or enhancing dugong numbers				
Priority: 1 — High				
1	Long-term trends in dugong numbers — Great Barrier Reef-wide	\$160 000 over 2 years, or \$224 000 over 2 years	6, 7	Undertaken routinely every 5 years between Cape York and Hervey Bay, funded by Great Barrier Reef Marine Park Authority.
2	Productivity of key seagrass species of importance to dugongs, at selected locations within the Great Barrier Reef	\$690 300 over 4 years	8	
3	Negotiated protocol for the use of Aboriginal and Torres Strait Islander knowledge to complement scientific knowledge on the distribution, abundance, movement, ecology and management practices of dugongs in the Great Barrier Reef	\$295 000 over 1 year	6, 7	Project should be Great Barrier Reef-wide. Partially addressed in Hopevale area through ARC SPIRT/PEW Fellowship project commenced in 1999. Part of Sea Forum Regional Agreement process.
4	Improving estimates of absolute abundance of dugongs	\$160 000 over 2–3 years	6, 7	Commenced as a component of ACR SPIRT/PEW Fellowship project in 1999.
5	Research for the management of seagrass resources in the Dugong Protection Areas of the Great Barrier Reef region	\$1.4 million over 4 years	8	Amalgamation of four projects originally proposed. Baseline surveys of seagrass beds in Mackay area DPAs to commence in 1999.
Priority: 1.5 — High (after revision)				
6	Dugong strandings: causes of mortality	\$22 000 per year	1	Project should be re-written. Project must be done in association with population biologist or not at all.
Priority: 2 — Medium				
7	Using microsatellite markers to study dugong phylogeography	\$85 000 over 3 years, or \$120 000 over 2 years	7	Subject of ARC SPIRT application for funding for commencement in 2000.

Project No.	Project Title	Funding needed	Performance indicator	Comments
Priority: 3 — Low				
8	Effect of boat traffic on dugongs (in conjunction with satellite project)	\$5000 over 1 year	5	Issue is very important but this project unlikely to provide useful results as scoped. A better project needs to be developed to address this topic.
9	Variation in dugong fecundity	\$5000 over 6 months	6, 7	Potentially important study but not high relevance as presently written. Needs to be scoped to incorporate the distribution and resource use by calves.
10	Improving the knowledge of dugong distribution in the Great Barrier Reef World Heritage Area through analysis of historic catch and effort information	\$20 000 over 1 year	7	Good project, but not directly relevant to management.
11	Organochlorine and heavy metal pollutant concentrations in dugongs and the implications for species management	in-house	6	ARC SPIRT project. Useful with respect to water quality issues and baseline setting. However, pollutant burdens are hard to interpret in a management sense as levels dangerous to dugong health are unknown.

Topic 2: Minimising the impacts of management decisions on industry and other affected groups

Priority: 1 — High

12	Enhancement of dugong recovery through the development of alternative methods to gill netting for harvesting inshore fin fish	\$150 000 over 3 years with FRDC grant	3, 6	Need to liaise with fishers, QCFO, QDPI and QFMA. Project needs to be species specific.
13	Local information from commercial fishers and the socio-economic impacts of the implementation of DPAs on the commercial fishing industry.	\$30 000	2, 7	Amalgamation of two projects originally proposed. Proposed for funding in 1999–00. Note: Linked to CRC Task 2.1.17 examining the socio-economic impact of representative areas on commercial fishing communities. Budget may be underestimated.

Project No.	Project Title	Funding needed	Performance indicator	Comments
Priority: 3 — Low				
14	Factors influencing the mortality of dugongs in shark nets	\$5000 over 6 months	1	Project commenced in 1999.

Topic 3: Development and implementation of cooperative management arrangements

Priority: 1 — High				
15	Investigate and implement models and mechanisms for cooperative planning of resource management between state agencies and Traditional Owners	\$474 350 over 3 years	2, 6, 7	Addressed as part of ongoing extension program in GBRMPA, assisted in Hopevale area by ARC SPIRT/Pew Fellowship project commenced in 1999.
16	Developing sustainable community-based management for dugongs and green turtles in the northern Great Barrier Reef, Australia	\$300 000 over 3 years	2, 6, 7	Revision of project previously proposed.

Topic 4: Assessing the effectiveness of current dugong protection measures

Priority: 1 — High				
17	Are there seasonal changes in dugong distribution in the southern Great Barrier Reef?	\$160 000 over 2 years, or \$5000 as a desktop	7	Low priority as full project, but high priority as a desktop study.
18	The spatial extent and intensity of the acoustic impact of underwater explosions in Shoalwater Bay	Unknown — 1 year	1	High priority for one DPA (Shoalwater). Also relevant to turtle conservation in this area. Being funded by the Department of Defence.
19	Response of dugongs to underwater explosions	\$40 000 over 1 or 2 years	1	High priority for one DPA (Shoalwater). Also relevant to turtle conservation in this area. Being funded by the Department of Defence.
20	Impact of changes in net fishery operations on dugong recovery	\$110 000 over 2 years	1	Important project, but will take several years to build a partnership with commercial fishers to provide necessary information.

Project No.	Project Title	Funding needed	Performance indicator	Comments
21	Monitoring compliance and vessel use in the Hinchinbrook Dugong Protection Area	\$7000 + \$3000/yr ongoing	5	Project to commence in 1999-00, funded by GBRMPA.

Priority: 1.5 — High (subject to justification)

22	Fidelity of dugongs to DPAs and their fine scale movements within them	\$90 000/yr for 2 years	6, 7	Note existing similar research at Shoalwater Bay and Hinchinbrook. High priority subject to justification after analysis of existing data.
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Topic 5: Not directly relevant to any topic

Priority: 3 — Low

23	Historical exploitation	\$5-10 000 over 6 months	nil	Historical information of general interest, but of little use in contemporary management of dugongs.
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APPENDIX 1: PROPOSED CRITERIA FOR ASSESSING SCOPING DOCUMENTS

Objective

To maintain and enhance dugong numbers, distribution and area of occupancy throughout the Great Barrier Reef World Heritage Area.

Proposed Procedure for Prioritising Research & Monitoring Projects

It is proposed that all potential research projects be prioritised according to their relevance to management, feasibility and affordability. A brief outline of a possible scoring method is set out below. Projects that score 'No' for any feasibility category should possibly not be considered further.

Feasibility

Can it be done?

Are appropriate methods developed and tested?	Yes/No
Are appropriately skilled people and equipment available?	Yes/No
Is there sufficient time to produce useful results?	Yes/No

Relevance

How useful is it to management of dugongs?

Relevance	Score
Likely to enable management action which will enhance success of Dugong Protection Areas (DPAs)	5
Likely to result in information which will directly assist in maintaining or enhancing dugong numbers outside the DPAs	4
Will provide feedback on dugong status over whole WHA	3
Likely to provide relevant information, but may not be immediately useful to management of dugongs	2
Will provide basic information on biology and ecology of dugongs which could enhance long-term management of dugongs	2

Affordability

How much will it cost?

Cost	Score
<\$5000	5
\$5000 – \$20 000	4
\$20 000 – \$50 000	3
\$50 000 – \$100 000	2
>\$100 000	1

Duration

How long before there are results which can be used for management?

1 year to complete, results available immediately	3
2 years to complete, useful results in progress reports	3
2 years to complete, results at end of project	2
3 years or more, useful results in progress reports	2
3 years or more, results at end of project	1

APPENDIX 2

PROJECT SCOPING PAPERS

Project No. 1

Title

Long-term trends in dugong numbers — Great Barrier Reef-wide

Objective

To monitor temporal changes in the distribution and relative abundance of dugongs (and sea turtles and dolphins) in the Great Barrier Reef region at a regional scale, by continuing the aerial survey program initiated in the mid 1980s and with the aim of surveying each region at five-year intervals.

Relevance

A time series of standardised dugong population estimates is required to determine regional scale trends in distribution and abundance, the status of populations and whether or not management is working.

Feasibility

Methods to estimate the distribution and abundance of dugongs at regional scales using aerial survey have been developed by researchers at James Cook University and extensively applied in the Great Barrier Reef, other parts of the dugong's range in Australia, and overseas.

Methodology

Aerial surveys are the only technique available to obtain quantitative information on dugong population size. Correction factors have been developed to standardise for availability bias (dugongs that are not available due to water turbidity) and correct for perception bias (dugongs that are visible but missed by observers). Trend analysis indicates that the optimum time between regional surveys is five years. The value of aerial surveys will increase as the time series gets longer.

