

Report on  
**Workshop on spatial closures as one of the possible management tools for community-based management of dugongs and turtles in Torres Strait**  
sponsored by MTSRF, TSRA and JCU

## Executive Summary

1. A workshop was held at the Port Kennedy Association Hall, Douglas St Thursday Island from October 14-16 to:
  - (1) repatriate the results of dugong and turtle research, and
  - (2) explain ongoing research conducted by CRC Torres Strait and MTSRF to Torres Strait Islanders by:
    - exploring the benefits of and challenges associated with using spatial closures as one of the possible tools for community-based management of dugongs and turtles in Torres Strait, and
    - building the collective capacity and mutual understanding of TSRA Land and Sea Managers, Dugong and Turtle Project Officers, Government agency staff and researchers conducting projects on dugongs and turtles in Torres Strait.
2. The first day of the workshop comprised a GIS/GPS training session and participatory mapping exercise for the Turtle and Dugong Project officers from the TSRA Land and Sea management Unit.
3. The main workshop was held over the next two days and was attended by four members of the staff of TSRA Land and Sea Management Unit, eight Dugong and Turtle Project Officers, a community ranger, a member of the Torres Strait Islander community, and representatives from various government agencies: AFMA (2), DEWHA (1), DFAT (1) GBRMPA (1), a representative from NAILSMA, and nine researchers from JCU.
4. The workshop consisted of:
  - **Presentations on:** TUMRAs, legal issues associated with spatial closures, spatial closures as a management tool for dugongs in Torres Strait, tools for managing sea turtles in Torres Strait, i-tracker, the history of the Torres Strait Dugong Sanctuary, how the information required for spatial closures could be managed in a GIS, update on ranger programs in Torres Strait.
  - **Group Exercises :** 10 year vision for the turtle and dugong fisheries in Torres Strait, features of an effective dugong and turtle management tool, spatial closures in the context of customary tools for managing turtles and dugongs in Torres Strait, the strengths and weaknesses of the Dugong Sanctuary, lessons learned from the workshop.
  - **Poster Session** to discuss the PhD research of three MTSRF sponsored students with the attendees.

### Evaluation Exercise

The evaluation exercise indicated that participants increased their understanding of four topic areas (1) Spatial closures as a management tool, (2) The use of traditional knowledge and GIS and how they can be used to inform closures, (3) Legal and enforcement issues and (4) Positives and negatives of closures. The least improvement

was with Question 3 regarding legal and enforcement issues, possibly because the scheduled overview of enforcement issues was not presented due to logistical issues. Even so, this question demonstrated a notable improvement in understanding of the legal issue. In addition, at the completion of the workshop two additional questions were asked to evaluate whether each participant increased their knowledge about either local cultural issues or the role of western science. The variation in change, and some people's scores of these two questions, probably reflect the variety of background knowledge of each participant.

## Introduction

The draft Strategic Assessment of the Torres Strait Turtle and Dugong Fisheries identified several shortcomings in the current management arrangements and suggested spatial closures as one of the potential management tools. Recent work by Grayson and others at JCU suggests that a major reason that the Torres Strait dugong fishery has persisted for >4000 years is that a significant proportion of the intermediate and high density dugong habitats are not hunted. At least 27% of the non-hunted habitat occurs in western Torres Strait including the Dugong Sanctuary and adjacent waters in the PNG jurisdiction. Spatial closures have also been identified as a management tool in some of the Turtle and Dugong Management Plans identified to date. Accordingly it was decided to hold a workshop to:

- (1) repatriate the results of the dugong and turtle research, and
- (2) explain ongoing research conducted by CRC Torres Strait and MTSRF to Torres Strait Islanders by:
  - exploring the benefits of and challenges associated with using spatial closures as one of the possible tools for community-based management of dugongs and turtles in Torres Strait, and
  - building the collective capacity and mutual understanding of TSRA Land and Sea Managers, Dugong and Turtle Project Officers, Government agency staff and researchers conducting projects on dugongs and turtles in Torres Strait.

The workshop was held at the Port Kennedy Association Hall, Douglas St Thursday Island from October 14-16.

## Summary of activities

### GIS/GPS training (October 14)

All project officers from the Land and Sea Management Unit took part in a GIS/GPS training session and participatory mapping exercise under the supervision of Alana Grech, Stephen Ambar and Aurélie Delisle.

This training built on the GIS/GPS workshops that took place on nine islands in February 2008 and which were organised and conducted by Alana Grech and Stephen Ambar. A summary of the results of the February workshops was presented at the beginning of the day.

The morning session of the October training workshop focused on consolidating the acquired knowledge and skills of the project officers about GIS and GPS. Taking advantage of the presence of Alana Grech, Stephen Ambar and Aurélie Delisle, the project officers were divided into two small groups to focus alternatively on GIS and on GPS. One-on-one GIS sessions were also organised to answer the specific queries of each project officer.

The afternoon session started with a presentation by Aurélie Delisle about the possible use of GIS to map features of interest and how the project officers could make use of the tool in their

respective communities. This presentation was followed by practical activities during which each project officers learned how to use different GIS tools to map features of interest to them. Examples included learning how to map places of interests, threats like marine debris or potential spatial closures included in some of the draft management plans.

## Main workshop (October 15 and 16)

The main workshop was held over two days and attended by four members of the staff of the TSRA Land and Sea Management Unit, eight Dugong and Turtle Project Officers, a community ranger, a member of the Torres Strait Islander community, and representatives from various government agencies: AFMA (2), DEWHA (1), DFAT (1) GBRMPA (1), a representative from North Australian Indigenous Land and Sea Management Alliance (NAILSMA), and nine researchers from JCU. A full list is at Appendix 1. The Queensland Boating and Fisheries Patrol was invited to send a representative but were unable to do so. Some people were able to attend only part of the workshop.

The workshop consisted of a series of presentations and group exercises and a poster session as outlined in the Program at Appendix 2. Appendix 3 is a summary of each of the presentations; Appendix 4 a Summary of the posters. The methods and results of each group exercise are summarized below.

The following techniques were used successfully to maximize cross-cultural communication between workshop attendees:

- sheets of butcher’s paper labeled “park it” for topics which were outside the scope of the workshop; “issues for discussion” for matters that needed further discussion at the workshop; “funny lingo” for terms unknown to at least one stakeholder group; and
- providing each table with a clicker to notify speakers when they were using unfamiliar words.

## Group Exercise: 10 year vision for dugongs and turtles in Torres Strait

Attendees divided into expertise-based groups to brainstorm their vision for Dugongs and Turtles in Torres Strait in 10 years’ time. The results of this exercise are summarized in Table 1 and indicate that the vision of the three major groups at the workshop had much in common.

