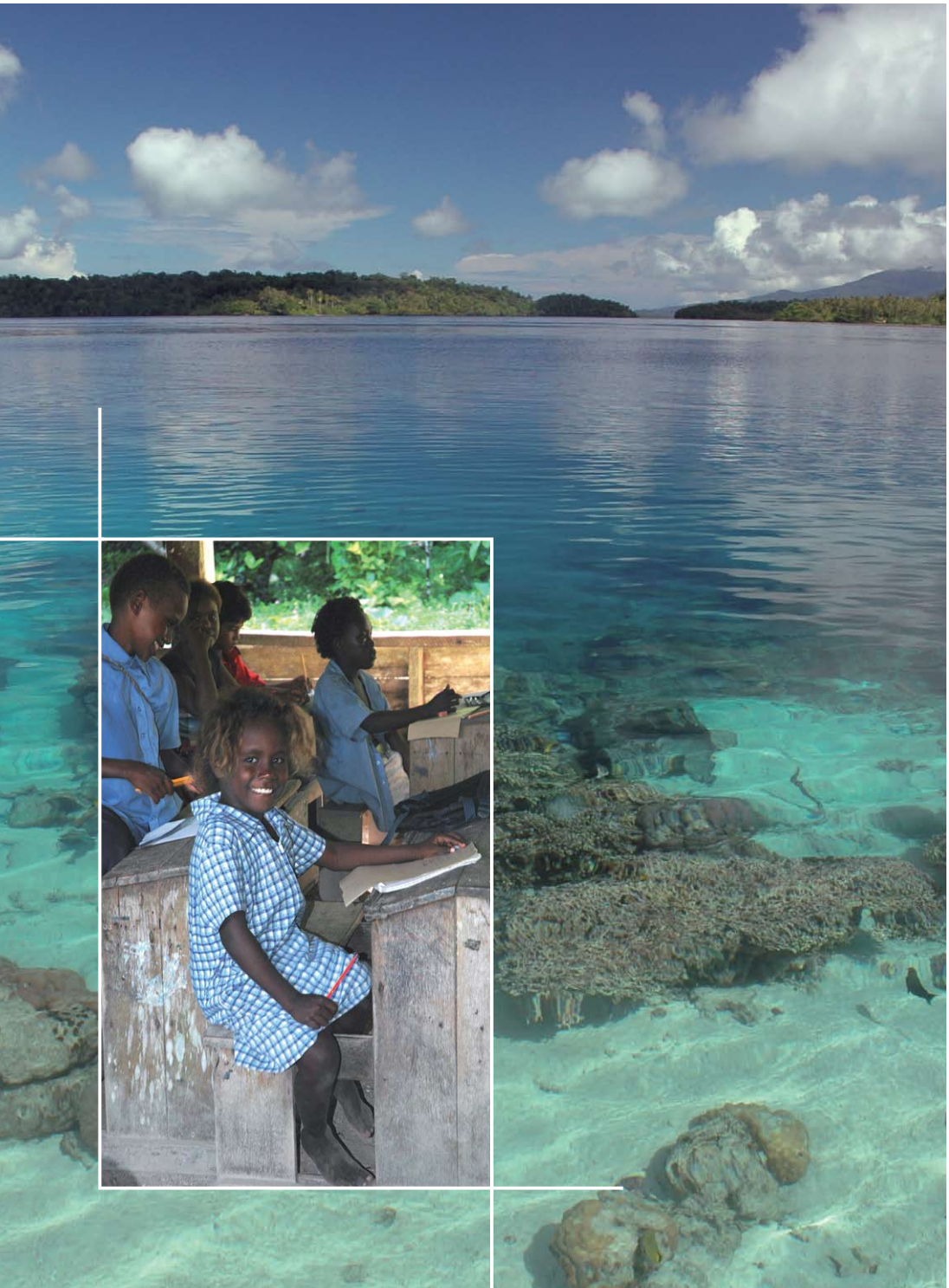
Conserving the marine biodiversity of Marovo Lagoon

Development of environmental management initiatives that will conserve the marine biodiversity and productivity of Marovo Lagoon, Solomon Islands



Norm Duke

James Udy

Simon Albert

Mark Love

Annie Ross

Ian Tibbetts

Chris Roelfsema

David Neil

Guy Marion

Joelle Prange

Jennifer Corrin Care

William Carter

Peter Dart

Sean Hough

MacArthur
The John D and Catherine T. MacArthur Foundation

The University Of Queensland
AUSTRALIA

First published 2007 by:
The University of Queensland

This book may be cited as:
Duke, N.C., Udy, J., Albert, S., Love, M., Ross, A., Tibbetts, I.R., Roelfsema, C., Neil, D., Marion, G., Prange, J., Corrin, Care J., Carter, W., Dart, P. and Hough, S. (2007). *Conserving the marine biodiversity of Marovo Lagoon: development of environmental management initiatives that will conserve the marine biodiversity and productivity of Marovo Lagoon, Solomon Islands*. The University of Queensland, Brisbane. 173p.

This book is available from:
Centre for Marine Studies, The University of Queensland, St Lucia Qld 4072, Australia.
http://www.cms.uq.edu.au/marbot/publications/books.htm

Design and illustrations by Kate Moore

Front cover photos:
Main photo: The clear water and corals of Marovo Lagoon, Chris Roelfsema
Inset: Students from Bili school, Chris Roelfsema

Photos throughout document:
Simon Albert, Chris Roelfsema, Norm Duke, Joelle Prange, James Udy, Alistair Grinham, Mark Love, Annie Ross, Ian Tibbetts, Jonathan Hodge

Print coordination by Brian Cassingham, Cass Ink, Brisbane Qld

Conserving the marine biodiversity of Marovo Lagoon

Development of environmental management initiatives that will conserve the marine biodiversity and productivity of Marovo Lagoon, Solomon Islands

Norm Duke[1]

James Udy[2]

Simon Albert[1]

Mark Love[3]

Annie Ross[3]

Ian Tibbetts[1]

Chris Roelfsema[4]

David Neil[7]

Guy Marion[1]

Joelle Prange[1]

Jennifer Corrin Care[6]

William Carter[5]

Peter Dart[8]

Sean Hough[4]

Supported by:

MacArthur
The John D. and Catherine T. MacArthur Foundation

The University Of Queensland
AUSTRALIA

Design and illustrations: Kate Moore[2]

[1] Centre for Marine Studies, The University of Queensland

[2] School of Engineering, The University of Queensland

[3] School of Social Science, The University of Queensland

[4] Centre for Remote Sensing and Spatial Information Science, The University of Queensland

[5] School of Natural and Rural Systems Management, The University of Queensland

[6] TC Beirne School of Law, The University of Queensland

[7] School of Geography, Planning and Architecture, The University of Queensland

[8] School of Land and Food Science, The University of Queensland

Contact:
Dr Norman C Duke
The University of Queensland
Email: n.duke@uq.edu.au

Executive Summary

With this three-year project from 2004 to 2007, The University of Queensland (UQ) team set out to provide a scientific basis to support community initiatives for the sustainable management of marine resources in Marovo Lagoon, Solomon Islands. We largely achieved this goal and provided the maximum benefit possible for local communities—albeit a work in progress. We learnt a lot, and this report captures important ideas and conclusions we trust will be useful for those who follow in our footsteps.

Our UQ project team comprised 17 members, including: eight research academics, four postgraduate students, three part-time coordinators, two graphic artists, and several volunteers. In each year, our project successfully followed an annual theme. The first year, 2004, involved our introduction to these special Pacific Islands—becoming acquainted with Government Offices, key NGOs and the Marovo setting. During this first phase, we were generously hosted by Greg Young (Rural Development Trust Board) and family, who provided their home on Tengomo Island as our first base of operations in the lagoon. From there, we developed a dialogue with local village communities and began the synthesis of information that makes up this report and Technical Report.

Our initial focus was a scientific assessment of marine ecosystem condition conducted concurrently with an assessment of related socio-political matters. To accomplish this, we worked closely with two Marovo communities in particular during 2005, namely Bili and Chea. In 2006, we responded to requests from these and other Marovo communities, and expanded our outreach to include all villages across the region, covering an area of more than 700 km^2, with more than 60 villages and 12,000 people. For this reason, we are confident we have a good working knowledge of the views of the broader Marovo community.

We learned about the environmental pressures present in Marovo Lagoon, and we built collaborations with enthusiastic individuals (such as those in Bili and Chea villages) and organisations (such as International Waters Programme, WWF, SILMMA and World Fish Center). Our aim was to collaborate with such groups to assist communities achieve sustainable use of their marine resources. To reinforce this objective, we maintained both bottom-up (village community) and top-down (government) strategies throughout the project. In regard to the latter strategy, our project was greatly aided by a pre-existing Memorandum of Understanding between The University of Queensland and the Solomon Islands Government.

From the outset, our group members were, and continued to be, challenged by their effectiveness in delivering tangible benefits as 'outsiders' to indigenous communities in Marovo. This self-questioning was initially manifest in our openness to new ideas and viewpoints, coupled with our thrill of learning about such an exotic natural and social setting. We found people ready to learn, keen to teach us, and our collaborations have led to strong and enduring friendships and partnerships.

We believe such partnerships were facilitated by the diversity of our team, which comprised members of both sexes and a wide range of ages. This helped forge many important bonds as we progressed through 2005 and into the second project phase, which chiefly involved the gathering of primary research data. During this phase, we made extensive use of locally owned guest house lodgings in Bili and Chea villages both to support local sources of alternative income, and to encourage close working relationships between the UQ team and village communities.

Our final year, 2006, was scheduled as that in which we would feedback our results to communities and attempt to find a way forward. During this year, we achieved a very high level of communication throughout the entire Marovo community. We came to fully appreciate, for instance, that people

consistently report dirtier lagoon waters, declines in fish catches, changes in benthic sediments, deterioration in reef condition, and losses of valuable upland forests with uncontrolled logging and clearing. The greater challenge became finding practical solutions to these matters. It was clear that communities felt powerless and ineffectual because they lack the authority to prevent even local exploitation of their immediate natural resources. This is due in part to the apparent failure of some traditional chiefs to exercise their authority in good faith and in an equitable fashion to the benefit of all in their community. Furthermore, there is no resource management authority speaking for the people that will act on their concerns and bring benefits to Marovo people.

The UQ project hosted Marovo Environment Day workshop held at Batuna in June 2006, during which the 350 attendees who participated, aired their concerns about the lagoon, provided an opportunity for those gathered to identify mechanisms that might empower the community's environmental agenda. Marovan representatives from around the lagoon nominated two 'unofficial' regional representatives from each of the six nominal regional areas of Marovo: Bili-Penjuku, Miche-Cheke, Ketoketo-Bale, Bisuana-Tatabiri, Patutiva-Zaera-Seghe, and Ramata-Chuchulu. This provided a catalyst for change that was quickly grasped and plans were made for a smaller, follow-up workshop in September 2006 for regional representatives to meet and effectively test their resolve. This second UQ-hosted community meeting sought to encourage and support this community-based initiative. All representatives eagerly attended the September workshop in Seghe. Delegates spoke frankly of their concerns and the need for continued assistance from the UQ project should it be successful in securing continuation funding. Their support for the UQ project was unanimously confirmed in a letter of support signed by all regional representatives. It was further agreed that representatives would form a communication network to disseminate information to their regional members. The network was tested in January 2007 with packages of requested legal information plus a mangrove identification handout prepared specially in Marovo language.

These latter achievements identify significant milestones in progress toward sustainable resource management by the Marovo community. So, coupled with the scientific knowledge provided by the UQ project in the Marovo language community report on environmental health of the lagoon[1], plus other information, including reference material on the formation of legal entities and associations, the community are well-placed and ready to take on the next challenge to achieve greater local management responsibility for their vulnerable natural resources.

The progress made in the three years of the first stage of this partnership between the people of Marovo lagoon, The University of Queensland, SI Government, the MacArthur Foundation and locally active NGOs has been considerable. Skills developed by the team, linkages and friendships, pathways and initiatives make lagoon resource sustainability a realistic option. While much hard work lies ahead the path at least is clear. The most effective way of delivering the benefits of advanced understandings of marine ecosystems into local community level resource challenges is through close engagement and cooperation at all levels.

Leana via.

1 *Chiniena ba lineana pa Marovo Lagoon* (Condition of the Marine Environments in Marovo Lagoon). University of Queensland Final Community Report.

Foreword

Marovo people have long depended on a profound traditional knowledge of their environment and natural resources to manage those resources. Great as this knowledge is, it does not embrace an understanding of how ecosystems function and are interconnected. Such understanding is needed to manage resources where they are exploited on a large scale. Mindful, too, that their population is increasing, along with families' economic needs and increased pressures on resources, Marovo people in 1985 sought information and guidance.

As the Senior Planning Officer for Western Province at that time, the resolution of the Marovo Area Council's call for assistance was passed to me for action. By the end of that year with the support of the London-based Commonwealth Science Council we had established a Marovo Lagoon Resource Management Project as a Marovo-driven framework within which scientific investigations of environment, resources and society that targeted local resource management information needs could be arranged. Over the course of several years 16 foreign researchers contributed.

Years later, in 2004, University of Queensland researchers offered their skills and knowledge in pursuit of a better understanding of the overall ecosystem health of Marovo Lagoon. The main base for these studies was Chea village, whose community had actively participated in the original Marovo Lagoon Resource Management Project and had already introduced resource management policy and rules suited to modern needs and pressures. The University of Queensland initiative was viewed locally as another contribution to the Marovo-managed research framework established years earlier. This meant Marovo people would tell the researchers what to study.

Two issues of concern for Marovo people—lagoon water quality and declining fish stocks—formed the core of the UQ scientific studies, producing results to guide resource management and for use in education. Consistent with the spirit with which Marovo people have accommodated visiting investigators the UQ research agenda altered in response to issues raised by Marovo people, examples being investigations into the effects of *Derris* (a plant poison used to stupefy fish) on corals, and the relationship between bêche-de-mer (sea cucumbers) and algal mats on the lagoon floor.

Marovo people also brought before the UQ team their concerns regarding weak governance, uncertainties between formal and customary law matters and educational and awareness needs. These are among the many matters addressed in this comprehensive and informed report.

All interventions in Marovo over the past 22 years have been learning experiences for both 'sides'—visiting investigators and Marovo people. Research conducted in the context of the social complexities of customary land and sea tenure and the persistent development versus conservation dilemma is not easy. Only those who work in partnership with Marovo people and are prepared to listen, learn and respond by altering their agenda to suit Marovo needs can succeed.

Graham Baines
Brisbane, April 2007

Acknowledgements

This project was made possible with the generous support and funding awarded by the John D. and Catherine T. MacArthur Foundation, with Michael Wright – Director for the Program for Conservation and Sustainable Development on Global Security and Sustainability, and administered by David Hulse – Program Officer, and Elsa Gutierrez – Program Administrator. The UQ project team and the people of Marovo and Solomon Islands thank you.

Within The University of Queensland, this project was embraced by the Solomon Islands administrative group, and administered under the Memorandum of Understanding agreement between the University and the Solomon Islands Government.

The Solomon Islands Government fully supported the project, as shown in the Research Permit and particularly in Letters of Support supplied by the Departments of Fisheries and Marine Resources, Environment, Education, and the Provincial Government of Western Province.

Through the journey of this project, we have met a considerable number of people representing an almost equally long list of organisations. Many of these are listed in Chapter 1. We want to add that we fully appreciate the support each has given. In particular, we thank the following: for collegial feedback and advice, Graham Baines, Shankar Aswani (University of California), Edvard Hviding (University of Bergen), Simon Foale (James Cook University), Jeff Kinch; for general support in the field and more, Greg and Elaine Young (RDTB), Corey and Waelinah Howell (Wilderness Lodge), Grant and Jill Kelly (Uepi Resort); for feedback and cooperation with non-government organisations (NGOs), Rod Little (SIISLAP-AusAID), Patrick Mesia (IWP), Anne-Maree Schwarz (WFC), Bruno Manele (WWF), Willie Atu (TNC); for the SI perspective, Herrick Ragoso (Chea, Marovo), Luten Hilakolo Watts (Bili, Marovo), Raeboy Logara (Bili, Marovo), Johnson Poghoso (Bili, Marovo), James Siloko (Bili, Marovo), Terrence Siloko (Bili, Marovo), Moloka (Milton) Luten (Bili, Marovo), Alrick Jimuru (Chea, Marovo), Risley Amos (Chea, Marovo), Morgan Jimuru (Chea, Marovo), Aseri Yalangono (Keru, Marovo), Alan Agassi (Biche, Marovo).

Morgan Jimuru has been a key Marovo contact assisting our project, with legendary navigational skills, and generously providing knowledge and ideas assisting the project reach out to the wider Marovo community.

Finally, we fully acknowledge the generous assistance of the people of Marovo. In particular, we thank the people of Bili and Chea villages. We dedicate this report to them and the Marovo community in general, and trust this report and the actions it will stimulate, justify their faith in our project team.

Leana

Glossary

ACIAR	Australian Centre for International Agricultural Research
AusAID	Australian Agency for International Development
CFC	Christian Fellowship Church
Chl *a*	Chlorophyll *a*
CI	Chief Investigator
CMT	Customary Marine Tenure
DIN	Dissolved inorganic nitrogen
DO	Dissolved oxygen
DFMR	Department of Fisheries and Marine Resources
FAC	Fishery Advisory Council
FRP	Filterable reactive phosphorus
GPP	Gross primary productivity
ICDP	Integrated Conservation and Development Project
ICLARM	International Centre for Live Aquatic Resources Management (now World Fish Center)
ICRAN	International Coral and Reef Action Network
IWP	International Waters Programme
KEB	Kumpulam Emas Berhad
LMMA	Locally Managed Marine Area
MAC	Marine Aquarium Council
MacArthur	John D and Catherine T MacArthur Foundation
MINBALT	Marovo Island Nature Biodiversity and Livelihood Trust, Chea village community, Marovo
MLTO	Marovo Lagoon Tourism Operators
MOU	Memorandum of Understanding
MPA	Marine Protected Area
NCSA	National Capacity Self Assessment, UNDP-GEF
NGO	Non-government organisation
NTU	Nephelometric turbidity units
NZWHP	New Zealand World Heritage Programme

ORPS	Office of Research and Postgraduate Studies, UQ
PMOC	Pacific Marine Ornamental Certification
P/S	Provincial/Permanent Secretary
RDTB	Rural Development Trust Board, Honiara
RVLMRMP	Roviana and Vonavona Lagoon Marine Resource Management Programme
RVRMDP	Roviana and Vonavona Research, Management and Development Project, Munda, Western Province
SDA	Seventh Day Adventist Church
SI	Solomon Islands
SIG	Solomon Islands Government
SICHE	Solomon Islands College of Higher Education, Honiara
SIISLAP	Solomon Islands Institutional Strengthening Land Administration Project
SILMMA	Solomon Islands Locally Managed Marine Area Network
SOPAC	Pacific Islands Applied Geoscience Commission, Suva, Fiji
SWIFT	Solomon Western Islands Fair Trade
TCSP	Tourism Council South Pacific
TDA	Tetepare Descendants Association
TN	Total nitrogen
TNC	The Nature Conservancy
TP	Total phosphorus
TSS	Total suspended solids
UNESCO	United Nations Educational, Scientific and Cultural Organisation
UQ	The University of Queensland, Brisbane, Australia
USP	University of the South Pacific, Suva, Fiji
WFC	World Fish Center
WPRMO	Western Province Resource Management Ordinance
WWF	World Wide Fund For Nature

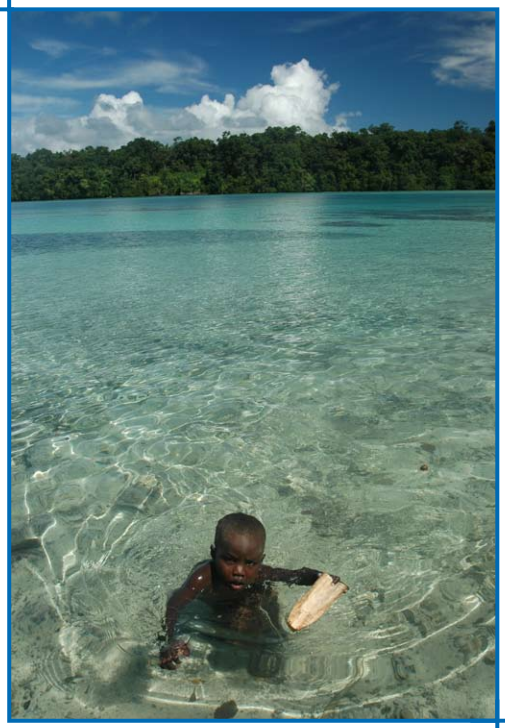
Dedication

Kogu Tahita Pa Marovo Pana Maena

Marovo People – The Lagoon is our Future

Tinoni pa Marovo inari laena ta kogu oro na tonga nia ria tingi tonga puko oro nato pa idere di kadi leadi via inomidi pa katiga vasina.

Marovo people value their lagoon and its marine life but are concerned that it is possibly unhealthy in some places



This report is dedicated to the people of Marovo, particularly those who recognise the great importance of their lagoons' healthy marine and natural environment and seek ways to sustain it.

Contents

Chapter 1

The UQ Marovo Experience

Science-based support for community management of marine resources

Norm Duke
Mark Love
Simon Albert
James Udy
Annie Ross
Ian Tibbetts
Chris Roelfsema
William Carter
Jennifer Corrin Care
David Neil

This is the final report for the introductory phase (2004–2007) of the University of Queensland (UQ) Solomons–Marovo Project. This chapter introduces the project, describes its conceptual framework, lists objectives, explains the overall rationale, and describes the approach and methodology. Subsequent chapters describe: the geographic, environmental and social setting of Marovo lagoon (Chapter 2); how UQ marine and social scientists identified and responded to community concerns about degradation of the marine environment (Chapter 3); key ways UQ scientists were able to assist in strengthening community capacity to deal with natural resource management (Chapter 4); specific observations of socio-cultural matters relating to resource management (Chapter 5); further observations of socio-economic matters and how livelihoods have been altered by environmental degradation, including tourism (Chapter 6); and, a series of recommendations and guidelines for the future (Chapter 7).

Our choice of study location in Marovo Lagoon in the Solomon Islands has been most fortunate for three reasons. First, the location is unequalled as both a natural and cultural wonder, making it clearly worthy of proposals that it be listed as a World Heritage site. Secondly, the continuous occupation of the area over nearly five thousand years infers there is a wealth of cultural tradition with a long history of sustainable resource management. Thirdly, the wealth of natural resources of Marovo further serves to identify the inherent vulnerability of such a place to change. In recent decades, these bountiful natural resources have caught the attention of 'entrepreneurs' who have sought quick and easy profits. The outstanding natural resources of Marovo have been markedly depleted. Large areas of dense forest vegetation are being cleared for palm oil plantations, logging and potential mining operations. Resource exploitation on this scale is likely to result in severe impacts downstream on marine resources. These impacts may be amplified by over fishing. These severe changes have depleted, damaged and polluted natural marine resources across the lagoon with reported instances of degraded fish stocks, decreased bêche-de-mer productivity, localised shoreline erosion, elevated nutrient levels and increased rates of sediment deposition. These factors are exacerbated by seemingly overwhelming socio-political ructions leaving local communities largely powerless to influence these pressures on their customary lands and its natural resources. This present situation stands in stark contrast with the prior effectiveness of traditional and customary natural resource management practices.

Research team members unanimously adopted a fundamental guiding principle in the pursuit of this study, namely that priority would be given to forming working investigative partnerships with indigenous communities. Together these partnerships would strive for effective application of natural resource management strategies based on sound scientific knowledge interpreted in the context of the socio-cultural milieu and delivered in a pragmatic cooperative framework. The partnerships clearly emphasize that useful knowledge is not restricted to Western scientific disciplines, but that it also resides in traditional and customary belief systems held and treasured amongst indigenous communities through the generations.

Introduction

A primary goal of the project was to build partnerships based on the shared knowledge of UQ researchers and Marovo communities to enhance social strategies and methods that would contribute to and support the sustainable management of the natural marine environment of Marovo Lagoon. As a consequence the improvement of natural resource use, exploitation, and management depends on the people and their governing institutions at all levels of jurisdictional authority—from village and community members (including local and absent landlords), to Provincial (Gizo-based, Western Province) and National (Honiara-based) Governments. The project was initially considered ambitious since it attempts not only fundamental science and social science investigations, but also to address all levels of authority in searching for solutions. This embodiment of both bottom-up and top-down strategies in the resolution of serious challenges to the sustainability of coastal communities is considered most likely to achieve sustainable and effective outcomes for the people of Marovo.

Project Objectives

The specific and stated project objectives, as outlined in the original proposal, were:

1. Initiate dialogue with the local communities (Bili Passage and Chea village) and complete a synthesis of the current uses of Marovo Lagoon (resources) and environmental impacts;
2. Undertake an ecosystem assessment of the various habitats in Marovo Lagoon and their current ecosystem health—this will include identification of major environmental stresses currently impacting on the lagoon's ecosystems;
3. Provide a map of the south-east region of Marovo Lagoon that identifies major habitat types and identifies regions of the lagoon where current habitats are 'at risk' due to anthropogenic or other environmental stresses;
4. Produce educational aids in the form of posters, leaflets and local trainers' guides to natural resource management issues to assist in communicating our findings to the community(s) and provide a catalyst for change; and,
5. Address the economic impacts of any recommendations to protect the marine ecosystem and attempt to design a solution that results in an improvement in the overall economic situation of the community(s).

All these objectives have been met, and the team has been fortunate in achieving much more than was initially foreshadowed. For example, collaborations and discussions held with specialists and international agency officials with compatible and sometimes parallel objectives permitted the development of additional layers of networks extending globally, locating yet more individuals and organisations with compatible aims. Team objectives were therefore supported and enhanced by others, and the team has been able to reciprocate. It therefore became a core aim to develop and enhance any and all synergies that would improve the outcomes for people of the Pacific Islands, particularly for communities in the Solomon Islands, and especially the Marovo area.

Project objectives and overall research rationale fit within a mosaic of recognised international, regional and national biodiversity and conservation priority areas, including:

- The Global Environment Facility (GEF) focal area of Biodiversity, operational programme no. 2 Coastal, Marine and Freshwater Ecosystems, engaging with each of the four strategic priorities[1];
- The United Nations Convention on Biodiversity (CBD) specifically Articles 6, 7, 8, 12, 13, 16, 17 and 18, including many of the actions identified in the Second Parties of the Convention (POC2) 'Jakarta Mandate'[2] ;
- The United Nations Convention to Combat Desertification (UNCCD)[3];
- South Pacific Regional Environment Programme (SPREP) Action Strategy for Nature Conservation in the Pacific Island Region (2003–2007);
- Solomon Islands Government (SIG) National Environmental Management Strategy (NEMS) 1993[4].

The strategies and knowledge/action 'gaps' identified by the team in this report were determined from the findings of many such agencies. The sum effect has contributed in various ways to our project activities and outcomes, as reflected in the final chapter on future directions and project recommendations.

---

1 The four GEF Biodiversity strategic priorities are: (SP1) Catalysing Sustainability of Protected Area Systems at National Levels; (SP2) Mainstreaming Biodiversity Conservation Production Landscapes/Seascapes and Sectors; (SP3) Capacity Building for the Implementation of the UN Convention on Biological Diversity Cartagena Protocol on Biosafety; and (SP4) Generation, Dissemination, and Uptake of Good Practices for Addressing Current Emerging Biodiversity Issues.

2 See De Fontubert et al. (1996);

3 Through the study of land use impacts on marine ecosystems in Marovo Lagoon

4 The NEMS identified 29 strategies to address environmental issues in the Solomon Islands. These included the mainstreaming of sustainability into government policy, protecting areas of high ecological and cultural value, improving environmental awareness and education and managing coastal environments. To date however, the only significant outcome has been the development of the Environment Act 1998.

Rationale and Methodological Approach

In order to meet the project objectives, a range of disciplines were integrated. The two dominant fields were the so-called 'hard' sciences (constituting specialists in marine botany, biology, nutrient and sediment issues and remote sensing), and the so-called 'soft' social science. The latter was represented by anthropology. The pragmatic marrying of these disciplines, which are often simplistically essentialised as disparate arenas of knowledge, proved a challenge that provided project members with considerable intellectual stimulus and scholarly debate. This task was facilitated by key team members, project coordinators and PhD students who quickly became deeply engaged in the socio-economic dimensions of the project, and took the opportunity to become well informed about key aspects of social science theory and methodology.

The integration of approaches facilitated a seminal cross-disciplinary investigation that did not simply require parceling of specific objectives into one or other discipline. Rather instead, each member of the team had to engage with paradigms outside of their disciplinary 'comfort zone', in order to help design and implement a research strategy that cut across epistemological barriers and cultural contexts. Some of the project objectives are clearly more 'discipline specific' than others, but in practice the social components of the project overlap nearly all the hard science objectives to some degree. For example, one of the project objectives (3), was to map a specific region of the lagoon, identifying key habitat types and areas 'at risk' from anthropogenic and other environmental stresses. How should one unequivocally define the phrase 'at risk'? Does it refer only to ecological biodiversity parameters, as measured empirically, or does it also refer to local perceptions and concerns, no matter what their empirical validity? The team resolved to incorporate both the scientific results (sediment, nutrient analysis and so on) and sociological qualitative data provided by the community concerning what they perceive as areas 'at risk', and present these perspectives as layers on a single map.

These insights are characteristic of a shift from 'multidisciplinarity' to 'interdisciplinarity', as numerous nodes of knowledge are methodologically combined by not only the project specialists, but also reconfigured via engagement with local knowledge systems, in an attempt to break down epistemological barriers. Such ambitious goals are of course a great challenge. As has been insightfully acknowledged by many commentators (e.g. Sillitoe and Bicker 2004), but most pertinently to our context by Edvard Hviding (2003a), the prevailing optimism associated with solving multidisciplinary problems through interdisciplinarity is often uncritical and overly simplistic in application. Hviding (2003a) argues that all too often 'interdisciplinarity' remains an elusive expression of compromise and is more often an object of conflict and debate between institutions, bureaucrats, and scientists than it is an affective tool of contact between plural spheres of knowledge.

Interestingly, in the project team's experience it was not only these barriers that needed to be addressed, but also structural limitations that needed to be carefully negotiated. In 'academia' for example, we experienced systemic challenges in the form of inter-faculty differences in university directives and policies. In the social science faculty for instance, there were different protocols regarding ethical clearance matters, resource allocation and post-graduate student guidelines that were in notable contrast to those operating in the hard science faculties. Cross-culturally, the dynamic and often fractious context associated with post-colonialism and the melting pot of *kastom*[5] and modernity, combined with the collective and individual 'wounds' associated with the recent 'tensions' in the Solomon Islands, often results in structural complexities in terms of gaining research permits and following local protocols. For example, one of the research sites had three individuals proclaiming chiefly title (where there is normally only one), which provided interesting dilemmas in terms of negotiation and community engagement just for permission to work there, let alone any subsequent application of effective resource management.

To surmount these epistemological and structural challenges a reflective and dynamic approach was developed, utilising components of an interactive project plan, which recognised that incomplete knowledge does exist, allowing room for meaning to be developed within local contexts (and not just solely imposed from the outside), and where 'errors' were viewed as integral to the process of learning (Honadle and Rosengard 1983). Working closely from the very beginning with other organisations

5 derived from the English work 'custom' and relating to entrenched traditional practices.

with similar objectives to our own (including IWP, WWF, WFC, TNC, CI, SOPAC), as well as continuing to build linkages with individuals such as the applied anthropologist Shankar Aswani, who has been instrumental in establishing the 'Roviana and Vonavona Lagoon Marine Resource Management Programme' (RVLMRMP), has also been important in terms of learning from others and avoiding 'reinventing the wheel'. Finally, one of the most important attributes in this project's arsenal has been our initial involvement with an 'in-country' NGO, the Rural Development Trust Board (RDTB) based in Marovo, from where the team was able to broaden the network first to two village communities of Chea and Bili, before reaching out to the more than 50 villages scattered throughout the Marovo region.

Project Design

Project design consisted of an integrated scientific and social approach, using targeted scientific research in parallel with sustained community engagement, education and awareness capacity building processes, and a significant anthropological research component. To understand the myriad of factors impacting on the social and environmental well-being of the lagoon, the project used an inter-disciplinary strategy, drawing on the resources of numerous university personnel from a broad spectrum of academic fields (see below).

While focused on key project objectives, an 'adaptive management' approach was applied. An adaptive management paradigm specifically refers to the integration of (project) design, management, and monitoring to systematically test assumptions in order to adapt and learn (Margoluis and Salafsky 1998; Salafsky and Margoluis 1999; Salafsky et al. 2000). Among other things, adaptive management recognises that incomplete knowledge exists, leaving room for meaning to be developed within local contexts. Importantly, 'errors' are viewed as integral to the process of learning rather than as inconvenient stumbling blocks (Honadle and Rosengard 1983). Such fluidity encourages dynamism and provides opportunities for project design and goals to be responsive to changing circumstances.

Examples of adaptive and additional project activities include: Extending our planned educational activities to include a Sabbath School Workbook; the formation of a pan-Marovo regional 'points-of-contact' network; several community-driven and assisted scientific experiments, and; the awarding of two diploma scholarships to high school teachers in the lagoon (see Chapter 4).

Natural Marine Resource Assessment Component

The principal scientific research focus of the project was to conduct a baseline ecosystem assessment of the various marine habitats of Marovo Lagoon. This was achieved with the production of a habitat and ecosystem health map of the south-east portion of the lagoon, identifying not only the dominant habitat types, but also the major environmental stresses. This part of the study primarily focused on identifying current anthropogenic environmental impacts, but also touched upon pertinent diachronic environmental factors by examining historical land-use changes (using aerial photographs from the 1940s to present day satellite imagery) and potential future impact scenarios (demographic pressures, climate change, sea level rise and intensified anthropogenic activities such as bait-fishing and mining). This task was achieved through the combined use of remote sensing technology, field sampling techniques and GIS (Geographical Information Systems).

Remotely sensed images of the lagoon and field data were combined in GIS environment to produce visual maps of the lagoon. The field data were gathered from two transects that represented an impact gradient from a terrestrial pollutant source (river mouths) to regions of the lagoon that have minimal terrestrial impacts and are dominated by oceanic influences (see Fig 3.1). Remotely sensed imagery was used for backdrop and for extrapolating the benthic information for field sites through out the lagoon. Four major benthic habitat types were assessed (mangroves, seagrass, coral/hard substrate and bare sediment) and the water column. Field data comprised: benthic photo transect and spot check surveys; water quality measures to identify sediment processes; nutrient concentrates and benthic microalgal biomass; seagrass and mangrove typology, distribution, and abundance; a broad assessment of coral parameters, such as coral and algal cover, fish populations, invertebrate populations, substrate type and macro algae biomass; and a survey of keystone fish grazers.

Social, Political and Economic Component

To fulfill the project's social research objectives a variety of research methods and approaches were applied. In addition to the customary anthropological practice of participant observation, a combination of 'standard' survey instruments such as socio-economic household surveys, semi-structured interviews and focus group discussions were used in conjunction with free-listing exercises and a cultural consensus analysis. These latter two techniques were part of the 'tool kit' of what is often referred to as 'cultural domain analysis'. Cultural domain analysis is a paradigm often subsumed under the rubric of 'cognitive anthropology' (Romney et al. 1986; Borgatti 1994; Colby 1996; Bernard 2003), and has been utilised to interesting and productive ends in numerous applied contexts (marine and otherwise) around the world (see Aswani 2005; Grant and Miller 2004; Miller et al. 2004 for maritime examples).

In addition to these methods, information was also sought that could directly supplement the scientific investigations of the project. Individual fish 'esky'[6] catch surveys (designed to provide a representative sample of the number and types of fish being caught by fishers for commercial sale) and a lagoon-wide total esky survey (intended to identify the volume of commercial fish being transported from Marovo to Honiara) was also undertaken.

Ecotourism

It was acknowledged by many commentators, and supported by discussions with Marovo community members, that tourism is a long-term activity that can help contribute towards sustainable livelihoods, poverty alleviation, and bestow meaning to, and assist with, conservation activities and goals. As part of the wider objective of investigating the economic impacts of project recommendations, and to shed more light on alternative economic 'pathways-of-change', a preliminary investigation of eco-tourism was undertaken. This consisted of a strategic review of tourism in Marovo Lagoon (see Technical Report). The research was primarily a desktop study, supplemented by partial field work and some limited stakeholder consultation.

Environmental Governance and Legislative Issues

To be successful and sustainable, community based resource management must be on a firm legal footing, which at present it is not. In the Solomon Islands, communities no longer live in isolation, and they are increasingly forced or choosing to interact with outsiders, including other customary groups, expatriate entrepreneurs and with national and provincial governments. The pace of social and economic change is creating more tensions than ever before around the intersections of *kastom* and Common Law (see NZLC 2006). Essential to any long term conservation aspirations is the clarification of the legal position of community resource managers, the provision of assistance to communities to enhance their understanding of the limitations of the State legal system, legislation and how existing laws interact with customary law and authority. It is vital to equip communities with this knowledge so that they may negotiate the changes necessary to enhance the operation of community based resource management.

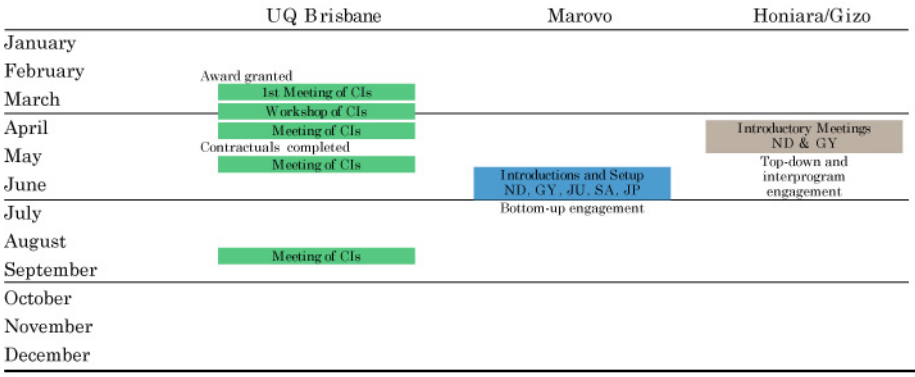
Education and Capacity Building

Sustained community engagement, supplemented by increasing local participation over the course of the project cycle, was a cornerstone of project ambitions and activities. During each field trip a handout was distributed, outlining who we were and what we were doing. We also conducted at least one meeting with the main target communities of Bili and Chea each field trip. This proved to be a popular and effective medium of engagement, and the photos of each UQ project member included on the handouts soon ensured that many people quickly new us by name. As the momentum of the project increased other communities in the lagoon began to contact us, requesting assistance and more information about our work. Although resource limitations and our scientific strategy precluded expanding the project too widely, we decided to conduct a pan-Marovo meeting to disseminate our results, stimulate discussion and canvas the broader issues and seek feedback from a wider and more representative sample of Marovo people. The meeting was a great success, attracting national press coverage (see Appendix). Likewise, the Marovo language Community Report was well received, stimulating much discussion and debate. In addition, the project provided resources to enable various Solomon Islands based NGOs to attend the meeting with representatives from: World Wildlife Fund for Nature (WWF), Conservation International (CI), International Waters Project (IWP), Tetepare Descendants Association (TDA) and the World Fish Center (WFC), several of whom conducted brief presentations during the morning session.

6 A large insulated box used to keep produce fresh, typically left in villages by agents and then later collected and its contents sold in Honiara

Figure 1.1: Chart of Project Activities and Key Events

2004 – Introductory Phase

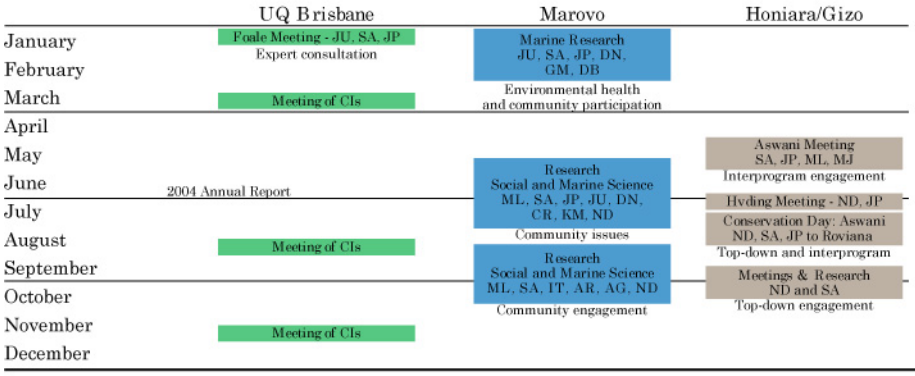


Major Achievements:

- Successful start-up, top-down and bottom-up engagement achieved

2004

2005 – Research Phase

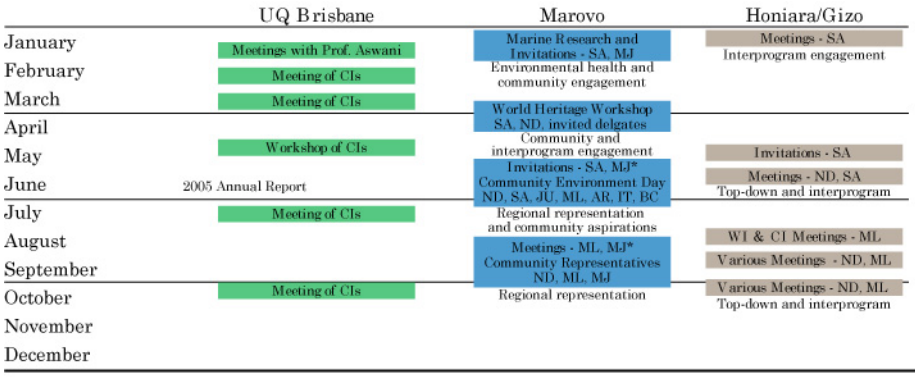


Major Achievements:

- Successful assessments of Marovo environment and its people, with community participation.
- Research approvals, official support, village MOUs and confirmation of community confidence in project personnel and objectives.
- Maintained and extended top-down engagement.
- Developed NGO collaborations and data sharing.

2005

2006 – Community Feedback Phase

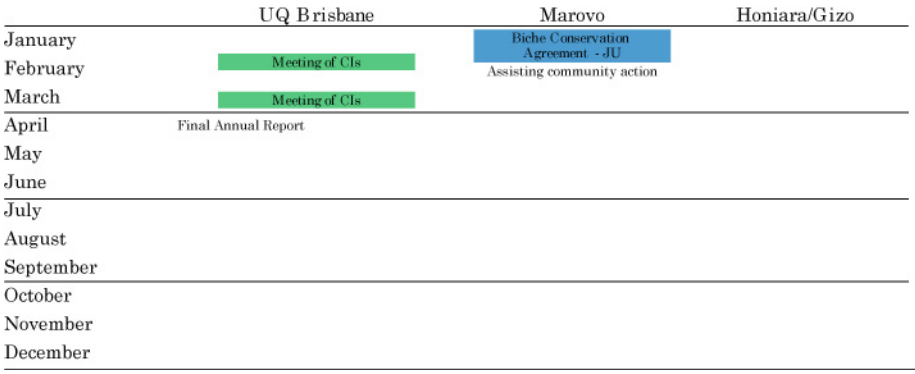


Major Achievements:

- Further developed NGO collaborations.
- Maintained and extended top-down engagement.
- Greatly extended community participation with mass workshop leading to the nomination of community regional representatives for future management of natural resources.
- Development of a Marovo contacts network for dissemination of ideas and information.

2006

2007 – Completion



Major Achievements:

- Commencement of an exploratory project, responding to requests from Biche community for a conservation agreement.
- Full synthesis of project findings and recommendations.
- Publication of final report.

2007

Strategies addressing community concerns about natural resource degradation

Having gauged community concerns about the deteriorating condition of their natural resources during our various social engagements, the first task of our marine researchers was to re-evaluate the issue(s) and work towards identifying the multiple causal factors at play. This was done in two ways, including: 1) an evaluation of comparable issues elsewhere and what might be learned from these instances; and 2) to design a field investigation with as much participation of relevant community representatives as feasible. The outcomes of several such investigations are described in Chapter 3. Our preliminary findings, translated into the local lexicon in our Community Report, were quickly disseminated amongst the wider community. Our social research and evolving project-community partnerships have helped ground our insights in the socio-political and economic context in which they must be embedded. This has not only informed our recommendations, but created a practical and considered platform on which to move forward.

The project explored the following key conservation issues.

Declining Water Quality

In view of recent extensive changes to catchment vegetation cover and increases in population centres in the Marovo area, there has been much written about possible increases in sediment loads, increased nutrients and dirty coastal waters and their potential effects on marine habitats of the lagoon. Our investigations help identify, quantify and link the relevant influencing factors with actual effects; information which is vital to informing management programmes.

Decreasing Fish Population

The cultural and practical centrality of fish resources to Solomon Islander's can not be underestimated. Fish is not only the main protein source for the majority of rural peoples—it is integral to local identity and practices. Quantifying fishery changes, and evaluating local attitudes and concerns about such changes, is essential to developing effective management programmes.

Benthic mats and bêche-de-mer decline

Extensive soft bottom habitats are a dominant feature of Marovo lagoon. The role they play is based on their dependant key biota, and they may have exceptional value as areas of high primary production and support important trophic linkages, like that between cyanobacterial[7] mats and bêche-de-mer[8]. There are notable issues concerning the taking of these species and their importance to the local economy.

Declining Reef Health

Coral reefs are arguably **the** treasured icons of Marovo lagoon. In reality, this habitat has a more profoundly multi-dimensional makeup. Reefs are found naturally across the lagoon ranging through a broad range of water quality conditions from the azure oceanic conditions to periodically quite muddy estuarine run-off zones associated with larger land catchments. In these instances, there is often a gradient from land affected to oceanic influenced reef. Hence in our marine research assessments, we have used transects across the lagoon in order to fully evaluate the range of local conditions to identify how they might have changed in recent decades.

Detrimental land use practices

Perhaps the greatest major threat for reefal marine habitats in Marovo Lagoon is the reported poor land use practices associated with large scale logging and agricultural practices. These impacts were assessed through a combination of social surveys, analysis of historical records and satellite imagery.

7 Also known as blue green algae

8 Also known as either sea cucumbers or trepang, these animals belong to the Phylum Echinodermata, Class Holothuria, many members of which play an important role in turning over sediment and removing organic material.

Project Components

The primary focus of the 2004–2007 project was the scientific assessment of marine ecosystem condition, coupled with a socio-political assessment. For practical and scientific reasons, two specific areas in Marovo lagoon were selected. The communities, Bili Passage and Chea became the primary 'field-sites' and the focus of our initial community engagement and social research component. It should be emphasised that in 2006 the views of the entire Marovo community were sought. This was undertaken for two major reasons: 1) to assess the wider relevance of issues identified through work with the Chea and Bili communities; and 2) in appreciation that to be effective, management actions designed to improve marine health must be applied throughout the lagoon.

Assessments were conducted by a multi-disciplinary team from UQ focusing on the following thematic components:

1. Marine Science Themes

- Water quality in the lagoon
- Sediments and geomorphology
- Coral reef interactions between corals and macroalgae
- Coral growth and health as determined from coral cores
- Fish and fisheries
- Mangrove habitat, benefits and uses
- Benthic microalgae

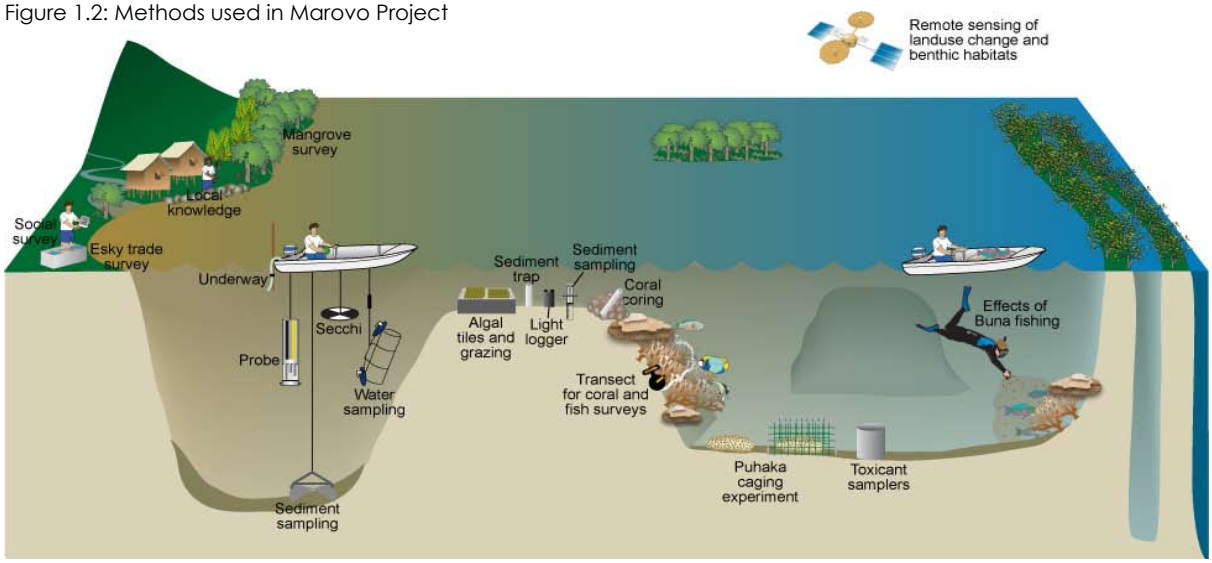
2. Social, Political and Economic Themes

- Anthropology and customary traditions
- Current socio-political situation and governance
- Community-relevant socio-economic circumstances
- Tourism in the lagoon

3. Community Issues developed from Themes 1 and 2

- Declining water quality—nutrients, turbidity, bathymetry and coral coring;
- Decreasing fish populations and fisheries production;
- Benthic mats and declines in bêche-de-mer—benthic communities, key invertebrates and effects on seagrass beds;
- Declining reef health—biodiversity and health of coral reefs (macroalgal–coral relationship);
- Detrimental land use practices, and effects on mangroves and tidal wetlands.

Figure 1.2: Methods used in Marovo Project



Team Members

The UQ project team comprised 17 people: eight were chief investigators, five were part-time coordinators and graphic artists, and there were several volunteers. The following is a brief biography of the project team, their relevant experience and roles.

Chief Research Investigators

- Dr Norman Duke, BSc (Hons) MSc PhD
  Centre for Marine Studies
  Project Leader, Mangrove ecosystems and coastal changes.
  Dr Duke led the project and conducted ecological assessment of mangrove wetland condition and health, including related field and remote sensing components. He also co-supervised the PhD students with the project. Dr Duke is an internationally-recognised authority on mangrove forest ecosystems, with a special interest in floristics, biogeography, evolution, genetics, productivity, plant-animal relationships, restoration, as well as the effects of pollutant stress and change.

- Dr James Udy BSc (Hons) PhD
  Centre for Water Studies, School of Engineering
  Ecological assessment of water quality and subtidal marine habitat.
  Dr Udy conducted ecological assessment of water quality and subtidal marine habitat components of this project. He co-supervised the PhD students with Dr Duke. Dr Udy has been involved in the application of many different biological monitoring techniques and involved in developing both the Estuarine/Marine and Freshwater Ecosystem Health Monitoring Programmes (EHMP) in S.E. Queensland, Australia.

- Dr Ian Tibbetts BSc (Hons) PhD
  Centre for Marine Studies
  Fish and fisheries monitoring
  Dr Tibbetts assessed the general health of fish communities, particulary that of grazing fishes, which play a major role in the health of coral reefs. Dr Tibbetts worked with Simon Albert on grazing related issues and Mark Love on the interpretation of the 'esky' catch, particularly where keystone fish guilds such as top predators and grazers are targetted. Dr Tibbetts teaches 3rd level Fish Biology, marine biology and reef ecology.

- Dr David Neil BSc (Hons) Dip. Geoscience, MSocSc, PhD, G.Cert.Education
  School of Geography, Planning and Architecture
  Sedimentary processes
  Dr. Neil conducted assessments of catchment processes and management and downstream effects of land use intensification. Dr Neil is an Associate Professor (Environmental Science) in the School of Geography, Planning and Architecture where he teaches and coordinates courses in Coastal Processes and Management Marine Science, Coral Reefs, Environment and Society, Biogeography and Geomorphology.

- Dr Annie Ross BA (Hons) PhD
  School of Social Sciences
  Co-ordinate community consultation
  Dr Ross conducted the social analysis investigation, working alongside BA (Hons) student, Mr Mark Love, whom she supervised. The combination of an older female researcher and a younger male researcher ensured that all levels of Marovo Society were able to have their views about the lagoon heard. Dr Ross worked mostly with the women in the lagoon, and some of the older men, while Mr Love was able to concentrate his research with the Marovo men. Dr Ross has a long-term research interest in Indigenous approaches to natural resources management, and she brought her experience in this area to the Marovo project.

- Dr Jennifer Corrin Care BA (Hons) PhD
  Department of Law
  Advisor on indigenous legal rights and South Pacific Customary Law
  Dr Corrin Care is a Senior Lecturer in South Pacific Customary Law at UQ. She also teaches in the Professional Legal Education and Training Programme, and was formerly an Associate Professor in the School of Law at the University of the South Pacific, and has had her own legal firm in Solomon Islands.

- Dr Bill Carter PhD BSc (Forestry) Hons, BSc (Zoology)
  School of Natural and Rural Systems Resource Management
  Advisor on environmental tourism and natural resource management at UQ
  Dr Carter lectures in environmental tourism and natural resource management at UQ. Dr Carter is a Churchill Fellow and his work is based on studies of, and with, indigenous communities throughout the Asia-Pacific region considering conservation through tourism. Two of the main case studies used in his work were based on the Arnarvon Islands and Tetepare Island in the Solomons.

- Dr Peter Dart BScAgr (Hons) PhD
  School of Land and Food Sciences
  Advisor on overall project management, particularly on the effects of land use
  Dr Dart has extensive experience with agroforestry and forestry research and development in the Philippines and Vietnam. He has been working with the Rural Development Trust Board to support reforestation activities by the community based at Duvaha in North New Georgia establishing a commercial tree nursery for the community and training local staff.

Postgraduate Students based at UQ

- Simon Albert BSc (Hons)
  Centre for Marine Studies
  PhD student. Ecosystem health and water quality, community participation in research.
  Mr Albert undertook benthic surveys, water quality sampling and ecological assessments in Marovo lagoon. Simon was also involved in the community education and facilitated the community meetings. Simon has been involved in similar projects in the Cook Islands, Fiji and Roviana Lagoon.

- Mark Love BA (Hons)
  School of Social Sciences
  Anthropological Field Researcher
  Mr Love completed his honours thesis while working on the Marovo Project, and conducted the bulk of the social research component of the project (under the supervision of Dr Annie Ross). With Simon Albert and Morgan Jimuru, Mark organised the Batuna and Seghe community meetings. Mark is currently undertaking his PhD, researching collective action issues and the intersection and tensions associated with extra-local/local interventions in Vanuatu and Solomon Islands.

- Chris Roelfsema BSc (PgDip) MSc
  School of Geography, Planning and Architecture and Centre for Marine Studies
  PhD student. Remote sensing and habitat mapping
  Chris conducted ecological assessments using a combination of effective low cost field and cutting-edge remote sensing techniques. His assessment has provided resource imagery for this project. Chris has worked since 1999 as a Marine Remote Sensing officer with the University of Queensland and in 2003, trained delegates from SOPAC member countries in coral reef remote sensing techniques.

- Alistair Grinham BSc MSc
  Centre for Marine Studies
  PhD student. Microalgal productivity and water quality
  Alistair monitored the productivity of cyanobacterial mats and benthic light in response to changes in water quality. He also evaluated the effect of bêche-de-mer grazing on the productivity of cyanobacterial mats.

Project Assistants (partly funded)

- Dr Joelle Prange BSc (Hons) PhD—Centre for Marine Studies. Coordination 2004–2005. Dr Prange was the co-ordinator for the Marovo Project at project inception until mid 2005, assisting with the day-to-day management and coordination. Her interests included incorporating traditional and scientific knowledge of ecosystem health within the Marovo area.
- Alicia Bell BSc (Hons)—Centre for Marine Studies. Coordination 2005–2006. A UQ graduate with a special interest in mangroves affected by herbicides.
- Jock Mackenzie BSc (Hons)—Centre for Marine Studies. Coordination 2006–2007. A UQ graduate with a special interest in nutrient exchange and trophic interactions in saltmarsh and mangrove habitats.
- Diana Kleine—Centre for Marine Studies. Graphic Artist. UQ Research Assistant with a special flair for layout and design of scientific books, handouts and web pages.
- Kate Moore BSc (Hons)—Centre for Water Studies. Desktop publisher and graphic artist. A UQ Research Assistant involved in production of scientific diagrams, maps and reports and field trip volunteer.
- Morgan Jimuru—Chea Village. Social and Marine Research Assistant. Mr Jimuru worked closely with project staff to implement the collection of marine and social science data. Morgan's navigational knowledge was critical in allowing the project to cover the 700km^2 lagoon in small fiberglass canoes.
- Moloka Luten—Bili Village. Social and Marine Research Assistant. Mr Luten was involved in all aspects of this project from collection of data, facilitation of meetings and translation of reports.

Project Volunteers

- Guy Marion, UQ Centre for Marine Studies PhD student. Mr Marion has developed and applied techniques to measure historical land use change using coral core proxies. Guy provided funding, equipment and expertise to undertake the coral coring component of this project which provided useful insights into recent changes in Marovo land use and water quality.
- Dana Burfeind, UQ PhD student
- Jonathan Hodge, EPA, Water Sciences.

Solomon Islands Government and Institutional Stakeholders

Many government and institutional officials were contacted regularly through the investigation, either in Honiara (capital of SI) or Gizo (capital of Western Province). Handout portfolios were prepared for distribution to those listed. Portfolios included an update of the project status and outcomes, personnel involved plus other documents produced by the research group. All contact details were compiled in project database files.