Previous surveys of the Great Barrier Reef region have been conducted in two series: (a) Cape Bedford to Cape York (next survey scheduled for 2000), and (b) Hervey Bay to Cape Bedford (next survey scheduled for 1999). In future, it would be advantageous to use two aerial survey crews in two aircraft simultaneously for each survey to maximise the likelihood of completing the survey in excellent weather conditions. There would also be some merit in overlapping the survey areas to provide information on the likelihood of mass movement of dugongs between the survey regions. (Genetic information suggests that such mass movement is unlikely). The suggested new regions are: (a) Bowen to Cape York; (b) Hervey Bay to Cape Bedford. This would mean that the Bowen–Cape Bedford region was surveyed in successive years.

Approximate cost

\$80 000 per survey assuming survey regions are: (a) Cape Bedford to Cape York, and (b) Hervey Bay to Cape Bedford. If the survey regions are altered as suggested above the cost of each survey would increase by an estimated 40%.

Time required

Ongoing. Additional information every five years within six months of survey.

Project No. 2

Title

Productivity of key seagrass species of importance to dugongs, at selected locations within the Great Barrier Reef

Objectives

1. To determine the productivity of seagrass species of importance to dugongs, at specific locations (coastal and deepwater).
2. To monitor seagrass productivity between seasons and years.

Relevance

Seagrasses are essential food for the dugong and there is relatively little information on the health and distribution of seagrasses within the Great Barrier Reef Marine Park and World Heritage Area. There is no information on productivity for most seagrass species, areas and habitat types. This is a major gap in the knowledge base required for effective management. Dugongs and those fish, turtles and prawns dependent on seagrasses for food rely on both available area of seagrass and the productivity (plant growth rate) as these determine the total available food and nutrient source. Changing conditions such as poorer light penetration could reduce seagrass productivity (leaf and root production and/or nutritional value) and increase the area of seagrass required to support a dugong. Seagrass area may not be affected by some downstream effects but productivity could be. Area alone is not necessarily the best measure of the ability of an area to support the food requirement of dugong and fish/ prawn/ turtle populations.

Feasibility

The methodologies for measuring productivity of near-shore tropical bladed seagrass species are well established and have been successfully conducted at several locations (Green Island, Cairns Harbour, Low Isles). Methodologies for measuring the productivity of deep-water plants are similar to shallow/near-shore plants, however they are currently being modified so as not to compromise safe diving practices.

Approximate cost

	1998–1999	1999–2000	2000–2001	beyond 2001
Salaries and wages (incl. oncosts)	\$113 400.00	\$119 000.00	\$125 000.00	\$131 200.00
Travelling	\$15 400.00	\$15 400.00	\$15 400.00	\$15 400.00
Operating	\$25 500.00	\$25 500.00	\$25 500.00	\$25 500.00
Administration services	\$8 400.00	\$8 400.00	\$8 400.00	\$8 400.00
Capital	\$4 500.00			
TOTAL	\$167 200.00	\$168 300.00	\$174 300.00	\$180 500.00

Salaries of temporary biologists and technicians estimated at \$113 400 per year in 1998–99 (increasing at 5% annually). Operating costs include vessel charter, travelling expenses, data analysis and preparation. Capital costs cover a standard computer workstation.

Time required

This project is to monitor seagrass productivity of key species, in selected areas of the Great Barrier Reef Marine Park, three to four times a year over a period of two to three years.

The project would be initiated in Summer 1998. A summary of results will be available each year in the form of interim reports, so that any finding of importance to management can be identified and appropriate management strategies implemented. The project will conclude late 2001, after which a major report will be produced summarising results of the study and recommendations for further research and management.

Project No. 3

Title

Negotiated protocol for the use of Aboriginal and Torres Strait Islander knowledge to complement scientific knowledge on the distribution, abundance, movement, ecology and management practices of dugongs in the Great Barrier Reef

Objective

To gather, adapt and/or directly apply Aboriginal and Torres Strait Islander knowledge into dugong management through a negotiated protocol.

Relevance

There are two major sources of dugong management information: one is mainstream science and the other, traditional knowledge. Traditional knowledge has not been adequately accounted for in the management process. This knowledge may be of much broader management value in relation to social behaviour of dugongs, fine scale movements, sexing in the water etc.

Feasibility

The project is highly feasible. Traditional Owner groups are currently negotiating protocols and management principles for various land tenures (e.g. protected areas). Groups are continually increasing their capacity for data collection, data management (e.g. Geographic Information Systems) and information exchange. Some large region forums are already operating (e.g. Sea Forum with participants from all Traditional Owner groups in the South Great Barrier Reef).

Methodology

The project should be facilitated through the Queensland Indigenous Working Group which includes the Representative Bodies of Queensland, the ATSIC Regional Council Chairpersons and a Commissioner. Project components include desktop study and a number of workshops at local, regional and state level with capacity building part of the workshop framework

Through desktop analysis, two to three best practice process model options would be worked up, narrowed to one to two through a small sample workshop and finalised through a series of local, regional and state workshops.

Cost

Facilitator's salary	\$30 000
Assistant	\$15 000
Workshops: (Local, Regional, State)	\$250 000
	<hr/>
	\$295 000

Time Required

Six months

Project No. 4

Title

Improving estimates of absolute abundance of dugongs

Objective

To obtain estimates of the absolute abundance of dugongs for use in harvesting models to estimate sustainable mortality levels.

Relevance

The existing aerial survey technique provides standardised indices of abundance only. Changes in population size can be detected using such indices, as it is not necessary to know exactly how many animals are present as long as the size of the population is measured in a standardised way. We know that the present estimates are underestimates but due to the unknown reliability of comparing surfacing behaviour as seen from land or a boat with that observed from an aircraft, we do not know by how much. Reliable estimates of absolute abundance are required to estimate sustainable levels of mortality using established harvesting models.

Feasibility

The methodology outlined below was discussed at a workshop on dugong aerial survey techniques held at James Cook University in November 1997 and attended by statisticians with relevant expertise, including Dr Ann Cowling (DMR CSIRO) and Professor Ken Pollock (University of North Carolina).

Video

In preliminary research funded by Seaworld, a helicopter was used to obtain aerial video footage of dugongs in clear water in Moreton Bay to improve methods to obtain accurate estimates of dugong abundance. The video footage was used to study the surface and diving behaviour of individual dugongs as seen from an aircraft. Analysis of the video footage shows that this method can be used to document the amount of time dugongs spend on the surface of the sea in clear water. The disadvantage of this method is that the presence of the helicopter may induce dugongs to behave abnormally.

Time depth recorders

Dugong diving and surfacing behaviour can also be documented using time depth recorders (TDRs) on dugongs fitted with satellite transmitters, using established methodology. The temporal and depth resolution of the resultant data may be insufficient to estimate the amount of time dugongs spend on the surface. However, they should aid in the interpretation of the video footage.

Methodology

Video

Focal dugongs (cows with attendant calves, calves, unaccompanied adults) will be videoed from helicopters in clear water at a range of depths, e.g. 0–5 m, 5–10 m, >10 m to estimate the probability of dugongs in various age/sex classes being sighted at the surface when all dugongs are potentially visible for various depth strata.

Time depth recorders

TDRs and satellite transmitters will be fitted to dugongs in various age/sex classes in an area where dugongs feed at a range of depths, such as Hervey Bay, to study the diving and surfacing behaviour at a range of depths.

Statistical models

The resultant data will be analysed in collaboration with Dr Ken Pollock, a statistician at the University of North Carolina to develop the statistical methodology required to generate

corrections for availability bias for the various depth/turbidity strata encountered during a survey.

