

Information to assist Torres Strait Islanders manage their traditional fisheries for dugongs and green turtles

Final project report prepared for the Ocean Park Conservation Foundation

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Executive summary

The purpose of this project was to collect ecological, social, economic and cultural information relevant to the development of community-based management of the traditional dugong and green turtle fisheries of Torres Strait by working with Torres Strait Islander counterparts. We successfully completed the project through working with communities on Hammond and Thursday Islands to establish a marine turtle and dugong catch monitoring project. Additional financial support for the project came from James Cook University, CRC Torres Strait and the Department of Environment and Heritage.

The project's results have greatly enhanced our knowledge of marine turtles and dugongs in Torres Strait.

Two workshops were held to train hunters. Hunters were successfully trained in turtle ovary assessment and in the measurement of turtles and dugongs. Hunters are now self assessing ovaries, and measuring hunted turtles.

An Indigenous research counterpart was employed at each of Hammond Island and Thursday Island. These Indigenous research counterparts were trained in, and involved with, all aspects of the project.

Catch monitoring of turtles and dugongs is running successfully on Hammond Island and with the TRAWQ community on Thursday Island. At Hammond Island 17 hunters registered and 92% of registered hunters participated in the survey. At Thursday Island 63 hunters registered and 25% participated in the survey.

In both Hammond and Thursday Islands, the participating hunters included the main hunters from the community. At Hammond Island two hunters accounted for 90% of the dugongs and three hunters accounted for 40% of the turtles recorded caught. On Thursday Island two hunters reported 56% of the dugongs and four hunters reported 52% of the turtles recorded caught.

For both Hammond Island and the Thursday Island group, more turtles than dugongs were caught. Fifty seven percent of the animals caught at Hammond Island were turtles and 43% were dugongs and for the Thursday Island group 64% of the animals caught were turtles and 36% were dugongs.

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Objectives

To collect ecological, social, economic and cultural information relevant to the development of community-based management of the traditional dugong and green turtle fisheries of Torres Strait by working with Torres Strait Islander counterparts.

1. Introduction

The six species of sea turtles that occur in Australian waters are all listed as threatened by the IUCN Red List 2003, the Australian *Environmental Protection and Biodiversity Conservation (EPBC) Act 1999* (C'wealth) and the Queensland *Nature Conservation Act 1992*. Dugongs are listed as vulnerable by the IUCN Red List 2003, and the Queensland *Nature Conservation Act 1992* and they are listed as Migratory and Marine species under the Australian *EPBC Act 1999*. The Indigenous fisheries for turtles and dugongs are listed as Article 22 fisheries under the Torres Strait Treaty between Australia and Papua New Guinea.

Torres Strait Islanders and Aboriginal people of Torres Strait assign dugongs and marine turtles great cultural, social, spiritual and dietary significance (Smith and Marsh, 1990; Johannes and MacFarlane, 1991; Bradley 1997). Dugongs and turtles also form the basis of subsistence economies in most Indigenous communities in Torres Strait (Kwan *et al.*, in press).

As a signatory to international conventions and adoption of their principles in legislation, Australia has obligations to balance the conservation of dugongs and turtles and the conservation of Indigenous culture of dugong and turtle hunting. The availability of data required for a robust scientific assessment of the sustainability of dugongs and marine turtles in Torres Strait are limited. Data limitations include, catch rates of dugongs and turtles, geographic ranges of stocks and population sizes in Torres Strait.

In addition to data limitations, the dugong and turtle fisheries are currently essentially unregulated. Limited efforts have been made by research groups or Government agencies to engage Torres Strait Islanders in the collection of the data required to manage the fisheries under both western scientific and traditional ecological knowledge frameworks. Such engagement is vital to the preparation of culturally and ecologically sensitive management strategies for marine turtles and dugongs in Torres Strait and is especially relevant to a successful implementation of Australian Government Policy as outlined in *Sustainable Harvest of Turtles and Dugongs in Australia – a National Approach*.

In Torres Strait, Indigenous people have considerable traditional knowledge of sea turtles and dugongs at a local scale. However, most Islanders do not appreciate the larger spatial and temporal scales at which these animals operate, because they have not been exposed to the tools and techniques employed by western scientists (e.g. aerial surveys, satellite telemetry). In addition, experience elsewhere shows that the results of western scientific research are more likely to be accepted if Indigenous people are involved in actual collection of the data (e.g. Kennett *et al.*, 2004). Active involvement in monitoring their traditional harvest also helps Indigenous people to: (1) understand the implications of their level of harvest, (2) evaluate the effectiveness of their management strategies, and (3) help design changes as necessary. Thus monitoring has the potential to provide important feedback to communities about the value and effectiveness of managing their turtle and dugong fisheries.

1.1 Aims of the project

To collect ecological, social, economic and cultural information relevant to the development of community-based management of the traditional dugong and green turtle fisheries of Torres Strait by working with Torres Strait Islander counterparts to:

1. Trial and scientifically verify different methods of community-based monitoring of catches of dugongs and green turtles with a view to developing correction factors for methods that are both culturally-appropriate and scientifically robust.
2. Describe the composition of the dugong and green turtle catch of the study communities in terms of sex and reproductive status.
3. Evaluate the selectivity of turtle catches by comparing the catch data on the community composition of turtles in major hunting areas collected by Hamann in a companion project.

The last two aims of the project about socio-economic factors affecting hunting and the potential to use the tusks of dugongs to provide a record of major life history events were not done because hunters preferred to concentrate on community-based catch-monitoring and other aspects of the project were completed instead.

2. Background

2.1 Why monitor dugongs and turtles?

The status of an animal population can be determined by several techniques including: (1) monitoring trends in abundance and (2) various modelling techniques especially population viability analysis (Taylor and Gerrodette, 1993). Both of these methods require data sets on life history parameters, mortality, survivorship, growth and behaviour. In general, monitoring changes in abundance is not the most reliable way to evaluate whether management intervention is needed because the change has to be very large, or occur quickly to be detected (Taylor and Gerrodette, 1993; Wade, 1998). Furthermore, for long-lived animals such as sea turtles and dugongs, by the time significant changes in abundance have occurred it is often hard to re-build population levels (e.g. green turtles in South-East Asia (Seminoff 2002), hawksbills (see Special edition of *Chelonian Conservation Biology* Vol 3; No. 2)).

In Australia, the dugong, *Dugong dugon*, has a panmictic genetic structure (Brenda McDonald *personal communication*). Individuals move large distances (hundreds of kilometres) with high spatial and temporal variability. Therefore the abundance of dugongs in any given region is naturally variable through time, further complicating the detection of population trends (Marsh *et al.*, 2004a, b; Gales *et al.*, 2004). Therefore declines in dugong abundance are unlikely to be detected until a population is seriously depleted and population census work in one foraging area is unlikely to provide accurate estimates of population abundance (Heinsohn *et al.*, 2004; Marsh *et al.*, 2004a, b).

For dugongs the Potential Biological Removal (PBR) technique has been used to estimate a sustainable level of anthropogenic mortality from all causes including Indigenous hunting (Marsh *et al.*, 2004b). The PBR is the maximum number of animals, excluding natural mortality, which may be removed sustainably from a marine mammal population (Wade, 1998). A PBR evaluation of the sustainability of anthropogenic mortality requires at least three sets of data: (1) an accurate estimate of population size, which for dugongs is typically estimated using aerial surveys, (2) the rate of increase for the population, which can be obtained from demographic information (see Marsh *et al.*, 2004b) and (3) the level of anthropogenic mortality.

For turtles, it is difficult to estimate a sustainable catch rate because of the difficulties associated with estimating population size (Limpus, 2002). Marine turtles show strong site fidelity to particular foraging areas, only migrating for breeding (Plotkin, 2003). However, studies that address population characteristics such as sex ratios and breeding rates over a series of foraging areas can provide valuable data from which to estimate population trends (Hamann *et al.*, 2002; Limpus and Limpus, 2003). For example, population modelling can be used to derive estimates of growth functions, age estimates, annual survivorship and recruitment rates and rates of change in population size. These sets of data can provide valuable information on population status, such data are not available for the northern Great Barrier Reef (GBR)/Torres Strait green turtle population.

Some of the data sets necessary for assessing population status are available, such as life history parameters and behaviour. Nevertheless, effective assessment and monitoring of the status of dugong and marine turtle populations will require estimation of anthropogenic mortality, baseline data on catch statistics and, for turtles, foraging area population dynamics and hatchling production (nest success). The former can be boosted by including data on turtles that are harvested. With appropriate training Indigenous hunters can collect valuable data on species, sex, size, maturity and breeding history from the turtles they hunt. Monitoring harvested turtles

can, therefore, provide a better understanding of the biological characteristics of the turtle population as well as the size of the catch.

2.2 Interactions between the dugong and turtle fisheries

Monitoring the catch of both dugongs and green turtles is necessary because both species are hunted together in the western islands of Torres Strait, using similar equipment. When a single species is targeted, hunting pressure should decline with the density of the prey species because it takes longer to find animals when the density is low. Thus hunting *per se* is unlikely to drive a species to extinction except when hunting targets more than one species (Bomford and Caughley, 1996) or the desired species is of substantial economic or cultural importance. In the first case, hunting of any target species is expected to cease only when the combined density of all target species is so low that hunting is not worthwhile. In the second case, the density at which hunting is not worthwhile is likely to be very low because of the substantial economic and/or cultural rewards associated with catching the target species. Turtles are considered to be naturally more abundant than dugongs in the Western Islands of Torres Strait. Therefore, unregulated opportunistic hunting of dugongs would be likely to continue until the abundance of turtles became low because dugongs could still be found while hunting for turtles despite their numbers declining (Marsh *et al.*, 1997). Hence the two species need to be managed simultaneously.

Similarly, either species may be caught incidentally during fishing activities targeting other species. For example, Kwan (1991, 2002) reported a negative relationship between landings of crayfish and dugong hunting at Mabuiag Island and Kwan *et al.* (in press) suggested that the hybrid nature of the local economy influenced this relationship. The hybrid economy consists of subsistence, state and commercial sectors (Altman and Cochrane 2003). When the amount and/or price of crayfish are low, greater subsistence hunting of dugongs may be necessary. In addition, when crayfish are abundant and/or prices are high, the resultant income may be used to buy better or additional dinghies and/or fuel, which can be used to hunt dugongs and turtles (Kwan *et al.*, in press). The interaction between dugong and turtle hunting and fishing for crayfish warrants further investigation in other Torres Strait communities.

2.3 Attempts to monitor the harvest of dugongs and turtles in Torres Strait

Projects to estimate the traditional catch of turtles in this region first began in the 1970s (Kowarsky 1982). However the most detailed surveys of dugong and turtle harvests in the Torres Strait Protected Zone (TSPZ) were started by CSIRO (funded by Australian Fisheries Management Authority (AFMA)) in 1991-1993 and continued by AFMA in each of 1993-1996 and 1996-2000/01. A survey method in which local Indigenous roving observers, based on Thursday Island, systematically monitored the 14 different island communities in the TSPZ for periods of 3-7 days throughout the year was used (Dews *et al.*, 1993). Sampling was stratified according to the contribution of the community to the total catch landed each year (Harris *et al.*, 1997). The number of sampling days for the TSPZ was doubled during the 1996-2000/01 survey (to 250 days in 2000/01) because of concerns about the low precision of the catch estimates. The observers collected information on the fishing activities (method, catch, composition, effort, location, boats, fishers, weather and tide), which was used to estimate the catch, effort and participation for the year (Harris *et al.*, 1997; Skewes *et al.*, 2002).

AFMA also ran a school based catch-monitoring project for dugongs and turtles from 1990-1999. School children from the various communities recorded dugong and turtle catches on calendars. This project had an excellent educational and extension role and the data were useful for comparisons amongst islands and identifying changes through time. However, the provision of reliable annual catch estimates was limited because of problems with precision and bias

(Skewes, *et al.*, 2002), which were improved through time with more emphasis on extension visits.

Kwan (2002) was based on Mabuiag Island in 1998 and 1999, and conducted a census of the catch of dugongs from 1 January 1998 – 31 October 1999 (except for the month of February in 1998 and 31 January – 1 March 1999). Kwan interviewed hunters and collected biological samples from dugongs caught by Mabuiag hunters. Hunters provided information on: the duration of their hunting trips; the location of hunting; the number in the hunting party; the number and sex of dugongs caught and, how the catch was used or distributed.