SI project partner (2004–2006)

Rural Development Trust Board	Director – Greg Young

SI Government officials (2004–2006)

Fisheries and Marine Resources	Permanent Secretary – Ethel Sigimanu, Tione Busotu, Fred Gnate, Peter Ramohia
Environment and Conservation	Director – Joe Horokau, Moses Biliki, Steve Likaveke
Geology	Director – Don Tolia
Ministry of Provincial Government	Under Secretary
Ministry of Education	Under Secretary – Timothy Ngele, Donald Malasa Director of Secondary Schools – Aseri Yalangono
SI Research Committee	Chairman – Donald Malasa
Museum	Director – Laurence Foanaota
Meteorological Service	Director – Chanel Iroi
National Disaster Management Office	Director – Loti Yates
College of Higher Education (SICHE)	Nat. Res. Director – Alex Makini, Gordon Nanau
Western Province	Premier – Alex Lokopio
Western Province Government	Provincial Secretary – Arnold Moveni, Eric Ghemu
Western Province Magistrates Office	Comm. of Oaths – Peter Ratusia
Telekom SI	Regional Director – Rollance Hilly

SI-based Australian Government officials (2004–2006)

Australian High Commission and AusAID	2nd Secretary, and Project Officer AusAID – Patricia Grey, Stacey Green
AusAID SIISLAP Mapping Project	Australian Team Leader – Rod Little

SI-based NGO officials and others (2004–2006)

NCSA (UNESCO-GEF) Project	National Coordinator – Nesta Leguvaka, Jackie Thomas – consultant
International Waters Programme (IWP)	Patrick Mesia, Anthony Mapelamao, Kenneth Bulehite
The Nature Conservancy (TNC)	William Atu – D/Programme Manager, Peter Ramohia
UNDP Environmental Programme	Jan McDonald
SOPAC SI	Don Tolia – SI contact

SIDT/SILMMA	Sylverio Wale
World Fish Center (ICLARM) SI	Chris Ramofafia, Anne-Marie Schwarz
WWF SI	Laurie Wein, John Pita, Bruno Manele, Jacky Healy – AVA
Tiola Conservation Foundation	Loti Gasimata, Mathew Garunu
Conservation International (CI)	Patrick Pikacha, USP and Melanesian Geo
EU Commission SI	Jenny Brown – Acting Charge d'Affaires
Tetepare Descendants Association (TDA)	Allan Tippet Bero – Project Coordinator, Jack Daniel, Maria
East Rennell World Heritage Area	Greg Taieha – Community Chairman
Intangible Heritage Tourism	Wilfred Atomea – Dolphin Calling Project
Rural Development Volunteers Assoc.	Alan Agassi
Choisel, Sasamuga SI	Myknee Sirikolo
Central Province SI	Catherine Pule
MINBALT	Herrick Ragoso, Alrick Jimuru, Wilson Liligeto

International NGO officials (2004–2006)

TNC	Alison Green – Pacific Project Officer
SOPAC	Bascarell – Deputy Director
SOPAC Fiji	Steve Booth – Regional Director Reg Sanday – GIS Officer based in Fiji
UNESCO WHC Paris	Ali Tabbasum Salamat, Ron Van Oers
UNESCO WHC Samoa	Hans Thulstrup
IUCN NZ	Paul Dingwall, Karen Upton
SPREP Samoa	Stuart Chape
USP Fiji	Dr Kenneth McKay, Dr Alfred Ghere Liligeto (from Marovo, Chea)
Wetlands International, Fiji	Aaron Jenkins

International collegial advisors (2004–2006)

Pacific Islands Specialist, Australia	Graham Baines
University of California, USA	Prof. Shankar Aswani – Roviana Project (RVRMDP)
University of Bergen, Norway	Prof. Edvard Hviding
James Cook University, Australia	Dr. Simon Foale
University of the South Pacific, Fiji	Prof. Leon Zann
Fisheries and Livelihoods Consultant	Jeff Kinch
Flamingo Bay Research	Capt. David Tomlinson – RV Flamingo Bay

Marovo community members by village and regional area

(also see Figure 4.1)

Bili-Penjuku Region

Bili	Luten Hilakolo Watts, Raeboy Logara, Johnson Poghoso, James Siloko, Willy Kay, Miloko (Milton) Luten, Foxly Arthur, Terrance Siloko, Douglas Luten, Bruce Soga, Kenroy Siloko, Chogakolo Luten, Credlyn Rusa, Taska Luten, Casten Osiwald, Witkin E.
Tibara Lodge	Luten Watts – Eco tourism Assoc.
Tengomo	Greg Young, Elaine Young, Peter Maepio, Judith Maepio, Delmay Apu
Sombiro	Kennith, Mirenda Choko, Leon Dalipanda, Rockson Gazo, Roncy Piko, Alvah Reno, Percy Reno, Alabus Elijah, Chris Albert, Trevor Ghemu, Holloway Ghemu
Mariu Lodge, Gatokae	Rockson Galotelia, Miranda Choko
Beka Beka	Undi Pelobule, John Philemon, Philip, Keenpiko, Biva, Fredie Nitalo, John Hivare
Kavalavata	Tonny Jamakolo – Gatokae elder, Terry Jamakolo, Maloe Stephen, Honaveko Miseke, Aleks Tony, Rinky Terry, Oshy Patson,
Peava	Wayne Hooper, Corey Howell, Wilfred Vaetalu, Elvis, Remy, Siana Watts, Gregory Henry, Kendrine, Kido Jeffry, Rolex Henry, Teddy
Peava, Wilderness Lodge	Waelinah and Corey Howell – Owner/Manager
Biche	Chief. Haron Bilusu, Vaetalu, Lowson Kukuli, Salady Allan, Oeta Kukúu, Kerry Wayne, Rodry, Relish, Jenna, Gleva, Ryan, Graeme, Annie, Aroni, Allan Agassi, James Otea
Ropiko Lodge, Gatokae	Ronsi Piko
Penjuku	Matali Vesoto, Glyn Pelekolo, Patrick Kukúu, Rutcliff Shadrack, Anney Billy, Jay Frank, Hawks Posala, Layrick Kukúu
Merusu	Rolio

Miche-Cheke Region

Michi	Moses Lela, Divinite
Kajoro	John Wein, Carvers Assoc, Eco Tourism Assoc.
Telina	Ielli Rini, Kevu Samu, John Wayne, James Wiys, Peter Tenber
Chea	Herrick Ragoso, Alrick Jimuru, Wilson Liligeto, Risley Amos, Dixon, Winter, Maleli Posala, Erick, Danton, Rex, Grace R., Morgan Jimuru
Chukope	Rex Andrew, Puleipu Kinio
Chubikopi	Aaron Ngonga, Jimmi Ngonga, Michael Ross, Ilona Belavaqara, Scofield Vora, Depen Raja, Christopher Hite, Merolyn Boti, Luisa Rade, Lepolo Nausi
Cheke	Verabule Paoni, Jumos, Jimosi R., Broad G., Lania, Elomira, Golpa, Ata, Chakebule, Mephlyn, Glance, Patrick Pikacha
Lagoon Lodge	Rumalesi Paoni
Rokotu	Isaka Isoa

Patukae	Dila, Philip, Charlie, Kivo, Betsy
Sasagahma	Ellioth Timothy, Elliot Temoti, Bilton Ellioth, Grinta V., Justus G., Sipina Koti, Rex Terry, Robert W., Grace Terry
Dehiri village	Dick Hotton

Ketoketo-Bale Region

Ketoketo	Peter Graywin, Victor Juda
Hogitasina	Johnny Amos
Vura	Katalina
Lalauru	Peni Kera
Manabuso	Halo Hudy
Tinge	Jet Lalao

Bisuana-Tatabiri Region

Tatabiri (Totumbiri)	Samson Giva, Pilma, Philmah Sute, Ivan Gehra, Maemi Senusu, Ibi Drelly, Amelani Hinton, Jaclyn Linton, Elisah Filma, Unice Raskim, Jilda Ninonal
Bisuana	Jaira Salato, Jaerus Salano, Collin Gilmi
Batuna	Kene Geri, Lawrence Tillie, Giri Lasilosi, Kiko Maneasa, Naeda Gideon, Fred Walter, Royal Parl, Gwenda Jim, Ruth Galo, Ocean Ghwena, Veronica Vevo, Dorcas Maneasha, Meola Peter, Anna Paul, Maelalu Kirri, Neroly Tilly, John Oti
Rogosakena Lodge	Ralph Tenapiko, Eco Tourism Assoc.
Gasini	Tena Piko, Viva Siba, Kiko Ghonisi, Nearly Redenve, Riru Viva, Florence Belo, Ralph Tenapiko, Eles Clay

Patutiva-Zaera-Seghe Region

Nazareth	Jonathan Kekevu, Fred Kekevu
New Land	Abraham Hitu, Betsy Pae, Alan Pae, Mercy Hitu, Vivian Ringa, Raymarlyn Ukelsuke
Bareho	Piali Tivuru, Sanue Tivuru, Phillip Varane, Aladio Pita, Skinner Rence
Seghe	Peter Ratusia – Owner/Manager Seghe Lodge
Patutiva (Patitiva)	Wilson Agiri, Isreal Seghe, Pamela Seghe, Jerimiah Kema, Hellen Kema, Alfred Ghaili, Terry Kimi
Matikuri	Benjamin Karuotoku- Owner Matikuri Lodge, Jillian Toku, Annije Lumuho
Bopo, Vangunu	Linus (Lymmo) Siso, Marshall Piduri, Laenas Pegona
Zaira, Vangunu	Julie Belavaqara, Issac Napata, Alice Blue Sakui, Sam Jino
Ninevah, Vangunu	Hamie Lavi, Jane Tepa, Pael Kavesu, Nicely Here
Tige, Vangunu	Whitlyn Viulu Chief, Perry Veno ex WWF

Ramata-Chuchulu Region

Ramata	Hetele Nelson, Dalano Jamakana, David Alejuru, Clayton Jamakana, Gregory Alekevu, Gorae Londy, Lynol Nighty, Daniel Julekana, David Alakevo
Ramata, Mavo Resthouse	Curren Rence, Cropton Cleven, Randle Cyril
CFC Church	His Grace Rev. Ikan Rove, Spiritual Leader
CFC Church	Junior Rove
CFC Church	Opportunity Kuku
Chuchulu (Chuchuklu)	Clement Loleke, Revalyn Loleke, Hudsol Loleke, Daniel Livingston
Keru	Lasi Pule, Aseri Yalangono
Tameneke	Nicholoson Offa, Vincent Vaguni – custom Botanist and environmentalist
Buinitusu (Bunitusu)	Rigley Baroa Chief, Shallar Posala
Onne (One)	Sam Patavangara – ex SWIFT
Vakabo (Vakambo)	Boyce Regeo
Uepi Island Resort	Grant and Jill Kelly – Owner/Manager

Chapter 2

Marovo: A lagoon and people facing change

Simon Albert

Mark Love

Chris Roelfsema

Norm Duke

James Udy

Ian Tibbetts

This chapter introduces the Marovo setting with brief descriptions of the key aspects of its geographic location, environmental habitats and political situation. Marovo Lagoon has been recognised for the beauty of its natural environments by many people, including novelist James Michener who described it as the 'eighth wonder of the world'. More recently the Marovo Lagoon and Tetepare Island have been proposed for World Heritage listing as a natural and cultural wonder (LaFranchi 1999; Bayliss-Smith et al. 2003). This 'paradise' status is primarily based on its natural features including abundant natural habitats in a vast coral lagoon filled with diverse biomes—lagoon, mangrove wetlands, seagrass beds, extensive coral reefs, bordered by an unusual double string of raised barrier islands, all set against the magnificent backdrop of recently dormant volcanoes clad in rainforest.

The local custodians of these spectacular natural resources are the Marovo people—numbering approximately 11,000 predominantly gardeners and fishers residing in 50–70 villages and hamlets throughout the lagoon. These communities have a rich history with firmly-established cultural beliefs based on a subsistence existence which remains to this day highly dependent on local natural resources. These communities currently face overwhelming and unprecedented pressures (mostly from external threats) that challenge deeply-rooted cultural beliefs and traditions. This poses significant challenges to local environmental management along with the growing possibility of further social upheaval. It is the escalation of commercial resource exploitation that demands urgent attention. Justifications for such ventures are usually based on pragmatic arguments to facilitate short-term economic development. This is largely unrealized, and any financial gain is at best, unfairly distributed. While people are divided and unsure about the advantages and disadvantages provided by such practices, most people are in agreement that the natural environment has become increasingly degraded.

The question is, how will these extractive practices impinge on the ecological function and uniqueness of Marovo Lagoon? Of particular local and extra-local concern is what affect will a decline in the natural resource base—which continues to remain the foundation of Marovo peoples' economic and cultural life—have on local communities? What 'state of the environment' will future generations inherit? What kind(s) and amount of 'natural capital' will be left for people to build upon?

Geographic Setting

Solomon Islands - the National Context

The Solomon Islands consist of 992 islands divided into Nine provinces. These islands form a scattered archipelago of mountainous islands and low-lying coral atolls which cover approximately two million square kilometers of the Pacific Ocean in a double chain oriented south-east from Bougainville, Papua New Guinea (in the southwest Pacific; Fig. 2.1). The islands are located about 1,900 km northeast of Australia between the latitudes 5° and 12° south and 152° and 170° east.

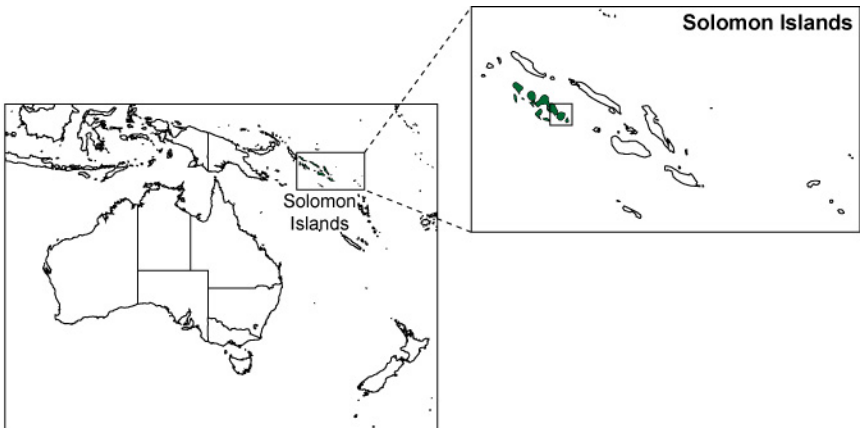


Figure 2.1: The Solomon Islands are located north-east of Australia.

The Solomon Islands lie along the junction of the Indo-Australian and Pacific Plates, a feature that accounts for past and present volcanic activity, and the origin of the islands themselves. Morton (1974) described the living coral reefs of Solomon Islands as being generally associated with uplifted shores and attached either to volcanic coastlines or growing upon the seaward members of successively elevated coral limestone benches and ramparts. The climate is tropical and humid, with many areas of abundant rainfall (3–4 m) supporting a species rich environment that places the Solomon Islands as one of the ten most biologically diverse nations on earth (Green et al. 2006).

Despite the extraordinary natural environment of the Solomon Islands there is little scientific information regarding its biodiversity. The first comprehensive scientific survey of the Solomon Islands' marine environment was undertaken in 2004 to gather critical data on the biodiversity and status of its marine ecosystems (Green et al. 2006). The Nature Conservancy Solomon Islands Marine Assessment focused on the seven main island groups in the Solomon Island chain, including the Western Province and Marovo Lagoon.

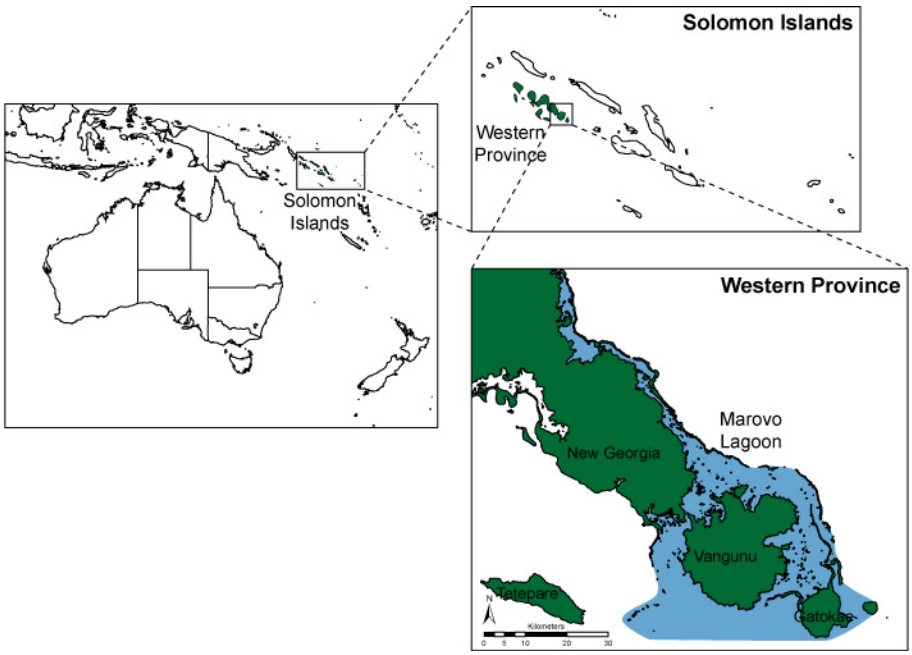


Figure 2.2: Marovo Lagoon is located in the Western Provice of the Solomon Islands

Marovo Lagoon - the Regional Context

Marovo Lagoon is located in Western Province of the Solomon Islands (Fig. 2.2). The lagoon has an area of around 700 km^2, and it is believed to be the best defined double-barrier enclosed lagoon in the world (Stoddart 1969). It contains numerous small islands including sand cays, mangrove islets, raised reefs and extinct volcanic cones, and is bordered along its southern edge by extensive mangrove forests and freshwater swamps. Larger islands on its southern and western boundaries (New Georgia, Vangunu and Gatokae) are volcanic in origin with extinct jagged peaks rising to 1000 m above the surrounding coral-lined waters. The precipitous mountain slopes are covered in dense tropical rainforest vegetation. Earthquakes and volcanic activity have lifted some of the lagoons' reefs up to 25 m above sea level. Their sheer cliffs face the open ocean, and their relatively flat tops are clad in dense rainforest vegetation. Towards the south-eastern end of the barrier, the islands curiously form the distinctive double chain that imparts its unique character to this special setting. Surrounding the lagoon, three major habitat types have been identified (Baines 1985), including: sand cay complexes within the lagoon; estuaries with muddy sediments on the larger islands; and the barrier islands of raised reefs.

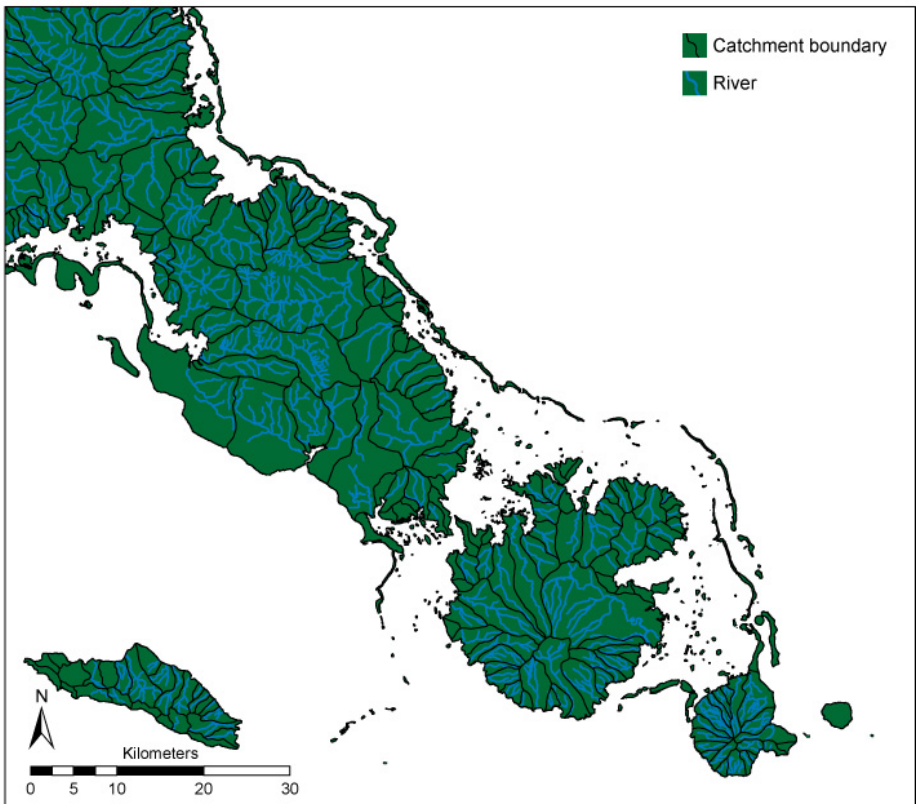


Figure 2.3: Rivers and catchments which drain into Marovo Lagoon

Coastal terrestrial

The reef and forest environment of Marovo has been usefully classified by Hviding and Bayliss-Smith (2000) based on the *Puava* concept. This concept categorizes the various features into land, coast and sea rather than by the taxonomy of species present. The classification, illustrated in Figure 2.4, is one used by the local population of Marovo.

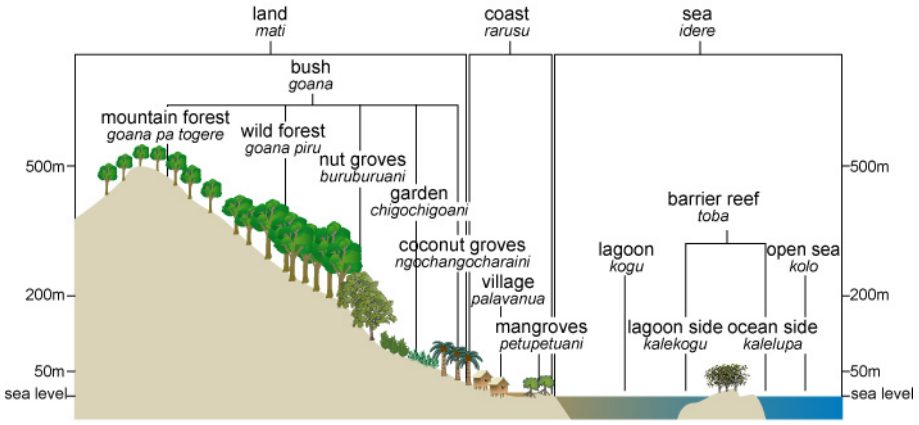


Figure 2.4. Land classification of Marovo Lagoon, according to *Puava* (Hviding 2005).

Marine Environmental Setting

The marine environment has been the major focus of current investigations by the UQ researchers. Our main aim was to characterize the chief features and habitats of the lagoon in conjunction with local representatives. From these surveys, we provide a brief assessment of environmental health and reveal the major influencing factors associated with water quality and the key biota associated with seagrasses, mangroves, reef fish communities and soft-bottom habitats.

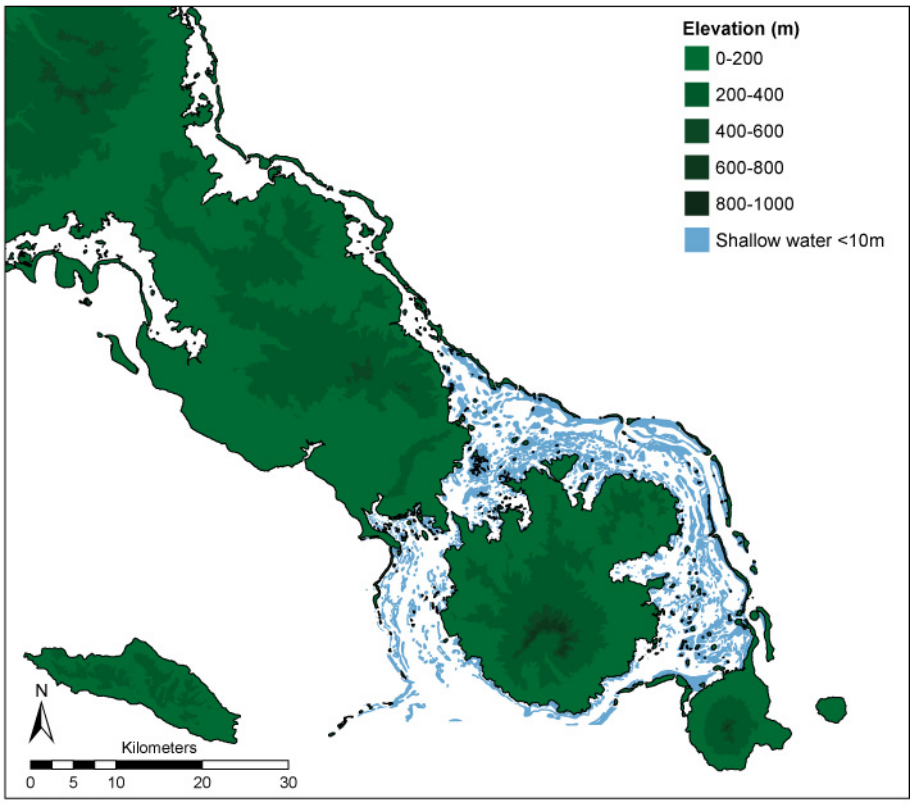


Figure 2.5: Topography and shallow water areas in Marovo Lagoon

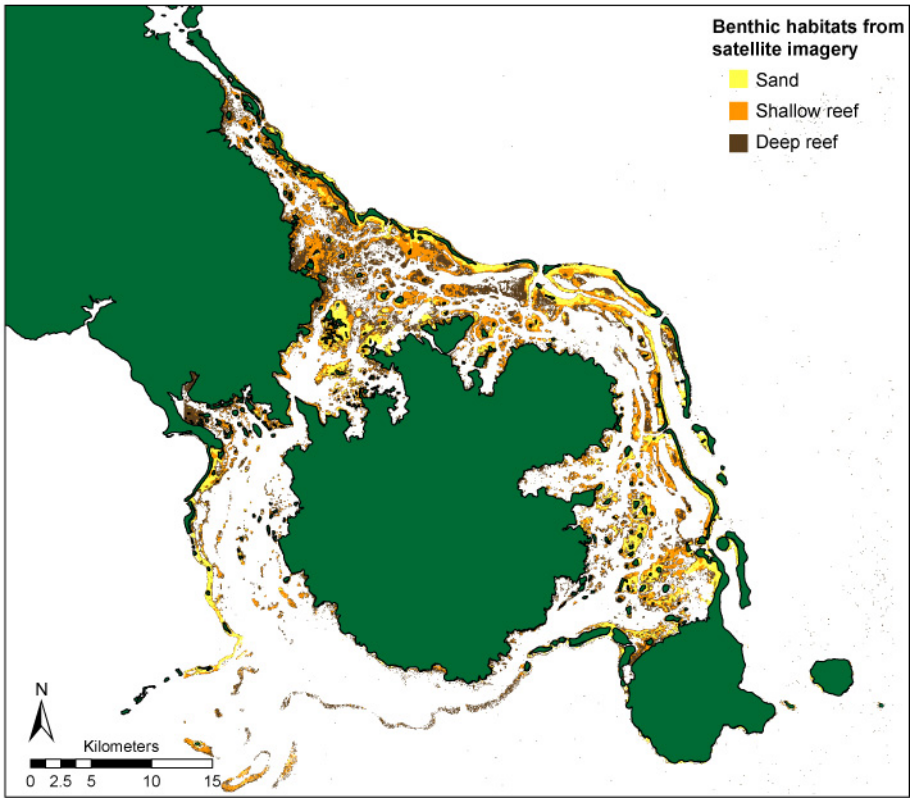


Figure 2.6: Benthic habitats in Marovo Lagoon

Water Quality and Oceanography

Marovo Lagoon is surrounded by clear tropical oceanic water, which has very low concentrations of nutrients, phytoplankton and zooplankton. This direct access to low nutrient, clear water suggests that run-off from the land may be diluted rapidly by oceanic exchange. However, relatively shallow and narrow openings through the double barrier reef system and a small tidal range (0.8 m) experienced in Marovo Lagoon reduce the effectiveness of tidal flushing of the lagoon. Although, we were unable to conduct a hydrological survey of flushing rates in the lagoon, our observations suggest that the majority of flushing of the lagoon occurs through Wickham Passage due both to its size (both wide and deep) and local wind patterns (see Chapter 3). The observed movement of river plumes always in a northerly direction, irrespective of the tidal cycle, also suggests that circulation in most of the lagoon is driven more by wind direction than tidal exchange. The lack of any swell in the lagoon and relatively short fetch for wind waves also reduces vertical mixing of the surface layer leading to stratification of the water column. Near river plumes a thin (~50 cm) freshwater layer with high sediment and nutrient concentrations, was often observed above clear oceanic water.

Seagrasses

Green et al. (2006) described the seagrasses in Marovo lagoon as predominately shallow subtidal with a narrow intertidal fringe, dominated by *Thalassia hemprichii, Cymodocea rotundata, Halodule uninervis, Enhalus acoroides* and *Halophila ovalis*. Our surveys indicated that seagrasses were relatively uncommon in the southern section of the lagoon, but formed extensive meadows in areas of the northern lagoon adjacent to New Georgia. These seagrass areas are considered important to subsistence fisheries by providing habitat for many juvenile and adult fish species.

Mangroves

Mangroves are found throughout Marovo lagoon. During surveys in 2005, we observed that while *Rhizophora* species were dominant, there were a broad range of mangrove genera often present, including *Bruguiera*, *Ceriops*, *Lumnitzera*, *Heritiera, Nypa, Sonneratia, Avicennia* and *Dolichandrone*. Mangrove species occurred in distinct distributional patterns restricted to one or two of the three habitat types: river, lagoon and barrier (Fig. 2.7). This pattern was observed in combination with other patterns where species have individual ranges dependant on salinity gradients of riverine estuaries, and across tidal wetland zones (Duke et al. 1998). During our surveys, twenty-two mangrove species were observed throughout the lagoon. This was slightly less than the number expected for the entire Solomon Islands area (around 30) and considerably fewer than the 41 reported in Australia, but consistent with the recorded distribution of mangroves in the pacific (Duke 2006).

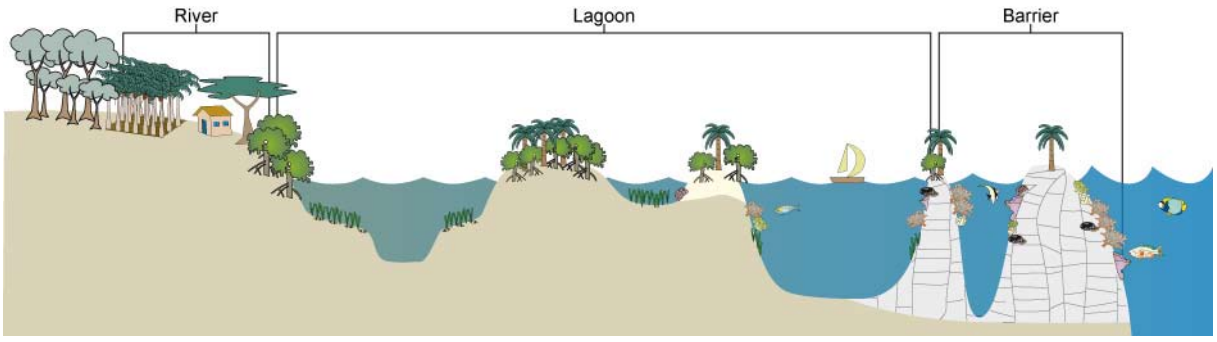


Figure 2.7: Conceptual diagram of a transect across south-eastern Marovo Lagoon from river dominated estuaries of Vangunu to the double barrier islands facing the open ocean. Three distinct mangrove habitats are observed: river, lagoon and barrier.

Reef Communities

The coral reefs of Marovo lagoon are arguably some of the highest diversity coral communities on earth. This was one of the key findings of the 2004 TNC survey (Green et al. 2006), reporting a total of 485 coral species belonging to 76 genera in 14 families. Such species rich habitat also includes an equally diverse assemblage of dependant reefal fauna, including fishes, that supports productive local and commercial fishing in the lagoon and nearshore waters. In recent years, there has been growing concern, supported in part by evidence (e.g. Lafranchi 1999) of the negative impacts of uncontrolled extractive industries, like logging (see Chapter 3). The loss of forest vegetation cover from the steep volcanic slopes in such a high rainfall area has reportedly resulted in increased levels of erosion, sedimentation and turbidity of lagoon waters (Morton 1974). This is considered harmful to coral survival and growth. Inshore reefs around Vangunu are dominated by dead coral and macroalgae, probably as a result of recent increases in erosion and sedimentation. Whilst the offshore reefs were typically high in live coral cover (40%) and support high fisheries productivity.

Fish communities

The fish fauna of the Solomon Islands includes more than 80 families, 340 genera and 1000 species (Green et al. 2006). Reef fishes hold important roles in the ecology of reef systems (Townsend and Tibbetts 2004) and impact on community structure can have far reaching effects on reef community integrity. Grazing fishes in particular are of interest because of their pivotal role in controlling algal growth (see Chapter 3), which unless checked by fish grazers can smother and kill corals weakening the fabric of the reef system. In 2004, the TNC research team found the subsistence-artisanal fishery was lower in worth than the offshore fishery but that it provided the major source of protein and income to the bulk of the population (Kile 2000; Green et al. 2006). The healthiest populations of food and aquarium fishes were observed in regions that had smaller human populations, while proximal to population centres the fish communities were often depleted. The dynamic between community needs to extract fishes for subsistence or trade and the functionality of the reef community in Marovo is of pivotal importance (see Chapter 6).

Soft Bottom Habitats

Approximately 23% of the shallow (<5 m) areas in Marovo lagoon are soft sandy habitats. Whilst these habitats do not support the visually stunning high diversity of coral reefs, they are equally important to the ecological and economic services provided by the lagoon. In the north western region of the lagoon, adjacent to New Georgia, the shallow sandy areas are covered in dense seagrass meadows which in turn support turtle and dugong populations and act as a nursery ground for many reef fish species. In the southern and eastern sections of Marovo Lagoon, the soft sandy areas provide an important habitat for bêche-de-mer and other invertebrates which graze on the productive mats of microscopic algae. Although low in biomass these benthic algal communities are important for lagoon health due to their photosynthetic oxygen production and nutrient processing abilities (see Chapter 3).

Socio-political Setting

Solomon Islands

The Solomon Islands has been an independent nation since 1978, and is a member of the British Commonwealth of nations. There are three distinct tiers of leadership in the Solomon Islands: national and provincial governments and local village leaders. The national government consists of a parliamentary configuration, in which members are elected from 50 electorates. Provincial governments, of which there are nine, elect ward representatives to manage their affairs at the Provincial level, while at the local level village chiefs and church leaders play an important leadership role. UQ Project members worked to gain the understanding and support of all levels of SI leadership, as each level had a critical role to play in the progress and overall success of the project.

Solomon Islanders are a diverse mix of cultures, with over 80 different Indigenous languages and dialects spoken. The most recent estimate of the country's population is approximately 538,000, with a growth rate of around 2.8% (National Statistics Office 2006). The majority of people (84%) live in rural areas, in small, dispersed coastal settlements (SIG 2002). Approximately 95% of all land and marine areas in the Solomon Islands are held under 'customary' tenure systems, with fishing, trade and subsistence agriculture the primary source of food and livelihood for most of the population. Most people's protein intake is derived solely from seafood, with Solomon Islanders having one of the highest per capita seafood consumption rates in the world (Kile 2000).

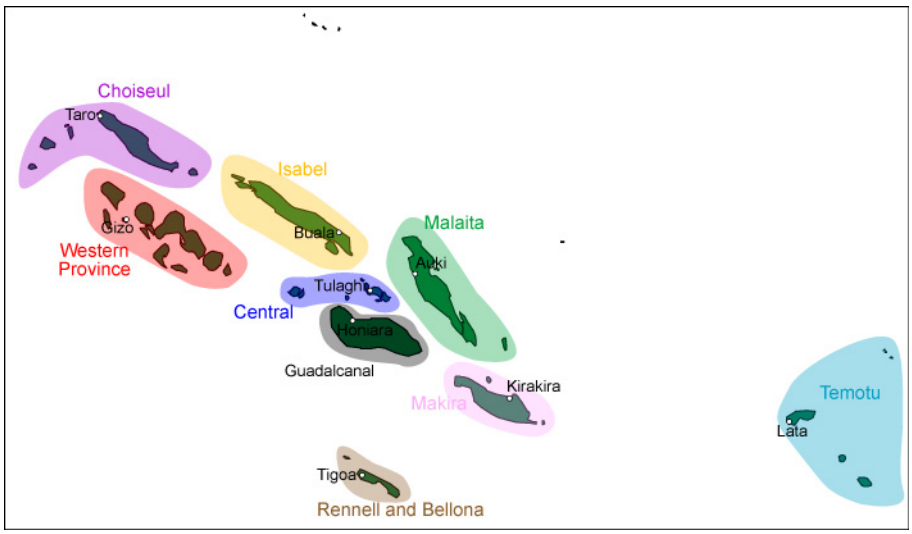


Figure 2.8: Solomon Islands provices and capitals

Economy

The Pacific has received almost US$50 billion of aid between 1970 and 1998, representing the highest aid inflows per capita in the world (Hughes 2003). Like all Pacific countries the Solomon Islands is heavily dependent on a wide variety of imports, with Gross Domestic Product (GDP) figures from 1990–2003 rarely showing exports outstripping imports (National Statistics Office 2006). The country has an exclusive economic zone (EEZ) of 1.6 million km^2. The government has relied almost entirely on natural resource rents, mainly fisheries and timber exports, to balance the country's fiscal trade deficit and provide economic growth. Non-tuna coastal resource exports peaked in 1992 at SI$16.6 (US$5.7 million), falling to SI$10.6 (US$2.2 million) by 1999 (Kile 2000). About half (SI$5.8 million) of these inshore reef and lagoon fishery earnings were derived from the sale of *Trochus* and *Trochus*-like gastropods, followed by bêche-de-mer (SI$1.9 million), shark-fin (SI$1.6 million), live reef fish (SI$1.3 million) and spiny lobsters (SI$0.63 million); all of which are considered over-harvested and in decline (Sulu et al. 2000). In response to a decline in bêche-de-mer stocks, the Government recently announced a ban on bêche-de-mer exports (Solomon Islands Broadcasting Corporation, August 1, 2005). However, prior to publishing of this report the government announced this ban would be lifted for a trial 9 month period to ease financial hardship of people in Western Province.

While marine resources are important, it is logging that has proved to be the backbone of the economy in recent years. In 1990 round log exports accounted for 43.5% of the country's total exports, increasing to 56% by 1994 (Kabutaulaka 2000). Logging exports peaked in 1996 and the economic dependence on logging has continued with logging contributing 68% of the national GDP in 2000 (Central Bank of Solomon Islands 2000). This trend is considered highly unsustainable by most commentators, with the harvest rate of 555,000 cubic meters in 2000 being more than twice the estimated sustainable rate of 250,000 cubic meters a year (Sheehan 2000).

These and other issues contribute to the characterisation of the Solomon Islands as a 'weak' Nation State (see Foale and Menele 2003; MacDonald 2006). Instances of bribery, the misappropriation of funds and the lax enforcement of regulations have been well documented (see SIG 2005a). Compounded by a poor economy, effective governance of natural assets and resources has been poor, with departments such as Fisheries simply not equipped to do their jobs. As elsewhere in the Pacific, state environmental governance efforts are relegated to 'crisis-management' status—able only to watch and react to the 'boom and bust' cycles of major export commodities (bêche-de-mer, trochus, black lip etc.) rather than actually managing resources in a proactive manner (Adams 1996 in Dalzell and Schug 2002).

Marovo Lagoon

Marovo human history began around 30,000 years ago (Flannery 1994). It now supports a population of around 11,000 people distributed throughout the lagoon and coastline in more than 50 villages. For the people of the lagoon, the rich reefs and rainforests are a source of vital sustenance, providing - food, medicine, raw material for houses and canoes, and a host of other products and services. Marovo people are culturally and practically linked with the region's ecological diversity, and are highly dependent on the continuing health of the natural resources of the lagoon and adjacent forests.

Resource Use in Marovo

Marovo people are usually described as both rural gardeners and fishermen. On the land, they practice shifting agriculture, and from the lagoon, they harvest fish, shells and other marine products. Popular plant products include coconuts, ngali nuts and sago palm. Mangrove timber is also used regularly for construction and firewood. Fish are taken for subsistence use and often also in small-scale commercial ventures where fishers sell reef fish preserved on ice each week for the Honiara fish markets. Additional marine harvests have included trochus and bêche-de-mer. Donnelly et al. (2000) reported that live fish trading had been active in Marovo since the mid 1990s. In addition, Marovo was an important source of baitfish used in the commercial skipjack tuna industry (Commonwealth Science Council 1986), but this activity has decreased significantly over the last five years. In the past, a small number of individuals practiced dynamite fishing in the lagoon, with anecdotal and empirical data suggesting that marine resource extraction—for commercial purposes—is on the increase due to an increasing population and greater integration into, and reliance upon, the cash economy (see Chapter 6).

Local Socio-political Organisation in Marovo

Marovo lagoon is composed of around 24 named *butubutu* (Hviding 1991). A *butubutu* is a kin-based group composed of consanguineal relatives who claim and control territories of land and sea (*puava*) (Hviding 1989). Each *butubutu's* affairs are managed by a senior male leader, the chief or *bangara*. A *bangara* is assisted in his duties by a number of associates or *palabatu* (important men) chosen from a core group of people with 'strong' descent (Hviding and Bayliss-Smith 2000). Today, many *bangara* reside in Honiara and it is the *palabatu* who are responsible for day-to-day village affairs. Currently, there appears to be a marked decrease in the level of respect afforded chiefly office, due to a range of factors (see Chapter 4). Contemporary socio-cultural variation in Marovo is generally characterised in relation to Christian denomination (eg. Hviding 1996a; Juvick 1993). Close to 60% of the lagoon's population belong to the Seventh Day Adventist Church (SDA), with the remainder being United Church (Methodist) and two villages in the north identifying as Christian Fellowship Church (CFC) communities (Juvick 1993). Each village adheres to one denomination only, but 'traditional' alliances continue to cross-cut religious affiliation.

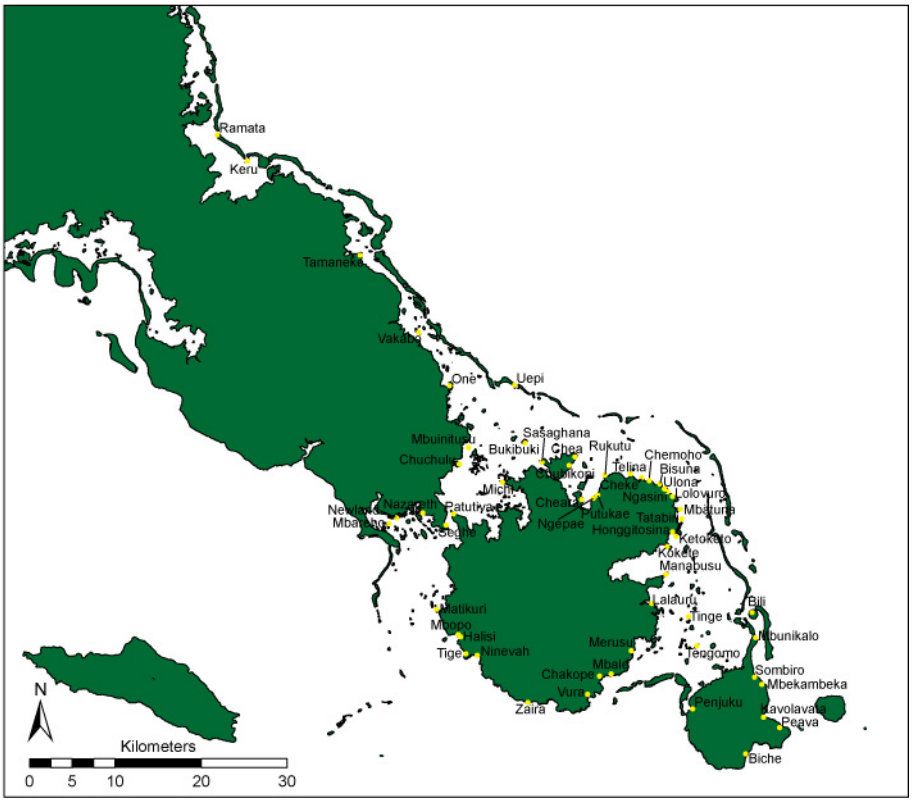


Figure 2.9: Villages in Marovo Lagoon

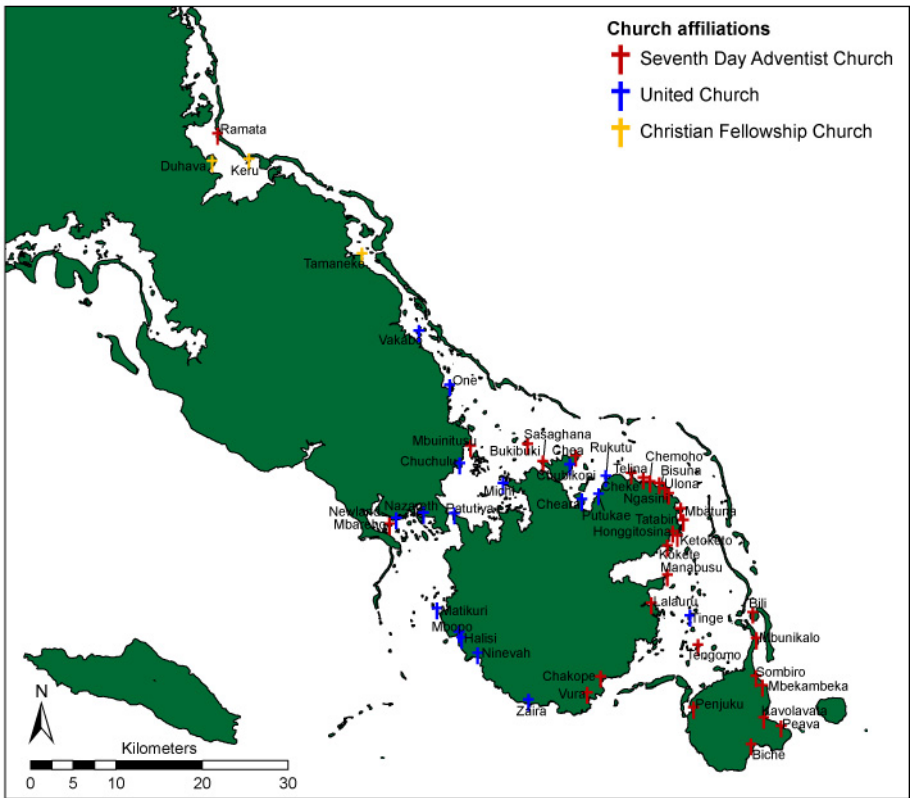


Figure 2.10: Church affilitations in Marovo Lagoon

Resource Management

'Traditionally' in Marovo, spiritually sanctioned taboos called *hope* existed which build on 'customary marine tenure' principles (see Hviding 1996) to constitute what contemporarily we could refer to as 'resource management' practices. Chea village is the only community in the lagoon with a formally established community resource management plan, the *Resource Policy Framework* (Chea Village Community 1991a, 1991b). While Marovo is increasingly the site of extensive commercial resource extraction (e.g., logging, live fish trade and tuna bait-fishing), it is noteworthy that some *butubutu* still continue to refuse to allow bait-fishing activities to be conducted in their territory (see Chapter 5 for details).

Tourism in Marovo

The cultural and natural wonders of Marovo Lagoon provide a multitude of attractive features for tourists. The scenery is spectacular, and friendly villagers offer magnificent wood carvings and handicrafts. Other attractions include a small number of World War II relicts, and proximity to an active submarine volcano. But, by far the most compellingly attractive features of Marovo are the diverse reefs, the crystal clear waters, the abundant marine life, which provide a wonderful resource for ecotourist operations based around diving with snorkel or SCUBA. Two small Australian expatriate operated resorts offer comfortable facilities and exciting trips. There have also been a number of landowner initiatives to develop small-scale, low-impact tourism ventures in the lagoon (Fig. 2.12). All these ventures have been impacted by the recent troubles in Honiara, which has reduced the number of visitors.

Tourism, the more sustainable major revenue-raiser enjoyed by many other countries in the Pacific, is yet to be a major contributor to the Solomon Islands economy. In 1999 (just before the 'ethnic-tension'), Solomon Islands enjoyed its highest number of visitors on record, at 17,395 people. However, by comparison, Fiji had 409,955, Vanuatu 50,746 and Papua New Guinea 67,357 visitors (see Cooper and Hall 2005; Harrison 2005; National Statistics Office 2006). In addition to the recent political and civil unrest, the high rate of malaria and below-par status of infrastructure and related services (including transport) currently delimits tourism prospects.

It is acknowledged by many commentators, and supported by discussions with Marovo community members, that tourism is a long-term activity that can help contribute towards sustainable livelihoods, poverty alleviation, and bestow meaning to, and assist, conservation activities and goals. As part of the wider objective of investigating the economic impacts of project recommendations, and to shed more light on alternative economic 'pathways-of-change', a preliminary investigation of eco-tourism was undertaken (see Chapter 6).

Chea and Bili Villages

In continuity with the broader project objectives of mapping the south-east region of the lagoon, project-community engagement and dialogue was developed with the inhabitants of the villages of Chea and Bili. Chea is located on *Patu Laiti* (Marovo Island) in central Marovo Lagoon, while Bili village is situated at the outer lagoon barrier, on Mijanga Island, at the south-eastern end of the lagoon (Fig. 2.9).

Figure 2.11: Chea village in central Marovo Lagoon

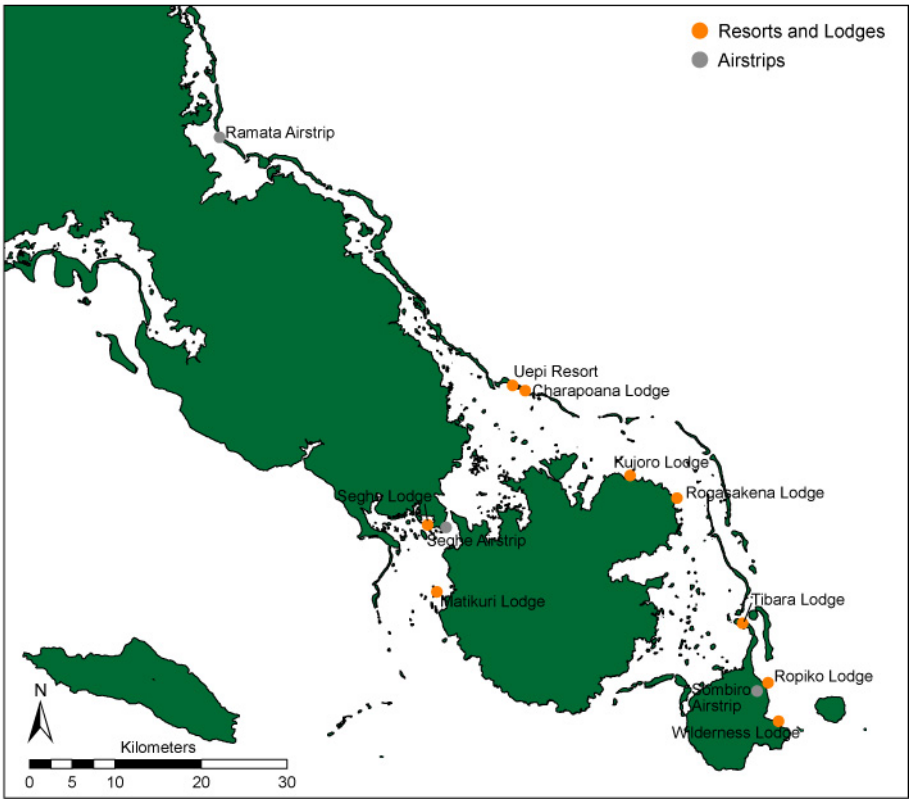


Figure 2.12: Resorts, lodges airstrips in Marovo Lagoon

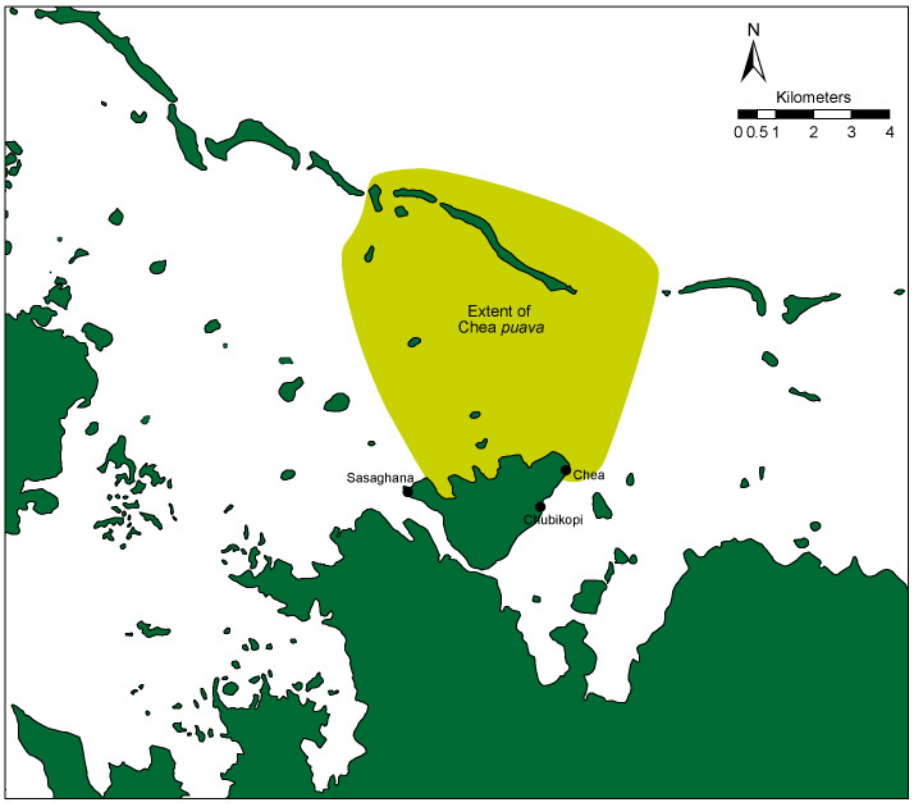


Figure 2.13: *Babata puava* shared with Chubikopi and Sasghena

Table 2.1: Major Community Partners

Chea

Chea is one of three villages located on Patu Laiti (Marovo Island), in the central portion of the lagoon. Established in 1958, the village is the primary settlement of the *butubutu Babata*. Figure 2.13 provides an approximate representation of the *Babata puava*, which is also shared by the neighbouring communities of Chubikopi (*butubutu Kalekogu*) and Sasaghena (*butubutu Olovotu*). According to a recent IWP survey, 85% of marine resource extraction in the *Babata puava* are harvested by the Chea community, 10% by other 'traditional' right users (people from other *butubutu* and villages who retain use-rights) and 5% by outsiders (Kinch et al. 2005). Population estimates for Chea are 300-350 people (including children).

The Chea community was officially incorporated in 1983, and has been actively involved in various Marovo wide initiatives, including the Marovo Area Council and the (completed) Marovo Lagoon Resource Management Project. Chea is one of the few villages in Marovo with a community constitution (established in 1991) and a *Resource Management Plan* (Chea Village Community 1991a, 1991b, 2003b, see also Liligeto 2006).

Bili

Also referred to as Bili Passage village, this community is situated on Minjana Island, a barrier island adjacent to the northern tip of Gatokae at the south-eastern end of Marovo Lagoon. The majority of people residing in Bili belong to, or have married into, the *Getu butubutu*, which is one of four major *butubutus* on Gatokae. Bili village *puava* (Fig. 2.14) extends along the marine rich *toba* (barrier islands), and is less 'robust' than Chea's in terms of interloping, with an estimated 65% of marine resources harvested by people from *butubutu Getu*, 15% by other traditional rights users and a significant 20% by outsiders (Kinch et al. 2005). The current population estimate for Bili is 300 people (Kinch et al. 2005).

An American conservation NGO, Seacology, is providing funds for the construction of a new primary school building as part of an Integrated Conservation and Development Project (ICDP), in exchange for a community covenant to protect 21 acres of marine reserve (MPA) and a 12 acre uninhabited island (see www.Seacology.com).

Figure 2.14: Area of Bili's customary fishing area (*puava*)

Chapter 3

Science addressing community concerns about the marine environment

Simon Albert
David Neil
Mark Love
Guy Marion
James Udy
Sean Hough
Ian Tibbetts
Annie Ross
Chris Roelfsema
Norm Duke

Each of the following sections is introduced by community concerns (see boxes), voiced at the Batuna meeting in June 2006, about the declining health of Marovo Lagoon. These are then assessed using independent data from the project team's social and scientific research, followed by suggested actions. In effect this chapter constitutes a reply to the people of Marovo based on our understanding of the marine ecosystem.

Declining Water Quality

Marovo People:

River (*kavo*) and lagoon waters (*idere*) are increasingly dirty (*nije via*).

Social Survey

Community Perceptions

The social survey is in agreement with the Batuna meeting outcomes; there was a clear signal in both the Chea and Bili communities that in the assessment of villagers interviewed water quality had declined. Responses confirm that people feel that significant environmental changes have occurred, especially in terms of increased turbidity. Most respondents reported that the lagoon water was less clear than it had been in the past (Table 3.1).

Table 3.1: Results of social science survey of villager perceptions of environmental change in Marovo Lagoon

Code	Statement	Bili		Chea	
		Disagree	Agree	Disagree	Agree
Q51EC	The sea (*idere*) is as clear as it has always been	28 (90%)	3 (10%)	27 (100%)	0 (0%)

Scientific Surveys

Case Study—Water Quality and dirty water

Introduction

Water quality includes many different measurements, but generally, in marine systems, it refers to the nutrient content or clarity of the water. The nutrient content of the water is important from an ecological perspective as high nutrient concentrations are likely to stimulate excess growth of either phytoplankton or benthic algae. In contrast to the stimulatory influence that nutrients have on the growth of these organisms, reductions in water clarity generally have a negative impact on benthic habitats (coral, seagrass and algae) by reducing the amount of light they receive (Udy and Dennison 1997; Grinham 2007). Water clarity is influenced by several factors: dissolved organic matter, suspended sediment particles and phytoplankton cells. In the current study we measured different parameters of water quality to provide an overview of the water conditions that influence the coral and other benthic habitats in Marovo Lagoon.

Methods

In January and June 2005 water quality parameters were measured throughout the southern section of the lagoon, focusing on the two main study transects (Bili and Chea) (Fig. 3.1). The water quality survey in January was added to those originally proposed to obtain data for the wet season, and to establish sites that could be monitored throughout 2005.

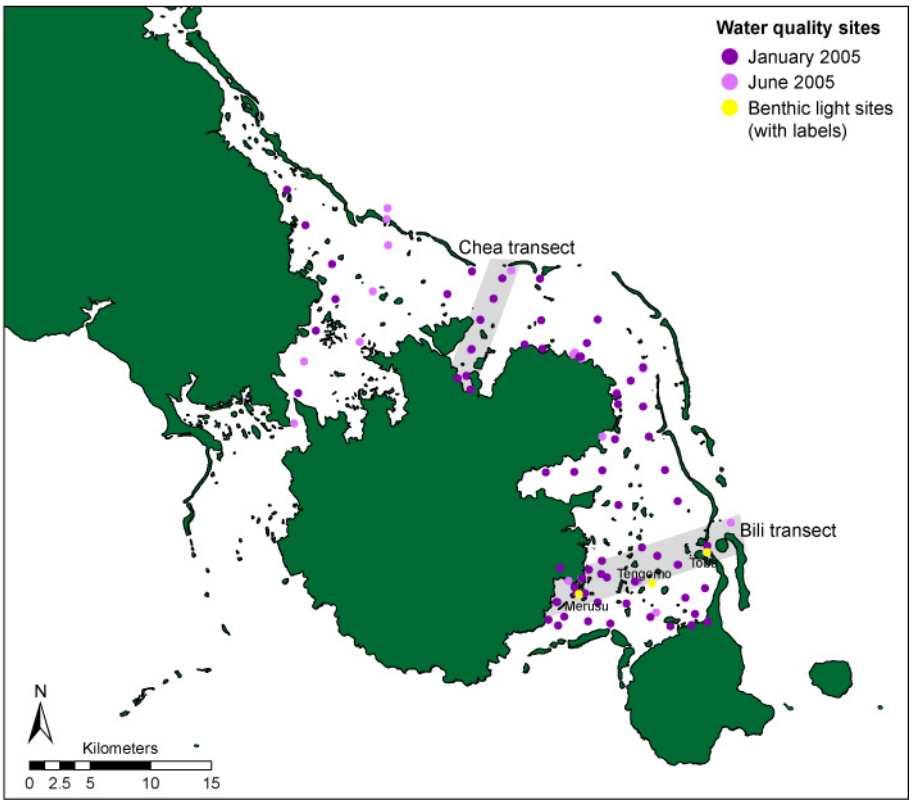


Figure 3.1: Water quality sites from January and June sampling

During the January and June field trips, parameters of water clarity (turbidity, total suspended solids (TSS), Secchi depth), salinity (‰), phytoplankton biomass (chlorophyll (chl) *a*) and nutrients (dissolved inorganic nitrogen (DIN), total nitrogen (TN), filterable reactive phosphorus (FRP), total phosphorus (TP)) were measured at 39 sites in the southern section of the lagoon (Wickham Passage north to Seghe and Uepi Passage). Some of these measurements were made *in situ* (e.g. Secchi depth, salinity, temperature, pH, turbidity), while other measurements were made on samples that were returned to Australia for analysis (e.g. Chl *a*, TSS, nutrients, phytoplankton analysis) (see Technical Report).

Water Quality Sampling

Water sampling for most parameters was conducted at 1 m water depth as water at this depth was likely to be similar to the water that interacts with the benthic community and avoided sampling a thin freshwater layer that was often present on the surface. *In-situ* sampling using a YSI multiparameter probe (YSI 6600) determined the salinity, temperature and turbidity. Following this a Niskin bottle was used to collect a water sample from 1 m depth to determine dissolved and total nutrients (DIN, FRP, TN, TP) as well as TSS and phytoplankton biomass (Chl *a*). Water samples from the Niskin bottle were treated in four ways:

1. Unfiltered water was collected for analysis of TN and TP and analyzed in Australia;
2. Filtered water (using a 0.45 µm membrane filter) was sampled for DIN and FRP and analyzed in Australia;
3. A known volume of water (1–2 L) was filtered through pre-combusted and pre-weighed 0.45 µm membrane filters to determine TSS;
4. A known volume of water (2 L) was filtered through a GF/F filter for determination of Chl *a* content using the spectrophotometric technique of Lorenzen (1967) on return to Australia.

