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RESEARCH PUBLICATION NO. 86

**A Dugong Research Strategy
for the Torres Strait, Great Barrier Reef
World Heritage Area
and south-east Queensland
2006 - 2011**

Amanda Hodgson



let's keep it great

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World Heritage Area
and south-east Queensland
2006 - 2011**

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PREAMBLE

The *Dugong Research Strategy for the Great Barrier Reef World Heritage Area and Hervey Bay* (Oliver & Berkelmans 1999) arose in response to a request by senior officers of the Queensland Parks and Wildlife Service (QPWS), the Great Barrier Reef Marine Park Authority (GBRMPA), and the Queensland Department of Primary Industries and Fisheries (QDPIF), on 22 August 1997. This request was for a report on proposals for monitoring trends in dugong populations and habitats, and to propose performance standards and priority data needs.

A workshop was convened by the GBRMPA (Dr Jamie Oliver) on 30 October 1997 to scope and prioritise research and management projects. It was attended by representatives from James Cook University (JCU), QDPIF, GBRMPA, QPWS, Indigenous interests, conservation groups, commercial fishing interests and the Australian Defence Force. Delegates at the workshop developed scoping papers outlining proposed research projects, which were then scored according to their relative importance. The scoping papers were reviewed by a focus group, categorised into topics of research, and ranked within each topic according to the priority of each project. The proposed projects then formed the *Dugong Research Strategy for the Great Barrier Reef World Heritage Area and Hervey Bay* (hereafter referred to as the *Dugong Research Strategy*).

On 30 May 1999 the Great Barrier Reef Ministerial Council¹ accepted the *Dugong Research Strategy* as a guiding document for setting priorities, allocating funding, and assessing performance of dugong recovery and conservation actions in the Great Barrier Reef and Hervey Bay Regions.

The *Dugong Research Strategy* was considered a living document, as it was recognised that new or altered research ideas and opportunities would develop as a result of the dynamic nature of research and the changing social and political environment that governs the management of dugongs. The document was reviewed by the GBRMPA in June 2003, at which time four of the 23 proposed projects were completed, 11 were underway, and eight were yet to begin.

The timeframe of the first *Dugong Research Strategy* was five years, at the end of which the Great Barrier Reef Ministerial Council requested a review be conducted. Thus the objectives of the current document are to:

- Review the status of the proposed projects in the first *Dugong Research Strategy*
- Present new research needs to formulate an updated *Dugong Research Strategy*
- Extend the scope of proposed projects to include the Torres Strait and south-east Queensland.

As with the first *Dugong Research Strategy*, the expected users of this second *Dugong Research Strategy* are:

- Researchers wishing to develop relevant project proposals for funding
- Management/funding agencies that need to be aware of major research priorities relevant to the conservation of dugongs in eastern Australia.

The geographical scope of this second *Dugong Research Strategy* extends beyond the Great Barrier Reef Marine Park to include south-east Queensland and the Torres Strait. These areas lie outside the jurisdiction of the GBRMPA and, as such, some of the proposed research projects are not directly relevant to the Authority. However, it is known that dugongs move between the Great Barrier Reef World Heritage Area and these regions, thus all research projects proposed for Queensland's east coast and the Torres Strait have been included in this document for completeness.

¹ The Great Barrier Reef Ministerial Council is made up of the Ministers for the Environment and for Tourism from each of the Commonwealth and Queensland Governments.

INTRODUCTION

Under the World Heritage Convention (WHC), Australia must protect the values for which the Great Barrier Reef was nominated as a World Heritage Area, one of which is the significant populations of dugongs (*Dugong dugon*) which occur there (Anon 1981). According to the IUCN Red List of Threatened Species, dugongs are considered 'vulnerable to extinction' internationally, based on an inferred significant population reduction (IUCN 2003). This is supported by Marsh et al. (2002) who indicates that dugong numbers have declined throughout their range. Furthermore, the future protection of high quality habitat for dugongs is doubtful in most countries where dugongs occur, as a result of high population growth and associated infrastructure and development (Marsh et al. 2002). It is likely that Australia will provide the last stronghold for dugongs, as it is the only developed country within the range of this species, and has the most extensive dugong seagrass habitat at low risk from coastal development (Marsh et al. 1999b; Marsh et al. 2002). A significant portion of Australia's dugong population occurs within Queensland, in particular the Torres Strait, the Great Barrier Reef World Heritage Area, and south-east Queensland.

Considerable research has been conducted to monitor dugong distribution and abundance in Queensland. Dedicated dugong aerial surveys have shown that dugong numbers have fluctuated within the Great Barrier Reef World Heritage Area. For example, aerial surveys conducted over the urban southern Great Barrier Reef Marine Park in 1986/87 (Marsh et al. 1990), 1992 (Marsh et al. 1994), and 1994 (Marsh et al. 1996), indicated that dugong numbers decreased by approximately 50 per cent over the eight year period. Moreover, in some areas this decline was as high as 80 percent (Marsh et al. 1996). The survey conducted in this region in 1999 showed that dugong numbers had returned to 1986/87 levels (Marsh & Lawler 2001b). The increase between 1994 and 1999 could not be explained by natural increase in the absence of immigration, rather it is indicative of the movement of dugongs over a large spatial scale in response to changes in seagrass availability (Marsh & Lawler 2001b). Results of the most recent survey conducted for the urban coast of Queensland in November 2005 suggest that dugong numbers are now stable at the scale of the entire urban coast, although populations fluctuate at the level of individual bays, probably largely due to natural changes in seagrass habitats (Marsh et al. in prep.)

Dugong numbers appear to have declined substantially along the urban southern Great Barrier Reef Marine Park and Hervey Bay region since the 1960s. Marsh et al. (2005) analysed dugong by-catch records from the Queensland Shark Safety Program (QSSP) where shark nets are set at popular beaches for bather protection. A substantial decrease of dugong by-catch in these nets, to an estimated 3.1 per cent of the initial catch rates, indicates a significant decrease in dugong numbers on the urban coast of Queensland since the 1960s (Marsh et al. 2005).

There are many possible reasons for this large decline. As herbivores feeding almost exclusively on seagrass, dugongs rely on a food source which is very sensitive to human impact (Marsh et al. 1999a) and severe weather events. Clearing of inland and coastal vegetation has caused erosion and increased sedimentation during floods, resulting in seagrass die-off (Heinsohn et al. 1977). Other impacts on seagrass include direct disturbance from dredging and trawling, as well as pollution from agriculture and sewage (Marsh et al. 1999a).

Dugong populations have also declined as a result of direct, incidental or indirect takes. Recent aerial surveys and analysis of hunting records, indicate that the current rate of hunting in Torres Strait and the northern Great Barrier reef is far too high to be sustainable (Heinsohn et al. 2004; Marsh et al. 2004).

Incidental take includes dugongs caught in commercial gill and mesh nets, as well as shark nets set for bather protection. Although this take has not been quantified, commercial set nets are known to have caught significant numbers of dugongs (Marsh et al. 1999a). A two-tiered

system of Dugong Protection Areas (DPAs) was implemented in 1997 and mirrored in 2004 as Species Conservation (Dugong Protection) Special Management Areas under the *Great Barrier Reef Marine Park Regulations 1993*, to reduce dugong by-catch mortalities in areas that are most heavily used by dugongs. This management intervention has been greatly enhanced by the huge expansion of 'no-take areas' resulting from the Representative Areas Program.

In recent years, the number of dugong deaths attributed to boat strikes has increased substantially, accounting for 64 per cent of human caused mortalities reported along the urban coast in 2002 (Limpus et al. 2003). The most recent stranding data for the year 2005 found that of the cases where cause of death could be determined, the majority of cases (84.6 per cent) were linked to human activities including boat strike (n=2 confirmed, n=2 unconfirmed), the QDPIF Shark Safety Program (n=1), netting (n=4), hunting (n=1) and unconfirmed human activity (n=1) (Greenland & Limpus 2006). Noise pollution is also a potential threat to dugongs, including noise from boat traffic, as well as other activities such as seismic surveys and Defence activities.