Kwan's study at Mabuiag Island (Kwan 2002) showed that continuous monitoring within a community produced more reliable data than periodic sampling in individual communities in Torres Strait. The reliability of periodic sampling is reduced because many factors influence hunting effort and success, making catches very variable through time. For example, the frequency distribution of catches of both dugongs and turtles in Torres Strait is very skewed towards days with no hunting or zero catches and there are relatively few days when large numbers of animals are caught (Kwan, 2002; Skewes *et al.*, 2002). Such variability makes it very difficult to obtain reliable estimates of total catch from periodic sampling. For example, in 1998 at Mabuiag Island, different catch-estimates of dugongs were obtained from sampling compared with continuous counts. CSIRO/AFMA estimated that 0.14 dugongs per day were caught based on 29 days of sampling (Skewes *et al.*, 2002) and in contrast Kwan (2002) estimated that 0.40 dugongs per day were caught based on 324 days of sampling.

It would be prohibitively expensive to employ independent government-funded observers to sample every community every day, as in Kwan's (2002) study. Furthermore, in some communities, where landing sites are dispersed, like on Thursday Island, it would also be logistically very difficult for independent observers to obtain a continuous count of catches of dugongs and turtles.

Essentially the CSIRO/AFMA projects, conducted over ten years, were not as successful as they could have been because they did not completely engage the community in the collection of data, rather sending independent observers to islands on sampling days. This approach was both financially expensive and limited the time and effort spent collecting data. These problems could have potentially been overcome through the development of community-based catch-monitoring programs, which are not new for marine turtles and have been used around the world for many decades (see Kinan, 2002). In addition, by staging specific sampling days the CSIRO/AFMA studies had no mechanism to ensure that the data they collected was representative and free from the bias associated with hunters changing behaviour on sampling days. In fact, the project was discontinued after 2000/01 because of the expense and difficulty in running the observer program and problems of precision, bias and coverage of the catch estimates it produced. Focus was shifted to establishing effective community-based monitoring programs (Skewes, *et al.*, 2002). AFMA held a technical catch-monitoring workshop in May 2003 to work out one or more appropriate community-based monitoring methods as discussed below (Turtle and dugong catch monitoring workshop, 2003).

The costs of community-based catch-monitoring programs will vary depending on the design and the number of people in the community. As an example, based on CDEP (Community Development Employment Project) wages of about \$13 per hour, employing eight monitors to work one day per week in a community would cost \$5408 per monitor per year. The number of monitors required and the number of days worked would depend on the size of the community. Additional costs would depend on, the capacity of the communities to undertake the work, a regional coordinator, training and infrastructure. However, communities view opportunities to

be involved with catch monitoring projects positively because these projects can make substantial contributions towards employment of islanders and improvements of social systems.

2.4 Chronology of community-based monitoring of dugongs and marine turtles in Torres Strait

The need for community-based approaches to dugong and turtle monitoring and management were stressed at the workshop *Towards Community-based Management of Dugongs and Turtles in Torres Strait* held on Thursday Island by AFMA in June 1998. The workshop was attended by Islander leaders, government management agency staff (from the Queensland Department of Primary Industries, Environment Australia, the Department of Environment, the Great Barrier Reef Marine Park Authority and Queensland Fisheries Management Authority) and technical experts and the following mission statement was developed:

“Effective community-based management of dugongs and turtles (should be) conducted in a way which maintains Ailan Kastom and ensures the long-term survival of those species as an essential component of Torres Strait Culture, Identity and sea life”.

Workshop participants agreed that achieving the above vision would involve:

- 1) empowering Torres Strait Islanders to manage their dugong and turtle resources effectively;
- 2) providing Torres Strait Islanders with the authority and capacity to manage their own affairs with respect to the management of dugongs and turtles;
- 3) clarifying the roles and responsibilities of community members of the Torres Strait Community with respect to the management of their dugong and turtle resources; and
- 4) ensuring that communities outside the region recognise the need for and commitment of Torres Strait communities to manage the dugong and turtle resources of Torres Strait.

Actions were recommended to achieve these objectives, but there was little progress.

In May 2003 a technical catch-monitoring workshop was run by AFMA on Thursday Island to discuss methods to monitor catches of dugongs and turtles in Torres Strait. The objectives of the workshop were to: develop at least one method to monitor the traditional catch of dugongs and turtles that would:

- provide the information required by the communities and management,
- be cost effective,
- provide accurate statistics,
- be culturally appropriate, and
- have a budget and staff to ensure its continuation.

At the workshop, the main information needs for dugongs and turtles were prioritised and the need for community involvement in the program was highlighted. For example, it was recognised that:

- greater community ownership was likely to lead to higher levels of involvement, more complete and accurate information gathering and greater uptake of program outcomes;
- local monitors needed to be trained and employed;
- monitors need to be adequately compensated for their time in order to provide good data and ensure some continuity of personnel to the program;
- catch-monitoring needs to be developed and implemented in a holistic way in the broader context of Indigenous management of marine resources, and
- monitors need to be involved in more activities than just monitoring of their own catch.

2.5 Scientifically robust monitoring

It is also important that monitoring of the dugong and turtle fisheries is scientifically robust so that balanced decisions can be based on reliable information using techniques such as potential biological removal and population viability analysis (Heinsohn *et al.*, 2004; Marsh *et al.*, 2004b). Moreover, it is important that hunters have confidence in the scientific advice they receive. For example, hunters are unlikely to accept management strategies reducing their catch if they are not convinced that the catch-estimate and the calculation of a sustainable catch rate are correct (Honneland, 2000). Furthermore, failure to accept the accuracy of scientific estimates is likely to lead to fewer hunters participating in catch-monitoring and/or future under-reporting of catch; consequently the accuracy of fishery-based data will decline resulting in further degradation of confidence in the scientific advice about the dugong and turtle resources (Anderson, 1984; Honneland, 2000).

2.6. Sampling bias

Scientifically robust monitoring requires catch estimates to be both accurate (close to the real value) and precise (repeatable). Precise estimates are required to track temporal changes in the catch; accurate estimates are required to determine the sustainability of the catch (Wade 1998). The precision and accuracy of a catch-estimate depends on the size of the sample. Therefore the more hunters that participate in the catch-monitoring program, the more likely the catch-estimate will be repeatable. If not all hunters participate, or they only participate some of the time, then catch-estimates can be biased. Bias can also occur if the sample of participating hunters is not representative of the community or there is under- or over-reporting of the catch by participating hunters. Bias can be more problematic than a lack of precision because it can lead to inaccurate and misleading conclusions rather than uncertain ones (Skewes *et al.*, 2002).

The representativeness of the sample affects whether the catch-estimate obtained from the sample can be legitimately extrapolated to the entire community. The group of hunters that participate may not be a representative sample if they differ in some important characteristic from non-participating hunters. This factor is particularly important if a few hunters are responsible for most of the catch as at Mabuiag in 1998-99 (Kwan, 2002; Kwan *et al.*, in press). If a sample of hunters is found not to be representative, then differences between the participants and non-participants may be measured to provide a more accurate catch-estimate. In addition, under- or over-reporting by participants may lead to the catch being under- or over-estimated. If under- or over-reporting is consistent it could be measured and corrected. However, inconsistent misreporting is problematic because bias in the catch estimates fluctuates in an unknown way through time.

3. Methods

3.1 Study communities

We based the study in the Kaiwalagal traditional sea country (Inner Islands) of Torres Strait (Figure 1), which includes the administrative centre, Thursday Island, and the smaller communities of Hammond Island, Horn Island and Prince of Wales Island. Prior to this study most dugong and turtle catch-data have been collected from the Torres Strait Protected Zone (TSPZ) and it was recognised that the Kaiwalagal communities will need a record of catches to be included in any future management arrangements developed at the community level such as catch-sharing arrangements. Furthermore, the dugong and turtle catch in the Kaiwalagal region is potentially significant compared with the TSPZ communities because of the large population centred on Thursday Island (>2000 people). It is potentially more difficult to monitor the catches of dugongs and turtles in such a large, diverse community than in smaller communities and it

was therefore important for the Kaiwalagal communities to develop strategies to help them meet the potential challenges of catch-monitoring associated with their demographics.

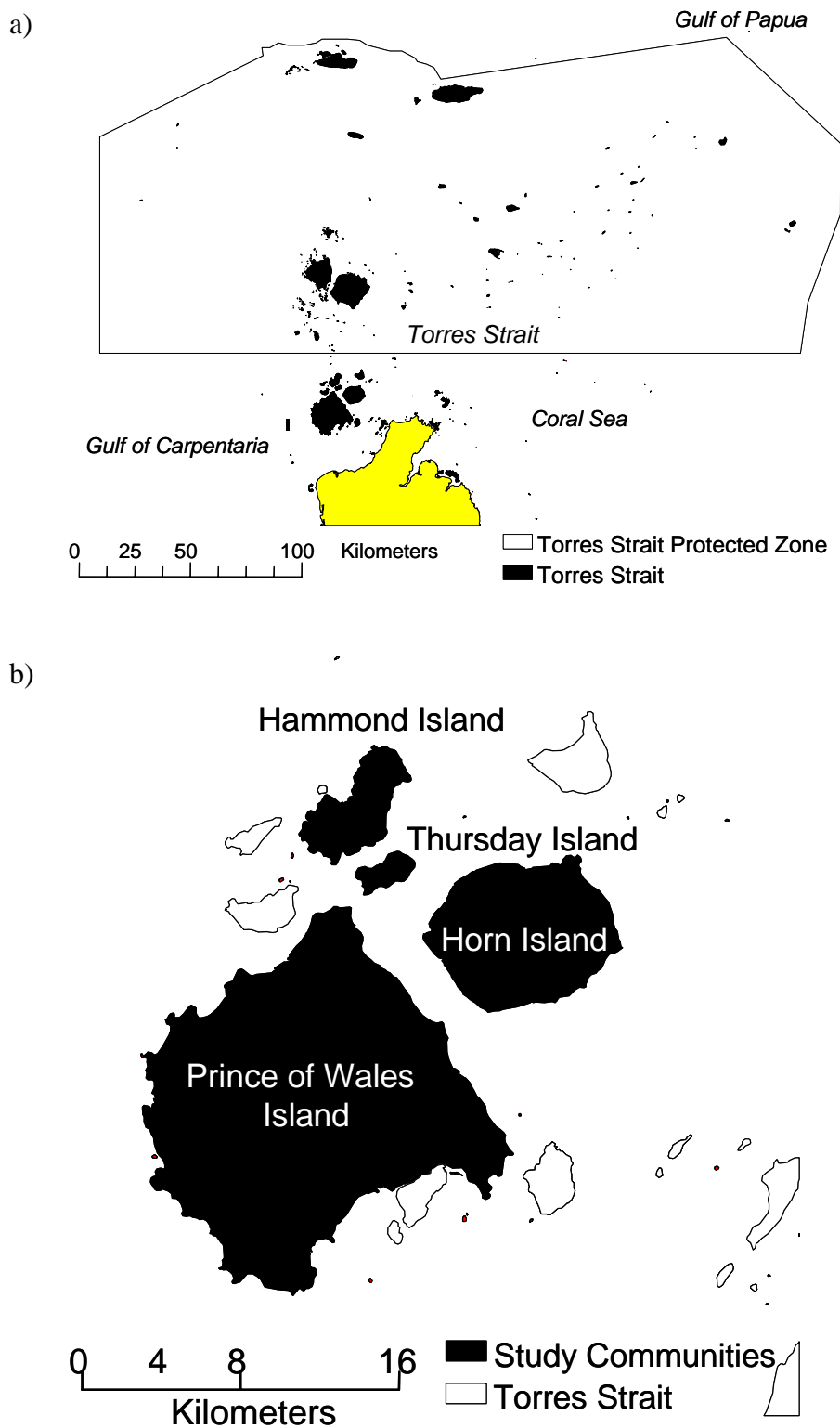


Figure 1. Map of a) Torres Strait and b) the study communities in the Kaiwalagal region of Torres Strait.

The study communities, Thursday Island and Hammond Island, were chosen with the assistance of the Marine Research Liaison Officer for CRC Torres Strait and the task associates from TSRA

(Torres Strait Regional Authority) and AFMA. These task associates were appointed as a result of the partial funding from CRC Torres Strait. Thursday Island has two main communities (Figures 1 and 2). The TRAWQ community has a population of 1049 people living in the suburbs of Tamwoy, Rose Hill, Aplin, Waiben and Quarantine. The TRAWQ community is administered by the TRAWQ Community Council and many members of the community work via the CDEP scheme¹. The Port Kennedy community has a population of 1631 people and is administered by the Torres Shire Council. Members of the Waiben (Thursday Island), Ngurapai (Horn Island) and Muralug (Prince of Wales Island) Community Fisher Group (WNM) mainly live in the Port Kennedy area; many are crayfishers. The Thursday Island group is diverse, comprising hunters from the WNM Community Fisher Group, the Prince of Wales Community Fisher Group (POW), the TRAWQ community on Thursday Island and some hunters from Horn Island. All these groups were involved in the project to varying degrees at various times. The landing sites on Thursday Island are dispersed. Hunters process dugongs and turtles at many different locations, not always in view of the community.