<b>Components of Vision (no particular order)</b>	<b>Islanders</b>	<b>Government Officers</b>	<b>Researchers</b>
Healthy populations of dugongs and turtles	√	√	√
Strong culture (Zenadth Kes peoples relate to dugongs and turtles the way their ancestors did)	√	√	√
Strong partnerships at all levels	√	√	√
Increased capacity for Islander employment	√	√	√
Improved knowledge and understanding of nature, communities and the interaction between them			√
Training in marine environmental science available in Torres Strait	√		
Effective collaboration between PNG and Australia		√	

## **Group Exercise: Features of an effective management tool**

The purpose of the exercise was to understand the features of an effective dugong and turtle management tool from the perspectives of the various stakeholders involved in the management of dugong and turtle hunting in Torres Strait with the goal of improving understanding between the stakeholder groups by providing a common ground on which to base communication, negotiation, and co-management strategies.

The exercise comprised the following sequential steps. The results of each step were recorded during the exercise.

- 1) The purpose of the exercise was explained and each participant signed an Informed Consent Form as required by the JCU Ethics Permit for the exercise (H2795).
- 2) Participants divided into mixed groups of four to five. (Researchers did not participate except to explain the exercise).
- 3) Each group identified the features of a good management tool for dugongs and turtles in a brainstorming exercise.
- 4) Participants finalised an agreed list of 15 features of an effective tool by removing redundancy from the ideas that emerged during the brainstorming process.
- 5) Each participant was asked to identify his or her top three features of the composite list of 15 features in a secret ballot.
- 6) Each participant was asked to weight the features in the composite list by allocating 10 dots between the features in a secret ballot.

The results are presented in Table 2 in rank order. The ranks were determined from the combined scores of all Islander and agency participants because of the relatively low number of the latter. The top four features of an effective management tool were identified as:

1. The management tool is legally and culturally enforceable
2. Use of the management tool provides real jobs for Indigenous rangers with on-going resourcing, training and support
3. The management tool is developed by and agreed to by Traditional Owners, elders and hunters
4. Use of the management tool will improve the likelihood that there will be dugongs and turtles for the children of the Zenadth Kes to hunt

There was some confusion among participants in the exercise and modifications designed to reduce confusion in future are listed in the Recommendations on p. 11. Nonetheless, the top features listed above are likely to be robust as they are similar to those identified in previous attempts at similar exercises facilitated by Marsh and Hamann. Some Islanders thought it very important that the commitment to jobs for Indigenous rangers with on-going resourcing, training and support was stated explicitly; some government agency workers placed similar emphasis on making the necessity for harvests to be sustainable explicit.

**Table 2: Features of an effective tool for managing dugong and turtle hunting identified by Islander and agency participants in rank order with one being the highest rank. Researchers did not actively participate in this exercise.**

Overall rank	Rank Top 3 <sup>1</sup>	Rank Votes out of 10 <sup>2</sup>	Feature
1	1	1	The management tool is legally and culturally enforceable
2	2	2	Use of the management tool provides real jobs for Indigenous rangers with on-going resourcing, training and support
3	3	3	The management tool is developed by and agreed to by Traditional Owners, elders and hunters
4	4	4	Use of the management tool will improve the likelihood that there will be dugongs and turtles for the children of the Zenadth Kes to hunt
5	5	6	The design and use of the management tool is based on an open exchange and understanding of relevant information, both Traditional Ecological Knowledge and western science
5	6	5	The management tool is compatible with other plans and processes e.g. strategic assessment; community plans; Indigenous Protected Area (IPA) plans
7	6	6	The management tool integrates knowledge across the nations of Torres Strait, across northern Australia and between Australia and PNG
8	9	8	The management tool leads to increased capacity to develop partnerships between community members and researchers
9	11	8	The management tool is simple to use and understand and is explainable using local terminology
9	11	8	The implementation of the management tool is accompanied by education and awareness for all members of the community
9	8	11	The management tool is assessed by a standardised system of data collection and storage
12	11	11	The management tool allows the community to maintain access to healthy food at affordable prices
13	9	14	The management tool addresses multiple impacts e.g. habitat loss, foreign fishing vessels
14	11	13	The effectiveness of the tool is regularly reviewed and the design and use of the tool is modified as new information becomes available
15	11	14	The management tool is consistent with cultural practices e.g traditional visitors and Traditional law

<sup>1</sup> Each participant was asked to identify (but not rank) the three features in the composite list of 15 features that they considered most important. The ranking is based on the cumulative votes of all participants.

<sup>2</sup> Each participant was asked to apportion 10 dots among the 15 features on the composite list to indicate their relative importance. The ranking is based on the cumulative votes of all participants.

## **Spatial closures in the context of customary tools for managing dugongs and turtles in Torres Strait**

A key learning from the spatial closure workshop was recognition by the non-Islander attendees that there was a strong influence of customary law in shaping the Turtle and Dugong Management Plans developed to date. There was agreement at the workshop that future discussion, development and implementation of additional closures (spatial & temporal) should be driven by communities and that it should be done in accordance with tradition and culture. Another key message, introduced by John Wigness, is that any future discussions regarding spatial closures should consider the outcomes of all the prior and current community consultation, as opposed to starting the process again. For example, the idea of spatial closures as a management tool has been discussed at a community level during the development of the current management plans and outcomes of these previous discussions would be useful to help shape future efforts. Continuing the process rather than beginning again would serve to build trust, awareness and prevent confusion, mixed messages and the feelings within community that “*we have told you all this before*”. This cultural backdrop informed much of the group discussion regarding the usefulness of spatial closures that is summarized below.

### **Benefits of culturally appropriate closures (temporal, spatial & combined) as identified by the workshop attendees**

- Closures can benefit communities by providing jobs and opportunity such as monitoring and enforcement – thus improving community capacity and support for natural resource management.
- Closures can provide a mechanism for improved enforcement through a shared arrangement (Government and community).
- The development of culturally appropriate closures will promote responsibility and sharing by individuals and communities.
- Spatial closures over sea country can serve to increase dugong and turtle numbers and protect source areas.
- Spatial closures on turtle nesting beaches can protect eggs, hatchlings and nesting turtles. One avenue for this is through the Indigenous Protected Area (IPA) system.
- In some areas seasonal (temporal) closures may be more appropriate and can be better aligned with customs/tradition than long-term spatial closures.
- Closures allow scope for enhanced education on culture and tradition for young people and hunters.

### **Difficulties with closures**

- It will be difficult to address illegal foreign fishing vessels that fish inside closures.
- In some communities or areas it could be inappropriate to tell people when and where they can hunt.
- There needs to be appropriate data on turtle and dugong distribution (numbers of animals or numbers of nests), plus information on habitat and other threats to decide on location and type of closure.
- Discussions need to follow on from where previous discussions left off (and take into consideration outcomes of prior discussions) because moving too fast will risk losing the support of community.

- Spatial management needs to consider impacts of commercial fishing and fisheries management on turtle and dugong habitat.

### **Options/mechanisms for developing closures**

- Plans for spatial/temporal closures need to build upon all the community consultation that is occurring and has occurred in the past (for development of plans). This approach will prevent confusing double messages and thus help generate community support.
- Closures need to ensure that hunting is by Traditional Owners only.
- There needs to be consistency in the plans.
- Closures need to be enforced – this means sufficient resources for enforcement agencies.
- Spatial closures need a cultural basis.
- Closures may be most effective if you close off areas where there is no hunting at present.
- Spatial closures need to be discussed with commercial fishers as there may be cross interest or conflict.
- PNG needs to be included in discussions about management – including closures.
- Potential closed areas need to be compared with sacred sites to determine significance of overlap (using GPS & GIS).