Secchi depth was determined by lowering a Secchi disk (black and white sections) through the water and measuring the depth at which the disk is no longer visible.

Sediment samples were collected from the top of coral bommies[1] (maximum 2 m water depth) using a cut off syringe to sample the top 20 mm. These samples were analysed for TN, TP and carbonate analysis on return to Australia. The sediment present between coral bommies (5–15 m) that is more likely to represent long term sedimentation patterns in the lagoon was sampled using a sediment grab, with the sample being collected to approximately represent the top 20 mm.

1 An abbreviation of bombora—an aboriginal word meaning shallow isolated reef.

All samples were kept cool and dark until transported to a freezer (4 h) and subsequent transport back to the laboratory in Queensland, Australia (< 2 weeks). All nutrient analyses were conducted by Queensland Health Scientific Services. Sediment carbonate content was estimated via the gravimetric loss of CO_2 technique (US Salinity Laboratory Staff, 1954).

Phytoplankton Analysis

The phytoplankton community composition was determined across the water quality gradient in the lagoon (from Merusu to Bili) by dragging a 20 µm phytoplankton net through the water at approximately 1 knot for 5 minutes at three locations. Samples were then preserved using Lugols solution and transported to Australia for identification using both light and scanning electron microscopy.

Benthic light logging

In September 2005 light loggers were deployed underwater (2 m depth) at three sites across the observed water quality gradient to monitor benthic light flux, with the light level recorded every 10 min. Surface light was also logged at Bili village near the Toba site to correct for incident light variations. Benthic light was logged for the full duration of the visit (12 days) with periodic visits to clean underwater loggers (approxiamtely every 4 days). Water column light attenuation coefficients (Kd) were derived using the Beer-Lambert function:

$$Kd = [\ln(I_o) - \ln(I_z)]/z$$

where:

I_o is surface light logged every 10 min from Bili village (µmol m^{-2} s^{-1})

I_z is benthic light logged every 10 min at each site (µmol m^{-2} s^{-1})

z is water depth (2 m for all sites)

Results

Although the scientific surveys could not provide a temporal perspective on environmental change to test the people's perspective that water quality had declined, trends in water quality parameters along transects running from island stream outflows to the outer barrier reef indicate that high nutrient and turbidity values occur adjacent to stream mouths, but attenuate rapidly with distance from source during low rainfall periods.

During both sampling periods (January and June 2005) the majority of Marovo Lagoon had oceanic salinity with freshwater only being detectable adjacent to river mouths on Vangunu and Gatokae (Fig 3.2). This suggests that the lagoon is naturally adapted to predominantly oceanic influences and is rarely dominated by freshwater inputs.

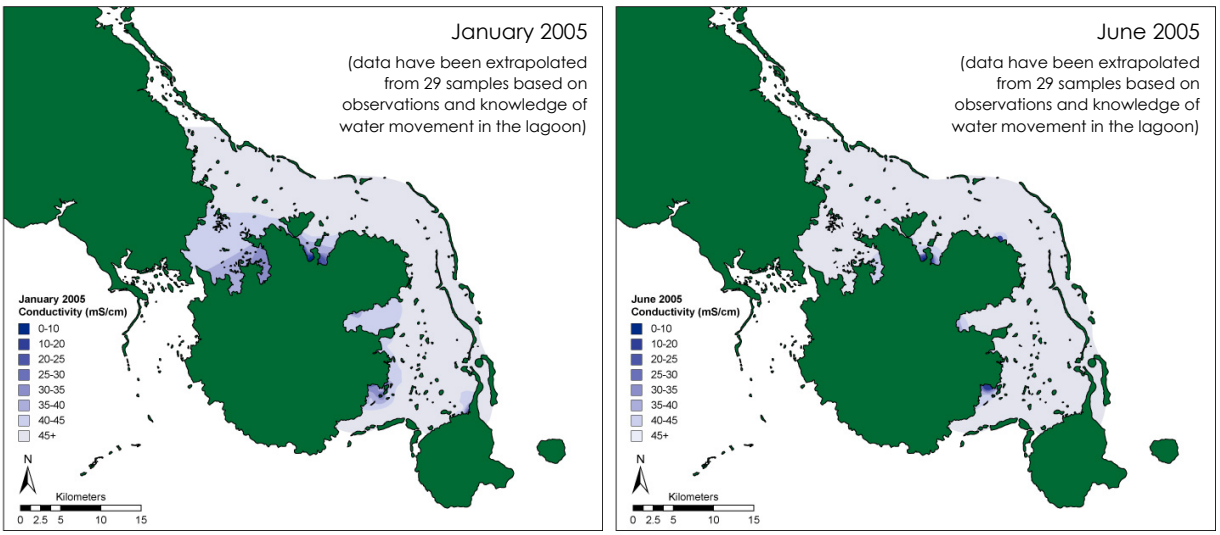


Figure 3.2: Interpolation of salinity data

Suspended sediment, measured using NTU and TSS were elevated in the freshwater influenced inshore regions resulting in a decrease in water clarity (Secchi depth) close to river mouths (Fig 3.3). The majority of Marovo Lagoon, with the exception of water adjacent to river mouths, had very clear water (high Secchi depth) due to its oceanic dominance and minimal sediment resuspension (i.e., small tidal currents, lack of large waves). There is also evidence from our work that the sediment rich plume from the Gevala River (adjacent to the Merusu oil palm plantation) moves in a northerly direction along the coast of Vangunu, and that much of the flushing of this southern section of Marovo Lagoon occurs through Wickham Passage.

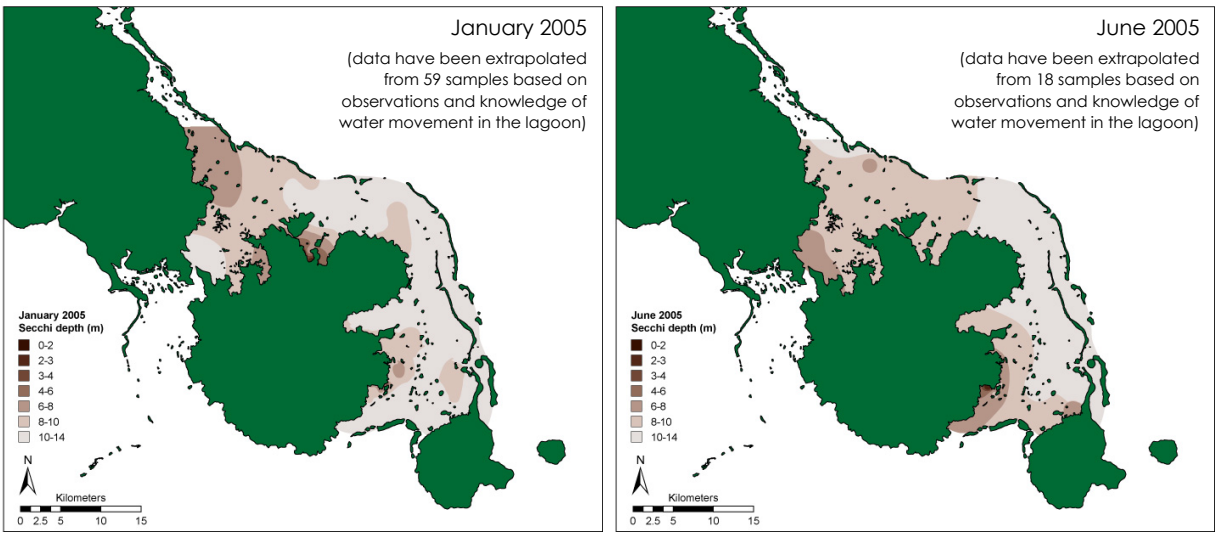


Figure 3.3: Interpolation of Secchi depth data

Nutrients and Chl *a* values showed similar trends to those reported for water clarity, with the highest nutrient and Chl *a* concentrations occurring near the river mouths (site of freshwater discharge), but generally low concentrations recorded throughout most of the lagoon, with the lowest concentrations occurring in the south adjacent to Wickham Passage (Fig. 3.4 and 3.5).

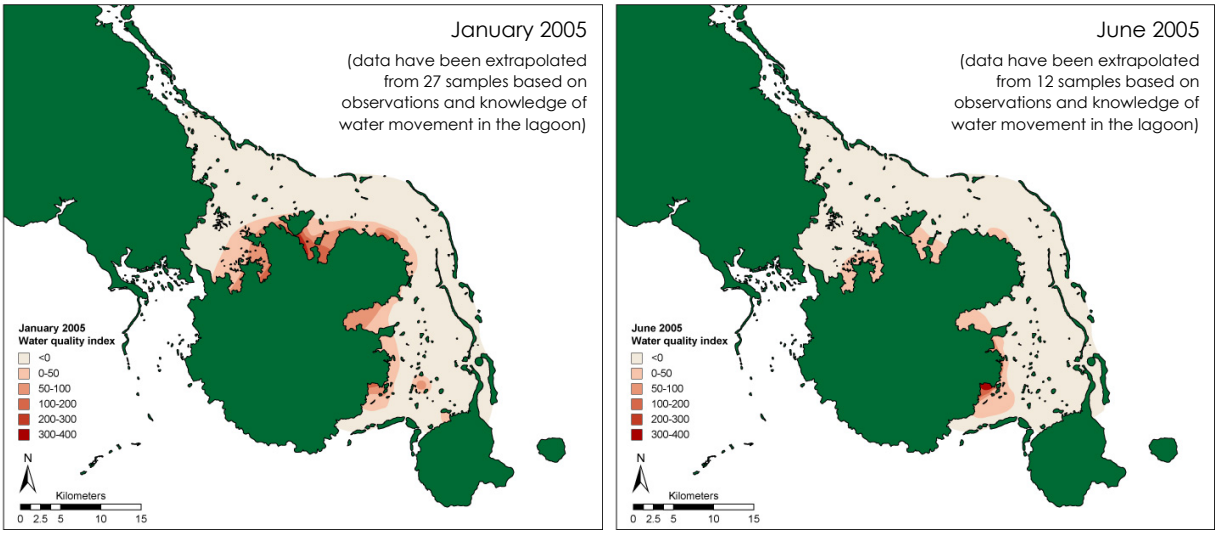


Figure 3.4: Interpolation of nutrients data

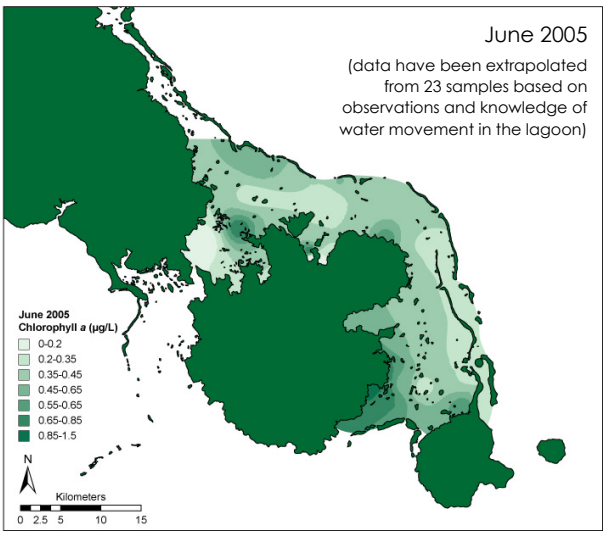


Figure 3.5: Interpolation of Chlorophyll *a* data

Given the relatively short visits to Marovo Lagoon as well as unpredictable and localised rain events, it was difficult to capture the impact of infrequent rain events on lagoon water quality. However, the team was able to monitor benthic light prior to and during one large rainfall event that occurred in September 2005 (Fig 3.6). These data showed water adjacent to Vangunu (near Gevala River mouth) was always more turbid than water in the mid lagoon (Tengomo Island) or close to the barrier islands (Toba). However, following a day of heavy rain on Vangunu the reef adjacent to Merusu was blanketed in turbid water that reduced the benthic light at 2 m to only 1% of incident light. The data also showed that this region of turbid water expanded rapidly in the lagoon, and one day later it had reduced benthic light levels at Tengomo Island (in the middle of the lagoon) to 19% of incident light. This is consistent with anecdotal evidence from villagers that following heavy rainfall on the island turbid freshwater can cover the surface of the lagoon out to the barrier islands making the lagoon appear brown. Unfortunately, due to travel commitments, the light loggers were removed before the water clarity returned to background conditions.

To increase the temporal sampling of water clarity and facilitate interaction with the local communities we also taught members of the local communities how to measure water clarity using a Secchi disk and established a sampling regime for water clarity adjacent to Chea and Bili (Fig 3.7, also Appendix: flyer from June field trip for synthesis).

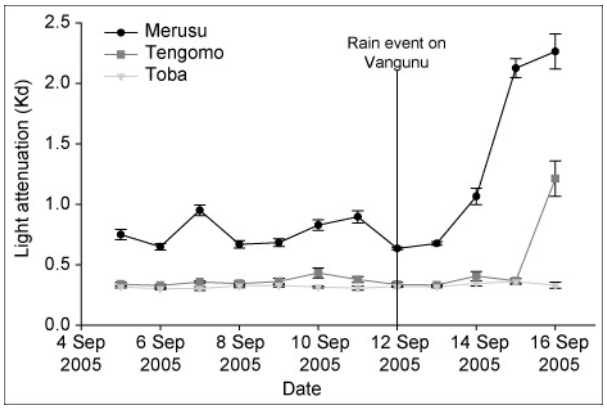


Figure 3.6: Benthic light at 2 m water depth at Merusu, Tengomo and Toba. Data collected prior to and following rain event on Vangunu September, 2005.

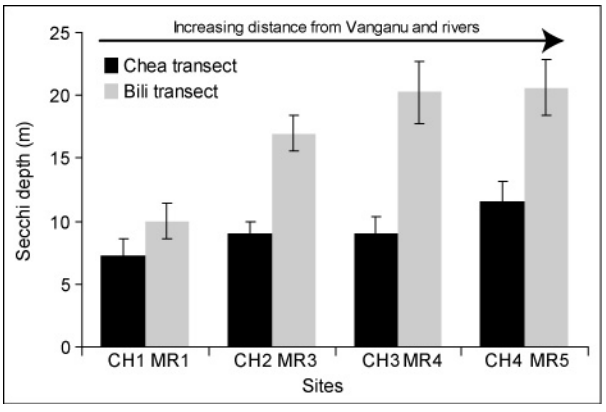
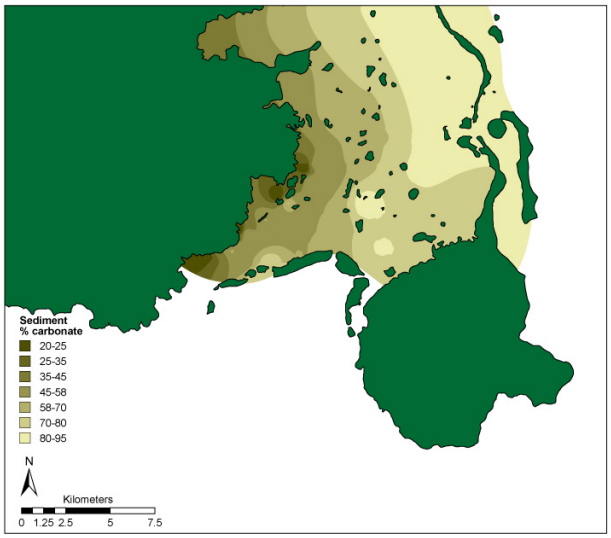


Figure 3.7: Secchi depth (m) measured by Chea and Bili community members

The distribution of carbonate sediment percentage was generally consistent with the spatial patterns of water quality and benthic light logging studies (Fig 3.8). Very low sediment percent carbonate values indicated significant terrigenous sediment input along the Vangunu coast, particularly in the vicinity of Merusu. The carbonate sediment percentages increase with distance across the lagoon from the Vangunu coast, suggesting that terrestrial runoff episodically effects water quality in the entire lagoon. This was consistent with the anecdotal accounts recorded in the social survey, which reported an increase in turbidity across the lagoon.



Plankton assemblages

Phytoplankton biomass throughout the lagoon was low, with Chl *a* concentrations being below reportable detection levels at the majority of sites sampled. There was a gradient in phytoplankton biomass (Chl *a*) from sites near Vangunu having relatively higher phytoplankton abundance than sites near the barrier islands.

Samples were observed from three sites: Merusu (site with the highest input of freshwater and highest nutrient loads), Tengomo (in the middle of the lagoon, with clear low nutrient water, except following a large rain event on Vangunu) and Bili Passage (close to the barrier islands, receiving fresh oceanic water on flood tides). Microscopic investigation of plankton was undertaken to determine whether any differences in the phytoplankton species composition and zooplankton abundance occurred to indicate differences in nutrient availability. The phytoplankton assemblage was dominated by diatoms, but there were also large numbers of dinoflagellates and relatively few cyanobacteria. Although these sites demonstrated a gradient in Chl *a* and nutrient concentration they did not demonstrate a consistent trend in species composition relative to proximity to Vangunu. The ratio of diatoms: dinoflagellates:cyanobacteria was similar at the Merusu and Bili Passage sites, however the relative proportion of dinoflagellates in the middle of the lagoon (Tengomo) was much higher (Fig. 3.9). There was also a trend for the abundance of zooplankton to be greater at Tengomo (mid lagoon) and Bili Passage sites, suggesting higher grazing rates in these areas. Zooplankton grazing has been shown to control phytoplankton biomass (Goericke, 2002) and it is possible that this influenced the observed phytoplankton trend in this transect.

It is difficult to properly interpret these data without better understanding the hydrodynamics of the lagoon and water residence times. One would expect to see the greatest changes in taxonomic composition in regions of the lagoon that have both long residence time and high nutrient load. It is possible that the similarity in composition between Merusu (high nutrient load) and Bili Passage (low nutrient load) represent their proximity to ocean passages, resulting in short water residence times at both sites. Whereas the species/genus composition at Tengomo, with an increased proportion of dinoflagellates, could be more representative of water that has been in the lagoon for a longer period.

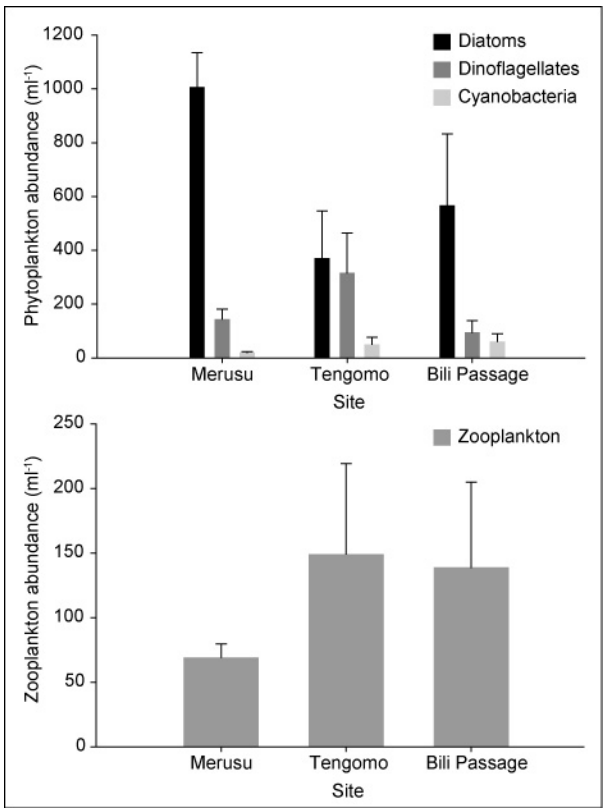


Figure 3.9: Plankton abundance across a water quality gradient in southern Marovo Lagoon.

Figure 3.10: *Ceratium dens* collected in phytoplankton tows in Marovo Lagoon, June 2005.

Figure 3.11: *Brachydinium capitatum* collected in phytoplankton tows in Marovo Lagoon, June 2005.

Two dinoflagellate species observed within the plankton should be recognised both as an important future risk and interesting biodiversity issue.

- *Ceratium dens* (Fig 3.10); this species has previously been observed in samples collected from the Solomon Islands (Wood, 1953) and is believed to be endemic to the Indian Ocean (Wood 1953; Hallegraff 1988). However recent plankton collections in the Gulf of California have identified *C. dens* to be a harmful red tide species associated with areas of high productivity (Altamirano and Pasten 2000). If nutrient loads are not controlled in the lagoon it is possible that this species could rapidly expand leading to toxic algal blooms in Marovo;
- *Brachydinium capitatum* (Fig. 3.11) is a distinctive species that according to Stiedinger and Tangen (1996) has only been previously identified in the Mediterranean Sea. The fact that this species has been observed in samples collected from the Solomons suggest a broader distribution and further supports the importance of this region for its marine biodiversity.

Discussion

The general outcome of this work showed that reefs close to the villages, predominantly on the western side of the lagoon and near the mouth of rivers and bays, experienced slightly elevated turbidity, nutrient concentrations and phytoplankton biomass (Chl *a*). However, during our visit, the majority of Marovo Lagoon had reasonably good water quality (high water clarity and low nutrients and Chl *a*), suggesting that any degradation in reef condition perceived by the local communities is either due to short term declines in water quality following major rain/run-off events, localised factors near the logging camps and villages or environmental factors other than water quality.

The water quality parameters measured during the current study (nutrient, turbidity and Chl *a*) in the water column throughout the lagoon were low compared to marine systems in Australia and the USA. The fact that Marovo has such low concentrations of contaminants in its water column are due to several factors:

1. Tropical marine systems have more rapid metabolic processes than temperate or sub-tropical systems, hence additional nutrients delivered to these ecosystems are rapidly used to support biological processes such as microbial, phytoplankton or algal growth. This was demonstrated in a manipulative experiment on Australia's Great Barrier Reef where nutrient concentrations, artificially increased on coral atolls, attenuated rapidly. After 40 minutes the nutrient concentrations were the same in the control as in the nutrient addition treatment (Koop et al. 2001).
2. Despite increases in diffuse nutrient load due to changes in land-use practice there is still a relatively low anthropogenic impact on the islands of Vangunu and Gatokae compared to Australia and the USA or even Fiji's Coral Coast, which occurs in a similar climactic zone to Marovo Lagoon but is more heavily populated.
3. During the time of sampling no heavy rain events occurred, hence there was minimal run-off, reducing the impact of anthropogenic activities on the two main islands (Vangunu and Gatokae) on the water quality in Marovo Lagoon (it is likely that the impact of land clearing results in pulsed delivery of sediment and nutrients to the lagoon immediately after and during large rainfalls).

Despite the fact that the nutrient and Chl *a* concentrations were low at most sites, it was still possible to detect a reduction in both parameters as distance from the river mouths on Vangunu and Gatokae increased. During periods of limited rain in an undisturbed catchment in this climate (i.e., dense rainforest) the vegetation would be expected to reduce sediment mobilisation, resulting in clear or almost clear freshwater streams and limited sediment and nutrient loads occurring at the river mouth. Based on this assumption the land use changes on Vangunu and Gatokae are likely to have contributed to the small localised impact near the river mouths even during periods of limited rain.

Case Study—Coral Coring

Background

The water quality data shows a clear inshore-offshore gradient in the lagoon, with areas adjacent to the large logged islands of Vangunu and Gatokae having significantly higher suspended sediment concentrations than ambient lagoon conditions. Such data, however, cannot be used to determine if these elevated sediment levels are the result of topsoil erosion and runoff associated with anthropogenic land use change, or simply the result of naturally higher levels of sediment and nutrient runoff entering nearshore coral reef environments. Coral cores can provide this critical historical context because their skeletons continuously record the ambient chemical environment by incorporating inorganic and organic materials from the water column. Down-core analysis of trace metals substituted into coral skeletal carbonate provides a means of tracing variations in suspended sediment loads over decadal to centennial timescales (McCulloch et al. 2003a). Likewise growth chronology of corals can provide information of environmental conditions over time. Massive corals such as *Porites* can live for hundreds of years. As they grow, they secrete their calcareous skeletons in clearly identifiable annual density bands, providing a means of accurately determining the age and vertical extension rates of a colony.

Methods

Short to medium-length (50–200 cm) 50 mm diameter cores were collected from massive corals (*Porites* sp.) at nine sites in Marovo using an underwater pneumatic drill and stainless steel core barrel. Cores were rinsed in freshwater following collection and oven dried at 60°C. Following delivery to the Australian Institute of Marine Science (Townsville, Qld.), the cores were sliced lengthwise using a diamond-tipped circular saw into 7 mm-thick 'slabs' and X-rayed. A combined densitometer/ luminometer (Barnes et al. 2003) was used to yield sub millimeter resolution of coral density and luminescence down the length of each core. These data were then processed to yield yearly growth rates and calcification of the sampled *Porites* coral at each site. Measurement of trace element concentrations were performed using laser ablation inductively coupled mass spectrometry (La-ICPMS) facilities based at the Australian National University (Canberra). As this section of the project was funded from sources external to the MacArthur Foundation grant, sampling was limited to a single core at the reef adjacent to the Merusu Oil Palm Plantation (Merusu 1).

Results

Extension and calcification of *Porites* corals did not follow any consistent temporal trends over the last 40 years so data were averaged to compare rates between different reefs in Marovo. The extension (growth) rate of *Porites* coral in Marovo Lagoon varied from 1.09 cm yr^{-1} at Tengomo Island in the mid lagoon to 1.41 cm yr^{-1} at the most inshore reef (Merusu 1). No clear relationship between extension rate and location along the inshore-offshore transect was evident. It is likely the variations in extension rate observed are due to localised factors (water depth, temperature and current). Calcification rates generally reflected extension rates (as calcification is a function of extension and density) with the highest calcification rate (1.82 g cm^{-2} yr^{-1}) also occurring at the Merusu 1 site, with no clear across lagoon trend.

Preliminary coral geochemical results are reported here, but analysis is still in progress. A *Porites* coral core collected from the inshore reef at Merusu show increases in Copper (Cu) and Zinc (Zn) and Barium (Ba) concentrations from 1995 to 2000. Between 2000 and 2005 these Cu and Zn concentrations returned to background levels. Increased variability in the Manganese (Mn) concentrations was evident after 2000 although the average concentration did not change substantially. The rapid rise in phosphorus (P) concentrations between 2004–2005 is reflective of high P concentrations contained within the coral tissue layer and not related to changes in the water quality at Merusu.

Discussion

Coral skeletal extension rates in Marovo were low compared to those predicted by the *Porites* growth model developed by Lough and Barnes (2000). Assuming an average sea surface temperature of 30°C in Marovo, *Porites* extension and calcification rates should be between 2.1 cm yr^{-1} and 2.5 g cm^{-2} yr^{-1} (Lough and Barnes 2000). However other drivers of growth in *Porites* are light and nutrients. The low nutrient availability and high cloud cover in Marovo (common in wet tropics) may limit *Porites* growth to rates below the theoretical maximum based on sea surface temperature.

Preliminary trace metal data from *Porites* coral at Merusu 1 indicate elevated Zn and Cu during the period 1995–2000, which is consistent with enhanced flux of terrestrially-derived sediments resulting from the the clearing of 6000 ha of the Gevala River catchment for a palm oil plantation over the same time period. However a longer record is required to establish a 'pre-impacted' baseline. Satellite imagery (Fig. 3.34) shows that large scale catchment disturbance occurred between 1989 and 2000. Evidence from the trace metal signatures in the corals suggests a decrease in the trace metal loads to inshore reefs following 2000 (between 2000–2005) suggesting that load from these cleared catchments has subsequently decreased. This may be attributed to the subsequent reduction in exposed soil areas (weed growth and oil palm planting) resulting in less terrigenous sediment being mobilised into streams during rainfall. However, the loads of terrestrial sediments that have already entered the lagoon will eventually be susceptible to resuspension by major storms or strong tidal currents resulting in reduced water quality (relative to natural conditions) potentially for an extended period. The Ba signature, which is a widely used proxy for sediment input, indicates there has been a significant increase in sediment input from 1995 to date.

Sites	Distance from FW input (m)	Extension cm yr^{-1}	SE	Calcification g cm^{-2} yr^{-1}	SE
Merusu 1	700	1.41	0.09	1.82	0.11
Koreke	700	1.32	0.07	1.63	0.1
Merusu 2	1400	1.24	0.06	1.64	0.08
Chumbikopi	2000	1.38	0.1	1.72	0.11
Chea	4900	1.32	0.06	1.78	0.08
Tengomo	6600	1.09	0.06	1.49	0.08
Chea Toba	9400	1.1	0.11	1.17	0.11
Bili	13900	1.39	0.1	1.78	0.13
Mean/SE		**1.28**	**0.18**	**1.63**	**0.37**

Table 3.2: Extension and calcification rates of *Porites* corals at nine sampling sites across Marovo Lagoon averaged over the past 40 years. Sites are listed in order from inshore to offshore. FW = freshwater; SE = standard error of the mean.

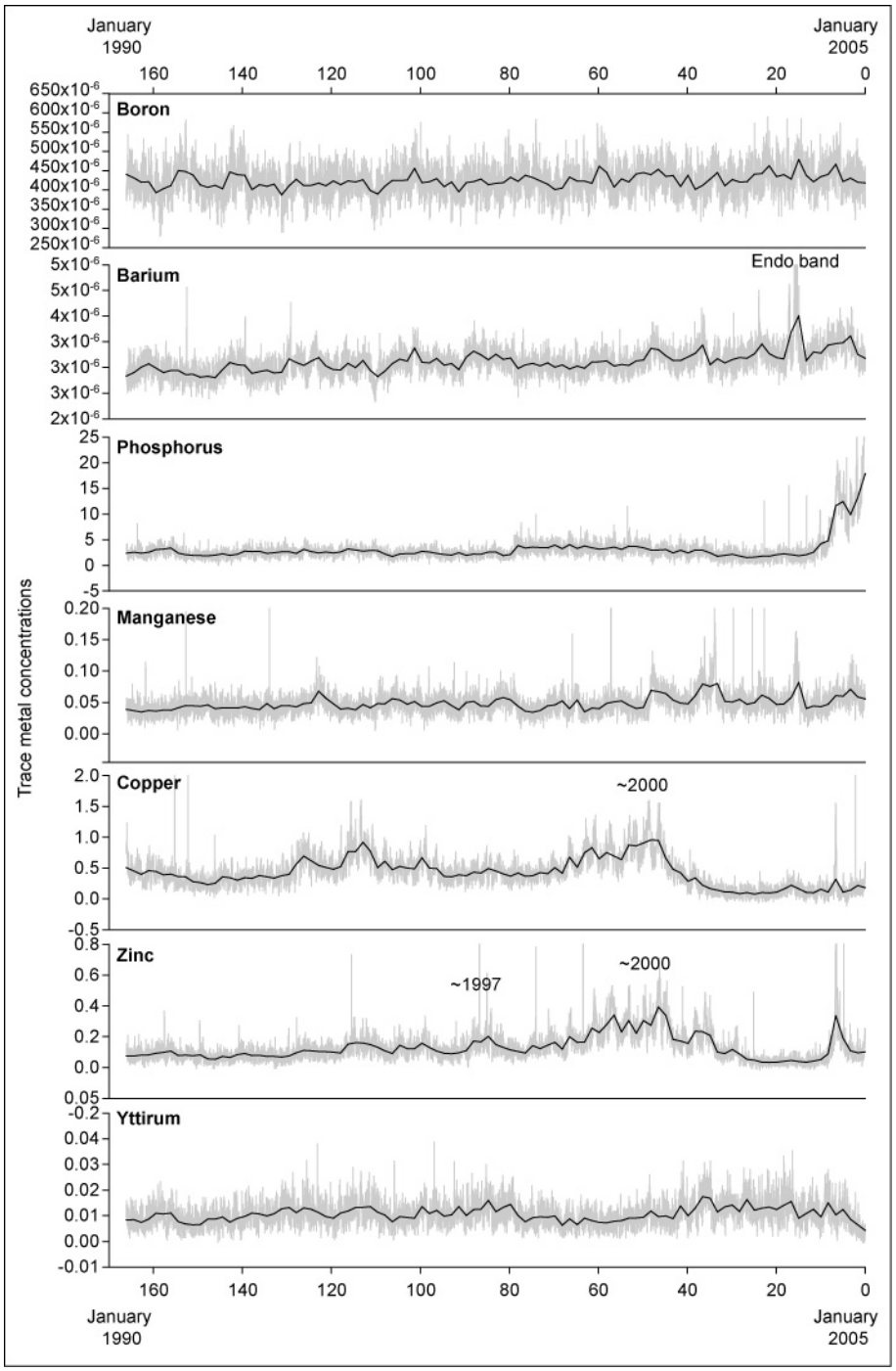


Figure 3.12: Trace metal concentrations in *Porites* coral at Merusu 1 (adjacent to oil palm plantation) between 1990 and 2005.

Key Findings

- There is evidence of water quality change in the lagoon that supports the perception by inhabitants of the lagoon that the water has become more turbid in recent years;
- Nutrient and sediment inputs into the lagoon are probably elevated above 'natural' levels due to changes in land use, but insufficient data could be collected to quantify accurately the relative change that has occurred;
- Ambient nutrient, suspended sediment and Chl *a* concentrations in Marovo Lagoon appear to be permanently elevated close to river mouths on Vangunu and Gatokae;
- Water quality (clarity, nutrients and phytoplankton) in the majority of the lagoon is currently excellent, relative to world comparisons, except following high rainfall events when overlying fresh surface waters rapidly become turbid;
- Flushing of the lagoon, predominantly through Wickham Passage and the low rates of sediment re-suspension, due to the low energy environment, has prevented significant degradation of water quality in most of the lagoon, despite increases in sediment and nutrient loads from the catchment;
- If nutrient/sediment input increases or grazing of phytoplankton and benthic microalgae decreases (e.g. 'bêche-de-mer' experiment), then it is likely the lagoon will turn green as there is a relatively long residence time for water in most of the lagoon;
- Growth rates of *Porites* corals are lower than would be predicted by growth models based on water temperature, suggesting that other environmental conditions are not ideal for *Porites* growth;
- Trace metal data suggest that terrestrial inputs increased in the period 1995–2000 and Ba indicates there has been a significant increase in sediment input from 1995 to present.

Social Impact

Increased water turbidity has several negative social impacts. It decreases visibility for divers, reduces coral health which can have flow on effects for other community components such as fish quantity and diversity. If the system continues to experience declines in water quality it is likely that there will be serious negative social outcomes due to a reduction in fish catch by local fisherman and adverse impacts on the small, but developing, tourism income.

Recommendations

To improve the water quality in the lagoon it will be necessary for the community to understand the direct impacts of poor water quality on their food resources within the lagoon. It will also be necessary for them to understand actions that can be taken to reduce highly turbid water from entering the lagoon. The actions outlined below will assist with improving community awareness of the problems.

1. Provide community groups with low technology and easily operated equipment to monitor water quality in the lagoon.

   This activity has already been initiated during the current project by teaching community members from Chea and Bili how to measure water clarity using a Secchi disk. The community data for water clarity agree well with the data collected during the January and June field trips and the higher temporal frequency of data provides a better representation of the variability in water clarity that occurs in the lagoon (Fig. 3.7).
2. Prepare information materials specific to Marovo that can be accessed by high school students to facilitate interactive learning about the consequences of reduction in water clarity and developing possible solutions, this material should be prepared to use both in traditional educational systems as well as the new internet system that has recently been established in Marovo;
3. Using data collected through the local school system (Batuna, Beka Beka, Seghe, etc) provide an annual report card on water quality and ecosystem health in the lagoon to encourage community participation in the solutions;
4. Review land use practices to limit sediment run off to the sea:
   a. Villagers could attempt to provide a vegetated buffer between the shore and the community to reduce runoff from villages;
   b. Encourage villagers involved in logging operations to adhere to the existing forestry guidelines to reduce sediment run-off.

Decreasing Fish Population

Social Survey

Marovo People:

Fish (*ihana*) are decreasing due to poor water quality and destructive fishing practices including the use of explosives and poisons

There was a strong community perception that fish stocks are decreasing throughout the lagoon (Table 3.3). This was clear from discussions at the Batuna meeting and in feedback from respondents during interviews (Tables 3.3 and 3.4). While a majority of respondents expressed a view that fishing was still 'okay', many felt that diversity had decreased (Table 3.5). Locals explained such decreases through reference to overfishing, tuna bait fishing, destructive fishing practices such as the use of poisons and explosives, decreasing water quality, and the use of highly selective and effective techniques such as night spearing. People are concerned for their livelihoods and pessimistic about the future of fish resources. However, while people in both Bili and Chea felt that fish stocks had declined, there were differences between villages in terms of the extent of perceived change in fish diversity (Table 3.5).

Table 3.3: Categories of environmental changes elicited by respondents

Response	Frequency
Fish and other marine species have decreased	15
Water is dirty	18
Coral is dying and changing color	4
No change	2

(Categories n=various; respondent n=32)

Table 3.4: Fisheries changes: Abundance

Code	Statement	Bili		Chea	
		Disagree	Agree	Disagree	Agree
Q16EC	There are not as many fish in the lagoon now as there were 10 years ago	4 (18%)	28 (82%)	0 (0%)	27 (100%)

Source: CAQ

Table 3.5: Fisheries changes: Diversity

	Bili		Chea	
	Number	Percent	Number	Percent
No (change in species variety)	0	0%	9	64%
Yes (change in species variety)	10	71%	5	36%
Not sure	4	29%	0	0%

Source: HHS:Q19a (n=28)

Socio-Economic Interpretation of the values of fish resources

Approximately 12,000 people, residing in 70 villages and hamlets, rely upon the fisheries resources of the lagoon for both subsistence and artisanal purposes. Intensive exploitation of fisheries resources is characteristic of most of the Solomon Islands coast (Aswani and Hamilton 2004a), and the country has one of the highest *per capita* seafood consumption rates in the world with 80% of the population deriving their protein from marine resources (Kinch et al. 2006b).

The 'esky catch' is dominated by carnivores (78%), which are fairly evenly divided between species that feed mainly on fishes (piscivores) and those that feed on animal prey from the reefs and sediments of

the lagoon (zoobenthivores). The 'esky catch' of herbivorous fishes (including *Bolbometopon muricatum*, which feeds on both algae and corals) was dominated by surgeon fishes and parrot fishes; however there was surprisingly a lack of spinefoot/ rabbitfishes (Siganidae), which are highly regarded as food elsewhere in the Pacific. Herbivores play an important role in coral reef health by limiting the growth of algae, which would otherwise grow and out-compete corals for light and space, especially in areas with elevated nutrients. In summary, 'esky' catches are dominated by coral reef fishes and therefore are likely to impact on coral reef habitats in particular.

Table 3.6: Esky catch data arranged by trophic (feeding) group

Trophic Group	Piscivores	Zoobenthivores	Planktivores	Carnivores	Herbivores/ Corallivores
Total Catch	1182	1580	51	2813	811
Percentage total catch	33%	44%	1%	78%	22%

Scientific Survey

Case study—Grazing Fish Community Structure

Introduction

The health of tropical coral reefs is sustained in part by the grazing activity of fishes that remove the algal competitors of corals, and link a highly productive source of primary production with other members of the food web (Choat 1991; Polunin and Klumpp 1992). The role of grazing fish is of such significance in Indo-Pacific reef systems that they are considered a keystone guild (Choat 1991). Invertebrate grazers also help maintain this crucial balance between corals and algae (Ogden and Lobel 1978; Klumpp et al. 1988). The health of the lagoon may well be dependent on the health of its grazing community. This community is subject to harvest for local consumption and as part of the 'esky' trade (Novaczech and Chamberlain 2001). Moreover, light trapping of small reef fish for use as bait in the tuna fishery (Johannes et al. 2000) is likely to further impact on the abundance and biomass of the grazing fish assemblage, as they feature in the by-catch of this fishery (Blaber and Copeland 1990). To assess the role of fishes and larger invertebrates in the health of the tropical reef systems of Marovo Lagoon we surveyed and compared the abundance and biomass of herbivorous and omnivorous grazing fishes on reef outcrops within the lagoon. To assess the relative health of Marovo herbivore communities, values from the survey of the lagoon were compared with data derived from other reef systems to assess the relative health of the grazing fish assemblage and the implications for the functionality of Marovan reefs.

Methods

Grazer biomass was estimated in September 2005 at five sites along a transect from Merusu to Bili village and four sites along a transect near Chea village (Fig. 3.13). All sites had extensive coral cover. Transects were conducted in waters 1–3 m depth, using a snorkel. Four underwater visual censuses (UVC) were completed at each site using a tape to centre a 50 x 4 m swathe (St John et al. 1990). The identity and estimated total length (LT ± 10 mm) of individual omnivorous and herbivorous grazing fishes were recorded. Biomasses (M) were estimated from total length (LT) using published weight-length relationships. Observer bias was countered by all data being collected by the same observer (IT) at all reefs in Marovo as well as for comparison reefs overseas.

Values of biomass (g m^{-2}) were compared graphically both among sites in Marovo Lagoon and between Marovo Lagoon and data sets for the following reefs: Myora and Amity, Moreton Bay, southeast Queensland, Australia (27° 24' S, 153° 26' E); Heron Island reef slope and reef crest, Great Barrier Reef (23° 26' S, 151° 55' E), and Gaulin and French reefs, San Salvador, Bahamas (24° 02' N, 74° 30' W). Mean fish size (g) for each site was estimated by taking the mean of the ratio of total biomass to total abundance from each replicate. The relative health of lagoon survey locations was estimated by summing the ranks of grazer biomass and mean grazer size. The former is indicative of level of grazing activity via mass balance relationships and the latter indicative of the presence of animals of reproductive size, those that have passed any ontogenetic shift in diet from animal to plant material,

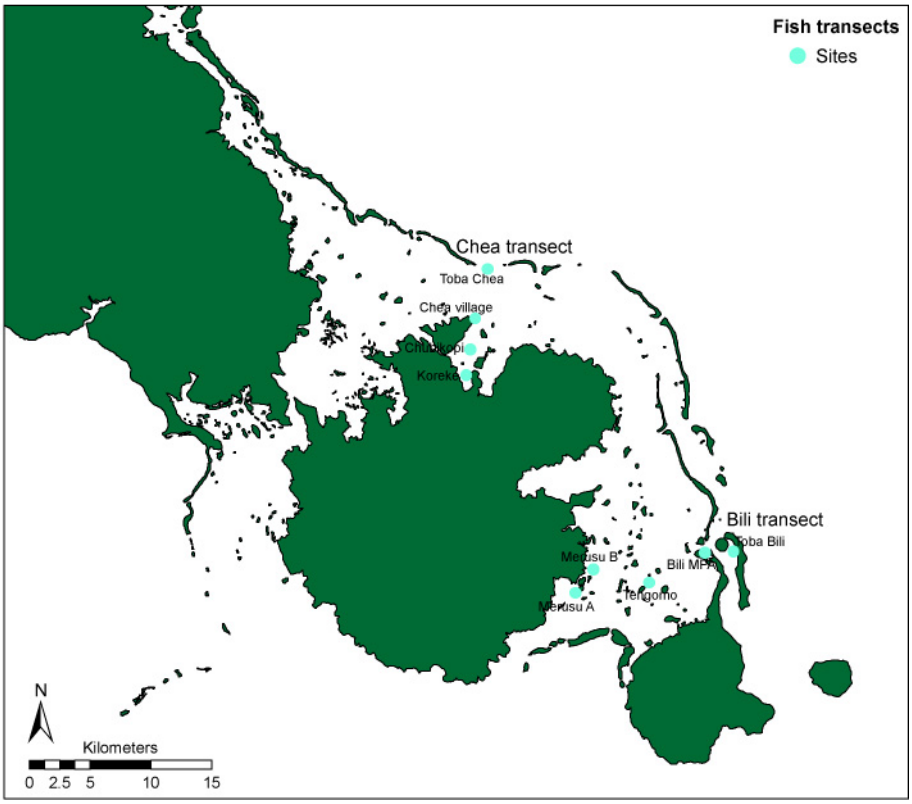


Figure 3.13: Fish sampling sites

which occurs in all but the Siganidae and Acanthuridae. While the focus of the survey was the structure of the community of grazing fishes, observations were also made of other grazers such as urchins, turtles, sea stars and crabs.

Results

Sites in close proximity to villages were heavily fished. At Chea, children were observed using small baits and hooks to capture fish for bait (Technical Report). Many people were observed fishing from dug-out canoes throughout the lagoon. The overall impression is that fishing effort is generally heavy and that all medium to large sized fishes are targeted, grazers not excepted. Only a single turtle was seen during the transect work; a small hawksbill (*Eretmochelys imbricata*), which is carnivorous. No large grazing crabs were seen, although these tend to be highly cryptic and more active at night. No grazing sea stars were observed, although the corallivorous sea star *Culcita novaeguineae* was observed, often at some distance from coral outcrops and may have been feeding on benthic microalgal mats. Crown of thorns sea stars, *Acanthaster plancii* were locally common corallivores.

Transect Data

A total of 3652 grazing fishes and 71 *Diadema* (sea urchins) were found in the 36 transects. Thirty seven species in sixteen genera from five families were represented in UVCs of shallow reefs in Marovo Lagoon. Damselfishes, parrotfish and surgeonfish dominated the community in both transects. Rabbitfish were important mainly in the Chea area, with relatively few being found at Bili.

The communities at Tengomo, Bili MPA and Toba Chea had more diverse grazing fish communities and a higher biomass of grazers than other sites (Fig. 3.15).

The mean of the total biomass of all grazing fishes at each location indicated that high biomass of grazers occurred at Tengomo and Bili MPA on the Bili transect (Fig. 3.15a) and at Chubikopi and Toba Chea on the Chea transect (Fig. 3.15b). However, mean size of grazing fishes was relatively high (≥20 g) only at Bili MPA and Tengomo (Figs 3.15 and 3.17). This means that high biomass values at Chubikopi and Toba Chea are largely a function of high abundances of smaller grazing fish. Averaging the ranks of grazing fish biomass and mean fish size (Table 3.7) indicated that Bili MPA ranks highest in the relative measure of reef fish health. *Diadema* (grazing urchins) were only found at five of the nine locations surveyed. Only at three locations did their abundance exceed two per transect, which equates to 1 urchin per 100 m^2.

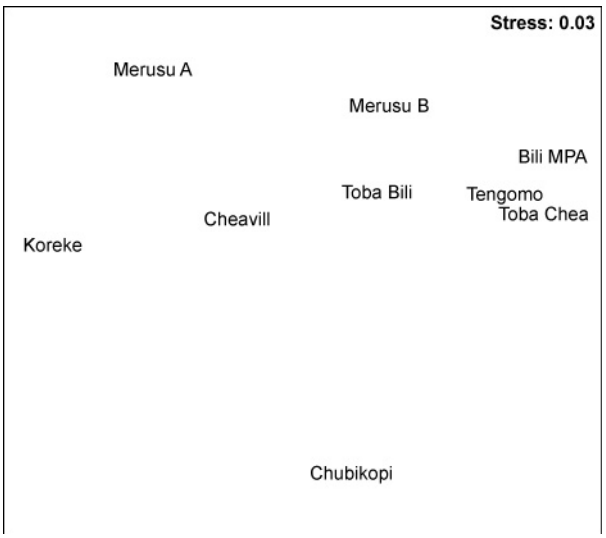


Figure 3.14: MDS Plot of sites (Variables) based on fish total mean biomass by family (Samples) for all Marovo Lagoon data. The principal axis is driven by biomass of the Acanthuridae and Scaridae, which were both high at locations in the right of the plot and low at locations to the left of the plot. The Y-axis is driven principally by the Siganidae, which were present in high biomass at Chubikopi, but low biomass elsewhere.

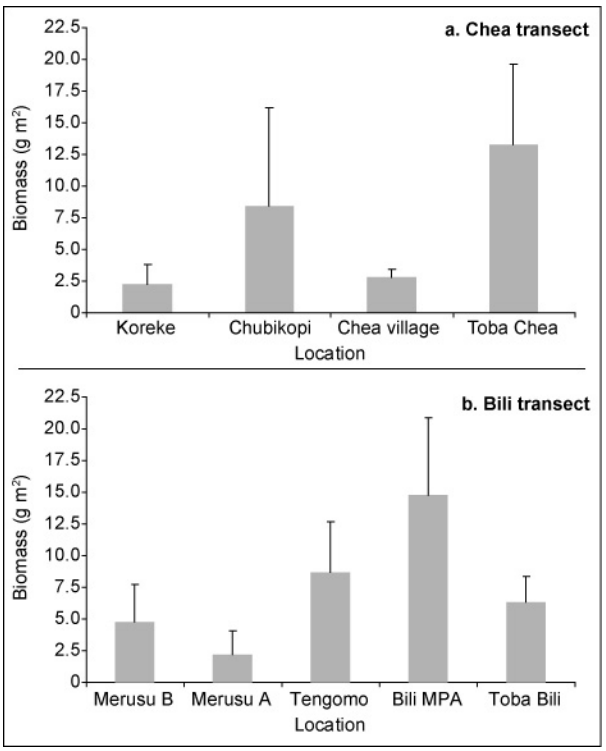


Figure 3.15: Mean biomass (± SD) of all grazing fishes for transects at Chea and Bili. More oceanic sites are to the left.

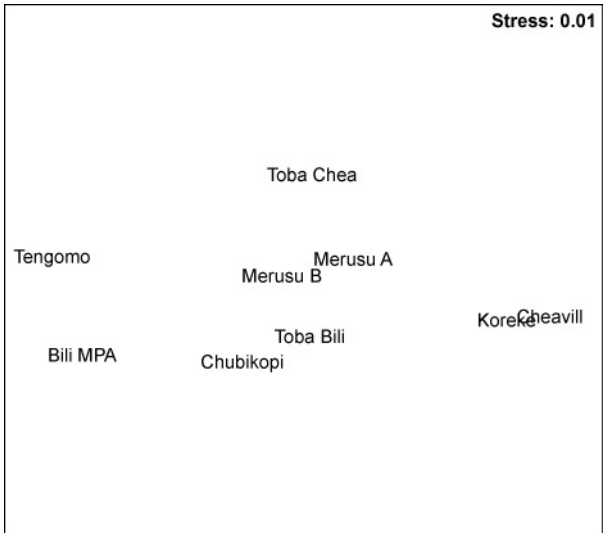


Figure 3.16: MDS of mean fish size (total biomass/total abundance) for all Marovo locations. Managed sites appear on the left of the principal MDS axis and 'commons' sites to the right.

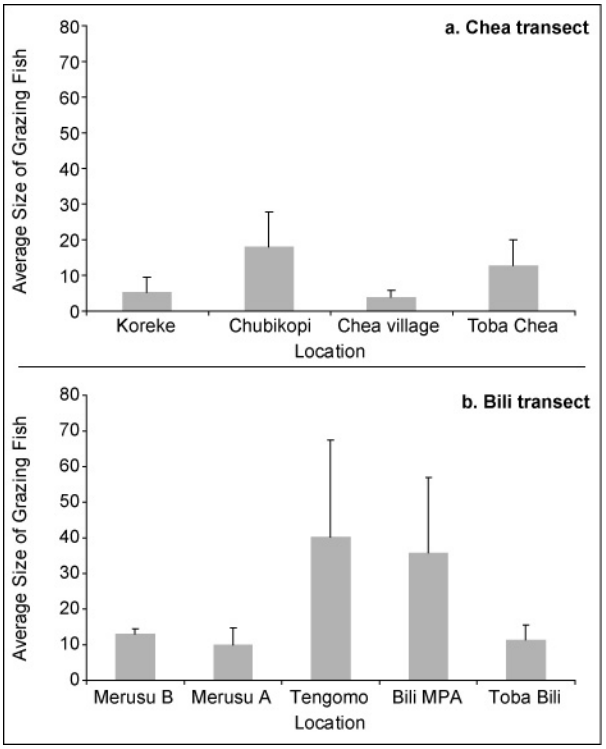


Figure 3.17: Mean (±SD) average size of grazing fish (total biomass/ total abundance, g) for locations along the Chea transect and the Bili transect of Marovo Lagoon. Sites with restricted access have larger grazing fishes.

Table 3.7: Ranks of overall grazer biomass and mean grazer size for locations in Marovo Lagoon, with indicative assignments of relative health of the grazing fish community.

Location	Biomass	Size	Mean	Relative
Bili MPA	1	2	1.5	High
Tengomo	3	1	2	High
Toba Chea	2	5	3.5	High
Chubikopi	4	3	3.5	High
Merusu B	6	4	5	Intermediate
Toba Bili	5	6	5.5	Intermediate
Chea Village	7	9	16	Low
Koreke	8	8	16	Low
Merusu A	9	7	16	Low

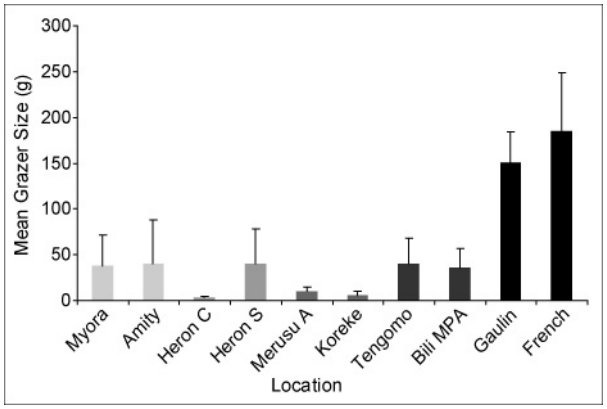


Figure 3.18: Mean size of grazing fishes at reef sites from Moreton Bay (Myora and Amity, which are classed as degraded), Great Barrier Reef (Heron Reef Crest Heron C and Heron Reef Slope, Heron S), four sites from Marovo lagoon representing sites with poor grazer health (Mersusu A and Koreke) and sites with good grazer health (Tengomo and Bili MPA); and sites from the Bahamas Gaulin and French reefs in San Salvador, which are very low in living coral cover, but also low in algal biomass. Sites with low health as estimated by the ranking of mean biomass/average size of grazer compared favorably with healthy reef sites such as Heron Reef Crest (Heron C), the community of which was dominated by small grazing blennies and damsels. Gaulin and French reefs in San Salvador, Bahamas had by far the largest grazers of any in the comparison.

Discussion

Sites in Marovo Lagoon which were afforded some level of protection from fishing by their proximity to villages with an interest in ecotourism outcomes[2] (Bili MPA, Tengomo) had grazing communities with a greater biomass and larger average size of grazers. The mean biomass of individual grazers at the Bili MPA and Tengomo were almost double that of any of the other sites in the lagoon. While a manipulative experiment would be required to unequivocally assess the effectiveness of 'managed' areas, the data collected during the current study suggest that areas subjected to reduced fishing pressure by the provision of a heightened level of protection raises both the overall grazer biomass and mean biomass of individual grazers. The MPA in the Chea transect is at Toba Chea, which had high biomasses of parrotfish and surgeonfish; however, the mean grazer size was reduced by the high abundance of small grazing pomacentrids.

Algal biomass in Marovo appeared generally low, except in the immediate vicinity of villages. *Sargassum* sp. was abundant at Chea village, but there were few fish. Grazing relationships therefore seem limited to the epilithic algal community (EAC), which comprises microalgae, the early life developmental stages of macroalgae, sediment, detritus, phytoplankton and demersal plankton (Wilson and Bellwood, 1997). Pandolfi et al. (2003) suggest that the health of reefs is directly indexed to the level of human impact on reef systems, and that as a consequence reefs worldwide are threatened by the cumulative effects of over fishing and pollution. They emphasize that the removal of grazers by over fishing can lead to a phase

2 Bili MPA and Tengomo are close to either potential or actual family operated resort accommodation in which the family has an interest in restricting fishing done at these sites to maximise their value to visitors. Also Tengomo is relatively remote from areas of high population density. The logistical challenges of distance and high fuel costs might also confer a level of protection.

shift in the coral reef community from a coral dominated substrate in which grazers restrict the growth of algal communities to a low turf algal community followed by a community dominated by foliose algae that occlude and kill corals. At further distance from villages and creeks the reefs of Marovo Lagoon seem relatively healthy; however, the population of large grazing fishes is low in most areas with the function of grazing not been visibly replaced by other groups of grazers. Moreover, worryingly high numbers of crown of thorns sea stars were observed at some sites and may pose a more direct threat to corals in the lagoon.

The grazing communities assemblage observed in Marovo Lagoon were similar in structure to those of other Indo-Pacific reefal areas. Sites receiving some level of community protection were similar in structure to assemblages at sites on the GBR that receive the highest level of protection under the GBR management structure, suggesting the reefs have the ability to be sustainable when excess fishing pressure is reduced. In contrast the grazer assemblages at other sites within the lagoon (exposed to higher fishing pressures) were relatively depauperate compared to other Indo-Pacific reef sites (Figure 3.18). So while there seems to be some modification of fish community structure within Marovo likely attributable to fishing, Marovo reefs with some level of protection have a relatively healthy grazing community.

Case study—Quantification of Grazing in Marovo Lagoon and the Implications for the Coral–Algal Equilibrium

Introduction

Reduction in either herbivory, water quality or both have been highlighted as the major localised threats to coral reef health (Littler and Littler 1984; Bryant et al. 1998). Both factors directly influence algal communities and dictate the nature of their equilibrium with hard coral. The global trend towards algal dominated reefs has manifested in Hawaii (Hunter and Evans 1995), the Caribbean (Hughes 1994) and the inshore Great Barrier Reef (Done 1992). Algal dominated reefs generally support less productive fisheries and are a step along the 'slippery slope to slime' described by Pandolfi et al. (2005).

This study used settlement tiles to monitor algal communities across two inshore to offshore transects in Marovo Lagoon. Both water quality and grazing pressure were quantified at each of the sites to determine the relative importance of these top down and bottom up pressures. Substrate availability is often a major driver of algal community structure, this factor was removed by using standardised artificial settlement tile substrates. Manipulative caging experiments were combined with the natural gradient to further explore how grazing influences algal communities in different regions of the lagoon.

Methods

In order to assess algal community composition on the reefs in Marovo a standardised settlement tile method was used. Nine replicate settlement tiles (7 x 7 cm roughened 3 mm grey PVC were randomly attached parallel to the substrate at ~1 m below LAT on each of the nine study reefs during January 2005. Three tiles were collected after 6 months, three were used in caging trials at 6 months (June 2005) and three were collected after 12 months (January 2006). Cover of algal functional groups on the upper surface was quantified at 24 random points on a digital image of the tiles (using Coral Point Count V3.2 (NCRI)). Decalcified dry weight was quantified by scraping algal community from the tile, drying for 48 hrs at 60° C, soaking in 10% HCl for 24 hrs, rinsing in distilled water, redrying at 60°C for 48 hrs then weighing.

Results

After six months the algal settlement tiles had developed a range of algal communities across the nine study reefs. Distinct differences could be observed visually between the inshore and offshore tiles and caged and ambient tiles. Inshore reefs were characterised by 100% cover of algal turfs (filamentous algae and cyanobacteria). Off shore reefs were generally characterised by a mixed community of 30–50% crustose coralline algae, 10% cyanobacteria, 10–20% foliose algae and 30% bare tile. Following caging for 28 days settlement tiles on inshore reefs remain unchanged with algal turfs dominating. Caging of the tiles on offshore reefs resulted in algal turfs overgrowing the coralline algae so that the algal communities more closely resembling inshore reefs than the ambient (uncaged) offshore reefs. Algal biomass varied across the nine study reefs, with biomass decreasing as the distance offshore increased (Fig. 3.19). Settlement tiles on the degraded inshore Merusu reef had the highest algal biomass with ambient tiles 7.23 ±1.95 mg cm^{-2} and caged tiles 7.35 ±1.37 mg cm^{-2} (mean ±SE). Offshore reefs had lower biomass communities of 1–2 mg cm^{-2}, that increased following caging to 3–4 mg cm^{-2}.

Herbivory by fish was isolated as the dominant factor determining the functional forms of algae present on settlement tiles across Marovo Lagoon (Figure 3.18). Whereas algal biomass was a function of both water quality and herbivory. Tiles on reefs with a high biomass of herbivorous fish were represented by grazing resistant crustose coralline algae and low biomass foliose forms. Following caging these communities were rapidly (28 days) overgrown by a dense turf of cyanobacteria and filamentous algal species that are typical of the low herbivory inshore reefs. This rapid shift shows the vulnerability of coral reefs to changes in key processes such as herbivory.