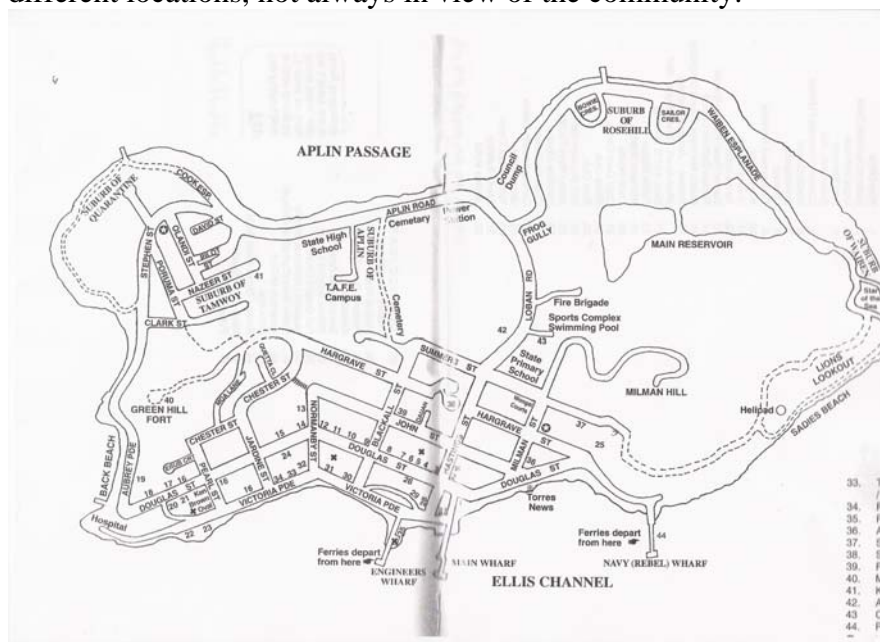


Figure 2. Map of Thursday Island showing the Port Kennedy area and TRAWQ suburbs of Tamwoy, Rose Hill, Aplin, Waiben and Quarantine.

Hammond Island (Figure 1) is a small cohesive community of about 200 people, with strong leadership. Most people use the same landing site, which is in view of the community. An alternative landing site is sometimes used, but can be monitored relatively easily. Most of the hunters in the Hammond Island community work on the community's CDEP scheme; some are crayfishers. The study communities are in the Kaiwalagal traditional sea country and the traditional owners are the Kaurareg people, represented by the Kaurareg Traditional Aboriginal Elders Corporation, which is based on Horn Island.

1. Community Development Employment Projects scheme – this scheme provides around 25% of Indigenous employment in rural communities. CDEP schemes also provide vocational training for Indigenous peoples to enhance their ability to improve the social and environmental conditions of their communities.

The individual median weekly income (from the 2001 census) for Torres Strait Islanders living in Torres Strait is \$251, which is only 60% of the median weekly income of \$419 for non-Indigenous people living in Australia (Arthur, 2003). This income disparity is exacerbated by the very high cost of store bought goods in Torres Strait resulting from high freight costs.

3.2 Pilot study

The pilot study was conducted from mid-May to mid-July 2004 and some of the activities were continued at a later date or throughout the project. The activities of the pilot study to negotiate support with elected councils, build relationships to encourage people to be supportive and participate effectively in the research, to seek the opinions of key people with respect to designing culturally appropriate community-based monitoring programmes and to negotiate a research agreement with communities are described in Section 3.3.4.

While attempting to facilitate the development of ideas to aid in the formation of appropriate interview questions during meetings with Community Fisher Groups it became apparent that Community Fisher Group members were not supportive of participating in socio-economic interviews and preferred to concentrate on community-based catch-monitoring. Therefore this aspect of the project was set aside.

3.3 Community-based catch-monitoring

Fieldwork for the OPCF-funded phase of the project was conducted between 1 November 2004 and 31 October 2005.

3.3.1 Workshop to train hunters in the measurement of harvested turtles and dugongs, recognition of maturity and breeding status and the collection of biological samples

Training workshops were provided to hunters at Hammond Island on February 25 and April 8, 2005. The aims of the first workshop were to: (1) broaden the awareness and understanding of the marine turtle and dugong catch-monitoring process, and (2) to disseminate information about marine turtle biology and western scientific methods that are used to gain such information. The aims of the second workshop were to: (1) discuss progress to date on the catch-monitoring process, and (2) provide more information to the community on marine turtle biology and the methods used to assess maturity and breeding status.

3.3.2 Employ an Indigenous research counterpart

The Chair of Hammond Island Council, the CEO of the TRAWQ Community Council on Thursday Island, TSRA staff, the CRC Torres Strait Liaison Officer and Community Fisher Groups, all indicated that they would prefer us to employ our Indigenous research counterparts through the CDEP top-up scheme. The resultant on-the-job training provided to these Indigenous research counterparts enabled the project activities to be incorporated by the CDEP program and continued by CDEP staff after the life of the project. The skills learnt and the experiences provided through this project will provide a solid basis for future turtle and dugong projects in Torres Strait.

An Indigenous research counterpart was employed from the Hammond Island Community. He is the Community Ranger for Hammond Island. From the 25 February 2005, he was paid for 8

hours per fortnight through the CDEP scheme. From the 2 June 2005 he was paid for 16 hours per fortnight.

The Board of the TRAWQ Community Council on Thursday Island accepted our proposal to employ an additional Indigenous counterpart and provide training to two others employed on CDEP. The Indigenous Counterparts began employment on the 18 July 2005. We paid one Indigenous research counterpart on CDEP top-up for 25 hours per week. TRAWQ Community Council provided another three Indigenous research counterparts for 16 hours each per week in return for training (Figure 3).

Additional funding for employment of Indigenous research counterparts was provided by the Australian Government Department of the Environment and Heritage.



Figure 3. Indigenous research counterparts; Cyril Stephen (TRAWQ; top second from left) with his research counterparts Paul Dai (bottom left), Jim Kris (top left), David Warria (bottom right) and Railey Gibia (TRAWQ fisheries portfolio Councillor) and Jillian Grayson. Note the project T-shirts (also see Appendix 1)

3.3.3 Train the Indigenous research counterpart and involve him/her in all aspects of the project

We have trained Indigenous research counterparts from Hammond Island and Thursday Island in all aspects of the project including the collection of biological data and catch monitoring. The Indigenous counterparts have been responsible for the distribution and collection of catch monitoring data sheets and passing them on to Grayson. A total of four Indigenous research counterparts received training in all aspects of the project.

3.3.4 Monitor the harvest of adult green turtles and dugongs by hunters based in the Kaiwalag region of Torres Strait

3.3.4.1 A Community-based dugong and marine turtle catch-monitoring program.

A community-based approach to catch monitoring requires communities to be involved from the outset. Initial engagement with the Indigenous communities was achieved by obtaining support for the project from the Board of the Torres Strait Regional Authority in May 2004. Support for the project was then obtained from the Kaurareg Traditional Owners, Community Councils and Community Fisher Groups.

Ongoing engagement of the Indigenous communities was facilitated through various means including: community meetings, training workshops and employing community members to work on the project. Grayson lived on Thursday Island throughout the project. This arrangement allowed her to work in partnership with communities and be on the ground to develop and adapt the community-based monitoring program as required.

Development of the catch-monitoring project

As outlined in the introduction, a community-based catch-monitoring approach, in which hunters provided continuous counts of their dugong and turtle catches was considered to be more likely to succeed than programs which rely on sampling or daily independent observations for several reasons: (1) it was more likely to provide reliable catch-estimates, (2) it would be less expensive, (3) more logistically feasible and (4) it met community priorities of employment and capacity building. In addition, hunters expressed their aspiration for such an approach at the various workshops/meetings (see below). Participation by hunters was therefore integral to the success of the community-based catch-monitoring program. Accordingly, hunters from the Community Fisher Groups (CFGs) from the Thursday Island group and Hammond Island were engaged separately in the development of the program in several meetings.

Monitoring options were discussed with the hunters. Several community-based catch-monitoring tools were considered including: (1) dedicated processing sites, (2) dedicated repositories for stockpiling turtle shells and dugong skulls, (3) photographic records, (4) verbal reports and (5) a datasheet survey. The hunters were used to completing datasheets for commercial fisheries. They overwhelmingly decided to trial a datasheet survey because it least disrupted their normal hunting practices, their identities could remain confidential and it was relatively inexpensive. Hunters identified the information required for them to manage their dugong and turtle fisheries during group workshops in May – July 2004 and this information was incorporated into the datasheet which the hunters helped design (Appendix 2).

A research Memorandum of Understanding was developed between Grayson, Marsh (James Cook University), the Kaurareg Traditional Aboriginal Elders Corporation, Hammond Island Council, TRAWQ Community Council, and the Torres Shire Council (representing Waiben, Ngurapai, and Muralag and Prince of Wales Community Fisher Groups) to ensure that the research was conducted in a culturally appropriate manner and that the information collected was acceptable to the community and would be used in an acceptable manner. A reference group was established to provide advice about cultural protocols, culturally sensitive information and the collection and use of information.

Implementation of the catch-monitoring project

Hunters were supplied with data collection kits consisting of a clipboard, datasheets, pencils and a tape measure. Hunters filled in datasheets, providing information about their catches, including morphometric and reproductive information about the animals caught. Indigenous research counterparts were employed to work on the project and to develop capacity within the community to continue a community-based catch-monitoring program after the completion of this project.

The Indigenous research counterparts recruited hunters to the catch-monitoring program, collected datasheets and biological samples from hunters and helped provide feedback to hunters about the program. At Hammond Island, the Chair and Councillors helped collect datasheets when they could and at Thursday Island some hunters delivered datasheets to Grayson.

3.3.4.2 A scientifically robust community-based catch-monitoring program

Maximum participation by hunters

A community-based catch-monitoring approach, where hunters provide continuous counts of their dugong and turtle catches, requires maximum participation by hunters to obtain reliable catch-estimates, because in such a study the hunters are the sampling units. Two strategies were employed by the research team to encourage hunters to participate in the catch-monitoring program. First, the importance of all hunters in the community participating all of the time was demonstrated to hunters using a practical sampling exercise during several meetings and workshops as opportunities arose (Appendix 3). The sampling exercise demonstrated that the more hunters that participated, the more likely it was that the catch-estimate would be close to the actual catch number. If only some hunters participated or if hunters participated only some of the time, then the catch number might be over- or under-estimated.

Second, the recruitment of hunters was an ongoing and adaptive process. This approach ensured that as many hunters as possible participated in the catch-monitoring program and the method of engaging them evolved and improved over time. Hunters from the Hammond Island Community Fisher Group were encouraged to participate by their Community Council. Ongoing participation was encouraged by the Indigenous research counterpart, who also recruited additional hunters.

Hunters from the Thursday Island group were recruited to participate in the catch-monitoring program in several phases. The hunters from the Community Fisher Groups of the Thursday Island group that were involved in the development of the datasheet survey began using the datasheet survey from mid-July 2004 but discontinued their participation in November 2004 in response to media coverage of the issue of dugong hunting. The hunters eventually re-joined the catch-monitoring program in May 2005, after a total of eight meetings during the six month period, some of which also involved other groups (e.g. the Kaurareg Traditional Owners; TRAWQ Community Council). Meetings were also held with the Kaurareg Traditional Owners to maintain their support for the catch-monitoring program.

The participation by hunters from the Thursday Island group in the catch-monitoring program was enhanced by engaging the TRAWQ Community. Hunters from the TRAWQ Community were recruited to the program by the Indigenous research counterparts employed through TRAWQ Community Council from mid-July 2005. The Indigenous research counterparts utilised their usual social networks and talked to as many hunters as possible from the Thursday Island group about the project and encouraged them to participate.

Quality assurance of the data

Training workshops were conducted to ensure the hunters were proficient in the catch-monitoring process, data collection, measurement of dugongs and turtles and provision of biological samples. Training workshops were held at Hammond Island on February 25 and April 8, 2005 (see Section 3.3.1). Hands on training in the identification of sex, maturity and breeding status of turtles from gonad assessment was gained as samples were available during the catch-monitoring program.

Hunters from the Community Fisher Groups of the Thursday Island group of islands were first trained in the measurement of dugongs and turtles and the collection of biological samples during the preliminary workshops in May-July 2004 which was convened to develop the catch-monitoring program and design the datasheet. Training workshops were offered to the Thursday Island group in February 2005 and August 2005, but the hunters were not interested. Grayson subsequently trained the Indigenous research counterparts in the measurement of dugongs and turtles and collection of biological samples. The counterparts have continued to pass these skills onto the hunters on a one-on-one basis when collecting datasheets from them. The Indigenous research counterparts also received hands on training in the identification of sex, maturity and breeding status from gonadal assessment as suitable samples became available during the catch-monitoring program.