### **Strengths and weaknesses of the Torres Strait Dugong Sanctuary**

Participants were asked to list the strengths and weaknesses of the current dugong sanctuary. There was substantial overlap between the discussion of the Sanctuary and discussion of spatial closure.

#### **Strengths**

- The current sanctuary is a statutory creation.
- The current sanctuary has good quality habitat and may be a dugong source area.
- The sanctuary is well known about by Islanders and thus regulation may be easier.
- Zenadth Kes communities agreed to the location of the sanctuary.
- The sanctuary acts as a reserve, increasing numbers of dugong and turtles.
- The sanctuary is a long way from communities (hence fewer people can access it).
- The existing sanctuary has set a precedence and the process should be able to be duplicated

#### **Weaknesses**

- Because the sanctuary is a long distance from communities, enforcement is difficult and would need support.
- There is low Government presence in the sanctuary for enforcement.
- There is an International Shipping lane that runs through the sanctuary and no studies have been done about possible impacts of the shipping lane on the habitat.
- More data is required on dugong and turtle numbers and seagrass quality/quantity in the sanctuary.

## Suggestions

- Consider expanding the sanctuary northwards.
- Consider developing and resourcing enforcement protocols.
- Collect more information on abundance and distribution of dugong, turtles and seagrass.
- **Group Exercise: Lessons learned**

Each workshop participant was asked to list independently the major lessons that s/he had learned from the workshop. These lessons have been synthesised and summarised in Table 3.

Table 3. Summary of the major lessons learned from the workshop by participants.

<b>The eight Turtle and Dugong Management Plans developed to date</b>
These plans have been based on extensive consultation with relevant communities and reflect customary norms that differ between communities.
The implementation and enforcement of these plans should be prioritised over the development of additional plans.
Successful implementation of these plans will require government investment in infrastructure and real jobs for rangers
<b>Spatial closures</b>
Spatial closures are a potentially important management tool for the Turtle and Dugong Fisheries in Torres Strait, especially the Dugong Fishery, despite the cultural, practical and legal challenges associated with their implementation..
Spatial (and particularly spatio-temporal) closures are included in several of the eight Turtle and Dugong Management Plans developed to date.
The Dugong Sanctuary is an important spatial closure that is generally accepted by Torres Strait Islanders who are keen to see it better enforced by government or by a community-government partnership.
The scientific knowledge of the significance of the Dugong Sanctuary as a management tool is inadequate. This deficiency needs to be remedied.
<b>Repatriation of Western Scientific Knowledge (WSK)</b>
The area of high density dugong habitat in the Torres Strait region is much more extensive than on the east coast of Queensland or in the Gulf of Carpentaria and the large proportion of the area which is rarely hunted is one reason why the dugong fishery has persisted for 4000 years.
There is congruence between Western Scientific Knowledge and Traditional Ecological Knowledge of turtles and dugongs. These two knowledge systems can be combined using GIS.
The Project Officers increased their knowledge of GIS, GPS and the results of recent research and feel more confident about transmitting this information back to their communities in their own language.
<b>Generic lessons</b>
The economic goals of communities need to be linked to their environmental goals.
Community based management based on customary norms and Traditional Ecological Knowledge should be the focus of the management process, supported by western scientific knowledge and government not visa versa.
Effective partnerships between Traditional Owners, government agencies and researchers are important.
Management needs to be evidence based and adaptive.
Different groups use terminology differently and these differences need to be resolved as a basis for effective communication including during group exercises.
The progress made to date is only the start; there is a long way to go. Effective communication with PNG should be a high priority. Some legislation may need to be amended.

In the Great Barrier Reef Region, Traditional Use of Marine Resource Agreements (TUMRAs) are being used as the basis of regulating the dugong and turtle harvests of some communities.

## Evaluation

We used a “dartboard” technique to evaluate changes in participants’ understanding of various issues and increased knowledge. At the start of the workshop participants were asked to score their level of understanding on four topics by placing a dot adjacent to the appropriate ring in the dart board (closer to the bull’s eye = higher understanding). The spread of dots at the start of the workshop was used as the baseline for each topic.



- 1) Understanding of spatial closures as a tool for management.
- 2) Understanding of how GIS can be used with Traditional Knowledge to inform management.
- 3) Understanding of legal and enforcement issues relating to spatial closures.
- 4) Understanding of positives and negatives of spatial management.

Upon completion of the workshop, participants were asked to repeat the dartboard exercise, and changes in understanding by the group were determined by evaluating the shift in dots towards or away from the bull’s eye. In addition, two extra questions were asked at the end of the workshop, one each for Indigenous and non-Indigenous participants.

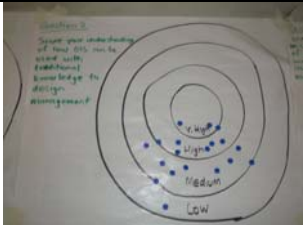

- 1) Score the change in your understanding of local (cultural/social etc) issues related to the management plans.
- 2) Score the change in your understanding of how western science can play a role in management.

## Results



### Question 1 - Understanding of spatial closures as a tool for management

	
Before (n=20)	After (n=19)
Low = 0 (0%) Medium = 4 (20%) High = 12 (60%) Very High = 4 (20%)	Low = 0 (0%) Medium = 0 (0%) - <b>20%</b> High = 14 (74%) <b>+14%</b> Very High = 5 (26%) <b>+6%</b>

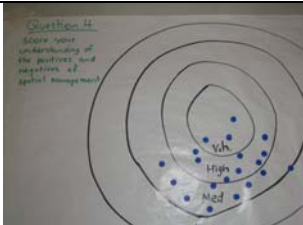
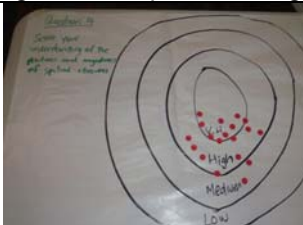
### Question 2 - Understanding of how GIS can be used with Traditional Knowledge to inform management

	
Low = 1 (5%) Medium = 10 (50%) High = 6 (30%) Very High = 3 (15%)	Low = 0 Medium = 0 - <b>50%</b> High = 12 (63%) <b>+33%</b> Very High = 7 (37%) <b>+22%</b>



### Question 3 - Understanding legal and enforcement issues relating to spatial closures

	
Low = 2 (10%) Medium = 10 (50%) High = 8 (40%) Very High = 0 (0%)	Low = 2 (11%) <b>+1%</b> Medium = 5 (26%) <b>-24%</b> High = 12 (63%) <b>+23%</b> Very High = 0 (0%)

### Question 4 - Understanding of positives and negatives of spatial management

	
Low = 0 (0%) Medium = 9 (45%) High = 8 (40%) Very High = 3 (15%)	Low = 0 (0%) Medium = 2 (11%) - <b>34%</b> High = 8 (42%) <b>+2%</b> Very High = 9 (47%) <b>+32%</b>

Questions 4 - Score the change in your understanding of local (cultural/social etc) issues related to the management plans (for non-Indigenous participants) and Question 5 - Score the change in your understanding of how western science can play a role in management (for Indigenous participants).