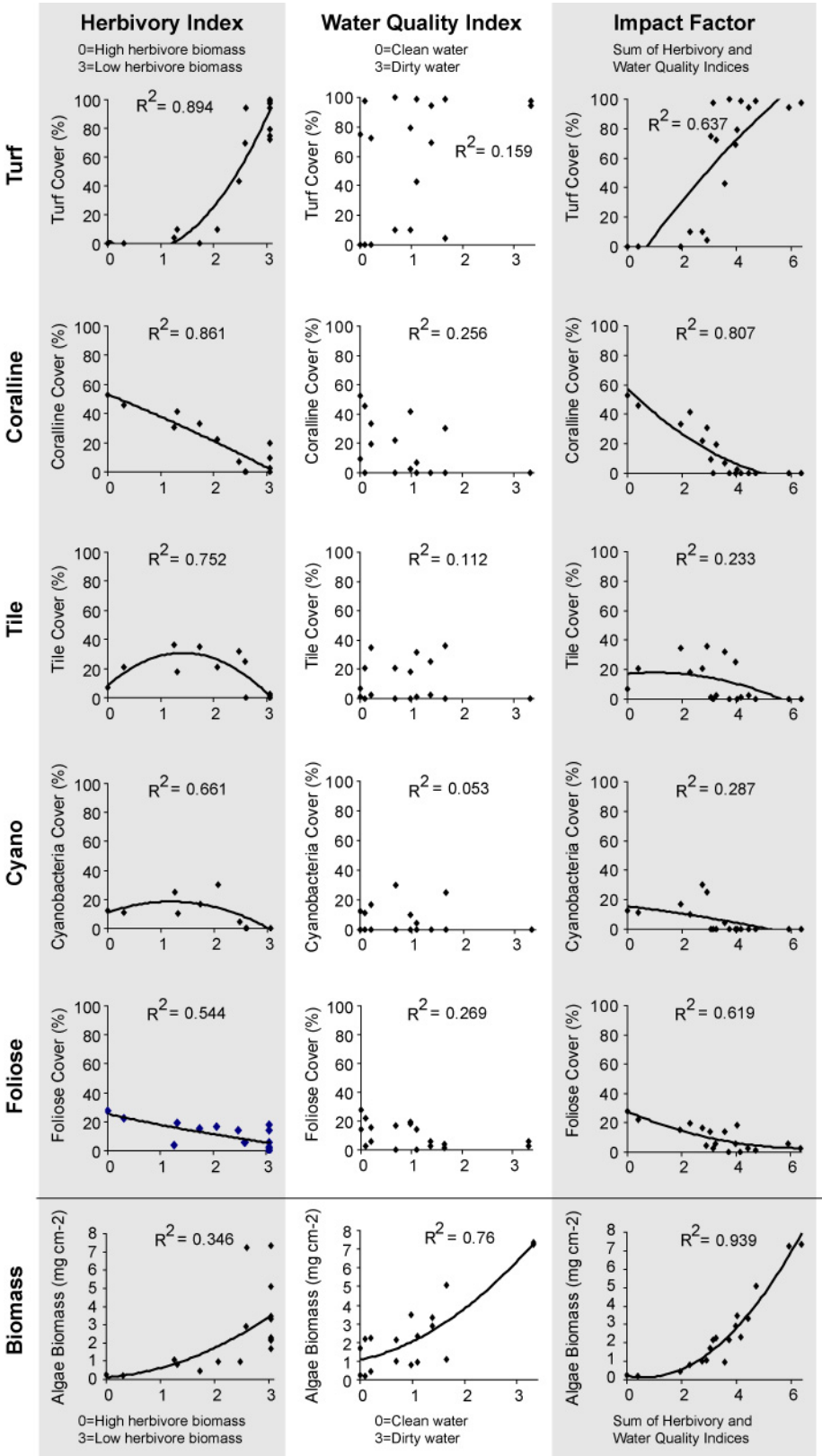


Figure 3.19: Relationships between algae functional groups and biomass on settlement tiles and a water quality and herbivory index derived for each site from empirical data. Impact factor is the sum of the water quality index and herbivory index, it provides an overall indication of pressures on the various reefs.

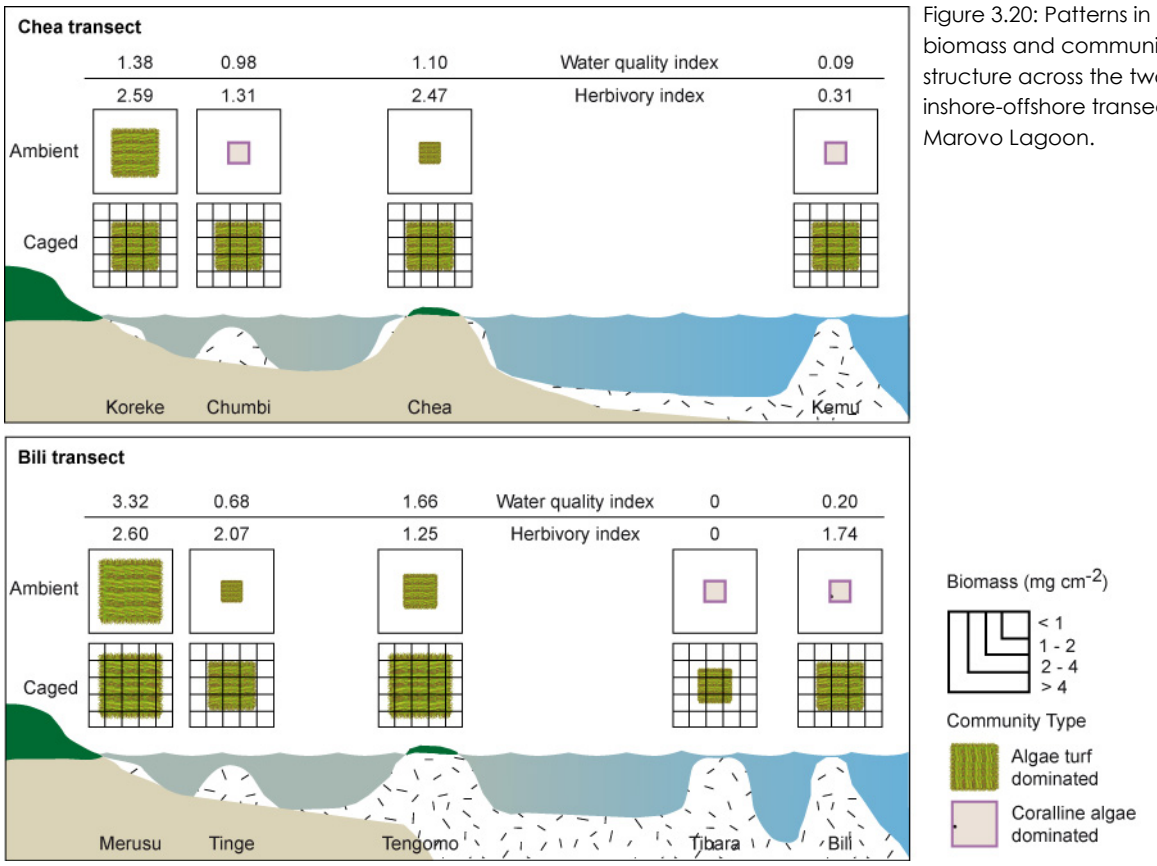


Figure 3.20: Patterns in algal biomass and community structure across the two inshore-offshore transects in Marovo Lagoon.

Discussion

The herbivore biomass across the study reefs in Marovo were relatively low (2.2–14.76 g m^2) compared with reefs worldwide; 7.5–44 g m^2 in the Great Barrier Reef (Russ 2003), 2.7–15.4 g m^2 in the Caribbean (Williams and Polunin 2001), and 25–160 g m^2 in Hawaii (Friedlander and DeMartini 2002).

Despite this limited herbivory the low nutrient status of Marovo has prevented rapid overgrowth of the reefs by large frondose, leathery or corticated groups observed in the Caribbean (Hughes 1994), Hawaii (Hunter and Evans 1995), and Great Barrier Reef (Done 1992). The removal of grazers on some reefs in Marovo has caused a shift to algal turfs, which are able to flourish in low nutrient environments via nitrogen fixation. Based on the correlations between herbivore biomass and macroalgal cover developed by Williams and Polunin (2001) for Caribbean reefs, reefs in Marovo would have 20–70% macroalgal cover. However the oligotrophic status of Marovo has limited the growth of macroalgae to <5% and hence reefs are still in a low algal/high coral state (Albert and Roelfsema, unpublished data). Many reefs in the Pacific are currently in this low nutrient/low herbivory situation as herbivorous reef fish are often targeted by local subsistence and artisanal fishing communities. The targeting of herbivorous fish through night spearfishing is an increasingly popular means of fishing in Melanesia, particularly as depleted fish stocks make traditional forms of fishing less productive. This increases the susceptibility of these reefs to rapid algal phase shifts in the event of low levels of nutrient enrichment of the system through catchment disturbance or sewage runoff.

Key Findings

- Community perceptions of depleted fish stocks were substantiated by surveys;
- Large grazers are in low biomass in most areas of the lagoon, yet herbivorous fish still appear to be important in preventing the overgrowth of coral by turf algae in many regions of the lagoon;
- Reduced grazing function appears to be partly compensated for by increased numbers of smaller herbivorous fish;
- Reefs with some degree of protection from fishing had healthier grazing fish communities;
- Invertebrate and other vertebrate grazers do not appear to be replacing the reduced grazing effort by fish, which implies that bottom up control on algal biomass (i.e., nutrients) is probably important;
- If nutrients are kept low the current situation is possibly sustainable, if not then conditions for a phase shift from a coral to an algal dominated system are likely to occur;
- Increased nutrient loads on inshore reefs near Vangunu have increased biomass of algae;
- The low biomass of herbivorous fish in Marovo makes the ecosystem vulnerable to further declines in water quality, which may lead to algal overgrowth of the reefs.

Social Impact

High extraction rates of fishes at all trophic levels has depleted fish communities, particularly the grazing fishes which are vital to maintaining reef health. The existence of healthier communities of reef grazers near villages interested in protecting biotic diversity suggests that such protection can have a material effect on reef fish community health. Reductions in fish diversity and reef health have the potential to impact negatively on both the availability of fish resources for local communities and to decrease their value to the 'tourist product'.

Recommendations

There is evidence of changes in fish communities that indicate that reef fish communities are declining due to fishing pressure. Some parts of the lagoon have a markedly reduced biomass of grazing fishes and may cause potentially serious negative social outcomes for tourism income and fishing if this situation is not ameliorated.

1. To protect corals, grazing must be maintained on all reefs (i.e., an MPA response is unlikely to protect all reefs), particularly those exposed to elevated nutrient levels;
2. The lagoon community should be provided with skills to quantitatively monitor the health of fish communities in the lagoon;
3. Marovo regional community groups should be facilitated, through the use of school resources (Batuna, Beka Beka, Seghe, etc), to produce an annual report card on fish community and ecosystem health to encourage wide participation in supporting conservation measures;
4. Community fishing practices should be reviewed to protect the sustainability of fish species with a focus on limiting the extraction of herbivorous fishes.

Sediments, benthic mats and decline in bêche-de-mer

Social Survey

Marovo People:

During numerous discussions with villagers the comment was made that bottom feeding fish (species) caught close to the villages often make people sick, but the same species when caught on the outer reef does not make people sick.

At a community meeting in June 2005 the puhaka (bêche-de-mer) divers asked why the benthic mat was changing color in places where there had been lots of bêche-de-mer extraction.

Comments from villagers and local fishers that certain fish if caught close to Vangunu would often make people feel weak for several days and experience strange dreams as well as the comment made by bêche-de-mer divers that the colour of the sediment appeared to be greener in area that they had heavily harvested alerted us to the need to investigate environmental factors that could influence benthic microalgal biomass and productivity in the lagoon. As benthic microalgae communities (BMA) are influenced by the availability of nutrients, light and grazing pressure it was important to quantify what environmental factors appeared to be driving changes in BMA communities in Marovo Lagoon. The lack of knowledge about the ecological role of 'bêche-de-mer' as well as other environmental factors on BMA in Marovo Lagoon is not surprising as these complicated interactions are at the microscopic level and hence often not well understood by community groups in many countries (including Solomons and Australia). The community concern over the banning of bêche-de-mer collection influenced the team's decision to investigate the impact of 'bêche-de-mer' as well as water quality on benthic algal communities.

Scientific Survey

Case study—benthic microalgal productivity in different light climates

Introduction

Large scale logging operations commenced on Vangunu Island in the early 1990s and, with very limited management of this resource, destruction of the catchment areas has been severe. Despite such activities having had a negative influence in many other shallow-water systems globally (Nixon 1995), the effect of this rapid modification to catchment areas on Marovo Lagoon has yet to be determined. Catchment modification typically results in increase pelagic primary production, declines in water clarity and decreased benthic primary production in adjacent waters. This study quantifies the patterns of modification in catchment vegetation and the patterns of gross benthic primary productivity in adjacent subtidal sediments.

Methods

Study Sites

Marovo Lagoon benthic substrate consists primarily of coarse-grained, carbonate sandflats interspersed by patch reef areas. Sites for the transect study encompassed the same gradient in water quality surveyed in other sections of this report including Merusu (nearshore site located near the Gevala river mouth), Tengomo (mid lagoon) and Bili Toba (near the outer barrier islands) (Fig. 3.21). Benthic incubations to determine gross primary productivity (GPP_{mid}) rates were conducted at a depth of 2 m at each site and sediment cores were collected to a depth of 20 mm for biomass analysis (n = 3).

Benthic productivity incubations

Benthic incubations were conducted by monitoring dissolved oxygen levels in light and dark containers. Cores were carefully inserted into sediments area ensuring that a 10 cm high water column remained above the sediment. Three light and three dark cores were used to measure GPP at each site. The dissolved oxygen level was measured in each chamber through the lid hole using a luminescent dissolved oxygen meter (Hach HQ10 LDO meter) at the end and beginning of each incubation and sealed with a rubber stopper during the incubation. Incubations were terminated on the appearance of tiny bubbles inside light cores, otherwise a 2 hour time period was used. Using a photosynthetic quotient of 1 (Falkowski and Raven 1997) and assuming an average day length of 12 hours (0.5 d) daily rates of carbon fixation were calculated using the methodology of Chapra (1997) and Grinham (2007).

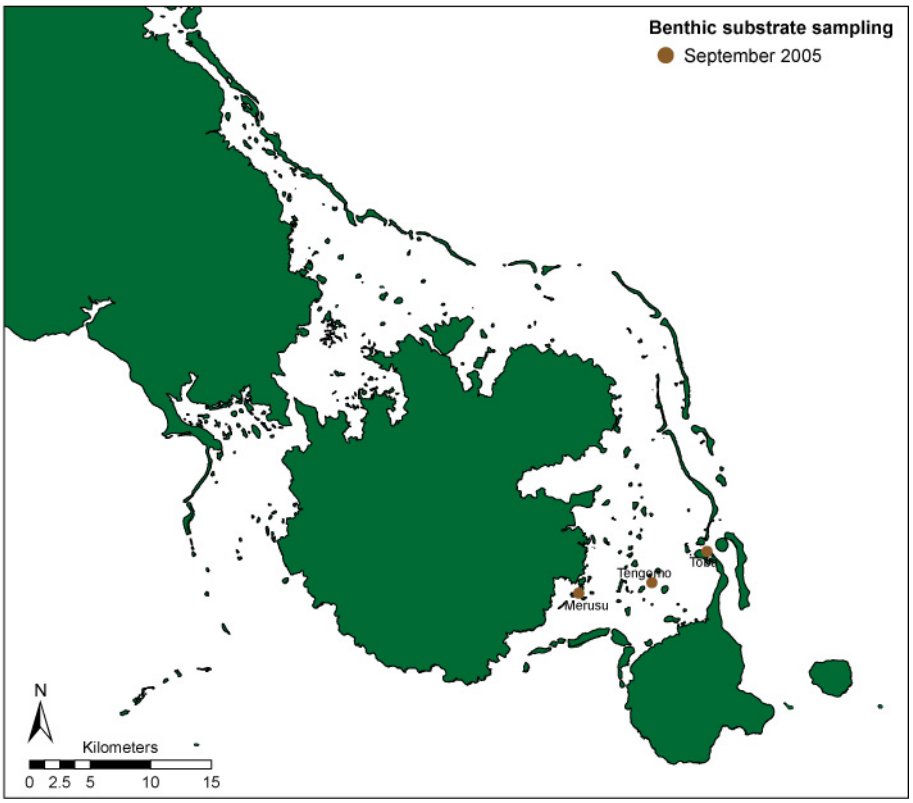


Figure 3.21: Grazing experiment sampling sites across southern Marovo Lagoon

Biomass estimation

Sediment samples were collected using a cut off syringe to sample a known surface area (5 cm^2) and placed in a cool dark container until transport to a freezer (< 6 h) and then to Australia for laboratory analysis (< 2 weeks). Benthic microalgal biomass was determined by estimating sediment Chl *a* content using the spectrophotometric technique of Lorenzen (1967).

Results

Site Characteristics

Water quality parameters from the intensive lagoonal survey revealed a strong decline in water clarity between the nearshore site (Merusu) and those further offshore (Tengomo and Bili Toba). Chlorophyll *a* content was an order of magnitude higher at the inshore site and total suspended solid content four times higher than the offshore sites. Secchi depth was at least five times lower than the offshore sites (Table 1). There was also an increased terrigenous sediment loading at the nearshore site with sediment carbonate content (20%) lower compared with sediments further offshore (80%) (Table 3.8). Salinity and water temperature were similar at all sites. There were small increases in total nutrient content of sediments and water column at the Merusu site (nearshore) compared to Bili Toba (offshore site) (Table 3.8).

GPP and sediment Chl *a* content

The gross primary production of benthic microalgal at Merusu (0.1 ± 0.01 g C m^{-2} d^{-1}) was only 10% of the carbon that was fixed at Bili Toba (1.2 ± 0.01 g C m^{-2} d^{-1}; $p < 0.05$), while sediments at Tengomo, in the middle of the lagoon, had highly variable rates of productivity (0.6 ± 0.2 g C m^{-2} d^{-1}) intermediate between the rates observed at Merusu and Bili, but not significantly different from either (Fig. 3.22).

Table 3.8. Site characteristics of transect study sites from intensive lagoonal survey in June 2005. Sediment carbonate values given as average ± SE (n = 3) no SE for other parameters as n = 1.

Site	Sediment Carbonate	Sediment Nutrients	Water Column	Total Suspended	Water Temperature	Salinity	Secchi Depth	Water Chl Content
	(%)	(µg L^{-1}) Total N Total P	(µg L^{-1}) Total N Total P	(mg L^{-1})	(°C)	(ppt)	(m)	(µg L^{-1})
Merusu	20±10	460 320	0.13 0.006	4.17	32.2	32.5	1.5	2.47
Tengomo	70±10	250 190	0.07 0.005	0.9	29.6	33.6	10.5	0.27
Toba	90±10	320 210	0.07 0.004	1.1	29.5	32.9	16	0.14

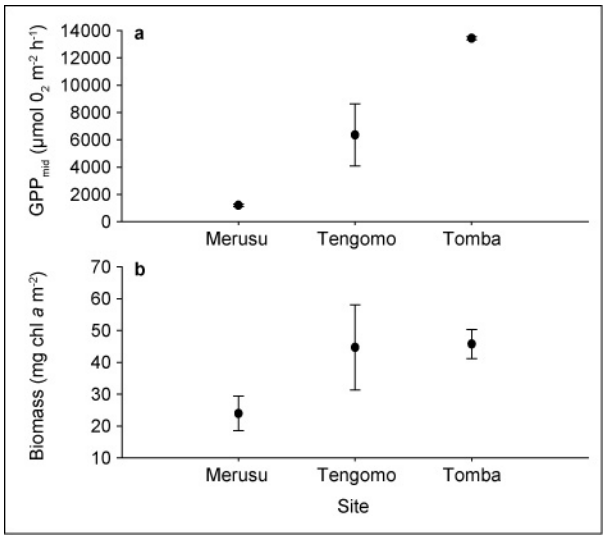


Figure 3.22: Changes in a) benthic microalgal productivity (GPPmid) and b) biomass across southern Marovo Lagoon. Error bars denote SE.

Discussion

Significant declines in the quantity of light reaching 2 m water depth and the very low rates of productivity recorded at Merusu suggest that reduced water clarity in this region of the lagoon is having a negative impact on the productivity of lagoon ecosystems close to Vangunu. As Merusu is adjacent to the mouth of the Gevala River, whose catchment has been heavily logged, it suggests that catchment modification over the past two decades is already impacting on benthic productivity. The two factors likely to have contributed to the low benthic productivity recorded at Merusu were lower benthic light (section 3.1) and lower benthic microalgal biomass than was observed at the other two locations in the lagoon. Although it is impossible to link these observed differences between sites with a specific cause, the conditions of lower benthic light flux in the Merusu area was maintained for the duration of the survey (12 days) suggesting that the suppression of benthic microalgal productivity and probably biomass may occur for significant periods in this region of the lagoon. In addition, following high catchment rainfall events, such as that observed on 15th September, reductions in benthic light probably occur across a larger spatial extent, resulting in sub-optimal rates of GPP of the BMA occurring in many regions of the lagoon.

The daily rates of carbon fixation observed at Tengomo and Bili (0.6–1.2 g C m^{-2} d^{-1}) were similar to rates recorded on shallow subtidal flats of a similar lagoonal system in French Polynesia (Charpy and Charpy-Roubaud 1990). (0.4–1.3 g C m^{-2} d^{-1}). However, productivity at Merusu (neashore) was well below the expected range expected for this climate suggesting that some environmental factor (light, nutrient, toxicant, other) is limiting nearshore productivity at this site.

Case Study—Sediment Nutrients and Bêche-de-mer

Introduction

The effects of catchment modification on the lagoon are further exacerbated by the removal of large quantities of bêche-de-mer for the lucrative bêche-de-mer fishery. A marked increase in this fishery occurred throughout the Solomon Islands during the 1990s (Fig. 3.23) and 50% was derived from the Western Province (Bruckner et al. 2003). Stocks are now so low that the Ministry of Fisheries implemented a moratorium on all bêche-de-mer exports in August 2005 (http://www.solomonstarnews.com).

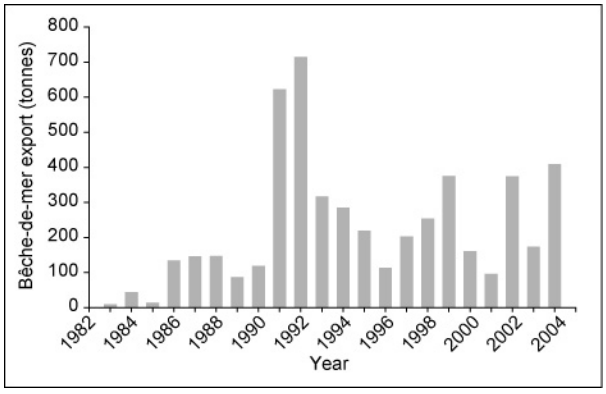


Figure 3.23: Increase of bêche-de-mer exports from the Solomon Islands during the early 1990s (Source: Kinch et al. 2006b).

No monitoring of the effect of removal of the bêche-de-mer population from lagoonal sediments has been conducted despite numerous studies demonstrating their importance to similar benthic communities (Massin 1982; Birkeland 1988; Uthicke 1999). Bêche-de-mer species in shallow coral lagoons are primarily deposit feeders, grazing upper sediment layers ingesting associated detritus, bacteria, microalgae and cyanobacteria (Yingst 1976; Moriarty 1982). The quantities of sediment grazed may be large (up to 25 kg dry wt individual^{-1} y^{-1}, Uthicke 1999) with the resultant bioturbation disrupting upper sediment structure, releasing interstitial nutrients and aerating lower, previously anaerobic layers (Massin 1982). The loss of important grazers coupled with slow recovery of over-fished populations (Uthicke et al. 2004) could have serious consequences for the lagoonal ecosystem. One consequence is that reduced bioturbation and increased nutrient availability could lead to benthic toxic cyanobacterial populations occurring in bloom densities (Bruckner et al. 2003). These effects need to be investigated as local communities in Marovo Lagoon have already reported recent dramatic increases in benthic cyanobacterial mats (Morgan Jimuru pers. comm.). The current study assessed the effect of bêche-de-mer grazing on sediments colonised by benthic cyanobacterial mats.

Methods

The grazing experiment occurred proximal to the Bili site in the southern lagoon (Fig. 3.24), in a small, sheltered inlet on shallow subtidal sediments (approximately 3 m below low water mark) evenly colonised by cyanobacterial mat (Fig 2). Three cages (0.25 m^2) were secured to the sediment surface (caged areas) and three uncaged areas (approximately 0.25 m^2) were marked out using dive weights between cages (control areas). Each cage was left open top and bottom but surrounded with plastic mesh (16 mm^2) on four sides. A single mature (~20 cm) bêche-de-mer (*Bohadschia vitiensis*) was placed into each cage, left undisturbed for five days and then removed. Cages were cleaned daily to prevent algal fouling. Productivity rates were estimated and sediment cores (20 x 20 mm) for biomass (Chl *a*) analysis (n = 3) were obtained prior to placing the sea cumber in each cage (day 0 = T0) and after their removal (day 5 = T5).

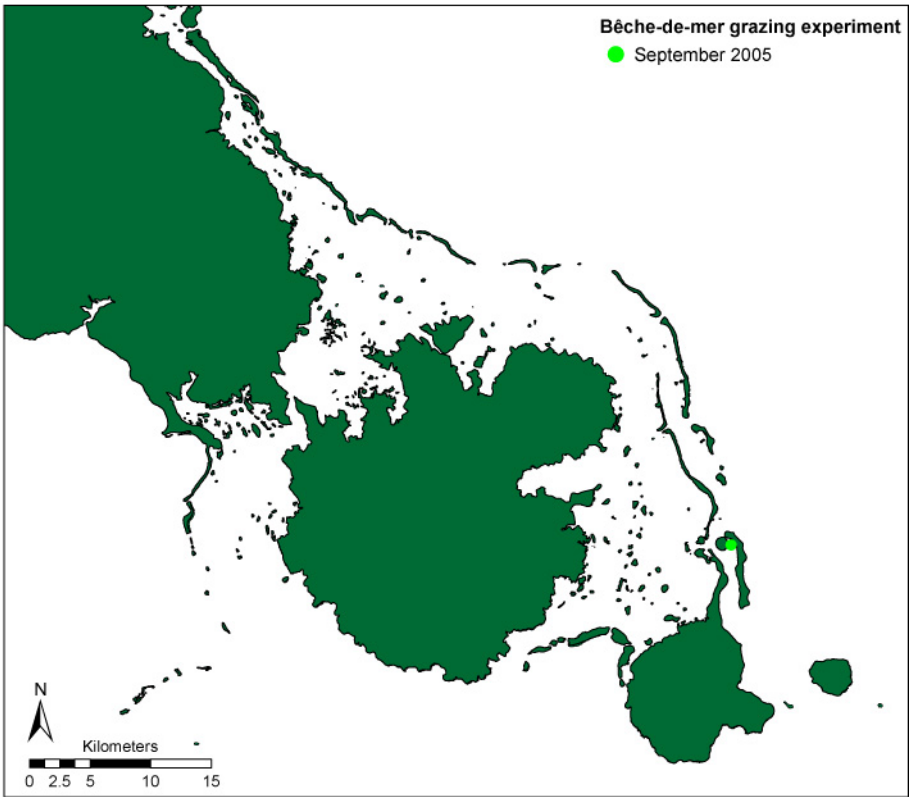


Figure 3.24: Bêche-de-mer sampling sites across southern Marovo Lagoon.

Benthic primary productivity and biomass

Measurements of benthic gross primary productivity (GPP_{mid}) and biomass were carried out following the same methods as page 64. A single light and dark core were used in each replicate area of the experiment, to determine the productivity for each replicate. Further details on the methods and statistical analysis conducted can be found in Grinham (2007) and the Technical Report.

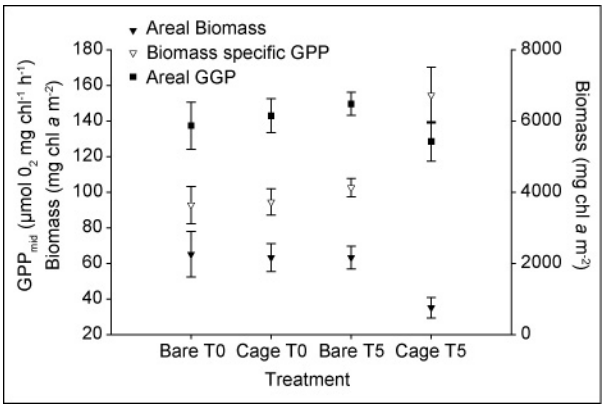


Figure 3.25: Changes in benthic microalgal biomass, productivity (GPPmid) rates and biomass-specific productivity (GPPmid) rates following addition of bêche-de-mer for 5 days. Error bars denote SE.

Results

The grazing experiment clearly demonstrated that the presence of bêche-de-mer in a region significantly decreased the benthic microalgal biomass and significant increased ($p < 0.01$) the rate of biomass-specific productivity compared to control areas with no bêche-de-mer present (Fig. 3.25). Although the total biomass of BMA was reduced in regions with bêche-de-mer, resulting in sediment that did not appear green, the subsequent increase in the productivity of the remaining BMA (biomass-specific productivity) meant that there was no significant difference in areal productivity rates in regions with or without bêche-de-mer.

Discussion

Grazing of the upper sediment layers by bêche-de-mer appears to be an important control of benthic microalgal biomass but not productivity. The reduction of benthic microalgal biomass by bêche-de-mer grazing although previously reported was under experimental conditions with grazing intensities 2–5 times higher than in the current study (Uthicke 1999, 2001). The increased in biomass-specific productivity rates observed in the current study suggest that the bêche-de-mer actually stimulate rates of primary production either by their physical break up of the cyanobacterial mat structure or the increase in bioavailability of nutrients that their bio-turbation creates. What ever the cause, these experiments suggest that, the ecological consequence of reducing bêche-de-mer in a reef environment is an increase in the biomass of BMA, but a subsequent reduction in its specific productivity. It is difficult

to predict all the flow on effects of this ecological change, except that a low biomass highly productive ecosystem is normally associated with high biodiversity and ecological health, while high biomass lower productive systems tend to have lower biodiversity (more often dominated by just a few species) with lower ecological health.

Potential ecosystem consequences
Increase in benthic cyanobacterial mat cover throughout Marovo lagoon has potentially dire consequences for lagoonal health. Currently there appears little nutrient input as a result of catchment modification. However, the establishment of the oil palm plantation on Vangunu island combined with year round high rainfall, is likely to result in greatly increased nutrient loading to large areas of the lagoon floor. The greatly increased nutrient supply could trigger cyanobacterial bloom cycles, which have been shown to negatively impact seagrass communities, fish stocks, tourism and human health (Osborne et al. 2001; Albert et al. 2005; Watkinson et al. 2005). The link between the reported increase in cyanobacterial mats and loss of the bêche-de-mer from the lagoon must also be explored as over-fishing of bêche-de-mer has been reported throughout the Indo-Pacific (Uthicke and Conand 2005). The current study cannot confirm the linkage between the reported increase in the cyanobacterial mats and the depletion of bêche-de-mer; however, the experiment demonstrates that their activity reduced microalgal biomass.

Major Findings

- Reduction in benthic light due to turbid water in nearshore environments appears to have had a negative impact on the productivity of benthic microalgae (BMA)
- Grazing by benthic feeders (specifically bêche-de-mer) appears to actually stimulate the biomass specific production rates of BMA, while also reducing its total biomass and possibly increasing its biodiversity.

Recommendations

1. Support local community efforts to reduce turbid run-off from land into adjacent reef waters (see page 44)
2. Support the government imposed restrictions on the bêche-de-mer fishery, while working with villagers to develop sustainable extraction procedures for a recovered population of bêche-de-mer;
3. Provide training in survey techniques so that villages can monitor their own resources and identify temporary closures to reduce the likelihood of a crash in the bêche-de-mer fishery;
4. Determine the expected recovery rates of various bêche-de-mer species and provide information to communities in designing their management plans; to provide a healthy seed stock population of bêche-de-mer;
5. Encourage communities to think of marine environments as gardens that need to provide a regular harvest, but also need care to maintain a successful harvest.

Social Impact

The dominance of benthic cyanobacterial mats in the sedimentary substrates between reefs, whether or not this is due to the reduction in the abundance of bêche-de-mer, is likely to fund major changes in sediment nutrient and overlying water column dynamics. Sediments will stabilize due to a lack of bioturbation. Combined with elevated sediment nutrient levels sediments will tend to become anoxic. This reservoir of sulfides and nutrients then awaits activation through resuspension by cyclonic events. The ensuing elevated nutrients are likely to stimulate water column algal blooms and result in coral mortality. Furthermore structural changes to the benthos is likely to modify food availability to lagoon fishes, restricting the abundance of macroinfauna and stimulating the abundance of the much smaller but potentially more abundant meiofaunal community. Bêche-de-mer depletion could potentially have system-wide effects that would attack the very foundation of sustainable livelihoods through major changes in lagoon resources.

Declining Reef Health

Social Surveys

The condition of coral reef habitats in Marovo is of critical importance in supporting the fisheries productivity of the region. There is general consensus among the Marovo community that the health of the reefs in Marovo has declined significantly in recent decades following commercial exploitation and logging impacts. These community perceptions of reef condition were quantified through household surveys and semi-structured interviews (Fig. 3.26; Table 3.9). In response to these concerns a scientific assessment was conducted on the structure of the reef communities and impacts of fish poison on corals.

Marovo People:

Coral reefs (*Saghauru*) are dying. Dynamite and the use of the poisonous leaf (*Derris*) damages the coral (*binubinuani/ patukae*)

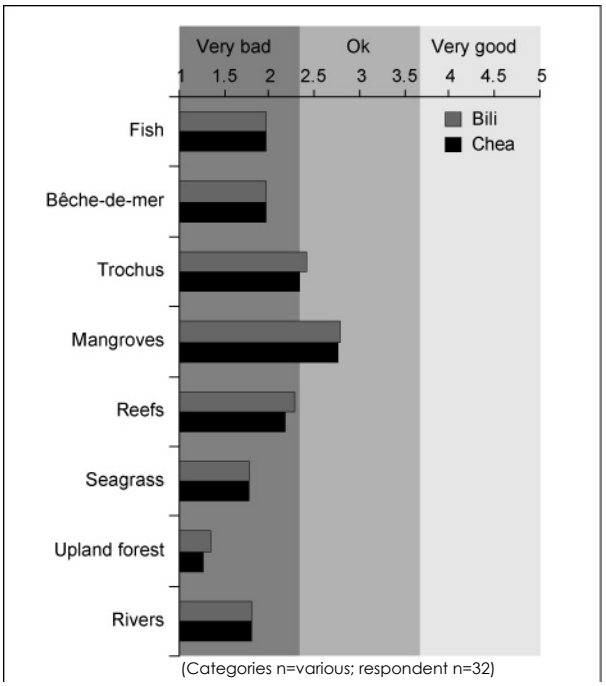


Figure 3.26: Mean measure of responses to 'health' of different ecological domains

Data are a mean measure of total responses to question (HHS: Q28): How would you describe the status/health of the following, on a scale from – (5) very good; (4) good; (3) Ok; (2) bad; (1) very bad (n=32) (Std.dev: Bili 1.07, Chea 0.81).

Table 3.9: Categories of environmental changes elicited by respondents

Response	Frequency
Fish and other marine species have decreased	15
Water is dirty	18
Coral is dying and changing color	4
No change	2

As an adjunct to the HHS, the CAQ also contained a number of statements relating to specific indicators of 'environmental change' (Table 3.10).

Responses confirm that people feel that significant environmental changes have occurred, especially in terms of increased water turbidity and overall coral reef degradation. A formal 'consensus analysis' of the agreement matrix reveals overall respondent consensus, with statistically valid eigenvalues for both Chea and Bili [Chea: Eigenvalues Factor (1) 25.730; (2) 0.966; Bili: Eigenvalues Factor (1) 25.568; (2) 2.344. These are much higher ratios of first-factor to second factor eigenvalues than the required 3–1 recommended (Borgatti 1992)]. Respondents in Chea showed more agreement and less deviation than informants in Bili; a trend evident throughout the research (Love and Ross 2006).

This sentiment was also highlighted as a Discussion Outcome of the Batuna worskhop, with participants agreeing that corals are dying, with dynamite and the use of poisonous leaf the main concern

The concerns formed the basis for the scientific investigations into lagoon health.

Table 3.10: Indicators of environmental change

Code	Statement	Bili		Chea	
		Disagree	Agree	Disagree	Agree
Q16EC	The sea (*idere*) is as clear as it has always been	28 (90%)	3 (10%)	27 (100%)	0 (0%)
Q3EC	There are as many giant clams (*ose*) in the lagoon as before	29 (94%)	2 (6%)	27 (100%)	0 (0%)
Q19EC	Some corals (*idaka*) have changed colour and become white	0 (0%)	32 (100%)	1 (4%)	26 (96%)
Q33EC	Some of the reefs (*saghauru*) are dying	0 (0%)	32 (100%)	0 (0%)	27 (100%)
Q34EC	There is less algae, Halimeda sp. (*tatalo*), than before	4 (14%)	24 (86%)	2 (8%)	24 (92%)
Q10EC	Dead tabular coral (*voa legudi*) are increasing in number	1 (3%)	31 (97%)	0 (0%)	27 (100%)
Q46EC	There is as much coral (*binubinuani*) as before	32 (100%)	0 (0%)	27 (100%)	0 (0%)

Source: CAQ (n=various, from 54–59)

Scientific Surveys

Case Study—Reef condition and mapping

Introduction

To assess the condition of the benthos through out the Marovo Lagoon a benthic habitat map was needed. Previous studies have conducted surveys of benthos in the area (TNC surveys in 2005) but no current map covering the complete extent of the study area is available. Spatial information on the benthos is frequently the basis for linking benthic information with other findings, such as water quality or faunal abundance and composition. Two approaches to characterize the benthos were chosen. First, detailed field photo transects, which give detailed insights into localised benthic conditions but which is limited in the area that can be covered (English et al. 1997; Hill et al. 2004; Roelfsema et al. 2004). In the second approach, field data are used to calibrate satellite imagery so that standard image processing will inter and extrapolate information on benthic cover(Green et al. 2000; Malthus et al. 2003; Mumby et al. 2004). The image based result is a habitat map with large spatial cover but less detail due to the limitations of remote sensing (Roelfsema et al. 2006).

Methods

The condition of coral reef habitats was assessed across two major transects from Vangunu to the outer barrier islands adjacent to Chea and Bili Villages. Transects of a 100 m in length were deployed on the benthos at maximum depth of 3 m. A diver took a photographs of the benthos at 2 m intervals along the transect line. Images were captured at a distance of 1 m from the seabed using a Sony Cyber shot in a marine pack housing and a 16 mm wide angle lens, so each photo covered a 1 x 1 m area. The snorkeller/diver capturing images also towed a waterproofed Garmin 72 GPS, to link GPS coordinates to each image (Roelfsema et al. 2004. Roelfsema et al. 2006).

Additional benthic surveys (photo transects and spot check) were conducted to gather information through out the study site for calibration and validation satellite imagery.

Photos were analysed using Coral Point Count Excel extension (Kohler et al. 2006). Twenty four random points were placed on each photo. Benthic substrate type was determined for each point (Joyce 2002; Roelfsema et al. 2004). The benthic features studied were coral (branching, massive, table, encrusting, soft), dead coral (branching, massive, table, encrusting), bleached coral (branching,

massive, table, encrusting), rock (clean, with turf, with crustose coralline algae), cyanobacteria, macroalgae (*Cladophora*, *Ulva*, *Dictyota*, *Padina*, *Sargassum*, *Caulerpa*, *Halimeda*), sand, rubble and diseased coral or bleached coral. The results of each photo analysis was then linked to coordinates and imported into a GIS software environment Arcview 3.2.

A benthic habitat map was created using Landsat 5 TM multispectral medium spatial resolution (30 m pixel) imagery. This type of imagery is historically available at low cost and is known for its ability to map benthic habitats in marine environments (Green et al. 2000, Joyce 2002, Roelfsema et al. 2004). The most recent archived Landsat 5 TM Scene with least amount of cloud cover was acquired at 9:30 am on 17 December 2002 of the Western Province. ERDAS ImagineTM imaging processing software was used to correct, enhance and analyse the satellite imagery. A subset of the digitally numbered images was created that covered the study area Marovo Lagoon. The subset was atmospherically corrected using a dark pixel correction (Jensen 1996). Land, deep water and clouds were masked out of the image, which was then unsupervised classified. The unsupervised classifications were then labeled to match up with the information gathered through benthic transects and spot check surveys, which then resulted in a study site wide benthic habitat map.

Results

Field Data

The reefs adjacent to Vangunu (CH1 and MR1) typically had low live coral cover (10%) compared to the offshore reefs adjacent to the barrier islands (20%-40%). A large amount of macroalgae (*Padina*, *Caulerpa* sp.) was observed overgrowing reefs adjacent to the Merusu oil palm development (MR1). Although no bleached corals were observed during the transects, significant bleaching of tabular and digitate *Acropora* was observed along outer barrier islands in January 2005. Coral types varied across the inshore-offshore transect from Merusu-Bili. Inshore reefs were dominated by massive coral species such as *Porites*. At sites further into the lagoon reefs were composed of massive and branching forms equally. Whilst offshore reefs were dominated by branching forms. Very limited (1–5%) soft coral communities were observed at some of the sites. Local fishermen have noticed significant declines in soft coral communities in recent years.

Image data were combined with field data. Figure 3.29 provides an overview of the three major habitat classifications derived from the remote sensing interpretation of a Landsat satellite image. A total of 164 km² of shallow habitats were identified, 40% of this area was occupied by shallow reef habitats, 37% of the area was deeper reef habitats and the remainder sandy soft bottom communities.

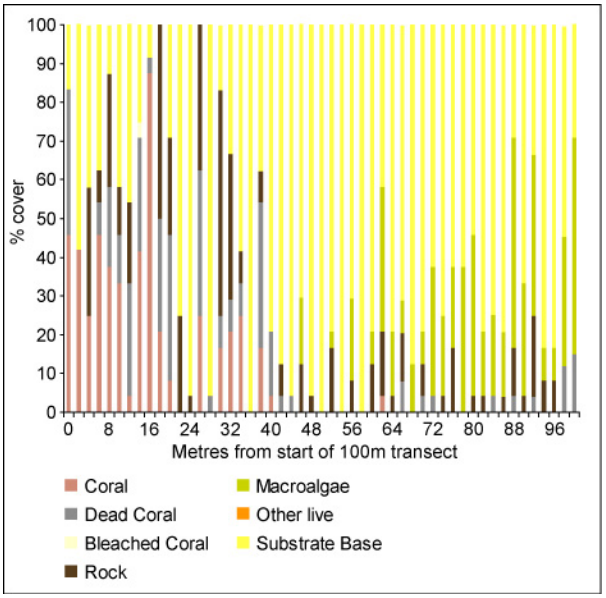


Figure 3.27: Example of a 100 m photo transect for Merusu 1.

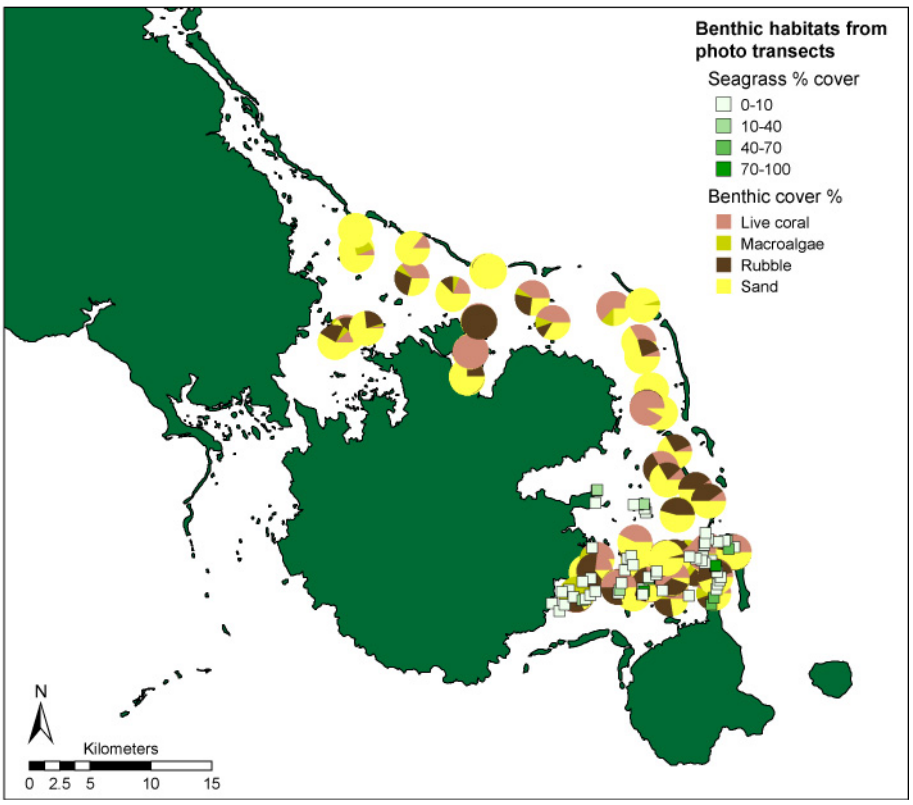


Figure 3.28: Major benthic cover types resulting from the benthic photo transect analysis for the South Eastern Marovo Lagoon region.

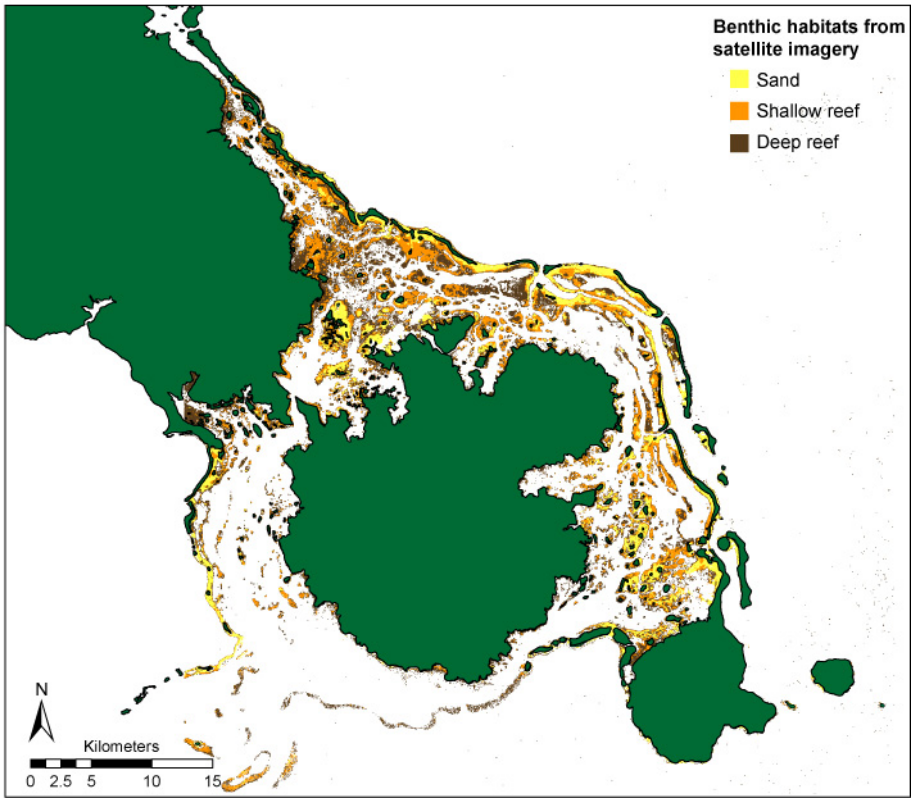


Figure 3.29: Benthic habitat map resulting from field surveys (spot check, benthic photo transect) and satellite imagery (Landsat 5 thematic Mapper) analysis for the South Eastern Marovo Lagoon region.

A closer inspection of the southern section of the lagoon along a transect from Merusu to Bili shows spatial patterns in the distribution of the shallow habitats. The majority of the shallow and deep reef areas are located towards the eastern (outer) side of the lagoon. The deep water between these reefs and Vangunu prevents the majority of sediments and nutrients from the land reaching this side of the lagoon, hence maintaining the reefs in a healthy state.

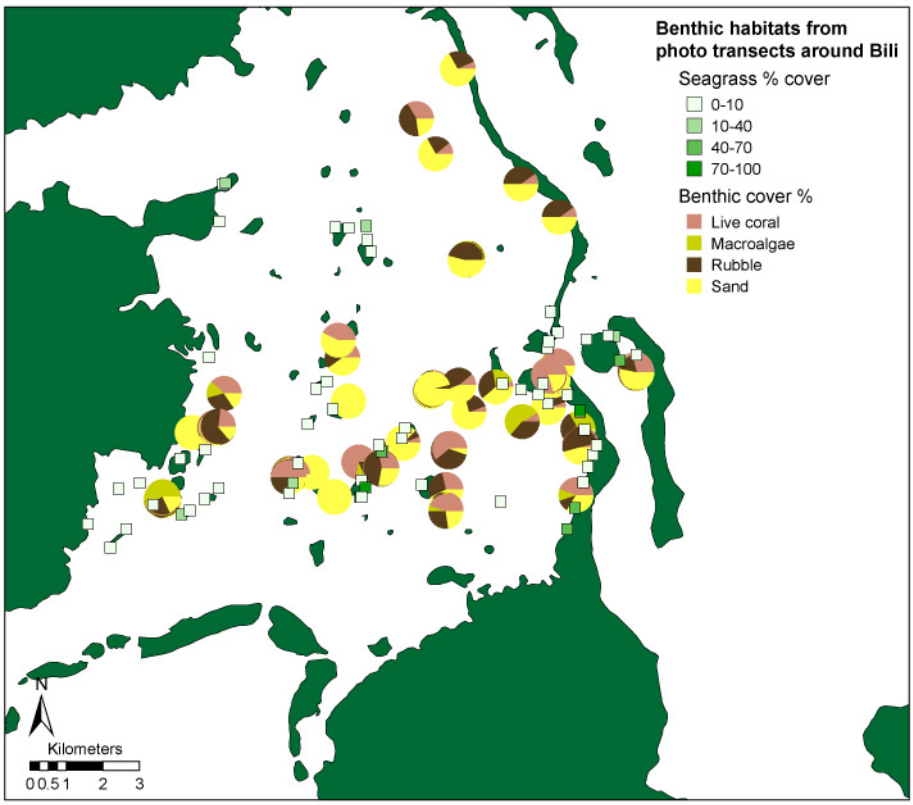


Figure 3.30: Benthic habitat map resulting from field surveys (spot check, benthic photo transect) and satellite imagery (Landsat 5 thematic Mapper) analysis for the Bili transect region.

Discussion

Remote sensing

The use of suitable low cost remote sensing imagery is limited due to either cloud cover or faults in the Landsat 7 scanner. The detail and accuracy of the benthic habitat maps could be improved by using higher spatial resolution satellite imagery such as Quickbird and Ikonos. This type of imagery could result in 10 or more different classification level and a resolution of 2.4 or 4 m instead of 30 m. There is archived Ikonos 2002 (4 m pixel spatial resolution) covering the whole of the Marovo Lagoon. Future work should consider purchasing this type of imagery. High spectral resolution imagery would increase the detail and accuracy even more but currently this can only be done using airborne sensors and the cost would be much higher then using Ikonos or Quickbird. The advantage of Landsat is that one can have historical comparisons over a larger time period since there is a 1989 20% cloud cover image of the same area. Notwithstanding the habitat classes that have been mapped in this report would possible not have changed significantly.

The three major habitats evident from classification of the satellite imagery were sand, shallow and deep reef. The sandy regions between the reefs provide important habitat for invertebrates such as bêche-de-mer and in the north-western lagoon are covered in dense seagrass meadows, which in turn provide important nursery habitats for marine fauna. Both shallow and deep reefs are composed of a mixture of branching and massive coral communities interspersed with rubble and rock. The close proximity of the sandy, reef, seagrass and mangrove habitats in Marovo supports the rich productivity and biodiversity of the fish community.

Inshore reefs adjacent to the large scale logging operation at Merusu have been overgrown by macroalgae and have significantly less live coral cover than reefs in the cleaner waters of the lagoon. Based on information collected from local fishermen these reefs have been recently degraded.

*Case Study—Impact of fish poisons (*Derris *root) on Coral Health*

Introduction

Many forms of plant-based fish poisons are used by subsistence fishers across the Pacific. The most common of these is *Derris* sp. vine, which contains rotenone. Rotenone acts by inhibiting oxidative phosphorylation, a critical step in cellular respiration, causing the fish to effectively suffocate. Whilst it is likely this process could also interrupt respiration and photosynthesis in corals, no experimental evidence is available.

Marovo fishers had noticed the regular use of *Derris* root on large coral colonies seemingly caused the coral to turn white and eventually die. In response to these concerns and requests, a small scale study was designed to assess the impacts of the *Derris* fish poison on the photosynthetic status of *Porites* coral near Bili Village, Marovo Lagoon. Whilst this experiment was restricted by time and equipment thus precluding sufficient replication for robust analysis of effects, it proved to be a very useful participatory project between the research team and local fishers. Much was learnt and shared by both parties.

An experiment was designed to test the impact of *Derris* on the health of *Porites* heads (massive coral) within Marovo Lagoon. The area of shallow reef inside the Bili barrier reef was used for this experiment as it contains many large *Porites* heads in close proximity. PNG *Derris* (*Derris elliptica*) was collected from the Bili village gardens and taken directly to the experimental site. Small pieces were broken and placed under a large (2 m) massive coral (*Porites* sp.). The local Marovo *Derris* (*Derris trifoliate*) was prepared in the traditional way by pounding leaves in a 30 cm deep hole dug in damp sand. The resulting leaf and sand combination was then placed under a separate massive coral (*Porites* sp.).

Pulse Amplitude Modulated (PAM) Fluorescence was used as a proxy for the photosynthetic condition of the coral in response to the *Derris* additions. Dark adapted (10 mins) photosynthetic yield (using Diving-PAM) was determined on five replicate locations on the two experimental coral colonies prior to *Derris* addition, and 20 minutes, 45 minutes, 135 minutes, 3 days (4395 mins), 8 days (11520 mins) after *Derris* addition.

Results

Initial (Fo) and maximum (Fm) fluorescence of the coral treated with the PNG *Derris* was stable for the first two hours of the experiment. On the third day following *Derris* addition a distinct whitening of the coral colony was observed and quantified by the reduced fluorescence (Fo and Fm) readings at this sampling point. After 8 days the photosynthetic status of the *Porites* had returned to baseline level.

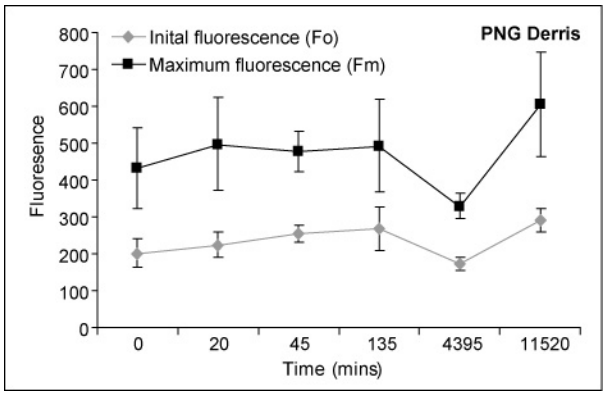


Figure 3.31: Graph showing PAM readings (Fo and Fm) for PNG *Derris*.

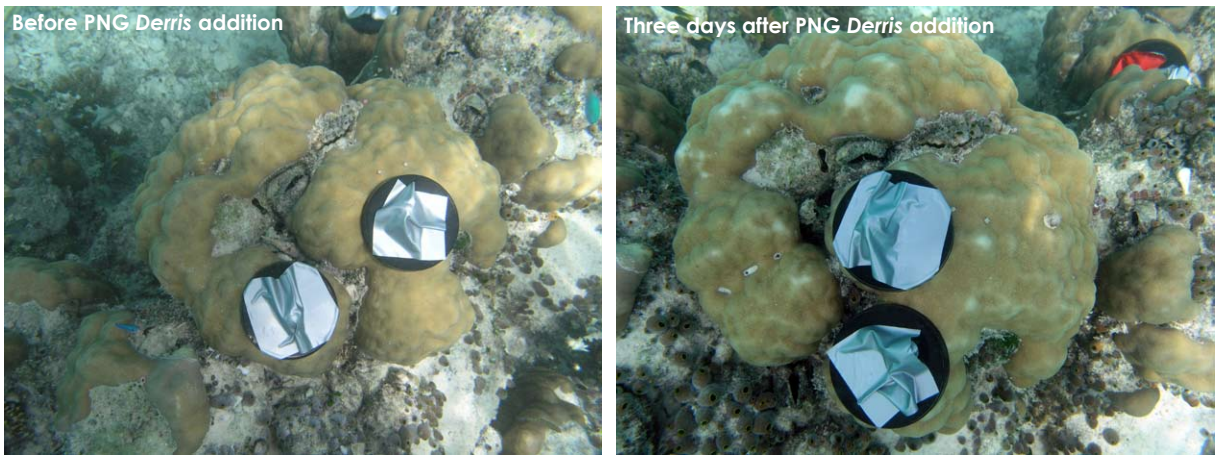


Figure 3.30: Photos of coral showing bleaching patch effects of PNG *Derris*.

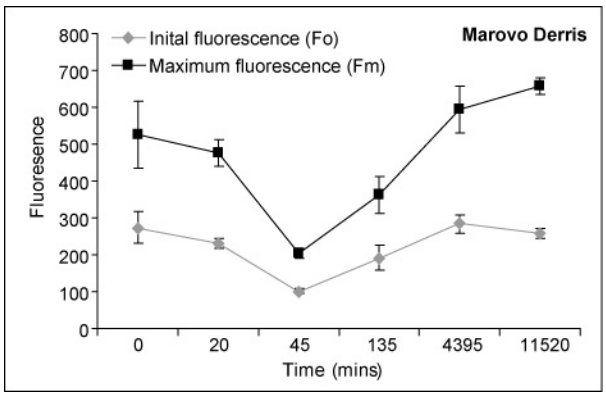


Figure 3.33: Graph showing PAM readings (Fo and Fm) for Marovo *Derris*.

A gradual reduction in both initial (Fo) and maximum (Fm) fluorescence occurred over the first 30 minutes following addition of Marovo *Derris* to the *Porites* colony. Recovery to baseline levels began after two hours and was complete three days after the *Derris* addition. Unlike the PNG *Derris*, no pale or bleached areas were observed on the *Porites* following addition of the Marovo *Derris*.

Discussion

Short term reductions in photosynthetic health of *Porites* coral was observed following the addition of both PNG and Marovo *Derris* varieties. The response and subsequent recovery to the Marovo *Derris* was more rapid (30 mins) than that of the PNG *Derris* (3 days). Photosynthetic health of both the PNG and Marovo *Derris* exposed *Porites* recovered to baseline levels after the 8 day duration of the experiment. This indicates no long term damage occurred. However local fishers informed the team that the pale coloration observed in the PNG *Derris* treated *Porites* becomes worse if PNG *Derris* is added repetitively (weekly or fortnightly) to the same *Porites* colony. Eventually the entire colony will become white and die in a fashion similar to coral bleaching. The colonies we used for this experiment had not been recently exposed to any *Derris* and it is likely this once off addition was not sufficient to assess the long term damage caused by repetitive *Derris* additions.

Key Findings

- Lagoon and barrier reefs in healthy condition with 20–40% live coral
- Inshore reefs are degraded with macroalgae colonizing dead corals
- 164 km² of shallow marine habitats; 40% shallow reef habitats, 37% deeper reef habitats and 23% sandy soft bottom communities.
- Both Marovo and PNG *Derris* caused short term reductions in coral photoynthesis
- Corals recovered quickly after the local (30 mins) and PNG *Derris* (3 days) was added
- Impact of repeated long term exposure to *Derris* is uncertain.

Social Impact

The majority of degraded reefs (low live coral cover) in Marovo are adjacent to the lagoon coasts of Vangunu, Gatokae and New Georgia. It is these reefs that are also close to villages and hence degradation has a direct impact on subsistence harvests. Generally the local community believe most of the degradation of the reefs in Marovo has been at the hands of logging companies (degraded water quality). However, studies of algae (an important reef health indicator) indicated both herbivory and water quality were influencing the algal community in Marovo.

