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Marine resources, biophysical processes, and environmental management of a tropical shelf seaway: Torres Strait, Australia – Introduction to the Special Issue

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In July 2003 the Australian Government funded a three year program of marine biophysical, fisheries, socioeconomic-cultural and extension research in the Torres Strait region of North Eastern Australia under its Co-operative Research Centre (CRC) Program. The Torres Strait CRC (www.crctorres.com) brought together the main resource agencies, research institutions and stakeholders in the Torres Strait to develop a single, integrated, multidisciplinary research initiative. Participants brought considerable experience and knowledge from existing Torres Strait research programs and from research and management in the adjacent Great Barrier Reef World Heritage Area.

On the completion of the research program in July 2006, the key partner research agencies (Geoscience Australia, James Cook University, CSIRO, and the Queensland Department of Primary Industries and Fisheries) felt that the co-operative nature of the research effort lent itself to producing a single compilation of the research outcomes. Despite complex geopolitical and marine environmental issues, Torres Strait has received little research attention on the world stage. This special edition of *Continental Shelf Research* addresses those issues and reports on the major research outcomes of the Torres Strait CRC.

Geographic location

The Torres Strait region lies between the southern Papua New Guinea coast and the north-eastern tip of the state of Queensland, Australia. Torres Strait is bordered by Australia and Papua New Guinea, with Indonesia's border located at longitude 141 degrees East (Fig. 1). This is an area of productive marine resources and fisheries,

complex habitat types and extensive coral reefs overlaid by often competing jurisdictional interests. The Australian Commonwealth and Queensland Governments, Papua New Guinea Government, local councils, traditional indigenous owners, traditional fishers, and traditional visitors from both countries all have input to the management of the region or rights to use its resources.

Torres Strait became an island archipelago by around 9,000 years ago, following the post-glacial sea level rise which inundated the land bridge connecting Australia with the island of Papua New Guinea (Harris, 2001). The shelf of Torres Strait extends just over 150 km from north to south covering some 48,000 km^2, is mostly shallow (10-15 m deep), and has numerous continental and volcanic islands, coral cays, mangroves, complex coral reef systems as well as some of the most extensive seagrass beds in the world (Coles et al., 2003). Some 580 coral reefs, including the Warrior Reefs and Eastern Patch Reefs, cover a total area of 2,400 km^2 in the region.

Traditional Inhabitants

Archaeological, linguistic and anthropological evidence indicate that the islands of Torres Strait have been inhabited for at least 2,500 years by people believed to be of Melanesian and Aboriginal descent, who maintain one of the oldest remaining 'marine oriented' and most 'sea-life dependent' societies in the world. Eighteen of the 247 islands in Torres Strait are inhabited. The inhabited islands are separated into four distinct regional groups: high continental Western Islands; swampy Top Western Islands adjacent to the Papua New Guinea mainland; low, sandy, Central Island group; and volcanic Eastern Islands (Fig. 1). The Western Islands, including Horn Island and Thursday Island, are the administrative centre of the region and are the traditional country of Kaurareg Aboriginal people. The mainland communities of Seisia and Bamaga are populated by Torres Strait Islanders who have moved from outer island communities such as Saibai and Boigu Islands to live on the Cape York Peninsula (Smyth et al 2006; Fig. 1).

Climate

Torres Strait has two wind regimes; the Northwest monsoon season dominates from November to April and alternates with the Southeast trade-wind season from May to October. Most of the annual rainfall occurs during the Northwest monsoon wet season. Periods of calm weather occur in spring and late summer between the two main seasons. The semi-diurnal tidal regime of the Coral Sea to the east and the diurnal regime of the Gulf of Carpentaria to the west result in a complex and

seasonally variable tidal regime and strong currents in Torres Strait. Temperatures in the region show little daily or seasonal variation with mean temperatures ranging between 26°C and 31°C (Smyth et al 2006).