 <p>Question 5 (Non-Indigenous) How much has your understanding of local issues of Tab (cultural, social, environmental) increased?</p>	 <p>Question 6 (Indigenous) How much has your knowledge on western science about whether or how science increased?</p>
<p>Very little increase = 0 Slight increase = 4 Large increase = 5 Very large increase (border-line) = 4</p>	<p>Very little increase = 0 Slight increase = 1 Borderline slight to large increase = 4 Large increase = 1 Very large increase = 0</p>

### Summary

Responses to Questions 1 to 4 show increased understanding across all four topics by participants. The least improvement was with Question 3 regarding legal and enforcement issues, possibly because the overview of enforcement issues was not presented due to logistical issues. Even so, there was a notable improvement in understanding of this issue.

Questions 5 & 6 revealed that, despite the mixed backgrounds of participants, each person increased their knowledge about local cultural issues and the role of western science to some extent. The variation in change probably reflects the variety of background knowledge of each participant. In hindsight, a before and after dartboard exercise for Questions 5 and 6 would have been useful.

### Recommendations

**These recommendations were developed at a meeting of JCU researchers after the workshop and do not represent the opinions of all workshop participants.**

#### Dugong and turtle management in Torres Strait

- Dugong and turtle management in Torres Strait should be coordinated across nations and communities against agreed goals.
- Priority should be given to enforcement of hunting by PNG nationals and in the Dugong Sanctuary.
- The existing plans should be strengthened by making explicit links between the various management tools and customary laws.
- Implementing the existing eight community management plans should have priority over developing new plans.
- Community rangers should be given assistance with monitoring and training.
- All monitoring programs should have clear goals.

#### Spatial closures

- Spatial closures or other tools for managing fisheries in sea country close to communities should be based on customary knowledge rules as much as possible. This recommendation is not limited to traditional fisheries.

### **Future workshops**

- Future workshops should consider the range of tools for management of dugong and turtle fisheries rather than concentrate on spatial closures *per se*.
- The exercise on indentifying “features of a good management tool” should be modified to:
  - better explain the exercise to participants;
  - refer to “features” of a good management tool rather than “indicators” (because of the quantitative connotation of the latter);
  - provide several (e.g. 4) randomly ordered arrangements of the list of agreed features before attendees are asked to indentify their top three features and to weight them to minimize the risk of scoring being confounded by position on the list;
  - ensure that the identification of the ‘top three’ and scoring were done independently by each participant.
- One day of technical training should be included before or after the workshop. There are advantages of both approaches. The most appropriate approach is likely to be workshop specific.

### **Acknowledgments**

MTSRF, TSRA and JCU funded this workshop. The attendance of turtle and dugong project staff was supported by the TSRA through funding provided under the NAILSMA Dugong and Marine Turtle project. The MTSRF funding was provided under the aegis of funds to repatriate western scientific knowledge generated by the Torres Strait CRC and MTSRF to Traditional Owners in Torres Strait. The logistics were organized by Frank Loban, TSRA and the JCU researchers. Vic McGrath facilitated the workshop. All these contributions are gratefully acknowledged.

## Appendices

### Appendix 1: List of attendees who came to at least some sessions of the workshop

- TSRA Land and Sea Management Unit (Frank Loban, Vic McGrath, Damian Miley, Rebecca Clear)
- Dugong and Turtle Project Officers
  - Eddie Sailor
  - Ishmael Gibuma
  - John Wigness
  - Pearson Wigness
  - Moses Wailu
  - Charles David
  - Terrence Whap
  - Maluwap Nona
- Ranger: Stephen Ambar
- Member of Torres Strait Islander community: Michael Angelo Newie
- Agency Representatives: AFMA (Annabel Jones, Stan Lui), DEWHA (Donna Kwan), DFAT (Joanne Leahy) GBRMPA (John Tapim), NAILSMA (Rod Kennett).
- Researchers: Aurélie Delisle, Mariana Fuentes, Jillian Grayson, Alana Grech, Mark Hamann, Paul Havemann, Helene Marsh, Natalie Stoeckl, Kristen Weiss

## **Appendix 2: Workshop Program**

**Day 1: Workshop:** Participatory spatial mapping exercise to demonstrate how Indigenous values associated with sea country could be identified and mapped (Dugong and Turtle Project Officers, Aurelie DeLisle, Alana Grech, Stephen Ambar).

### **Day 2 (All participants)**

**Welcome and Introduction** (Facilitator Vic McGrath).

- Opening prayer, welcome to country
- Overview and purpose of workshop (Helene Marsh)
- Discussion of protocol for photos and permissions, 'funny lingo', 'park it', 'issues for further discussion' and role of researchers (Facilitator Vic McGrath).
- Dartboard Evaluation Exercise (Mark Hamann)

**Visioning Exercise:** 10 year vision for dugongs and turtles in Torres Strait (Facilitator Vic McGrath).

**Group Discussion.** Divide into **expertise-based** groups of 4 -5 e.g. project officers, government people in separate groups.

### **Presentation**

Overview of tools incorporated in Turtle and Dugong Management Plans (Frank Loban)

### **Morning Tea**

#### **Group Exercise**

Features of an effective management tool (facilitators Helene Marsh, Jillian Grayson and Mark Hamann).

**Mixed Groups**, People sit where they like. Researchers in support roles only.

**Poster Session** – Opportunity to discuss research information on: (1) dugong and turtle spatial models; (2) Mariana Fuentes, Kristen Weiss and Aurélie Delisle's PhD projects

### **Lunch**

**Presentation:** TUMRAS (John Tapim)

### **Presentation**

Spatial closures: definitions, possible legal issues and models (Paul Havemann)

**Group discussion of questions and concerns.**

### **Afternoon Tea**

**Presentation:** Spatial closures as a management tool in Torres Strait (Jillian Grayson)

**Group Discussion**

### **Day 3 (All participants)**

#### **Group Discussion:**

Spatial closures in the context of customary tools for managing dugongs and turtles in Torres Strait

#### **Morning Tea**

**Presentation:** Feedback from Day 1 workshop on participatory mapping. (Stephen Ambar)

**Presentation:** Tools for managing turtles in Torres Strait (Mark Hamann)

#### **Lunch**

**Presentation:** i-Tracker (Rod Kennett)

**Presentation:** History of Dugong Sanctuary (Helene Marsh)

**Group Exercise:** What are the strengths and weaknesses of the Torres Strait Dugong Sanctuary? Could it be more effective? (Facilitator Damian Miley)  
Mixed groups

**Presentation:** How the information required for spatial management could be combined in a GIS (Alana Grech)

**Presentation:** Update on plans for ranger programs: Rebecca Clear

#### **Afternoon Tea**

#### **Exercise:**

Identification of lessons learned from workshop (all participants)