3.4 Composition of dugong and turtle catches

3.4.1 Collect and analyse data from hunters of the Kaiwalagal region of Torres Strait on the size, age class, maturity and breeding status of dugongs and turtles

3.4.1.1 Collection of information on the size, age class, maturity and breeding status of dugongs and turtles.

The total numbers of dugongs and turtles caught cannot be reported because of the research MoU with all of the communities which required keeping such information confidential (Appendix 4). Therefore data on the proportions of turtles and dugongs caught by the community (i.e. all hunters for which information was recorded) are presented in the results. In addition, for Hammond Island only, information on the proportion of successful and unsuccessful hunting trips is presented. Most hunters did not hand in datasheets when they went hunting and caught nothing. Therefore to determine the proportion of unsuccessful hunting trips an independent survey was implemented in October 2005. Hammond Island hunters were asked how many times they had been hunting and caught nothing since the survey started at the end of February 2005. This information was recorded for hunters that actively participated in the survey from at least April 2005.

Hunters were trained in sample collection, storage and assessment. Information on the size, age class, maturity and breeding status of harvested dugongs and turtles was collected in two ways: 1) hunters recorded the information on their datasheets; or 2) hunters provided samples to the Indigenous research counterparts and/or Grayson. The sizes of the harvested turtles (curved carapace length) were measured using a flexible tape measure following standard practices for sea turtle research in Australia. Cultural protocols precluded the measurement of the size of dugongs. The dugong is totem, a spiritual God for certain clans. The myth of Gelam speaks of the journey of life to its resting place and establishment of its permanent house in the eastern Torres Strait, what is now known as Mer Island. It is the Kaurareg's and Mualagal's belief that by measuring the animal gives a precise measurement of a house (coffin), in the spiritual sense marking the hunter and his family members for a short life (Willie Wigness *personal communication*). Instead, hunters estimated the sizes of harvested dugongs visually. Grayson independently confirmed that the size estimates made by hunters were accurate.

The maturity and breeding status of female turtles was determined by examining their ovaries. Hunters recorded whether or not female turtles had enlarged follicles in their ovaries (known locally as Webud or yellow eggs), indicating that they were in vitellogenesis for the upcoming breeding season. In addition, hunters provided samples of the ovaries of female turtles to the research counterparts, who with the assistance of Grayson and JCU turtle experts, interpreted the finer scale elements of the breeding status of the turtle. Several hunters were trained to interpret

these finer scale elements of breeding status from the ovaries. The breeding status of female dugongs was determined by examining their uteri. Hunters recorded whether or not female dugongs were pregnant on the datasheets. In addition, hunters provided samples of the uteri of dugongs to the research counterparts, who with the assistance of Grayson assessed whether the dugong had bred before. Dugong tusks were collected for age determination. The sex of turtles and dugongs was recorded on the datasheets by the hunters who used either external characteristics or internal reproductive organs to determine the sex.

3.4.1.2 Selectivity of the catch

The selectivity of the green turtle harvest was determined by comparing the sex ratio and size distribution of harvested green turtles to those found for turtles on feeding grounds during rodeo sampling in a companion project by Hamann.

3.4.1.3 Collection of information on the use of the dugong or turtle meat

The use for which the dugong or turtle was hunted was recorded on the catch-monitoring datasheet (e.g. Tombstone unveiling, wedding, shaving ceremony, Kai Kai (subsistence food), funeral, initiation ceremony, coming of age ceremony, other).

4. Results

4.1 Community-based catch-monitoring

4.1.1 Provide a workshop in the Kaiwalagal region for Torres Strait Islander hunters which train hunters in the measurement of harvested turtles and dugongs, recognition of age class, maturity and breeding status and the collection of biological samples.

During the first workshop on 25 February 2005, participants were trained in the catch-monitoring process and measurement of marine turtles and dugongs. Ten of the Hammond Island hunters participated and one outcome was to document the threats to marine turtle populations in Torres Strait as perceived by the Torres Strait Islanders (Table 1) and also to develop a list of information that participating hunters would like to know about marine turtles in Torres Strait (Table 2).

Table 1. Threats to marine turtles in Torres Strait and the Northern Great Barrier Reef as perceived by participants in the Hammond Island Community workshop (in no particular order).

Threats identified by Hammond Island residents

- Outboard motors – noise, damage to bottom and fuel/oil residue, boat strike
- Plastic bags and other discarded rubbish (from ships or land)
- Ghost nets and discarded fishing lines
- Oil spills from ships or port facilities
- Direct fishing – targeting of turtles
- Over hunting of turtle and eggs by TS Islanders, PNG and people of other nations (Indonesia, New Caledonia, Solomon Islands and Vanuatu)
- Spot light fishing
- Boat strike from ships
- Natural predation – sharks, crocodiles, birds, goannas
- Commercial Exploitation of turtles by peoples of other nations
- Erosion of nesting beaches and flooding of nests
- Alterations in fishing methods – e.g. use of nets in PNG
- Treaty – i.e. it allows commercial sale of turtles in PNG providing more incentive

for PNG peoples to hunt larger numbers of turtles

- Lack of knowledge on sustainable take of turtle, including purposes, numbers taken and reasons for catching

Additional threats added after the workshop

- Fibropapilloma disease (wart like tumours on turtle's skin)
- Lack of biological data on harvested populations and harvests (e.g. sex ratio, size range, size at maturity, juvenile recruitment)
- Fisheries by-catch (within Australian and international waters)

Table 2. Information required by Torres Strait Islanders to allow effective management decisions to be made regarding marine turtles in Torres Strait and the northern GBR

- Types of food preferred by different species of marine turtle
- Important feeding areas for different species of marine turtle
- How many turtles are being caught and variation in capture rates between areas (in TS and overseas)
- Why people are catching turtles – the price of meat is expensive for low income people
- How many nests are being laid and how many hatchlings are surviving
- How many hunters hunt and how often
- How many eggs are collected per year (by species)
- Main nesting areas (by species)
- Catch rates of turtles and eggs by PNG communities
- Main hunting areas
- How often turtles nest and how many eggs do they lay (all species)
- Survival chances of hatchlings
- How long do they live
- Growth rates
- How are other communities in the region participating
- Map of feeding areas and how to protect them
- How does eating turtle effect diabetics
- How much turtle do people waste

At the second workshop on April 8 2005 at Hammond Island, six additional hunters signed up to the catch-monitoring process and showed support for assisting in the field aspects of the project.

Each of the hunters at Hammond Island and the TRAWQ research monitors have been shown how gonads can be examined to identify sex, maturity and breeding status.

4.1.2 Monitor the harvest of adult green turtles and dugongs by hunters based in the Kaiwalagal region of Torres Strait

4.1.2.1 Obtaining maximum participation by hunters in the datasheet survey

Media controversy surrounding the issue of dugong hunting acted as a catalyst for the Thursday Island group to withdraw from the catch-monitoring program. Eight meetings with traditional hunters from the Thursday Island group were held to re-negotiate their support for and participation in the project (Table 3). The small focussed meetings were much better attended than the larger, more general meetings. Between three and 20 people attended the small focussed meetings. Both of the larger, more general meetings were poorly attended.

Table 3. Summary of meetings held with traditional hunters to regain support for the project.

Date	Location	Type	Attendees
29/11/2004	Thursday Island	Meeting	Thursday Island traditional hunters
26/02/2005	Thursday Island	Workshop	Thursday Island hunters
8/03/2005	Thursday Island	Meeting	Kaiwalagal Aboriginal Corporation; WNM Community Fisher Group hunters, Community members
24/03/2005	Horn Island	Meeting	Kaiwalagal Aboriginal Corporation
7/04/2005	Thursday Island	Information	Traditional hunters
28/04/2004	Thursday Island	Meeting	TRAWQ CDEP workers

5/05/2005	Thursday Island	Meeting	TRAWQ CDEP workers
6/05/2005	Thursday Island	Meeting	WNM/POW Community Fishers

The following issues were raised at all the meetings:

1. Protection of information

Restriction of hunting was a major issue raised in the media in late 2004 especially, proposed restrictions on the traditional hunting rights of Torres Strait Islanders (e.g. quotas; *Australian* November 8, 2004) (e.g. legislative changes *Daily Telegraph* November 8, 2004; *Courier Mail* November 13, 2004). Such reports raised concerns that Torres Strait Islanders would be forced to stop practising a very important part of their culture and they would not be given the opportunity to manage their traditional natural resources and instead would have management imposed upon them. Consequently, hunters wanted assurances that the information they provided about their harvest levels and hunting practices would be protected.

2. Misrepresentation of hunting practices in the media

Animal cruelty associated with the hunting practices of Indigenous people also featured in the media in late 2004. The media reports focussing on animal cruelty, in particular, were negative, emotive and portrayed Indigenous people as insensitive and uncaring in their traditional practices (for example see Appendix 5). Consequently, hunters were reluctant to allow non-Indigenous researchers to observe their processing practices.

3. Discord between scientific information and traditional knowledge

In general, communities in Torres Strait acknowledge a problem with the sustainability of dugong stocks and some Torres Strait Islander leaders have been calling for assistance with implementing management arrangements for many years. Many Torres Strait Islanders and Aboriginal people of Torres Strait, however, do not trust the outcomes of the research of Marsh *et al.* (2004a, b) and Heinsohn *et al.* (2004). They have extensive traditional knowledge from spending a lot of time out on the water and they perceive several problems with the aerial survey technique that makes them think that Marsh *et al.* (2004a, b) underestimate the number of dugongs using aerial surveys. These problems include that: 1) local people see more dugongs at night than during the day because dugongs hide in the deep water during the day; 2) dugongs spend a lot of time diving underwater and therefore cannot be seen; 3) dugongs might all dive at the same time, so there might not be any on the surface; 4) dugongs move large distances and therefore may have moved out of an area before they could be counted. (Most of these concerns are addressed by the aerial survey protocol as discussed below).

4. Harvesting and catch-sharing by Papua New Guinean traditional inhabitants

Under the Torres Strait Treaty, traditional inhabitants of Papua New Guinea (PNG) are permitted to hunt dugongs and turtles in waters in the vicinity of the Protected Zone which are under Australian jurisdiction and vice versa (Articles 11 and 12). The PNG take of dugongs and turtles in Torres Strait is largely unrestricted, except with respect to their traditional fishing areas and the Fisheries Management Notices. In particular under the Treaty, PNG fishermen are permitted to sell turtles commercially, which is not allowed for Australian Torres Strait Islanders. Furthermore, there are recent reports of Indonesian boats fishing for sharks within the Torres Strait region, and catching dugongs as by-catch. In addition, genetic studies indicate that 12% of the Indonesian harvest of turtles, which is in the thousands per year, come from the Torres Strait/northern Great Barrier Reef (GBR) stock of turtles (Dethmers *in press*). Therefore, traditional hunters are concerned that the PNG and other overseas harvests of dugongs and turtles from Torres Strait are having an impact on the populations at least equivalent to traditional hunting by Australian Torres Strait Islanders and Aboriginal people of Torres Strait. The traditional hunters were therefore concerned that any monitoring and management of the

dugong and turtle fisheries needs to include provisions for monitoring and managing the catch by PNG fishermen and other overseas harvests.

5. Lack of action on other impacts

The traditional hunters were concerned at the apparent lack of action to address impacts on dugongs and turtles other than traditional hunting by Torres Strait Islanders (e.g. overseas commercial harvest, commercial fishing nets, illegal foreign fishing vessels, seagrass dieback, marine debris, coastal erosion of nesting beaches, etc). Concern was expressed that these impacts should be addressed at the same time as traditional Indigenous hunting, otherwise dugong and turtle numbers will decline despite restrictions on their traditional hunting practices.

6. Options for managing dugongs and turtles and enforcement of management strategies.

Torres Strait Islanders wish to play a major role in managing their traditional natural resources, including dugongs and turtles (resolution from the “turtle and dugong catch-monitoring workshop” held by AFMA in May 2003). Concerns were raised that they would not be given the opportunity to manage dugongs and turtles and would instead have management imposed upon them. In addition, hunters were not aware of the status of dugong and turtle management at the level of the Protected Zone Joint Authority.

These issues were addressed in the following ways:

1. Protection of information:

The research MoU was developed further to reflect concerns raised by hunters and Traditional Owners during these meetings. The Research MoU was explained in detail to the hunters. The matters addressed by the MOU included the following: (1) that participant’s names would be handled confidentially; (2) that information would not be released without consultation via the reference group, including press releases, and (3) that the total number of dugongs and turtles recorded as caught would not be reported in any research outputs and would be kept confidential.

2. Misrepresentation of hunting practices in the media

Agreement was reached that the processing of animals would not be observed by researchers, but collection of biological samples could be done after processing was complete. The fact that hunting and processing practices were never intended to be described in research outputs was reiterated to hunters.