Recommendations

1. Develop training opportunities for people in Marovo Lagoon to monitor the health of the reef, and especially the level of algal growth in the lagoon.
2. Use existing education systems (e.g. the school internet system) and local community organisations as a forum for exchange on reef health.
3. Circulate information about reef health and factors affecting reef health through workshops and/or information sheets (preferably in pijin or Marovo language).
4. Support locally formed community organisations to encourage alternatives to night fishing, and to encourage the development of locally-based governance and policing systems.

Detrimental land use practices

Social Survey

There is general consensus among the Marovo community that the health of the marine environment in Marovo lagoon had declined significantly in recent decades following commercial exploitation of upland ecosystems, and logging impacts in particular. These community perceptions were quantified through household surveys and semi-structured interviews. There was a strong community perception that the least healthy natural habitat was upland forests (Figure 3.26).

Problem Definition and Solutions—impacts of logging

Respondents were asked to nominate, unprompted, what (if any) they considered to be the major problem and/or threats to the health of Marovo Lagoon (Table 3.11).

Table 3.11: Threats

Main Threats	Bili	Chea	Misc. villages	% total
Logging	12	13	3	68 %
Over harvesting of fish	4			10 %
Waste (oil etc.)		2	2	10 %
Solomon Taiyo	1	2		7 %
Community disharmony	1			2 %
None		1		2 %

Source HHS:Q28 (n=32)

Logging, rather than over harvesting of fish, is unanimously (within Marovo community) considered the number one threat/problem in the lagoon. Although this sample is small, the emphasis on logging and the perception that over harvesting of fish is only a minor 'threat', is backed-up by anecdotal and informal information (field notes, observation)

Resource Management Issues. Both the HHS and the CAQ explicitly inquired about resource management issues. In the HHS, if respondents stated that they thought there were problems with the lagoon environment, they were asked if they had any ideas about how to solve these problems, and who should implement these solutions (Table 3.12).

Table 3.12: Solutions: What, how and who

What should be done	**Bili**	**Chea**	**Combined Total**
Better manage resources	5 (26%)	9 (56%)	39%
Stop logging/Not allow logging	7 (37%)	4 (25%)	29%
Better education	2 (11%)	0 (0%)	7%
Have enforceable community regulations	2 (11%)	1 (6%)	7%
Stop Solomon Taiyo (bait-fishing)	0 (0%)	1 (6%)	3%
Don't know	3 (15%)	1 (6%)	15%
Who should do it	**Bili**	**Chea**	**Combined Total**
Government and landowner	8 (42%)	5 (29%)	41%
Landowner/Community	2 (10%)	6 (35%)	21%
Government	4 (22%)	2 (12%)	15%
Company (with other stakeholders)	0 (0%)	2 (12%)	5%
Chief	1 (5%)	1 (6%)	5%
Help from NGOs	2 (10%)	0 (0%)	5%
Don't know	2 (10%)	1 (6%)	8%

Ideas about broad 'solutions' and who should implement them varied. The majority of respondents from Chea believed 'better management of resources' was the optimal 'solution' (56%), while in Bili 'stopping logging' was the most cited response (37%). Explicit processes to achieve such aspirations were inquired about, but details were rarely proffered.

Table 3.13: Consensus regarding 'Development' Issues

Code	**Statement**	**Bili**		**Chea**	
		Disagree	Agree	Disagree	Agree
Q26DEV	The money from logging and baiting is important for the country	18 (56%)	14 (43%)	26 (96%)	1 (4%)
Q8DEV	Logging is important for the national economy	23 (72 %)	9 (18%)	26 (96%)	1 (4%)

Batuna Workshop Discussion outcomes

At the Batuna Environment Day workshop, the overwhelming concern was about logging from most regional areas. It was people's opinion that logging has made lagoon water dirtier and caused family and community problems. The uneven distribution of material and financial equity derived from logging and bait-fishing royalties was noted. Logging was considered the most dominant threat to the lagoon, logging is the most noticeable large-scale commercial activity in the lagoon,

The most controversial 'development' to date has been the Malaysian owned Sylvania Oil Palm Plantation, situated on 10,299 ha of once forested land on the island of Vangunu. This 'development' promised to bring jobs, electricity, and a small metropolis to the island, but to date only 600 ha have been planted, a processing mill has yet to be built and it appears that the company's primary objective is logging: oil palm was simply a pretext to lure privileges from the government and to solidify their logging operation (see Riemana 2003).

Scientific Survey

Case Study—Mapping landuse change over time on southern Vangunu Island, 1989 to 2000

Background

The advent and rapid expansion of industrial logging and oil palm plantations to facilitate the short-term economic development of the Solomon Islands has caused great concern among locals and the international conservation community, especially those who cite the Marovo area for possible inclusion into UNESCO World Heritage conservation listing (LaFranchi 1999; Bayliss-Smith et al. 2003).
An economic study conducted by LaFranchi (1999) claims that the benefits provided by small-scale economic activities (i.e. using the forest and reef resources as food, shelter and cash income) exceeds those provided by the industrial alternatives, at least from a local perspective—and for resource sustainability.

Changing land use practices (most notably logging) in the Marovo lagoon region have had a real and noticeable effect on the landscape, which in turn is expected to negatively impact on biodiversity. This summary of findings of our brief assessment of land use cover using remote sensing tools provides insight into the extent of land use change in in southern Vangunu between 1989 and 2002.

Processing methodology

Land cover change was assessed using two image data sets including a 1989 Landsat 5 Thematic Mapper (TM) image and a 2002 Landsat 7 Enhanced Thematic Mapper (ETM+) image. Images followed a course of pre-processing and enhancement using standard techniques before information extraction and assessment. This process resulted in three output maps: two of land cover state (in 1989 and 2002) and one change detection matrix image detailing land cover change over this 13 year period.

A tentative list of land cover categories and vegetation species (based on Hviding, 2005) provides a classification scheme of the reef and forest environment of Marovo based on the *Puava* concept; that is, the separation of features into land, coast and sea categorisation rather than by taxonomy. The classification is used by the local population of Marovo and is illustrated in Chapter 2. It was considered advantageous to adopt these classifications for remote sensing work in Marovo, for reasons of communication and local relevance.

The preliminary classification scheme for mapping land cover change at Marovo was developed using forest cover categories developed by Bayliss-Smith (2003) and selected based on the applicability to image data available.

- Exposed ground (*Puava*): Bare soil types, tracks, logging roads/skids and so on.
- Grassland (*Checheu*): Grass, weeds, shrubs and other early successional species.
- Disturbed forest (*Kotukotuani*): Forest that is less dense than primary, where some previous disturbance is evident through logging, cyclone activity or other sources.
- Primary forest (*Goana Piru*): A combination of completely and partially shade tolerant trees where there is no evidence of disturbance.

The processing methodology carried out in this assessment followed a five-stage process, summarised as follows:

- Stage 1: Pre-processing operations including geometric correction and the creation of separate image masks to remove water bodies from both images.
- Stage 2: Spectral enhancement techniques including Normalised Difference Vegetation Index (NDVI) and Principal Component Analysis (PCA) were applied to both images followed by a stack layers operation.
- Stage 3: Additional pre-processing using an image mask to remove clouds from both images.
- Stage 4: Unsupervised classification of land cover classes into four categories (exposed ground, grassland, disturbed forest and primary forest).
- Stage 5: Post-classification assessment of defined classes (i.e., recode) followed by a temporal change analysis (post-classification change matrix).

Results

Three maps of land use and vegetation cover were produced, including:

- Satellite image of southern Vangunu in 1989 (Figure 3.34a)
- Satellite image of southern Vangunu in 2002 (Figure 3.34b)
- A change detection image of the area between these two periods (Figure 3.35).

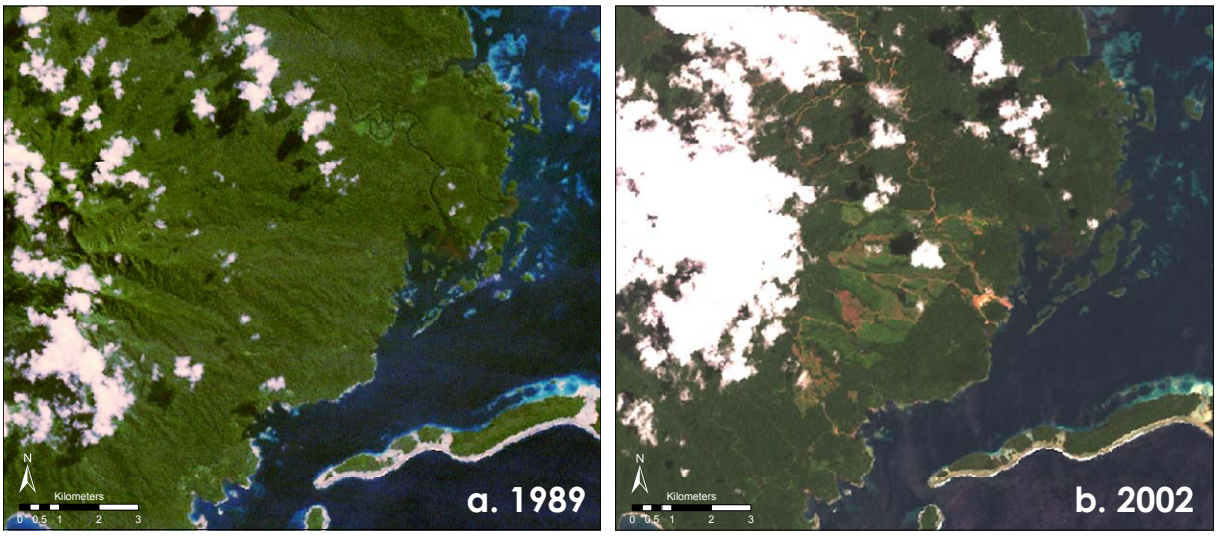


Figure 3.34: Landsat satellite imagery of southern Vangunu in 1989 and 2002. The impacts of the Merusu Oil Palm plantation can be clearly seen.

Land Cover in Marovo (1989 and 2002)

Land cover in Marovo was classified into four categories; bare ground, grassland, disturbed vegetation and forest.

Table 3.14: Land Cover 1989

Land Cover	Hectares	Land cover (%)
Bare Ground	96	0.9
Grassland	229	2.1
Disturbed vegetation	251	2.3
Forest	10322	94.7
Total	10899	

Table 3.15: Land Cover 2002

Land Cover	Hectares	Land cover (%)
Bare Ground	460	6.3
Grassland	525	7.2
Disturbed vegetation	572	7.8
Forest	5769	78.7
Total	7325	

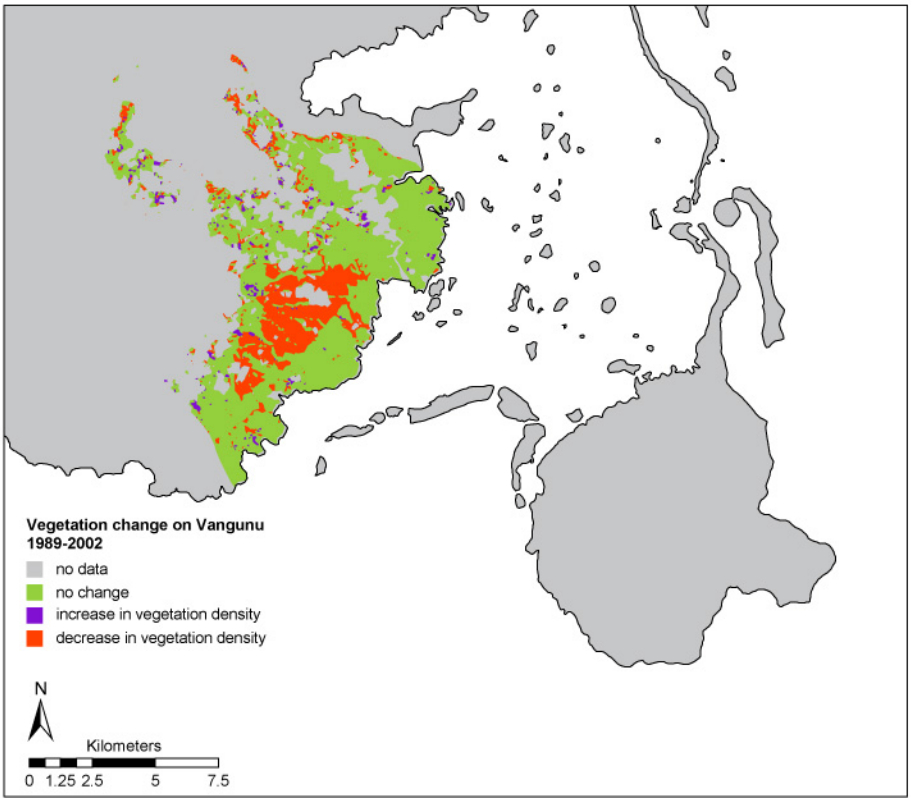


Figure 3.35: Land cover change assessment showing large-scale clear-felling from 1989 to 2002 of the catchment area of Gevala River, Vangunu Island.

Table 3.16: Post-Classification Change Comparison Matrix—Land Cover Area (hectares)

Hectares			**From 1989**						
			1	2	3	4	**Summary**		
			Bare Ground	Grassland	Disturbed	Forest	Static	Veg gain	Veg loss
to 2002	1	Bare Ground	5.55	3.62	1.77	407	5048	105	1413
	2	Grassland	0.25	0.25	0.59	513			
	3	Disturbed	4.37	4.63	6.56	486			
	4	Forest	25.82	34.82	35.3	5036			
					TOTAL:	6567			

Table 3.16: Post-Classification Change Comparison Matrix—Land Cover Percentage

Percentage			**From 1989**						
			1	2	3	4	**Summary**		
			Bare Ground	Grassland	Disturbed	Forest	Static	Veg gain	Veg loss
to 2002	1	Bare Ground	0.08	0.06	0.03	6.2	76.9	1.6	21.5
	2	Grassland	0.00	0.00	0.01	7.8			
	3	Disturbed	0.07	0.07	0.10	7.4			
	4	Forest	0.39	0.53	0.54	76.7			
					TOTAL:	100%			

Discussion

The impact of deforestation is most clearly seen in the south-eastern section of Vangunu Island where logging has converted a large tract of forest to bare soil, grassland and disturbed vegetation (Fig. 3.35). The grassland category is likely bare ground that has been colonised by weed vine and grass species. The areas of bare ground that have resulted from clear felling yield the high sediment loads observed entering the lagoon through the Gevala River.

Asner et al. (2002) and others claim that classifications based on Landsat lack the necessary spatial resolution to map the structure of rainforest features. As such, these methods could be considered on a qualitative basis only. While this is not expected to be an issue where wide tracts of forest have been felled (i.e., in the south-eastern section of Vangunu Island), assessment of the impact of selective logging areas has proven more difficult by comparison. It is important to note that post-classification accuracy assessment (such as an error matrix) is an integral part of any remote sensing work (Jensen, 2005 and Lillesand et al. 2004). At best, the information provided in this study should be largely considered on a qualitative basis only. Further remote sensing work accompanied by ground validation exercises is needed to provide a more accurate classification assessment.

For such reasons, the 21% reduction in forest density is a gross under-estimate since the satellite imagery was only able to pick up disturbance areas larger than a 25 m square pixel size. The selective logging methods used across most of Marovo had mostly caused disturbances on a smaller scale (less than 25 m) and hence do not show up in these analyses. These selective logging practices have modified approximately 80% of the Marovo catchment are likely to have a major impact on fragile rainforest ecosystem. Despite this underestimation, the remote sensing information does provide an important measure of change over time, in the future satellite images can be classified using the same methodology to determine if the rate of forest destruction is increasing or decreasing.

According to Hviding (2005), many areas over a century ago were cleared for large-scale taro cultivation and human habitation, lands which have since regenerated to dense rainforest. It is probable that those logged areas will continue to regenerate in a similar fashion provided that logging activities involve minimal clear-felling and plantations are not subsequently introduced following the removal of the rainforest.

Figure 3.36: Logging road at Merusu

Key Findings

- Between 1989 and 2002, around 21 % (>1400 ha) of primary forests on southern Vangunu Island were destroyed to become bare ground, grassland and disturbed vegetation.
- The majority of this change resulted from a degradation of fully forested areas to disturbed vegetation (7.4 %), grasslands (7.82 %) and bare ground (6.2 %).

Social Impact

There is considerable contention and social fracture in the community over several issues, and particularly in regard to the seemingly unfair distribution of royalty monies from logging rights received by certain individuals in the community rather than by a general public legal entity. This intra-community 'tension' is further exacerbated with community disputes arising in relation to the legal validity of the logging operation, plus the community's' real concerns about the unregulated environmental damage beyond that which is reasonable for resource extraction operations. Marovo communities now have tenuous subsistence livelihoods, which are thought to have been disrupted by marked declines in forest and lagoon food supplies and other living resources damaged by logging and, palm oil plantations. Future mining operations if developed will no doubt exacerbate this situation.

Recommendations

The Solomon Islands government has a series of legislative controls on the question and utilisation of timber rights. The Forestry Act and recent 2005 regulations define environmental standard for logging operations through the Code of Logging Practice (SIG 2003). Sound limits on riparian areas, steep terrain and high elevation harvesting have been set to ensure environmental protection. Recent revisions have also stipulated that companies process 20% of their logs locally. Unfortunately the majority of companies capitalise on the lack of enforcement of these policies seeming to operate illegally and destructively. It is clear the entrenched corruption associated with logging agreements and the remote nature of the provinces has prevented any attempts of Honiara-based enforcement of these policies.

Methods to empower local communities to ensure sustainability of forests include the following

1. Circulate information about land clearing to members of the community through workshops and/ or information sheets (preferably in Marovo language). Provide information about the available legal options for protecting environmental resources and resolving disputes.
2. Inform people of their rights under the Forestry Act.
3. Support the Solomon Island government to act on the recommendations of the Riumana (2003) investigation into the failed oil palm plantation, including clawing back all lost revenues associated with this company's oil palm activities. If successful, the monies could be used to fund alternative sustainable agricultural activities.
4. Support locally formed community organisations, such as the Marovo contact-network, that will encourage the enforcement of the regulations of the Forestry Act and the development of locally-based governance and policing systems.
5. Support Chiefs and other entitled Land custodians to pressure companies to comply with the Forestry Act's regulations.
6. Investigate and/or support research into alternative forestry and agricultural activities (such as commercial production of *ngali* nuts [*Canarium salomonense* and *C. indicum*]; orchid farming; and vanilla and chilli farming) aimed at improving rural based livelihoods.

Chapter 4

Strengthening community capacity

Mark Love

Annie Ross

Jennifer Corrin Care

This chapter provides an overview of project activities directly related to marine conservation capacity issues. The first section presents the results of our research into legislative issues related to environmental governance, including a discussion of national, provincial and customary laws relating to marine resource management issues. This research component was tasked with identifying resource related capacity weaknesses. The subsequent sections of the chapter document our local capacity strengthening initiatives, namely: literature resource outputs; community engagement and participation activities (community meetings and workshops); school-based engagement and capacity programmes; and the establishment of the regional 'points-of-contact' network, which aims to foster local/extra-local linkages.

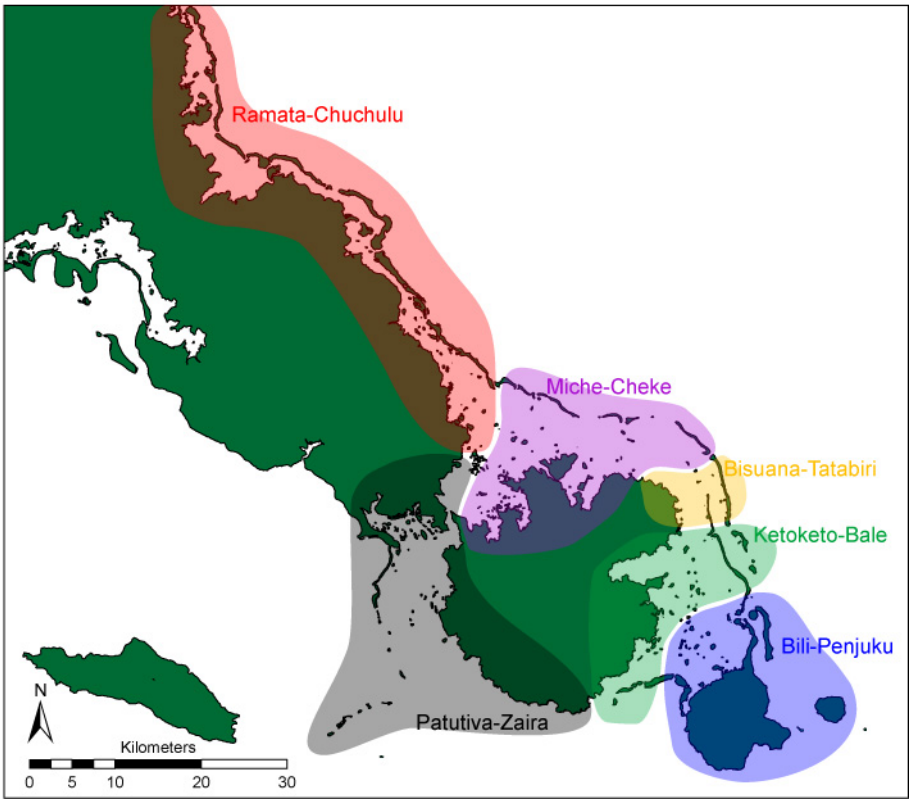


Figure 4.1: Regional areas of Marovo Lagoon

Environmental Governance: Legislative Issues

Background to the Legal Sector

The legal system of the Solomon Islands is an uncertain mix of statute (State) law and customary law. The position is exacerbated by the fact that a large portion of State law was not made locally, but was introduced during the Protectorate period and was carried forward at Independence. The Constitution is the supreme law, followed by locally enacted statutes, and then customary law, which is equivalent to English statutes of general application. The law also includes common law and equity, consisting mainly of rules developed in English courts. It is important to note that, outside the commercial centres, introduced law is generally of little account as disputes are governed by customary law.

The Solomon Islands is currently considering the introduction of a federal system of government. The final draft of the Federal Constitution of Solomon Islands Bill does not alter the hierarchy of laws except in some minor ways, which confound existing uncertainties. The Bill lists some aspects of justice as being within federal power and others to be held concurrently with the states. Custom is within the states' power and land and water and environment and conservation are concurrent powers.

In addition to our work, numerous other studies regarding environmental governance and related legislative issues have been undertaken in the Solomon Islands, namely: Corrin Care (2002), IWP (2003), McDonald (2006) and Ranken (nd.).

Findings relating to the Legal Sector and Environmental Governance

Initiatives taken by the team have highlighted a number of problems regarding the legal system which directly or indirectly relate to the effective management of coastal marine resources in Solomon Islands.

Customary Law

We identified four main issues relating to customary law that impact upon conservation aspirations in the Solomon Islands:

- The lack of clarity between different sources of law

While the hierarchy of laws can be broadly described as set out in the Introduction above, in practice, demarcations are unclear. For example, although customary law is theoretically superior to common law and equity, in actuality, where there is no legislation on point, courts tend to apply common law and equity without considering if there is any relevant customary law (Corrin Care 2001).

- The position of customary law within communities is slowly changing, and the authority of traditional leaders is weakening

While in Marovo chiefly office is certainly losing community sanction and respect, it is clear that people are reluctant to embrace other systems of governance completely. Our social research elucidates, not surprisingly, that people do not want to forgo hundreds of years of cultural heritage. Nonetheless, people are realistic about the limits of chiefly office and customary governance generally, and are increasingly critical of, and vocal in relation to, traditional authority (see Seghe workshop details, below). Regardless, Chiefs remain very important, both practically and figuratively.

- An increasingly large number of factors influence people to go outside the customary system to challenge the customary position in the State courts, particularly in relation to valuable natural resources

The 'fluid' nature of *Kastom* generally (Hviding 1998; Keesing and Tonkinson 1982), combined with uncertainties about land ownership, further complicates this issue. For example, historically in Marovo robust intra-cultural tribal and social differentiation existed between 'people of the coast' (*tinoni pa sera*) and 'people of the bush' (*tinoni pa goanna*). While still an important cultural dichotomy, this 'bush/coastal' identity, along with genealogical reckoning, is increasingly contested. With some individuals having stronger customary 'ownership rights' (*nginira*) than others, it is not uncommon for people today to emphasise their 'bush side' or 'coast side' selectively, to amplify lineage connections (*soto*) to suit circumstances and economic aspirations (for example, to gain access to logging and bait-fishing royalties). In one of the villages in which this project worked, examples of such contested genealogical 'fluidity' emerged as a major destabilising factor in terms of community homogeneity.

- The lack of clarity between different customary laws

Customary law is not a homogenous body of rules; it differs from island to island, and even from group to group on the same island. The religious orientation of a community further influences intra-cultural customary law issues. In Marovo, for instance, there are Seventh Day Adventist, United Church and Christian Fellowship Church communities. Each different denomination has subtle historical and socio-political particulars that impact differently on resource use, communal homogeneity and how customary governance is applied and sanctioned. Where customary laws differentiate between groups, it is unclear which law will prevail, although it is possible that the customary laws in question will supply the answer (NZLC 2006).

Tenure Issues

Over 80% of the land and inshore waters of the Solomon Islands is deemed customary land and directly used and controlled by local customary governance systems. Most Solomon Islanders believe that customary landowners have complete rights over their land and resources, and the State has no authority to control land use. This belief may stem from the Constitution. However, this does not accord with the legal view that areas below the high water mark belong to the Crown (although there is conflicting case law on this in the Solomon Islands). Even where land is above the high water mark,

it is arguable that constitutional recognition does not confer superior private property rights to those recognised by the common law, and that the State can interfere if it sees fit (as long as this is preceded by consultation and compensation is paid if land is acquired) (McDonald 2006).

We identified the following weaknesses related to tenure that currently affect environmental governance in Marovo:

- The lack of appropriate, clear and effective legislation to regulate natural resources and environmental matters, including a comprehensive scheme governing land and marine ownership

This contributes to creating legal uncertainty as to the ownership of land and reefs below the high water mark.

- The lack of an effective system of dispute resolution in relation to land and natural resources

This point was echoed by participants at the Seghe Workshop (see below), who stated that the Western Provincial Customary Land Appeal Court was no longer an impartial or effective arbiter of land disputes.

- The lack of enforcement of the existing legislative regime relating to natural resources and environmental matters

A lack of capital (financial and human) means that the effective enforcement of resource management laws is extremely difficult. The State can simply not afford to enforce its own legislative decrees. Further, as attested by the recent Fisheries and Forestry audits (SIG 2005a, 2005b), instances of public service bribery and corruption are high, and there is a general culture of laxity and a disregard for 'western' notions of accountability.

- The lack of clarity concerning the areas of authority between national and provincial governments and their law making powers

The Provincial Government in the project area has passed the *Western Province Resource Management Ordinance* 1994, which gives some legal standing to community resource management arrangements (MacDonald 2006). However, there are a number of problems with this, including questions of scope and jurisdiction and lack of adequate enforcement mechanisms.

We would highlight the first point—the lack of adequate legislation providing for the legal recognition of land management groups—as one of the most substantial stumbling blocks to developing sustainable, long-term, community-based conservation initiatives in Marovo. Unlike some other South Pacific countries, such as Papua New Guinea, the Solomon Islands does not have any legislation allowing customary groups to record their interest in land. The *Customary Land Records Act*, Cap 132, provides for the recording of customary land holdings, the names of land-holding groups and their representatives for the purposes of any dealing with recorded land. However, although the legislation has been passed it is not operational. In any event, recording under the Act does not give land owners any status regarding their land in the State system unless they register it under the *Land and Titles Act*, Cap 133. This is problematic as registration involves alienation.

Legislative Awareness

The final area highlighted by our investigation concerns a general lack of awareness by the people of Marovo of legislation (at both national and provincial levels), constitutional matters, and legislative practice, and the impact such legislative provisions may have, potential and current, on local land/marine resource issues. The main issues are:

- The lack of understanding by local leaders, resource owners and members of society generally of the State system of government and law and how they interrelate with the customary sphere

This 'knowledge gap' leads to unrealistic expectations and a false sense of security regarding the enforceability of existing measures designed to protect the environment.

- The lack of information in the community regarding the available legal options for protecting environmental resources and resolving disputes

This was highlighted by several informants during our social research activities, with numerous people noting that the reason the IWP and Seacology MPAs were not working, and unlikely to work in the future, was that there was no legal recognition of them (see Chapter 5).

- The lack of information in the community regarding shortfalls in State law and the legal system and its interaction with customary law and authority

This hinders community efforts to advocate for the change required to enhance the operation of community based resource management.

Achievements in relations to the Legal Sector

In response to suggestions arising from attendees at the Batuna meeting regarding the need for some kind of pan-Marovo 'resource association', the UQ research team conducted an analysis of the legal position relating to the recognition of such community groups in the Solomon Islands. As mentioned above, there is no legislative provision for this, although there are other legal options allowing individuals to join together to pursue a common enterprise. A positions paper regarding Members' Associations in the Solomon Islands was produced in relation to this matter (see Appendix).

Some additional research was also conducted in relation to the legal situation surrounding Conservation Agreements or Covenants in the Solomon Islands context. This was precipitated by the development of a Conservation Agreement with the customary land owners of Biche village and its surrounds. Currently there is no legal recognition of such agreements and no way customary owners can enter into a legally binding agreement with another party that protects a resource (in this instance trees) from exploitation. Further, it is not legally possible to protect forest by buying a logging license and paying royalties to a community in lieu of logging without actually extracting the timber.

Conclusion

Solomon Islands communities no longer live in isolation. Increasingly they choose or are forced to interact with outsiders, including other customary groups, expatriate entrepreneurs and with national and provincial governments. To be successful and sustainable, community based resource management must be on a firm legal footing. At present it is not. Clarifying the legal position of community resource managers, assisting communities to further understand the shortfalls of the State legal system and laws and its interaction with customary law and authority, and equipping communities to negotiate the changes necessary to enhance the operation of community based resource management is essential to any long term conservation aspirations. A list of appropriate recommendations, based on this research, is included in Chapter 7.

Education: Strengthening Local Capacity

Objective (6) of the original project proposal was to:

- Produce educational aids in the form of posters, leaflets and local trainers' guides to natural resource management issues to assist in communicating our findings to the community(s) and provide a catalyst for change.

This objective was achieved via numerous strategies and tangible outputs:

Literature Resources

The project produced and distributed a wide range of paper-based resources, including: Fact Sheets; Fieldtrip Information Handouts; Posters; Community Reports; and a Sabbath School Activity Workbook. In response to local requests, we have also recently disseminated copies of the SIG Fisheries and Forestry Audits and a report on the Marovo based Malaysian owned Sylvania oil-palm plantation, using the project facilitated 'points-of-contacts' network (see below).

Engagement and Participation

We undertook a concerted effort to develop a sustained programme of productive community engagement. Going beyond merely community consultation and knowledge extraction, we attempted to develop an equitable two-way platform of knowledge exchange that respects and acknowledges local culture and knowledge.

School Engagement and Capacity Strengthening
Village-level engagement and participation was supplemented by regular visits to local schools. A focus group discussion with students and teachers was held at each of the Marovo Secondary Schools, and an environmentally themed essay competition was conducted to coincide with the Batuna workshop. Two Primary Schools were also regularly visited by project personnel, resulting in a class-room project and a drawing competition. Finally, project personnel negotiated the offer of two University of Queensland diploma scholarships for one teacher from each of the two Secondary Schools in Marovo.

Building Local Networks and Extra-Local Linkages
The project helped facilitate the interim formation of a pan-Marovo 'points-of-contact' network. These contacts act as informal representatives for regional collections of villages and are responsible for ensuring the dissemination of information to all the communities in a given region of the lagoon. The objective of the network is to provide a tangible and effective means with which to distribute and exchange information, enhance collaboration and facilitate equity and inclusion between local and extra-local agencies.

Providing resources to locally based NGOs and SI government departments to attend and contribute to the project initiated workshops at Batuna and Seghe (see below) also resulted in productive multi-party inputs and has laid the foundation for more productive collaborations in the future.

Project-Community Literature Outputs

Information Handouts
The project produced and distributed a wide range of paper-based resources (laminated for longevity). Written in the Marovo vernacular, a range of Environmental Fact Sheets and Posters were disseminated, covering topics including: fish, seagrass, mangroves and coral (see Appendix). Additionally, during each field-visit we circulated Information Handouts, outlining the overall project focus, specific trip details and objectives, and introductions to relevant project personnel. This proved a popular and effective medium, and the photos of each team member included in the handouts soon ensured that everyone knew us by name.

Community Report
A major Community Report, detailing preliminary project results, was produced in June 2006. Written in both English and Marovo, the report was translated by Marovo people at both the village and urban level. Richly illustrated and presented, the Community Report was widely distributed at the Batuna meeting (see 4.2.2.1) and helped stimulate constructive discussions. In addition to presenting selective results, the report also contains 'educational' information designed to target certain 'knowledge gaps' identified by our social research (such as the interconnectivity between nutrients, fish, and lagoon ecosystem functions and the importance of mangroves in sustaining the health of fisheries and in mitigating coastal erosion).

<u>Addressing knowledge change</u>
Although local knowledge of fish aggregations, spawning times and other direct utilitarian concerns are extensive in Marovo, as Johannes (1998) has correctly noted, Pacific island fishers often have limited knowledge of key aspects of the life history of fisheries (see also Foale 2002; 2006). It is clear from our research that some of the local knowledge that Marovo people have regarding their environment is beginning to be eroded—especially amongst younger generations. Forty-five percent of Solomon Islanders are under the age of 15, and frequent and direct contact with the micro-local environment is diminishing. Young people are obliged to attend boarding schools outside their home *puava*, and many people migrate elsewhere. This results in less experiential contact with the local environment (relative to the past), and is resulting in a dissolution of local knowledge systems. Further, some commentators argue that the 'modern' school education curriculum is also eroding the practical foundation on which 'traditional' management systems are built (Ruddle 1998). This has recently been partially redressed through the production and distribution of a local 'environmental encyclopaedia' (Hviding 2005) which contains over 1,200 entries organised around local biotope classification. This is an extremely important and useful document whose value to Marovo people can be enhanced through explanations of scientific principles such as interconnectivity, and ecosystem function.

Some of the baseline data gathered during this project and presented in the Community Report made available to Marovo people at the Batuna meeting provides a basis for an extension of knowledge and understanding in these areas that are so important for marine resource management.

Batuna Meeting Report
A smaller additional report was distributed during the final project trip in September (see Appendix). This document summarises the main outcomes of the afternoon discussion section of the Batuna workshop, and was produced at the request of locals who could not attend the Batuna meeting.

Sabbath School Activity Workbook
The final literature-based output was the production of a Seventh day Adventist (SDA) Sabbath School Activity Workbook (see Appendix). This workbook was developed in consultation with the Head Pastor of the Seventh Day Adventist Church in Marovo, Pastor Newton Gelo. The workbook builds on the theme of 'environmental stewardship' extant in some sections of the Bible, with the aim of reinforcing a 'conservation ethic'. The book, designed for Saturday Sabbath School classes, contains numerous activities, songs, games and ideas for discussions relating to natural resource issues. Although only a pilot project, the workbook is currently being used in the communities of Bili, Chea and Peava, and we have been requested to produce an appropriate United Church version.

The development of an 'adult' version, based on the same themes but for use by church groups such as the women's Dorcas assembly and the Adventist Men collective, is planned for the future.

Community Engagement and Participation

In the Pacific, project dependency arising from aid is a well established phenomenon. So, too, is suspicion and cynicism towards research bodies that do not adequately recognise and/or articulate the necessity for 'findings' to be made applicable, or ensure that an equitable transfer of skills to locals is part of the research process (Baines 1993). Learning from the mistakes of others—such as WWF and Greenpeace (see Foale 2001; Hviding and Bayliss-Smith 2000)—we made a stringent effort not to raise community expectations or attempt to uncritically apply 'western' templates of egalitarianism or 'conservation' where they were not welcome. Engaging in a culturally appropriate manner required dealing regularly with respected community leaders (*palabutu*) at the beginning of each visit, and holding regular community meetings to discuss our progress. We also negotiated a Memorandum of Understanding (MOU) with each community (see Appendix), and our anthropological researchers received permission from both communities that formed the focus of research, and the University of Queensland Ethics Committee, before undertaking fieldwork.

We conducted regular community meetings in Bili and Chea as well as additional meetings with important community representatives in Honiara and Gizo. As the momentum of the project developed and our exposure in the lagoon increased, other communities began to contact us, requesting assistance and further information regarding our work. Resources limited us from expanding the project too widely, but we decided to conduct a pan-Marovo workshop to disseminate our results and to stimulate discussion with a wider and more representative sample of Marovo communities, by organising a Marovo Lagoon 'Environment Day'. Planning began seven months prior to the workshop, with project personnel visiting the majority of communities in Marovo to deliver invitations and hold meetings with each village Chief or his representatives. In May and early June, just prior to the meeting, further invitations were delivered and transport and petrol arranged for one canoe-load of people from each village to attend the meeting.

Marovo Lagoon Environment Day: Batuna Workshop
On 22 June 2006, the UQ project team hosted the 'Marovo Lagoon Environment Day' at the Seventh Day Adventist Vocational School at Batuna. The workshop was attended by over 300 people from more than thirty communities, and received national press coverage (see Appendix). After a prayer from Pastor Newton Gelo and the obligatory opening speeches, project members conducted a half-hour presentation using power-point images and themes from the Community Report. Representatives from World Wildlife Fund for Nature (WWF), Conservation International (CI) and the International Waters Project (IWP) followed with brief presentations. We were also fortunate to have representatives from the Tetepare Descendants Association (TDA) and the World Fish Centre (WFC) at the meeting. The

rationale behind supporting such institutional inclusiveness was to help facilitate (and in some cases reinvigorate) linkages with relevant in-country agencies that might result in future collaborations.

After lunch, attendees gathered into groups representing six different geographically defined regions of the lagoon. Each group nominated a Marovo facilitator and note-taker, and a UQ representative was assigned to each cluster. The names and contact details for each person were recorded, as were the main points discussed. At the conclusion of the discussion each regional group reported back to the meeting. Summaries of group discussions are presented in Tables 4.1 and 4.2.

The meeting was closed with a Melanesian feast prepared by women from the Bili and Chea communities.

Table 4.1: Batuna Workshop Discussion outcomes I

PROBLEMS: Environmental Issues
• River (*kavo*) and lagoon waters (*idere*) are increasingly dirty (*nije via*)
• Fish (*ihana*) are smaller and harder to catch than before
• Coral reefs (*binubinuani*) are dying
• Logging has made the lagoon water dirtier and caused family and community problems
• Resources used for carving and weaving are becoming over-harvested
• Dynamite and the use of the poisonous leaf (*buna buna*) has damaged the coral (*binubinuani*)
• Over-harvesting of bait fish is having a negative impact on the lagoon

Table 4.2: Batuna Workshop Discussion outcomes II

SOLUTIONS: Management Ideas
• Establish some kind of Marovo 'environment association' made-up of regional groups
• Outside assistance needed to help with establishment and costs of the association
• Education should be a focus of any such association
• *Kastom* fishing management practices (*hope* and *tabu*) should be reintroduced
• Land and marine resources are an important source of income and subsistence, and this must be recognised by any management initiatives
• Eco-lodges need to be supported

Area Representatives Meeting: Seghe Workshop

On Thursday 28 September 2006, we conducted an additional meeting at Seghe, the administrative centre of Marovo Lagoon. This meeting was a response to requests from some participants at the Batuna meeting and other interested parties who were not able to attend the previous gathering. The workshop was primarily designed to accomplish three objectives:

1. Distribute more copies of the Community Report and dispense a small report based on the Batuna workshop outcomes;
2. Facilitate the formation of a regional representative 'points of contact' network; and
3. Canvas local views regarding what any future UQ project should focus upon.

While it proved difficult to arrange for senior SI Government officials to attend the Batuna meeting, at Seghe we were fortunate to have Mr. Aseri Yalongono, from the Ministry of Education and Human Resources Development, adjudicate and present at the workshop. Numerous issues were discussed at the meeting and all our objectives were fulfilled. The intimate nature of the gathering, combined with the accumulative 'good-will' the project had engendered (especially over the final year) resulted in a forthright discussion.

At the close of the meeting, participants formally endorsed the UQ project and signed a 'document of support' for the continuation of UQ's work in the lagoon (see Appendix). Attendees also nominated and chose individuals as interim regional 'points of contact'. An overview of topics and issues discussed is presented in Table 4.3, and elaborated upon below.

Table 4.3: Seghe Workshop outcomes

THEMES: Workshop Discussion Topics
• Governance: The issue(s) surrounding 'traditional' governance—its importance, limitations and strengths—was openly discussed. What is the role of the Council of Chiefs in environmental (and wider social) governance matters? How can Chiefly office regain some of its diminishing community support?
• Representation and Inclusion: The challenges associated with facilitating community inclusiveness and appropriate lagoon-wide representation were raised. Why do some communities receive more assistance than others? How can wider and more equitable mechanisms be activated that will ensure genuine opportunities for inclusiveness in the future?
• Ideas for the Future: An open forum was held regarding participants' ideas and suggestions for the future. What are the key priorities? Where does World Heritage fit in the overall scheme of things? What are the limitations and strengths of UQ's capacity, and with these in mind, what would people like to see tackled in any future UQ-Marovo effort?

Implications: *Governance*

A clear message from participants of the Seghe workshop (and also elucidated by our social research) was that people are losing respect for many of their Chiefs. The Chiefs currently sitting on the Western Provincial Customary Land Appeal Court were particularly criticised and clearly viewed with suspicion by many. The selective nature and limited focus of the 'Council of Chiefs of Marovo' was also highlighted. People expressed a desire for the Council to broaden its agenda beyond its current focus solely on customary land disputes, and to reintegrate wider 'traditional' governance roles and responsibilities into its purview. The uneven distribution of material and financial equity derived from logging and bait-fishing royalties was also noted, as was a general despondency relating to the degree and pace of socio-cultural change. There was considerable debate, and some confusion, regarding the direction and the extent that *kastom* should, or could, be strengthened and/or re-orientated.

Opportunely, there are currently two independent and organic (home-grown) 'movements' currently attempting to redress these shortfalls. Both are concerned with widening the roles of the Chiefs, while simultaneously attempting to create, through education and community sanction, a more accountable and socially responsible Chiefly system. These moves are locally driven from two independent sources, and until recently without the knowledge of each other's efforts. Neither appears to be an initiative of the traditional leaders resident in Marovo, but rather each comes from within the extended Marovo community: one is Marovo-Honiara based and the other a Marovo-Gizo based initiative.

The first formal workshop of the Marovo-Gizo based Council of Chiefs of Marovo was held on 16–17 October 2006 in Seghe. The originator and convenor of the workshop was Peter Ratusia Lolo, and while the workshop focused only on land tenure issues at that stage, there are said to be plans to extend the focus. The workshop was led by Magistrate Leonard Maina of Western Province. The Premier of Western Province, who is a Chief of Marovo, opened the workshop.

The Marovo-Honiara initiative is currently being formulated by Aseri Yalangono and Allan Agassi (originally from Keru and Biche respectively, but now both based in Honiara), and has identified many of the same themes and issues. On learning of these initiatives the UQ team was able to assist in mediating their initial collaboration through a series of small meetings in Honiara after the Seghe workshop. Progress is being monitored and further assistance provided on request.

Implications: *Representation and Inclusion*

One of the themes tackled at the Seghe meeting was how best to ensure continued, and meaningful, community liaison. We had already recognised that a wider pan-Marovo focus proposed by some in Marovo would improve prospects for the establishment of effective and sustainable management of the lagoon's resources. However, how best to achieve such a result remains a challenge. Based on discussions arising from the Batuna meeting we facilitated a discussion forum at Seghe about how to achieve adequate representation and social and ecological inclusiveness in relation to resource

management mechanisms. An informal collective of interim 'points-of-contacts' was nominated as the best option. Aware that such initiatives have been tried in the past, we discussed the short-falls of these previous attempts. An approach based on geographically defined sub-regions of Marovo was deemed most likely to succeed, and is also an approach not tried before in Marovo.

Regardless of the suspicions and wider issues surrounding a modern role for chiefs, a pertinent point raised at the Seghe meeting was the necessity of engaging the Council of Chiefs and gaining the appropriate sanction of other Marovo chiefs and associated *palabatu*. While many people at the meeting were present as 'Chiefs' representatives', wider inclusivity is necessary for the effective and long-term success of the 'points-of-contact' network. People thus elected to define nominated individuals as 'interim' contact points for an 18 month period only, with the aspiration being that some reinvigorated Council of Chiefs or other customary authority would officiate and/or lend sanction to these regional contact points in the future. The possibility of forming a more formal regional 'members' association' was also raised by participants, and this small network may prove to be a springboard towards such an organisation in the future.

While it is our intention to use the network to disseminate the final project report to Marovo people, the establishment of a regional Marovo-wide network is not solely for UQ purposes. Other groups have shown an interest in utilising this network as a vehicle for their support to Marovo communities, including WWF, World Fish Centre and SI Fisheries. We have recently 'tested' the network, sending out some pertinent reports, such as the SI Government Forestry and Fisheries audit (SIG 2005a; SIG 2005b), and a report on the Merusu oil palm plantation (Riumana 2003). We believe that such information should be available at the 'grass-roots' level, as they can raise awareness and positively contribute to local capacity building.

Implications: *Ideas for the Future*

Due to time constraints this component of the workshop was briefer than we had hoped, but nonetheless enlightening. Participants re-discussed broad themes from the Batuna workshop and after a brief presentation of UQ's work (including abilities and limitations), salient points about working towards the sustainable management of the lagoon were discussed. One community representative noted that in his community's eyes enough research had already been undertaken, and action (in the form of alternative economic projects and general development programmes) was what was required. This instigated much debate, and while everyone agreed that health, education and wider income-generating opportunities were an important component of any successful 'solution', the majority of participants also argued that their communities required meaningful engagement, in the form of targeted information and capacity-strengthening initiatives, as an initial first step. After further clarifying the limitations that a research institution such as UQ has, it was decided that logistical and capital support in helping facilitate local efforts, identifying and supporting the establishment of appropriate management mechanisms (at National, Provincial and local levels) combined with agreed targeted scientific research and education programmes, was the most appropriate and beneficial input that UQ could make to any future efforts.

Key topics highlighted by participants included:

- The need for the development of further targeted education resources and continued strengthening of human capacity in the general education sector through scholarships and exchange programmes;
- A desire for the provision of advice and logistical assistance to help establish and monitor Marine Protected Areas (MPAs) in communities who have requested such support;
- A request for support training and other capacity initiatives relating to the tourism sector, as part of the broader long-term goal of building tourism within the lagoon;
- While working at the national and provincial levels was deemed necessary and welcome, participants were unanimous that any future project, and any other potential programmes, should concentrate the bulk of their efforts on working at the grass-roots level where the benefits are more tangible and accountable.

At the close of the meeting everyone signed a letter of support for the UQ project, and representatives from 8 villages made formal requests for us to work with their communities in any future programme. Importantly, several of these communities have already attempted to establish MPAs, but believe they require outside assistance to help such initiatives to work. Several representatives also stated that they required assistance in mediating with neighbouring communities about the benefits of resource management initiatives.

Building Capacity through Local Networks and Extra-Local Linkages

One of the key themes to emerge from the Seghe workshop and earlier discussions with Marovo people was the need for 'outsiders' such as the UQ project team to help facilitate and act as mediums to the 'outside' world. People used the metaphor of a 'main water pipe' to outline how UQ could help funnel support to various points (communities) throughout the lagoon. The fact that outsiders are being asked to serve in this role illustrates how ineffective are the linkages between governance at the level of rural community and governance at provincial and national levels.

The UQ team can assist with the 'points-of-contact' network, particularly in terms of seeking legal recognition for any formal organisation, and with respect to facilitation of the establishment of formal communication channels, but the success of the 'points of contact' in the long term cannot come as a result of outsider influence. To be sustainable, any community-based group in Marovo must be a local institution with local support and with local legislative recognition. Nevertheless, in the short term, this network requires continued assistance to keep the 'flow' going. Aware that many programmes in the past have been either totally externally driven and/or instigated by so-called 'urban-elites' dwelling elsewhere, people emphasised that long term local/extra-local partnerships were the best way to provide assistance and support conservation initiatives in the lagoon. The objective of the network is to provide a tangible and effective means to distribute and exchange information, enhance collaboration, and facilitate equity and inclusion between local and extra-local agencies.

Employment and Inclusion

Going beyond merely 'community consultation' and linear 'knowledge extraction' is a reasonable goal but a difficult task. Nonetheless, we attempted to develop a two-way platform of knowledge exchange and inclusivity. One way this aspiration was met was through the maintenance of an adaptable employment strategy, while another was through conducting several community-assisted scientific experiments explicitly designed to address local concerns and questions (e.g. the *Derris* root and benthic mat experiment, see Chapter 3).

The project employed numerous people. Aiming for representative equity we employed individuals from both focus communities (i.e. Bili and Chea) and supported local preferences by hiring people whom the community suggested (two were trained IWP facilitators and one a designated community 'boat-driver'). At every opportunity we encouraged wider involvement and employed others where possible. For instance, we ensured that a 'grass-roots' component had the opportunity to be involved in the translation of our Community Report—not just 'educated elites' residing in Honiara (an issue about which villagers had strong feelings). We also used our knowledge of village kin-networks to ensure that a number of people, from as many different family groups as possible, had the opportunity to have some contact with project personnel and activities. We also invited and provided the resources for representatives from Bili and Chea to attend a meeting in Roviana Lagoon, organised by Shankar Aswani and the Roviana and Vonavona Lagoon Resource Management Project (RVLRMP).

Additionally, two project personnel, Simon Albert and Joelle Prange, independently provided the funds for one of our key research assistants, Mr. Morgan Jimuru, to visit Australia. This cross-cultural exchange provided an opportunity for Mr Jimuru to attend key project meetings and visit the University to talk to both staff and students. Importantly, Mr Jimuru also had the opportunity to experience first-hand some of the issues associated with marine conservation in the Australian context, by touring Moreton Bay, Fraser Island and the Great-Barrier Reef Marine Park. The insights and capacity raised by such an exchange cannot be overestimated, and he will be a key figure in future project work.

Extending our policy of employing local people in research activities wherever possible, we are now in a position (for Phase 2 of our project) to decrease outside 'expert' inputs and save resources for, and make space in support of, more local (paid) participation.

School Engagement and Capacity Strengthening

Project-School visits were a regular occurrence, especially during the last two years of the project. This engagement culminated in two productive focus group discussions, an environmentally themed school competition and the provision of two UQ scholarships to local secondary teachers.

Primary Schools: Bili Village and Hinakole

Various project personnel conducted multiple visits to the primary schools servicing Bili and Chea communities. We provided some much needed resources (mainly paper, notebooks and pens) and held discussions with both teachers and students. Before the 'Marovo Lagoon Environment Day' meeting we also held smaller preliminary meetings in each school, organised an environmentally themed drawing competition and subsequently awarded prizes to the students (see Figure 4.2). We also arranged for the principal and a teacher from Hinakole Primary School, and the teacher from Bili village Primary School, to attend the Batuna workshop.

Figure 4.2: Prizes were awarded to primary school students for an environmentally themed drawing competition

Secondary Schools: Bekabeka (SDA) and Patukae (UC)

After introductory meetings between project personnel and senior staff at the two secondary schools in Marovo—BekaBeka Seventh Day Adventist Secondary School and Patakea United Church Secondary School—we developed a continued policy of engagement. Our key social field researchers conducted a focus-group discussion with one senior class and teachers at each school. This resulted in some interesting discussions. Students raised concerns not mentioned by other stakeholders, such as the negative impact that tourism can have on lagoon society (increased 'westernisation' and a general harbinger of socio-cultural change). While knowledge of, and concerns about, environmental change were high, there were clear knowledge gaps: biological life histories of marine organisms; ecosystem interconnectivity; the role of key habitats in ensuring ecosystem health (i.e. mangroves and grazers); and the relationships between increased nutrients and sediment and the impact of this on the overall health of the lagoon, are some of the knowledge fissures identified.

As with the Primary Schools, prior to the 'Marovo Lagoon Environment Day' meeting an essay competition was held in each school and prizes awarded to the winning entries (see winning essay opposite). Teachers were invited to, and attended, both the Batuna and Seghe meetings. Finally, project personnel negotiated the offer of two tailor-made diploma scholarships from the University of Queensland, for a teacher from each of the Secondary Schools. The scholarship is to be conducted via distance education, with the University allocating additional resources for a tutor to visit the lagoon and conduct face-to-face tutoring twice a year. The two scholarships have been awarded and the recipients are currently being assessed for their level of English competency before formally taking up the scholarship offers.

Environmental effects caused by logging

Cynthia Bird (Age 13) Patukae High School

When logging first started decades ago in Marovo, it was mentioned by certain people at that time that logging has the potential and capability to transform the Marovo society and environment into a far better place. But judging by the transformations to the environment as well as the society noticed today, I can truthfully say that the prediction of these certain people did not turn out as they expected.

My main aims in this essay will be very much localised. I will be mainly basing this essay on the different types of effects which have been inflicted on the society of Marovo and areas in which Marovo people live and survive these effects, which are:

1. Environmental effects
2. Society effects
3. Moral ethical effects

The period during the logging boom in the 1990s has boosted the scale of logging resulting in mass destruction of forest and rivers. It was totally different scenery to the once beautiful landscape of Marovo. It became a routine to see groups of foreign loggers visiting villages, luring the not so educated ones with bribes and offers, in return for granting concessions to their lands. Once the concessions were granted, the company then snaked its way inland along he ridges to extract logs. The roads are flanked by swathes of broken forest in which the red patches of eroded clay can be seen beneath the tattered fragments of canopy. In all areas where the logging companies operate, the forest canopy has been greatly reduced … soil erosion has taken place and traces of oil spills can be noticed floating in the lagoon, along mangrove areas and village shorelines. Sedimentation at the mouth of rivers affected by logging has also extended into lagoon areas, killing the reefs close to the river mouth.

The core values of the culture of Marovo are based on sharing, trust, community responsibility, mutual protection and religious beliefs. Social structure is based on the traditional authority of the chiefs and elders and the authority structures of the Christian religion. Since logging has started in Marovo, the core values of Marovo culture, which Marovo people have long lived by, are beginning to erode. Severe and sometimes permanent social unrest has occurred in villages affected by large scale logging. Disputes over land ownership, rights and entitlements to income from logged areas have escalated, causing division in communities and tribes. It is therefore an undisputable fact that the once energetic tradition of a community working together is now almost vanished and individualism is emerging. This kind of behaviour only creates mistrust, suspicion and uncertainty in communities.

Religion is very important to Marovo people. Nearly every village has at least one church and people spend at least a few hours everyday for religious activities. Logging has dealt a master blow to religious beliefs and commitments. Moral and ethical values which bind families and communities together are no longer practised; pornographic films, prostitution and the consuming of alcoholic drinks are on the rise. Church activities which were once the centre of people's social and spiritual nourishment have radically dropped.

We can now try to grasp the reality of the situation that is occurring in Marovo. The information I have presented clearly describes the degradation of the forests and the pollution of the lagoon. I personally believe that if logging activities are not halted, then the people of Marovo are going to face serious problems that can affect their course of daily living, both on the environment and their society as a whole.

Chapter 5

Social and cultural considerations

Mark Love

Annie Ross

This chapter provides a discussion of some socio-cultural factors relevant to marine biodiversity conservation in the Solomon Islands and Marovo Lagoon. Using results from the project's social research work and additional information taken from numerous published and unpublished sources, the chapter begins with an analysis of the Melanesian socio-cultural phenomenon of *wantokism* and *kastom*, followed by a discussion of 'traditional' marine resource management practices and Customary Marine Tenure (CMT). The chapter closes with an overview of MPAs, cross-referencing the literature with a preliminary assessment of two MPAs established by other organisations in Marovo. This review and analysis is provided to validate our recommendations and provide a rationale for future directions.

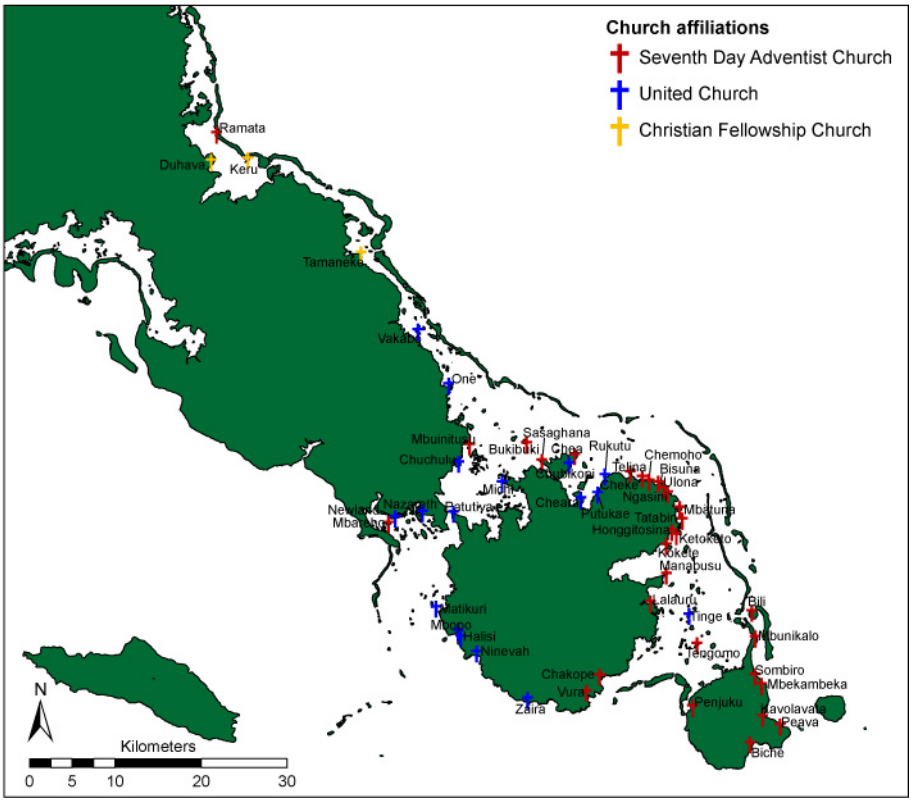


Figure 5.1: Church affiliations in Marovo Lagoon

Wantokism

The Solomon Islanders constitute a diverse mix of cultures and peoples, with over 80 different Indigenous languages and dialects spoken throughout the country. Despite this diversity, two pan-Melanesian concepts associated with the Pijin terms '*wantok*' and '*kastom*' criss-cross local ethnic and cultural boundaries. An understanding of these two concepts, in particular how they are objectified in day-to-day rural and national affairs, is integral to comprehending not only broad socio-political subtleties but also marine conservation objectives more specifically.

'*Wantok*' derives from 'one talk', meaning people from the same language group, but more specifically indicates people who are part of the same lineage or clan (Jourdan 2002). In historical terms *wantok* identity is a relatively new mode of social identification which grew out of situations where different language groups came together, such as in schools and plantations. As a social category the *wantok* system advocates cooperation and involves a series of obligations based on reciprocity: a phenomenon sometimes called '*wantokism*' (Kabutaulaka 1998). Honiara residents, for instance, are obliged to lodge, feed and often financially support visiting *wantok* from rural areas, as well as send financial remittences and bring gifts when returning to the village (see Gooberman-Hill 1999; Jourdan 2002). In the Indigenous Australian context, such reciprocal duties have been referred to as 'demand sharing' (see Peterson 1993). As well as a prism through which national consciousness can be expressed, the *wantok* reference can also serve as a destabilising factor (Kabutaulaka 1998). The fluidity of political alliances, widespread instances of government corruption and the near ubiquitous failure of

small businesses to last more than a few years is often explained via recourse to the collectivist, and perceived 'anti-capitalistic' tendencies, inherent in the reciprocity associated with *wantokism*.

