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The Subsistence Coral Reef Fish Fishery in the Torres
Strait
Monitoring Protocols and Assessment

Thesis submitted by

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for the degree of Doctor of Philosophy
in the School of Marine and Tropical Biology
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Statement of contribution

This research project is part of an education and extension program in the Torres Strait (CRC TS) established in 2003 by the Cooperative Research Centre for the Great Barrier Reef World Heritage Area (CRC Reef) with support of the Australian Government. CRC TS funded the fieldwork component of this research, including additional funds to involve schools in the monitoring program and employment of research assistants. Further funds for the education extension were granted by the Project AWARE foundation. Stipend support and university fees were provided by a James Cook University Postgraduate Research Scholarship and two Australian Federation of University Women Fellowships. In-kind, logistical and technical supports were provided throughout the research by the Fishing and Fisheries Team/Centre.

Supervisors of this thesis were Dr. Gavin Begg, Dr. Garry Russ, Dr. Stephen Sutton and Dr. Ashley Williams. Initial supervision was also provided by Dr. Sean Connolly, when the thesis still included a modelling component. Dr. Tim Skewes provided the historical data on the traditional fishery used in Chapter 6, which were collected during a previous monitoring program in the Torres Strait (CSIRO). Dr. Annabel Jones, as communication officer of the Fishing and Fisheries Team (CRC Reef), provided crucial assistance and support in all the extension activities during my fieldwork. CRC Torres Strait Task Associates for this research project were Mr. Jim Prescott and Mr. John Marrington from the Australian Fisheries Management Authority (AFMA) in the Torres Strait. Mr. Toshio Nakata (TSRA), liaison officer for CRC TS had a crucial role in all the extension activities during my fieldwork, since the first introductory meeting. Statistical advice was provided by Dr. Yvette

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Declaration of Ethics

The research presented and reported in this thesis was conducted within the guidelines for research ethics outlined in the National Statement on Ethics Conduct in Research Involving Human (1999), the Joint NHMRC/AVCC Statement and Guidelines on Research Practice (1997), the James Cook University Policy on Experimentation Ethics. Standard Practices and Guidelines (2001), and the James Cook University Statement and Guidelines on Research Practice (2001). The proposed research methodology received clearance from the James Cook University Experimentation Ethics Review Committee (approval numbers A922 and H2252).

Signature

Date

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To my son Leonardo – with all my love

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Abstract

The Torres Strait Finfish Fishery (TSFF) in far northern Australia is a typical example of a multi-sectoral reef fish fishery where data are scarce, especially for the subsistence sector. No management arrangements are in place for the subsistence fishery. The lack of such arrangements is an effort to maintain its cultural value as required by the *Torres Strait Treaty* (1985). Nonetheless, to protect this traditional subsistence fishery, information on trends in catch and catch rates, the socio-economic importance of the subsistence sector, possible impacts of the recreational and commercial fisheries on the subsistence fishery, and the status of exploited stocks is required. Therefore, the overall aim of this study was to gain a better understanding of the dynamics of the subsistence reef fish fishery in the Torres Strait and ultimately provide a number of recommendations relevant to the more effective monitoring and management of this traditional subsistence fishery. In this context this study made a significant contribution, providing the required information and insight into the interdependence of the human context and the ecological system. A holistic approach, which allowed the investigation of the socio-economic as well as the ecological characteristics of the fishery, was used. The specific objectives of this study were to:

1. Develop robust protocols to monitor the subsistence reef fish fishery in the Torres Strait.
2. Determine the main factors influencing fishing effort and the socio-economic aspects of the subsistence reef fish fishery in the Torres Strait.

3. Assess the interactions between the subsistence and the Indigenous commercial sectors of the reef fish fishery in the Torres Strait.
4. Compare catch and catch rates of the subsistence reef fish fishery between the Torres Strait Islands and over time.

Monitoring protocols were developed to assess the subsistence reef fish fishery in the Torres Strait (Objective 1). Protocols developed in this study, and information collected, could be used when monitoring other similar Indigenous fisheries in Australia. Creel surveys, usually used to monitor recreational fisheries, were employed. Semi-structured interviews were also used to collect additional information on subsistence fishing and on perceptions of community members about fisheries issues. The long-term employment of a local research counterpart, a common strategy to monitor reef fish fisheries, was precluded in this study by several socio-economic and cultural conditions of the communities. This is a point to carefully consider when developing monitoring programs in the Torres Strait, since it can determine their extent and success.

Socio-economic factors, such as involvement in, and income from, commercial fishing, other wage-employments and welfare programs were found to influence patterns of subsistence fishing effort (Objective 2). These socio-economic factors should be explicitly addressed in future fisheries assessments and management decisions for the TSFF. Different levels of modernisation of fishing activities on the islands studied had an impact on fishing effort. This trend was different to that usually observed in other coastal communities, with higher quantities of fish being taken as modernisation increased. 206 and 248 kg person⁻¹ year⁻¹ of fish were caught annually on Yorke and Darnley Islands, respectively, which were the islands with the higher level of modernisation of fishing activities. These extremely high

catches were a consequence of the fact that today part of the catch is sent off-island rather than consumed locally. In contrast, catch of fish per capita on Murray Island (98 kg person⁻¹ year⁻¹) was similar to values previously estimated for the Torres Strait. Overall, this study highlighted the primary importance of subsistence fishing as a source of animal protein and of replacement income, with a very high level of community involvement in subsistence fishing. These communities still rely greatly on subsistence fishing for their everyday livelihood.