3. Discord between scientific information and traditional knowledge

The adjustments used by Marsh *et al.*, (2004a, b) to correct for potential problems associated with availability of dugongs to aerial survey observers and observer bias were explained to hunters during the meetings. These were: 1) aerial surveys were done on high spring tides during the day to maximise the likelihood that dugongs are in shallow water where they can be seen; 2) the count was adjusted after calculating the proportion of dugongs that are diving and therefore are not available to be seen; 3) analyses of video footage taken from a blimp were used determine that dugongs in a group dive independently of each other and therefore do not all dive together; 4) two aircraft were used simultaneously so that dugongs do not have sufficient time to move into adjacent blocks during the survey and therefore be missed or counted twice. In addition, two observers are used for each transect to maximise the chance that the dugongs that are available to be seen are counted and to enable those missed to be estimated using mark-recapture methods.

The video “*Dugong for our children*” was updated and distributed to all Torres Strait communities. On the video, scientists explained some of the research that has been done on dugongs in Torres Strait and how it can help communities. The research includes aerial surveys, determining the age of dugong using their tusks and satellite tracking. Torres Strait Islander

leaders and hunters also appeared on the video talking about the need to look after dugongs in their region.

Finally, attempts were made to separate the aims and objectives of this study from the broader issues (i.e. issues 4, 5 and 6 above) associated with dugong and turtle monitoring and management. Hunters were advised to talk with the appropriate management authorities (e.g. TSRA and AFMA) about their concerns about the PNG harvest, the lack of action on other impacts and options for managing dugongs and turtles and enforcement of management strategies.

4.1.2.2 Participation by hunters in the datasheet survey

The number of hunters participating in the datasheet survey increased during the survey period. At Hammond Island, the number of hunters registered to participate increased from seven in February 2005 to 16 in April 2005 and then remained the same until June 2005. By November 2005, 17 hunters were registered to participate in the datasheet survey, with three hunters leaving the community and four more registering (Figure 4). Four of these hunters did not go hunting during the survey period and only one has not provided any datasheets and therefore 92% of registered hunters that went hunting participated in the survey. In addition, there are about another nine hunters that did not agree to participate in the survey, at least two of which do not actually live in the community.

Hunters from the Thursday Island group registered to participate from April 2005, with 14 hunters registering, none of whom had handed in any datasheets by mid-April. By June 2005 there were 27 hunters registered to participate, but only three had handed in datasheets. The Indigenous research counterparts have recruited a further 36 hunters since July 2005, bringing the total number of hunters from the Thursday Island group registered to participate to 63. Nonetheless, datasheets have only been received from 13 of these hunters (Figure 5). In addition, another four hunters have provided information anonymously. The number of hunters that did not agree to participate is not known at this stage for the Thursday Island group.

4.1.2.3 Assessment of the datasheet survey in obtaining reliable catch-estimates

Is the sample representative?

At Hammond Island, 59% of the hunters who went hunting during the survey period were registered to participate in the datasheet survey. The sample of registered hunters was considered by the Indigenous research counterpart and the Council to include all of the main hunters in the community. In fact, two of these hunters accounted for 90% of the dugongs reported by registered hunters and three hunters accounted for 40% of the turtles.

Although the total number of hunters in the Thursday Island group is not known at this stage, the sample of 63 registered hunters is considered by the CRC Torres Strait liaison officer and Indigenous research counterparts to include the main hunters in the community. Although the proportion of registered hunters who reported catches is small, two hunters reported 56% of the dugongs and four hunters reported 52% of the turtles.

Is the sample biased?

At Hammond Island 92% of registered hunters filled in datasheets when their hunting trips were successful and 88% of registered hunters that have been participating since at least April 2005 reported, via a survey, the number of hunting trips on which they caught nothing. Therefore most of the participating hunters consistently filled in datasheets. In addition, the Indigenous research counterpart maintained contact with the hunters to ensure they were recording all of their catches.

Only 25% of registered hunters from the Thursday Island group have filled in datasheets, including several hunters who provided information anonymously. Most of these participating hunters however consistently filled in datasheets and the Indigenous research counterparts maintained contact with them to ensure they were recording all of their catches.

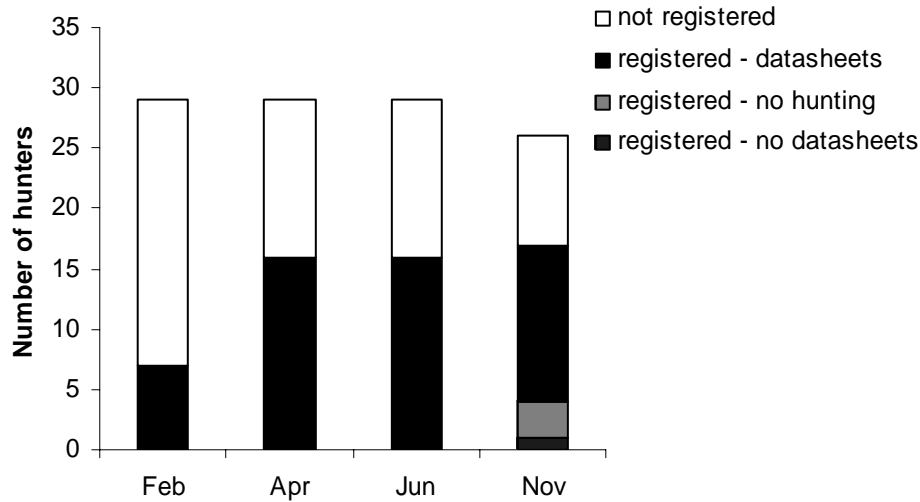


Figure 4. The number of Hammond Island hunters registered to participate in the datasheet survey through 2005 as a function of the total number of hunters in the community. As at November 2005, four registered hunters had not gone hunting and one had not provided any datasheets.

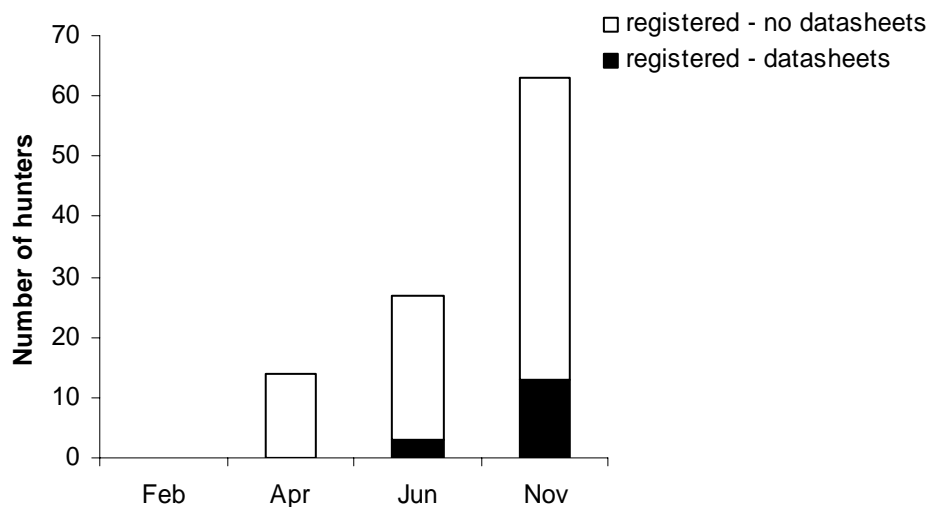


Figure 5. The number of Thursday Island hunters actively participating in the datasheet survey through 2005 as a function of the number of registered hunters.

4.2 Composition of dugong and turtle catches

4.2.1 Collect and analyse data from hunters of the Kaiwalagal region of Torres Strait on the size, age class, maturity and breeding status of dugongs and turtles.

4.2.1.1 Information on the size, age class, maturity and breeding status of dugongs and turtles.

For both Hammond Island and the Thursday Island group, more turtles than dugongs were caught. Fifty-seven percent of the animals caught at Hammond Island were turtles (1:1.3 dugongs to turtles) and for the Thursday Island group 64% of the animals caught were turtles (1:1.75 dugongs to turtles). The proportion of successful to unsuccessful trips was determined for Hammond Island only. On most of the hunting trips at Hammond Island nothing was caught (72%). Turtles were caught on 14% of trips, dugongs were caught on 13% of trips and both dugongs and turtles were caught on 1% of trips.

Information on sex ratio, size, age class, maturity and breeding status for dugongs or turtles recorded as caught was not recorded by all hunters. The proportion of animals for which the information was recorded is presented in Table 4.

Table 4. Proportion of turtles and dugongs caught for which information on sex, size, maturity and breeding status was recorded from each of Hammond Island and the Thursday Island group.

	Hammond Island		Thursday Island group	
	Turtle	Dugong	Turtle	Dugong
Sex	77%	81%	93%	87.5%
Size	44%	69%	71%	50%
Maturity	14%	1 female	45%	25% of females
Breeding status	9%	1 female	19.5%	25% of females

The following results are based on the turtles and dugongs caught for which the relevant information was collected (Table 4).

Hammond Island – turtles

All of the turtles caught from Hammond Island for which data on sex were recorded were female. The average size of harvested turtles was 112 cm (CCL) and sizes ranged from 92 cm to 135 cm. The size range of mature turtles from Raine Island in Eastern Queensland over 25 years was 86.0 cm – 130.1 cm CCL (Limpus *et al.*, 2003) and therefore all of the turtles caught in Torres Strait were above the minimum breeding size. The average size of turtles in vitellogenesis, and therefore confirmed to be adults was 105.6 cm.

The ovaries of 9% of turtles were examined. Two-thirds of these turtles were in vitellogenesis in preparation for breeding in the summer of 2005/2006 and all of them had bred in previous years.

Thursday Island group – turtles

Ninety-seven percent of turtles caught from the Thursday Island group for which data on sex was recorded were female and 3% were male. The average size of harvested turtles was 102.2 cm (CCL) and sizes ranged from 91.5 cm to 130 cm. Similar to Hammond Island, all of the turtles caught were larger than the minimum breeding size for green turtles recorded from Raine Island over 25 years. The average size of turtles in vitellogenesis and therefore confirmed as adults was 102.1 cm.

The ovaries of 19.5% of female turtles were examined. Three-quarters of these turtles were in vitellogenesis in preparation for breeding in the next breeding season. Almost all of them (87.5%) had bred in previous years.

Hammond Island - dugongs

The female:male sex ratio of dugongs caught from Hammond Island for which hunters recorded the sex was 1:1.6. The average size of dugongs estimated by hunters was 198 cm and ranged from 150 cm to 240 cm. Dugongs smaller than 220 cm are considered to be immature and those larger than 250 cm are considered to be mature (Marsh *et al.*, 1984a). Only one female dugong

was pregnant and therefore confirmed as mature. The pregnant dugong recorded was estimated to be 200 cm long. Kwan (2002) also recorded a pregnant dugong which was smaller than those recorded in previous studies at 205 cm long. Hunters have not yet provided the uteri of any adult female dugongs for examination.

Thursday Island group - dugongs

The female:male sex ratio of dugongs caught from the Thursday Island group for which hunters recorded the sex was 1:0.75. The average size of dugongs estimated by hunters was 215.5 cm and ranged from 165 cm to 250 cm. Only 25% of the female dugongs were recorded as pregnant and therefore confirmed as mature. As for Hammond Island, pregnant females were small compared to those in previous studies. The average size of pregnant females was 216.6 cm. Only a few hunters have provided the uteri of adult female dugongs and these are yet to be examined. In addition, only a few hunters have provided the tusks of dugongs for analysis of the age class, which are also yet to be examined.

4.2.1.2 Selectivity of the green turtle catch

Ninety-two percent of the green turtles caught during daytime turtle rodeos were juveniles and the sex ratio of juveniles was not significantly different from 1:1 (companion study by Hamann), which indicates that the harvest of green turtles is very selective.

4.2.1.3 The uses of dugongs and turtles

Most of the dugongs and turtles caught were used for subsistence purposes (i.e. Kai Kai). Seventy-five percent of dugongs and 60% of turtles at Hammond Island and 47.5% of dugongs and 58% of turtles at Thursday Island, respectively, were used in this way. Other reasons for taking dugongs and turtles included funerals, tombstone unveiling ceremonies, church days, wedding anniversaries, weddings, coming of age parties, shaving ceremonies and NAIDOC week celebrations.