In managing human impacts on the dugong population in eastern Queensland and the Torres Strait, management agencies are limited by the paucity of relevant scientific information needed to minimise the threats outlined above. The purpose of this updated *Dugong Research Strategy* is to:

- (a) Ensure that future management decisions can be made on the basis of better scientific information
- (b) Assess the effectiveness of current management strategies
- (c) Ensure that high quality dugong habitats are maintained within Torres Strait, the GBRWHA and south-east Queensland to allow dugong numbers to recover.

REVIEW AND DEVELOPMENT OF AN UPDATED DUGONG RESEARCH STRATEGY

A detailed outline of the development process for the first *Dugong Research Strategy* is provided in Oliver and Berkelmans (1999).

The review process for this updated strategy began by seeking the participation of all key stakeholders via email. This involved contacting representatives from:

(a) Research groups

(James Cook University, CRC Reef Research Centre, University of Queensland, and CRC Torres Strait)

(b) Government agencies

(GBRMPA, Queensland Environmental Protection Agency, Department of the Environment and Heritage, and Queensland Department of Primary Industries and Fisheries)

(c) Native title representative bodies

(Torres Strait Regional Authority, Cape York Land Council, North Queensland Land Council, Central Queensland Land Council, and Girringun Aboriginal Corporation)

(d) Natural Resource Management Boards

(Cape York, Far North Queensland, Burdekin Dry Tropics, Fitzroy Basin, Mackay/Whitsundays, and Burnett Mary)

(e) Conservation groups

(North Queensland Conservation Council)

(f) Industry

(Queensland Seafood Industry Association)

(g) Advisory Committee

(GBRMPA's Conservation Reef Advisory Committee).

All stakeholders were supplied with a Review Form comprising a table that collated the project proposals of the first Research Strategy and the GBRMPA's 2003 review. Contributors were asked to provide feedback on the status of the projects and any related publications. The outcome of this review highlights the status of each project proposed (Table 1). Stakeholders were also invited to develop new scoping papers that would provide an overview of how research needs could be synthesised into a research project. These new project proposals have been combined with the incomplete projects from the first *Dugong Research Strategy* to formulate this second *Dugong Research Strategy* (Table 2). Scoping papers for each project are provided in Appendix 1.

The first *Dugong Research Strategy* assigned priority levels to all projects according to their feasibility, relevance, affordability, and duration. During the review, contributors were also asked to reassess the priority of the original projects. However, this priority assessment was difficult given the wide scope of the proposals and research needs, and was considered unnecessary for the current review. Moreover, it seemed likely that each government agency, research provider and research organisation would prioritise actions to meet their needs. Thus, these priority categories have been omitted from this updated *Dugong Research Strategy*. Instead, key research questions from the Research Needs for Protection and Management of the Great Barrier Reef Marine Park (GBRMPA 2005), have been identified and linked to that project, along with its associated Priority and Urgency categories. These are included with the scoping papers in Appendix 1.

Table 1. Summary of the proposed projects in the *Dugong Research Strategy for the Great Barrier Reef World Heritage Area and Hervey Bay* (Oliver & Berkelmans 1999) and a review of their current status.

[Shaded projects are those that are partially completed or yet to begin].

Project No.	Abbreviated Title	Funding Needed	Original Comments	Current Status	Resulting Publications
Topic 1: Maintaining or enhancing dugong numbers					
1	Long-term trends in dugong numbers	\$160 000 over 2 years, or \$224 000 over 3 years	Undertaken routinely every five years between Cape York and Hervey Bay, funded by the Great Barrier Reef Marine Park Authority.	<ul style="list-style-type: none"> GBRMPA funded and published surveys of the southern and northern Great Barrier Reef in 1999 and 2000, respectively. QPWS funded aerial surveys of dugong populations in the Hervey Bay and Moreton Bay regions. MTSRF/DEH/CRC Reef funded aerial surveys of dugongs in the urban southern GBR, Hervey Bay, Moreton Bay and a reference block in the Torres Strait in 2005. Aerial surveys to occur in November 2006 of the remote northern GBR, Torres Strait and a reference block in Hervey Bay. Refinement of survey design to more adequately address movement issue is required. This has now happened. Ongoing population estimates are needed for discussions on hunting and other anthropogenic mortality. Population dynamics of dugongs in Moreton Bay and the Great Sandy Marine Park is being conducted by Janet Lanyon 	GBRMPA Research Publication 70 (Marsh & Lawler 2001b) and 77 (Marsh & Lawler 2001a) EPA report (Lawler 2001) Scientific publication: Marsh et al. 2004
2	Productivity of key seagrass species	\$690 300 over 4 years		<ul style="list-style-type: none"> Partially completed within a JCU PhD project (funded under CRC Reef Task C1.15) reviewing seagrass and sediment nutrient status in the central GBR region. Partially completed QDPIF survey of seagrass nutrient profiles and productivity in the Torres Strait. 	Completed PhD project (Mellors 2003)
3	Negotiated protocol for the use of Aboriginal and Torres Strait Islander knowledge	\$295 000 over 1 year	Project should be Great Barrier Reef-wide. Partially addressed in Hopevale area through ARCSPIRT/PEW Fellowship project commenced in 1999. Part of Sea Forum Regional Agreement process.	<ul style="list-style-type: none"> Partly underway with development of Traditional Owner Information System (TOIS) by the GBRMPA. Linkage with the North Australia Indigenous Land and Sea Management Alliance (NAILSMA) Turtle and Dugong Management Strategy. 	

Project No.	Abbreviated Title	Funding Needed	Original Comments	Current Status	Resulting Publications
4	Improving estimates of absolute abundance	\$160 000 over 2-3 years	Commenced as a component of ACR SPIRT/PEW Fellowship project in 1999.	<ul style="list-style-type: none"> Completed with final reports submitted to the GBRMPA and Australian Fisheries Management Authority and published in a peer reviewed journal. 	AFMA Report (Pollock et al. 2004) Journal article (Pollock et al. 2006)
5	Research for the management of seagrass resources	\$1.4 million over 4 years	Amalgamation of four projects originally proposed. Baseline surveys of seagrass beds in Mackay area DPAs to commence in 1999.	<ul style="list-style-type: none"> A baseline mapping study of seagrass distribution in all Zone A Dugong Protection Areas (DPAs) was completed under GBRMPA funding. A GBRMPA report and journal article has been published in regard to Upstart, Newry/Sand, Ince/Llewellyn Bays, and Clairview DPAs. A report on "<i>Post-flood monitoring of seagrasses in Hervey Bay-Great Sandy Strait, 1999</i>" has been published by QDPIF. A peer-reviewed paper has been published: Flood related loss and recovery of intertidal seagrass meadows in southern Queensland, Australia Estuarine, Coastal and Shelf Science, 2004 Analysis of seagrass pasture identified from tracking study to be important dugong habitat currently being peer-reviewed. Further work may be initiated according to recommendations in the Reef Water Quality Protection Plan. 	GBRMPA Research Publication 72 (Coles et al. 2001) Journal article (Coles et al. 2000) QDPI report (McKenzie et al. 2000) Peer-reviewed paper: Campbell & McKenzie (2004) Peer-reviewed paper: Sheppard et al. (In Review)