Regional environmental management

There are several major policy and institutional frameworks in the Torres Strait region that support the sustainable use and management of marine resources while also protecting habitats, biodiversity and the traditional islander way of life. Most important of these is the Torres Strait Treaty entered into by Australia and Papua New Guinea in February 1985. The Treaty defines sovereignty and maritime boundaries in the area between the two countries. It guides decision makers on protecting the way of life and livelihood of traditional inhabitants, on managing the protection of habitats, and on sharing the commercial and traditional fisheries resources. The Treaty established a Torres Strait Protected Zone (Fig. 1) within which both nations manage access to fisheries resources. Each country exercises sovereign jurisdiction for resources on either side of the agreed jurisdiction lines (Fig. 1). Commonwealth Australian and Queensland State fisheries and environmental legislation also control various functions and decision making processes in the Australian jurisdiction (Elmer and Coles, 1990; and Laffan 1990). Similar legislation directs and guides decision making in the Papua New Guinea jurisdiction.

Research outcomes of the Torres Strait CRC reported in this volume

The Cooperative Research Centre program was designed to coordinate and facilitate research which aimed to provide knowledge and tools to meet three aims:

1. To support the sustainable development of marine resources and minimize impacts of resource use in Torres Strait;
2. To enhance the conservation of the marine environment and the social, cultural and economic well being of all stakeholders, particularly the Torres Strait peoples; and
3. To contribute to effective policy formulation and management decision making.

This was delivered through a set of programs having the following research themes:

1. Sustaining the harvest of marine resources;

2. Understanding ecosystem processes;
3. Evaluating management strategies and risks; and
4. Education and training.

The marine resources of Torres Strait are vital to indigenous islanders who harvest either as traditional fishers, or as islander commercial fishers through the arrangements of the Torres Strait Treaty. There are also conventional commercial fisheries for fin fish, crustacean shellfish and holothurians. Although the management of resources in the region is complex, and obtaining data on traditional fishing is difficult, there are now good examples of indigenous resource management. The papers by Williams et al. (this volume, a and b) address approaches to monitoring traditional catches on the remote islands, whilst Phelan et al. (this volume) present an example of indigenous resource management for black jewfish.

Torres Strait is home to a large population of Dugong (*Dugong dugon*) which, although a threatened species, are caught for food and for ceremonial purposes by Torres Strait islanders; concerns for their sustainability are considered by Marsh and Kwan (this volume). Other papers describe the Rock Lobster fishery (Ye et al, this volume), whilst Duckworth et al. (this volume) investigate the potential for sponges as a new aquaculture venture exploiting local marine resources and expertise.

Providing insight into how the biophysical processes interact in Torres Strait was a key aim of the Co-operative Research Centre program. Local inhabitants in the Australian jurisdiction have long expressed concern regarding sediment transported from Papua New Guinea, where mining and deforestation have affected river sediment loads, and how this sediment interacts with bottom habitats such as seagrasses and ultimately the animals – notably dugong and rock lobsters – that depend upon them (Harris, 2001). Papers by Heap and Sbaffi (this volume) and Daniell et al. (this volume) address issues of sediment movement and its impact on the seagrasses in Torres Strait. A further four papers add to this body of knowledge by studying water movement and tide and wind-driven currents to provide a picture of the dynamic nature of short- and long-term sediment and water processes (Hughes et al., Saint-Cast et al., Margvelashvili et al, and Samosorn and Woodroffe, this volume). Three papers study specifically the growth, productivity and nutrient status of the seagrass meadows (Campbell et al., Sheppard et al. and Rasheed et al., this volume) and this is integrated with the results of a survey of deeper, inter-reefal seafloors to provide an assessment of biodiversity and benthic assemblages by Pitcher et al. (this volume).