The '*wantok* system' is one of many social factors that can positively and negatively impact on resource management aspirations. For example, recently in Marovo *wantok* connections between select 'urban-elites' and their 'home' villages has been a significant factor in the establishment of two recent marine conservation initiatives in the lagoon—IWP and Seacology (see Love 2006). While there was a national three-month-wide media campaign by the Solomon Islands Broadcasting Corporation regarding the IWP programme, many locals were surprised to hear that their village had solicited an 'expression of interest', let alone won the site selection process. Many people were also unaware of the Seacology project (see Love and Ross 2006). While the project staff of IWP are Solomon Islanders and the Seacology project was invited into the community by a 'local' (who resides elsewhere), the projects are not 'home grown' and are thus external interventions. Families closely related to those responsible for the projects have been locally perceived as benefiting from the projects more than others, leading to some members of the target communities feeling excluded, alienated and resentful—ultimately contributing to community indifference towards the project's conservation objectives (for details see Love 2006, and Technical Report).

Kastom

The use of the word *kastom* throughout Melanesia loosely refers to the English notion of 'tradition' and 'custom'. However, more specifically it refers to generic pan Melanesian cultural traits such as the *wantok* system, collective national ideals and identity, in addition to the shared 'traditions' and life-ways of a single language group. Being such a polysemous concept, *kastom* has been the focus of considerable academic debate (e.g. Akin 1993 in Kupiainen 2002; Akin 2005; Jolly 1992; Jolly and Thomas 1992; Keesing, 1993; Keesing and Tonkinson 1982; Lindstrom and White (eds) 1993; Tonkinson 1982).

Some commentators stress the counter hegemonic and invented nature of *kastom*, arguing that rather than representing a body of 'traditional' knowledge based on historical continuity, *kastom* is more correctly a selective, political and legitimising discourse built in opposition to modernity and Christianity (e.g. Keesing 1982, 1993, 1994; Babadzan 1988). Other scholars caution that acutely emphasising the invented and constructed nature of *kastom* ignores the intricacies and fluidity of local knowledge and praxis, as well as subjugating local ways of knowing relative to outside interpretations (e.g. Kupiainen 2002; see also Hviding 2003). Such 'middle-road' interpretations of *kastom* recognise it as both a fluid concept that involves processes of strategic nostalgia and contemporary construction, as well as being a body of knowledge which draws on local cultural practices and history that have some basis in reality. The pertinent aspect of *kastom* relevant to our interests is how it directly and indirectly relates to land and sea tenure issues.

Customary Land/Sea Tenure

Throughout the Solomon Islands, land and sea is held under customary ownership. In Marovo, kinship-based groups (*butubutu*)[1] claim and control territories of land and sea referred to as *puava* (literally 'soil', 'ground'—but subsumed with much wider meanings). The resident members of a given *butubutu* control and manage a *puava* as communal property, and have 'power' or 'ownership rights' (*nginira*) over an area and its resources. This is in contrast to other Marovo peoples, who generally have only 'user rights'. In relation to fishing, these latter categories are ideally allowed to fish for subsistence purposes but not for commercial purposes (e.g. bêche-de-mer harvesting or fishing for the esky trade). Only people with *nginira* rights have the power to speak about sea/land issues or receive royalties from bait-fishing or logging monies. However, the acknowledged social flexibility of Marovo genealogical reckoning (Hviding 1996) appears to be increasingly challenging traditional axioms. Increasingly today, people appear to be 'creatively' representing their lineage histories in order to gain access to key fishing grounds or to claim rights to royalties, resulting in increased intra-community tensions.

1 Marovo Lagoon is composed of around 24 named *butubutu*, 10 of which are considered 'bush' groups and 7 'salt-water' peoples (Hviding 1991). These kinship groups are composed of consanguineal relatives, with the basis of a *butubutu* being cognatic descent with varying degrees of patrilateral and matrilateral biases (Hviding 1996).

Local Resource 'Management' Systems

'Traditionally' in Marovo, spiritually sanctioned taboos called *hope* existed which constitute (by most definitions) what contemporarily we refer to as 'resource management' practices[2]. One such *hope* was a general fishing taboo called *hope chinaba*, which involved prohibitions on what types of fish could be caught at what time, constituting a system of spatial-temporal reef fishing closures (Hviding 1996). Another *hope* was referred to as *hope valusa*, which was specifically concerned with regulating tuna stocks. While *hope chinaba* applied to only specific sections of the shallow reef, *hope valusa* applied to the entire tuna-fishing grounds extending into the open ocean (Hviding 1996).

A detailed analysis of the current status and strength of such management practices was not possible during the current project. Anecdotally, however, some people did report that a few Chiefs and their *butubutu* still occasionally called a *hope chinaba* in their *puava*—although informants were not in agreement as to the level of sanction that such decrees attracted. It is noteworthy that some *butubutu* continue to refuse to allow bait-fishing activities to be conducted in their territory.

The underlying principle informing these micro management regimes is customary marine tenure (CMT). Ideally, CMT regulates access to a given territory (through the discerning categories of 'user rights' discussed above), thus controlling who can fish, and for what purpose, in each *puava*. Again, a detailed investigation regarding the current standing of CMT was beyond the scope of the current study, but as a heuristic proxy the following section provides a summary of some of the debates surrounding CMT. Regardless of its effectiveness in normative conservation terms, it remains an integral part of Marovo life and must be engaged with.

Customary Marine Tenure and 'Traditional' Fisheries Management in the Pacific

Numerous scholars have written about customary marine tenure institutions in the context of both Marovo and the Pacific more widely, documenting not only much of the detailed knowledge held by local people regarding fisheries and marine related phenomena, but also providing various perspectives on CMT's relevance to contemporary marine resource management practices (e.g. Adams 1998; Aswani 1997a, 1997b,2000; Aswani and Hamilton 2004a; Baines 1985, 1989, 1991; Baines and Hviding 1992; Foale and Macintyre 2000 ; Foale and Manele 2003; Hviding, 1988, 1990, 1996; Hviding and Baines 1992, 1994; Johannes 1984, 1988, 1998; Ruddle 1998; Ruddle and Akimichi 1984; Ruddle and Hviding 1992; Ruddle and Johannes 1985). The following discussion draws heavily on these and other scholars' works.

It is now widely acknowledged that Pacific cultures '…devised and practised almost every conservation measure centuries ago, long before the need for marine conservation was even recognised in western countries' (Johannes 1982). Numerous management systems have existed throughout the Pacific—broadly referred to today as *tabu* systems in Melanesia and *kapu* systems in Polynesia. These systems involve restrictions on fishing effort via closed seasons, closed areas, size restrictions and/or gear restrictions (Johannes 1978, 1982). The foundation of these models is customary marine tenure. CMT can be formally defined as:

> 'Customary' refers to a system that emerges from traditional roots, constitutes part of what is often termed 'customary law', and which has continuous links with local history as it adapts to changing circumstances; 'marine' refers to the system dealing with reefs, lagoon, coast, and open sea and including islands and islets contained in this overall seaspace; 'tenure' refers to a social process of interacting activities concerning control over territory and access to resources (Hviding 1989).

Most of the commentary associated with CMT and its potential to reinforce or even constitute effective community-based marine resource management, is positive (Anderson 1999 in Dalzell and Schug 2002). Nonetheless, there are recognised limitations to CMT. Especially in contemporary contexts, the ability of local CMT systems to act as a viable management mechanism on their own is being

2 Hviding (1996) cautions that there is no direct translation of the term 'resource management' in the Marovo vernacular, with the closest approximation for 'management' being *chakei* (guardianship). Hviding rightly declares that the interface between 'resources' and 'management' is heuristically problematic in cross-cultural ontological terms, and in his monograph the phrase 'resource management' is taken to mean 'allocation of resources and regulation of resource utilisation' and does not necessarily equate with 'western' understandings of long term conservation (Hviding, 1996). See also Johannes (1982b) for a more general discussion regarding indigenous 'conservation ethics'.

increasingly questioned. The following two tables provide an overview of some of the arguments extolling the virtues of CMT (Table 5.1), and a gloss of the main arguments outlining its limitations (Table 5.2). As well as referring to the primary sources noted above, much of this information was taken from a review by Dalzell and Schug (2002).

Table 5.1: The Strengths of Customary Marine Tenure

Strengths
• Management Efficiency: CMT is cost effective. It is local people, not State institutions, who are best situated to allocate resources in an equitable manner, punish transgressors and adjudicate disputes appropriately (e.g. Johannes 1978; Johannes et al. 1991). • Rural Development: CMT is adaptable to 'modern' contexts such as aquaculture and capture fisheries (Johannes 1993; see also Hviding and Baines 1992). This is thought by some to potentially provide an incentive for its development as it protects peoples' investments (e.g. Johnson 1977 in Dalzell and Schug 2002). Royalties generated from bait-fishing are another example proffered as a positive economic outcome of CMT (Dalzell and Schug 2002; but cf. below). • Political Autonomy: Some authors emphasise the wider political and economic self-determination aspects of CMT. Johannes (1993), Hviding (1998) and Hviding and Baines (1992), for instance, argue that CMT provides some control over local development trajectories. • Cultural Values: Some commentators stress the socio-cultural aspects of CMT, emphasising that CMT has more than just subsistence and economic attributes—it also provides a historical link with the past that contributes to cultural identity (e.g. Carrier 1981, Carrier and Carrier 1989, Hviding 1996, Johannes 1993).

In addition to its benefits, many scholars acknowledge the vulnerability of CMT practices. Among other things, people are increasingly concerned about the ability of tenure institutions to withstand the onslaught of global resource-based capitalism (e.g. Kinch 2002). In relation to MPAs and conservation aspirations generally, some commentators go as far as to argue that marine tenure is a hindrance rather than a help to conservation goals, and state that representations of CMT as beneficial to fisheries management are 'romantically inclined' and unlikely to succeed (Foale and Manele 2003). Some studies have further shown that CMT developed in parts of Melanesia in response to external pressures (such as trade), and as such are not necessarily a 'traditional' regime at all (Foale and Manele 2003; Kinch 2003; but cf. Hviding 1989). The *ad hoc* statutory framework associated with CMT (Ruddle 1998) and the potential for discriminatory inequity to be applied in relation to privatising access and the allocation of resources, are additional critiques of CMT.

Relevant to our research area, a recent report by Kinch et al. (2006b) states that 20% of fishers in Bili's tenured waters—or more correctly the *Getu* tribes *puava*—are locally estimated not to have appropriate 'user rights'. This suggests that tenure is weakening, although it does not necessarily signal its demise altogether. In addition, disputes have already arisen regarding the IWP and Seacology MPAs as people from neighbouring villages (who have a customary rights to fish in the same territory) claim that they were not properly consulted about the closures, and thus will not respect the MPAs.

Table 5.2: The Limitations of Customary Marine Tenure

Limitations
• Demographic Change and Urbanisation: CMT systems tend to collapse in areas of high coastal population; the very places many people argue are the most in need of management (Ruddle 1998) • Equity: CMT systems can be discriminative. As Polunin (1984 in Ruttan 1998) notes, restricting access to a resource does not necessarily change how much is harvested, just who gets it. The erosion of the 'traditional' principles of reciprocity and redistribution can create more privatised and individualistic systems of resource access (Dalzell and Schug 2002; also Foale and Menele 2003). • Legal and Policy Issues: Some commentators argue that the formalisation of 'traditional' management systems can stop them from being undermined and eroded (Ruddle 1998), and thus reduce social conflict (Aswani 1997b). Contrary to this view, however, others argue that codification can 'fossilise' and weaken the contextual flexibility of tenure regimes, which is the very characteristic that is integral to its survival and effectiveness (Hviding 1998; see also Dalzell and Schug 2002). • Economic/Development Aspirations: Today, people are more dependent on cash and imported goods than in the past. With resource extraction often the only means of earning an income, the detailed local knowledge associated with CMT can be combined with new technologies such as under-water torches and out-board motors to rapidly deplete a resource just as easily as such knowledge can be used to conserve it (Hamilton 2003; Smaalders and Kinch 2003).

Implications

The complexities associated with CMT make it difficult to confidently ascertain the direct and indirect impacts that CMT currently has, and/or is likely to have, on conservation in Marovo. Further research into CMT's current status is needed (see Recommendations, Chapter 7). However, it is essential to stress that CMT cannot be partitioned as a management or governance issue alone, but must be recognised as a central component of Marovo socio-cultural realities that is integral to local identity, history and political autonomy. In both intellectual and applied terms, this makes it a potentially difficult arena of inquiry.

Inter-village continuity and contrast

In the two study sites where we worked (Chea and Bili), people interviewed had significantly different preferences in relation to 'solution identification' and marine resource issues, depending on where they lived. The majority of informants in Bili declared that they prefer outside assistance (Church and State) to assist in regulating fishery resources, in contrast to respondents in Chea who consistently stated that it was the community's responsibility to manage resources and make decisions, and didn't need or want outside assistance. This variability can be directly linked to numerous historical and contemporary factors. However, what is important from an applied perspective is not so much causation but how this differentiation impacts on contemporary conservation practices. This intra-cultural contrast highlights that management solutions must be tailor-made for each community/*butubutu*—a 'one-size-fits-all' solution is simply not going to work (see Love 2006). Different locally framed 'problem identification' and 'optimal solution strategies' require different approaches. Working with a single 'community' is not sufficient, as the socio-political fabric of Marovo is not neatly demarcated into site-specific geographic 'spots' on a map. As noted above, genealogical reckoning in Marovo is such that people in neighbouring communities—even in villages far away—through marriage or birth can still have a 'primary right' to fish in a given *puava*. While it is impossible to consult with every conceivable individual who may have fishing rights to a certain area, it is necessary to expand the standard level of community engagement from a 'site specific' community focus to a more culturally appropriate and inclusive approach that recognises such localised subtleties.

Generally speaking, it is clear that customary governance practices are under increasing pressure from both external and internal forces. Our research demonstrates that in many people's opinion, Chiefly office and wider associated customary mechanisms are losing local support, but nevertheless remain an important social institution and cultural marker (see Chapter 4). Thus, as flagged in our recommendations, the strengthening of these customary domains is a necessary prequisite for successful community-based resource management initiatives. One of the rationales behind the regional 'points of contact' network was not only to acknowledge relevant socio-cultural institutions such as CMT, but also to better position ourselves to engage with broader governance issues in the future.

Intra-cultural differentiation

An important socio-cultural fact that must be taken into consideration is to note that considerable intra-cultural and inter-community differentiation exists within the lagoon (see Technical Report). These differences go beyond the 'typological' religious denominational differences generally discussed in the literature (e.g. Juvick 1993).

Marine Protected Areas (MPAs)

Two NGOs are currently establishing MPAs in both Bili's and Chea's territorial waters: the International Waters Project (IWP) have a proposed MPA in both communities, and Seacology have two MPAs in Bili. While the MPAs were still in the process of being 'formalised' during our fieldwork, it was well known amongst community and project personnel that the MPAs were 'operational'. Several questions relating to the MPAs were incorporated into our social research survey activities after the issue was raised, unprompted, during a scoping trip in July 2005. The objective was to use the MPAs as a case-study to explore some of the challenges and issues associated with establishing MPAs in the Marovo context. The details of our social research results regarding people's opinions of the MPAs (awareness and compliance), along with the other social research results, are included in the Technical Report. In sum, during our research period 60% of respondents felt that no one currently respected the MPAs (n=58). Nonetheless, it is important to stress that this is a temporal 'snap shot' only. During the last project field trip (September 2006), IWP (through the Solomon Islands Fisheries Department) had begun to implement a seaweed trial in each village (as originally promised as part of the MPA 'package'), and anecdotal information suggests that this had increased interest in, and possibly sanction of, the IWP MPAs in each village. Nonetheless, more recent reports suggest that these 'alternative income' ventures have ceased to operate.

'Factors of Success': A Preliminary Assessment of Community and Project Attributes relating to MPAs in Marovo Lagoon

In this final section we present an abridged discussion and analysis developed by one of our researches (Love 2006), which uses a range of indicators developed from a literature review of applied MPA case studies to offer a preliminary assessment and evaluation of 'community' and 'project' attributes considered integral to the successful implementation of MPAs in Marovo. This was undertaken to further develop our understanding of contemporary resource management issues in the lagoon.

A substantial volume of literature attempts to identify various 'factors' or 'attributes' considered imperative to the success of MPAs. Tabel 5.3 summarises the most frequently listed 'factors of success' adapted from a wide variety of sources.

Table 5.3: Factors influencing MPA success (Literature review)

Community	Resources/Capacity	Process/Design
Community support	Legal and policy support /framework	Ensure consideration is given to both resource use and conservation
Clear communication processes	Straightforward, not overly complex legislative framework	Regular monitoring and assessment (ecological, social and management)
Involvement of all segments of the local community in all aspects of MPA	Ability to enforce user rights	Must be tailored to local conditions, attitudes and needs
Relative community homogeneity	Inputs from local government	The MPA must be part of integrated management scheme (i.e. ICZM)
High levels of community decision making	Staff training and availability of technical support	Design and management must be both 'top down' and 'bottom up'
A positive attitude towards rules and collective action	Adequate and long-term financial support	Assessment of local biological and socio-economic conditions of an area prior to the establishment of an MPA
Participatory decision making	The presence of community conflict resolution mechanisms	The use of both sanctions and incentives to increase compliance
Community consensus and formal / informal recognition of CMT rights	NGO presence	Objective and management should be adaptable to changing circumstances (adaptive management)
Community has perceived crisis in fish stocks prior to MPA establishment	Co-ordination between agencies implementing the protected area	Properly defined boundaries
Understanding of socio-economic and historical factors	Low material/capital expectations from community	Long timeframe
Positive history of other 'projects' in community	Successful alternative income projects for community	The application of science to MPA management
		Utilisation of local knowledge
		The ability of the MPA to show tangible benefits and outcomes (e.g. improved fishery yields)

Source: Alder 1996; Alder et al. 2002; Aswani 2000; Aswani and Hamilton 2004a; Aswani and Weiant 2003; Bunce et al. 1999; Dahl-Tacconi 2005; Foale and Manele 2003; Gravestock 2002; Hockings and Phillips 1999; Hockings et al. 2000; Kelleher and Recchia 1998; The Locally-Managed Marine Area Network 2003; Lundquist and Granek 2005; MPA News 7(10), 2006; Pollnac et al. 2001; Pomeroy and Rivera-Guieb 2006. 2004; Salafsky et al. 2000; White et al. 2002)

Table 5.4 lists various *in situ* factors ideally extant in the community and/or region where MPAs are planned, while Table 5.5 lists various *ex situ* indices ideally prevalent in the activities, processes and general workings of the agency implementing the MPAs. A summary of the existence of these factors with respect to the MPAs in Bili and Chea is also provided in these tables.

Table 5.4: 'Factors of Success': Indicators for community

Community	**Bili**	**Chea**
Involvement of all segments of community		
Involvement of community in monitoring and evaluation	x	x
Formal participatory aspect to project	X	X
High levels of community decision making		x
Commitment to Protected areas amongst all/most community members		
(Relative) Community homogeneity		X
Consensus regarding perceived crisis in fish stocks	x	
Legal and Policy framework—Community level		X
Adequate informal, community level conflict resolution mechanism		x
Awareness of legal and policy framework		
Enforceability of collective action decisions	-	-
Tenure recognised and respected	X	X

Note: X = Yes (a lot); x = Yes (a little); blank = No/none; – = not able to make judgment (too early to tell or not applicable)

Table 5.5: 'Factors of Success': Indicators for community

	IWP	Seacology
Resources/Capacity		
Legal and Policy framework—Government/Provincial level	X	X
Availability of technical support	x	
Training of some community members	x	
Adequate and long term financial support		
NGO presence in community/region		
Co-ordination/communication between implementing agency and other NGOs	x	
Process/Design		
Consideration given to both resource use (sustainable use) and conservation (environmental protection) (i.e. zoning of human activities within an MPA)		
Ongoing monitoring and assessment (ecological, social and management)		
Assessment of local biological and socio-economic conditions	X	
Sanctions and incentives used to increase compliance		
Adaptive management process		
Mod.-High utilisation of local knowledge		
Clear and properly defined boundaries		
The application of science	x	
The ability of MPA to show tangible benefits	-	-
Incentive component to MPA establishment		X
Alternative income generation component to project		
MPA part of broader integrated ecosystem management schemes, such as ICZM programme		

Note: X = Yes (a lot); x = Yes (a little); blank = No/none; – = not able to make judgment (too early to tell or not applicable)

This preliminary evaluation demonstrates that many of the so-called 'factors of success' are not in evidence; either in the communities themselves or amongst the two projects under investigation. In terms of community attributes Chea has nearly twice as many relevant 'factors' as Bili (64% vs 37%), while in relation to project attributes IWP meets more criteria than Seacology (33% vs 11%).

Remarks on the MPA 'case-studies'

Around the world MPAs or Locally Management Marine Areas (LMMAs) are increasingly becoming the preferred fisheries management mechanism of choice. However, their effectiveness remains a subject of debate—in both social and biological terms (Russ and Alcala 2004). Numerous studies and evaluations demonstrate that the majority of MPAs currently fail to meet their conservation objectives (e.g. Alder 1996; Kelleher et al. 1995; McClanahan 1999). A conservative summary of these assessments suggests that 70–80% of MPAs are 'paper-parks' only.

In the case studies under investigation here, Chea and IWP meet more of the indicators than do Bili and Seacology. This is supported by some other survey results, which showed that there was more awareness of IWP's MPAs than there was of Seacology's, and less consensus amongst respondents in Bili compared to Chea overall. While the indicators provide a quick and broad overview of the case studies, such check-list approaches also mask and ignore important issues. For example, while IWP

has a formal participatory aspect to their project, in practice this was insignificant and numerous informants noted that both the IWP community engagement process, and the local IWP representative committee, was selective, ineffectual and tokenistic.

When asked why people thought agencies such as IWP and Seacology might think their communities needed an MPA, 90% of respondents replied that the reason was 'to increase the amount of fish' (n=21). This was further paralleled in the consensus questionnaire with 98% of respondents agreeing that 'MPAs will increase the amount of fish in the lagoon' (n=59). In all, 97% of respondents answered in the affirmative to the statement: 'We need more MPAs' (n=59). This last result is in agreement with Donnelly's (2001) survey, where 90% of SDA respondents stated that having areas where no fishing was allowed is important (2001). The confounding issue of people's willingness to affirm that they think they need more MPAs, while simultaneously stating that few people (as yet) actually respect the MPAs, is an interesting contradiction. Awareness of the potential benefits of MPAs is likely a mix of people's historical experience with *hope* closures and project-associated rhetoric. Understanding the variety of reasons for people's current lack of sanction towards the MPAs is more complex, but certainly includes factors such as:

- The economic importance of fisheries;
- A lack of viable fiscal alternatives;
- Project implementation issues (i.e. inadequate participation and consultation);
- Tenure issues (the fact that the MPAs are situated in traditional shared fishing grounds);
- A general lack of perception of fisheries as being 'in-crisis';
- People's historical and cultural affinity with fishing;
- Governance issues (a weakening of 'traditional' chiefly office and the general socio-political reluctance to self-regulate enforcement without practical Government support);
- Failure by external agencies to consult adequately with relevant community groups.

Concluding Remarks

In closing, it is clear that MPAs are not a 'given' or 'certain' solution to the marine problems of Marovo Lagoon. Alternatively, we are not advocating that they are not part of an eventual solution; only that they are a tool that must be 'handled-with-care'. We have been directly approached by individuals from communities requesting assistance to establish MPAs, but are mindful that a handful of supporters does not equate to wide community support. What the above analysis highlights is the importance of understanding local context(s) and engaging in real community consultation.

The majority of case studies from other places in the Pacific illustrate that in cases where marine reserves do appear to be working, they have built on not only traditional practices but have also been further legitimated through either State support (i.e. Cook Islands and Samoa [MacKay nd], Fiji [Veitayaki et al. 2003], or in the case of nearby Roviana, authoritive religious sanction. In the first two instances traditional sanctions have allowed for the enforcement of local compliance, but external legitimisation was necessary to force compliance on outsiders (MacKay nd; Veitayaki et al. 2003; see also Hunnam and Baines 2002, Keen and Lal 2002). This perspective was echoed by some informants during our consultations and is a strategy that the WPRMO may be able to assist—if adequately resourced—in the future. However, finding the right balance between customary and Common Law approaches is fraught not only with ideological difficulties, but is further confounded by structural barriers; such as the fact that the Western Province does not currently appear to be adequately equipped to register Resource Management Ordinances, let alone enforce them.

Finally, it is important to reiterate that one of the most significant 'findings' of our social research is that significant intra-cultural/inter-community differentiation exists in Marovo. Competently identifying the specific content and degree of such differences (while also not essentialising and amplifying such distinctions) is integral to building functional project-community partnerships and assisting with (locally directed) applied conservation activities in the future.

Chapter 6

Economic considerations

Mark Love

Annie Ross

James Udy

Bill Carter

Corey Howell

This chapter focuses on socio-economic issues that impact on marine conservation aspirations. The chapter begins with an overview of the socio-economic context of the communities where we primarily worked, followed by the results of our analysis of tourism in the lagoon (paying particular attention to livelihood and resource management issues) and a discussion of a Pilot Conservation Agreement (not directly part of the UQ project), undertaken by a private group with the Biche community. The chapter closes with a critical overview of selected income generating activities that are judged to have the potential to provide alternative economic pathways that may enhance marine conservation objectives in Marovo Lagoon.

Socio-Economic Setting

Overview

The people of Marovo rely on both subsistence and income generating strategies to meet their livelihood needs. There is significant gender differentiation in work patterns and type, with men predominantly fishing and carving and women gardening and responsible for domestic tasks. Nonetheless, there is considerable flexibility between these domains (Hviding 1996a), and women and children increasingly fish in a manner and frequency not permitted in the past. Several reports have documented that increased male involvement in the cash economy, whether it be carving, eco-lodges or the Live Reef Food Fish Trade (LRFFT), significantly increases women's workload (Donnelly 2001; Oliver and Greenpeace Australia-Pacific 2001).

In Marovo, SDA communities are considered more 'individualistic' and 'monetised' than both United Church and Christian Fellowship Church communities (Juvick 1993). Like Pacific economies generally, the household is the primary focus of production and the economy can be described as 'hybrid' in nature (Rodnam 1987), with people deriving their incomes from numerous opportune and ever dynamic sources. In the SDA communities where we were based, most households derived a significant portion of their income from wood carving and handicraft production, followed by marine resource exploitation and the sale of garden produce. The most economically important marine resources in Marovo are reef fish and, until recently, bêche-de-mer, followed by the sale of trochus and other shellfish. Small-scale commercial reef fishing has been a feature of the lagoon since the 1980s when more than 25 fishery centres were established to stimulate commercial fishing in the region (Donnelly 2001; Kinch et al. 2006b; LaFranchi 1999). While today most of these projects have ceased to operate, small-scale commercial reef fishing has continued with local 'esky owners' or intermediary 'esky handlers' buying fish from locals, which is transported on ice to the municipal market in Honiara.

People's integration into the cash economy is escalating, as people are more reliant on cash than ever before. In terms of expenses, school fees in SDA communities are the highest in the region (Donnelly 2001) and SDA devotees are obliged to pay a tithe to the Church of one-tenth of all their cash income, garden produce and fish catch. There is increasing household reliance on tinned fish (Solomon Blue Taiyo) (Oreihaka and Ramohia 2000), fuel, tobacco and importantly rice, which along with sweet potato and cassava has replaced taro as the main dietary staple (Bayliss-Smith 1993; Hviding and Bayliss-Smith 2000). These combined expenses constitute a significant financial challenge in the absence of waged work and welfare, and puts increasing pressure on natural resources as the only available source of income.

Survey Results

Fishing Activities

Subsistence fishing (60%) and esky fishing (22%) were reported as the primary objectives of most fishing trips (see Table 6.1). Half the households surveyed reported that at least one family member was involved in esky fishing. However, it should be noted that these categories are fluid and informants made it clear that there is often overlap with each activity. For example, people are opportunistic fishers and if a surplus is caught while 'subsistence' fishing, people will opportunistically market the excess to fellow villagers (for trade or cash).

Table 6.1: Main fishing activities

Activity	Frequency	% of Total
Subsistence (household) fishing	41	60
Esky fishing	15	22
Market (local) fishing	5	7
Trochus (*Bikoho*)	5	7
Kastom money (*Poata mala*)	1	1.5
Bêche-de-mer harvesting	1	1.5

(n=41: 29M/12F): Frequency count = number of times one category was nominated by an individual household member as the main purpose for going fishing)

Subsistence Fishing

Overall, 60% of fishing trips were primarily subsistence oriented (n=41). This is indicative of the fact that Solomon Islanders have one of the highest per capita seafood consumption rates in the world. The 1999 Census states that 90% of households in the Western Province fish for subsistence, eating approximately 54kg of fish per person, per year (cited in Kinch et al. 2006a).

Esky Fishing

Esky fishing (or 'chilled fishery') is a small scale commercial (artisinal) fishery. Local individual 'esky owners' or intermediary 'esky handlers' buy fish from local fishers, which are subsequently stored in insulated boxes on ice which are then transported on the weekly inter-island boat to the municipal market in Honiara.

Fishers' target popular reef fish such as *Marogo* (Red snapper), *Osanga* (Emperor), *Tarasi* (Surgeon fish) and various *Pajara* (Groupers and Coral trouts). During our primary fieldwork period (Sept–Oct. 2005) the price paid per kilogram of fish was between SI$6.00 and SI$8.00, with the fish selling in Honiara at anywhere between SI$8.82 to SI$22.05 a kilogram. The expenses involved in the esky trade are substantial, and a commodity chain analysis reveals that there is relatively little profit to be made in the esky trade—for local fishers or for the esky owner.

Approximately 50% of the households surveyed (n=28) had at least one family member involved in esky fishing, which is in accordance with results from other surveys (e.g. Donnelly 2001; Kinch et al. 2006a; LaFranchi 1999). One household reported that they were planning to commence involvement in esky fishing in response to the recent closure of bêche-de-mer harvesting, and a further 6 respondents stated that they would increase their fishing efforts in order to replace this lost income. This increase in esky fishing activity has since been substantiated (although not quantified) by more recent observations. The diversification of livelihood strategies is both a natural response to, and driver of, environmental, social and legislative change (see Warren et al. 2001; Cleaver 2002; Ellis 1998; Love 2006). It appears certain that the bêche-de-mer closure will increase pressure on fisheries (not only fin-fish, but also trochus—see below) as people have few other income earning opportunities.

Bêche-de-mer

Until very recently bêche-de-mer harvesting was one of the main sources of income for a large number of families in the lagoon (see Donnelly 2001; Hviding 1996; Kinch et al. 2006a; Ramofafia 2004). The national Government had officially announced that the industry would be suspended from August 2005, but due to a chorus of complaints from industry and locals about a lack of adequate forewarning and consultation, the closure was not formally instigated until November 2005. Our survey results reveal that 77% of respondents in Bili and 30% in Chea (n=28) had household members who used to harvest bêche-de-mer [1].

1 This result is slightly higher than the 2004 IWP survey, which was 63% for Bili and 27 % for Chea (Kinch et al. 2006a).

Miscellaneous Fishing Activities

The remaining 2% of fishing activities recorded by respondents were explicitly concerned with fishing for the local market (7%), harvesting trochus (7%) and molluscs for making *kastom* money (1.5%). 'Local market' fishing was defined by informants as fishing done predominantly for the purpose of selling the catch locally; either in people's resident villages, at 'market days' in neighbouring villages, or at the larger weekly market at Batuna on Thursdays. While men do the majority of fishing, the selling is generally done by women (Kinch et al. 2006a)—although this is changing with numerous informants reporting that women and children fish much more regularly than in the past.

Trochus was the most important non-fin fishery in terms of export earnings in the 1980s and early 1990s, but has since been in steady decline. According to recent IWP surveys around Bili and Chea, trochus are in low abundance and show signs of being heavily exploited (Maniolo 2004). Several informants stated that the price for trochus had recently increased (up to $20–$25 a kilo)[2] and during informal conversations some individuals made it clear that in response to the bêche-de-mer closure, trochus was looking like an attractive prospect once again.

Two species of Cardita clam (*Beguina semiorbiculata* and *Atrina vexillum*), known locally as ke'e and kurila respectively, are sold to other Solomon Islanders for the manufacture of *kastom* shell money (in Kinch et al. 2006a). Only one respondent reported spending time explicitly in pursuit of these molluscs.

Fishing Effort

Detailed catch-per-unit-effort (CPUE) was not recorded as it was beyond the practical scope of the current project. Other researches have conducted CPUE studies in the lagoon, most notably Hviding (1996), whose data from 1986–1987 reported a mean output in fishing effort and return as 2.7kg of whole fish per person per hour. Less detailed but nonetheless relevant information is also provided by Bayliss-Smith (1993), Donnelly (2001), and Kinch et al. (2006a)[3]. While CPUE data collection was not appropriate during our study, broad details were sought from respondents regarding the average number of days per week people spent fishing, how many hours per day and what were the main purposes of the fishing trips.

On average, respondents spent 1.98 days per week, for 3.9 hours a day, fishing. Although subsistence fishing was reportedly the primary objective of most fishing trips, esky fishing was the most time-consuming activity overall. Some respondents reported spending up to seven to eight hours a trip, often at night, esky fishing. Regardless of activity, the combined weekly mean for fishing, regardless of activity, was 7.72 hours a week.

Based on these results, one can reasonably infer that the time respondents spend esky fishing is currently limited by the infrequent (once weekly) transport situation. Given Marovo peoples' increasing reliance on imported goods (rice, kerosene, petrol) and services (school fees), it is not unreasonable to assume that if the opportunity arose people would increase their fishing efforts.

Fishing Techniques

The detailed knowledge local people have concerning fish species, fish behaviour and the marine habitat generally is reflected in the fact that there are more than 60 different types of recorded fishing techniques used by the people of Marovo (Agassi 2004; Hviding 1996). Some fishing methods are fairly broad and opportunistic in scope, targeting many species, while others are much more specific. Our research showed that spear fishing (*tope ihana*) was the most frequently employed fishing technique used by respondents in both Chea and Bili villages, followed by 'handline', 'dropline fishing' (hook and line using a rock), and 'trolling'. Only in Chea village was net usage reported (3 people).

As noted by others in nearby Roviana, night-time spear fishing with underwater torches—combined with detailed local knowledge of fishery behaviour—can have a devastating affect on fisheries (see Hamilton 2003; Aswani and Hamilton 2004a). As noted above, nigh-time spear fishing was the technique of choice for many involved in the esky trade.

2 One informant stated they could collect 2–3 kilo in a day, while another claimed he had recently collected 23 kilogram of trochus in three days, and was paid $500.

3 Donnelly (2001) records the mean number of fish caught per esky fishing trip in SDA communities to be 20 in 1999 (2001). Kinch et al. (2006a) conducted a very small CPUE analysis of the bêche-de-mer fishery, reporting an average return of 18 bêche-de-mer per person, per trip.

Implications: Utilitarianism and the flow-on effects of the bêche-de-mer closure
The centrality of fishing for Marovo people is integral to peoples' basic livelihood needs, as well as of historical and socio-cultural import. For marine conservation programmes to be effective over the long-term this fact must inform all planning and management aspirations. In terms of fishing 'controls', rotational spatial closures and/or locally identified multiple-use marine 'zones' are likely to attract more support and have less of a detrimental economic impact on families than large 'no-take' MPAs (Aswani and Hamilton 2004b).

It is also clear from our research that the recent ban on bêche-de-mer harvesting will intensify other fishery extraction activities—namely esky fishing and trochus collection. In agreement with the recommendations of others (e.g. Kinch 2004), we believe that a thorough scientific investigation into the feasibility of the Department of Fisheries and Marine Resources (DFMR) lifting the ban on green snail, pearl shell and crocodile skins should be undertaken. These bans have been established for over a decade, and our research shows that local people perceive that these resources have recovered and are becoming plentiful once again. Many people expressed frustration as they could not understand why the Government had not lifted the ban on these resources. A community-based management plan—supported by both the Provincial and National Government—consisting of well monitored short 'pulse' harvesting periods of these marine resources would ease some of the economic burden, and disperse the increased harvesting pressure placed on other marine resources, associated with the recent bêche-de-mer closure.

While community perceptions of the 'abundance' of pearl, green snail and crocodile may not prove to be scientifically validated, without evidence to the contrary, local suspicion towards, and resentment of, Government controls over these resources is only likely to increase. This is counterproductive to long-term resource management goals. Better extension work and communication of the rationale for such management decisions is essential.

Ecotourism[4]

Introduction

In Marovo Lagoon tourism, as a primarily non-extractive activity, has been regarded by many as the ideal 'economic alternative' to large-scale commercial industries such as logging and oil-palm (e.g. LaFranchi 1999; Oliver and Greenpeace Australia-Pacific 2001; Shearman and WWF-SI 1999). Others have critiqued these claims, arguing that such perspectives ignore the fact that people have 'large', not 'small', developmental aspirations (Foale 2001; Hviding 2003; Hviding and Bayliss-Smith 2000). Cognisant of these debates we asked: What are the real limits and scope for a tourism future in Marovo Lagoon?

Study assumptions
A fundamental assumption in this work was that tourism may not happen over-night, but it will happen. The issue becomes: Will tourism shape the future environmental and socio-cultural state, or will these shape the character of tourism? We began consideration of tourism in Marovo with the following broad understandings:

- Marovo Lagoon has the natural and cultural resources that could form the basis of a viable and sustainable tourism industry;
- Tourism does change the lifestyle of Indigenous people, particularly those who participate directly in providing tourism services;
- While it is clearly a force in socio-cultural change, tourism is one of the few areas of economic activity with the potential to bring economic benefits through employment, the arts and crafts industry, natural and cultural tours and joint ventures;
- Infrastructure and services that support tourism are essential for tourism success;
- Once tourism gains momentum, growth and negative impacts become increasingly difficult to manage.

4 This is an edited summary of our Tourism Technical Report.

Tourism trends

Visitor numbers to the Solomon Islands are small, reflecting the recent civil unrest in the country. Growth would be attained if the image of the country as a safe destination can be achieved and appropriate tourism services are in place.

Table 6.2: Visitor arrivals 2000–2004

Year	2000	2001	2002	2003	2004
Solomon Islands	10,134	3,418	4,508	6,000	6,000

Source: South Pacific Tourism Organisation – Regional Tourism Strategy for the South and Central Pacific 2003.
Solomon Islands 2003 and 2004 arrival figures are South Pacific Tourism Organisation estimates.

The main tourist products available in the Solomon Islands are: dive tourism, including live-aboard-dive-boats; adventure tourism related to one or both 'nature' and 'culture' experiences; ocean kayaking; game fishing; village stay tourism; and World War II heritage tourism.

Marovo Lagoon has the potential to attract each of these markets, although adventure and village stay tourism are the most accessible to the local community. While capital investment levels for these products is relatively low, if Marovo Lagoon is to compete with similar products in the wider Asia Pacific region (and indeed within the Solomon Islands), it requires a high level of service input, quality and value for money. These characteristics currently do not exist.

The main tourist profile for the Solomon Islands can be characterised as the 'explorer' market segment (see Smith 1989), which tends to be a very limited and highly specialised market.

Infrastructure and services

The constraints identified by the Tourism Council South Pacific (TCSP) to the growth of tourism development in the Solomon Islands are all relevant to Marovo Lagoon. These are: the poor state of commercial accommodation; the high cost of airfares and unreliable schedules; limited tourism infrastructure; a lack of developed attractions; and the minimal and ineffective promotion of the Solomon Islands as a tourism destination. Our investigations support these findings.

Unreliable airline timetables and booking issues currently impede tourism growth. In Marovo, the status of the airfields, concomitant with a maintenance regime dependent on the local patronage of a select few tourist operators, is unsustainable and further limits tourism growth. The tourist market is restricted to highly resilient travellers who travel to Marovo for specific activities. Many are repeat visitors.

In an analysis of tourism in the Marovo context, Hviding and Bayliss-Smith (2000) categorised Marovo Lagoon 'tourist products' as: private enterprise; WWF sponsored eco-tourism; and World Heritage Programme sponsored tourism (2000).

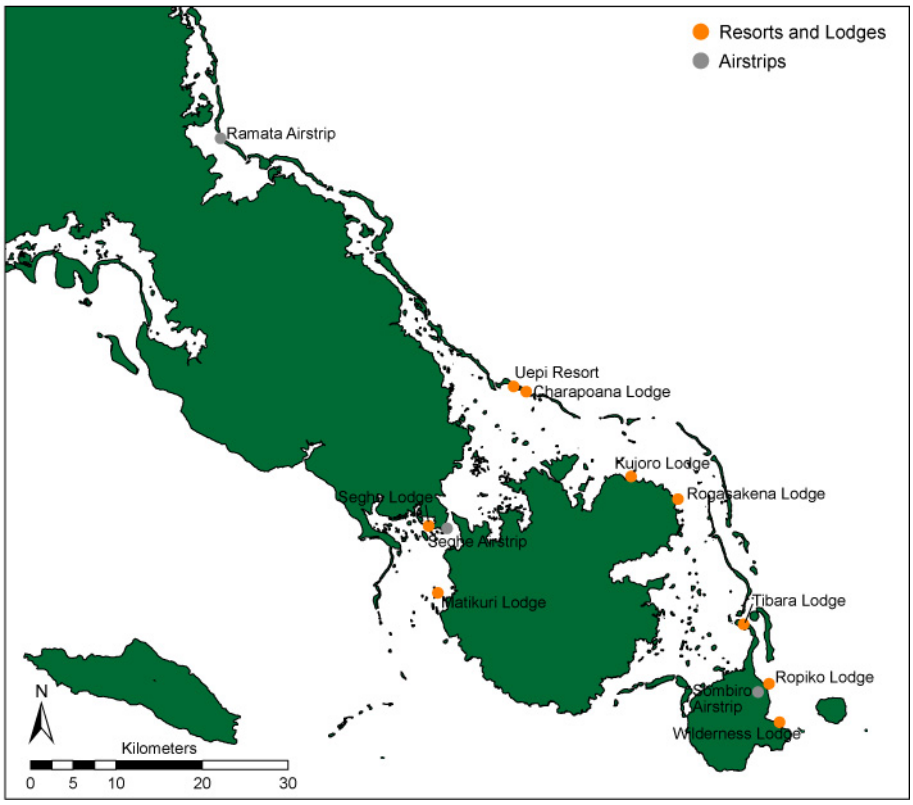


Figure 6.1: Map of tourist lodges, resorts and airports

Private enterprise: foreign

There is one small resort/hotel-style business in the lagoon—the expatriate owned and operated Uepi Resort—which caters mainly to packaged Australian tourists. They offer scuba diving and kayaking tours throughout the lagoon, plus minor cultural 'specific' opportunities. Uepi has its own electricity and a dive shop. Bookings are made through an Australian travel agent, and transfers from Seghe (or elsewhere) are reliable and efficient.

Private enterprise: local

Numerous locally operated lodges exist in Marovo (Fig 6.1). They are generally constructed from local bush-materials, provide clean bedding, sitting furniture, mosquito nets and have a shower and 'western' toilet. The lodges are normally family operated, and provide local cuisine using fresh seafood, chicken, green vegetables and various tubers. Some lodges are wholly locally driven enterprises while others have received some 'outside' support.

Wilderness Lodge and Matikuri Lodge appear to be the most 'functioning' lodges in terms of bed occupancy rates. Located in Peava village on Gatokae Island, Wilderness Lodge consists of one main building constructed in traditional island style, two large bedrooms, a big communal dining area and toilet and showers. The lodge is equipped with solar electricity and a fridge. Wilderness Lodge has reliable transport and communication facilities (including satellite phone) and some direct linkages with travel agents in Australia. Wilderness Lodge has made a concerted effort to develop the tourist potential of terrestrial activities, such as bush walking and cultural village visits.

Matikuri Lodge, located on an island on the Western side of Vangunu, has multiple dwellings (three main accommodation buildings), toilet, shower, communal dining, and a reliable 40–horse powered boat. Matikuri does not have travel agent support outside the Solomon Islands, but relies on post, e-mail contact through the PF-Net station at Seghe, and established 'word-of-mouth' to generate business.

WWF-sponsored eco-tourism

The WWF sponsored Vauna Rapita lodge based at Michi was a flagship programme and part of a wider 'development conservation project' in the lagoon (and was also involved in 'encouraging' the Biche

community to establish a lodge). The programme attempted to create a community-wide 'alternative' business stream to support conservation and discourage the Tobakoorapa *butubutu* of Michi from allowing widespread logging on their territory (Hviding and Bayliss-Smith 2000). The lodge enterprise failed due to social divisions in the community (amongst other things), and the buildings are now in a state of disrepair. This example serves as a poignant reminder of the problems associated with the implementation of predominantly outsider driven economic ideas based strongly on a conservation rationale.

World Heritage Programme

World Heritage interest in Marovo Lagoon began around 1987, with New Zealand acting as the primary driver and eventually establishing a bilateral aid project with the Ministry of Culture and Tourism in the mid 1990s (Hviding and Bayliss-Smith 2000). The New Zealand World Heritage Programme (NZWHP) assisted individuals within the lagoon to improve existing lodges or establish new eco-lodges.

Service providers and organisations

Dive operators

Scuba diving in the Solomon Islands is regarded as some of the best in the world because of clear waters, World War II wrecks and spectacular coral reef dive sites. Several businesses operate in the Western Province.

At present, dive operators are the main-stay of the country's tourism industry, and provide substantial financial inputs into local economies through handicraft sales[5]. In the villages of Bili and Chea, where most of our social research was conducted, handicraft sales were among the top three earners for most families. However, this is simply value-adding to the dive experience, and the potential economic benefits of tourism will only be realised when the environmental-cultural character of Marovo Lagoon becomes the attraction and not just an activity within a wider tourist experience.

Of notable concern is the inclusion of heritage items for sale at many of the 'tourist markets'. *Kastom* money and other heritage items are openly available for purchase. 'Heritage for sale' in the Solomon Islands is an issue for the country and its communities, but from a tourism perspective the loss of artefacts is a detriment to tourism and decreases the intrinsic quality of future heritage tourism products.

As well as its limited benefits, dive tourism can also be locally disruptive. The live-aboard-dive-boats attempt to distribute the economic benefits associated with handicraft sales equitably, by visiting a number of villages during any one 'tour'. Regardless, carvers come from all over the lagoon to display their wares at these 'carving shows', sometimes resulting in animosity from carvers who live in the 'home' village. Diving royalties are also a highly contested issue. With marine waters owned under customary tenure, dive operators are required to pay royalties. This money tends to reach the Chief (or Chiefs) only, with the majority of people in the community not receiving any financial remuneration. Diving royalties are supposed to be paid per dive, but this is allegedly regularly flouted. The amount of royalties paid appears to vary from operator-to-operator, and from Chief-to-Chief, but are quite low considering that the live-aboard-dive-boats charge US$200 a day for accommodation, food and dives. From 1986 until very recently, the MV Bilikiki and MV Spirit of Solomon reportedly paid a mere SI$5.00 per person per dive. This royalty figure has apparently been renegotiated to SI$10.00 per person per dive. In the past, disputes over diving royalties have resulted in the expulsion of diving activities from tenured waters in the lagoon.

Tour operators

In economic and visitor number terms, non-diving related tourism is minimal in Marovo, but integral to the long-term success of local lodges. Overall, most non-diving tourists to Marovo are independent travellers, but may attempt to, or accurately go through, tour operators. Nonetheless, the existing tourism profile of Marovo does not match the demand for tour operator services at this time.

5 For a number of historical reasons, it is predominantly members of SDA communities who practice carving in Marovo. However, this trend has started to spread to the other religious denominations, especially United Church villages.

Tourism organisations

Numerous government and non-government organisations, nationally, provincially and regionally, have been established to market, facilitate and manage tourism. Given the size of the industry and the lack of performance, this appears to be inefficient.

'Values' of Marovo Lagoon

Regardless of the infrastructure and service issues, Marovo Lagoon continues to attract a 'dribble' of tourists. The proposed listing of Marovo Lagoon as a World Heritage site is likely to increase awareness of the conservation values of the lagoon, attracting tourists in response to the identification of a number of natural and cultural values, which include the double barrier lagoon, clear reefs, and the number and range of fish, world renown carvings, cultural sites and gardens. The intrinsic and extrinsic qualities of the Marovo 'tourist product' are high (see Appendix), but are largely dependent on the perceived health of its natural environment. If tourists expecting a 'pristine landscape' experience are disappointed by the scale of logging around the lagoon (clearly visible when you fly in to the lagoon) and the increased water turbidity that decreases diving visibility and fish species diversity, it will seriously harm the 'tourist product'.

The benefits of tourism

Tourism is the fastest growing industry in the world, with nature-based tourism representing a significant share of this market, especially in the Asia-Pacific. Marovo Lagoon can share in this growth if it can establish a clear identity to entice visitors who seek the attractions and services that the lagoon and region can offer—a market niche.

Ecotourism in Marovo has the potential to:

- Act as an incentive for maintaining and protecting of the integrity of local culture;
- Support conservation by strengthening environmental awareness and commitment through increased understanding and appreciation of nature;
- Diversify the economic base of local communities directly and indirectly through small business development; and
- Increase cross-cultural understanding through social interaction.

However, the flow of these benefits is not assured without planning, strategic investments and the united vision of the Marovo communities.

The perception of tourism by Chea and Bili residents was that it is beneficial overall, even though most villagers surveyed agreed that tourism benefits are not shared equitably (see Table 6.3).

Table 6.3: Consensus analysis of tourism

Code	Statement	Bili/Chea	
		Disagree	Agree
Q15TOR	Only some people benefit from tourism	10 (17%)	49 (83%)
Q30TOR	Tourism is good for the peopls of Marovo Lagoon	1 (2 %)	59 (98%)

Most people in Marovo see tourism as an activity to supplements existing livelihood strategies. This model of tourism development has been 'successful' in a diverse range of cultures. However, ultimately with growth, some in the community will gravitate to tourism being the sole source of income.

Ecotourism limitations…

Tourism is no economic panacea, and any growth in tourism has its limitations and problems. In Marovo Lagoon, tensions have already arisen over royalties with the live-aboard-dive-boat operators, and there is some animosity towards, and jealousy of, both existing expatriate and local family-based tourist initiatives. Some people have also expressed concern that increased tourism could erode local

Marovo culture[6]. Acknowledging the infrastructure and logistical limitations extant in Marovo and the Solomon Islands generally, concomitant with the high rate of malaria and the nature of recent (and unresolved) civil unrest, one must remain realistic about the short and medium term prospects of tourism in the lagoon.

…and opportunities

Regardless of its limitations, we are confident that Marovo Lagoon retains enormous potential as a tourism destination and can positively contribute to local livelihood and development aspirations while simultaneously contributing to resource management activities. This confidence is based on the inherent cultural and environmental characteristics of the area.

Conservation Objectives and Tourism

Our research suggests that there is a link between tourism and conservation which could be potentially harnessed and extended. The fish surveys showed that in Bili and Tengomo, fish communities appeared to be healthier than elsewhere in the lagoon; in both these cases, fish health data came from sites in close proximity to where tourism ventures operate, or in the case of Tangemo, once operated. Field observations and informant interviews in Bili verify that the area opposite Tibara Lodge—which has also recently been declared an MPA[7]—has long been 'protected' from intensive community fishing with the specific aim of enhancing visitor dive experiences. Elsewhere in the lagoon, formal and informal conservation measures are undertaken based on the same rationale. On Gatokae, Wilderness Lodge and the community of Peava have established an MPA adjacent to the lodge (4 years old), and Uepi have an MPA which is close to 30 years old. An example of a less 'formal' tourist conservation activity can be found at Matikuri Island, where the lodge owners have requested that surrounding communities not harvest coconut crabs on the island, again to enrich the tourist experience. Clearly, an increase in tourism numbers to these and other similar appropriate tourism developments could further conservation objectives.

Conclusion and Strategic Directions

Marovo Lagoon and the surrounding region have the natural and cultural features to become one of the most popular ecotourism destinations in the South Pacific. However, the development and maintenance of appropriate facilities and activities is necessary to ensure the area is perceived as an attractive holiday destination. By presenting and marketing a high quality experience, Marovo can capture an appropriate share of the market.

Three main groups of tourists can be identified as most likely to be interested in visiting Marovo Lagoon.

1. Visitors wanting to see features in the quickest, most convenient way. To service this group requires considerable capital investment. The others will also use infrastructure provided for this group;
2. Visitors wanting to experience local environments and cultures, spending more time around the lagoon, learning about its features and often mixing with the local community. This group is an important target for the eco-lodges. Members of this group are 'experience collectors', and it is this aspect that eco-lodges are currently missing;
3. Visitors seeking specific experiences, such a scuba diving and sport fishing, and bushwalking and bird watching. The former require capital intensive facilities, while the latter need comfortable accommodation, but more importantly specialist interpretive services.

Our tourism investigation has highlighted a number of weaknesses and strengths specific to the current status of tourism in Marovo. Besides infrastructure issues, we pin-pointed a number of local service-based issues which could easily and rapidly be corrected with training and relatively small capital investment. A summary of our tourism related recommendations are included in Chapter 7.

6 Focus-group discussion conducted with students at Beka Beka High School.

7 This area was, in part, chosen as the location for the IWP MPA because it had been partially protected in the past.

(Pilot) Conservation Agreement: Biche Village

As an adjunct to project activities, one of our chief investigator used his initiative and contacts to source outside additional funds and subsequently developed a Conservation Agreement with the community of Biche.

Cognizant of the high level of local dependence on natural resources in 'developing' nations, many conservation initiatives have taken what has been called an 'indirect' approach to engaging with the economic realities of biodiversity conservation. Examples include Integrated Conservation and Development Programmes (ICDP) and community-based natural resource management approaches (Ferraro and Kiss 2002). Partly in response to the failings of many ICDPs around the world (Wells et al. 1998; Wells and McShane 2004; West 2006), there has recently been an increase in 'direct' approaches—initiatives various termed 'forest protection payments', 'conservation leases' and 'conservation concessions'—whereby biodiversity preservation is directly purchased (Hardner and Rice 2002). This latter approach uses 'innovative finance measures' to acquire land (Verweij 2002). Such conservation incentive programmes can take numerous forms, and it is this flexibility that is considered one of its strengths (see Rice 2002).

During the period of the current study it became clear that many communities in Marovo did not want their forests logged, but logging agreements continued to be signed as monies derived from logging royalties were one of only a few ways that communities could attract outside financial inputs. Further, when logging does take place it is often the case that most of the money never reaches the rural village level—villagers lose both the forests and fail to receive financial benefits.

In an attempt to demonstrate that villagers could receive tangible benefits from supporting conservation as well as the ecological benefits, a conservation agreement was piloted with the Biche community (Fig 6.2). This activity was additional to the activities in the original proposal and the financial requirements of the conservation agreement have been supported by funds donated by an Australian donor. The conservation agreement was signed with the village of Biche in January 2007, following a two day village meeting to discuss their aspirations and desires for the future.

Biche village is located on the weather coast, south eastern portion of Gatokae Island, with a population estimated at around 300–350. It is renowned throughout the lagoon and the Solomon Islands for the production of stone *kato* (local mortar and pestle) and customary stone carvings. Members of Biche *butubutu* (Mategele) have a large customary land area encompassing much of the south eastern portion of Gatokae. While a reported 50% of Gatokae has been logged since 1993 (Manele 2001), the majority of Biche community members have withstood the advances made by logging companies. In the late 1990s and early 2000s, Biche was part of WWF's Marovo Resource Conservation Development Project—but for a number of complex reasons (namely the lack of the promised development component, see Foale 2001)—the programme failed. However, with its rich cultural heritage, outstanding geographic and archaeological significance and close proximity to Wilderness Lodge, Biche village has the potential to reap the rewards of tourism over the long-term if it can retain its environmental values. Combined with other tangible developmental deliveries, we believe that this has the potential to translate into real conservation benefits.

Key aspects of the Biche agreement are:

1. The agreement is binding on both parties for a fixed period of 5 years, but is renewable if both parties are happy with the situation;
2. It allows customary harvesting of timber to continue, but does not allow the sale of timber or other materials (e.g. from mining) to people outside Marovo (except for carvings);
3. It will provide financial support (approximately US$7,500 p.a.) to assist community development activities with an aim to enhancing villagers' opportunities for alternative incomes and suppling other community needs (e.g. School, Clinic, Hydro-electricity);
4. The agreement is an agreement of friendship and a way of building trust between the village and UQ and seeks to support the village to discuss and make decisions about its future.

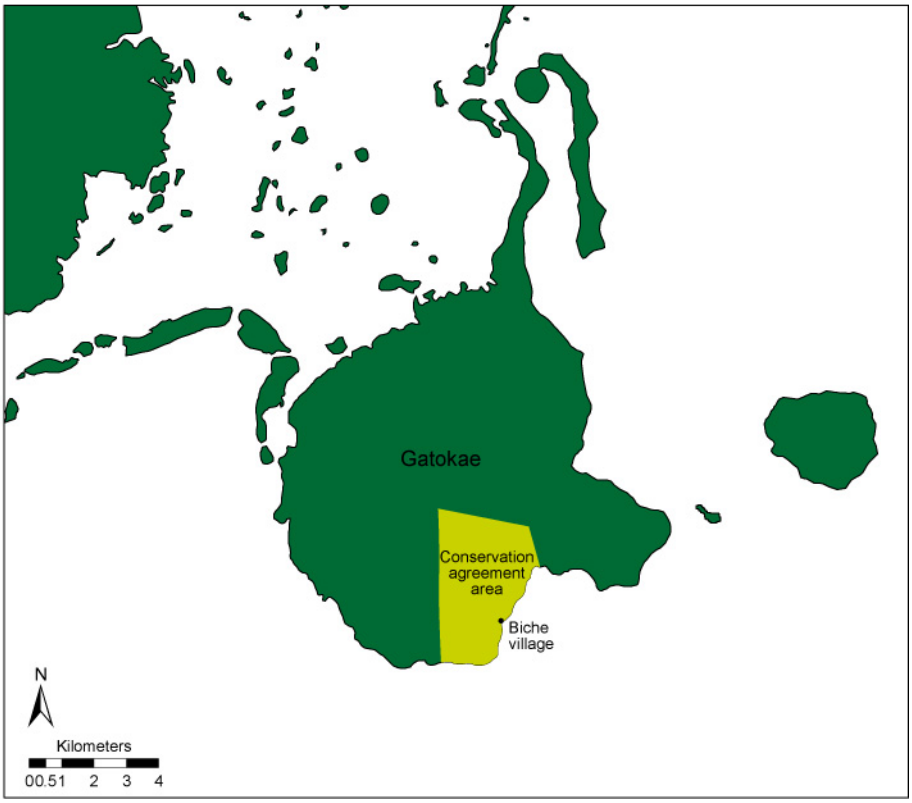


Figure 6.2: Map of conservation agreement area

Those financing this initiative are acting in the hope that this agreement will contribute towards strengthening the local interest in conservation and provide reasons for people to become pro-active in the protection of biodiversity. In addition, the agreement assists villagers to achieve some of their development goals, addressing a common criticism of conservation NGOs that they do not offer tangible benefits to village people. At a local scale, if this agreement is honoured it will provide a significant contribution to the conservation of terrestrial biodiversity (as it covers approximately 20% of Gatokae Island), but this model will need to be expanded to both terrestrial and marine conservation agreements throughout the lagoon if it is to have a significant impact on marine biodiversity in Marovo Lagoon.

We are aware that this approach is experimental, and is no overarching panacea to the environmental woes of the lagoon. As noted in Chapter 4, there are no regulatory safeguards in Solomon Islands law relating to such schemes. Further, as with logging generally, ensuring that all the 'correct' land custodians have been properly consulted is no easy task, and there is nothing to stop the community turning around and selling logging rights down the track (see Romero and Andrade 2004 for more critiques of conservation concessions). Nonetheless, the fact that the community has generally held out against logging thus far, has a rich and relatively 'intact' cultural heritage, and is in close proximity to one of the few operational and successful tourist operations in the lagoon, provides some capital on which to build alternatives into the future. During Phase 2 we plan to conduct a socio-economic impact assessment of the agreement to evaluate the process and outcomes (from both a local and biodiversity conservation perspective). It is hoped that this will provide some important insights into the applicability of incentive schemes for conservation in the Solomon Islands.

Alternative Income Options

This final section of the chapter provides an overview of some important areas of economic development that have been, or are currently being, investigated by other research bodies/agencies, with the aim of investigating their potential in the context of Marovo Lagoon. The primary rationale is to inform ourselves (and others) of wider socio-economic issues and potential alternatives, and to identify gaps and/or opportunities that may arise in the future. The summary is presented in two parts—marine and terrestrial—and broadly outlines issues and activities that impinge upon marine conservation objectives in the Solomon Islands.