Approximate cost

- | | |
|---|----------|
| 1. Obtaining and analysing video footage | \$60 000 |
| 2. Obtaining and analysing time-depth profiles using TDRs | \$80 000 |
| 3. Developing statistical models | \$20 000 |

Total	\$160 000
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Time required

2–3 years

Project No. 5

Title

Research for the management of seagrass resources in the Dugong Protection Areas of the Great Barrier Reef region

Objectives

1. To conduct one summer and one winter baseline survey of each DPA (where a baseline does not already exist).
2. To re-survey the seagrass resources (inshore and deep-water) on a fine-scale each summer within each of the Dugong Protection Areas of the Great Barrier Reef (Oct–Nov 98, Oct–Nov 99, Oct–Nov 2000, Oct–Nov 2001).
3. To produce each year a detailed (fine-scale) Geographic Information System on seagrass habitats within each of the DPAs.
4. To monitor long term trends in seagrass parameters (abundance, productivity, species composition, etc.) at two localities (possibly Mission Bay – Cairns and Missionary/ Shepherd Bays – Hinchinbrook) by sampling every two months for three to four years to identify changes and potential impacts which may cause loss of seagrass habitats and consequently dugong populations.
5. To broad-scale map non-DPA coastal areas of seagrass that are potential food for dugongs and to confirm estimated areas of seagrass species used by dugongs identified in 1980–1987 surveys (Cooktown – Cardwell, Bowling Green Bay – Rockhampton, Rockhampton – Bundaberg).
6. To identify areas of seagrass with a distribution and species composition ideal for dugong feeding areas and to estimate long-term trends.
7. To provide information needed to further improve understanding of the relationship between dugong feeding behaviour and the location and species characteristics of seagrasses.
8. Complete a cartographic model which identifies seagrass habitats using a set of replicable physical, environmental and resource use parameters, to assist in regional scale assessment of seagrass and dugong distributions.
9. To provide a strategic plan for seagrass management in the southern Great Barrier Reef.

Relevance

Seagrasses are essential food for dugongs and there is relatively little information on the health and distribution of seagrasses within the Great Barrier Reef Marine Park and World Heritage Area. Information that is available is broad-scale and over 10 years old.

Dugong populations in the Great Barrier Reef Marine Park south of Cooktown have declined dramatically since 1987. In November 1996, at a meeting of the Great Barrier Reef Ministerial Council, it was agreed that emergency action was required to save dugongs in the Great Barrier Reef World Heritage Area. The Ministerial Council acknowledged that one of the reasons for the decline in dugong numbers may be habitat loss.

Broad-scale surveys by the Queensland Department of Primary Industries (QDPI) of separate regions from 1984 to 1989 indicated where seagrasses occurred in estuaries, shallow coastal bays and inlets, on some fringing reefs, barrier reef platforms and limited sites in deep water. Coastal waters were broadly mapped for all of Queensland, but surveys of deeper water (>15 m), inter-reef, inshore-reef and barrier-reef platform areas have only recently begun. Seagrasses have been found to depths of 58 metres in the Cairns and Far Northern Sections.

Despite being 10 years old these maps are being used to support a case for excluding some types of activities, particularly net fishing, from areas where seagrasses were found. Research at Shoalwater Bay and the CRC-funded deep water surveys together with work on dugongs suggest the relationship between dugong feeding behaviour and their seagrass food is complex.

The species of seagrass, its location and the tidal range of the area, the depth of the seagrass and the seasonality of the seagrass growth rate are all important factors. For example, a seagrass bed at 10 metres may be a food source for an adult dugong but not suitable for a neonatal calf. A relatively small but suitable area of seasonal *Halophila* may be far more important in the dugong life cycle than anticipated by aerial surveys of animal distribution. While the establishment of Dugong Protected Areas is an important step it is also important to continue research on the dugong's food source. It is appropriate to have an up-to-date picture of the seagrass resource on which to base management decisions and it is important to have some knowledge of the options available to dugongs in the event of major changes in seagrass distribution or loss.

Natural cyclone and flood events in some locations have caused loss of seagrasses. Agricultural land-use practices may exacerbate the effects of these natural events or reduce the resilience and recovery of seagrasses from natural impacts. The most immediate threats from urban and agricultural run-off, or coastal and Barrier Reef development appear in southern, populated regions. Localities which have shelter and water conditions ideal for productive seagrass habitat are often sites for port development, and/or are at the downstream end of heavily disturbed catchments.

There is no information on productivity for most seagrass species, areas and habitat types. This is a major gap in the knowledge base required for effective management. Dugongs and those fish, turtles and prawns dependent on seagrasses for food rely on both available area of seagrass and the productivity (plant growth rate) as these determine the total available food and nutrient source. Changing conditions such as poorer light penetration could reduce seagrass productivity (leaf and root production and/or nutritional value) and increase the area of seagrass required to support a dugong. Seagrass area may not be effected by some downstream effects but productivity may be. Area alone is not necessarily the best measure of the ability of an area to support the food requirement of dugongs and fish/prawn populations.

Natural seasonal variation in biomass has been documented and more recent detailed surveys have indicated some large long-term changes in seagrass areas at regional scales, although natural year-to-year change in Queensland seagrasses remains little studied and the causes, scale and ecological consequences of long-term changes are poorly understood. Seagrass monitoring programs need long-term support. Large seasonal variations make it hard to detect loss over a short period of time. Trend analysis over several years will provide an early warning of potential problems.

Feasibility and other closely related projects

Detailed (fine-scale) surveys have been successfully conducted by the Seagrass Ecology Group from the Northern Fisheries Centre (QDPI) at several localities. Methodologies are established and have been reviewed by both the scientific and resource management communities.

- The objective to monitoring long term trends in seagrass parameters (abundance, productivity, species composition, etc.) overlaps with CRC Reef Research Task 1.4.2, and vessel charter and equipment costs are predominantly covered by current funding from CRC Reef Research Centre and have been taken into account in this proposal.
- CRC Reef Research Task 1.4.6 currently provides part funding for a Research Scientist and Biologist to obtain a detailed baseline measure of coastal, deepwater and reef platform seagrass resources in the Great Barrier Reef province. These staff could assist with the supervision and field work for some sections of the current proposal and this has been taken into account in the budget.
- Seagrass surveys of deep-water (>15 m) resources are currently conducted under CRC Reef Research Task 1.4.6. This current proposal and CRC Task 1.4.6 compliment each other in providing a complete coverage of the southern Great Barrier Reef regions (Cooktown – Capricorn Bunker Group).

Methodology

1. The sampling design for the baseline and monitoring surveys of the DPAs will be similar to the fine-scale surveys conducted recently by QDPI in localities such as Shoalwater Bay and Dunk Island – Cape Cleveland. Sampling intensity will be at a level adequate for mapping boundaries of seagrass communities.
2. The sampling design for the broad-scale surveys of seagrass resources between Cooktown and Hervey Bay (excluding DPAs) would be similar to previous surveys conducted by QDPI. Sampling intensity would be set at a level adequate for identifying the boundaries of seagrass communities. A combination of dive sampling and video camera techniques would be used.
3. Methodologies for measuring the productivity of deep-water plants are similar to shallow/near-shore plants, however they are currently being modified so as not to compromise safe diving practices.
4. All data would be entered on a Geographic Information System (GIS) as a tool to overlay dugong distribution and movement. The maps of habitat types will provide a tool for interpretation and assessment of possible impacts.

Cost

Item	1998–1999	1999–2000	2000–2001	2001–2002
Salaries (<i>including oncosts</i> 0.7)	\$212 035.00	\$201 636.75	\$211 718.59	\$222 304.52
Travelling	\$9 979.02	\$9 512.27	\$9 400.25	\$8 821.48
Operating	\$146 400.00	\$95 600.00	\$97 100.00	\$66 100.00
Administration services	\$15 000.00	\$15 000.00	\$15 000.00	\$15 000.00
Capital	\$27 500.00			
TOTAL	\$410 914.02	\$321 749.02	\$333 218.84	\$312 226.00

Salaries of temporary biologists and technicians are estimated at \$212 000 per year in 1998–99, increasing at 5% annually. Each survey requires a minimum of five to six persons (suitably experienced and qualified occupational divers) to conduct fieldwork. Operating costs include vessel charter, travelling expenses, data analysis and preparation. Each survey requires one support vessel and two small survey vessels. Capital costs include the purchase of two differential Global Positioning System rovers (\$20 000) and a GIS work station (\$7500) in 1998–99.

Time required

This project is to conduct winter and summer baseline surveys of seagrass distribution and abundance within the nine proposed Dugong Protection Areas of the Great Barrier Reef Marine Park, and re-map seagrass meadows in each DPA for three years to assess any changes or impacts which may effect dugong populations. The project would be initiated in Summer 1998. Interim reports and GIS maps will be available approximately four months after each baseline or monitoring survey, so that any changes or major losses can be identified and appropriate management strategies implemented. The project will conclude in Winter 2002, and a major report will be produced summarising results of the monitoring program and recommendations for continued monitoring and management.