Indigenous commercial fishing for reef fish has socially and economically reshaped the characteristics of the traditional subsistence sector by increasing the use of motorised boats but decreasing the frequency that fishers were involved in traditional subsistence fishing, with consequent changes in catch rates (Objective 3). Indigenous commercial fishing generally did not take the same reef fish species as traditional subsistence fishing. However, catch taken for subsistence during commercial fishing (which is inconsistent with current legislation) may have a negative impact on harvested stocks, since it formed approximately 22% of the total commercial catch and, more importantly, consisted mainly of undersized target species. These characteristics of the reef fish fishery should be closely monitored to maintain viable harvested stocks.

Overall, the traditional subsistence catch had a 4-fold increase in the last two decades, with the most recent annual value for the three islands (169±31 t) similar to that of the commercial sectors (Objective 4). Underestimations of the historical totals are likely, however, as a consequence of biases in the previous monitoring program. Reasons behind the increased catches are concomitant with social, cultural and economic conditions triggered by an increase, at different rates, in modernisation (use of motorised boats and introduction of nets) on the islands.

Although increases in traditional fishing effort and catch were observed over time, the lack of any decline in yields and catch rates suggested that fish resources have not been overexploited. Yields increased in the observed period from a very low $0.4 \text{ t km}^{-2} \text{ year}^{-1}$ in 1991/1992 to the current $2.5 \text{ t km}^{-2} \text{ year}^{-1}$. This current yield is comparable with other fish yields between 2.3 and $3.7 \text{ t km}^{-2} \text{ y}^{-1}$ recently reported as reference points of sustainability for fisheries in the South Pacific. Catch rates for single gears may indicate signs of localized overexploitation. Catch rates of gillnet and castnet from shore have been decreasing over time, and current values are low compared to catch rates from similar reef fish fisheries in the South Pacific. Some families of fish, such as Mugilidae and Siganidae, which are commonly targeted by those gears from shore, showed a similar decrease in catch over time. Families of commercial importance (i.e. Serranidae, Lutjanidae and Lethrinidae), which are now taken for subsistence during commercial fishing, also decreased in catch over time in the traditional subsistence fishery. This is further evidence of interactions between the traditional subsistence and commercial sectors of the reef fish fishery. In contrast, Carangidae increased in importance as a target group of fish in subsistence fishing (traditional and commercial-associated) and will need to be monitored more closely in future.

Overall, although the economic and cultural value of the subsistence reef fish fishery has to be regarded as a key priority, management measures nonetheless should be implemented to ensure the sustainability of subsistence fisheries. The Treaty imposes on involved parties obligations to protect flora and fauna in the Protected Zone (article 14). Protection and preservation of marine resources are fundamental to protecting their traditional and cultural use. This study indicates that the catch levels in the subsistence reef fish fishery in the Torres Strait may be sustainable.

Three main findings of this study pose a challenge for the management of the fin fish fishery in the Torres Strait. Firstly, increased modernisation of fishing techniques on the islands is positively correlated with increased fishing effort. If modernisation of fishing on the islands increases in the future it will place greater pressure on reef fish resources. Secondly, part of the subsistence catch is nowadays shipped off the islands. If shipping facilities become more organised and cheaper and fishery catches rise for the reasons outlined above, then more fish will be sent to the mainland, where the Torres Strait Islander population was 47,325 in 2006. Thirdly, taking fish for subsistence during commercial fishing is a normal practice. If this activity persists, it will be important to continue to monitor this component of the fishery and consider it in management decisions, particularly because of the practice of harvesting undersized individuals in species of commercial importance. A recommended approach to enforce existing regulations and increase participation of communities in the monitoring and management of marine resources, is to implement community-based sea management programs coordinated by the Torres Strait Regional Authority (TSRA)'s Land and Management Unit, which is a local management agency. Funds would allow the employment of additional rangers who could take responsibility for several aspects of the education of fishing communities, and the monitoring and management of marine resources.

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List of acronyms

ABS	Australian Bureau of Statistics
AFMA	Australian Fishery Management Authority
APS	Access Point survey
BRS	Bus Route Survey
BRUCS	Baited Remote Underwater Census System
CDEP	Community Development Employment Program
CPUE	Catch Per Unit of Effort
CRC	Cooperative Research Centre
CSIRO	Australian Commonwealth Scientific and Industry Research Organisation
CTI	Coral Triangle Initiative
ERE	Estimation Recorder Effectiveness
FAO	Food and Agriculture Organisation of the United Nations
FL	Fork Length
ICC	Island Coordinating Council
MDS	Multi Dimensional Scaling
MLS	Minimum Legal Size
MOU	Memorandum Of Understanding
MSE	Management Strategy Evaluation
PNG	Papua New Guinea
RAPTS	Regional Activity Plan for Torres Strait
TIB	Traditional Inhabitant Boat Licence
TL	Total length
TSFF	Torres Strait Finfish Fishery

TSRA	Torres Strait Regional Authority
TVH	TS Fishing Boat Licence
UVC	Underwater Visual Census