**Group Exercise:** Repeat of Dartboard Evaluation Exercise

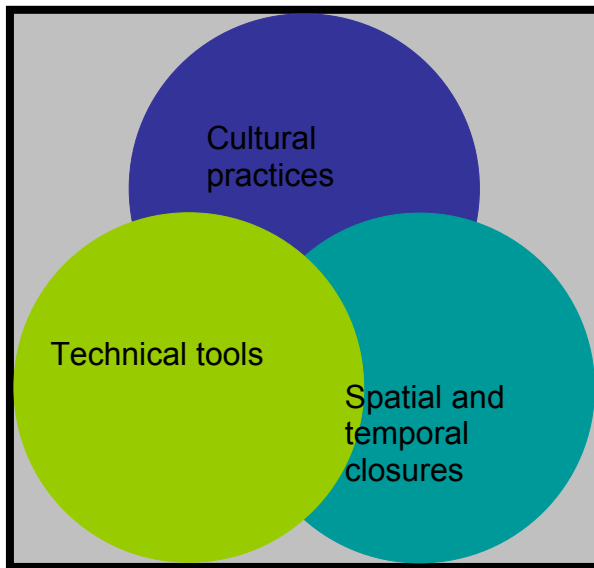
## Appendix 3: Presentation Summaries

# Overview of tools incorporated in Turtle and Dugong Management Plans

The eight Turtle and Dugong Management Plans variously include three overlapping categories of tools to manage the turtle and dugong fisheries in Torres Strait:

1. cultural practices e.g. No women, No non-Indigenous people present in dinghy unless accompanied by traditional inhabitant
2. technical tools e.g. one turtle nest per dinghy per month; no spotlight to be used whilst hunting or chasing dugongs
3. closures: temporal e.g. no turtles during the mating season; and spatial e.g. some islands closed to harvesting of turtle eggs.

The use of quotas as advocated by government presents a problem to Islanders because quotas could present Islanders from fulfilling their cultural obligations e.g. need to feed 500 people at a tombstone opening.



**Contact:** Frank Loban, TSRA, Thursday Island  
**Phone:** 07 4069 2957  
**Email:** frank.loban@tsra.gov.au

# The Great Barrier Reef - Traditional Use of Marine Resource Agreements

The Great Barrier Reef stretches more than 2,300km along the northeast coast of Australia from the tip of Cape York south to Bundaberg. More than 70 Indigenous Traditional Owner groups maintain connections with the Great Barrier Reef, which predate European settlement by many thousands of years. Contemporary Indigenous groups retain their cultural association with the reef and their use of it in the face of increasing pressure from coastal development, commercial fishing, private recreational use and rapidly increasing tourism.

A Traditional Use of Marine Resources Agreement, or TUMRA, is a new type of legal instrument that describes how Traditional Owner groups wish to manage the traditional use of marine resources in their sea country. Traditional Owners who are Native Title holders generally do not require permits for traditional use of marine resources activities from the Great Barrier Reef Marine Park Authority, (GBRMPA) as these activities may be conducted under s.211 of the Native Title Act 1993. Traditional activities also may be conducted in accordance with TUMRAs that have been accredited by the GBRMPA, or with a GBRMPA permit.

TUMRAs are developed by Traditional Owner groups and are submitted for accreditation by the GBRMPA. TUMRAs do not bind all Traditional Owners within a group to the agreement, although for the TUMRA to be workable, the GBRMPA prefers that more than half of a Traditional Owner group agree to the TUMRA. If TUMRAs are accredited their provisions are able to be enforced.

TUMRAs will help to ensure sustainable harvest of marine resources using culturally appropriate methods. Although TUMRAs can technically be used to negotiate generic management arrangement for sea country, GBRMPA has focussed on the management arrangements for the traditional hunting of dugongs and turtles.

In December 2005, Giringun traditional owners signed the first ever such agreement in Australia for the management of traditional hunting of protected species in the greater Hinchinbrook Island area between Rollingstone and Mission Beach. This agreement was subsequently accredited by the GBRMPA (Great Barrier Reef Marine Park Authority) and the EPA (Environment Protection Authority). Implementation of the agreement is steered by the Giringun TUMRA Steering Committee. The six Giringun sea country groups include: Djiru, Gulnay, Girramay, Bandjin, Warragamay and Nywaigi.

In June 2007 the Dharumbal TUMRA-Woppaburra Section was accredited. It recognises that the Woppaburra Traditional Owners, the GBRMPA and the Queensland Government are willing to work together and share responsibility for managing the traditional use of marine resources and associated sea country issues for the Keppel Islands region.

In June 2008, the GBRMPA Board accredited the the Mamu (Innisfail) and Wuthati (Shelburne Bay) TUMRAs for five years. The total area in the GBRWHA now covered by TUMRAs is 19,500 km<sup>2</sup>.

Contact:	<b>John Tapim, GBRMPA, Townsville</b>
Phone:	07 47500700
Email:	<a href="mailto:j.tapim@gbmpa.gov.au">j.tapim@gbmpa.gov.au</a>

# Spatial closures for dugong and turtle management in the Torres Strait: some legal issues and questions

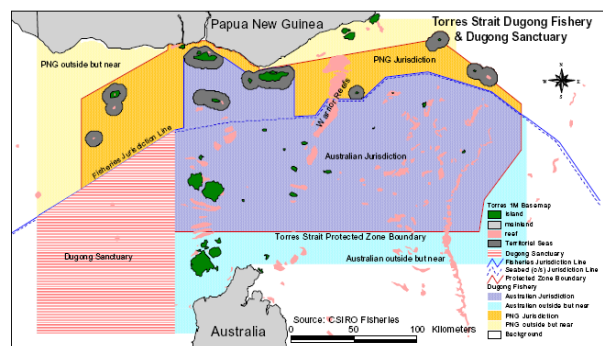
The Torres Strait Treaty 1978 (1985) between Australia and Papua New Guinea (PNG) creates a Protected Zone that both states cooperatively administer. Australia's fisheries obligations are governed by the *Torres Strait Fisheries Act 1984* (Cth) and the TSFA (Qld) and administered by the Protected Zone Joint Authority (PZJA). The existing forms of spatial closure for the dugong and turtle fisheries include that access is confined to traditional inhabitants in the area of the fisheries, a dugong sanctuary (Fisheries Management Notice No. 65) and community-based management plan closures. The 2006 *Environment Protection and Biodiversity Conservation Act 1999* Dugong and Turtle Fishery Assessment Report suggested the PZJA considers the use of more permanent and temporary spatial closures and enhancing community-based management, including spatial closure measures.

Spatial closures in the Protected Zone should not threaten Traditional Owners' rights because they are intended to promote the sustainable harvest of the species by Traditional Owners, which is consistent with the purposes of establishing the protected zone under the Treaty, which include protecting the traditional way of life and livelihood of the traditional inhabitants including their traditional fishing and free movement and protecting and preserving the marine environment and indigenous fauna and flora in and in the vicinity of the protected area.

Native Title rights over the sea often co-exist alongside the rights of other people because the right to possess and occupy an area to the exclusion of all others (often called 'exclusive possession') has not, so far, been recognized in relation to sea claims according to the High Court and the Federal Court. For example, exclusive possession may not exist over sea country where rights of transit and innocent passage also exist. Such rights exist in Torres Strait under the United Nations Convention on the Law of the Sea (UNCLOS).