Seagrass productivity of key species will be monitored in selected areas (possibly Mission Bay – Cairns and Missionary/Shepherd Bays – Hinchinbrook), six times a year over a period of two to three years. The project would be initiated in Summer 1998. A summary of results will be available each year in the form of interim reports, so that any finding of importance to management can be identified and appropriate management strategies implemented. The project will conclude late 2001, after which a major report will be produced summarising results of the study and recommendations for further research and management.

The broad-scale mapping of seagrass resources between Cooktown and Bundaberg (excl. DPAs) could commence in October 1998 and be completed in 2000. The three sections would be Cooktown to Cardwell in 1998; Bowling Green Bay to Rockhampton in 1999 and Rockhampton to Bundaberg in 2000. Information would be available in GIS form early in the year following each survey.

Project No. 6

Title

Dugong strandings: causes of mortality

Objectives

1. To maintain a database for dugong strandings in Queensland that integrates the records from all regions and agencies.
2. To conduct a pathological investigation of suitable dugong carcasses to determine causes of death.

Relevance

A knowledge of the distribution (geographic and temporal), frequency and sources of dugong mortality is necessary for guiding effective and timely management responses.

Identification of the cause of death is not always obvious to the non specialist. Pathological examination of suitable carcasses by a veterinary specialist is necessary to provide knowledge on the range of health issues impacting our dugongs as well as to provide clear evidence of mortality from anthropogenic sources.

Feasibility

This project is achievable. A preliminary state-wide database already exists and receives records from a wide variety of sources. Preliminary investigation of dugong pathology has been in progress since 1997 as a collaborative project between Queensland Parks and Wildlife Service (QPWS) and the Department of Primary Industries (DPI) staff in Rockhampton.

The first findings from the pathology research have been published (Hill, B.D., Fraser, I.R. and Prior, H.C. 1997, *Cryptosporidium* infection in the dugong (*Dugong dugong*), *Australian Veterinary Journal*, 75(9)). A second manuscript is in advanced preparation: Hill, B.D., Byron, G.T. and Cook, D. (in prep). Severe tracheitis and broncho-pneumonia in a juvenile dugong caused by infection of *Cochleotrema indicum*.

Methodology

Database

Regional reports on stranded dugongs will be validated and collated into a state-wide relational database. Currently the database is maintained by the Environmental Protection Agency, Brisbane (fax: 07 3227 6386) and is compatible for analysis with standard GIS software. It integrates information recorded on site at stranding locations with results from clinical and pathological studies. The database will be made available to regional offices and other users via the Departmental computing services.

Pathology

A training module will be developed for relevant personnel in post mortem examination of dugongs, specimen collection and storage and transport for pathological investigations.

Training will be undertaken with QPWS and Great Barrier Reef Marine Park Authority staff in regional locations and autopsy kits and protocols will be provided to ensure optimum pathological specimens.

Post mortems will be conducted on freshly dead and moribund dugongs along the coastline from Cairns to the Gold Coast with particular emphasis on:

- gross and histopathological examination of a standard range of organ tissue specimens, including the brain; and
- haematological and biochemical examination of blood and fresh tissue specimens.

Parasitological and protozoological examination of faecal specimens will be undertaken where warranted.

Results of autopsies will be immediately available including feedback to agencies and staff involved. Summary reports will be prepared annually. Significant scientific results will be submitted for publication within peer reviewed journals.

Approximate cost

Database development and maintenance	\$ 5 000
Pathology	\$17 000
Total	\$22 000 p.a.

Time required

Two years

Project to be reviewed with a view to long-term continuance at the end of the second year.

Project No. 7

Title

Using microsatellite markers to study dugong phylogeography

Objective

To investigate the intraspecific genetic structure of dugongs along the coast of Queensland using microsatellite markers.

Relevance

Information on the genetic structure of dugong populations provides insights into the appropriate spatial scale for management. The significance of the decline in dugong numbers along the urban coast of the Great Barrier Reef depends on the time scale for recolonisation from adjacent regions. The present information on the genetic structure of dugongs based on mitochondrial DNA marker, suggests a low level of female mediated gene flow between neighbouring populations and indicates that successful recolonisation of a depleted area may be extremely slow. The precise number and boundaries of genetic units along the Australian coast were not well defined by the mitochondrial marker.

Feasibility

Preliminary work by Dr Dani Tikel provides a substantial foundation for the development of microsatellite markers. Parallel work on microsatellite markers for the West Indian manatee (University of Florida) is yielding promising results which should have application to dugongs. When suitable microsatellite markers are developed, they are expected to have two advantages over the mitochondrial markers used to date.

- They may provide finer spatial resolution of the genetic structure of dugongs and insights into their social organisation.
- They will provide information on both male and female mediated gene flow (mitochondrial DNA provides information on females only).

Methodology

Already established is an extensive dugong tissue bank held at James Cook University, as well as a dugong genomic library. Ideally, at least 20 informative loci are required. About 30 clones from the library have screened positive for dinucleotide microsatellites. Six of these microsatellites have been sequenced. This project would involve characterisation of the existing microsatellites to examine if they would be informative for an intraspecific level study of the dugong, and the expansion of the existing genomic library in order to identify additional microsatellite loci. In addition, microsatellite markers developed for West Indian manatees in Florida will be trialed to determine their suitability for dugongs.

Cost

\$ 85 000 if done as a PhD project.

\$120 000 if done as a post-doctoral project.

Time

Three years if done as a PhD project, two years if done as a post-doctoral project.

Project No. 8

Title

Effect of boat traffic on dugongs

Objective

To determine experimentally whether changes in boat traffic can influence short-term habitat use by dugongs.

Relevance

Anecdotal evidence suggests that dugongs can be displaced from an area by boat traffic. This is likely to be a serious impact in urban areas, and to reduce the effectiveness of Dugong Protection Areas.

Feasibility

It is possible to design experiments to study the dugong's short-term response to simulated boat traffic activity. However, only a small sample of such activities will be able to be simulated and over relatively short periods. It will not be possible to control the very large number of variables involved in complex natural systems. However, the simulations will provide insights into the short-term response of dugongs to boat traffic, provided the necessary ethics approvals can be obtained.

Methodology

This research will need to be carried out in an area where enough baseline information exists to allow firm conclusions to be drawn about the distribution and movements of dugongs. The short-term response of individual dugongs and dugong groups will be documented under a limited range of boat traffic regimes. The dugong's responses to such manipulations will be monitored from aircraft and by monitoring the movements of individuals tagged with satellite transmitters whose movement patterns are known. The experiments will be controlled by using undisturbed groups and/or by monitoring before, during and after experiments as appropriate. Parameters of boat traffic that will be examined include intensity, proximity, duration and frequency of disturbance.

Approximate cost

Assuming that this data were collected in association with an existing project (e.g. satellite tracking) then the cost would be approximately \$5000 (\$3000 aircraft charter, \$2000 boat charter). A stand-alone project would also involve personnel costs in the order of \$15 000).

Time required

Six months time to collect data, two months for analyses and write up.

Project No. 9

Title

Variation in dugong fecundity

Objectives

1. To document spatial and temporal variation in dugong calving rates in an attempt to generate hypotheses to explain the patterns observed.
2. To determine whether the proportion of calves observed on aerial surveys is consistent with current understanding of dugong population dynamics.

Relevance

Calving rates are a measure of fecundity, one of the major parameters used in population models to determine sustainable harvest rates. Data from carcass studies indicate that there is considerable variation in dugong fecundity but the reasons for this are poorly understood.

Feasibility

Data on dugongs are available from two sources at James Cook University:

1. Carcass studies based in Townsville, Torres Strait and Numbulwar (Northern Territory)
2. Calf counts on aerial surveys

Methodology

This would be a desktop study to study the data listed above:

1. To document spatial and temporal variation in dugongs calving rates to generate hypotheses to explain the patterns observed and to document the impact of the fluctuations in fecundity on population change using established population models, and
2. To determine whether the proportion of calves observed on aerial surveys is consistent with current understanding of dugong population dynamics given the data on the relative amounts of time spent at the surface by cows with calves and unaccompanied adults obtained for the project entitled 'Improving estimates of absolute abundance of dugongs'.

Approximate cost

\$5000

Time required

Two months

Project No. 10

Title

Improving the knowledge of dugong distribution in the Great Barrier Reef World Heritage Area through analysis of historic catch and effort information

Objectives

1. To assess the availability and quality of catch information for dugongs in Queensland waters.
2. To evaluate the use of such catch information for broad-scale monitoring of dugong distribution.
3. To collate the available historic catch and effort information for dugongs to identify trends in distribution.