5. Discussion

5.1 Community-based catch-monitoring

5.1.1 Monitor the harvest of adult green turtles and dugongs by hunters based in the Kaiwalagal region of Torres Strait

5.1.1 Community-based catch monitoring

This is the first community-based catch-monitoring program implemented for dugongs in Australia and is only the second for turtles after the Dhimurru Miyapuna project (Kennett *et al.*, 1998). A community-based catch-monitoring program ensures that the community has a sense of ownership and control of the process and is able to direct the process towards outcomes that are important for the community as well as the species. The Hammond Island community and the Thursday Island group wanted to be involved in this project so that they could collect information to help them develop community-based management plans to look after dugongs and turtles. They wished to develop a catch-monitoring process that they could continue to use in the future to collect the information they needed for management. As a result of this project, a monitoring process is being developed adaptively and community members have gained valuable experience in using western scientific research methods to monitor catches, which they can continue to apply in the longer-term. In addition the research team have a better understanding of the concerns and aspirations of Torres Strait Islanders regarding the future management of marine turtles and dugongs.

In this project, communities were engaged in the catch-monitoring process through employment of Indigenous research counterparts and training community members in catch-monitoring. The

employment of Indigenous research counterparts was integral to the involvement of other community-members in the program because they were able to explain the reasons for monitoring catches from an Islander perspective. In addition, hunters felt more comfortable providing information to, and receiving information from, fellow Islanders than from outside researchers. The employment of Indigenous research counterparts was also integral to the collection of data (see below).

Training in catch-monitoring was facilitated through workshops for hunters and on-the-job training for Indigenous research counterparts. All of the participating hunters from the Hammond Island community have received training. The Indigenous research counterparts from the Thursday Island group have been trained, but the hunters have not yet taken up the offered workshops. The Indigenous research counterparts, however, are in regular contact with the hunters and are able to discuss the need to monitor catches and show them how to measure the animals and take samples on a one-on-one basis. Many community members now have experience in using western scientific monitoring methods.

Maximising participation by hunters was the major challenge for community-based catch-monitoring. Through the gradual development of the project a high level of participation by hunters has been achieved at Hammond Island (92% of registered hunters). The Thursday Island group have achieved a lower level of participation (25% of registered hunters), but have been involved for a shorter amount of time and have a much larger population of hunters from diverse parts of the community to engage. However, at Thursday Island an encouraging start has been made in obtaining and maintaining participation by some hunters. The next challenge is to broaden the focus to actively engage other “registered” hunters to provide datasheets. Employing Indigenous research counterparts in each part of the community would greatly simplify this challenge, but was not feasible for this current project because of available funding.

Achieving and maintaining participation by hunters is susceptible to factors that they perceive might threaten their use of dugongs and turtles or their aspirations to manage their dugong and turtle resources. Torres Strait Islanders are highly dependent on dugongs and turtles as part of their way of life and livelihood and they wish to play the major role in managing their dugong and turtle resources and therefore their resilience to changes with respect to dugong and turtle hunting is likely to be limited (e.g. N. Marshall personal communication), particularly given their dependence on these resources for food.

The catch-monitoring process was adapted by the Indigenous research counterparts to suit their communities. Initially few hunters handed in datasheets without being asked. This reluctance was overcome through the employment of Indigenous research counterparts and these counterparts extended their usual social networks to maintain regular contact with hunters to collect their datasheets. Kennett *et al.*, (1998) also reported that most of the datasheets in the Dhimurru Miyapuna Project were filled in by Dhimurru staff as opposed to the hunters. The inherent danger is that the project is dependent on the employment and often the enthusiasm of the Indigenous staff. However, Dhimurru hunters were not as experienced with datasheets as the hunters in Torres Strait (Rod Kennett personal communication) who have relevant experience through participating in fisheries. Hence datasheets have been a successful method of data collection on Hammond and Thursday Islands, and we believe that the effort required to ensure their continued completion will be less than for communities such as Dhimurru.

Kwan (2002) found it difficult to maintain the motivation of rangers employed through the CDEP scheme to help with her project because most of the hunting occurred on weekends and early in the morning requiring them to work after-hours (their normal hours were 8am to 5pm and they were employed on alternate weeks only). In addition, the rangers were required by Council to work on other projects, therefore making it difficult for the rangers to make the

project a priority. Motivation of Indigenous research counterparts has not been an issue in this project because both the Hammond Island Council and TRAWQ Community Council have allowed the Indigenous research counterparts to work very flexible hours, including weekends and the TRAWQ Indigenous research counterparts are scheduled to work on the project every week. In addition, the Indigenous research counterparts generously collect datasheets and biological samples opportunistically outside their scheduled work hours and are able to adjust their hours worked accordingly. The Indigenous research counterpart on Hammond Island has many other duties as the Community Ranger, but the TRAWQ Indigenous research counterparts are dedicated to the marine turtle and dugong project. Topping-up the normal CDEP wage made it worthwhile for the Indigenous research counterparts to take on a position where flexible hours were required. The project is fortunate to have Indigenous research counterparts who are interested in their work, recognise its importance and are proud to be involved in the project to look after dugongs and turtles for future generations.

5.1.1.2 Assessing the catch-monitoring method

In this project both the representativeness of participating hunters and potential biases have undergone preliminary examination for the datasheet survey.

At Hammond Island, the main hunters are participating in the datasheet survey and therefore, it may not be necessary, or appropriate, to extrapolate the catch-estimates to the entire community because most of the catch is likely to be accounted for. For example, two hunters accounted for 90% of the dugongs caught from Hammond Island in this study, so it is likely that legitimate estimates can be obtained from the data. Kwan (2002) similarly found that a few hunters accounted for most of the dugongs caught at Mabuiag Island. The two main hunters at Mabuiag Island, caught 56% and 59% of the dugongs in 1998 and 1999, respectively. At Daru in PNG, Kwan (1991) found that most of the fishermen targeting turtles did so infrequently. The distribution of catches of turtles amongst hunters at Hammond Island was more even. However, a few hunters were still responsible for a large proportion of the catch with three hunters catching 40% of the turtles.

The Indigenous research counterpart maintained regular contact with the registered hunters at Hammond Island. Consequently, the catch-estimates at Hammond Island were unlikely to be biased due to hunters only participating some of the time or under- or over-reporting their catches. All but one of the registered hunters consistently provided datasheets. In addition, the transparent nature of dugong and turtle hunting process at Hammond Island make it difficult for hunters to exaggerate or under-report the number of dugongs and turtles they caught. Both the small size of the community and the visibility of the main processing site to the community mean that most of the catches are seen. In contrast, the small proportion of registered hunters in the Thursday Island group actively participating in the datasheet survey makes it inappropriate to assess the representativeness of the sample of registered hunters at this stage for this location. The hunters who did fill in datasheets were likely to be doing so consistently because, similar to Hammond Island, the Indigenous research counterpart maintained regular contact with them.

There are three main possible reasons why a large proportion of the registered hunters from the Thursday Island group have not filled in datasheets. First, these hunters may not have been hunting during the survey period. Second, these hunters may have been hunting but caught nothing and therefore decided not to fill in a datasheet. Third, these hunters may be under-reporting their catches. These reasons need to be disaggregated using a process external to the datasheet survey to assess the representativeness of participating hunters and identify any biases introduced from their patterns of reporting. Grayson plans to interview hunters about their hunting patterns and participation in the project with the help of the Indigenous counterparts.

However, it is also possible that these hunters may not have yet been adequately engaged in the project and therefore have not been reporting their hunting trips. Most of the hunters filling in

datasheets (82%) were either recruited by the Indigenous research counterparts and/or live in the same community. This result suggests that the focus needs to be broadened in the Thursday Island group to re-engage the hunters who have not been filling in datasheets to date.

5.1.1.3 Implications for monitoring

The datasheet survey is heavily reliant on hunters providing information. The monitoring process is much more difficult in the Thursday Island group than at Hammond Island because of the relative levels of transparency of the catch. The Hammond Island community is relatively small, with one main processing site, which almost everyone uses and which is in view of the community. Therefore, catches of dugongs and turtles are very obvious to the community. In contrast, for the Thursday Island group, the community is large and diverse and there are many dispersed processing sites, including people's backyards. Therefore, catches of dugongs and turtles are much less obvious to the wider community. It might therefore be worthwhile considering incorporating other monitoring options to increase the transparency of the catch for the Thursday Island group to help the monitoring process. For example, making the community more like smaller communities by having one or a few common processing sites might be one way to achieve greater transparency. In fact, TRAWQ Community Council is in the process of seeking funding to construct a common processing site on Thursday Island. Greater use of these facilities could be achieved through council by-laws making it compulsory to process dugongs and turtles at such facilities.

Kennett *et al.*, (1998) found that datasheets underestimated the number of turtles captured compared with data derived from measuring stockpiled shells. Shells accumulated around cooking fires on beaches which are used on a regular basis and hunters assisted the monitoring process by stockpiling the shells. Stockpiling shells of turtles (and skulls or other body parts of dugongs) was suggested to Torres Strait Islanders, but they rejected this monitoring method because unlike the Yolgnu people of NE Arnhem Land cultural practices in Torres Strait dictate that hunters must return the remains to the sea. In addition, hunters consider it to be unhygienic to leave carcasses out and were concerned about attracting crocodiles.

5.2 Composition of the dugong and green turtle catch

5.2.1 Collect and analyse data from hunters of the Kaiwalagal region of Torres Strait on the size, age class, maturity and breeding status of dugongs and turtles.

5.2.1.1 Catches, size and biology of harvested turtles and dugongs

Similar to communities in the Torres Strait Protected Zone, dugong and turtle hunting is a significantly important activity in the Kaiwalagal sea country of Torres Strait. The results indicate that it will be very important to collect catch-data from the Kaiwalagal communities to address the historical imbalance of collecting catch data from the Torres Strait Protected Zone only, because of the need for the Kaiwalagal communities to have evidence-based inclusion in any catch-sharing arrangements.

At Hammond Island data indicate that a very large proportion of the hunting trips were unsuccessful. This result is different from Kwan's (2002) findings at Mabuiag in 1998 and 1999 for dugongs where only 12% and 25% of trips, respectively were unsuccessful. This difference could reflect differences between the communities, abundances of dugongs or could be an artefact of Kwan's data being only for dugongs. Additional data including the intended target species could be collected prior to hunters beginning their trip to further analyse the success rate of hunting trips, which is needed to determine the spatial and temporal variation in catch per unit effort of hunting.

More turtles than dugongs were caught in both communities. 57% of the animals caught at Hammond Island were turtles and 64% of animals caught by the Thursday Island group were turtles.

Marine turtles

Johannes and MacFarlane (1991) suggested that Torres Strait Islanders selected adult female turtles and avoided males, whenever they could differentiate the males by their longer tails. Data from our study indicate that hunters from Hammond Island and the Thursday Island group assert that they prefer large adult female turtles and the results show that the sex ratio of harvested turtles was heavily skewed towards females, with 98% of turtles caught across both communities being females larger than the minimum breeding size (86 cm CCL; Limpus *et al.*, 2003). This result is similar to the ratio reported by Skewes *et al.*, 2002 (Table 5). The sex ratio of randomly caught turtles (companion study) in Torres Strait was close to 1:1, and in eastern Queensland sex ratios for green turtles are about 1:2 in favour of females (Limpus *et al.*, 1994; 2005). The size ratios of green turtles in GBR foraging areas is generally a balance of all size classes. Therefore, the harvest by Hammond Islanders and the Thursday Island group is not likely to be a random sample from the natural population of turtles.

This pattern is not restricted to Torres Strait, indeed, Indigenous hunters from other parts of northern Australia also appear to prefer female turtles to males. For example, more female than male turtles were recorded in the Dhimurru Miyapuna project by Yolgnu hunters in north east Arnhem Land and similar to hunters in this study the hunters stated that females are preferred to males because they are larger, fatter and contain large numbers of ova (yellow eggs; Kennett *et al.*, 1998).

Conversely, Kwan (1991) did not find such marked selectivity in the catch of turtles at Daru from 1985-1987 based on a much larger sample than in this study. Although the female bias in the sex ratio was significantly different from 1:1 (Table 5; Chi Square with Yates correction = 247.58), the sex ratio was similar to the natural sex ratio found for turtles stranded in the Gulf of Carpentaria after a cyclone (Limpus and Reed, 1985). In addition, only 67.9% of the female turtles caught at Daru were larger than 90 cm CCL (Kwan, 1991). Choice of sex and size would be limited if turtles were caught by nets, but only 0.2% - 1.4% of turtles at Daru were caught in nets and most were caught using a harpoon. Turbid water would also make it more difficult to distinguish sex. Kwan (1991) suggested that sexual selection by Daru fishermen who sold their catch in the market was minimal because of the high demand for fresh turtle meat. Interestingly previous studies by Kowarsky (1982) and Nietschmann and Nietschmann (1981) also imply that adult females are preferred and that most hunting occurs over reef areas.

Table 5. Sex ratio of marine turtles caught in Torres Strait in various studies.