Project No.	Abbreviated Title	Funding Needed	Original Comments	Current Status	Resulting Publications
6	Dugong strandings: causes of mortality	\$22 000 per year	Project should be re-written. Project must be done in association with population biologist.	<ul style="list-style-type: none"> GBRMPA published a technical manual for the salvage and necropsy of dugongs. GBRMPA funded a JCU masters project to identify stomach contents obtained from dugong carcasses in the Townsville-Hinchinbrook Region, published both on the GBRMPA website and in a peer reviewed journal. Analysis of stomach contents from dugong carcasses recovered from the Torres Strait published in a journal. CRC Reef provided funding to review and refine the stranding program in the GBRWHA. This project is now ongoing as part of the revised Day-to-Day Management Unit Stranding Program, prioritised on key species, threats and areas. Research into the cause of death of dugong and other marine mammals in Moreton Bay is being conducted by Kathy Townsend. 	GBRMPA Research Publication 64 (Eros et al. 2000) – updated & reprinted 2006. GBRMPA web report (Lawler & Andre 2001) Journal article (Andre et al. 2004) QPWS Annual Stranding and Mortality Reports (Limpus et al. 2003) Kwan (2004)
7	Using DNA sequencing and microsatellites to study dugong phylogeography	\$85 000 over 2 years or \$120 000 over 3 years	Subject of ARC SPIRT application for funding for commencement in 2000.	<ul style="list-style-type: none"> Samples are collected as part of the routine dugong necropsy procedures in Queensland. The study was conducted by a JCU PhD student under an ARC SPIRT grant. CRC Reef funded PhD project underway at JCU to analyse dugong population genetic structure. 	Completed PhD project (McDonald 2006). Other genetic analyses are ongoing at University of Queensland and James Cook University, e.g. PhD project lead by Adrian McMahon at JCU
8	Effect of boat traffic	\$5000 over 1 year	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.	<ul style="list-style-type: none"> GBRMPA funded and published a comprehensive study of dugongs and other marine animals in relation to vessel use in the Hinchinbrook Region. The behavioural responses of dugongs to boats were examined in a JCU PhD project (funded under CRC Reef Task C1.4.3.1S). JCU Honours project investigated boat traffic across important dugong habitat in Hervey Bay identified from satellite tracking study. 	GBRMPA Research Publication 67 (Preen 2001) Completed PhD project (Hodgson 2005). Papers are pending, visual footage available from Amanda Hodgson, JCU. Peer-reviewed paper:

Project No.	Abbreviated Title	Funding Needed	Original Comments	Current Status	Resulting Publications
					Maitland et al. 2006
9	Variation in dugong fecundity	\$5000 over 6 months	Potentially important study but not high relevance as presently written. Needs to be scoped to incorporate the distribution and resource use by calves.	<ul style="list-style-type: none"> Information on the effects of habitat quality (seagrass availability) on dugong fecundity was obtained in a JCU PhD project on the Indigenous dugong fishery in the Torres Strait. This proposal still requires a desktop study of aerial survey data. 	Completed PhD project (Kwan 2002)
10	Improving the knowledge of dugong distribution in the GBRWHA through analysis of historic catch and effort information	\$20 000 over 1 year	Good project, but not directly relevant to management.	<ul style="list-style-type: none"> Partially completed in a project to determine historical numbers of dugongs according to dugong catch rates in the Queensland Shark Safety Program. Published by the GBRMPA and in a peer reviewed journal. Similar analysis of data from commercial netters is needed to complete the project. PhD project on post-European settlement of the GBRMPA completed: includes section on historical dugong population numbers. 	GBRMPA Research Publication 70 (Marsh et al. 2001) Journal article (Marsh et al. 2005) Completed PhD project Daley 2005.
11	Organo-chlorine and heavy metal pollutant concentrations	In-house	ARC SPIRT project. Useful with respect to water quality issues and baseline setting. However, pollutant burdens are hard to interpret in a management framework, as levels dangerous to dugong health are unknown.	<ul style="list-style-type: none"> Completed by the GBRMPA in collaboration with QPWS and other organisations. Published in a special edition of the Marine Pollution Bulletin journal, which is a compilation of papers presented at the <i>Catchment to Reef: Water Quality Issues in The Great Barrier Reef Region</i> hosted by the GBRMPA and CRC Reef. Exposure and sensitivity of marine turtles and dugongs to dioxins – a risk assessment in near shore marine environments in Queensland is being conducted by Caroline Gaus in Moreton Bay Marine Park. 	Journal article (Haynes et al. 2005) Conference proceedings (Haynes & Schaffelke 2004) Gaus et al. 2001a,b Gaus et al. 2005
Topic 2: Minimising the impacts of management decisions on industry and other affected groups					
12	Enhancement of dugong recovery through the	\$150 000 over 3 years with FRDC grant	Need to liaise with fishers, QSIA, and QDPIF. Project needs to be species specific.	<ul style="list-style-type: none"> Yet to begin. 	

Project No.	Abbreviated Title	Funding Needed	Original Comments	Current Status	Resulting Publications
	development of alternative methods to gill netting				
13	Local information from commercial fishers and the socio-economic impacts of the implementation of DPAs	\$30 000	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.	<ul style="list-style-type: none"> Superseded by the Representatives Areas Program. 	
14	Factors influencing the mortality of dugongs in shark nets	\$5000 over 6 months	Project commenced 1999	<ul style="list-style-type: none"> GBRMPA funded this as part of a desktop study investigating dugong population decline according to Queensland Shark Control Program records of dugong catches. Published by GBRMPA and in a peer reviewed journal. 	GBRMPA Research Publication 70 (Marsh et al. 2001) Journal article (Marsh et al. 2005)
Topic 3: Development and implementation of cooperative management arrangements					
15	Investigate and implement models and mechanisms for cooperative planning of resource management between state agencies and Traditional Owners	\$474 350 over 3 years	Addressed as part of ongoing extension program in GBRMPA, assisted in Hopevale area by ARD SPIRT/Pew Fellowship project commenced in 1999.	<ul style="list-style-type: none"> Assisted in Hopevale area by ARC SPIRT/Pew Fellowship JCU PhD project commenced in 1999 and the Sea Forum Regional Agreement process. Superseded by the development of the Traditional Use of Marine Resources Agreements (TUMRAs), implemented by the GBRMPA, as a management tool. 	PhD thesis, Nursey-Bray (2006)
16	Developing sustainable community-based management	\$300 000 over 3 years	Revision of project previously proposed.	<ul style="list-style-type: none"> Superseded by the development of the Traditional Use of Marine Resources Agreements (TUMRAs), implemented by the GBRMPA, as a management tool. CRC Torres Strait funded PhD project underway: An 	PhD thesis, James Cook University, by Jillian Grayson pending Kwan et al. (2006)

Project No.	Abbreviated Title	Funding Needed	Original Comments	Current Status	Resulting Publications
				information base for a sustainable traditional fishery of green turtles and dugongs in the Northern Peninsula Area (NPA) and Inner Islands of Torres Strait	
Topic 4: Assessing the effectiveness of current dugong protection measures					
17	Are there seasonal changes in dugong distribution in the GBR?	\$160 000 over 2 years, or \$5000 as a desktop	Low priority as full project but high priority as a desktop study.	<ul style="list-style-type: none"> Completed at JCU as a desktop study, funded by GBRMPA and published on the GBRMPA website. 	GBRMPA web report (Marsh & Penrose 2001)
18	The spatial extent and intensity of the acoustic impact of underwater explosions in Shoalwater Bay	Unknown – 1 year	High priority for one DPA (Shoalwater). Also relevant to turtle conservation in this area. Being funded by the Department of Defence.	<ul style="list-style-type: none"> The Defence department, Defence Science and Technology Organisation (DSTO), funded and published a project measuring the propagation of noise and pressure waves from underwater blasts. 	DSTO report (Box et al. 2000)
19	Response of dugongs to underwater explosions	\$40 000 over 1 or 2 years	High priority for one DPA (Shoalwater). Also relevant to turtle conservation in this area.	<ul style="list-style-type: none"> Yet to begin 	
20	Impact of changes in net fishery operations on dugong recovery	\$110 000 over 2 years	Important project but will take several years to build a partnership with commercial fishers to provide necessary information.	<ul style="list-style-type: none"> Superseded by the Representatives Areas Program. 	
21	Monitoring compliance and vessel use in the Hinchinbrook DPA	\$7000 + \$3000 per year ongoing	Project to commenced in 1999-2000, funded by GBRMPA.	<ul style="list-style-type: none"> GBRMPA obtained Natural Heritage Trust funds to carry out this survey. An inter-agency working group is over-seeing the study. 	Completed honours project (Groom 2003)
22	Fidelity of dugongs to DPAs and their fine scale movements	\$90 000 per year for 2 years	Note existing similar research at Shoalwater Bay and Hinchinbrook. High priority subject to justification after analysis of existing data.	<ul style="list-style-type: none"> Dugongs were satellite tracked by a JCU PhD student (Funded under CRC Reef Task C1.4.3.2S) to determine their fine scale habitat use. A JCU PhD student has completed a study on dugong 	PhD thesis, James Cook University, by James Sheppard pending Peer-reviewed paper:

Project No.	Abbreviated Title	Funding Needed	Original Comments	Current Status	Resulting Publications
	within them			genetics. <ul style="list-style-type: none"> JCU PhD student is working on identifying individuals and their age through genetic samples. Foraging ecology of dugongs in the Great Sandy Marine Park is being conducted by James Sheppard. 	Sheppard et al. 2006 PhD thesis, James Cook University, by Adrian McMahon pending
Topic 5: Not directly relevant to any topic					
23	Historical exploitation	\$5000-10 000 over 6 months	Historical information of general interest, but of little use in contemporary management of dugongs.	<ul style="list-style-type: none"> PhD project on post-European settlement of the GBRMPA completed: includes section on historical dugong population numbers. 	Completed PhD project Daley 2005
24	Auditory characteristics of the dugong ear	~\$150 000		<ul style="list-style-type: none"> The auditory brainstem response of one captive dugong at Sea World in Queensland was tested by Dr Darlene Ketten funded by the Department of Defence. Further tests are needed on this animal and others to improve the sample size for these experiments. A manipulative study to determine pressure thresholds of the middle ear using dugong heads taken from fresh carcasses is still to be completed. 	Journal article pending
25	Satellite tracking of dugongs	\$15 000		22 dugongs were satellite tracked by a JCU PhD student (Funded under CRC Reef Task C1.4.3.2S) to determine their fine scale habitat use in the Great Sandy Marine Park.	PhD thesis by James Sheppard pending Peer-reviewed paper: Sheppard et al. 2006

Table 2. The Dugong Research Strategy for the Torres Strait, Great Barrier Reef World Heritage Area and south-east Queensland proposed projects for 2006 – 2011.

Project No.	Abbreviated Title	Funding Needed	Project Summary
Topic 1: Maintaining or enhancing dugong numbers			
1	Productivity of key seagrass species	> \$100 000 over 3 years	Monitoring of the productivity of seagrass in important dugong habitat areas across seasons and years.
2	Negotiated protocol for the use of Aboriginal and Torres Strait Islander knowledge	> \$100 000 over 2 years	Develop a protocol for gathering, adapting and/or applying Indigenous knowledge into dugong management, with a focus on employing local Indigenous facilitators.
3	Variation in dugong fecundity	\$5000 - \$20 000 over 1 year	A desktop study of aerial survey calf counts to determine the spatial and temporal variation in calving rates, and to generate a hypothesis to explain these variations.
4	Improving the knowledge of dugong distribution through analysis of historic catch information	\$20 000 over 1 year	Analysis of the catch data from commercial gill nets and evaluation of this data as an indicator of dugong distribution.
5	Community knowledge of local dugong populations and movements	\$20 000 - \$50 000 over 1 year	Collate community knowledge of dugong populations and movements by surveying representative members of the community.
6	Development of a population model for dugongs in the GBR, Torres Strait, Great Sandy Marine Park and Moreton Bay Marine Park	\$150 000 over 3 years	Design and validate a population model. Supply an operational modelling system that can be used by management agency staff.
7	Detailed analysis of dugong live strandings and carcasses	\$5000 - \$20 000 over 1 year	Analyse data from the QPWS stranding database to examine spatial and temporal variation in dugong strandings.
8	Large-scale aerial surveys of dugongs	> \$100 000 for an ongoing project	Conduct aerial surveys across the entire dugong range of north-eastern Australia, to account for large-scale dugong movements and to facilitate an assessment of the impact of the Indigenous dugong fishery.
9	Important dugong mating areas	\$20 000 - \$50 000 over 2 years	Survey traditional owners to determine local knowledge of areas regularly used for mating by dugongs.
10	The risk of boat strike	\$20 000 - \$50 000 over 1 year	Examine the effects of boat type and speed, and water depth and turbidity, on the risk of boat strikes to dugongs using controlled experiments
Topic 2: Minimising the impacts of management decisions on industry and other affected groups			
11	Reduction of threats of commercial fishing nets	> \$100 000 over 3 years	The development of bycatch mitigation devices, and alternative fishing methods, that are economically viable and that reduce dugong entanglements in gill nets.
12	Aerial monitoring of responses of dugongs to underwater explosions at Triangular Island, in the Shoalwater Bay Defence Training Area	> \$50 000 over 1 year	Determine short-term (minutes-hours-days) responses by dugongs to detonations conducted in the intertidal zone of Triangular Island during Department of Defence training exercises.
13	Assessment of 'pingers' or other deterrent devices	> \$100 000 over 2 years	Assess the effectiveness of pingers and/or develop alternative deterrent devices to reduce dugong entanglements in commercial fishing gear.

Project No.	Abbreviated Title	Funding Needed	Project Summary
14	Management of dugong watching tourism	\$20 000 - 50 000 over 2 years	Determine an effective management strategy to address commercial dugong watching.
Topic 3: Assessing the effectiveness of current dugong protection measures			
15	Assessment of the effectiveness of voluntary transit lanes in the Hinchinbrook Area and the statutory 'go slow' areas in Moreton Bay Marine Park and Great Sandy Marine Park.	\$60 000 over 3 years	Consultation with the local community to determine the extent of compliance with transit lanes and obtain recommendations for changes.
16	Fine-scale habitat use by dugongs in areas of high human use	> \$100 000 over 3 years	Track dugong movements using GPS satellite tags in habitats with high human use, to assess the influence of human activities on these movements.
17	Economics of Indigenous hunting and its management	> \$100 000 over 3 years	Investigation of the economics of the Indigenous harvest of turtles and dugongs in remote areas and the economic costs and benefits of management options.
18	Culturally and ecologically sustainable Indigenous hunting	> \$100 000 over 3 years	Options for the management of Indigenous hunting of dugongs and turtles in Torres Strait and the Northern Peninsular Area on the basis of community acceptance, cultural and ecological sustainability and cost.
Topic 4: Information on dugong biology which will assist in implementing all management actions to maintain high quality habitats			
19	Auditory characteristics of the dugong ear	> \$100 000 over 1 year	Further tests of auditory brainstem response on available captive dugongs to determine auditory capabilities, together with a manipulative study to determine pressure thresholds of the middle ear. The latter would be conducted using dugong heads taken from fresh carcasses.
20	Seasonal changes in dugong diet	> \$100 000 over 3 years	Determine regional, seasonal and individual differences in dugong diets using a range of methods to analyse chemical signatures in hair and faeces.
21	Spatial differences in mating behaviour	> \$100 000 over 2-3 years	Investigate the mating systems of dugongs in various locations through behavioural observations and genetic sampling techniques.
22	Dugong genetics: insights into social structure and habitat use	> \$100 000 over 3 years	Gather genetic samples of live dugongs to examine the sex, identity and relatedness of individuals, and infer social structure and fine-scale habitat use.

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APPENDICES

Appendix 1. Project Scoping Papers

Project No. 1

Title

Productivity of key seagrass species of importance to dugongs, at selected locations in Torres Strait, the Great Barrier Reef and south-east Queensland

Objectives

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

Relevance

Seagrasses are essential food for the dugong. Yet there is relatively little information on the health and distribution of seagrasses within Torres Strait, the Great Barrier Reef Marine Park World Heritage Area, Great Sandy Marine Park and/or Moreton Bay Marine Park. 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 their 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.

Are appropriate methods developed and tested?	Yes
Are appropriately skilled people and equipment available?	Yes
Is there sufficient time to produce useful results?	Yes

Approximate cost

> \$100 000

- Boat time
- Laboratory
- Salary

Time required

Three years or more, useful results in progress reports.

Links to Research Needs for Protection and Management of the Great Barrier Reef Marine Park (GBRMPA, 2005)

[What are the trends in the condition of major habitat types in the Great Barrier Reef Marine Park and what human and natural factors influence those trends?](#)

Priority - Critical

Urgency 1 - 3 years

Project No. 2

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

Objectives

1. Gather, adapt and/or directly apply Aboriginal and Torres Strait Islander knowledge to dugong management through a negotiated protocol within each community
2. Raise awareness in Indigenous communities about the need for dugong conservation and harvest management, and incorporate Indigenous knowledge into dugong conservation management
3. Employ local Indigenous facilitators to engage the community and assist with the recording of information relevant to dugong conservation management in collaboration with the North Australian Indigenous Land and Sea Management Alliance (NAILSMA) Turtle and Dugong Management Strategy.