Torres Strait is a major shipping focal point for vessels bound around northern Australia. Thursday Island is the largest settlement in the area and provides harbour facilities for prawn trawlers, naval patrol boats, coastal trading vessels and the Torres Strait Pilots. Torres Strait has a sill depth of about 12 m (Harris, 2001) and many large bulk carriers discharge ballast water in order to pass through the strait. Neil and Stafford (this volume) studied the risks associated with pests introduced from ballast water and as hull fouling. Ultimately it is necessary to consider interacting uses, and risks, together in a multiple-use management framework, and an initial step in that direction has been taken by Ellis and Pantus (this volume), who studied the trawl fishery for Penaeid prawns as a model to evaluate the effects of management decisions on both the prawn stock itself, and other biota of the seafloor. The modeling system they developed has been designed to be broadened to consider additional interacting uses.

The final papers describe a project that takes steps to involve the local community in monitoring the health of Torres Strait's extensive seagrass meadows (Mellors et al., this volume) and better means of communicating science outcomes to the local island communities (Jones et al., this volume).

Torres Strait is an environmentally complex but poorly known part of the world. The island communities are genuinely concerned to protect their way of life and to maintain access to resources in the face of major challenges. These include an increasing local population, environmental impacts from pollution and introduced pests, increasing resource exploitation (and over-exploitation), and an uncertain exposure to the effects of global climate change. We hope that in compiling these papers we have given some insight into the issues confronting Torres Strait and ideas and tools that are relevant to other similar regions, to better manage our planet's marine resources.

Acknowledgements

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Figure Captions

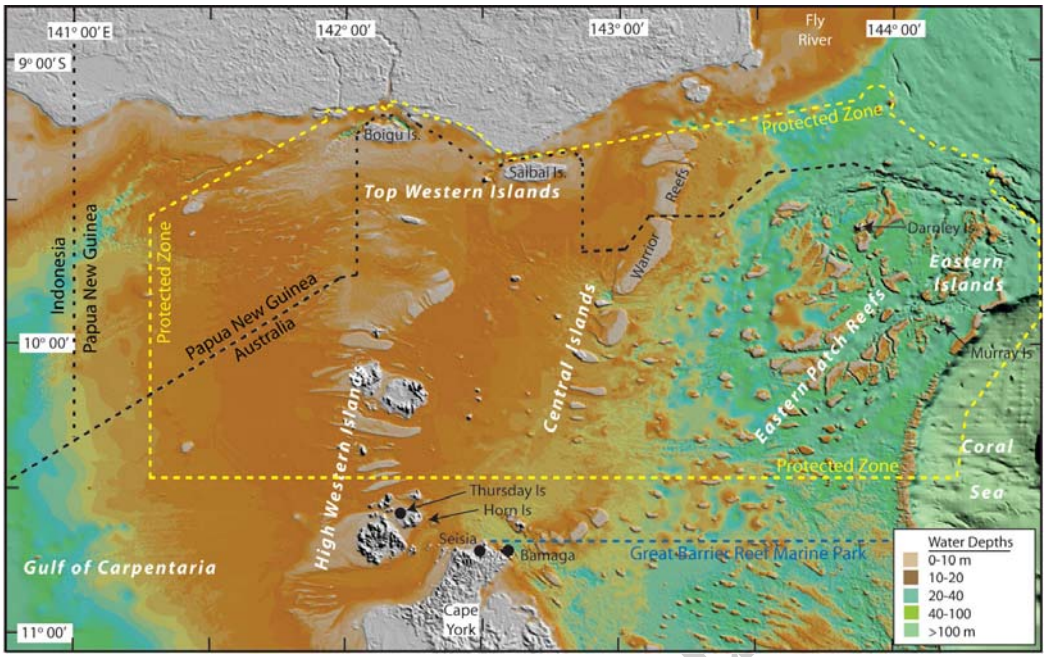

Figure 1. False colour bathymetric map of the Torres Strait region derived from a bathymetry grid developed by Daniell (in press). Colours represent water depths, as indicated. The locations of the Torres Strait Protected Zone, the northern limit of the Great Barrier Reef Marine Park and the fishing/seabed jurisdiction boundaries of Australia, Indonesia and Papua New Guinea are shown.