Location	Sex ratio F:M	Date	Study
Hammond Island	1:0.00	2005	present
Thursday Island	1:0.03	2005	present
Daru	1:0.22	1985-1987	Kwan (1991)
TSPZ	1:0.05	1996-2001	Skewes <i>et al.</i> (2002)

Dugongs

Previous work suggested that Torres Strait Islanders preferred large female dugongs (Haddon, 1912; Nietschmann and Nietschmann, 1981; Raven, 1990; Johannes and MacFarlane, 1991; Ponte, 1996). On this basis, it is surprising that more male than female dugongs were caught at Hammond Island (Table 6). For the Thursday Island group, however, more female than male dugongs were caught (Table 6) and neither of these sex ratios were significantly different from

1:1 (Chi Square with Yates correction). Similarly, the bias towards females in recent studies is relatively small and Kwan (2002) suggested that it was unlikely that hunters from Mabuiag Island were actively selecting for females. Kwan (2002) and Hudson (1986) each found that slightly more females than males were caught at Mabuiag Island in 1998-1999 and Daru from 1978-1982, respectively. Harris *et al.*, (1997) also found a bias towards female dugongs from the TSPZ from 1990-1996 and this bias was smaller in the same area in 1996-2001 (Table 6; Skewes *et al.*, 2002). Based on the small sample size from this study and the proportion of males to females, there is no evidence that hunters are selecting dugongs on the basis of sex in this study. As more information on the sex ratio of harvested dugongs is collected a better idea of the population dynamics will emerge.

Table 6. The sex-ratio of dugongs caught in Torres Strait in various studies.

Location	Sex ratio F:M	Date	Study
Hammond Island	1:1.6	2005	Present
Thursday Island	1:0.75	2005	Present
TSPZ	1:0.5	1990-1996	Harris <i>et al.</i> , 1997
TSPZ	1:0.88	1996-2001	Skewes <i>et al.</i> , 2002

Many of the dugongs caught in this study were relatively small compared to the Daru harvest of 20-30 years ago. All of the dugongs caught in this study were smaller than the average size of dugongs caught at Daru from 1978-1982. In addition there has been an apparent downward shift in both the average size and the largest size of dugongs reported in other studies from Torres Strait since that time (Table 7).

Table 7. The average size and range of sizes of dugongs caught in the Torres Strait area.

Location	Average size (cm)	Size range (cm)	Date	Study
Hammond Island	198.2	150 – 240	2005	Present
Thursday Island	215.5	165 – 250	2005	Present
TSPZ	213.3	79 – 280	1996- 2001	Skewes <i>et al.</i> , 2002
Mabuiag Island	233.0*	132 – 320	1997-1999	Kwan, 2002
Daru	251.0	150 – 331	1978-1982	Hudson, 1986

*unpublished data

A downward shift in the sizes of dugongs caught could indicate that the population is being over-harvested because it suggests that the larger, reproductive animals have been removed and are not being replaced fast enough to counteract the effects of hunting (e.g. Hudson, 1986). The sample of dugongs from the Kaiwalagal region in this study is relatively small compared with the other studies and does not include a full year of sampling, which excludes the time when dugongs are most abundant in the area. Dugongs from the Kaiwalagal area come from the same genetic stock as those from Daru, so it is unlikely that the dugongs near Daru are actually larger than dugongs near the Kaiwalagal area (Kwan, 2002). Further information on sizes of harvested dugongs needs to be collected to determine, first, if there really is a shift towards harvesting smaller dugongs in the population and second, if there is, what has caused it. In addition, more tusks need to be collected to determine whether dugongs are small because they are young or due to some other factor affecting growth.

Some of the pregnant females caught here were among the smallest such females ever recorded (Marsh *et al.*, 1984a, b). The average size from both communities was 212.5 cm and ranged from 200 cm to 240 cm (Table 8). Kwan (2002) also recorded a small pregnant female (205 cm)

from Mabuiag (Table 8). As mentioned above, previous studies have suggested that dugongs reach sexual maturity at sizes greater than 220 cm (Marsh *et al.*, 1984a, Marsh 1995; Table 8).

Table 8. Comparison of the minimum sizes of sexually mature female dugongs recorded in various studies.

Location	Min. size sexually mature (cm)	Date	Study
Kaiwalagal region	200	2005	Present
Mabuiag Island	205	1997-1999	Kwan, 2002
Townsville	234	1969-1981	Marsh <i>et al.</i> , 1984a
Numbulwar	229	na	Bertram & Bertram 1973
Daru	240	1978-1982	Hudson, 1986

Density dependence theory suggests that when populations are below carrying capacity because of exploitation, colonisation or a natural event, age and size at first reproduction decreases and the population growth rate increases (see Fowler, 1981, 1984). Therefore, coming into breeding at a young age and small size could be a demographic signal of over-harvesting. Alternatively it could be a response to temporal or spatial shifts in environmental conditions (Marsh *et al.*, 1984b; Marsh 1995; Boyd *et al.*, 1999). For example, Kwan (2002) suggested that the early maturity of dugongs in her study was most likely due to favourable environmental conditions with good seagrass resources, but could not rule out a density dependent response to a reduction in the population size through over-harvesting. More information on age is needed to determine whether dugongs are breeding at a younger age or the animals are small because of some factor affecting their growth.

More information on sizes and ages of pregnant/sexually mature female dugongs caught by hunters in this study is needed to determine whether this apparent pattern is real. If it is, to disaggregate the possible causes, more information on seagrass distribution, abundance and nutritional quality in Torres Strait would be needed.

The collection of data in this section is dependent on the hunter's willingness to provide biological samples. The rates of collection of biological samples have been increasing from both the Thursday Island group and Hammond Island as hunters have become more familiar with the data collection system.

5.2.1.2 Selectivity of the green turtle harvest

For turtles, the catch-data alone would not be useful for understanding the composition of the population of turtles resident in Torres Strait because there was a strong bias in the catch data towards adult females. Most (92%) of the green turtles caught on the reefs during daytime turtle rodeos were juveniles and the sex ratio of juveniles was not significantly different from 1:1 (companion study). In addition, while travelling through and across deep water channels the project team often saw adult and sub-adult sized green turtles surfacing for breaths, although these were not quantified. This suggests that green turtles of a range of sizes are resident in the Kaiwalagal region and therefore the green turtle harvest is very selective.

5.2.1.3 Uses of dugongs and turtles

A relatively large proportion of the dugongs and turtles caught were used for subsistence compared to other uses. The high cost of living and lower incomes in Torres Strait relative to other parts of Australia means buying store bought meat is expensive and therefore reducing the number of dugongs and turtles caught is difficult. For example, the individual median income of Torres Strait Islanders living in Torres Strait is only 60% that of non-Indigenous people living in Australia, but meat is several dollars more expensive per kilogram (e.g. Table 9). This disparity

is probably even greater on the outer islands and PNG than Thursday Island and would need to be considered in the development of any community based management arrangements, including options such as catch sharing across communities.

Table 9. Comparison of the prices of meat between Canberra and Thursday Island

Item	Price per kilogram	
	Canberra	Thursday Island
Lamb chops/rump steak	\$13.99	\$15.99
Rib fillet steak	\$16.99	\$24.50
Eye fillet steak	\$26.99	\$29.99

6. Key areas for research and management focus

This study, and discussions held with Community members have identified several key areas that warrant further study, or are areas that are deemed important from local communities with regard to management of marine turtles.

6.1 Research needs

6.1.2 Turtles

- **Fine scale analysis of foraging behaviour and habitat uses of green turtles (juveniles and adults)**

These research projects would use methods such as telemetry, time depth recorders and stomach content analysis to elucidate about foraging behaviour. In particular whether there are any ontogenetic differences in fine scale temporal and spatial habitat choice. Results from these activities would add to our ability to interpret population level data for the species, such as night time bias in catch effort. Outcomes of this project would lead to more robust management and monitoring options by providing empirical data on habitat use.

- **Continued description of the population dynamics of green and hawksbill turtles in Torres Strait (especially the central and eastern Islands)**

The first data on the population characteristics of green and hawksbill turtles foraging in Torres Strait have been collected in a companion project in the Kaiwalagal region. However, for a more robust evaluation of the demography and trends in population function, and how these may change temporally and spatially a longer data set and monitoring period is necessary.

6.1.2 Dugongs

- **Cross-jurisdictional aerial survey of Torres Strait, northern GBR and Queensland coast of Gulf of Carpentaria**

This survey is required to estimate the sustainable levels of mortality for dugongs across this entire region. Previous surveys have been conducted within geographic areas in different years and the results are confounded to an unknown degree by movements between regions between surveys.

- **Investigation of changing demography of the dugongs harvested in Torres Strait**

This study and Kwan's (2002) study at Mabuiag Island in 1997-98 indicate that the size of dugongs harvested in Torres Strait and the size and possibly age of first reproduction has

declined. This result may be a demographic signal of over-harvest which requires further investigation by:

- Further investigations of the size, age and sex ratio of harvested dugongs;
- Investigation into the temporal changes in the age at first reproduction and calving interval revealed by examination of the Growth Layer Groups in the collection of tusks of Torres Strait dugongs held at JCU and collected by this project.

6.1.3 Turtles and Dugongs

- **Economic value of the Torres Strait dugong and turtles harvests**

This project confirms that much of the harvest of dugong and turtle meat is used for subsistence by community members on very low incomes. If there are to be quotas on the number of animals harvested, alternative sources of protein will be a high priority for affected communities. The economic value of the current harvest needs to be quantified in the context of the cost of hunting and living in different communities.

- **Arrangements between communities and between PNG and Australia**

The biggest challenge for turtle and dugong management in Torres Strait is the coordination of management at culturally (community) and ecologically (stock) relevant scales. Research is needed to develop principles for future community based arrangements for catch-sharing at several spatial scales: (1) between Australia and PNG, (2) between Torres Strait and the northern GBR and Gulf of Carpentaria communities; and (3) within Australian communities in Torres Strait

- **Developing a toolbox of tools to ensure that the dugong and turtle harvests in Torres Strait are sustainable**

There are a range of tools that could be used to ensure that the harvest of dugongs and turtles in Torres Strait is culturally and ecologically sustainable. These options include catch quotas, area and temporal closures and gear restrictions. The acceptability of these alternatives to Islanders needs to be investigated using focus groups, along with a spatial risk assessment of the management outcomes of the various options based on: (1) the information on the spatial distribution of dugongs and turtles in Torres Strait obtained from the temporal series of aerial surveys since the late 1980s and (2) contemporary information on the hunting patterns and egg harvest of individual communities.

6.2 Management needs (as identified by the Hammond Island Community)

These management needs were identified through talking to Hammond Island community members.

- **Development of educational and awareness raising materials**

There is a strong need for the development and distribution of plain English (or language) materials that describe biological data and results of research for turtles and dugongs.

- **Development of community based management plans**

Community based management plans are one management option that communities are willing to support. Assistance should be provided where possible to support Islander aspirations in the development of these community based plans, and to ensure that they are based on robust scientific and Indigenous knowledge. The Australian Government is currently funding initiatives to address this need, but such projects will undoubtedly need to be extended to achieve this outcome.

Management of the PNG and Indonesian harvest of marine turtles and dugongs from within Torres Strait waters

Torres Strait islanders have expressed significant concern about international harvest – such as the commercial harvest by PNG. Unless there are steps taken to reduce the pressure from international hunters on Torres Strait (and Australian) turtle and dugong populations; local management by Australian agencies and communities will be exceedingly difficult.

7. Lessons learned

Many lessons have been learned from this project. These lessons need to be distilled to inform other attempts at managing and monitoring marine hunting and fishing, especially of threatened species of cultural significance. Our list of such lessons follows:

7.1 Lessons for community-based monitoring of dugongs and turtles

- It is important for researchers and managers to work with communities in culturally appropriate education and extension programs before monitoring and other management initiatives are negotiated. Communities must understand a problem if they are to respond effectively.
- Negotiations about monitoring must be conducted in a manner that allows all parties to participate on an equal footing, and to respect each other's aspirations. Jones (2004) provides practical advice about how to set up an effective negotiation table in such circumstances.
- The development and implementation of Indigenous community-based catch-monitoring for dugongs and turtles must be gradual and adaptive. Engagement of communities is slow because developing the necessary trust and capacity throughout the community takes time. The development of trust can be facilitated by employing local staff with extensive social networks and the enthusiasm to engage other participants and maintain their trust. Communities also need access to scientific expertise to ensure that their collection techniques are robust.
- Because of the cultural significance of the Indigenous hunting of dugongs and turtles, trust is quickly destroyed by media controversy. If effective community based monitoring and management is to be developed in Torres Strait, a comprehensive culturally-sensitive media strategy is essential. All stakeholders need to respect the need to work in a culturally sensitive manner.
- In addition to the cultural significance of dugong and turtle hunting, Torres Strait Islanders are highly dependent on dugong and turtle meat for food. Consequently, Islanders will be very resistant to change unless they are meaningfully involved in the decision-making process. Actively involving Islanders in catch monitoring and research is valuable because this involvement increases their understanding and trust of the need for change and potentially provides them with some control over their future (e.g. N. Marshall, personal communication)
- Large meetings are not effective in engaging hunters. As Havemann *et al.* (2005) explained, interacting with the key hunters is integral to successful programs. Smaller, more focussed meetings and one-on-one interactions are likely to be much more effective in engaging hunters, especially the main hunters in the community.
- Catch-monitoring of dugongs and turtles is complicated by the many issues associated with dugong and turtle management in Torres Strait. These issues need to be addressed before, or

at least at the same time as implementing the catch-monitoring program. The major management needs identified by the communities we worked with were the need for long-term employment, the development of community-based management plans, assessment of the PNG and Indonesian harvest of dugongs and turtles from within Torres Strait waters, development of educational and awareness raising materials for both western scientific and traditional knowledge and greater action on impacts other than traditional harvesting. Concern about options for management and enforcement increased concerns about sharing ownership of research projects and outcomes and protecting sensitive information.