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. To implement the National Partnership Approach to Sustainable Indigenous Hunting of Dugongs and Turtles, the development of a protocol for management agencies and Indigenous communities to work together to achieve conservation outcomes is desirable.

Feasibility

The project is highly feasible. Traditional Owner groups are currently negotiating protocols and management principles for various land tenures (for example protected areas). Groups are continually increasing their capacity for data collection, data management (for example Geographic Information Systems) and information exchange. Some large region forums have operated in the past (for example Sea Forum with participants from all coastal Traditional Owner groups south of Cooktown).

Are appropriate methods developed and tested?	Yes
Are appropriately skilled people and equipment available?	Yes
Is there sufficient time to produce useful results?	Yes

Approximate Cost

> \$100 000

- Salary
- Travel

Time Required

Two years to complete, results at end of project.

Links to Research Needs for Protection and Management of the Great Barrier Reef Marine Park (GBRMPA, 2005)

[What research and management protocols are appropriate to support Indigenous engagement and partnerships on issues of Indigenous use of marine resources and cultural heritage, and use of information in management decisions?](#)

Priority - High

Urgency 1 - 3 years

[What are the direct, indirect and potential impacts of Indigenous hunting on dugongs and what level of hunting is sustainable?](#)

Priority – Critical

Urgency 1 - 3 years

Project No. 3

Title

Variation in dugong fecundity

Objectives

1. Document spatial and temporal variation in dugong calving rates in an attempt to generate hypotheses to explain the patterns observed
2. 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. Thus this project will provide feedback on dugong status over the whole Torres Strait to Moreton Bay region.

Feasibility

This could be conducted as a desktop study using data from dugong aerial surveys available from James Cook University and University of Queensland.

Are appropriate methods developed and tested?	Yes
Are appropriately skilled people and equipment available?	Yes
Is there sufficient time to produce useful results?	Yes

Approximate cost

\$5000 – \$20 000

- Salary

Time required

One year to complete, results available immediately.

Links to Research Needs for Protection and Management of the Great Barrier Reef Marine Park (GBRMPA, 2005)

[What is the status of dugongs: life history parameters?](#)

Priority – High Urgency 3 - 5 years

[What are the direct, indirect and potential impacts of pollutants, including bioaccumulation of pollutants, on dugongs?](#)

Priority – Medium Urgency 3 - 5 years

[What are the direct, indirect and potential impacts of diseases on dugongs?](#)

Priority – Low Urgency 3 - 5 years

Project No. 4

Title

Improving the knowledge of dugong distribution through analysis of historic catch and effort information

Objectives

1. Assess the availability and quality of catch information for dugongs in commercial gill nets in Queensland waters
2. Evaluate the use of such catch information for broad-scale monitoring of dugong distribution
3. Collate the available historic catch and effort information for dugongs to identify trends in distribution.

Relevance

The project is likely to result in information that will directly assist in maintaining or enhancing dugong numbers outside the Dugong Protection Areas (DPAs). Involvement of the fishing 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. 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 by-catch. Over the past thirty years, a level of trust has been built up between commercial fishers and staff of the Northern Fisheries Centre (NFC). It is therefore likely that the cooperation required will be obtained, particularly if the fishers are directly involved in the project.

Are appropriate methods developed and tested?	Yes
Are appropriately skilled people and equipment available?	Yes
Is there sufficient time to produce useful results?	Yes

Approximate cost

\$20 000

- Salary

Time required

One year

Links to Research Needs for Protection and Management of the Great Barrier Reef Marine Park (GBRMPA, 2005)

[What is the temporal and spatial distribution of fishing activities in the Great Barrier Reef Marine Park, with respect to the incidental take of non-target \(for example by-product and by-catch\) species in fisheries?](#)

Priority – High

Urgency 3 - 5 years

[What are the direct, indirect and potential impacts of incidental catch in fisheries on dugongs, and methods \(for example pingers\) to mitigate those effects?](#)

Priority – Critical

Urgency 1 - 3 years

[What species of conservation concern \(for example dugong, turtles, dolphins, whales, sea snakes and syngnathids\) are at risk from fishing activities in the Great Barrier Reef Marine Park, how great is that risk and what is the recovery from such impacts?](#)

Priority – High

Urgency 3 - 5 years

[What highly vulnerable species are at risk from fishing activities in the Great Barrier Reef Marine Park, how great is that risk and what is the recovery from such impacts?](#)

Priority – High

Urgency 3 - 5 years

Project No. 5

Title

Community knowledge of local dugong populations and movements

Objectives

1. Encourage community participation and ownership in the management of dugong populations at local and regional scales
2. Gather and collate knowledge of local dugong populations and geographical movements from representative samples of community participants through the use of local patch knowledge from the Torres Strait to Moreton Bay over a 12-month period
3. Analyse and present the data at local and regional scales for the southern and northern dugong populations.

Relevance

Will provide feedback on dugong status over the whole Torres Strait to Moreton Bay region.

Feasibility

Are appropriate methods developed and tested?	Yes
Are appropriately skilled people and equipment available?	Yes
Is there sufficient time to produce useful results?	Yes

Approximate cost

\$20 000 – \$50 000

- Salary
- Travel

Time required

One year to complete, results available immediately.

Links to Research Needs for Protection and Management of the Great Barrier Reef Marine Park (GBRMPA, 2005)

[What are the social, cultural, economic and natural resource management issues relating to Indigenous hunting and fishing in the Great Barrier Reef?](#)

Priority - Critical Urgency 1 - 3 years

[What are the community attitudes, perceptions, concerns and needs with respect to the use and management of the Great Barrier Reef?](#)

Priority – Critical Urgency 1 - 3 years

Project No. 6

Title

Development of a population model for dugongs in the Great Barrier Reef Marine Park, Torres Strait and south-east Queensland

Objectives

1. Design and validate a population model for the dugong in the Great Barrier Reef, Torres Strait, Great Sandy Marine Park and Moreton Bay Marine Park
2. Supply an operational system for modelling the dugong population, including all data, scripts and files used to model the dugong population
3. Install and test the system and provide relevant documentation for training and system operation
4. Train management agency personnel in the use of the model for modelling the dugong population.

Relevance

Likely to result in information which will directly assist in maintaining or enhancing dugong numbers and provide further information to inform modellers elsewhere in Australia where dugongs are found.

Feasibility

Are appropriate methods developed and tested?	Yes
Are appropriately skilled people and equipment available?	Yes
Is there sufficient time to produce useful results?	Yes

Approximate cost

\$150 000

- Salary

Time required

Three years to complete, results at end of project.

Links to Research Needs for Protection and Management of the Great Barrier Reef Marine Park (GBRMPA, 2005)

[What is the status of dugongs: life history parameters?](#)

Priority – High Urgency 3 - 5 years

[What are the status and trends in distribution and abundance of dugongs?](#)

Priority – Critical Urgency 1 - 3 years

[What is the status of dugongs; movements/behavioural patterns?](#)

Priority – High Urgency 3 - 5 years

[What are appropriate performance indicators for assessing the effectiveness of management actions for the conservation of dugongs?](#)

Priority – High Urgency 1 - 3 years

Project No. 7

Title

Detailed analysis of dugong live strandings and carcasses in Queensland

Objective

Identify spatial and temporal patterns and trends in dugong live strandings and carcasses in Queensland.

Relevance

This desktop study is likely to raise awareness about mortality factors impacting upon Queensland's dugong population and result in information that will directly assist management actions that will enhance the success of dugong conservation in Queensland.

Data on dugong live strandings and carcasses is collected through the Queensland Marine Mammal and Turtle Stranding Program and is entered into the Queensland Parks and Wildlife Service's StrandNet database. Annual stranding and mortality reports are generated, but a detailed analysis is required to be of most use to managers.

Feasibility

Are appropriate methods developed and tested?	Yes
Are appropriately skilled people and equipment available?	Yes
Is there sufficient time to produce useful results?	Yes

Approximate cost

\$5000 – \$20 000

- Salary

Time required

One year to complete, results available immediately.