Marine

The Live Reef Food Fish Trade (LRFFT)

The LRFFT first began in the Solomon Islands in Vella La Vella Lagoon in the Western Province in 1994 (Johannes and Lam 1999), expanding to Marovo and Roviana Lagoons in the mid 1990s (Donnelly et al. 2000). In 1999, in response to concerns of over-harvesting, a moratorium banning the export of live fish was declared. This was repealed in late 2000 (Hamilton 2003). While offering some economic benefits to both the national and rural economy, the money paid to customary authorities and the local workers is minimal relative to the profits being made by the LRFFT companies. Numerous studies have documented the ecologically unsustainable and socially disruptive impact that the industry can have on rural coastal communities and their maritime environment (Donnelly 2001; Sadovy et al. 2003).

In the late 1990s the Australian Centre for International Agricultural Research (ACIAR) financed a project entitled the Sustainable Management of the Live Reef Fish Trade-Based Fishery in Solomon Islands. The ACIAR project was designed to assist the government in the development of a national LRFFT Management Plan (see Donnelly et al. 2000; Kile et al. 2000). However, to date the plan has not yet been activated, although many of the main recommendations of the draft plan were incorporated into a 2002 revised version of the LRFFT interim license conditions (Hamilton 2003).

Alternative marine related income generating options

In addition to the marine harvesting activities noted above, numerous other marine related income generating activities exist. Mariculture activities such as coral farming, seaweed farming, clam farming and pearl farming, as well as developing alternative offshore fisheries such as raft fishing (tuna and deep water snapper) are some of the key areas which have been identified, and in some instances trailed, by various government agencies and NGOs in the Solomon Islands.

If adequately monitored and managed, these alternatives have the potential to disperse harvesting pressure over a broader range of marine resources, thus reducing the ecological impact and easing the economic burden of rural communities. As noted above, a wider resource base allows for more management options, with rotational pulse harvesting periods, for instance, spreading the impact and diminishing local economic losses. Combined with education and awareness initiatives, this could both supplement and build resource management capacity at the local level while supporting marine conservation goals.

As an example, the following section discusses the potential of four of these livelihood alternatives within the context of Marovo Lagoon: seaweed farming; the aquarium trade; pearl farming; and, coral gardening.

Seaweed farming was introduced to the Solomon Islands (Western and Choiseul Provinces) in the 1980s. *Kappahycus alvarezi* seaweed (trade name cottoni) is farmed for its carrageenan extract and has various applications, mainly in food and pharmaceutical products. Total world production is estimated at 220,000 metric tonnes, with the Pacific accounting for just 1,000–1,500 tonnes. Presently, only Kirribati, Fiji and the Solomon Islands produce commercial quantities, with production in the Solomon Islands expanding from 4 tonnes in 2002 to 332 tonnes in 2005.

Various *ad hoc* attempts at seaweed farming have been tried in Marovo Lagoon, but for a number of reasons they have not yet proved viable and sustainable (the same can be said for clam farming).

Building on the work of IWP, the Department of Fisheries and Marine Resources (DFMR) is currently trialling a seaweed farming project in the communities of both Bili and Chea, in an effort to provide some incentive and support for the IWP-instigated MPAs. Independent ongoing social and scientific monitoring of this initiative, including its impact on and correlation with conservation objectives (the MPAs) could provide important lessons regarding the linkages between conservation and development initiatives within the Marovo context.

Numerous aquaculture activates related to the Marine Aquarium Industry are undertaken in the Solomon Islands, including: Giant clam farming (*Tridacna derasa*, *T. maxima* and *T. crocea*) (see Hart et al. 1998; Lawrence, 1999); coral gardening (see below); and, fish harvesting and husbandry (see

WFC 2006a). However, to our knowledge none of these initiatives is currently active in Marovo Lagoon (although we talked to several people who had farmed giant clams in the past).

Coral Farming or Coral Gardening is another initiative that has the potential to provide livelihood assistance to rural, coastal communities in the Solomon Islands. From 2003–2006 the International Coral and Reef Action Network (ICRAN), supported by numerous national, regional and international organisations (funded by the European Union), implemented the Coral Gardens Initiative throughout the Pacific. This project promoted poverty reduction in rural areas by building capacity among communities to farm corals for the aquarium trade, along with capacity building in community-based resource management. ICRAN ran training and technical assistance projects in three Provinces in the Solomon Islands: Malaita (Langa Langa), Guadalcanal (Marau) and Central (Ngella).

Currently, the WFC in the Solomon Islands is running a pilot Coral Farming project around Gizo, in the Western Province. Working in partnership with WWF, WFC is providing training, technical assistance and a starters-kit to interested persons from communities where WWF has developed various management plans and established MPAs. Due to its geographic proximity to Marovo Lagoon, and the livelihood-conservation link, we plan to maintain dialogue and contact with this WFC/WWF initiative, and if possible and appropriate, possibly support WFC's extension of this work into Marovo Lagoon as an adjunct pilot project in the future.

In addition to these community coral garden projects, a regional Pacific Marine Ornamental Certification (PMOC) programme was completed in late 2004. The PMOC project, which is administered by the South Pacific Forum Secretariat and implemented by Marine Aquarium Council (MAC), aims to transform the marine ornamentals industry by creating a certification process which ensures both quality and environmental sustainability in coral farming (see MAC 2002). While a positive development, some concerns have been raised regarding the complicated nature and financial costs associated with the certification process, and the subsequent difficulties and delays this can create for local enterprises (Anne-Maree Shwarz, WFC scientist, pers. comm. 2006). An independent commodity and regulatory chain analysis of the PMOC, identifying problem areas in the certification process, would be beneficial.

Pearl Farming is a US$1.5 billion global industry (WFC 2006b), and is another activity that has the potential to provide sustainable income opportunities to some coastal communities in the region. The black pearl that comes from the black-lipped oyster, *Pinctada margaritifera*, has successfully been cultured and marketed from a pilot pearl farm established at the WFC Nusa Tupe field station. Spat (juvenile oyster) surveys have been conducted in the region, and various production techniques were developed to protect the oysters from predators—technological achievements which are now in use in Tonga and Fiji (WFC 2006b). The low costs of operating in the Solomon Islands (compared to many other countries in the Pacific), means the potential for pearl farming to provide new livelihood pathways is high. Nonetheless, for community-based pearl farming initiatives to be sustainable and to compete successfully with the potential influx of large international commercial operations in the future, a strategic, well resourced and sustained programme of extension support is essential (i.e. training, on-going technical assistance, marketing and sales support).

In Marovo Lagoon, village coconut news is replete with stories of the amount of money the government has supposedly received from the harvesting and sale of black-lipped pearls from the WFC facility. People expressed frustration that the government, as yet, had not widened the programme to include villages in the lagoon. As with local perceptions regarding the abundance of green snail, trochus and the like, it is clear that in the absence of engagement and adequate information, people become suspicious and frustrated. For conservation and resource management plans to be effective (at both the state and local level), effective and ongoing communication about such issues is essential.

Socio-economic Research Gaps

The above noted livelihood alternatives have the potential to contribute positively towards poverty alleviation in Marovo Lagoon, and provide meaning and impetus to biodiversity conservation efforts. However, while relevant scientific knowledge and technological advancements are increasing, serious knowledge gaps exist in relation to the socio-cultural factors impinging on their take-up by locals (Anne-Maree Shwarz, pers. comm. 2006). Other than Edvard Hviding's (1993) in-depth and

valuable anthropological study of Giant Clam Mariculture, there is a dearth of relevant studies into this important applied domain.

Questions that need investigation include:

- What are people's motives, perceptions and attitudes regarding these and other economic mariculture alternatives?
- What individual, socio-cultural and familial factors can be identified amongst those who have chosen to trial such initiatives in the past?
- What are the socio-cultural impacts of aquaculture on families and communities (i.e. gender, economic, governance issues)?
- Can such activities enhance biodiversity conservation goals?

A concurrent issue associated with the up-take of the alternative forms of economic activities under discussion is the impact that such initiatives could have on customary marine tenure. There is evidence to suggest that the commercial intensification of previously un-harvested, or little-harvested, marine resources can strengthen marine tenure (see Hviding 1996). Others, to the contrary, argue that CMT systems can lead to selective privatisation of the commons and thus amplify existing social inequity (see Foale and Manele 2003). A better understanding of CMT is integral to the success of these livelihood activities just as it is for resource management generally.

Terrestrial

As articulated by our research findings, a major contributor to marine degradation in Marovo Lagoon is related to anthropogenic terrestrial impacts, predominantly sediment dispersal from logging activities. While in some contexts aquaculture has been said to decrease people's reliance on unsustainable and exploitive land based activities (Dowd and Tlusty 2000), the horse has already bolted in Marovo and reliance on and support for logging, and increasingly oil palm, is well established. Combined with the temporal limitations associated with establishing new aquaculture livelihood initiatives, marine based economic activities can only ever be part of the overall solution. Viable and culturally acceptable land based economic alternatives are needed if long-term marine conservation is ever to be achieved in Marovo Lagoon.

The World Bank and European Union are currently assisting the Solomon Islands government in the preparation of an Agriculture and Rural Development Strategy. In addition, AusAID has a Transitional Support for Agriculture Programme, while ACIAR, in line with their Pacific Island Indicative Research Priorities, have several terrestrial focus areas around improving farming systems and sustainable forestry management. Remaining aware of these initiatives and their outcomes is important. In addition to these broader programmes, specific areas which have been highlighted as potential alternative terrestrial economic activities include: the commercialisation of *ngali* nuts (*Canarium salomonense* and *C. indicum*); orchid farming; and, vanilla and chilli farming[8].

Sustainable logging alternatives, such as eco-logging initiatives (community-based logging using walk-about (Lucas) sawmills), are one of the most widely cited and trailed alternatives designed to limit the impacts of large-scale logging. This has been attempted in Marovo Lagoon in the past. The most renowned of these is the United Church sustainable forestry management programme, begun in the 1990s, called the Solomon Western Islands Fair Trade project (SWIFT) (see Schep 1997). However, for a number of complex reasons (see Hviding and Bayliss-Smith 2000) the scheme failed and has ceased operation in Marovo.

The continued absence of significant activities at the Sylvania oil palm plantation on Vanganu (such as noteworthy planting and the construction of a processing mill), combined with the increase in supposed oil palm plantations throughout the lagoon over the last few years, indicates that the recommendations of the Riumana (2003) report have not been taken seriously by the government. This report, in addition to wider anecdotal information, suggests that the company responsible, Kumpulam

8 In the Isabel Province, some research has been conducted into the commercial potential of *ngali* nuts (in Kinch 2004), and this is a strategy that would potentially also suit Marovo. Vanilla and chilli farming is an alternative proposed by Bili and Chea residents during IWP community consultation (Kinch et al. 2006a), and orchid farming is another alternative that has been identified as a potential cottage industry (Pikacha 2006).

Emas Berhad (KEB), have no intention of developing a successful oil palm industry in the Solomon Islands. Rather, they appear to be interested only in logging and have used the pretext of oil palm as a tool to win concessions from the government and garner local support for clear-felling. If, in line with the Riumana (2003) recommendations, the government clawed back some or all of the lost revenues associated with this company's oil palm activities, the monies could be used to fund alternative sustainable agricultural activities.

Carving/Handicraft Production

Carving and other arts and crafts activities such as weaving are an established and integral economic activity amongst SDA villages in Marovo Lagoon. It is also a livelihood strategy increasingly adopted by people in other communities in the lagoon (predominantly United Church). While an attempt to establish a carving and handicraft export business in the past failed, the weakness appears not to be related to local factors but rather to a lack of experience on behalf of the external NGO who instigated the project (and other outside issues)[9].

While the tyranny of distance does provide fiscal challenges for such enterprises in the Pacific, the high quality, variety of carving products available and degree of cultural richness invoked by them suggests that further investigation into the feasibility of establishing an export business that targets the high-end of the market is warranted. The existence of an established lagoon-wide carving association, the decreasing number of indigenous tree species used for carving combined with the *a priori* existence of communally identified replanting areas, suggests that reforestation projects that include these species would likely attract local support. As with appropriate tourism development, carving can enhance and give additional meaning to conservation activities.

Concluding Remarks

Recognition that biodiversity conservation programmes must be cognisant of, and if possible designed and promoted as integral components of wider sustainable development initiatives, is increasingly accepted as a fundamental given in applied conservation circles. However, such engagement must provide genuine contributions to economic and social development and not be short-lived attempts at merely buying cooperation from target communities for biodiversity protection schemes (Hunnam 2002; see also West 2006).

Importantly, one must remain cognisant that throughout the Asia-Pacific region direct and formalised conservation by economic persuasion strategies, especially in the guise of Integrated Conservation and Development Projects (ICDPs), have been fraught with problems and to date have rarely been successful in meeting either conservation or developmental aspirations (see Wells et al. 1998, also Hunnam 2002). Nonetheless, awareness of local dependency on natural resources and its base economic necessity cannot be ignored. How to engage with development and establish the right mix between economic realities and conservation aspirations is the *modus operandi* of resource management objectives. The ultimate elixir, however, is highly elusive.

In nearby Roviana and Vonavona Lagoon, the applied anthropologist Shankar Aswani and his team use community capacity and infrastructure projects as an adjunct to a large marine conservation programme—the Roviana and Vonavona Lagoon Marine Resource Management Programme (RVLMRMP). While reportedly successful, the biological/conservation and social impact of the MPA network is yet to be independently verified. Nonetheless, it is significant that Aswani is building on years of field-work experience in the region and has a thorough understanding of local socio-cultural and historical processes. The RVLMRMP has drawn on science, local knowledge, traditional management and marine tenure protocols as well as the existence of strong governance mechanisms

9 The Marovo Carvers and Weavers Artisan Association (MCWAA) is a local initiative that worked in partnership with Live and Learn Environmental Education (LLEE) on an Eco-Carving Project (ECP). LLEE is an organisation dedicated to environmental education, the promotion of the sustainable resource use and assisting communities with eco-enterprises. Around 1999–2001 LLEE worked with 30 communities around Marovo to establish a revegetation project of degraded areas along rivers and reefs in the lagoon. LLEE bought and shipped a significant amount of carvings to Australia for sale. Communities pledged areas of land to set aside for the replanting of local trees. However, the project was short-lived. The carvings were apparently damaged en-route to Australia, and the marketing and sales strategy appears to have been flawed and was ultimately unsuccessful. There has been little to no follow-up with partner communities in Marovo, or the president of MCWAA, by LLEE.

to establish a network of MPAs throughout the two lagoons (see Aswani 2005; Aswani and Hamilton 2004a; Aswani and Lauer 2006).

As noted by others (e.g. Hviding 2006), it is this last factor, the existence and support of powerful local leaders, that has been a central component of the programme. Many of the inhabitants of Roviana and Vonavona Lagoons are Christian Fellowship Church (CFC) adherents, and these communities retain a strong sense of Melanesian communalism which has, to a large extent, been eroded in many of the United Church and Seventh Day Adventist communities in Marovo Lagoon. Proclamations emanating from the leaders of the CFC church hold a lot of weight on-the-ground in these communities, and have undoubtedly contributed to building local support for the management programme. In Marovo, by contrast, chiefly office and wider customary governance measures have, especially over the last decade, lost much of their power (especially in relation to male youth—often the major resource extractors). Recognition of these micro socio-cultural contextual differences, combined with an awareness of our own applied limitations in this arena, has led us to believe that a different strategy is necessary in Marovo Lagoon.

We are cognisant that our primary strength is research and applied capacity strengthening—not community economic development. Likewise, we recognise that while we have begun to develop a sound understanding of many of the socio-cultural issues extant in the lagoon, we still have much to learn. Nevertheless we are constantly faced with the dilemma that the primary issue in Marovo Lagoon, like that of many developing regions, is economic. Both nationally and locally peoples developmental aspirations are not being met. In an attempt to meet these ambitions, and increasingly to simply subsist, people are forced to rely on the only source of capital available to them: resource extraction. Attempting to assist local communities in either strengthening existing or developing new resource management programmes is a difficult task as it is. It is further compounded if these economic realities are not engaged with. We elaborate on this important point and provide a rationale for our future directions and recommendations, in Chapter 7.

Chapter 7

Lessons learned, future directions and recommendations

Mark Love

Jennifer Corrin Care

Annie Ross

with Simon Albert, Ian Tibbetts, James Udy, Chris Roelfsema and Norm Duke

Introduction

In this chapter we draw together the range of issues identified by our research and reflect on their importance for making meaningful recommendations for Marovo Lagoon. In keeping with our interdisciplinary research design, we set our research findings and consequent recommendations in a scientific and social discourse. Many of the issues we identified through our scientific research were problems recognised by Marovo people themselves, as demonstrated throughout this report.

Intersections between what scientists know and what Indigenous peoples know about natural resources management throughout the world has been widely documented in anthropological literature (e.g. Agrawal 1995, Brosius 2000, Head 2000, Sillitoe 2002). Nevertheless, profound differences exist between how knowledge is constructed, with Indigenous peoples' knowledge often expressed in ways that are perceived by the West as 'unscientific'. As a consequence, Indigenous knowledge is often dismissed as irrelevant in a modern world that privileges the reductivism and positivism of scientific approaches to resource management (Bradley 1998a, 1998b, 2001, Gegeo and Watson-Gegeo 2001, 2002, Hunn et al. 2003, Sillitoe 2002).

In our research we aimed to break down the barriers that often exist between Western and Indigenous epistemologies (ways of knowing) by allowing Marovo peoples' knowledge to have an equal voice with that of the scientists. Although expressed differently from the scientific findings, issues of declining water quality and poor coral health, a diminishing fishery and the consequences of bêche-de-mer harvesting, for instance, are known by many people in the lagoon and are of concern, as they are for science. By sharing scientific and Indigenous knowledge equally, we were able to identify knowledge gaps in both epistemologies and begin to develop shared management aims.

Many of the recommendations outlined in this report have been independently generated by the scientific research and Indigenous knowledge. The whole of community meeting in Batuna (see Chapter 4) demonstrated the conjunction between the research findings of the scientists and the local knowledge of the people of Marovo. Yet this does not mean that our research has been unnecessary or irrelevant. On the contrary, the coincidence of our research findings with the management concerns of Marovo people demonstrates the importance of sharing knowledge and working together to achieve sustainable management outcomes.

This kind of shared research and management is rare in modern resource management (Igoe 2004, Nadasdy 1999, Scott 1996, Smith and Burke 2005). Our research demonstrates the value of this kind of research, and provides an extra-ordinary example of the positive outcomes possible when research is undertaken with a genuine aim of developing a collaborative working environment.

In this chapter, therefore, we outline some of the lessons we have learned during our research, our suggestions for future directions and our recommendations for management of resources, most of which are based on shared concerns for the future of Marovo Lagoon.

Lessons Learned

As noted at the close of chapter 6, one of the primary issues in Marovo Lagoon, like that of many regions, is economic. Marovo people are increasingly experienced and sophisticated in their understanding of the issues at hand and in their dealings with outside agents (e.g. representatives of conservation/research organisations such as ours), and are impatient with rhetoric alone and demand action, not '*tok tok no moa*' (only talk).

The tourism component of the current project was designed in acute recognition of these fundamental issues, and our research demonstrates that tourism does have the potential to positively contribute to economic development and conservation objectives. However, terrestrial and marine resource utilisation will always remain a significant part of local economic activities, due to their historical and cultural centrality and, in regards to logging and mining, the large sums of money involved. With this in mind, outside assisted community-based resource management regimes must remain cognizant of, and realistic about, the boundaries and limitations that this has on conservation goals. As our research shows, local concerns about the 'state of the environment' are not of the same degree or kind as those of

outsiders. These factors highlight that a 'utilitarian' management ethos, rather than a 'preservationist' one, must inform all management options (at the national, regional and local level).

In our view, we believe that if an organisation such as ours is unable to directly and tangibly engage in economic development activities, then we should endeavour to help build solid linkages with partner institutions or other agencies that can deliver such assistance. Where such 'partners' are unavailable, advocacy and lobbying of NGOs who can contribute towards economic and social development aspirations should be part of the project's brief. Strengthening the capacity of local community organisations in the areas of communication, networking and linkage support, can assist sustainable development goals and is the focus of future research activity in Marovo Lagoon, as outlined in our Phase 2 proposal.

Our research highlighted governance (National, Provincial and local) as a fundamental limitation to strengthening and/or initiating effective resource management. This is true in relation to customary law, tenure issues, community governance and general legislative awareness. Important gaps include the fact that there is no legislative provision in the Solomon Islands for establishing community associations (the establishment of a pan-Marovo Resource Association was suggested by people at the Batuna meeting). Additional research was also conducted in relation to the legislative situation in the Solomon Islands context. There is also no legal recognition of Conservation Agreements or Conservation Covenants, and no way that a community can make a legally binding agreement with another organisation that adequately protects a resource from being exploited. Combined, these limitations significantly limit resource management and conservation options.

One of the challenges faced by the current project was how to adequately and effectively engage with the Chiefs of Marovo. While we built good relations with the Chiefs in the communities where we worked, it was difficult to replicate our pan-Marovo community inclusivity at the Chiefly level, and we found engaging with the Council of Chiefs a challenge for a number of reasons. First, the dispersed nature of the Chiefs (many no longer live in the lagoon) makes it expensive and difficult to hold meetings and build relationships. Our emphasis on spending the majority of our time and resources at the rural level was extremely successful and popular at the regional level, but did alienate some Chiefs and community secretaries who reside elsewhere. Second, there is contestation about the legitimacy of some members of the Council of Chiefs. As it was our first foray into the lagoon we did not want to be unwittingly caught up in political controversies. Third, while they were invited to our major community meetings (Batuna and Seghe), many Chiefs were reluctant to come (even with airfares supplied) without being paid, and we were reluctant to do this as it would set a precedent which would distort the nature of the support that UQ was able to provide.

However, now that we have initiated relationships with a few individual members of the Council, any future project should spend more time and resources dealing with traditional leaders, the Council of Chiefs where appropriate, and exploring how best to extend this relationship. Working in partnership with the Chiefs to support existing local initiatives (aimed at sorting out 'legitimation' issues, establishing a culture of 'accountability' and strengthening traditional and community governance) has the potential to produce positive results. Working with other grass-roots groups and organisations is also important in building community-wide capacity and strengthening community governance.

Before closing this reflection and outlining our recommendations, it is pertinent to acknowledge briefly that the three key concepts of 'participation', 'community' and 'governance'—concepts important to this project and central to our future plans—are not problem- or value-free discourses. For example, numerous critics have shown that beneath the 'heroic' aims of 'participation' (Cleaver 2001) lies a desire to reduce resistance and increase compliance. However, all too often 'participation' becomes a means of coercion and project legitimisation rather than a method of inclusion and empowerment (see Cooke and Kothari 2001; Hickey and Mohan 2004). Moving along the continuum of 'community consultation' from 'engagement' to meaningful 'participation' is a difficult and highly political process strewn with contestation. Nonetheless, it remains an integral objective of our research that cannot be disregarded.

Like participation, the use of the term 'community' has attracted increased critical attention. Contemporary iterations of 'community' have come to connote ideas of a relatively bounded, homogonous, empowered and self-governing collective of disparate individuals united though

connection to place and a shared identity (Watts 2006). However, as elucidated by the intra-cultural and inter and intra-community differentiation identified by our social research, such readings conceal the power relations extant within 'communities', as well as masking biases and ideational interests based on, for instance, age, class, religion and gender (Gujit and Shah 1998). 'Community' is also scale variant: just as there is a pan-Marovo 'community' and/or a collective of 'SDA communities', there are singular locales of village 'communities'. Within each village there are also both formal and informal examples of 'micro-communities' (e.g. Church, Youth, Women's groups/'back-sliders' and age-set cohorts). As discussed elsewhere (Chapter 5), genealogical reckoning in Marovo is such that people in neighbouring communities—even in villages far away—through marriage or birth can still have a 'primary right' to fish in a given *puava*. Engaging with the realities of such diversity necessitates an informed and critical tact. To develop an equitable dialogical process that can facilitate meaningful participation and foster ownership of outside interventions takes not only cultural competence and genuine relationship building, but perhaps most significantly, time.

As with the duo of 'participation' and 'community' already discussed, the language of 'governance'—viewed through a critical optic—reveals numerous discursive underpinnings. In the context of the neo-liberal reworking(s) of political economy, the state's role has been downplayed in favour of the market, with civil society being granted a larger role in organising reproduction and production than before (Nelson and Wright 1995 in Radcliffe 2006). In the current context, the emergence of community based natural resource management as the primary management tool (especially in 'developing' contexts) is a reflection of this de-centralist trend. The aspiration of harnessing the power of 'traditional institutions' to further conservation objectives is a logical, but highly complicated and political undertaking. First, simply recognising and effectively engaging with the legitimate representative of a community or regional council inevitably has unintended consequences (such as promoting one clan over another, see Watson 2006). Second, as articulated by commentators such as Duffield (2005) and Pupavac (2005), such development models can be critiqued as collapsing the material developmental aspirations of people into a security paradigm that values self-reliance and *kastom*, while conveniently removing responsibility for development from the state. Pupavac (2005) sees this trend as a form of 'therapeutic governance'—built on a foundation of social psychology—whereby material and other modern development aspirations are reduced to a 'managing conflict' scenario drawing on customary discourse(s).

While perhaps an overly academic appraisal, these critiques have merit and highlight the importance of remaining reflective and self-critical about our overarching aims and processual approach. In response to the 'governance' critique, we would argue that governance (at the local, provincial and national level) has been articulated by Marovo people themselves as an area needing attention and assistance. At the pan-Marovo and village level, as outlined in our Phase 2 plans, the key is to provide human and financial assistance to existing local initiatives, and otherwise avoid directive (and unwarranted) interference. As articulated in Chapter 4, at the provincial and national level there are many gaps and tensions around the intersection between *kastom* and Common Law, and there is room for more engagement on this front.

Future Directions

Successfully navigating the socio-cultural, political and economic milieu of any region is no easy task, and we certainly do not claim to have mastered the traverse. 'Good practice' is about more than creating 'good will', and 'awareness' of the issues does not necessarily equate to 'application'. One of the questions we were constantly confronted with was: How do we, as predominantly a research organisation, engage with conservation issues without directly (and observably) engaging with the forces and constraints of the economic reality we observed?

Dealing with this dilemma by attempting to directly meet developmental aspirations in an immediate and applied manner is to move beyond our area of expertise and is simply not possible. The development of the eco-tourism strategy was designed to meet some of these concerns. However, while it goes some way towards providing applied benefits in the future it does not necessarily quell local aspirations and immediate expectations.

We believe that using science, with local community involvement and input, to design resource management plans that take local governance issues (i.e. CMT), indigenous knowledge and economic/resource utilisation needs into consideration, is achievable and can ultimately meet biodiversity conservation aspirations. A mix of some immediate and mid-term 'development' component is an ideal adjunct—if managed and implemented appropriately. The way we believe we can assist, and an avenue also articulated by some Marovo people themselves, is through acting as an advocate and conduit to the outside world. Aware of our limitations, and the lessons learned from others, we have chosen to concentrate on what we do best: research (scientific, social, legislative, tourism) and capacity strengthening (community, local governance, school and tertiary education). Ideally, we would like to work in parallel with one or more NGOs or agencies already established in the region.

Our overall aims are to strengthen capacity in community-based research, management and governance through supporting the development of local partnerships. This is the key aim of Phase 2 of the UQ Marovo Project: 'Conserving marine biodiversity in Marovo Lagoon through community capacity building and action'. The recommendations below emphasise these aims.

Recommendations based on scientific research

The following recommendations aim to provide a framework for implementing the results of our scientific research, expanding on the lessons learned, and providing a direction for future research, either in Phase 2 of this project, or by others. The recommendations range from management options based on our scientific research, through economic considerations, to a select overview of income generating projects that can offer alternative economic pathways and thus enhance conservation objectives. We identify which recommendations can be achieved within the purview of Phase 2 of the UQ project, and which are general recommendations that lie outside the specific capacity of the UQ research project.

Declining Water Quality

Environmental Factors

Scientific research presented in Chapter 3 provides independent confirmation of Marovo community observations regarding declining water quality. The findings of the scientific research are that, compared to the rest of the world, water quality in Marovo is currently excellent, but that the potential for significant decline in the relatively near future is real. The fact that Marovo people have seen a decline in water clarity over recent years provides the base-line evidence that water quality in Marovo is indeed in danger. Destructive logging and oil palm operations have increased sediment and nutrient export onto inshore reefs of Marovo. Should water quality continue to be affected by land clearance and other variables, the potential for harmful impacts on tourism and the Marovo fishery is high.

Governance/Education Factors

Many of the causes of declining water quality (logging, oil palm plantations, and new proposals for mining) lie outside local governance controls in the lagoon. Nevertheless, empowering the local community to monitor water quality over time and space can ensure that local peoples are informed of the consequences of such terrestrial activities, and that they can voice their concerns with authority. Education kits that have already been produced as part of the UQ project, and the formation of the local points of contact network, provide a springboard for further education and training about lagoon environments and encourage a whole-of-community response to environmental degradation.

Social Factors

Marovo community members have stated that dirty water in the lagoon causes the corals to die and reduces visibility for divers which results in a reduced fish catch. It also has the potential to harm tourism that depends much on Marovo's world renown for clear waters and a quality diving experience, and currently provides much needed income generating opportunities through carving and handicraft sales.

Recommendations

1. Train members of the Marovo Lagoon community to monitor water quality throughout the lagoon using simple technology and easily operated equipment. This is an aim of Phase 2 of the UQ Marovo Project.
2. Use existing education systems and local community organisations as a forum for exchange on water quality data. This is an aim of Phase 2 of the UQ Marovo Project.
3. Circulate information about water quality monitoring and factors affecting water quality through workshops and/or information sheets (preferably in Marovo language). This is an aim of Phase 2 of the UQ Marovo Project.

Decreasing Fish Population

Environmental Factors

Scientific research presented in Chapter 3 provides independent confirmation of Marovo community observations regarding decreasing fish stocks. Many people recognised that fish are less plentiful today than in the past, and this was confirmed by fish surveys undertaken by UQ scientists. The reduction in fish numbers is in part related to the increasing turbidity in the lagoon, but has also resulted from an increasing economic reliance on fishing for commercial gain.

Governance/Education Factors

Historically, fishing and access to marine resources has been governed by a customary marine tenure system that used a variety of management techniques to ensure a reliable and sustainable fishery in Marovo Lagoon. Temporary closure of targeted fishing grounds in the lagoon, known as *hope*, was one of the most widely used fishery management tools. Nevertheless, as demonstrated in Chapter 5, customary governance practices are under increasing pressure from both external and internal forces and our research demonstrates that in many people's opinion Chiefly office and wider associated customary mechanisms such as CMT are losing local support. Consequently, the re-strengthening of these customary domains has been identified as a necessary prequisite for successful resource management by many Marovo people. However, this needs to be done using local governance systems and processes—defined and directed by locals—rather than being an externally imposed directive which uses customary procedures as a convenient proxy to ensure conservation objectives. However, as noted in Chapters 4 and 6, provincial legislative support for such customary governance processes is a necessary adjunct to ensure locals have the ability to control outside encroachment and transgressions.

Social Factors

Subsistence fishing is the single most important fishing activity undertaken by the people of Marovo Lagoon, with 60% of respondents nominating subsistence as the primary reason for fishing (Love and Ross 2006). Solomon Islanders have one of the highest per capita seafood consumption rates in the world. The 1999 Census details stated that 90% of households in the Western Province fish for subsistence, eating approximately 54kg of fish per person, per year (cited in Kinch et al. 2006b).

In recent years, fishing for cash has become a significant activity for most Marovo families. The need for cash to pay for school fees, 'new' food staples such as rice and tinned fish, fuel for outboard motors and other modern necessities has increased the pressure on marine resource extraction.

Recommendations

1. Develop training opportunities for people in Marovo Lagoon to monitor the health of fish communities in the lagoon. This is an aim of Phase 2 of the UQ Marovo Project.
2. Use existing education systems and local community organisations as a forum for exchange on fishery health. This is an aim of Phase 2 of the UQ Marovo Project.
3. Circulate information about fishery health and factors affecting fishery health through workshops and/or information sheets (preferably in Marovo language). This is an aim of Phase 2 of the UQ Marovo Project.
4. Support locally formed community organisations to encourage local solutions to over-fishing, and to encourage the development of locally-based governance and policing systems. This is an aim of Phase 2 of the UQ Marovo Project.
5. Support the immediate appointment and establishment of the Fishery Advisory Council as provided for under the Fisheries Act 1998. This could help ensure that national Fisheries Management and Development Plans are implemented. This is not an immediate goal of the UQ Project, but is an action which should be supported by Marovo community organisations and NGOs throughout the Solomon Islands.
6. Support the implementation of the National Management and Development Plan for the Live Reef Food Fish Trade (LRFFT). This is not an immediate goal of the UQ Project, but is an action which should be supported by Marovo community organisations and NGOs throughout the Solomon Islands.

Declining Reef Health

Environmental Factors

The overall decline in reef health is generally the result of declining water quality and decreasing fish populations, particularly the reduction in fish and other marine organisms that eat marine plant life such as algae. These marine herbivores are especially important for their ecological role as algae grazers that help to prevents algal blooms that cause 'dirty' reefs and decreased water clarity. Reefs that are dominated by high amounts of algae generally support less productive fisheries (Pandolfi et al. 2005).

Governance/Education Factors

As outlined above, customary measures to control fishing impact are much less effective than they were in the past. Our research was able to demonstrate to Marovo fishers the links between declining numbers of grazing fish species and increasing algal blooms (see Community Report). Expansion of opportunities for Marovo fishers to monitor reef health, and the provision of education/awareness materials on this topic will ensure that information generated by our research remains available to local marine management groups, and contributes to fostering 'ownership' of the issue(s).

Social Factors

Local fishers often target reef grazers for the esky fishing trade. Such species are easy to catch at night using torches and spears. The economic necessity of esky fishing is difficult to under-estimate, and any management regime that aims to halt the decline in marine herbivores by controlling local fishing practices must take this economic imperative into consideration.

A recent TNC (Green et al. 2006) report recommends the government ban the use of gillnets and night- spear fishing. While we acknowledge the devastating impact that these fishing techniques have on certain fisheries, we are reluctant to support such a recommendation as the government is not, and is not ever likely to be, capable of regulating such as ban. As with the 'paper parks' syndrome (i.e. MPAs in name only), a known 'plan' that does not have wide-spread local endorsement simply further contributes to eroding rural communities' 'respect' for government and other 'outside' derived regulations and management plans. Strengthening and adapting existing provincial regulations

such as the Western Province Resource Management Ordinance (WPRMO) (see McDonald 2006) and supporting communities and Chiefs in the capacity to design, monitor and regulate their own resources, is the way we believe that the target of sustainable resource management and conservation should be approached in Marovo Lagoon.

Mariculture activities such as coral farming, seaweed farming, clam farming and pearl farming, as well as alternative offshore fisheries such as raft fishing (tuna and deep water snapper) are some of the key commercial alternatives which could disperse fishing pressure from intensive reef fisheries extraction, as well as positively contributing to local livelihood aspirations.

Recommendations

1. Encourage the National and Provincial Governments to implement a Bêche-de-mer Management Plan that recognises a role for local communities to monitor and manage this resource. If appropriate and possible, Phase 2 of the UQ project could assist with (scientific and social) monitoring of such a plan in the Marovo context.
2. Develop training opportunities for people in Marovo Lagoon to monitor the return of bêche-de-mer to Marovo Lagoon and assess the impact of a growing bêche-de-mer population on the health of reef communities generally. If appropriate and possible, Phase 2 of the UQ project could assist with (scientific and social) development and monitoring of such a plan.
3. Develop training opportunities for people in Marovo Lagoon to monitor the health of the reef, and especially the level of algal growth in the lagoon. This is an aim of Phase 2 of the UQ Marovo Project
4. Use existing education systems and local community organisations as a forum for exchange on reef health. This is an aim of Phase 2 of the UQ Marovo Project
5. Circulate information about reef health and factors affecting reef health through workshops and/ or information sheets (preferably in Marovo language). This is an aim of Phase 2 of the UQ Marovo Project
6. Support locally formed community organisations to encourage alternatives to night fishing, and to encourage the development of locally-based governance and policing systems. This is an aim of Phase 2 of the UQ Marovo Project
7. Alternative marine related income generating options (including LRFFT and mariculture) should be encouraged, and where possible and appropriate, assisted. This is not an immediate goal of the UQ Project, but is an action which should be supported by Marovo community organisations and NGOs throughout the Solomon Islands.

Detrimental land use practices

Environmental Factors

Logging on Vangunu Island has been documented since 1989. Clear-felling of timber has left considerable areas of originally forested land as exposed soil or grassland. Run-off from these areas is most pronounced after heavy rains, producing high levels of turbidity in the lagoon—especially close to river mouths. The failure of the oil-palm venture has brought massive environmental degradation for little or no economic return to either the Solomon Islands Government or Marovo people.

Governance/Education Factors

Detrimental land use practices (logging, oil palm extraction, and new proposals for mining) lie outside most of the local governance controls in the lagoon. The Forests Act 1999 was passed by Parliament in June 1999 and implemented with Regulations on 29 February 2000. Critical reviews of the Act have seen it as a vast improvement on the old legislation, but stress that it remains only a framework (Sheehan 2000) and it is obvious from on-the-ground observations that many regulations are not enacted upon or enforced. In Marovo, for example, laws against cutting close to rivers and the coast are often violated. The people of Marovo need to ensure they have a strong voice in developing practical measures to monitor and police land clearing activities that adversely affect the lagoon. This was a clear message from the Batuna and Seghe workshops (see Chapter 4).

Social Factors

There is considerable contention and social fracture among Marovo peoples over numerous issues, but particularly in regard to the distribution of royalty monies from logging rights. This intra-community 'tension' is further exacerbated by disputes arising in relation to the legal validity of the logging operations, plus real concerns about the unregulated environmental damage associated with such resource extraction. Marovo people have, and are likely to continue to have, their subsistence livelihood base disrupted and eroded by declines in forest and lagoon resources through unsustainable logging, the ineffective and *ad hoc* increase in oil palm plantations throughout parts of the lagoon, and the potential of mining in the future. This has more than just the tangible consequences of impacting upon food security; it also extends to eroding local heritage generally—both material (the destruction of *tabu* sites and other locales of cultural significance) and ideational (contributing to the dissolution of local knowledge systems in some instances).

Recommendations

1. Circulate information about land clearing to members of the community through workshops and/or information sheets (preferably in Marovo language). Provide information about the available legal options for protecting environmental resources and resolving disputes. This is an aim of Phase 2 of the UQ Marovo Project
2. Inform people of their rights under the Forest Act 1999. This is an aim of Phase 2 of the UQ Marovo Project
3. Support locally formed community organisations, such as the Marovo contact-network, that will encourage the enforcement of the regulations of the Forest Act 1999 and the development of locally-based governance and policing systems. This is an aim of Phase 2 of the UQ Marovo Project
4. Support Chiefs and other entitled Land custodians to pressure companies to comply with the Forest Act's regulations. This is an opportunity for any future Marovo Natural Resources Organisation, formed as a result of the 'points of contact' established out of the Batuna and Seghe meetings, to target
5. Investigate and/or support research into alternative forestry and agricultural activities (such as commercial production of *ngali* nuts [*Canarium salomonense* and *C. indicum*]; orchid farming; and vanilla and chilli farming) aimed at improving rural based livelihoods. This is not an immediate goal of the UQ Project, but is an action which should be supported by Marovo community organisations and NGOs throughout the Solomon Islands.

Recommendations based on social science research

Governance Issues

In most areas of the Solomon Islands, communities no longer live in isolation. Increasingly they choose or are forced to interact with outsiders, including other customary groups, expatriate entrepreneurs and national and provincial governments. To be successful and sustainable, community-based resource management must be on a firm legal footing. At present it is not. It is thus recommended that any further project involvement with local communities include the following:

Recommendations

1. Research to clarify the current legal position of community resource managers, particularly regarding legal recognition of land management groups and ownership of land and reefs below the high water mark and to use the results as a basis for advising communities and Provincial and National Government on this matter. This is an aim of Phase 2 of the UQ Marovo Project
2. Research to clarify the available options for protecting environmental resources and resolving disputes at all levels. This is an aim of Phase 2 of the UQ Marovo Project
3. Disseminate information to members of the community through the most effective means (e.g. workshops and/or information sheets in the local language, where possible) about the available legal options for protecting environmental resources and resolving disputes. This is an aim of Phase 2 of the UQ Marovo Project
4. Assist communities to work out their priorities regarding shortfalls in the State legal system and laws, and their interaction with customary law and authority. Assistance should be designed to equip local communities to attempt to negotiate the changes to the law and legal system required to enhance the operation of community based resource management. This is an aim of Phase 2 of the UQ Marovo Project

Strengthening Capacity

As well as assisting Provincial and National administrative, human, and technical capacity, strengthening local rural capacity is fundamental to meeting long-term conservation objectives. Based on our social research and the experience gained from producing, translating and distributing our numerous educational/awareness aids, we believe that a three tiered approach to local capacity strengthening is necessary: a formalised Education component that specifically targets school students (primary and secondary) and teachers; a wider community approach (Church groups and general community members) that uses a variety of communication media to inform people (radio, print mediums, workshops); and assisting existing and/or helping to build additional Community Networks to support ongoing intra-lagoon dialogue and establish local/extra-local linkages with outside organisations.

Education

There are a number of excellent education resources already available in the Marovo language, and there are additional projects by other parties currently under funding consideration. Nonetheless, our project has identified additional ways in which education resources on environmental issues could be developed, and will continue to look for 'gaps' which we may be able to fill. Depending on the outcome of these other projects, we will endeavour to produce, in conjunction with the relevant SIG departments and officials, a suitable school based education programme. Providing resources and assistance to secondary teachers, such as scholarships, is also a fruitful avenue worthy of further exploration.

Recommendations

1. Work with the University of Queensland or the University of the South Pacific to procure and support tertiary scholarships for a select number of appropriately qualified Marovo secondary teachers to undertake studies at the University of Queensland or USP. This is an aim of Phase 2 of the UQ Marovo Project

2. Extend the scope and coverage of the 'environmental stewardship' SDA 'pilot' Sabbath School Workbooks to other communities; develop an equivalent United Church Workbook (as requested by some local UC communities); and, widen the target audience by developing appropriate 'discussion resources' for adult Church groups (i.e. Adventist Men, Dorcas Women's group, Pathfinders, Adventures). This is an aim of Phase 2 of the UQ Marovo Project

3. Develop more specific and substantial community information handouts based on the 'gaps' identified by our research, in parallel with a series of community workshops focusing on: ecological information (such as the life cycles of fish and bêche-de-mer, the importance of mangroves, interconnectivity between reefs and interrelationships between algae, reef and fish); regulatory awareness (i.e. forestry and fishery); community governance issues (i.e. conflict resolution). This is an aim of Phase 2 of the UQ Marovo Project.

Communication

Building on the goodwill established over the last three years and responding to requests from various communities, future project activities could build on this momentum by hosting workshops in more communities. These would ideally include local Chiefs, SIG staff from DFMR and other appropriate personnel (i.e. WFC staff, and where appropriate representatives from NGOs such as WWF and CI etc.). These smaller gatherings would be designed to foster an atmosphere of dialogue that, where appropriate, can lead to the development of a locally specific strategy of action regarding community-resource management.

As elaborated by our research, significant intra-cultural and inter-community differentiation exists in relation to both 'problem identification' and alternative 'pathways of change' solution scenarios. Consequently, workshops must be individually tailored yet be inclusive enough to include neighbouring villages where appropriate. Other communication opportunities (e.g. videos, look-and-learn experiential exchanges to other locales, etc.) should be investigated to effectively reinforce the fundamental (but not necessarily always locally understood) linkage between economic/developmental 'well-being' and a healthy environment.

Positive developments in inter-community communication (see Chapter 4) should be the basis for the expansion of partnerships both within the lagoon and with organisations throughout the Western Province, and with other agencies that can provide some tangible economic and/or developmental merit.

Recommendations

1. Produce and/or assist in the development of a series of short radio 'information and awareness' programmes, based on various environmentally themed topics and issues. This is an aim of Phase 2 of the UQ Marovo Project

2. Engage, assist and cooperate with newly formed/forming appropriate government councils and committees. This is an aim of Phase 2 of the UQ Marovo Project

3. Disseminate research findings to government bodies such as the Fishery Advisory Council (FAC). Such bodies are designed to advise the government on national resource management policy, and thus are integral to biodiversity conservation objectives. This can be achieved during Phase 2 of the UQ Marovo Project, with input from local, NGO and government environmental institutions.

4. Support SIG forestry and fisheries extension agents with information derived through UQ research. This can be achieved during Phase 2 of the UQ Marovo Project, with input from local, NGO and government environmental institutions.

Alternative Livelihoods Activities

As outlined at the beginning of this Chapter, peoples' 'developmental aspirations' cannot be met whilst conservation ideals do not take account of the economic needs of the local people. In Marovo Lagoon, harvesting the natural resources of the lagoon is the only viable way in which people can enter the cash economy which is increasingly dominating livelihoods. The following recommendations provide an overview of possible activities which could alleviate the current reliance on extractive industries in Marovo Lagoon by providing alternative commercial livelihood opportunities for the people of Marovo.

Recommendations

1. Investigate and assess the feasibility of lifting the ban on pearl shell, green snail and crocodile skins to provide alternative commercial marine fishery income. UQ scientists working in Marovo during phase 2 will be in a position to offer information in relation to this.
2. Investigate aquaculture activities related to the Marine Aquarium Industry including: giant clam farming (*Tridacna derasa*, *T. maxima* and *T. crocea*) (see Hart et al. 1998; Lawrence 1999); coral gardening (Green et al. 2006); pearl farming (WFC 2000); and fish harvesting and husbandry (Green et al. 2006). UQ scientists working in Marovo during phase 2 will be in a position to offer information in relation to this.
3. Maintain a dialogue and contact with WFC/WWF regarding their coral farming initiative, and if possible and appropriate, link with and/or support the possibility of WFC extending this work into Marovo Lagoon. This is a matter to be considered during Phase 2 of the UQ Marovo Project.
4. Undertake further research into the factors affecting the 'up-take' of new livelihood activities. This is not an activity that can be undertaken by UQ during Phase 2 of the Marovo Project, but is a possible research area for a PhD student, based either at UQ or elsewhere.
5. Assess the relationship(s) between the previously noted 'alternative' aquaculture livelihood activities and customary marine tenure. This is an activity that could be addressed during Phase 2 of the UQ project, but may be more completely investigated by a PhD student, based either at UQ or elsewhere.

Ecotourism

Marovo Lagoon has outstanding natural and cultural resources that make it a potentially significant international tourism destination in the South Pacific. However, the Solomon Islands tourism investment environment is poor due to its image as an unsafe destination (politically and medically), and as a result of inadequate regional and local public utilities (power, water, sewage, health services) and infrastructure (transport, telecommunications) to support tourism development. The tourism investment environment in Marovo Lagoon is confounded by local socio-political and customary tenure and resource ownership circumstances.

Marovo communities have numerous opportunities to be involved in tourism offering low capital cost products that only they can provide because they possess the knowledge capital. Realising opportunities and minimising impacts require empowerment of the communities with tourism related knowledge and inclusive decision-making systems. The opportunity exists for the Marovo community to be prepared for a future in tourism that is directed by community aspirations: a form of tourism that will be a welcomed difference to existing destinations in the Asia Pacific region. But investment in developing human capital is essential.

Recommendations

1. Investigate opportunities to work with Solomon Islands government and national tourism advisory committees to improve national tourism infrastructure.
2. Support the Marovo Lagoon Tourism Operators (MLTO) and the Eco-Tourism Association to develop lagoon-wide projects that will enhance tourism opportunities in the lagoon.
3. In collaboration with successful local tourism venturers (such as Uepi and Wilderness), develop training programmes for members of the Marovo Lagoon Tourism Operators (MLTO) and the Eco-Tourism Association to encourage better planning for eco-tourism in the lagoon, and close some of the gaps in the Marovo tourism industry, as identified in Chapter 6.
4. In collaboration with successful local tourism venturers (such as Uepi and Wilderness), develop training programmes for members of the Marovo Lagoon Tourism Operators (MLTO) and the Eco-Tourism Association to enhance community understanding of markets, marketing, destination image and the range of possible synergistic tourism businesses that could exist at Marovo.
5. Work with the Marovo Lagoon Tourism Operators (MLTO) and the Eco-Tourism Association to improve marketing opportunities, possibly via internet networks in Seghe, Beka Beka, Wilderness, etc.
6. Encourage the Marovo Lagoon Tourism Operators (MLTO) and the Eco-Tourism Association to lobby provincial and national governments to levy appropriate dive fees.
7. Initiate research into cultural heritage in Marovo and develop recommendations, in consultation with Marovo community organisations, for the management and protection of cultural heritage items and places.
8. Provide training for members of the Marovo Lagoon Tourism Operators (MLTO) and the Eco-Tourism Association to monitor the impacts of tourism on local natural resources and social organisations as a first step towards mitigating the adverse effects of tourism.

References

Adams, T. J. (1998). The interface between traditional and modern methods of fishery management in the Pacific islands. *Ocean and Coastal Management* 40:127–142.

Agassi, A. S. (2004). *Feast or Famine? Fishing for a Living in Rural Solomon Islands*. Unpublished Paper.

Agrawal, A. (1995). Dismantling the divide between Indigenous and scientific knowledge. *Development and Change* 26:413–439.

Akin, D. (1993). *Negotiating Culture in East Kwaio, Malatia*. PhD dissertation, University of Hawaii. UMI Dissertation Services, Ann Arbor.

Akin, D. (2005). Ancestral vigilance and the corrective conscience in Kwaio: *Kastom* as Culture in a Melanesian Society. In J. Robbins and H. Wardlow (eds.) *The Making of Global and Local Modernities in Melanesia: Humiliation, Transformation and the Nature of Cultural Change*. pp.183–206.

Albert, S., O'Neil, J.M., Udy, J.W., Ahern, K.S., O'Sullivan, C.M. and Dennison, W.C. (2005). Blooms of the cyanobacterium Lyngbya majuscula in coastal Queensland, Australia: disparate sites, common factors. *Marine Pollution Bulletin* 51:428–437.

Alder, J. (1996). Have Tropical Marine Protected Areas Worked: An initial analysis of their success. *Coastal Management* 24:97–114.

Alder, J., Zeller, D., Pitcher, T. and Sumaila, R. (2002). A Method for Evaluating Marine Protected Area Management. *Coastal Management* 30:121–131.

Altamirano, R.C. and Pasten A.N., (2000). Distribution and annual abuindance of *Ceratium dens* (Peridinales: Ceratiaceae) in the Gulf of California, Mexico. *Revista de Biologia Tropical* 48(2–3):305–311

Asner, G., Kellerc, M., Pereirad, R., and Zweeded, J. (2002). Remote sensing of selective logging in Amazonia, Assessing limitations based on detailed field observations, Landsat ETM+, and textural analysis. *Remote Sensing of Environment* 80:483–496.

Aswani, S. (1997a). *Customary sea tenure and artisanal fishing in the Roviana and Vonavona Lagoons, Solomon Islands: The evolutionary ecology of marine resource utilization*. PhD dissertaiton, University of Hawai'i. UMI Dissertation Services, Ann Arbor

Aswani, S. (1997b). Troubled water in South-western New Georgia, Solomon Islands: is codification of the commons a viable avenue for resource use regularization. *SPC Traditional Marine Resource Management and Knowledge Information Bulletin* 18:2–16.

Aswani, S. (2000). Women, rural development and community-based resource management in the Roviana lagoon, Solomon Islands: establishing marine invertebrate refugia. *SPC Traditional Marine Resource and Management and Knowledge Information Bulletin* 12:11–22.

Aswani, S. (2005). *Roviana and Vonavona Lagoons Marine Resource Management Program: Final Report (Phases 1 and 2), 2000–2004*. Roviana and Vonavona Lagoons Marine Resource Management Program 151p.

Aswani, S. and Hamilton, R. (2004a). Integrating indigenous ecological knowledge and customary sea tenure with marine and social science for conservation of bumphead parrotfish (*Bolbometapon muricatum*) in Roviana Lagoon, Solomon Islands. *Environmental Conservation* 31:69–83.

Aswani, S. and Hamilton, R. (2004b.) The value of many small vs. few large marine protected areas in the Western Solomon Islands. *SPC Traditional Marine Resource Management and Knowledge Information Bulletin* 16:3–10.

Aswani, S. and Lauer, M. (2006). Benthic mapping using local aerial photo interpretation and resident taxa inventories for designing marine protected areas. *Environmental Conservation* 33:263–273.

Aswani, S. and P. Weiant (2003). Community-based management and conservation: Shellfish monitoring and women's participatory management in Roviana, Solomon Islands. *SPC Women in Fisheries Information Bulletin* 12:19–22.

Babadzan, A. (1989). Kastom and Nation Building in the South Pacific. In R. Guildieri, F. Pellizzi and S.J. Tambiah (eds.) *Ethnicities and nations: Processes of interethnic relations in Latin America, South-east Asia, and the Pacific.* Austin: Rothko and University of Texas press.

Baines, G.B.K. (1985). A Traditional base for inshore fisheries development in the Solomon Islands. In K. Ruddle and R. E. Johannes (eds.) *The Traditional Knowledge and Management of Coastal Systems in Asia Pacific*. Paper presented at the UNESCO-ROSTEA Regional Seminar, 5–9 December, 1983. UNESCO, pp.40–52.

Baines, G.B.K. (1989). Issues in the application of traditional knowledge to environmental science. In R.E. Johannes (ed.) *Traditional Ecological Knowledge: A Collection of Essays*. Gland, Switzerland: IUCN, World Conservation Union, pp.67–69.

Baines, G.B.K. (1991). Asserting traditional rights: Community conservation in Solomon Islands. *Cultural Survival Quarterly* 15(2):49–51.

Baines, G.B.K. (1993). Conservation issues in Oceania: prospects for conservation of biological diversity in the Pacific island region. In C. Moritri and J. Kikawa (eds.) *Conservation Biology in Australia and Oceania*. Beatty and Sons. Chipping Norton. pp.181–185.

Baines, G. and Hviding, E. (1992). Traditional Environmental Knowledge from the Marovo Area of the Solomon Islands. In M. Johnson (ed.) *Lore: Capturing Traditional Environmental Knowledge*. Ottawa: International Development Research Centre. pp.91–110.

Barnes, D.J., Taylor, R.B. and Lough, J.M. (2003). Measurement of luminescence in coral skeletons. *Journal of Experimental Marine Biology and Ecology* 295:91–106.

Bayliss-Smith, T. (1993). *Time, Food and Money in the Marovo Lagoon, Solomon Islands: Village Surveys in a Proposed World Heritage Site*. Report prepared for Commonwealth Science Council, London UK. 25p.

Bayliss-Smith, T., Hviding, E. and Whitmore, T. (2003). Rainforest composition and histories of human disturbance in Solomon Islands. *Ambio* 32:346–352.

Bernard, H. R. (2002). *Research Methods in Anthropology: Qualitative and Quantitative approaches* (3rd ed.). New York: Altamira Press.

Blaber, S.J.M. and Copland, J.W., (1990). Tuna baitfish in the Indo-Pacific Region: proceedings of a workshop, Honiara, Solomon Islands, 11–13 December. Australian Centre for International Agricultural Research, 211p.

Birkeland, C. (1989). The influence of echinoderms on coral-reef communities. In: M. Jangoux and J.M. Lawrence (eds) Echinoderm Studies, 3. AA Balkema. Rotterdam.

Borgatti, S.P. (1992). Special issue on blockmodels—Introduction. *Social Networks* 14:1–3.

Borgatti, S. P. (1994). Cultural domain analysis. *Journal of Quantitative Anthropology* 4:261–278.

Bradley, J. (1998a). 'How can a whitefella know it all?' Indigenous Science-Western Science and Marine Turtles. In R. Kennett, A. Webb, G. Duff, M. Guinea, and G. Hill (eds.) *Marine Turtle Conservation and Management in Northern Australia*, Proceedings of a Workshop held at the Northern Territory University Darwin 3–4 June 1997, pp.25–32.

Bradley, J. (1998b). 'We always look north': Yanyuwa identity and the maritime environment. In N. Peterson and B. Rigsby (eds.) *Customary Marine Tenure in Australia* pp.125–124. Oceania Monograph 48. Oceania Publications, University of Sydney.

Bradley, J. (2001). Landscapes of the mind, landscapes of the spirit: negotiating a sentient landscape. In R. Baker, J. Davies and E. Young (eds.) *Working on Country: contemporary Indigenous management of Australia's lands and coastal regions* Oxford University Press, Melbourne. pp.295–307.

Brosius, J.P. (2000). Endangered forest, endangered people: environmentalist representations of Indigenous knowledge. In R. Ellen, P. Parkes and A. Bicker (eds.) *Indigenous environmental knowledge and its transformations: critical anthropological perspectives* Overseas Publishers Association, Harwood Academic Pyublishers, Amsterdam. pp.293–318.

Bruckner, A.W., Johnson, K.A. and Field, J.D. (2003). Conservation strategies for sea cucumbers: Can a CITES Appendix II listing promote sustainable international trade? *Bêche-de-mer Information Bulletin* 18:25–33.

Bryant, D., Burke, L., McManus, J.W. and Spalding, M. (1998). *Reefs at Risk: A Map-Based Indicator of Threats to the World's Coral Reefs.* World Resources Institute.

Bunce, L., Townsley, P., Pollnac, R. and Pomeroy, R. (1999). *Socioeconomic Manual for Coral Reef Management.* Townsville, Australia: Australian Institute or Marine Sciences.

Carrier, J.G. (1981). Ownership of Productive Resources on Ponam Island, Manus Province. *Journal de la Societe des Oceanistes* 72–73:205–217.

Carrier, J. G. and Carrier, A.H. (1989). Marine Tenure and Economic Reward on Ponam Island, Manus Province. In J.C. Cordell (ed.) *A Sea of Small Boat* Cultural Survival. Cambridge, Mass pp.94–120.

Central Bank of Solomon Islands (2000). *Central Bank of Solomon Islands Annual Report.* Honiara. Solomon Islands.

Chapra, S.C. (1997). *Surface Water-Quality Modeling*. WCB McGraw-Hill. Boston.

Charpy, L. and Charpy Roubaud, C.J. (1990). A model of the relationship between light and primary production in an atoll lagoon. *Journal of the Marine Biological Association of the United Kingdom* 70:357–370.

Chea Village Community (1991a). *Chea Village Community Constitution: Village Committee Regulation and By-laws*. Constitution for the Chea Community, Marovo Lagoon, Western Province, the Solomon Islands.

Chea Village Community (1991b). *Policy Statement: Butubutu Babata and the Use of Their Resources.* Policy Statement for the Chea Community, Marovo Lagoon, Western Province, the Solomon Islands.

Chea Village Community (2003a). *Babata Tribe, Chea Village Community: General Policy Directives on Community Development Foundations.* Policy Statement for the Chea Community, Marovo Lagoon, Western Province, the Solomon Islands.

Chea Village Community (2003b). *Chea Village Community Development Framework and Strategic Plan, Patu Laiti, Marovo Island: Five Year Development Framework, 2003–2007, Projects and Programmes.* Development Framework for the Chea Community, Marovo Lagoon, Western Province, the Solomon Islands.

Choat, J. H. (1991). The biology of herbivorous fishes on coral reefs. In P.F. Sale (ed.) *The Ecology of Fishes on Coral Reefs*: Academic Press. San Diego, CA. pp.120–155.

Cleaver, F. (2001). Institutions, Agency and the Limitations of Participatory Approaches to Development. In B. Cooke and U. Kothari (eds), *Participation: The New Tyranny?* Zed Books. London. pp.37–54.

Cleaver, F. (2002). Reinventing institutions and the social embeddedness of natural resource management, *European Journal of Development Research* 14(2):11–30.

Colby, B. N. (1996). Cognitive Anthropology. In D. Levinson and M. Ember (eds.) *Encyclopedia of Cultural Anthropology* (Vol. 2). Henry Holt and Company. New York pp.209–215.

Commonwealth Science Council (1986). *South Pacific Coastal Zone Management Programme (SOPACOAST), Project Document.* Environmental Planning Programme: Coastal Zone Management of Tropical Islands. CSC Technical Publication Series No.204, CSC(86) EPP–8.

Cooke, B. and Kothari, U. (eds.) (2001). *Participation: The New Tyranny?* Zed Books. London

Cooper, C. and Hall, M.C. (eds.) (2005). *Oceania:A Tourism Handbook*. Aspects of Tourism Series. Channell View Publications.