- Active involvement of Islanders in other aspects of dugong and turtle research and management can increase interest in catch-monitoring. For example, hunters actively involved in turtle rodeos in a companion project became more interested in monitoring their catches because they were getting a broader understanding of the biology and ecology of the animals. This idea that catch-monitoring needs to be developed and implemented in a holistic way in the broader context of Indigenous management of marine resources was also raised at the Catch-monitoring Workshop held on Thursday Island in 2003, where it was recognised that monitors need to be involved in more activities than just monitoring of their own catch.
- As raised during the Catch-monitoring workshop in 2003 (Turtle and dugong catch-monitoring report, 2003), employment and training of Indigenous research counterparts was integral to the success of the program. Ongoing employment will be integral to the continuation of catch-monitoring programs within communities because of the high level of contact needed between hunters and Indigenous research counterparts to collect datasheets.
- Using datasheets to monitor the catches of relatively small species of marine wildlife like dugongs and turtles is not very transparent. It might, therefore, be worthwhile considering incorporating other monitoring options like community processing sites to increase the transparency of the monitoring process. Rules for using such sites could be incorporated into community by-laws as the communities of Torres Strait achieve local government status.
- Catch-monitoring needs to be community focussed, but scientifically structured for catch-data to be meaningful. The information to be collected and how it will be analysed and used needs to be considered upfront to avoid collecting data that may not be useful. Managers, Indigenous or otherwise, need to be sure that the data being presented to them from the community is real and free (as it can be) from bias and error.
- Consideration needs to be given to controlling the use and/or distribution of data and reports. There is a need for transparency among all parties about what data will be collected and which data will be openly shared or withheld from public access. This will prevent misunderstandings.

7.2 Lessons for management of dugong and turtle harvests

- Australian Indigenous communities do not trust western research or researchers. Nonetheless, because research is conducted over many years, it provides a valuable opportunity to build trust by following agreed protocols and should be considered as part of the community education and extension process. Meaningful Indigenous participation even extending to “co-managed” research (Innes and Ross 2001), at all levels of the research process from framing and prioritizing the questions, designing the research protocol, collecting and analysing the data, and disseminating the results helps to build trust in the outcomes of the research process, especially if the results can be set in the context of relevant traditional knowledge.

- Management of the Indigenous dugong and turtle harvests should be conducted in the context of broader ‘Caring for Country’ initiatives. Indigenous peoples wish to create employment options within communities to manage “Caring for Country” initiatives. Indigenous peoples wish to be involved in all aspects of the management of their country in a manner which they consider culturally appropriate and which uses their traditional knowledge.
- It is important to develop a management framework for managing dugong and turtle harvest at ecologically relevant scales. If individual communities are treated as prototypes they may resent an initiative that does not apply to other communities. Communication between communities, even isolated communities in remote areas with a low socio-economic base, is now fast and efficient. Another imperative for implementing management at regional scales is that both dugongs and turtles undertake extensive movements. The large scale movements that both turtles and dugongs make means that both ecological scale of the animals’ spatial use and the cultural scales necessary for management need to be acknowledged and be incorporated into management practice.
- Indigenous communities are understandably wary of initiatives that they consider threatening to their aspirations. In Australia, this includes Native Title aspirations. Thus management initiatives should acknowledge these concerns.
- Management initiatives should be culturally appropriate and developed together by the community and the managing agencies. Successful initiatives are an iterative mixture of both top-down and bottom-up strategies. Top-down initiatives from managing agencies are important for statutory support, capacity building and resources. Bottom-up initiatives from the community are an essential pre-requisite for community ownership and control.
- Management arrangements need to be flexible and adaptive, allowing the management partnerships to grow iteratively in a distinct cycle, which treats management intervention as a hypothesis for testing and evaluation. This approach allows all parties to test their assumptions systematically and to measure how well the arrangements have worked and improve them if necessary. Thus successful co-management initiatives are likely to take many years to develop, and would incorporate several “management tools” other than catch regulation.
- The problem and the proposed solution have to be owned by many people in both the community and the managing agencies, rather than a few champions. An initiative must have the capacity to survive changes in personnel.
- Planning management initiatives is much easier than implementation, which requires resources and community capacity. The resources required for implementation should ideally be available before planning is completed to capitalise on the momentum generated during the planning phase and as an incentive during the negotiation process. Although, funds have been provided by the Australian Government to support community-based management of dugongs and sea turtles in northern Australia, this funding is project based and short-term. A secure long-term funding base is required. Altman and Cochrane (2003) note that ‘supporting Indigenous economic futures on country has the potential to generate benefits not just for Aboriginal people but also for a variety of national stakeholders’. The development of local Indigenous natural resource management of land and sea country in the remote regions of northern Australia is a potentially cost effective option. Such an initiative has the potential to provide employment opportunities in communities that are at present largely dependent on social security to manage remote areas that are currently managed largely by benign neglect. Using locals should be much more cost-effective than meeting the logistical challenge and

expense of re-locating management agency staff from other areas, either permanently or on an expeditionary basis.

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Appendix 1: Logo on Polo-shirts worn by Indigenous counterparts



Appendix 2: Data sheet for catch monitoring

Fill in 1 datasheet per animal (if no dugongs or turtles were caught, fill in the other details for the trip).
To be filled in by one member of the hunting party only.

HUNTING DETAILS:

Date: ___/___/___
Day Month Year

Code number of hunter: _____

Number in hunting party: _____

CATCH DETAILS: (Use a separate sheet for each animal)

What type of DUGONG, if any, did you catch:

Type	Sex	Pregnant female?	Time caught ____
Adult <input type="checkbox"/>	Female <input type="checkbox"/>	Yes <input type="checkbox"/>	How far from the island where you live: ____
Youth <input type="checkbox"/>	Male <input type="checkbox"/>	No <input type="checkbox"/>	_____ km
Calf <input type="checkbox"/>			Guess size: _____ cm

What type of GREEN TURTLE, if any, did you catch (Use a separate sheet if you also caught a dugong and have filled in the information for dugongs on this sheet):

Type	Sex	webud?	Time caught: ____
Waru <input type="checkbox"/>	Female <input type="checkbox"/>	Yes <input type="checkbox"/>	How far from the island where you live: ____
Murai <input type="checkbox"/>	Male <input type="checkbox"/>	No <input type="checkbox"/>	_____ km
Waru kas <input type="checkbox"/>	Measure size: _____ cm	Tag number: _____	

What equipment did you use for the hunt?

Dinghy & clinker Dinghy only Dinghy and spotlight Wap Hand catch Hook (turtle)

Catch rate:

Today, what time did you: Start your trip? _____ Finish your trip? _____

How many hours did you spend hunting? _____ (including looking for dugongs and turtles)

What did you set out to catch today?

Dugong Turtle Crayfish Fish Other ____

What was the purpose for hunting today?

Tombstone unveiling <input type="checkbox"/>	Funeral <input type="checkbox"/>
Wedding <input type="checkbox"/>	Initiation ceremony <input type="checkbox"/>
Shaving ceremony <input type="checkbox"/>	Coming of age ceremony <input type="checkbox"/>
Kai Kai <input type="checkbox"/>	Other (please say what) ____

Did someone else ask you to hunt for them today? Yes No

How many people? _____

How many people did you share your personal Turtle or dugong with? _____

Comments: _____

Appendix 3: Practical sampling exercise

The sampling exercise demonstrates that the more hunters that participate, the more likely it is that the catch-estimate for the community will be close to the actual number of dugongs caught.

Hunters are given cards with the number of dugongs caught. The first two hunters call out their numbers (i.e. 8 and 0) and the estimated number of dugongs caught by the community is calculated based on the sample of 2 hunters. The estimated number of dugongs is 120, which is an over-estimate because only 36 dugongs were actually caught. This is repeated with a sample of 15 hunters (half the hunters in the community) and the estimated number of dugongs is 20, which is an under-estimate. This is repeated again using all of the hunters and the estimate is 36, the actual number of dugongs caught. If only the second set of 15 hunters provides data, then the estimated number of dugongs caught by the community is different from the estimate obtained using the first set of 15 hunters. This demonstrates that the estimate may be different depending on which hunters participate.

Appendix 4: Relevant section of the Research MoU

4. INTENDED USES FOR THE CULTURAL HERITAGE AND TRADITIONAL KNOWLEDGE PROVIDED BY COMMUNITIES TO THE STUDENT

The research will result in outcomes, disclosure of Cultural Heritage and Traditional Knowledge provided by Communities to the Student, feedback, and outputs.

Outcomes

It is intended that the methods developed and information collected in this project can be used by the participating communities to assist:

- Decision-makers in designing future management plans for their turtle and dugong fisheries.
- In designing community-based catch-monitoring programmes that are appropriate for individual communities.

Disclosure of Cultural Heritage and Traditional Knowledge provided by Communities to the Student

Some facets of Cultural Heritage and Traditional Knowledge provided by the Communities to the Student will be in the public domain and will therefore be able to be accessed by anyone interested. Other facets of Cultural Heritage and Traditional Knowledge provided by the Communities to the Student will not be in the public domain and people would need to apply for formal permission to use it. During the project, the Reference Group and the Student will discuss what such information is made available in the public domain, as in the Project Sheet (item 5).

Some Cultural Heritage and Traditional Knowledge provided by the Communities will not be disclosed, but the Student does need to disclose some other Cultural Heritage and Traditional Knowledge provided by the Communities:

Cultural Heritage and Traditional Knowledge provided by Communities to the Student that will not be disclosed:

The total numbers of dugongs and turtles recorded as harvested will not be disclosed in any outputs and will be confidential until otherwise agreed.

Appendix 5: Example of a story on animal cruelty

Cairns Post 11th November 2004

Dugong harvest 'cruel'

THE RSPCA has condemned cruel Torres Strait hunting methods such as drowning dugongs and cutting flesh off live turtles but says it is powerless to prosecute.

RSPCA's chief inspector Byron Hall yesterday said tradition was excusing indigenous hunters for a level of cruelty to animals that would not be tolerated in the rest of society.

"It's cruel to drown animals. We prosecute people for drowning kittens. You can receive a fine of up to \$75,000 or two years in jail," Mr Hall said.

"It's an air-breathing mammal like the dugong, what's the difference?"

Likewise, he said it was clearly cruel

Margo Zlotkowski
Indigenous reporter

to cut up any animal while it was still alive. However, the RSPCA's hands are tied because traditional indigenous hunting is exempt under the State Government's Animal Care and Protection Act.

Two of the traditional hunting methods reported to *The Cairns Post* yesterday included tying a speared dugong to a boat then drowning it by towing it to shore by the tail and cutting limbs and organs off turtles while they were still alive.

Photos provided to the newspaper graphically showed the process of a live

turtle having its flippers severed and its stomach carved open.

Another showed a dead female adult dugong, a rope tied around its tail after being dragged behind a boat for several kilometres.

The Cairns man who supplied the photo, who asked not to be named, said the animal was speared after being lured to the surface by the cries of its young who had been captured, tied to the boat then shaken to make it cry out.

Mr Hall said the report was very disturbing because the baby dugong, which was later released, would have little chance of survival without its mother.

Questions over how the rare and gen-

tle species are being hunted have emerged in the wake of federal plans to reduce the Torres Strait's unsustainable harvest of about 1000 dugong a year.

Fisheries and Conservation Minister Senator Ian Macdonald yesterday confirmed a review of the harvest would include hunting methods being used.

No inhumane treatment of animals would be tolerated, the senator said.

The Cairns Post yesterday was also told of dugong being speared after being chased in speedboats until they collapsed from exhaustion and drowning after being tied up and left at the Horn Island wharf.

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