A report to the National Native Title Tribunal by Stuart Kaye (2002/4) suggests that spatial closures would not threaten Native Title rights and interests. He stated that "Traditional hunting of dugong is permitted ... in the Strait. Community involvement in the management of the traditional dugong catch with AFMA suggests that the continuation of the sanctuary will not be problematic, and its overlap with the claim area will not create difficulties."

MAP: Torres Strait Dugong Fishery & Sanctuary



Spatial closures might impact positively on Torres Strait Islanders Rights because regulation of a right does not amount to the abolition of that right. In fact, everyone has rights that are regulated. Spatial closures are a form of regulation of a fishing/hunting right and the intention of spatial closures is the continuing protection of the right to take dugong and turtle. The right to be a participant in determining the nature of the regulation and enforcing it is very important (e.g. through community-based management which is promoted by the PZJA under the *Torres Strait Fisheries Act*).

Contact: **Paul Havemann**, James Cook University, Townsville  
Phone: 07 47814517  
Email: [Paul.Havemann@jcu.edu.au](mailto:Paul.Havemann@jcu.edu.au)

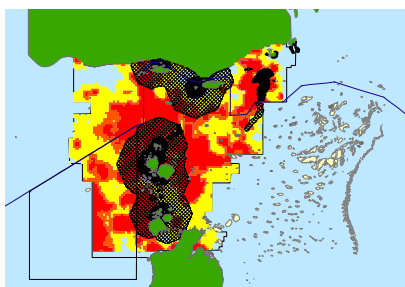
## Sources and sinks: options for spatial management

Torres Strait has the largest population of dugongs in the world and this population has been an important cultural and socio-economic resource for Torres Strait Islanders for at least 4000 years. Sustainability models, based on population estimates from 20 years of aerial surveys, suggest that the current harvest levels are too high to be sustainable. In addition, information from archaeological excavations of dugong bone mounds suggests that substantial harvests of dugongs have occurred for at least the past 300 years of the 4000 year hunting period. We investigated how there could still be such a large dugong population in Torres Strait despite substantial hunting over a prolonged period of time. We then used our data to present a case for the benefits of spatial management.



### SOURCES AND SINKS

Populations of species of bushmeat (e.g. monkeys) hunted in forests in Africa and South America have been shown to persist despite high levels of hunting because they live in two types of habitats, sources and sinks. Sources are areas of good quality habitat, in which the population is not hunted, that supplies animals to sinks, in which the population is hunted. The population in sinks would eventually be hunted out if individuals did not move from the source areas into the sink areas. We proposed that the large population of dugongs in Torres Strait might persist despite substantial hunting if it lived in sources and sinks.



Hunting areas (hatched) and good quality dugong habitat (red, orange and yellow).

The dugong density model developed by Alana Grech and Helene Marsh shows that there are substantial areas of good quality dugong habitat in Torres Strait. We used information from Torres Strait and PNG hunters to investigate whether any of these areas with good quality dugong habitat only had minor hunting. Dugong hunting mainly occurred close to inhabited islands or on reef tops. Most of the aerial survey region with good quality dugong habitat occurred outside these core hunting areas. Therefore, unofficial spatial closures may already protect dugongs in Torres Strait because substantial areas of good quality dugong habitat are not readily accessed by hunters. Furthermore, dugongs are capable of large-scale movements. These movements would

enable them to move between minor and core hunting areas, which could enable the dugong population to persist through source-sink dynamics.

### POTENTIAL OF SPATIAL MANAGEMENT

Spatial management shows considerable potential as a tool to manage dugong hunting in Torres Strait because: 1) it is not as susceptible to errors in population data as other tools such as quotas, 2) formally closing existing natural spatial refuges would pre-empt future expansion of hunting, and 3) it could be implemented in stages to minimise the initial impact on communities and provide time for capacity-building, monitoring and negotiations with PNG.

Contact:	<b>Jillian Grayson</b> , James Cook University, Townsville
Mobile:	0428 876 101
Email:	<a href="mailto:Jillian.Grayson@jcu.edu.au">Jillian.Grayson@jcu.edu.au</a>

# Options for management of marine turtles

## The main issues

There are six species of marine turtles residing in Torres Strait; including three species that nest. There are globally important populations of green, hawksbill and flatback turtles residing and nesting in the area.

For green turtles: hatchling production at Raine Island – the main rookery for the northern GBR and Torres Strait population- has declined over the last 10 to 15 years to the point that in recent years very few hatchlings are likely to have been produced.

For flatback and hawksbill turtles predation of eggs by both native and feral predators could be significant at some locations. Data on this issue are scant.

## Management

Management can be difficult because each of the species may require specific actions and, management actions for one species may need to be tailored for particular communities and their issues.

The management plans currently have most of the options covered. However, a tailored monitoring program in the first 1-3 years of the management plans will be important to identify key areas for management at a regional and community based scale. In some areas such as Sassie Island by lama and Dowar by Mer people have begun.

## Raine Island

Raine Island is a rookery for green turtles. Turtles nesting at Raine Island are the same genetic population as those nesting elsewhere in the northern GBR and into Torres Strait. Raine Island is the most important – in terms of numbers – rookery for the population. Data from QPWS show that very few hatchlings are being produced from Raine Island since the mid 1990s. It takes around 5-10 years for hatchlings to grow to small juvenile size and around 35 years to reach maturity. If few hatchlings are produced since 1995 then the corresponding numbers of turtles in foraging areas such as Torres Strait may start to decline. Hence the Raine Island problem has significant implications for Islanders.

## Other issues that need concurrent management

The large scale, and commercial, fishery for green turtles from Australian waters by PNG people needs to be addressed.

The issue of FFV and the impact on marine turtles needs to be assessed.

Contact:	Mark Hamann, James Cook University, Townsville
Phone:	07 4781 4491
Email:	<a href="mailto:mark.hamann@jcu.edu.au">mark.hamann@jcu.edu.au</a>

# I-Tracker – a tool for Ranger patrols

## What is I-Tracker?

I-Tracker is a network of Indigenous Land and Sea managers and researchers across north Australia who are working together to collect and share information for better land and sea management.

I-Tracker is developing new tools to help Indigenous Land and Sea managers to collect and manage information about natural and cultural resources across remote north Australia.

I-Tracker is supporting Indigenous Land and Sea managers to use the information they collect to improve land and sea management at local, regional, national and even international scales.

## How does I-Tracker work?

I-Tracker matches state-of-the-art, “field-tough” hand-held computers with internationally acclaimed software known as ‘CyberTracker’. Together these tools provide a user-friendly, culturally appropriate and scientifically approved way of collecting information while out on country or on the sea.

I-Tracker also includes a group of people who provide training and technical support in the use of the I-Tracker tools. This training and support group includes Rangers and Coordinators who use I-Tracker tools frequently, researchers, and other people with skills in GIS, computer software, and information management.