Relevance

The project is likely to result in information which will directly assist in maintaining or enhancing dugong numbers outside the DPAs. Involvement of the fishing and indigenous communities in the assessment of the status of dugongs, using their own catch data, will give ownership of such assessments and a greater degree of cooperation with future management policies. Furthermore, incorporating diverse sources of information gathered over a wide geographic range will provide feedback on dugong status over the whole World Heritage Area. Assessments drawn from this information can be validated against fishery independent aerial surveys that have been carried out or are planned in future projects.

Feasibility

The key to this project is access to catch and effort data for dugong bycatch. Over thirty years a level of trust has been built up between commercial fishers and staff of the Northern Fisheries Centre (NFC) hence there is a good chance to obtain the cooperation required, particularly if the fishers are directly involved in the project. Similarly NFC, in conjunction with Balkanu Aboriginal Development Corporation and the Queensland Parks and Wildlife Service, have developed a culturally appropriate fisheries survey for Indigenous communities. NFC staff are also currently involved with Balkanu and James Cook University, Tropical Environmental Studies and Geography (TESAG), in a proposed fisheries resource study of the black jew fish at Injinoo. Again, the personal contacts and trust built up with Indigenous community representatives should ensure cooperation with the collection of dugong catch data. The final source of bycatch data is the Queensland Shark Control Program (QSCP) which has already been made available to NFC Stock Assessment and Modelling staff.

The proposal is a complement to two current FRDC funded research projects involving NFC staff: the **Tropical Resource Assessment Program**, which is developing stock assessment and population dynamics models for the inshore set net fisheries, and **The effects of net fishing on coastal biodiversity and bycatch**, which is assessing the effects of mesh nets on inshore biodiversity.

Methodology

To collate catch and effort information from:

1. Commercial fisher records (private logbooks and diaries);
2. Indigenous fisher records (oral history);
3. Shark control bycatch (QSCP records).

A meta-analysis is proposed using triangulation of sources to assign reliability to the data (Gribble and Robertson, 1998). The most reliable catch and effort data will be used to estimate biomass time-series (biomass-dynamic fisheries production models) at locations along the Queensland East Coast. More complex models are possible if 'fishery' independent biological parameters such as population age structure and age at length (growth) are available. It is

essential that local fishing communities and Indigenous communities be involved with the assessments to facilitate the gathering of data and to ensure the widest possible community cooperation.

Reference

Gribble, N.A. and Robertson, J. 1998, Fishing effort in the Far Northern cross-shelf closure of the Great Barrier Reef Marine Park: the effectiveness of area closures, *Journal Environmental Management*, January 1998 edition in press.

Approximate cost

\$20 000

- Salary for part-time facilitation officer
- Travel and allowances
- Computer sundries and site license contributions.
- Corporate services charge and operating expenses.

Time required

One year

Project No. 11

Title

Organochlorine and heavy metal pollutant concentrations in dugongs (*Dugong dugon*) and the implications for species management

Objectives

1. To assess pollutant concentrations in key dugong habitat along the Queensland coast.
 - a. To document concentrations of organochlorine pesticides, PCBs, dioxins, atrazine and heavy metals in key tropical Queensland coastal environments (nearshore sediments and seagrass meadows);
 - b. To correlate environmental pollutant burdens with human activity; and
 - c. To use pollutant partitioning models to investigate movement of pollutants between sediments, seagrass and biota.
2. To document pollutant concentrations in dugongs along the Queensland coast.
 - a. To document concentrations of organochlorines, PCBs, dioxins, PAHs and heavy metals in blubber and liver samples collected from stranded dugongs;
 - b. To compare body burdens of pollutants from geographically disjunct dugong populations to identify areas of contamination risk to dugongs; and
 - c. To correlate pollutant body burdens with other key dugong anatomical measurements and data.
3. To produce a risk assessment for Queensland dugong habitat.
 - a. To develop a risk assessment for dugongs from pollutants incorporating data obtained from this study and elsewhere; and
 - b. To assess health risks to Indigenous communities from consumption of contaminated dugong tissue.

Methodology

Tissue samples to be collected opportunistically from dugongs reported stranded along the marine park seaboard and elsewhere between September 1996 and July 2000. Carcass recovery will be carried out in conjunction with Queensland Parks and Wildlife Service staff. Following analysis, temporal and spatial variation in dugong pollutant body burdens will be examined and correlated with animal sex, age, condition and home range. Potential hazard to human health from tissue consumption will also be examined.

Sediment and seagrass samples were collected from 17 sites from Torres Strait to Moreton Bay between February and June 1997.

Sites selected include:

Shelburne Bay	Cleveland Bay
Lockhart River	Cape Upstart
Princess Charlotte Bay	Edgumbe Bay
Flinders Island	Newry Bay
Bathurst Bay	Shoalwater Bay
Low Isles	Hervey Bay
Cairns Harbour	Gladstone Harbour
Hinchinbrook Channel	Moreton Bay
Cape Pallarenda	

All sites selected (with the exception of Cairns) are recognised dugong habitat and are under a range of human urban and agricultural influences. Samples will be collected using clean techniques and be analysed for organochlorines, PCBs, dioxins, atrazine and heavy metals

during 1997. This data will then be combined with other information to carry out risk assessment for dugong habitat and stocks within Queensland waters. Partitioning models will be used to develop pollutant mass balances for Marine Park waters.

Time

Three years

Funding

The project was initially (1997–1998) funded through the Great Barrier Reef Marine Park Authority Water Quality Programs and is being continued through an ARC SPIRT grant.

Project No. 12

Title

Enhancement of dugong recovery through the development of alternative methods to mesh netting for harvesting inshore fin fish

Objectives

1. To develop and evaluate the use of 'dugong safe' fishing gear as a possible replacement for mesh nets in the commercial inshore fishery.
2. To investigate methods of maintaining fishers' economic viability while reducing or eliminating adverse impacts of mesh nets on marine megafauna.

Relevance

Netting has been nominated as a key threatening process for dugongs, leading to the current strategy of removing commercial mesh nets from areas of high dugong significance. This has caused dislocation, market loss and social disruption to local fishing communities. There is an urgent need to develop methods for harvesting valuable commercial species that satisfy the goals of dugong protection, that are ecologically and environmentally acceptable, and that ensure continuity to local fishing communities. Providing viable alternatives to mesh netting will enhance the success of Dugong Protection Areas (DPAs) and, if widely adopted, will directly assist dugong recovery outside the DPAs. This proposal responds to issues raised at the Dugong Research Strategy Workshop, 30 October 1997, and subsequent discussions with the Queensland Commercial Fishing Organisation.

Feasibility

Alternative techniques to mesh netting for fish species with similar life histories to those in Queensland are used in inshore fisheries overseas (e.g. South Africa, United States of America). The need for evaluation of the potential for such alternatives in the Queensland inshore net fishery is:

- Industry driven, to maintain local and national markets;
- Local fishing community driven, to maintain local economies and life style; and
- Wider community driven, to see more environmentally acceptable harvest techniques used in the fishing industry.

The Queensland Department of Primary Industries Northern Fisheries Centre has a long research history in the biology and harvest of target species in the inshore fisheries, and has built-up excellent links with the commercial fishing industry. It is essential that the fishing community be involved with the proposed gear assessments to facilitate the transfer of technology and to ensure the widest possible adoption by the industry.

Methodology

The following methods for fish harvest are to be field-tested and evaluated.

1. Replacing mesh nets with hook and line, both long line (multi hook) and single hook gear;
2. Attracting fish to specific locations with artificial fish aggregating devices (FADs), improved baits, chemical attractants, or drives; then use lift, ring or haul nets to harvest (i.e. active netting not unattended mesh-nets);
3. Using fish traps to target fish aggregations and migration pathways (using small mesh or solid bar trap walls). Possible use of bubble curtains or sound barriers on the outer walls of the trap;
4. 'Sea ranching' cage culture for holdover of legal size fish at times of high abundance but low market prices, to ensure maximum economic return from fewer fish.

Performance criteria to be used in the evaluations will include catch of target species, catch per unit of fishing effort, cost per unit of fishing unit, and fishing gear selectivity with identification

and quantification of bycatch. Commercial fishing operators will be involved in the development and evaluation program to promote industry cooperation and acceptance.

Cost

\$50 000 per year (to be supplemented by a FRDC grant proposal).

1 full-time staff member to be appointed plus on-costs.

Fishing gear, boat time, and operating costs.