Links to Research Needs for Protection and Management of the Great Barrier Reef Marine Park (GBRMPA, 2005)

[What are the status and trends in distribution and abundance of dugongs?](#)

Priority – Critical

Urgency 1 - 3 years

Project No. 8

Title

Large-scale aerial surveys of dugongs

Objective

To survey the following areas on a five-year cycle:

- (1) Between Cooktown and the Queensland/ Northern Territory border including Torres Strait, with supplementary surveys of several important dugong habitats on the east coast of Queensland, south of Cairns
- (2) Between the Queensland/New South Wales border and Cairns with index blocks in Torres Strait.

Relevance

Much of the information used to manage dugong populations in north-eastern Australia has been provided by aerial surveys conducted since the mid 1980s using standardised techniques. These surveys have been used to identify the most important dugong areas as a basis for conservation planning, and have provided snapshot population estimates which have been used to estimate sustainable levels of anthropogenic mortality as a basis for comparison with estimates of actual anthropogenic mortality. The potential for the surveys to provide sound scientific advice is confounded by the capacity of the dugong to undertake large-scale movements. Surveys need to be conducted simultaneously across jurisdictions to provide an essential component of the science required to implement the *Sustainable Harvest of Marine Turtles and Dugongs in Australia – A National Partnership Approach 2005* in the regions where harvests are believed to be highest.

Feasibility

Are appropriate methods developed and tested?	Yes
Are appropriately skilled people and equipment available?	Yes
Is there sufficient time to produce useful results?	Yes

Approximate cost

> \$100 000

- Aeroplane
- Equipment
- Travel
- Salary

Time required

Ongoing: useful information in progress reports.

Links to Research Needs for Protection and Management of the Great Barrier Reef Marine Park (GBRMPA, 2005)

[What are the status and trends in distribution and abundance of dugongs?](#)

Priority – Critical Urgency 1 - 3 years

[What is the status of dugongs: movements/behavioural patterns?](#)

Priority – High Urgency 3 - 5 years

[What are appropriate performance indicators for assessing the effectiveness of management actions for the conservation of dugongs?](#)

Priority – High Urgency 1 - 3 years

[What are the best locations for transit lanes to protect key habitat areas \(for example Dugong Protection Areas\) of dugongs?](#)

Priority – Low Urgency 3 - 5 years

Project No. 9

Title

Important dugong mating areas in the Torres Strait to south-east Queensland region

Objective

1. Determine whether dugongs regularly use particular areas for mating by conducting a systematic programme of interviews with Traditional Owners
2. Analyse these areas to determine what environmental parameters influence dugong mating.

Relevance

Specialised areas used for mating activities are of high conservation value and protection of such areas should be a management priority. Anecdotal evidence suggests that dugongs use shallow reefal and inshore areas for mating but there is little information on specific localities.

Feasibility

Are appropriate methods developed and tested?	Yes
Are appropriately skilled people and equipment available?	Yes
Is there sufficient time to produce useful results?	Yes

Approximate cost

\$20 000 - \$50 000

- Salary

Time required

Two years to complete, useful results in progress reports.

Links to Research Needs for Protection and Management of the Great Barrier Reef Marine Park (GBRMPA, 2005)

[What is the status of dugongs: movements/behavioural patterns?](#)

Priority – High

Urgency 1 - 3 years

Project No. 10

Title

The risk of boat strike to dugongs

Objective

Determine what factors influence the risk of boat strike to dugongs by observing the behavioural response of dugongs to boats by using an aerial observation platform (the blimp-cam), and conducting controlled experiments to test the effects of the following variables:

- Boat type (size, hull design, engine type)
- Boat speed
- Water depth
- Water turbidity.

Relevance

Boat strikes have become one of the main threats to dugongs on the urban coast of Queensland. Recent work on the behavioural response of dugongs to boats suggested that the main factor influencing the risk of boat strikes to dugongs is boat speed (Hodgson 2005). This theory needs to be examined further so that managers can adequately assess the risk of boat strikes in various locations, and determine what measures can be taken to minimise this risk.

Feasibility

Are appropriate methods developed and tested?	Yes
Are appropriately skilled people and equipment available?	Yes
Is there sufficient time to produce useful results?	Yes

Approximate cost

\$20 000 - \$50 000

- Boat time
- Equipment

Time required

One year to complete, results available immediately.

Links to Research Needs for Protection and Management of the Great Barrier Reef Marine Park (GBRMPA, 2005)

[What are the direct, indirect and potential impacts of vessel and aircraft traffic on dugongs?](#)

Priority – Medium Urgency 3 - 5 years

[What are the direct, indirect and potential impacts of tourism and recreational activities on dugongs?](#)

Priority – Low Urgency 3 - 5 years

[What are the direct, indirect and potential impacts of coastal development on dugongs?](#)

Priority – Medium Urgency 3 - 5 years

Project No. 11

Title

Reduction of threats of commercial fishing nets to dugong

Objectives

1. Identify, investigate, evaluate and make management recommendations on mitigation devices, suitable for use in commercial nets, that reduce interactions between nets and dugong
2. Identify, investigate, evaluate and make management recommendations on alternative net construction, deployment or practices in commercial netting, that reduce interactions between nets and dugong
3. Identify, investigate, evaluate and make management recommendations on alternative fishing methods to net fishing, which reduce or eliminate threats to dugong.

Relevance

Likely to result in information that will directly assist in maintaining or enhancing dugong numbers outside the Dugong Protection Areas.

Feasibility

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

Approximate cost

> \$100 000

- Equipment for field experiments
- Boat time
- Salary

Time required

Three years or more, useful results in progress reports.

Links to Research Needs for Protection and Management of the Great Barrier Reef Marine Park (GBRMPA, 2005)

[What are the direct, indirect and potential impacts of incidental catch in fisheries on dugongs, and methods \(for example 'pingers'\) to mitigate those effects?](#)

Priority – Critical

Urgency 1 - 3 years

[How can by-catch mitigation devices \(for example trawls, by-catch reduction devices, turtle excluder devices and 'pingers'\) be improved to reduce the by-catch of incidental species and the impact of fishing?](#)

Priority – High

Urgency 3 - 5 years

[What is the status of dugongs: anatomy and physiology \(for example physiological and auditory acuity in species adversely affected by vessels and the effectiveness of 'pingers'\)?](#)

Priority – High

Urgency 1 - 3 years

[What species of conservation concern \(for example dugong, turtles, dolphins, whales, sea snakes and syngnathids\) are at risk from fishing activities in the Great Barrier Reef Marine Park, how great is that risk and what is the recovery from such impacts?](#)

Priority – High

Urgency 3 - 5 years

[What highly vulnerable species are at risk from fishing activities in the Great Barrier Reef Marine Park, how great is that risk and what is the recovery from such impacts?](#)

Priority – High

Urgency 3 - 5 years

Project No. 12

Title

Aerial monitoring of responses of dugongs to underwater explosions at Triangular Island, in the Shoalwater Bay Defence Training Area

Objective

Determine short-term (minutes-hours-days) responses by dugongs to detonations conducted in the intertidal zone of Triangular Island during Department of Defence training exercises.

Relevance

The Department of Defence funded a project to determine the propagation of noise and pressure waves from underwater explosions conducted at intertidal sites on Triangular Island during occasional Clearance Diver training courses (Box et al. 2000). The aim was to predict the impact of explosions on dugongs and determine the distance at which dugong would be safe from anatomical injury from the explosions. Aerial monitoring of dugongs during Defence exercises will yield valuable information on dugong behavioural responses to the noise of detonations, and can also detect any inadvertent dugong death (although such impacts are considered highly unlikely based on all current evidence). Mortality should be readily detectable since the carcass will quickly become buoyant and rise to the surface due to rapid stomach and intestinal bacterial gas production.