## Who is involved in I-Tracker?

The I-Tracker network currently involves the Djelk Rangers (Maningrida, NT) and ranger groups involved in the NAILSMA Dugong and Marine Turtle Project, the Carpentaria Ghost Nets Programme and the Wild Rivers Ranger Program (QLD).



To learn more and see the video visit <http://www.nailsma.org.au/projects/i-tracker.html>

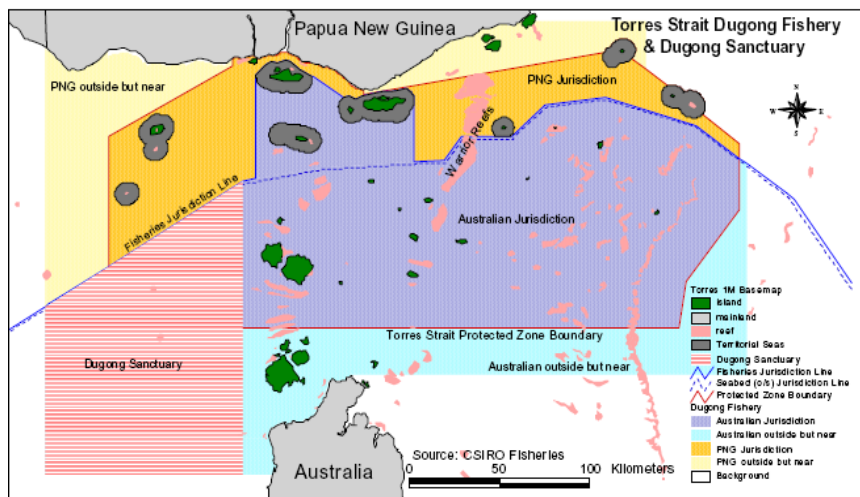
<b>Contact:</b>	<b>Rod Kennett</b> , NAILSMA, Charles Darwin University, Darwin
Phone:	08 8946 6271
Email:	<a href="mailto:rod.kennett@cdu.edu.au">rod.kennett@cdu.edu.au</a>

# History of the Dugong Sanctuary

The 13,000 km<sup>2</sup> Dugong Sanctuary was established in Australian waters in south western Torres Strait as a regulation under the Torres Strait Fisheries Act 1984 C'wlth. Dugong hunting is banned in the sanctuary. The sanctuary was declared in 1987 as Fisheries Management Notice #13. Fisheries Management Notice #13 was revoked and replaced by Fisheries Management Notice #65 in 2004 without change to the regulations governing the sanctuary. The sanctuary as not been actively enforced.

The sanctuary was established after face-to-face negotiations between officers from AFMA, Helene Marsh from JCU and communities in Western Torres Strait including the Moa communities, Badu, Mabuig, Sabai and Biogu.

MAP: Torres Strait Dugong Fishery & Sanctuary



Contact: **Helene Marsh**, James Cook University, Townsville  
Mobile: 0409873377  
Email: [helene.marsh@jcu.edu.au](mailto:helene.marsh@jcu.edu.au)

# Computer mapping (GIS) as a tool to design spatial closures

Geographical Information Systems (GIS) are a computer program that captures, stores, analyzes, and manages spatial information. Applications within GIS allows users to create questions or queries, analyze [spatial](#) information, edit data, maps, and present the results in the form of images or graphics and hardcopy maps. A GIS is a visual representation of information, and can provide a simple and clear way of creating, communicating and analyzing data in a manner accessible to audiences of different cultural backgrounds. Thus, GIS has a great capacity to assist Torres Strait Islander communities in the design of dugong and turtle spatial closures.

## **Spatial information and the design of spatial closures**

There is a variety of information (both spatial and non-spatial) that is required to inform the design of closures for dugong and turtle in Torres Strait, including: Traditional Ecological Knowledge (TEK), Traditional Owner Knowledge (TOK), legal information and Western Scientific Knowledge (WSK; biological, social and economic information collected by researchers). Because of the primacy of TEK and TOK to Torres Strait Islanders and the primacy of WSK Knowledge to governments, management of dugong and turtle must be based on both knowledge systems. The capacity of these knowledge systems to better inform such decision making is enhanced if both types of information are presented in compatible formats.

## **Why use GIS to design spatial closures?**

There are three good reasons to use GIS as a tool to design spatial closures in Torres Strait:

- (1) GIS is able to bridge the gap between knowledge systems by collating a variety of information into a common format. This function allows for the estimation, evaluation and comparison of alternatives that is based on multiple knowledge systems;
- (2) GIS can store information permanently and so support, maintain and conserve knowledge systems that contribute to the design of spatial closures;
- (3) Information that informs the design of spatial closures in the Torres Strait varies across the local (community), nation (group of islands) and regional (Torres Strait) scales. GIS allows decisions about the design of spatial closures to be informed over multiple spatial scales.

Contact:	<b>Alana Grech</b> , James Cook University, Townsville
Mobile:	0407 705 088
Email:	<a href="mailto:alana.grech@jcu.edu.au">alana.grech@jcu.edu.au</a>

## Update on plans for ranger programs

The Commonwealth Minister of Environment has confirmed the federal government's commitment to Indigenous rangers. There are three sources of funding for the Ranger program in the Torres Strait:

- 'Caring for our Country' Grant to TSRA Land and Sea Management Unit (via the 2008-09 Regional Investment Strategy) that will fund a ranger program facilitator and two ranger mentors, for the transitional year of the 'Caring for Our Country' program.
- 'Working on Country' Grant to TSRA (on behalf of Mabuiag community) that will fund three rangers for four years from November 2008 as a pilot project. This project will be delivered in partnership with Torres Strait Island Regional Council (TSIRC), who will employ the Rangers. Rangers will work on the Pulu Islet Indigenous Protected Area, implement priority activities identified in the Turtle and Dugong Management Plan, and address land based cultural and natural resource management issues.
- Current application to 'Working on Country' for five years of funding to implement the Turtle and Dugong Management Plans in the remaining seven communities. The results of this application will be known in November-December 2008. It is expected that the funding to the seven communities will be staged.

The existing Turtle and Dugong Project Officers are funded until December 2008. The project officers are encouraged to apply for the ranger positions when they become available.

TSRA is committed to:

- Developing a longer term strategy for community-based land and sea country management in Torres Strait;
- Implementing the existing plans;
- Developing plans for the remainder of Torres Strait communities.

Contact: **Rebecca Clear**, Torres Strait Regional Authority, Land and Sea Management Unit  
Phone: 07 4069 2957  
Email: [rebecca.clear@tsra.gov.au](mailto:rebecca.clear@tsra.gov.au)

## Appendix 4: Poster Summaries

### The economics of hunting and its management

The presentation introduced the PhD project entitled “The economics of hunting and its management” to the workshop participants. The aim of this project is to improve the understanding of the market and non-market costs and benefits associated with traditional dugong and marine turtle hunting.



Traditional hunting is a topical issue and one over which there are differences in the interests of Indigenous communities, management agencies and the wider community. But all costs and benefits associated with this activity are not completely understood.