Time required

Three year program, with annual milestone reports providing useable results from the first year.

Project No. 13

Title

Local information from commercial fishers and the socio-economic impacts of the implementation of Dugong Protection Areas on the commercial fishing industry

Objectives

1. To collect fine-scale information from commercial fishers regarding historical and present distribution and abundance of dugongs.
2. To determine the social and economic impacts of the implementation of Dugong Protection Areas on commercial fishing families, seafood processors and processing businesses, seafood marketers and marketing businesses.
3. To determine whether netting regulations in Zone 'B' DPAs represent workable regulations from the aspect of viability of commercial operators.
4. To identify any potential changes to netting regulations which will increase the viability of commercial operators in Zone 'A' and 'B' DPAs while further decreasing the threat to dugongs from mesh netting.
5. To determine if translocation of netting effort has occurred or will occur due to the establishment of DPAs.

Relevance

If this project were to proceed it would provide information which will establish the social and economic impacts of the establishment of DPAs on the commercial fishing sector and build on existing dugong anecdotal information bases. It would also give commercial fishers a greater sense of 'involvement' in ongoing monitoring of dugong populations. All objectives would potentially enhance the management of dugongs inside both Zone 'A' and 'B' DPAs and outside DPAs.

Feasibility

Simple interview techniques and an appropriate questionnaire can be easily designed and employed. There are appropriately skilled people both in the Queensland Department of Primary Industries, James Cook University and the University of Queensland to design and conduct the project. This project will need to be linked with CRC Reef Research Centre Task 2.1.17 examining the socioeconomic impact of Representative Areas on commercial fishing communities.

Methodology

A questionnaire together with face-to-face interviews will be conducted.

Cost

An rough estimate of the cost of the project would be in the vicinity of \$30 000.

Time

The project could be finished within one year.

Project No. 14

Title

Factors influencing the mortality of dugongs in shark nets

Objective

To identify factors influencing the mortality of dugongs in shark nets.

Relevance

Carcass records suggest that the mortality of dugongs is higher in the months July through October than at other times of the year. It is not known whether this is due solely to the seasonality of fishing operations or to seasonal influences on dugong behaviour. Investigation of the temporal trends in the pattern of mortality in shark nets (which fish for 24 hours each day for most of each year) provide an opportunity to investigate this problem.

Feasibility

Excellent records are available of the capture of dugongs in the Queensland Shark Protection Program since the early 1960s including the number caught for each net location, location and length of net and date of capture.

Methodology

A desktop study of the records of the Queensland Shark Protection Program could investigate factors associated with the probability of a dugong being caught in a shark net. Potential independent variables that could be investigated include: location of net, length of time location was netted, time since last removal of net, year, month within year etc.

Approximate cost

\$5000

Time required

Two months

Project No. 15

Title

Investigate and implement models and mechanisms for cooperative planning of resource management between state agencies and Traditional Owners

Objectives

1. To negotiate a regional management agreement between Traditional Owners and key management agencies.
2. To implement cooperative planning.

Relevance

Cooperative management was agreed by the Ministerial Council as one of a number of key dugong strategies. A regional agreement sets the basis for individual estate cooperative management agreements.

Feasibility

This project is underway via the Sea Forum which includes representation of all Traditional Owner groups with marine estates between Cooktown and Fraser Island.

Methodology

A discussion paper which identifies Traditional Owner aspirations in issues of marine resource management, potential benefits of a cooperative management regime and a process for achieving a Regional Agreement will be developed.

Negotiations for a Framework Agreement between state agencies and Traditional Owners which sets out what negotiations will deal with, the processes and protocols to be used, resourcing requirements and key issues requiring resolution will be undertaken.

Regional agreement between Traditional Owners with marine estates in the SGBR and state agencies will be sought.

Cost

Approximate costs to date have included

ATSIC: Sea Forum meetings	
QFMA: Contribution towards meeting costs	\$2 000
ATSIC/CSIRO Partnership (technical support for research etc)	\$50 000
ATSIC Administrative Support (Full time Coordinator etc.)	\$35 000
CSIRO Technical Support (additional to partnership)	Not available
Gurang Land Council and other Representative Bodies	\$50 000

Costs to 2001

Balance 1998–99	\$9 650
1999–2000	\$226 600
2000–2001	\$238 100
	\$474 350

Time

Three years

Project No. 16

Title

Developing sustainable community-based management for dugongs and green turtles in the northern Great Barrier Reef, Australia

Objective

To assist the Indigenous peoples of Cape York and the Great Barrier Reef Marine Park Authority (GBRMPA) in their efforts to develop a functional framework for the sustainable community-based management of dugongs and green turtles.

A research protocol will be negotiated with the relevant community to ensure a cooperative and participatory approach to the project, recognition of Indigenous intellectual property rights and access to data. The project, which will be conducted according to the draft statement of principles regarding biophysical research into Aboriginal lands, islands and waters of Cape York Peninsula will be developed by the Cape York Land Council.

Relevance

The traditional way of life of the residents of communities such as Hopevale and Lockhart River is dependent on the continued sustainable use of dugongs and green turtles. Additional information is required as the basis of a plan for their sustainable harvest.

Feasibility

The methodology for the western science aspects of the project is largely developed at James Cook University. Support for the project from the relevant community is essential and the details will need to be negotiated with the traditional owners.

Methodology

1. The scientific basis for sustainable co-management will be improved by developing methodology to estimate the absolute abundance of dugongs for incorporation into appropriate harvesting models, by:
 - a. developing the methods to estimate the absolute abundance of dugongs (see Project 4)
 - b. estimating the absolute abundance of dugongs in the sea country of the relevant community using aerial survey methodology and incorporating this estimate into harvesting models to estimate a sustainable catch.
2. Assisting in the development of community - based management through activities including:
 - a. designing and testing methodologies to incorporate Aboriginal knowledge of dugongs and green turtles in management decisions. (Dr Andrew Smith documented relevant traditional knowledge of the Hopevale and Lockhart communities in the 1980s but additional contemporary documentation is of local knowledge is required).
 - b. developing culturally sensitive public education materials (e.g. video, interactive computer programs) which incorporate both Aboriginal and western scientific knowledge of dugongs and green turtles in association with GBRMPA
 - c. training community rangers to: (1) collect biological samples and data as part of the dugong and turtle monitoring program being developed by some communities; (2) participate in dugong aerial surveys as observers
 - d. facilitating an exchange of information between community elders and Indigenous officers of the overseas bodies practising community-based management, such as the Alaskan Eskimo Whaling Commission, with a view to their sharing information relevant to the sustainable cooperative management of marine wildlife.
 - e. facilitating workshops to: (1) explore the Native Title implications of co-management with traditional owners; (2) train community members to write proposals to gain funding for co-management activities and training

- f. developing material to educate the wider Australian community about the significance and practice of hunting of dugongs and green turtles. (Concerns of the wider community were documented by Dr Fernando Ponte, in his PhD in 1996.)

Cost

\$300 000 (\$100 000 per year for three years). Some funding is available via a Pew Fellowship to Helene Marsh, JCU; additional funding has been obtained from ARC SPIRT.

Project No. 17

Title

Are there seasonal changes in dugong distribution in the southern Great Barrier Reef?

Objective

To determine whether the Dugong Protection Areas support a significant proportion of the dugong population in the southern Great Barrier Reef at all times of the year.

Relevance

The rationale behind the Dugong Protection Areas is that they support a significant proportion of the dugongs in the southern Great Barrier Reef throughout the year. This conclusion was based on the analysis of all available distribution data by Preen and Morissette (1997). However, most of the regional scale surveys have been timed to take advantage of the calm weather after the south-east trades finish and before the wet season. The importance of the Dugong Protection Areas as year-round sanctuaries for dugongs needs to be verified.

Feasibility

Winter survey(s)

Methods to estimate the distribution and abundance of dugongs at regional scales using aerial survey have been developed by researchers at James Cook University and extensively applied in Australia and overseas. Although the methodology to do this is well established, this approach is expensive (e.g. \$80 000 for the area Hervey Bay to Cape Bedford) and it may be difficult to find the necessary weather window in winter months. However, it would probably be possible in June–July using two aircraft and two survey crews. Ideally, it should be done in the same year as the regular regional survey timed for November 1999 (i.e. either or both July 1999 and July 2000). This approach will still provide only one or two snapshots of the winter distribution of dugongs in the southern Great Barrier Reef and would need to be replicated.