Feasibility

Experienced observers using high wing light aircraft can successfully monitor dugong numbers and movements across relatively large areas containing shallow water seagrass feeding grounds, such as those within Shoalwater Bay. Key factors influencing the success of this method are wind strength and direction, since these can increase wave action and water turbidity and hence lower dugong sighting frequency and counting accuracy. To optimise dugong monitoring success with respect to local weather conditions during Clearance Diver training, the precise timing, location and type of the training detonations will be closely coordinated with the series of before, during and post-detonation flights undertaken for this project. Consideration would also be given to fitting several dugongs with GPS and satellite transmitters some two weeks before the detonations and tracking their movements and habitat use before and after the detonations.

Are appropriate methods developed and tested?	Yes
Are appropriately skilled people and equipment available?	Yes
Is there sufficient time to produce useful results?	Yes

Approximate Cost

> \$50 000

- Aeroplane
- GPS and satellite tracking gear

Time Required

One year to complete.

Links to Research Needs for Protection and Management of the Great Barrier Reef Marine Park (GBRMPA, 2005)

[What are the direct, indirect and potential impacts of noise on dugongs?](#)

Priority – Medium

Urgency 3 - 5 years

[What is the status of dugongs: anatomy and physiology \(for example physiological and auditory acuity in species adversely affected by vessels and the effectiveness of 'pingers'\)?](#)

Priority – High

Urgency 1 - 3 years

[How can by-catch mitigation devices \(for example trawls, by-catch reduction devices, turtle excluder devices and 'pingers'\) be improved to reduce the by-catch of incidental species and the impact of fishing?](#)

Priority – High

Urgency 3 - 5 years

Project No. 13

Title

Assessment of 'pingers' or other deterrent devices in reducing dugong and inshore dolphin interaction and catch in the commercial net fishery

Objective

Identify, investigate, evaluate and make management recommendations on the effectiveness of 'pingers' or other deterrent devices in reducing dugong and inshore dolphin interaction and catch in the commercial net fishery.

Relevance

Likely to enable management action which will enhance success of Dugong Protections Areas (DPAs) and reduce risk of entanglements outside of DPAs.

Feasibility

Are appropriate methods developed and tested?	Yes
Are appropriately skilled people and equipment available?	Yes
Is there sufficient time to produce useful results?	Yes

Approximate cost

> \$100 000

- Boat time
- Equipment

Time required

Two years to complete, results at end of project.

Note – The GBRMPA has for the last 12 months, been considering conducting a workshop with other Government Departments and researchers with expertise and experience in the field of 'pingers' and commercial nets. Preliminary discussions regarding such a workshop have occurred with Helene Marsh and Department of Primary Industries and Fisheries. The intended aim of the workshop is to exchange ideas on knowledge and work to date on 'pingers' throughout Northern Australia and identify information gaps and research priorities with respect to commercial netting in the Great Barrier Reef World Heritage Area. It was hoped if possible that the workshop participants could provide management advice on the best and most responsible use of 'pingers' on nets at the present time. Such a workshop could provide a first step in the implementation of this project proposal.

Links to Research Needs for Protection and Management of the Great Barrier Reef Marine Park (GBRMPA, 2005)

[What are the direct, indirect and potential impacts of incidental catch in fisheries on dugongs, and methods \(for example 'pingers'\) to mitigate those effects?](#)

Priority – Critical

Urgency 1 - 3 years

Project No. 14

Title

Management of Dugong Watching Tourism

Objective

Identify, investigate, evaluate and make management recommendations to ensure a sustainable commercial dugong watching industry.

Relevance

The *Nature Conservation Act 1992* has been reviewed which enables commercial dugong watching to occur in some state marine parks.

Feasibility

Are appropriate methods developed and tested?	Yes
Are appropriately skilled people and equipment available?	Yes
Is there sufficient time to produce useful results?	Yes

Approximate cost

\$20 000 to \$50 000

- Boat time
- Equipment

Time required

Two years to complete, results at end of project.

Links to Research Needs for Protection and Management of the Great Barrier Reef Marine Park (GBRMPA, 2005)

[What alternative management strategies and arrangements \(for example critical approach distances\) are suitable for the enhanced protection of seabird nesting and roosting, high use sites, dugongs and turtles, and threatened species?](#)

Priority – High

Urgency 1 - 3 years

[What performance indicators are suitable to assess the effectiveness of management actions for the conservation of species of conservation interest \(for example dugong, turtle, Humpback and Dwarf Minke Whales\)? How can these performance indicators be implemented?](#)

Priority – High

Urgency 1 - 3 years

[Who is using the Great Barrier Reef Marine Park, where and how, and what impact does this have on key breeding sites for seabird nesting and roosting, high use sites, turtle and dugong and other threatened species?](#)

Priority – High

Urgency 1 - 3 years

[What are the direct, indirect and potential impacts of noise on dugongs?](#)

Priority – Medium

Urgency 3 - 5 years

[What are the direct, indirect and potential impacts of vessel and aircraft traffic on dugongs?](#)

Priority – Medium

Urgency 3 - 5 years

[What are the direct, indirect and potential impacts of tourism and recreational activities on dugongs?](#)

Priority – Low

Urgency 3 - 5 years

Project No. 15

Title

Assessment of the effectiveness of voluntary transit lanes in the Hinchinbrook Area and statutory 'go slow' areas in Moreton Bay Marine Park and the Great Sandy Marine Park

Objective

Assess, in consultation with the local community, the extent of compliance with existing voluntary boat transit lanes and obtain recommendations for any changes.

Relevance

Likely to provide relevant information, but may not be immediately useful to management of dugongs.

Feasibility

Are appropriate methods developed and tested?	Yes
Are appropriately skilled people and equipment available?	Yes
Is there sufficient time to produce useful results?	Yes

Approximate cost

\$60 000

- Boat time
- Salary

Time required

One to three years, results at end of project.

Links to Research Needs for Protection and Management of the Great Barrier Reef Marine Park (GBRMPA, 2005)

[What are the best locations for transit lanes to protect key habitat areas \(for example Dugong Protection Areas\) of dugongs?](#)

Priority – Low Urgency 3 - 5 years

[What are the direct, indirect and potential impacts of vessel and aircraft traffic on dugongs?](#)

Priority – Medium Urgency 3 - 5 years

Project No. 16

Title

Fine scale habitat use by dugongs in areas of high human use along the urban coast of Queensland

Objective

1. Use GPS technology to track the movement of individual dugongs at a fine scale (tens of metres) within habitats that have high levels of human use in the Great Barrier Reef World Heritage Area
2. Determine the influence of human activities on the movement of these animals
3. Provide information for management planning in these areas.

Relevance

Information on dugong movement patterns in relation to human use areas will provide direct information on how and what human activities affect dugong distribution and the activities likely to displace dugongs from their important habitat areas.

Feasibility

Capture:mark:recapture studies are already occurring in Moreton Bay and improvements in satellite technology have meant the fine scale habitat use by dugongs is achievable.

Are appropriate methods developed and tested?	Yes
Are appropriately skilled people and equipment available?	Yes
Is there sufficient time to produce useful results?	Yes

Approximate cost

> \$100 000

- Equipment
- Boat time

Time required

Three years or more, useful results in progress reports.

Links to Research Needs for Protection and Management of the Great Barrier Reef Marine Park (GBRMPA, 2005)

[What is the status of dugongs: movements/behavioural patterns?](#)

Priority – High Urgency 1 - 3 years

[What are the status and trends in distribution and abundance of dugongs?](#)

Priority – Critical Urgency 1 - 3 years

Project No. 17

Title

Economics of Indigenous hunting and its management

Objectives

1. To apply the hybrid economy framework (customary [non-market] state and market sectors) to an investigation of the economics of the Indigenous harvest of turtles and dugongs in the Torres Strait and Northern Peninsula Area (NPA)
2. To investigate the economic costs and benefits (including social and health benefits) of management options available within this framework including the possible role of payment for environmental services (PES).

Relevance

Many remote Indigenous communities rely on the dugong as an important source of meat and oil and invest considerable resources in dugong hunting. Controls on the number of dugongs caught would be at high social and economic cost to the community. These costs have not been quantified to date and there may be considerable economic costs and benefits (including social and health benefits) by paying communities for providing environmental services such as caring for country.