The project will not only focus on the financial costs and benefits of hunting but will consider these costs and benefits in the wider context of sea country management. Cost refers to the choices that individuals and society must make between the uses of resources. Costs and prices are often thought to be identical. But cost is better defined as any “benefits foregone”. This can involve money, time and other resources, or the loss of an opportunity to enjoy benefits. Also, price does not measure all values, some of which are in the market and others are non-market.

In the context of the project, there are two major objectives:

1. Identify and, where possible, measure costs and benefits of Indigenous hunting of dugongs and marine turtles. For instance, market costs can include fuel, gear and time spent hunting rather than earning an income; non-market costs include adverse publicity and injuries; market benefits are that there is no need to buy meat at the store; while non-market benefits include the preservation of traditional practices and the passing on of knowledge.
2. Compare the market and non-market costs and benefits of different dugong and marine turtle management arrangements. There are potential costs and benefits associated with the management of hunting to ensure it is sustainable. Market costs might include potential loss of catch; non-market costs can include limitations on where and when to hunt; benefits might include employment as rangers; while non-market benefits can be the guarantee that animals are there for the next generation to hunt.

The project will greatly benefit from the involvement of different Torres Strait Island communities. Engagement will take place at the community level to explain the research, its potential benefits, and the methodology so as to develop research agreements between the research team and each of the interested communities.

#### POTENTIAL OUTCOME AND BENEFITS

The project can give information about all the costs and benefits (non-market and market) of traditional hunting activities in Northern Australia that will help people think about the full impact of different management arrangements. This understanding and documentation of the costs and benefits associated with traditional hunting activities could be used by communities to design sustainable and suitable management arrangements.

Note: As a result of the workshop, it has been decided to enlarge the scope of this project to the economics of community-based sea country management rather than turtle and dugongs *per se*.

Contact:	<b>Aurélie Delisle</b> , James Cook University, Townsville
Mobile:	0421 183 786
Email:	<a href="mailto:Aurelie.Delisle@jcu.edu.au">Aurelie.Delisle@jcu.edu.au</a>

# Potential impacts of climate change on the northern Great Barrier Reef green turtle population.

Sea turtles are thought to be particularly vulnerable to climate change. Not only are they threatened globally by a range of anthropogenic activities - which reduces their resilience to climate change- but they also have life history traits strongly tied to environmental variables and nest in coastal areas vulnerable to sea level rise and cyclonic activities. Climate change can affect sea turtles in three broad ways: 1) their distribution, 2) foraging ecology and 3) reproductive output. This study focuses on how the northern Great Barrier Reef green turtle population's reproductive output could be affected by a) increase in temperature, b) cyclonic activities, c) sea level rise and d) changes to carbonate producers. Expected outcomes from this project include tools to aid managers to direct and focus management and conservation actions in a strategic way to protect sea turtles as climate change progresses.



**Fig. 1** Key nesting grounds for the nGBR green turtle population

## **The nGBR green turtle population**

The nGBR green turtle population is the largest green turtle population in the world, with an average of 50,000 females breeding each year. Nesting for this population occurs in the northern GBR region and in Torres Strait (Fig. 1). Not only does this population have important ecological value but it also has strong, social and cultural value.

## **Climate change and the nGBR green turtles**

During the past two nesting seasons (2007/2008) field work has been conducted at key nesting sites, used by the nGBR green turtle population, to:

- 1) Determine each nesting beach's current thermal profile.
- 2) Investigate factors that influence sand temperatures.
- 3) Develop a model to predict possible temperature profiles at these nesting grounds and how hatching success and hatchling sex ratio will be impacted by increases in temperature.
- 4) Identify morphological characteristics of each nesting site and investigate their sensitivity to climatic events (cyclone, sea level rise).

The involvement of the TSRA, local communities and especially the turtle and dugong officers has been essential to set up this project as well as to conduct field work and collect data.

Contact: **Mariana Fuentes**, James Cook University, Townsville  
Phone: 07 47816943  
Email: [mariana.fuentes@jcu.edu.au](mailto:mariana.fuentes@jcu.edu.au)

# Resolving issues of scale in marine resource management

Species of marine wildlife have ecological ranges that vary from individual bays to thousands of kilometres across international waters. Management, on the other hand, is bounded by geopolitical scales (nations, states), and influenced by international treaties and conventions. Community-based management at local scales reflects the needs of individual communities, which often come into conflict with larger-scale management priorities of state or national governments. There have been very few coordinated attempts at management across these scales and across species. International strategies such as the Convention for Migratory Species often have limited success, because they fail to address the socio-economic needs or ecological knowledge at the local community level. In-depth research on scale mismatch in resource management is needed in order to understand how to resolve scale problems, leading to more holistic and cooperative management approaches.

## RESEARCH AIMS

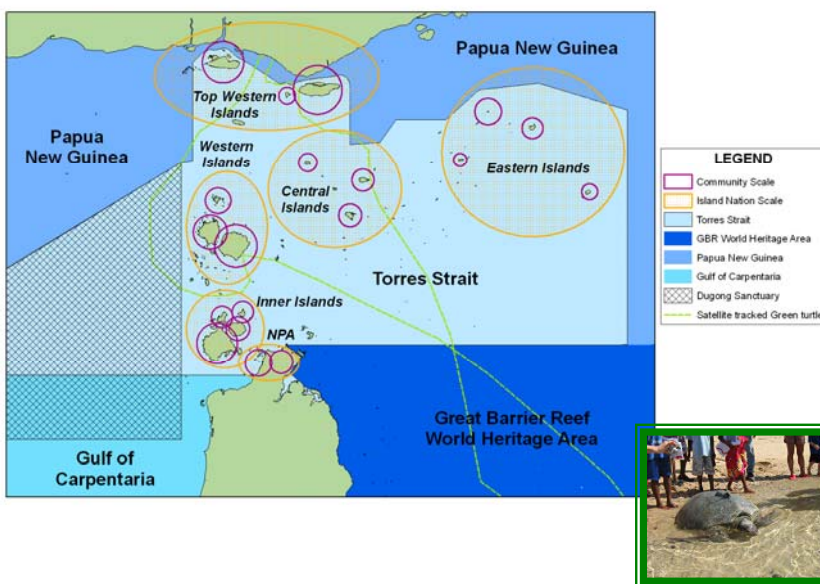
- Explore issues of scale mismatch in the management of dugongs and green turtles
- Find methods of resolving mismatch through communication, knowledge sharing, strategic planning, and better incorporation of Indigenous ecological knowledge

## RESEARCH METHODS

- Review the relevant scientific, political, cultural, and socio-economic literature
- Conduct interviews with key stakeholders in dugong and green turtle management
- Host focus group sessions with community-based managers

## INTENDED OUTCOMES

- A better understanding of how to resolve mismatch among ecological, jurisdictional, and socio-political scales
- A comparison of several alternative cross-scale strategies for turtle and dugong management
- Information for community-based and agency resource managers about how to achieve cross-cultural communication and holistic, cooperative management
- Educational materials, written reports, presentations, and public forums to share the results and get feedback from communities



Contact: **Kristen Weiss**, School of Earth and Environmental Sciences, James Cook University  
Email: [Kristen.Weiss@jcu.edu.au](mailto:Kristen.Weiss@jcu.edu.au)