Desktop study

This approach is likely to be spatially less comprehensive than the winter surveys proposed above because there are no winter regional scale surveys except some qualitative shoreline surveys conducted by Heinsohn in the 1970s. However, it is far more temporally comprehensive than one or two winter regional surveys and has the advantage of using data for a variety of sources. There are several series of local scale surveys conducted at intervals of weeks/months for the Shoalwater Bay region and the Townsville–Hinchinbrook region as well as information from satellite-tracked dugongs.

Methodology

There are two approaches to answering this question:

1. To repeat the regional scale surveys at different times of the year.
2. To conduct a desktop study of all available information on dugong distribution in the southern Great Barrier Reef (aerial survey and satellite tracking) to determine if there is any evidence for seasonal trends in distribution or movements.

Approximate cost

1. Winter surveys
 - July 1999 \$80 000
 - July 2000 \$80 000
2. Desktop study
\$5000 (could be done in conjunction with study of relationship between fine-scale habitat use and impacts).

Project No. 18

Title

The spatial extent and intensity of the acoustic impact of underwater explosions in Shoalwater Bay

Objective

To determine the spatial extent of the acoustic impact of underwater explosions conducted by the Department of Defence in Shoalwater Bay.

Relevance

Concern has been expressed at the impact of underwater explosions at Triangular Island in Shoalwater Bay on dugongs in the Shoalwater Bay Dugong Protection Area. There is no information on the spatial extent and intensity of the explosions in relation to the distribution of dugongs in the Bay.

Feasibility

The methodology to measure the spatial extent and intensity of the acoustic impact of underwater explosions is available. The work could be conducted by specialists in marine acoustics such as Dr Doug Cato of the Maritime Operations Division, Defence Science and Technology Organisation in Sydney and Rob McCaughley of Curtin University.

Methodology

An array of underwater microphones and underwater tape recorders would be used to record sound at a range of stations in Shoalwater Bay during a standard series of underwater explosions. These would subsequently be used to produce an acoustic map of the Bay during underwater explosions. This map would be compared with maps of dugong use of the Bay produced by Dr Tony Preen on the basis of aerial surveys and satellite tracking of dugongs.

Approximate cost

Unknown

Time

One year (estimated)

Project No. 19

Title

Response of dugongs to underwater explosions

Objective

To determine whether the underwater explosions conducted by the Department of Defence in Shoalwater Bay result in dugong mortality within a few days.

Relevance

Concern has been expressed at the impact of underwater explosions at Triangular Island in Shoalwater Bay on dugongs in the Shoalwater Bay Dugong Protection Area. Triangular Island is the site of the only deepwater seagrass bed in Shoalwater Bay.

Feasibility

Dugongs can be successfully observed from light aircraft and/or helicopters.

Methodology

Shoalwater Bay will be systematically searched for dugongs before and for several days after each of several series of underwater explosions conducted by the Department of Defence. If dead and/or injured animals are located, they will be necropsied by a veterinarian to determine the cause of death.

Approximate cost

\$40 000

Time required

Depends on detonation schedule of Department of Defence, estimate 10 days per series for five series.

Project No. 20

Title

Impact of changes in net fishery operations on dugong recovery

Objective

1. To evaluate the effectiveness of changed fishery practices as a tool for dugong recovery.
2. To establish what further changes may be required to eliminate adverse impacts on dugong populations.

Relevance

A plethora of measures to aid dugong recovery have been introduced by regulation and through industry codes of conduct. The effectiveness of these measures needs to be evaluated as a matter of urgency. There are concerns on the one hand that the measures are unnecessarily restrictive (commercial fishers) and on the other hand that they are not effective (conservation groups). The results of this evaluation will enable management action to be taken if necessary which will enhance the success of the dugong recovery plan.

Feasibility

Queensland Fishing & Boating Patrol (QB&FP) has special tasking responsibilities in the dugong recovery plan, including field assessment of the level of non-compliance. The Queensland Department of Primary Industries (QDPI) and the Australian Institute of Marine Science (AIMS) are currently involved in a research investigation into the effects of net fishing on coastal biodiversity and bycatch. An observer program and bycatch recording logbook program are components of this joint study. The proposed project would integrate with QB&FP and QDPI/AIMS programs, and would extend the observer program in particular, to deliver cost-effective monitoring of fisher operations in both DPAs and elsewhere. It must be emphasised that for the project to succeed the goodwill and full cooperation of commercial fishers are essential. Therefore the fishing industry must be involved at all stages and must have a real ownership of the outcomes. *(Note: This proposal has been vetted by the Queensland Commercial Fishing Organisation and has received their support).*

Methodology

1. Evaluation of effects of changes to netting practices.

Year 1

- Bycatch log issued to fishers
- Observer program for catch verification
- Enforcement monitoring to determine compliance levels
- Historical dugong catch data obtained to establish baseline prior to the introduction of DPAs.

Year 2

Interactions with netting operations can give a good indication of the effectiveness of the DPAs and gear changes required in the dugong recovery plan. This can be assessed from the logbook and observer records and validated where possible using physical counts of dugongs in selected areas where netting is carried out.

2. Identification of continuing at-risk practices.

Year 1

Incidence of dugong capture and interactions with netting operations would be identified by habitat, location and net type. Detailed case by case analysis undertaken to identify problems and possible solutions to incidental capture.

Year 2

Improved practices will be assessed and further modification recommended if required.

Cost

\$110 000

2 x Salary for fishery observers.

Travel, allowances and operating for observers.

Note: *Costs associated with QB&FP monitoring program are not included.*

Time

Two years

Project No. 21

Title

Monitoring compliance and vessel use in the Hinchinbrook Dugong Protection Area

Objectives

1. To monitor compliance of voluntary transit lanes in the Hinchinbrook Dugong Protection Area.
2. To monitor vessel traffic (type and number) in the Hinchinbrook channel.

Relevance

As per the Cardwell/Hinchinbrook Region Plan of Management, a series of voluntary vessel transit lanes and go slow areas will be introduced within the Hinchinbrook Dugong Protection Area. These measures are designed to minimise the impact on dugong and seagrass areas.

As use of the lanes will be voluntary a program is needed to monitor compliance of vessels to transit lanes in the Hinchinbrook Dugong Protection Area.

Feasibility

Since 1997 the Great Barrier Reef Marine Park Authority (GBRMPA) has trialed the use of time-lapse video equipment to estimate the type and number of boats around the Oyster Point area south of Cardwell. This video surveillance technique has proved very successful as a low cost, accurate method for quantifying and establishing patterns of vessel use in small areas. This technique is easily adapted to monitor compliance to vessel traffic lanes in the Cardwell/Hinchinbrook Region Plan of Management because one or more video cameras can be set up on navigation markers which are proposed to be installed as part of the Plan (see map, page 49).

Methodology

The video equipment has been purpose designed and built and will be used to take periodic 'snapshots' of the target area. At pre-determined or random times each day the camera will take short sequences of video. This will allow for a reasonably frequent sample of vessel movement in the area along with a sample long enough for an analyst to identify the type and size of the vessel and whether or not the vessel is using the transit lane. Data are stored on video tapes which are changed on a regular basis and this will be carried out by staff of the Cardwell Department of Parks and Wildlife Service (QPWS).

Currently a video camera sits on the jetty at Cardwell. It is proposed that this camera be moved from the jetty to site 1 in Missionary Bay (see map, page 49). This camera will be situated on a pylon which marks a transit lane turn point and will face north-west along the transit lane. Calibrated marks in front of the camera lens and Garden Island in the distance will provide a reference for determining adherence to vessel traffic lanes. A second high quality, digital camera will be purchased. This camera will be mounted on another pylon which marks a turn point (site 2 on map, page 49) and will face east along the transit lane or north-east towards Garden Island.

A third camera is to be installed on the Telstra tower at Cardwell. This camera will provide a panoramic view of the Hinchinbrook Channel (site 3) and monitor vessel numbers in the area.

Cameras at sites 1 and 3 will record onto 90-minute tapes. However, it is proposed that the new camera (site 2) will relay digital still images, via a VHF radio, to a computer at the Cardwell office of QPWS. These images will be recorded in real-time and will allow staff to respond immediately to infringements if required. At regular intervals these images will be collated and forwarded to GBRMPA for analysis. Subject to a successful trial of the digital still camera, the video camera at site 1 can be changed to a similar system at a later date.