Feasibility

This project will involve the new application of established techniques. This will include participant observation and management organisations and a sample of communities actively engaged in marine turtle and dugong harvesting; evaluation of the direct contribution of customary harvesting to livelihoods and to social life; and examination of indirect and induced benefits from payment to Islanders for environmental services and an examination of costs and benefits of strategies developed by Torres Strait NAILSMA- Marine Turtle and Dugong Management project and proposed by Project 18.

This project will be funded by the Marine and Tropical Science Research Facility from 2007-2009.

Are appropriate methods developed and tested?	Yes
Are appropriately skilled people and equipment available?	Yes
Is there sufficient time to produce useful results?	Yes

Approximate cost

> \$100 000

Time required

Three years, results at end of project.

Links to Research Needs for Protection and Management of the Great Barrier Reef Marine Park (GBRMPA, 2005)

[What are the direct, indirect and potential impacts of Indigenous hunting on dugongs and what level of hunting is sustainable?](#)

Priority – Critical

Urgency 1 - 3 years

[What are the cumulative impacts on the environment and stakeholder groups of existing developments \(to facilitate more informed decision-making regarding new developments: for example aquaculture, marinas, research stations/activities, volume of boats, Indigenous hunting, whale watching\)?](#)

Priority – High

Urgency 3 - 5 years

Project No. 18

Title

Culturally and ecologically sustainable Indigenous hunting

Objective

To develop and quantify options for the management of Indigenous hunting of dugongs and turtles on the basis of community acceptance, cost and cultural and ecological sustainability.

Relevance

The management of dugong and turtle hunting conducted by remote communities needs to be culturally appropriate, ecologically effective, logistically achievable and cost effective. This research would feed into the TUMRA process and the processes being developed to manage the harvest of dugongs and green turtles by Torres Strait communities.

Feasibility

The project would be based on a novel combination of established techniques including community based cultural mapping to record Indigenous knowledge relevant to the management of dugongs and turtles at a local sea country-based scale; interviews with hunters about their concerns regarding dugongs and turtles and their management; focus groups with hunters in major dugong and turtles hunting communities; and an assessment of cultural and ecological sustainability of options using results of: (1) cultural mapping and (2) focus groups and interviews with hunters and spatial data sets of the distribution of dugongs, turtles and seagrass obtained from the aerial surveys.

Are appropriate methods developed and tested?	Yes
Are appropriately skilled people and equipment available?	Yes
Is there sufficient time to produce useful results?	Yes

Approximate cost

> \$100 000

Time required

Three years, results mainly at end of project.

Links to Research Needs for Protection and Management of the Great Barrier Reef Marine Park (GBRMPA, 2005)

[What are the direct, indirect and potential impacts of Indigenous hunting on dugongs and what level of hunting is sustainable?](#)

Priority – Critical

Urgency 1 - 3 years

Project No. 19

Title

Auditory characteristics of the dugong ear

Objective

Determine the auditory characteristics of the dugong ear with respect to its acoustic capabilities and sensitivity to pressure wave injury.

Relevance

This project forms part of the dugong research program being funded by the Department of Defence to assess the effects of underwater explosions, which are conducted at two intertidal sites at Triangular Island during occasional Clearance Diver training courses. Part of this study has been undertaken, with Auditory Brainstem Response (ABR) measurements having already been obtained from a captured dugong at Sea World. Further ABR tests, together with an examination of shock wave impacts on the dugong ear, will add considerable information to our currently limited knowledge of dugong hearing ability. The results will therefore be valuable for auditory zoologists in general, as well as for environmental appraisals of other noise-generating activities such as boating and underwater seismic exploration by the petroleum industry.

Feasibility

Based on work already undertaken elsewhere, particularly that on the Florida manatee at the Woods Hole Oceanographic Institute, a comparative morphological and histological investigation of preserved dugong skulls and ear structures will enable the auditory characteristics to be determined. It is hoped that this project can include a manipulative study using one to two dugong heads taken from fresh carcasses. This will allow the project to provide a reliable estimate of both auditory capabilities and pressure thresholds that could injure the middle ear (a sensitive structure present in all mammals and considered the most susceptible to pressure wave damage).

Are appropriate methods developed and tested?	Yes
Are appropriately skilled people and equipment available?	Yes
Is there sufficient time to produce useful results?	Yes

Approximate Cost

> \$100 000

- Laboratory
- Travel

Time Required

One year to complete.

Links to Research Needs for Protection and Management of the Great Barrier Reef Marine Park (GBRMPA, 2005)

[What is the status of dugongs: anatomy and physiology \(for example physiological and auditory acuity in species adversely affected by vessels and the effectiveness of 'pingers'\)?](#)

Priority – High

Urgency 1 - 3 years

[What are the direct, indirect and potential impacts of noise on dugongs?](#)

Priority – Medium

Urgency 3 - 5 years

Project No. 20

Title

Seasonal changes in dugong diet

Objective

1. Analyse the diet of dugongs using modern methods of looking at stable isotope ratios, fatty acid analyses and other chemical signatures in hair and faeces
2. Apply these methods to live dugongs from various regions throughout eastern Queensland, and verify findings using carcasses from the necropsy programme
3. Determine the regional, seasonal and individual difference in dugong diets.

Relevance

Will provide basic information on biology and ecology of dugongs which could enhance longer-term management of dugongs.

Feasibility

Are appropriate methods developed and tested?	Yes
Are appropriately skilled people and equipment available?	Yes
Is there sufficient time to produce useful results?	Yes

Approximate cost

> \$100 000

- Laboratory
- Boat time

Time required

Three years or more, results at end of project.

Links to Research Needs for Protection and Management of the Great Barrier Reef Marine Park (GBRMPA, 2005)

[What major factors determine the condition of major habitat types in the Great Barrier Reef Marine Park?](#)

Priority – High

Urgency < 1 year

Project No. 21

Title

Spatial differences in the mating behaviour of dugongs

Objective

1. Investigate the mating systems within dugong populations at various locations in Australia by applying methods developed to study dugong behaviour using the blimp-cam in combination with modern genetic techniques
2. Determine whether geographic differences exist in dugong mating behaviour and what environmental parameters influence these differences.

Relevance

The limited studies to date suggest major geographical variation in the mating behaviour of dugongs ranging from lekking in Shark Bay, Western Australia to male mating herds exhibiting violent competition for single females in Moreton Bay, Queensland. An understanding of dugong mating behaviour will enhance knowledge of dugong ecology, which aids in predicting the effects of human influences.

Feasibility

Are appropriate methods developed and tested?	Yes
Are appropriately skilled people and equipment available?	Yes
Is there sufficient time to produce useful results?	Yes

Approximate cost

> \$100 000

- Boat time
- Laboratory
- Equipment

Time required

Two to three years, results at end of project.

Links to Research Needs for Protection and Management of the Great Barrier Reef Marine Park (GBRMPA, 2005)

[What is the status of dugongs: movements/behavioural patterns?](#)

Priority - High

Urgency 1 - 3 years

[What is the status of dugongs: life history parameters?](#)

Priority - High

Urgency 3 - 5 years

Project No. 22

Title

Dugong genetics: insights into dugong social structure and fine-scale habitat use

Objective

Gain insights into dugong social structure and individual patterns of fine scale habitat use by obtaining genetic samples of live animals. This would incorporate established techniques such as mitochondrial DNA sequencing, genotyping using developed microsatellite markers, and molecular sexing to determine the identity, sex and relatedness of individuals.

Relevance

Will provide basic information on the biology and ecology of dugongs which would enhance long-term management of dugongs.

Feasibility

Genetic studies have been conducting using mitochondrial DNA and microsatellite markers on tissue samples collected from opportunistically available carcasses and from capture:mark:recapture studies.

Are appropriate methods developed and tested?	Yes
Are appropriately skilled people and equipment available?	Yes
Is there sufficient time to produce useful results?	Yes

Approximate cost

> \$100 000

- Boat time
- Laboratory

Time required

Three years or more, results at end of project.

Links to Research Needs for Protection and Management of the Great Barrier Reef Marine Park (GBRMPA, 2005)

[What is the status of dugongs: movements/behavioural patterns?](#)

Priority - High

Urgency 1 - 3 years

[What is the status of dugongs: life history parameters?](#)

Priority - High

Urgency 3 - 5 years