Approximate cost

As this project will be managed by GBRMPA with field assistance provided by the QPWS the cost is minimal. The time-lapse video cameras for sites 1 and 3 have been built and trialed and remain to be deployed. There will be an initial cost of purchasing an additional camera for site 2 (approx. \$7000).









The project will also involve an analysis of the tapes and report write-up on an annual basis. Each 90-minute tape generally takes two hours to analyse and each camera will record 12 tapes per year (approx. 72 hours of analysis time per year) — estimate \$3000 per annum for analysis and progress reporting.

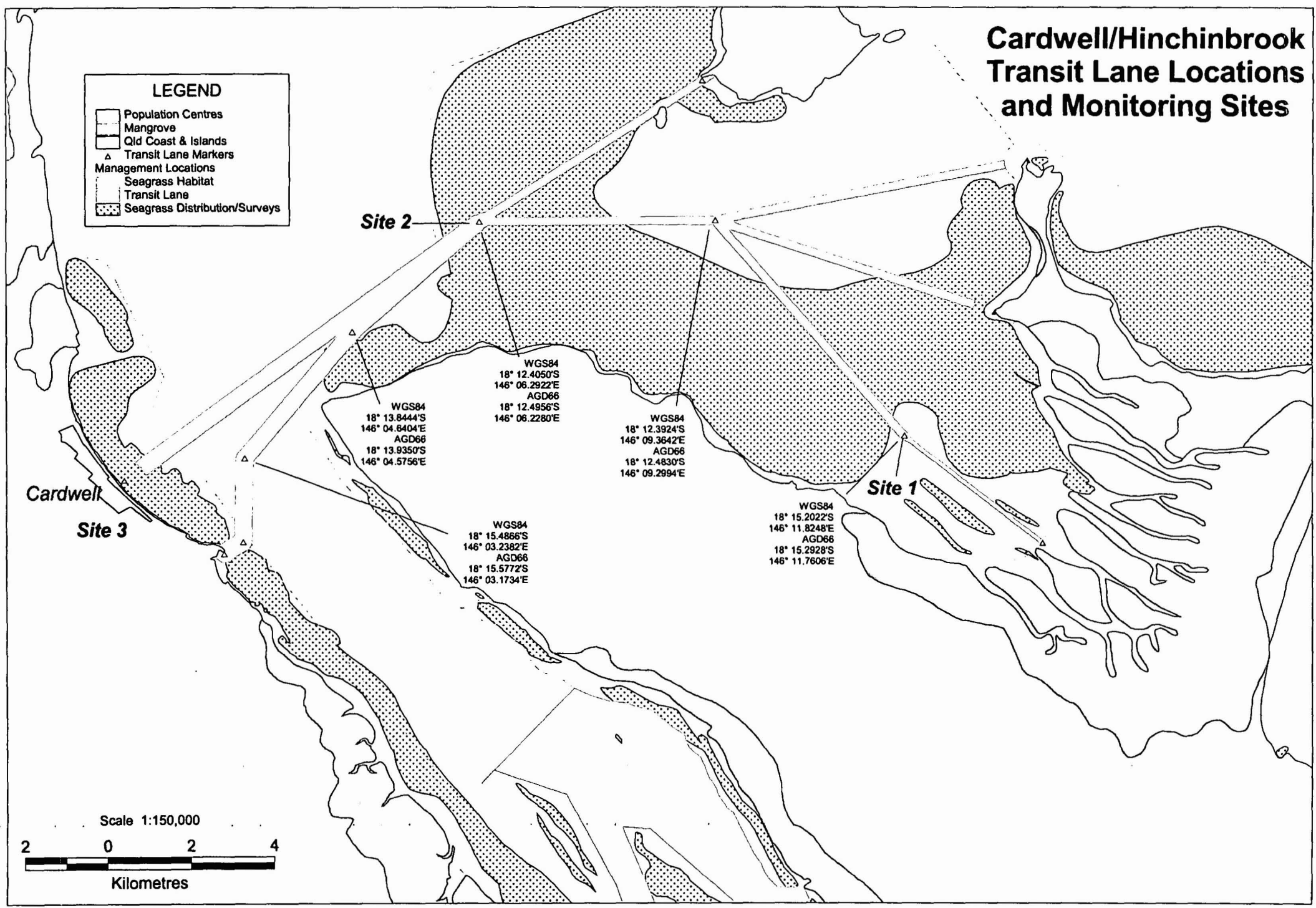
Time required

This project will be ongoing.

Cardwell/Hinchinbrook Transit Lane Locations and Monitoring Sites

LEGEND

-  Population Centres
-  Mangrove
-  Qld Coast & Islands
-  Transit Lane Markers
-  Management Locations
-  Seagrass Habitat
-  Transit Lane
-  Seagrass Distribution/Surveys



Site 2

WGS84
18° 13.8444'S
146° 04.8404'E
AGD66
18° 13.9350'S
146° 04.5756'E

WGS84
18° 12.4050'S
146° 06.2922'E
AGD66
18° 12.4956'S
146° 06.2280'E

WGS84
18° 12.3924'S
146° 09.3642'E
AGD66
18° 12.4830'S
146° 09.2994'E

Site 1

WGS84
18° 15.2022'S
146° 11.8248'E
AGD66
18° 15.2928'S
146° 11.7606'E

Site 3

WGS84
18° 15.4886'S
146° 03.2382'E
AGD66
18° 15.5772'S
146° 03.1734'E

Cardwell

Scale 1:150,000



Project No. 22

Title

Fidelity of dugongs to Dugong Protection Areas and their fine-scale movements within them

Objective

To document the fine-scale habitat use of dugongs in the Dugong Protection Areas (DPA) Zone A and their fidelity to those areas.

Relevance

If the Dugong Protection Areas are to work, the areas will have to support significant numbers of dugongs at all times and management will need to minimise all impacts. This will require knowledge of the fine-scale habitat use of dugongs within these areas and the movement of dugongs within DPA boundaries. At present, such information is available only for the Hinchinbrook and Shoalwater DPA As. Priority should be accorded to the other DPA As in the Great Barrier Reef, especially those in the Townsville and Mackay regions.

Feasibility

James Cook University researchers have documented small and large scale movement patterns of more than 50 dugongs in five areas in Australia using this technique which has also been used successfully for more than 100 manatees in Florida over 10 years.

Methodology

At least five satellite transmitters will be used to track dugongs for up to six months in each of two years and each of two regions: (1) Townsville and (2) Mackay. Dugongs will be caught in each area and fitted with the transmitters which broadcast information to polar-orbiting NOAA satellites. This information will be interpreted and disseminated by Service ARGOS, and information on location (correct to 150 m), dugong activity and water temperature made available via e-mail. Parallel studies in the southern Great Barrier Reef and the Gulf of Carpentaria suggest that an average of two locations will be received from each dugong daily. Tagged dugongs will also be telemetered with time-depth recorders to record dive behaviour. This information will be used to refine correction factors used in the aerial surveys (see Project 4 entitled 'Improving estimates of absolute abundance of dugongs').

After six months of tracking the transmitter attachment will self-release from the dugong. Attempts will be made to retrieve the transmitter using the latest satellite derived locations and the VHF beacon in each transmitter. If the instruments are retrieved, they will be re-deployed on additional dugongs after replacement of batteries and down-loading of the dive data. Some instruments may shed prematurely due to failure of the attachment link which is designed to snap if the transmitter becomes fouled in mangroves or coral, or if it is attacked by sharks or crocodiles.

The data on the movements of the tagged dugongs will be compared with the spatial information on other impacts using a Geographic Information System.

Approximate cost

\$90 000 per year for two years per area

Time required

Two years per area

Project No. 23

Title

Historical exploitation of dugongs

Objective

To determine the likely impact of the dugong oil industry on dugongs on the east coast of Queensland.

Relevance

Anecdotal information suggests that the decline in dugong numbers along the eastern coast of Queensland has been occurring since European settlement. The dugong oil industry presumably contributed to this decline. An industry to supply dugong oil to non-Indigenous Australians and for export persisted until dugongs were protected in 1967. The production of oil to supply Indigenous communities persisted for some years after that.

Feasibility

Information on the dugong oil industry is found in government records and newspaper files. Most of the records have been collected at James Cook University and by Claire Peterkin, Queensland Department of Primary Industries, Deception Bay, but have not been collated into a coherent whole.

Methodology

Information on the dugong oil industry from government records and newspaper files would be collated and synthesised in a desktop study.

Approximate cost

\$5 000 – \$10 000

Time required

Six months