Corrin Care, J. (2001). Customary Law in Conflict: The status of Customary Law and Introduced Law in post-colonial Solomon Islands. *27 Commonwealth Law Bulletin 1290.*

Corrin Care, J. (2002). Cultures in Conflict: The role of Common Law in the South Pacific. *Journal of South Pacific Law* 9(1).

Dahl-Tacconi, N. (2005). Investigating Information Requirements for Evaluating Effectiveness of Marine Protected Areas—Indonesian Case Studies. *Coastal Management* 33:225–246.

Dalzell, P. and Schug, D. (2002). *Synopsis of Information Relating to Sustainable Coastal Fisheries.* Issues for Community-based Sustainable Resource Management and Conservation: Considerations for the Strategic Action Programme for the International Waters of the Pacific Small Island Developing States, Volume 4. Apia. SPREP.

De Fontubert, A.C., Downes, D.R., and Agardy, T.S. (1996). *Biodiversity in the Seas: Implementing the Convention of Biological Diversity in Marine and Coastal habitats*. IUCN Gland and Cambridge. 82p.

Done, T.J. (1992). Phase shifts in coral reef communities and their ecological significance. *Hydrobiologia* 247:121–132.

Donnelly, R. (2001). *Socio-Economic Environment and the Effects of the Live Reef Food Fish Trade in Marovo Lagoon, Roviana Lagoon and Ontong Java, Solomon Islands*. Discussion Paper No. 5. ACIAR. Canberra. 91p.

Donnelly, R.J., Davis, D.C. and Lam, M. (2000). *Socio-economic and biological aspects of the live reef food fish trade and its development in Solomon Islands*. Discussion Paper No.1. Report to Australian Centre for International Agricultural Research. ACIAR. Canberra. 52p.

Dowd, S. and Tlusty, M.F. (2000). Project Piaba—working toward a sustainable natural resource in Amazon freshwater fisheries. *Endangered Species Update* 17:88–90, University of Michigan. School Natural Resources.

Duffield, M. (2005). Getting savages to fight the barbarians: Development, security and the colonial present. *Conflict, Security & Development* 5(2):141–159.

Duke, N.C. (2006). *Australia's Mangroves. The authoritative guide to Australia's mangrove plants.* University of Queensland and Norman C Duke, Brisbane. 200p. http://www.cms.uq.edu.au/marbot/publications/books.htm

Duke, N.C., Ball, M.C. and Ellison, J.C. (1998). Factors influencing biodiversity and distributional gradients in mangroves. *Global Ecology and Biogeography Letters* 7:27–47.

Ellis, F. (2000). *Rural Livelihoods and Diversity in Developing Countries.* University Press. Oxford.

English, S., Wilkinson, C.R. and Baker, V. (1997). *Survey Manual for Tropical Marine Resources*. Australian Institute of Marine Science.

Falkowski, P.G. and Raven, J.A. (1997). *Aquatic Photosynthesis*. Blackwell Science, Malden, Massachusetts.

Ferraro, P., and Simpson, R.D. (2002). The cost effectiveness of conservation payments. *Land Economics* 78:339–353.

Flannery, T.F. (1994). The future eaters: an ecological history of the Australasian lands and people. Reed Books, Port Melboune. 423p.

Foale, S. (2001). Where's Our Development? Landowner Aspirations and Environmentalist Agendas in Western Solomon Islands. *The Asia Pacific Journal of Anthropology* 2 (2):44–67.

Foale, S. (2002). Nature and empire: Science and the colonial enterprise. *Journal of Pacific History* 37:329–330.

Foale, S.(2006). The intersection of scientific and indigenous ecological knowledge in coastal Melanesia: Implications for contemporary marine resource management. *International Social Science Journal* 58(187):129–137.

Foale, S. and Manele, B. (2003). *Privatising fish? Barriers to the Use of Marine Protected Areas for Conservation and Fishery Management in Melanesia*. Working Paper, No. 47. Resource Management in Asia-Pacific Series. Canberra

Foale, S. and Macintyre, M. (2000). Dynamic and flexible aspects of land and marine tenure West Nggela: Implications for marine resource management. *Oceania* 71:30–45.

Friedlander, A.M. and DeMartini, E.E. (2002). Contrasts in density, size, and biomass of reef fishes between the northwestern and the main Hawaiian islands: the effects of fishing down apex predators. *Marine Ecology Progress Series* 230:253–264.

Gegeo, D.W. and Watson-Gegeo, K.A. (2001) "How we know": Kwara'ae rural villagers doing Indigenous epistemology. *The Contemporary Pacific* 13(1):55–88.

Gegeo, D.W. and Watson-Gegeo, K.A. (2002) Whose knowledge? Epistemological collisions in Solomon Islands community development. *The Contemporary Pacific* 14(2):377–409.

Gooberman-Hill, R.J.S. (1999). *The constraints of "feeling free": Becoming middle class in Honiara (Solomon Islands)*. PhD dissertation, Edinburgh University.

Goericke, R. (2002). Top-down control of phytoplankton biomass and community structure in the monsoonal Arabian Sea. *Limnology and Oceanography*. 47:1037–1323.

Grant, K.L. and Miller, M.L. (2004). A cultural consensus analysis of marine ecological knowledge in the Solomon Islands. *SPC Traditional Marine Resource Management and Knowledge Information Bulletin* 17:3–13.

Gravestock, P. (1999). *Towards a Better Understanding of the Income Requirements of Marine Protected Areas*. Unpublished MSc Thesis. Cranfield University, Silsoe.

Green, A., Lokani, P., Atu, W., Ramohia, P., Thomas, P. and Almany, J., (eds.) (2006). *Solomon Islands Marine Assessment: Technical report of survey conducted May 13 to June 17, 2004*. TNC Pacific Island Countries Report No. 1/06. The Nature Conservancy, Brisbane.

Green, E.P., Mumby, P.J., Edwards, E.D. and Clark, C.D. (2000). *Remote sensing handbook for tropical coastal management*. UNESCO Publishing. 316p.

Grinham, A. (2007). *Downstream effects of land use on shallow-water benthic microalgal communities in Moreton Bay, Australia and Marovo Lagoon, Solomon Islands*. PhD Thesis, University of Queensland, Brisbane.

Gujit, I. and Shah, M. (eds.) (1998). *The Myth of Community: Gender Issues in Participatory Development*. ITDG Publishing. London.

Hamilton, R.J. (2003). The role of indigenous knowledge in depleting a limited resource – A case study of the bumphead parrotfish (*Bolbometopon muricatum*) artisanal fishery in Roviana Lagoon, Western Province, Solomon Islands. University of British Colombia: *Fisheries Centre Research Reports* 11:68–77.

Hallegraeffe, G.M. (1988). *Plankton: A microscopic world*. CSIRO. Bathurst. 112p/

Hardner J. and Rice, R. (2002). Rethinking Green Consumerism. *Scientific American*, pp.89–95.

Harrison, D. (2005). Introduction: Themes in Pacific Island Tourism. In D. Harrison (ed.) *Pacific Island Tourism*. London Institute for Culture, Tourism and Development. Metropolitan University. London pp:1–23.

Hart, A.M., Bell, J.D. and Foyle, T.P. (1998). Growth and survival of the giant clams *Tridacna derasa*, *T. maxima* and *T. Crocea* at village farms. *Aquaculture* 165:203–220.

Head, L. (2000) *Second Nature*: *the history and implications of Australia as Aboriginal landscape* Syracuse University Press. New York.

Hickey, S. and Mohan, G. (eds.) (2004). *Participation: From Tyranny to Transformation? Exploring New Approaches to Participation in Development*. Zed Books. London.

Hill, J. and Wilkinson, C. (2004). *Methods for Ecological Monitoring of Coral Reefs*. Australian Institute of Marine Science and Reef Check.

Hockings, M. and Phillips, A. (1999). How well are we doing? – Some thoughts on the effectiveness of protected areas. *Parks* 9(2):5–14.

Hockings, M., Solton, S. and Dudley, N. (2000). *Evaluating effectiveness: A Framework for Assessing the Management of Protected Areas*. Best Practice protected Area Guidelines Series, No. 6. IUCN. Gland, Switzerland.

Honadle, G. and Rosengard, J.K. (1983). Putting 'Projectized' Development in perspective. *Public Administration and Development* 3:299–305.

Hughes, T.P. (1994). Catastrophes, Phase Shifts, and Large-Scale Degradation of a Caribbean Coral Reef. *Science* 265:1547–1551.

Hughes, H. (2003). Aid has failed the Pacific. *Issue Analysis, No. 33*. The Centre for Independent Studies. http://www.cis.org.au/IssueANalysis/ia33/ia33.htm

Hughes, T.P., Baird, A.H., Bellwood, D.R., Card, M., Connolly, S.R., Folke, C., Grosberg, R., Hoegh-Guldberg, O., Jackson, J.B.C., Kleypas, J., Lough, J.M., Marshall, P., Nystrom, M., Palumbi, S.R., Pandolfi, J.M., Rosen, B. and Roughgarden, J. (2003). Climate change, human impacts, and the resilience of coral reefs. *Science* 301:929–933.

Hunn, E.S., Johnson, D.R., Russell, P.N., and Thornton, T.F. (2003). Huna Tlingit traditional environmental knowledge, conservation, and the management of a 'wilderness' park. *Current Anthropology* 44 (Supplement):S79–S103.

Hunnam, P. (2002). Lessons in conservation for people and projects in the Pacific islands region. United Nations Development Programme. New York. 14p.

Hunnam, P. and Baines, G.B.K. (2002). Supporting Pacific Islander community resource management: Some practical lessons. *Development Bulletin* 58:60–63.

Hunter, C. and Evans, C. (1995). Coral reefs in Kaneohe Bay, Hawaii: Two centuries of western influence and two decades of data. *Bulletin of Marine Science* 57:501–515.

Hviding, E. (1989). *All things in our Sea: The Dynamics of Customary Marine Tenure, Marovo Lagoon, Solomon Islands*. Special Publication No.13. The National research institute, Papua New Guinea

Hviding, E. (1990). Keeping the Sea: The Dynamics of Customary Marine Tenure, Marovo Lagoon, Solomon Islands. In K. Ruddle and R.E. Johannes (eds.) *Traditional Marine Resource Management in the Pacific Basin: An Anthology*. UNESCO/ROSTEA. Jakarta. pp.7–44.

Hviding, E. (1991). Traditional Institutions and their role in the contemporary coastal resource management in the Pacific Islands. *Naga* 14(4):3–6.

Hviding, E. (1996). *A Guardians of Marovo Lagoon: Practice, place, and politics in maritime Melanesia*. Pacific Islands Monograph, Series 14. University of Hawai'i Press. Honolulu.

Hviding, E. (1996b). Nature, Culture, Magic, Science: On Meta-Languages for Comparison in Cultural Ecology. In P. Descola and G. Palson (eds). *Nature and Society: Anthropological Perspectives* Routledge. London. pp: 65–84.

Hviding, E. (1998). Contextual flexibility: present status and future of customary marine tenure in Solomon Islands. *Ocean & Coastal Management* 40:253–269.

Hviding, E. (2003a) Between Knowledge's: Pacific Studies and Academic Disiplines. *The Contemporary Pacific* 15:43–73.

Hviding, E. (2003b) Contested Rainforests, NGOs and Projects of Desire in Solomon Islands. *International Social Science Journal* 55(4):539.

Hviding, E., (2005) *Reef and Rainforest: An Environmental Encyclopedia of Marovo Lagoon, Solomon Islands*, Knowledges of Nature 1. UNESCO. Paris.

Hviding, E. and Baines, G.B.K. (1992). *Fisheries Management in the Pacific: Tradition and the Challenges of Development in Marovo, Solomon Islands*. United Nations Research Institute for Social Development, Discussion Paper. 23p.

Hviding, E. and Baines, G.B.K. (1994). Community-based Fisheries management, tradition and the Challenges of Development in Marovo, Solomon Islands. *Development and Change* 25:13–39.

Hviding, E. and Bayliss-Smith, T. (2000). *Islands of rainforest: Agroforestry, Logging, and Ecotourism in Solomon Islands*. SOAS, Studies in development geography. Ashgate. Sydney.

Igoe, J. (2004) *Conservation and Globalization: A Study of National Parks and Indigenous Communities from East Africa to South Dakota*. Thomson/Wadsworth. Belmont, CA.

IWP (2003). *Review of Legislation and Regulation: National Assessment of Environment, Natural Resources and Relevant Related Legislation and Regulation in Solomon Islands*. Prepared by John Hauirae. 61p.

Jensen, J.R. (1996). *Introductory digital image processing: a remote sensing perspective. Second edition*. Prentice Hall; Series in Geographic Information Science. 316p.

Jensen, J. (2005). *Introductory Digital Image Processing, A Remote Sensing Perspective*, Pearson Education Australia, Sydney.

Johannes, R.E. (1978). Traditional marine conservation methods in Oceania and their demise. *Annual Review of Ecological Systamatics* 9:349–364.

Johannes, R.E. (1982). Traditional conservation methods and protected marine areas in oceania. *Ambio* 11(5):258–261.

Johannes, R.E. (1984). Marine conservation in relation to traditional life-styles of tropical artisanal fishermen. *The Environmentalist* 4(7):30–35.

Johannes, R. E. (1988). The role of marine resource tenure systems (TURFs) in sustainable near shore marine resource development and management in US affiliated tropical Pacific Islands. In B. D. Smith (ed.) *Topic Reviews in Insular Resource Development and Management in the Pacific US-Affiliated Islands*. University of Guam Marine Laboratory. Guam. pp.1–28.

Johannes, R.E . (1993). Integrating traditional ecological knowledge and management with environmental impact assessment. In J.T. Inglis (ed.) *Traditional Ecological Knowledge: Concepts and Cases*. International Development Research Centre. Ottawa. pp. 33–40.

Johannes, R.E. (1998). Government-supported, village-based management of marine resources in Vanuatu. *Ocean and Coastal Management* 40:165–186.

Johannes, R. and Lam, M. (1999). The Live Reef Food Fish Trade in the Solomon Islands. *SPC Live Reef Fish Information Bulletin* 5:8–15.

Johannes, R.E., Ruddle, K. and Hviding, E. (1991). *The value today of traditional management and knowledge of coastal marine resources in Oceania*. 23rd Regional Technical Meeting on Fisheries, South Pacific Commission, New Caledonia. SPC/Fisheries 23/WP 11.

Johannes, R.E., Freeman, M.M.R., and Hamilton, R.J. (2000). Ignore fishers' knowledge and miss the boat. *Fish and Fisheries* 1(3):257–271.

Jolly, M. (1992). Custom and the way of the land – past and present in Vanuatu and Fiji. *Oceania* 62:330–354.

Jolly, M. (1992). Spectres of Inauthenticity. *Contemporary Pacific*. 4(1):49–72.

Jolly M. and N. Thomas (ed.) 1992. The Politics of tradition in the South Pacific. *Oceania*. Special Issue 62(3).

Jourdan, C. (2002). *Pijin: A Trilingual Cultural Dictionary*. Pacific Linguistics. Canberra, Australia

Joyce, K.E., Phinn, S.R., Roelfsema, C., Neil, D.T. and Dennison, W.C. (2002). Mapping the GBR Using Landsat ETM and Reef Check. *The Transect Line* 1.

Juvik, S. (1993). Christian denominational influences on attitudes toward resources development, Marovo Lagoon, Solomon Islands. In L.S. Hamilton (ed.) *Ethics, Religion, and Biodiversity: Relations between Conservation and Cultural Values*. White Horse Press. Cambridge, UK. pp.147–175.

Kabutauka, T.T. (1998). *Pacific Islands Stakeholder participation in Development: Solomon Islands*. A Report for the World Bank.

Kabutauka, T.T. (2000). Rumble in the Jungle: Land, culture and (un)sustainable logging in the Solomon Islands. In A. Hooper (ed.) *Culture and Sustainable Development in the Pacific*. Asia Pacific Press. Canberra.

Keen, M. and Lal, P. (2002). Creating supportive frameworks for community based resource management. *Development Bulletin* 58:46–51.

Keesing, R.M. (1982). Kastom in Melanesia: An Overview. In R. Keesing and R. Tonkinson (eds) Reinventing Traditional Culture: The Politics of Kastom in Island Melanesia. *Mankind*. Special Issue. 13(4):297–301.

Keesing, R.M. (1993). *Kastom* Re-examined. In L.Lindstrom and G.M. White (eds) Custom Today. *Anthropological Forum*. Special Issue. 6(4):587–596.

Keesing, R.M. (1994). Colonial and counter-colonial discourse in Melanesia—In-memoriam. *Critique of Anthropology* 14:41–58.

Keesing, R.M., and Tonkinson, R. (eds.) (1982). Introduction. Reinventing Traditional Culture: The Politics of Kastom in Island Melanesia. *Mankind*. Special Issue. 13(4).

Kelleher, G., Bleakley, C. and Wells, S. (eds.) (1995). *A Global Representative System of Marine Protected Areas*. World Bank. Washington D.C., USA.

Kelleher, G. and Recchia, C. (1998). Lessons from marine protected areas around the world. *Parks* 8(2):1–4.

Kile, N., Lam, M., Davis, D.C. and Donnelly, R.J. (2000). *Managing the live reef fish trade in Solomon Islands: the role of village decision-making systems in Ontong Java, Roviana and Marovo Lagoons*. Discussion Paper No.2 Report to Australian Centre for International Agricultural Research. ACIAR. Canberra. 28p.

Kinch, J. (2002). *The Role of Traditional Reef Closure for Conservation in the Milne Bay Community-based Coastal and Marine Conservation Program, Papua New Guinea*. Paper prepared for the Global Forces and their Impacts on the Pacific's Biodiversity: Towards Local and Regional Response Strategies, Jul 04–02, Rarotonga, Cook Islands.

Kinch, J. (2004). *Status of Marine Resources, Santa Isabel Province*. Report prepared for the UNDP, Pacific Sustainable Livelihoods Progaram, Suva, Fiji; and the Isabel Province Developemnt Program, Buala, Santa Isabel Province, Solomon Islands. 57p.

Kinch, J., Kere, N., Mesia, P., Manioli, J. and Bulehite, K. (2006a). *Community Engagement and Participation in the Marovo Lagoon, Western Province, the Solomon Islands*. SPREP. Apia, Samoa. 27p.

Kinch, J., Kere, N., Mesia, P., Manioli, J. and Bulehite, K. (2006b). *Socio-economic Baseline study: Eastern Marovo Lagoon, Solomon Islands*. SPREP. Apia, Samoa. 103p.

Klumpp, D.W., McKinnon, A.D. and Mundy, C.N. (1988). Motile cyrptofauna of a coral reef – abundance, distribution and trophic potential. *Marine Ecology Progress Series* 45:95–108.

Kohler, K.E. and Gill, S.M. (2006). Coral Point Count with Excel extensions (CPCe): A Visual Basic program for the determination of coral and substrate coverage using random point count methodology. *Computers and Geosciences* 32:1259–1269.

Koop, K., Booth, D., Broadbent, A., Brodie, J., Bucher, D., Capone, D., Coll, J., Dennison, W., Erdmann, M., Harrison, P., Hoegh-Guldberg, O., Hutchings, P., Jones, G.B., Larkum, A.W.D., O'Neil, J., Steven, A., Tentori, E., Ward, S., Williamson, J. and Yellowlees, D. (2001). ENCORE: The Effect of Nutrient Enrichment on Coral Reefs. Synthesis of Results and Conclusions. *Marine Pollution Bulletin* 42:91–120.

Kupiainen, J. (2002). *Tradition, Trade and Woodcarving in Solomon Islands*. The Finnish Anthropological Society TAFAS 45. Intervention Press. Denmark.

LaFranchi, C. (1999). *Islands adrift? Comparing industrial and small-scale economic options for Marovo Lagoon region of Solomon Islands*. Greenpeace Pacific. Suva, Fiji.

Lawrence, J. (1999). ACIAR and ICLARM: partners for progress in mariculture. *ACIAR Partners in Research and Development* 12:1–10.

Liligeto, G. W. (2006). *Babata, our land, our tribe, our people: a historical account and cultural materials of Butubutu Babata, Marovo*. Institute of Pacific Studies, The University of the South Pacific. 175p.

Lillesand, T., Kiefer, R. and Chipman, J. (2004) *Remote Sensing and Image Interpretation, Fifth Edition,* John Wiley & Sons, New York.

Lindstrom L. and White, G. (eds.) (1993). Custom Today. *Anthropological Forum*. Special Issue, 6(4).

Littler, M. and Littler, D.S. (1984). Relationships between macroalgal functional form groups and substrata stability in a subtropical rocky-intertidal system. *Journal of Experimental Marine Biology and Ecology* 74:13–34.

Locally-Managed Marine Area Network. (2003). *Learning Framework for the Locally-Managed Marine Area Network*. LMMA Network. Suva, Fiji.

Lorenzen, C.L. (1967). Determination of Chlorophyll and Pheo-Pigments: Spectrophotometric Equations. *Limnology and Oceanography* 12:343–346.

Lough, J.M. and Barnes, D.J. (2000). Environmental controls on growth of the massive coral Porites. *Journal of Experimental Marine Biology and Ecology* 245:225–243.

Love, M. (2006). *Projectised Epistemologies and Unintended Consequences: In Consideration of Environmental Change and Marine Protected Areas in Marovo Lagoon, Solomon Islands*. Honours Thesis. University of Queensland.

Love, M. and A. Ross, (2006). *Preliminary Anthropological Field Report: UQ-Solomon Marovo Project Report*. 89p.

Lundquist, C.J. and Granek, E.F. (2005). Strategies for successful marine conservation: Integrating socioeconomic, political, and scientific factors. *Conservation Biology* 1771–1778.

MAC (2002). *Conservation Benefits of MAC Certification: Information Sheet*. http://www.aquariumcouncil.org/pdf/ConservationBenefitsofMACCertification.PDF

MacKay, K. T. (nd). *Managing Fisheries for Biodiversity: Case studies of community approaches to fish reserves amongst the small island states of the Pacific*. World Fisheries Trust, IDRC and UNEP.

Malthus, T., and Mumby, P. (2003). Remote sensing of the coastal zone: an overview and priorities for future research. *International Journal of Remote Sensing* 24:2805–2815.

Manele, B. (2001). *Biche Community Report*. World Wide Fund for Nature. Solomon Islands. 21p.

Manioli, J. (2004). *Baseline Survey Report – invertebrates, 8th – 17th September 2004.* A report prepared for the International Waters Programme, Honiara, Solomon Islands. 8p.

Margoluis, R and Salafsky, N. (eds), 1998. *Measures of Success: Designing, Managing and Monitoring – Conservation and Development Projects*. Washington DC: Island Press.

Massin, C. (1982). Food and feeding mechanism: Holothuroidea. In M. Jangoux and J.M. Lawrence (eds) *Echinoderm nutrition*. Balkema. Rotterdam.

McClanahan, T.R. (1999). Is there a future for coral reef parks in poor tropical countries? *Coral Reefs* 18:321–325.

McCulloch, M., Fallon, S., Wyndham, T., Hendy, E., Lough, J.M. and Barnes, D. (2003). Coral record of increased sediment flux to the inner Great Barrier Reef since European settlement. *Nature* 421:727–730.

McDonald, J. (2006). *Marine Resources Management and Conservation in Solomon Islands: Roles, Responsibilities and Opportunities*, Report to Solomon Islands International Waters Project, SPREP.

Miller, L. M., Kaneko, J., Bartram, P., Martkds, J. and Brewer, D.D. (2004). Cultural consensus analysis and Environmental Anthropology: Yellowfin tuna fishery management in Hawaii. *Cross-Cultural Research: The Journal of Comparative Social Sciences* 38(3): 289–3313.

Moriarty, D.J.W. (1982). Feeding of *Holothuria atra* and *Stichopus chloronotus* on bacteria, organic carbon and organic nitrogen in sediments of the Great Barrier Reef. *Australian Journal of Marine and Freshwater Research*. 33:255–263.

Morton, J.E., (1974). The coral reefs of the British Solomon Islands: A comparative study of their composition and ecology. *Proc. 2nd Int. Coral Reef Symp* 2:31–53.

MPA News (2006). *International News and Analysis on Marine Protected Areas* 7(10), April, 2006.

Mumby, P.J., Skirving, W., Strong, A.E., Hardy, J.T., LeDrew, E., Hochberg, E.J., Stumpf, R.P. and David, L.T. (2004). Remote sensing of coral reefs and their physical environment. *Marine Pollution Bulletin* 48:219–228.

Nadasdy, P. (1999). The politics of TEK : Power and the integration of knowledge. *Arctic Anthropology* 36:1–18.

National Statistics Office (2006). *Solomon Islands Statistics* [on-line] Available from: http://www.spc.int/prism/country/sb/stats/ [Accessed on: 20 March 2006]

Nixon, S.W. (1995). Coastal marine eutrophication: A definition, social causes, and future concerns. *Ophelia* 41:199–219.

Novaczech, I., and Chamberlain T. (2001). Post harvest fisheries development project. Marine Studies Programme, University of the South Pacific, Suva. 38p.

NZLC (2006). *Converging Currents: Custom and Human Rights in the Pacific*. New Zealand Law Commission, Study Paper 17.

Ogden, J. C. and Lobel, P. S. (1978). The role of herbivorous fishes and urchins in coral reef communities. Environmental Biology of Fishes 3:49–63.

Oliver, P. and Greenpeace Australia-Pacific (2001). *Caught between two worlds: A social impact study of large and small scale development in Marovo Lagoon, Solomon Islands.* Edited and produced by G. Rossoman; assistance from Solomon Islands Development Trust. Greenpeace Australia-Pacific. Suva, Fiji. 24p.

Osborne, N.J.T., Webb, P. M., and Shaw, G. R. (2001). The toxins of *Lyngbya majuscula* and their human and ecological health effects. *Environment International* 27:381–392.

Oreihaka E. and Ramohia, P. (2000). *The status of Inshore Fisheries Project*: Funded by OBFCF – status of the fishery and its management. A report prepared for the Division of Fisheries and Marine Resources, Ministry of Natural Resources, Honiara, Solomon Islands.

Pandolfi, J.M., Bradbury, R.H., Sala, E., Hughes, T.P., Bjorndal, K.A., Cooke, R.G., McArdle, D., McClenachan, L., Newman, M.J.H., Paredes, G., Warner, R.R. and Jackson, J.B.C. (2003). Causes of coral reef degradation – Response. *Science* 302:1502–1503.

Pandolfi, J.M., Jackson, J.B.C., Baron, N., Bradbury, R.H., Guzman, H.M., Hughes, T.P., Kappel, C.V., Micheli, F., Ogden, J.C., Possingham, H.P. and Sala, E. (2005). Are U.S. Coral Reefs on the Slippery Slope to Slime? *Science* 307:1725–1726.

Peterson, N. (1993). Demand Sharing: reciprocity and the pressure for generosity among foragers. *American Anthropologist* 95(4):860–874.

Pollnac, R. B., Crawford B.R. and M.L.G. Gorospe (2001). Discovering factors that influence the success of marine protected areas in the Visayas, Philippines. *Ocean and Coastal Development* 44:683–710.

Polunin, N.V.C. and Klumpp, D.W. (1992). Algal food supply and grazer demand in a very productive coral-reef zone. *Journal of Experimental Marine Biology and Ecology* 164:1–15.

Pomeroy R. and Rivera-Guieb (2006). *Fishery co-management: a practical handbook*. [on-line] International Development Research Centre. Available from: http://www.idrc.cca/en/ev–8958–201–i–1–DO_TOPIC.html.

Pupavac, V. (2005). Human security and the rise of global therapeutic governance. *Conflict, Security & Development* 5(2):162–181.

Radcliffe, S.A. (2006). Culture in development thinking: Geographies, actors, and paradigms. In S.A. Radcliffe (ed.) *Culture and Development in a Globalizing World: Geographies, actors and paradigms*. Routledge. London. pp.1–29.

Ramofafia, P. (2004). *Baseline Survey: Assessing Abundance of Commercially Important Invertebrates of the Marapa and Simeruka Marine Protected Areas, Marau Sound, Guadalcanal.* Department of Fisheries and Marine Resources, Honiara. Unpublished report. 24p.

Ranken, E.J. (nd.). *Report on the Western Province Resource Management Ordinance 1995. Prepared for the Western Province legal adviser*. WWF Community Resource Conservation & Development Project. 20p.

Rice, E.R. (2002). *Conservation Concessions: Our Experience to Date*. Paper presented at: Annual meetings of the Society for Conservation Biology, Canterbury, UK. July 15, 2002.

Riumana, S. (2003). *Progressive Report on KEB, 18th – 30th January, 2003 on Kumpulam Emas Berhad (KEB) Malaysia*. Report prepared for the Ministry of Agriculture and Primary Industry. Solomon Islands Government. Honiara.

Rodman, M. (1987). Constraining capitalism? Contradictions of self-reliance in Vanuatu fisheries development. *American Ethnologist* 14(4):712–726.

Roelfsema, C.M., Joyce, K.E. and Phinn, S.R. (2004). *Evaluation of benthic survey techniques for validating remotely sensed images of coral reefs*. International Coral Reef Society.

Roelfsema, C.M., Phinn, S.R., Dennison, W.C., Dekker, A. and Brando, V. (2006). Monitoring Toxic Cyanobacteria *L. majuscula* in Moreton Bay, Australia by Integrating Satellite Image Data and Field Mapping. *Harmful Algae* 5:45–56.

Romero, C. and Andrade, G.I. (2003). International Conservation Organisations and the Fate of Local Tropical Forest Conservation Initiatives. *Conservation Biology* 18(2):578–580.

Romney, A. K., Weller, S. and Batchelder, W. (1986). Culture as consensus: A theory of culture and information accuracy. *American Anthropologist* 88(2):313–338.

Ruddle, K. (1988). A framework for research on the traditional knowledge and management of coastal systems, with particular reference to coral reef fisheries. *Galaxea* 7:179–184.

Ruddle, K. and Akimichi T. (eds.) (1984). *Maritime Institutions in the Western Pacific*. Osaka. National Museum of Ethnology, Senri Ethnological Studies 17.

Ruddle, K. and Hviding, E. (1992). Marine resources management in the context of customary tenure. *Marine Resource Economics* 7:249–273.

Ruddle, K. and Johannes, R.E. (eds.) (1985). *The Traditional Knowledge and Management of Coastal Systems in Asia and Pacific*. UNESCO, Jakarta.

Russ, G.R. (2003). Grazer biomass correlates more strongly with production than with biomass of algal turfs on a coral reef. *Coral Reefs* 22:63–67.

Russ, G.R. and Alcala, A.C. (2004). Marine reserves: benefits long-term protection is required for full recovery of predatory fish populations. *Oecologia* 138:622–627.

Ruttan, L.M. (1998). Closing the commons: Cooperation for gain or restraint? *Human Ecology* 26(1):43–66.

Sadovy Y.J., Donaldson, T.J., Graham, T.R., McGilvray, F., Muldoon, G.J., Phillips, M.J., Rimmer, M.A., Smith, A. and Yeeting, B. (2003). *While stocks last: The live reef food fish trade*. Pacific Studies Series. Asian Development Bank. Manila, Philippines. 147p.

Salafsky, N. and Margoluis, R. (1999). *Greater than the sum of their parts: Designing conservation and development programs to maximise results and learning.* Biodiversity Support Program.Washington D.C.

Salafsky, N., Margoluis, R. and Redford, K. (2000). *A toll for conservation practitioners.* Biodiversity Support Program. Washington D.C. http://fosonline.org/resources/Publications. [Accessed 21 April 2006].

Schep, J. (1997). International trade for local development: The case of western Solomon Islands fair trade. In B. Burt and C. Clerk (eds.) *Environmental and Development in the Pacific Islands*. Pacific Policy Paper 25, National Centre for Development Studies, Research School of Pacific and Asian Studies. The Australian University. Canberra. pp.78–90.

Scott, C. (1996). Science for the West, Myth for the Rest? The Case of James Bay Cree Knowledge Construction. In L. Nader (ed.) *Naked Science: Anthropological Inquiries into Boundaries, Power and Knowledge,* Routledge. London. pp.69–86

Shearman, P. and WWF Solomon Islands (1999). *Development options study, Marovo Lagoon, Solomon Islands: Balancing the needs of Marovo and the prosperity of the nation*. In P. Hunnam and E. Mealey (eds.). WWF South Pacific Program. Suva, Fiji.

Sheehan, P. (1999). Solomon Islands forests sector. Policy Dialogue. *Pacific Economic Bulletin*. 15(1):126–131.

Shwarz, A. (2006). Personal communication (Mark Love). WFC Scientist. September, Solomon Islands.

Sillitoe, P. (2002). After the 'affluent society': Cost of living in the Papua New Guinea highlands according to time and energy expenditure-income. *Journal of Biosocial Science* 34:433–461.

Sillitoe, P. and Bicker, A. (2004). Introduction: Hunting for theory, gathering ideology. In A. Bicker, P. Sillitoe and J. Pottier (eds.), *Development and Local Knowledge*. Rutledge Hardwood Anthropology. London. pp.1–18.

Smaalders M. and Kinch, J. (2003). Canoes, Subsistence and Conservation in Papua New Guinea's Louisiade Archipelago. *SPC Traditional Marine Resource Management and Knowledge Information Bulletin* 15:11–21. http://www.spc.int/coastfish/News/Trad/15/Smaalders.pdf.

Smith, S. L. J. (1989) *Tourism analysis: A Handbook,* Longman Scientific & Technical, Harlow.

Smith, C. and Burke, H. (2005) Joining the dots: Managing the land and seascapes of Indigenous Australia. In I. Krupnik and R. Mason (eds) *Northern Ethnographic Landscapes: Perspectives from the Circumpolar Nations,* Smithsonian Institution Press. Washington D.C. pp.381–401.

Solomon Islands Government, (2002). *Human Development Report, 2002: Building a Nation*. Solmon Islands Government. Honiara.

Solomon Islands Government, (2003). *Code of Logging Practice (COLP)*. Solomon Islands: Department of Forestry. Honiara.

Solomon Islands Government (2005a). *Special Audit Report into the Financial Affairs of the Department of Fisheries and Marine Resources*. National Parliament Paper. No. 9 2005. Prepared by the Office of the Audito-General. Honiara. Solomon Islands.

Solomon Islands Government (2005b). *Special Audit Report into the Financial Affairs of the Department of Forestry, Environment and Conservation*. National parliament paper. No. 10 2005. Prepared by Office of the Auditor-General. Honiara. Solomon Islands.

Steidinger, K. A., and Tangen, K., (eds.) (1996). *Dinoflagellates* (San Diego, Academic Press, Inc.).

St John, J., Russ, G. R. and Gladstone, W. (1990). Accuracy and bias of visual estimates of numbers, size structure and biomass of coral reef fish. Marine Ecology Progress Series 64:253–262.

Stoddart, D.R. (1969). Geomorphology of the Marovo Elevated Barrier Reef, New Georgia. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences* 255:383–402.

Sulu, R., Hay, C., Ramohia, P. and Lam, M. (2000). *The Coral Reefs of Solomon Islands, Global Coral Reef Monitoring Network (GCRMN) Report*. Global Coral Reef Monitoring Network (GCRMN) Report.

Tonkinson, R. (1982). National identity and the problem of kastom in Vanuatu. *Mankind* 13:306–15.

Townsend, K. A. and Tibbetts, I. R. (2000). Biomass and distribution of herbivorous blennies in the southern Great Barrier Reef. *Journal of Fish Biology* 56: 774–791.

Udy, J.W. and Dennison, W.C. (1997). Growth and physiological responses of three seagrass species to elevated sediment nutrients in Moreton Bay, Australia. *Journal of Experimental Marine Biology and Ecology* 213:253–277.

U.S. Salinity Laboratory Staff. (1954). Alkaline-earth carbonates by gravimetric loss of carbon dioxide. In L.A. Richards (eds) *Diagnosis and improvement of saline and alkali soils*. U.S. Government Printing Office. Washington D.C.

Uthicke, S. (1999). Sediment bioturbation and impact of feeding activity of *Holothuria (Halodeima) atra* and *Stichopus chloronotus*, two sediment feeding holothurians, at Lizard Island, Great Barrier Reef. *Bulletin of Marine Science*. 64:129–141.

Uthicke, S. (2001). Interactions between sediment-feeders and microalgae on coral reefs: grazing losses versus production enhancement. *Marine Ecology Progress Series*. 210:125–138.

Uthicke, S. and Conand, C. (2005). Local examples of bêche-de-mer overfishing: An initial summer and request for information. *SPC Bêche-de-mer Information Bulletin*. 21:9–14.

Uthicke, S., Welch, D. and Benzie, J.A.H. (2004). Slow growth and lack of recovery in overfished holothurians on the Great Barrier Reef: Evidence from DNA fingerprints and repeated large-scale surveys. *Conservation Biology*. 18:1395–1404.

Veitayaki, J., Aalbersberg, B., Tawake, A., Rupeni, E. and Tabunakawai, K. (2003). *Mainstreaming Resource Conservation: The Fiji Locally Managed Marine Area Network and its Influence on National Policy Development*. Research School of Pacific and Asian Studies, The Australian National University. Resource Management in Asia-Pacific Series, Working Paper No. 42. ANU. Canberra.

Verweij, P. (2002). *Innovative financing mechanisms for conservation and sustainable management of tropical forests: Issues and perspectives*. Discussion Paper presented at the International Seminar: 'Forest Valuation and Innovative Finance Mechanisms for conservation and sustainable management of tropical forests'. Tropenbos International and the European Tropical Forest Research Entwork (ETFRN), The Hauge, 20–21 March 2002.

Warren, A., Batterbury, S. and Osbahr, H. (2001). Soil erosion in the West African Sahel: a review and an application of 'local political ecology' approach in South West Niger. *Global Environmental Change* 11(1): 79–95.

Watkinson, A.J., O'Neil, J.M. and Dennison, W.C. (2005). Ecophysiology of the marine cyanobacterium, *Lyngbya majuscula*, (Oscillatoriaceae) in Moreton Bay, Australia. *Harmful Algae* 4:697–715.

Watson, E. E. (2006). Culture and conservation in post-conflict Africa: changing attitutdea and approaches. In S.A. Radcliffe (ed.) *Culture and Development in a Globalizing World: Geographies, actors and paradigms*. Routledge. London. pp.58–82.

Watts, M. (2006). Culture, development, and global neo-liberalism. In S.A. Radcliffe (ed.) *Culture and Development in a Globalizing World: Geographies, actors and paradigms*. Routledge. London. pp.30–57.

Wells M. P. and McShane, T.O. (2004). Integrating protected area management with local needs and aspirations. *Ambio* 33:513–519.

Wells M., Guggenheim, S., Khan, A., Wardojo, W. and Jepson, P. (1998). *Investing in Biodiversity: A Review of Indonesia's Integrated Conservation and Development Projects*. East Asia Region, World Bank. Washington, D.C.

West, P. (2006). *Conservation is our government now: the politics of ecology in Papua New Guinea*. Duke University Press, Durham, North Carolina.

WFC. (2006a.) *Developing sustainable fishery for the marine aquarium trade in the Pacific*. http://www.worldfishcenter.org/tjtan_5.htm.

WFC. (2006b.) *Pearl Farming for new livelihoods in the Solomon Islands and Pacific*. http://www.worldfishcenter.org/tjtan_5.htm.

White, A.T., Courtney, C.A. and Salmanca, A. (2002). Experience with marine protected area planning and management in the Philippines. *Coastal Management* 30:1–26.

Williams, I. and Polunin, N. (2001). Large-scale associations between macroalgal cover and grazer biomass on mid-depth reefs in the Caribbean. *Coral Reefs* 19:358–366.

Wilson, S. and Bellwood, D.R. (1997). Cryptic dietary components of territorial damselfishes (Pomacentridae, Labroidei). *Marine Ecology Progress Series* 153:299–310.

Wood, E. (1953). *Dinoflagellates in the Australian region* Commonwealth Scientific and Industrial Research Organisation. Cronulla Australia. pp.347.

Yingst, J.Y. (1976). The utilization of organic matter in shallow marine sediments by an epibenthic deposit feeding Holothurian. *Journal of Experimental Marine Biology of Ecology*. 23:55–69.

List of figures and tables

Figures

Tables

Appendices

Research Permit

THE RESEARCH ACT 1982
(No. 9 of 1982)

RESEARCH PERMIT

Permission is hereby given to:

1. Name: *Norm Duke*
2. Country: *Australia*
3. To undertake research in (subjects): *Conserving the Marine Biodiversity*
4. Ward(s): *Marovo*
5. Province(s): *Western*
6. Condition:

a. To undertake research only in the subject areas specified in 3 above.
b. To undertake research only in the ward(s) and Province(s) specified in 4 and 5 above.
c. To observe with respect at all times local customs and the way of life of people in the area in which the research work is carried out.
d. You must not, at any time, take part in any political or missionary activities or local disputes.
e. You must leave 4 copies of your final research report in English with the Solomon Islands Government Ministry responsible for research at your own expense.
f. A research fee of SBD100.00 and deposit sum of SBD200.00 must be paid in full or the Research Permit will be cancelled. (See sec. 3 Subsect. 7 of the Research Act).
g. This permit is valid until: 31/05/2007 provided all conditions are adhered to.
h. No live species of plants and animals may be taken out of the country without approval from relevant authorities.
i. A failure to observe the above conditions will result in automatic cancellation of this permit and the forfeit of your deposit.

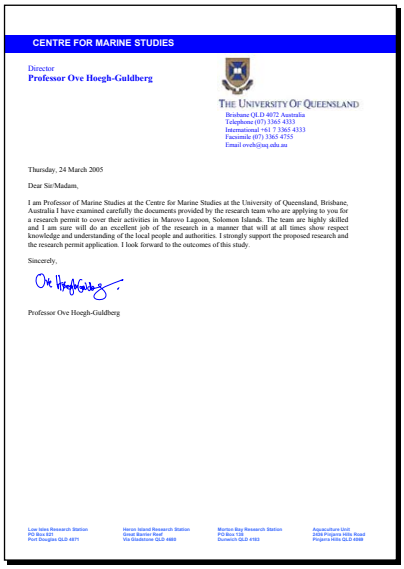
Signed: Ministry for Education and Human Resources Development

Date: 23/6/06

Solomons Islands Government
23 June 2006

Signatories:
Minister for Education and Human Resources

Letters of Support and Memorandums of Understanding



CENTRE FOR MARINE STUDIES

Director
Professor Ove Hoegh-Guldberg

THE UNIVERSITY OF QUEENSLAND
Brisbane QLD 4072 Australia
Telephone (07) 3365 4333
International +61 7 3365 4333
Facsimile (07) 3365 4755
Email ove@uq.edu.au

Thursday, 24 March 2005

Dear Sir/Madam,

I am Professor of Marine Studies at the Centre for Marine Studies at the University of Queensland, Brisbane, Australia I have examined carefully the documents provided by the research team who are applying to you for a research permit to cover their activities in Marovo Lagoon, Solomon Islands. The team are highly skilled and I am sure will do an excellent job of the research in a manner that will at all times show respect knowledge and understanding of the local people and authorities. I strongly support the proposed research and the research permit application. I look forward to the outcomes of this study.

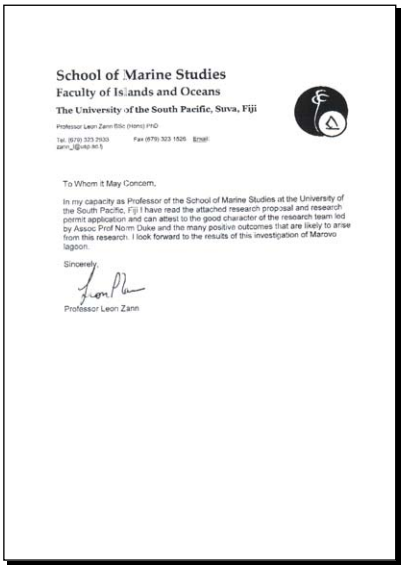
Sincerely,

Professor Ove Hoegh-Guldberg

Low Isles Research Station PO Box 621 Port Douglas QLD 4871 | Heron Island Research Station Great Barrier Reef Via Gladstone QLD 4680 | Morton Bay Research Station PO Box 126 Dunwich QLD 4183 | Aquaculture Unit 2456 Pinjarra Hills Road Pinjarra Hills QLD 4068

University of Queensland
Centre for Marine Studies
24 March 2005

Signatories:
Professor Ove Hoegh-Guldberg



School of Marine Studies
Faculty of Islands and Oceans
The University of the South Pacific, Suva, Fiji

Professor Leon Zann BSc (Hons) PhD

Tel. (679) 323 2930 Fax (679) 323 1526 Email:
zann_l@usp.ac.fj

To Whom it May Concern,

In my capacity as Professor of the School of Marine Studies at the University of the South Pacific, Fiji I have read the attached research proposal and research permit application and can attest to the good character of the research team led by Assoc Prof Norm Duke and the many positive outcomes that are likely to arise from this research. I look forward to the results of this investigation of Marovo lagoon.

Sincerely,

Professor Leon Zann

University of the South Pacific
School of Marine Studies
2 May 2006

Signatories:
Professor Leon Zann

DEPARTMENT OF FISHERIES AND MARINE RESOURCES
P. O. Box G13
Honiara
Solomon Islands

Please reply to Permanent Secretary

Telephone: (677) 38730
Fax: (677) 38106
E-mail: sbfish@fs.net

Your Ref:
Our Ref: F/3/7

9 September 2005

Chairman
Research Committee
Ministry of Education and Human Resources Development
P.O Box G28
Honiara

Dear Sir,

RE: CONSERVING THE MRINE BIODIVERSITY OF MAROVO LAGOON

This note serves to inform you that this Department fully supports the proposal by the Centre for Marine Studies of the University of Queensland todo research on the marine biodiversity of Marovo Lagoon, western Province.

The conservation of marine biodiversity is important for the sustenance of livelihoods of those who depend on marine resources. A better understanding of marine biodiversity is therefore very important for purposes of marine resources management and conservation. Unfortunately available information on Solomon Islands' marine biodiversity is very limited. It is no doubt that marine ecosystems are increasingly being threatened by various factors such as pollution, coastal degradation, destructive fishing practices, etc. With the scarcity of available information, no proper management decision is possible at this stage. Information collected during this study will provide the basis for sound management advice and decision. This will undoubtedly contribute towards a better understanding of the marine biodiversity in Solomon Islands, particularly Marovo Lagoon, which is regarded a potential world heritage site.

A representative form this Department's International Waters Project will participate in the field work of this study and from time to time this Department's fisheries research officers may participate when time and resources allow.

This project is fully supported by the Western Province. Because of the collaborative nature and associated benefits derivable from this undertaking, this Department recommends this proposal for your approval.

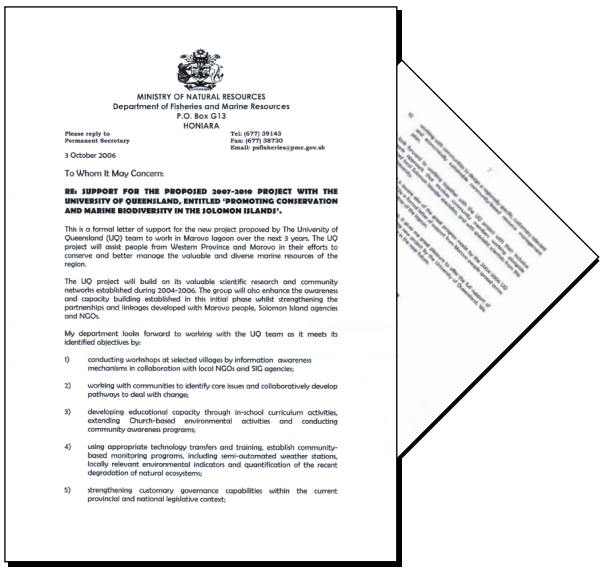
Yours Sincerely,

Eddie Oreihaka
Director
For: Permanent Secretary
Department of Fisheries and Marine Resources

Cc: Dr. Norm Duke/University of Queensland

Solomon Islands Government
Ministry of Natural Resources
Department of Fisheries and Marine Resources
9 September 2005

Signatories:
Eddie Oreihaka, Director



MINISTRY OF NATURAL RESOURCES
Department of Fisheries and Marine Resources
P.O. Box G13
HONIARA

Please reply to
Permanent Secretary

Tel: (677) 39143
Fax: (677) 38730
Email: pafisheries@gmc.gov.sb

3 October 2006

To Whom It May Concern:

RE: SUPPORT FOR THE PROPOSED 2007-2010 PROJECT WITH THE UNIVERSITY OF QUEENSLAND, ENTITLED 'PROMOTING CONSERVATION AND MARINE BIODIVERSITY IN THE SOLOMON ISLANDS'.

This is a formal letter of support for the new project proposed by The University of Queensland (UQ) team to work in Marovo lagoon over the next 3 years. The UQ project will assist people from Western Province and Marovo in their efforts to conserve and better manage the valuable and diverse marine resources of the region.

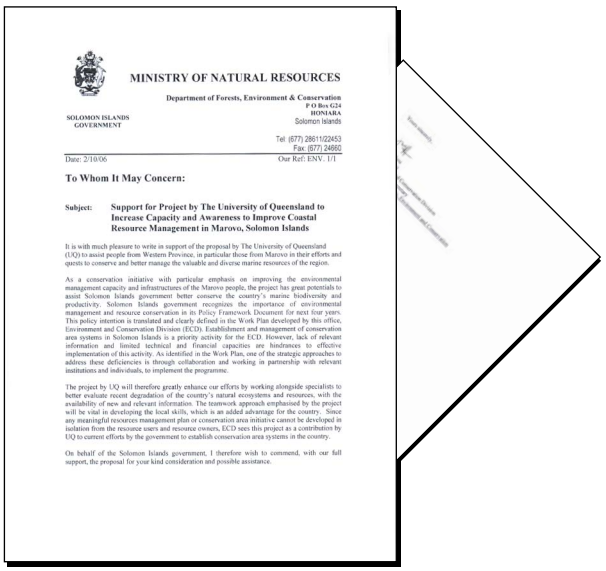
The UQ project will build on its valuable scientific research and community networks established during 2004-2006. The group will also enhance the awareness and capacity building established in this initial phase whilst strengthening the partnerships and linkages developed with Marovo people, Solomon Island agencies and NGOs.

My department looks forward to working with the UQ team as it meets its identified objectives by:

1) conducting workshops at selected villages by information awareness mechanisms in collaboration with local NGOs and SIG agencies;
2) working with communities to identify core issues and collaboratively develop pathways to deal with change;
3) developing educational capacity through in-school curriculum activities, extending Church-based environmental activities and conducting community awareness programs;
4) using appropriate technology transfers and training, establish community-based monitoring programs, including semi-automated weather stations, locally relevant environmental indicators and quantification of the recent degradation of natural ecosystems;
5) strengthening customary governance capabilities within the current provincial and national legislative context;

Solomons Islands Government
Ministry of Natural Resources
Department of Fisheries and Marine Resources
3 October 2006

Signatories:
Mrs Ethel Sigimanu, Permanent Secretary



MINISTRY OF NATURAL RESOURCES

Department of Forests, Environment & Conservation
P O Box G24
HONIARA
Solomon Islands

SOLOMON ISLANDS GOVERNMENT

Tel: (677) 28611/22453
Fax: (677) 24660

Date: 2/10/06
Our Ref: ENV. 1/1

To Whom It May Concern:

Subject: Support for Project by The University of Queensland to Increase Capacity and Awareness to Improve Coastal Resource Management in Marovo, Solomon Islands

It is with much pleasure to write in support of the proposal by The University of Queensland (UQ) to assist people from Western Province, in particular those from Marovo in their efforts and quests to conserve and better manage the valuable and diverse marine resources of the region.

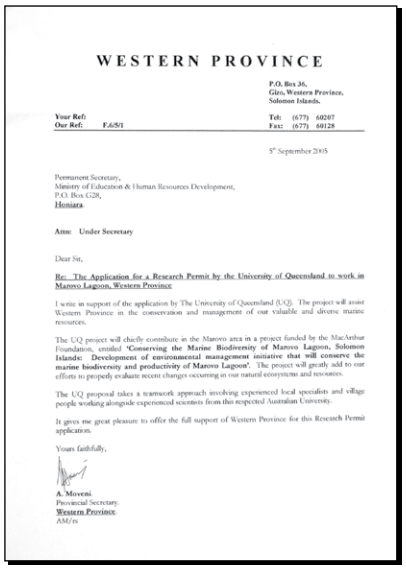
As a conservation initiative with particular emphasis on improving the environmental management capacity and infrastructures of the Marovo people, the project has great potentials to assist Solomon Islands government better conserve the country's marine biodiversity and productivity. Solomon Islands government recognizes the importance of environmental management and resource conservation in its Policy Framework Document for next four years. This policy intention is translated and clearly defined in the Work Plan developed by this office, Environment and Conservation Division (ECD). Establishment and management of conservation area systems in Solomon Islands is a priority activity for the ECD. However, lack of relevant information and limited technical and financial capacities are hindrances to effective implementation of this activity. As identified in the Work Plan, one of the strategic approaches to address these deficiencies is through collaboration and working in partnership with relevant institutions and individuals, to implement the programme.

The project by UQ will therefore greatly enhance our efforts by working alongside specialists to better evaluate recent degradation of the country's natural ecosystems and resources, with the availability of new and relevant information. The teamwork approach emphasised by the project will be vital in developing the local skills, which is an added advantage for the country. Since any meaningful resources management plan or conservation area initiative cannot be developed in isolation from the resource users and resource owners, ECD sees this project as a contribution by UQ to current efforts by the government to establish conservation area systems in the country.

On behalf of the Solomon Islands government, I therefore wish to commend, with our full support, the proposal for your kind consideration and possible assistance.

Solomons Islands Government
Ministry of Natural Resources
Department of Forests, Environment and Conservation
2 October 2006

Signatories:
Joe Horokou, Director



WESTERN PROVINCE

P.O. Box J6,
Gizo, Western Province,
Solomon Islands.

Your Ref:
Our Ref: F.6/5/1

Tel: (677) 60207
Fax: (677) 60128

5th September 2005

Permanent Secretary,
Ministry of Education & Human Resources Development,
P.O. Box G28,
Honiara.

Attn: Under Secretary

Dear Sir,

Re: The Application for a Research Permit by the University of Queensland to work in Marovo Lagoon, Western Province

I write in support of the application by The University of Queensland (UQ). The project will assist Western Province in the conservation and management of our valuable and diverse marine resources.

The UQ project will chiefly contribute in the Marovo area in a project funded by the MacArthur Foundation, entitled **'Conserving the Marine Biodiversity of Marovo Lagoon, Solomon Islands: Development of environmental management initiative that will conserve the marine biodiversity and productivity of Marovo Lagoon'**. The project will greatly add to our efforts to properly evaluate recent changes occurring in our natural ecosystems and resources.

The UQ proposal takes a teamwork approach involving experienced local specialists and village people working alongside experienced scientists from this respected Australian University.

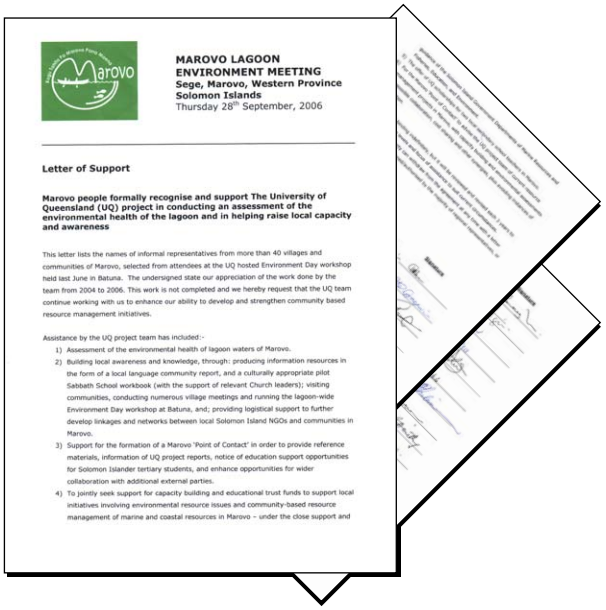
It gives me great pleasure to offer the full support of Western Province for this Research Permit application.

Yours faithfully,

A. Moveni
Provincial Secretary
Western Province
AM/rs

Western Province
5 September 2005

Signatories:
A. Moveni, Provincial Secretary



MAROVO LAGOON
ENVIRONMENT MEETING
Sege, Marovo, Western Province
Solomon Islands
Thursday 28th September, 2006

Letter of Support

Marovo people formally recognise and support The University of Queensland (UQ) project in conducting an assessment of the environmental health of the lagoon and in helping raise local capacity and awareness

This letter lists the names of informal representatives from more than 40 villages and communities of Marovo, selected from attendees at the UQ hosted Environment Day workshop held last June in Batuna. The undersigned state our appreciation of the work done by the team from 2004 to 2006. This work is not completed and we hereby request that the UQ team continue working with us to enhance our ability to develop and strengthen community based resource management initiatives.

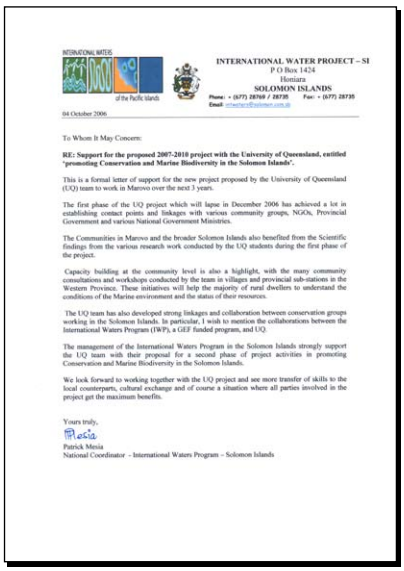
Assistance by the UQ project team has included:-

1) Assessment of the environmental health of lagoon waters of Marovo.
2) Building local awareness and knowledge, through: producing information resources in the form of a local language community report, and a culturally appropriate pilot Sabbath School workbook (with the support of relevant Church leaders); visiting communities, conducting numerous village meetings and running the lagoon-wide Environment Day workshop at Batuna, and; providing logistical support to further develop linkages and networks between local Solomon Island NGOs and communities in Marovo.
3) Support for the formation of a Marovo 'Point of Contact' in order to provide reference materials, information of UQ project reports, notice of education support opportunities for Solomon Islander tertiary students, and enhance opportunities for wider collaboration with additional external parties.
4) To jointly seek support for capacity building and educational trust funds to support local initiatives involving environmental resource issues and community-based resource management of marine and coastal resources in Marovo – under the close support and

Marovo Regional Representatives attending the Seghe Workshop
28 September 2006

Signatories:

Verabule Paoni
Peter Graywin
Tonny Jamakolo
Darlano Jamakana
Morgan Jimuru
Benjamin Karuotoku
Shallar Posala
Linus Siso
Milton Moloka
Israel Seghe
Wilson Agiri
Blement Loleke
Depen Raja
James Oeta
Hetele Nelson
John Philemon
John Wayne
Elliot Timothy
Pamela Seghe
Johnny Amos
Revalyn Loleke
Alrick Jimuru
Aseri Yalangono
Alan Agassi



INTERNATIONAL WATER PROJECT – SI
P O Box 1424
Honiara
SOLOMON ISLANDS

04 October 2006

To Whom It May Concern:

RE: Support for the proposed 2007-2010 project with the University of Queensland, entitled 'promoting Conservation and Marine Biodiversity in the Solomon Islands'.

This is a formal letter of support for the new project proposed by the University of Queensland (UQ) team to work in Marovo over the next 3 years.

The first phase of the UQ project which will lapse in December 2006 has achieved a lot in establishing contact points and linkages with various community groups, NGOs, Provincial Government and various National Government Ministries.

The Communities in Marovo and the broader Solomon Islands also benefited from the Scientific findings from the various research work conducted by the UQ students during the first phase of the project.

Capacity building at the community level is also a highlight, with the many community consultations and workshops conducted by the team in villages and provincial sub-stations in the Western Province. These initiatives will help the majority of rural dwellers to understand the conditions of the Marine environment and the status of their resources.

The UQ team has also developed strong linkages and collaboration between conservation groups working in the Solomon Islands. In particular, I wish to mention the collaborations between the International Waters Program (IWP), a GEF funded program, and UQ.

The management of the International Waters Program in the Solomon Islands strongly support the UQ team with their proposal for a second phase of project activities in promoting Conservation and Marine Biodiversity in the Solomon Islands.

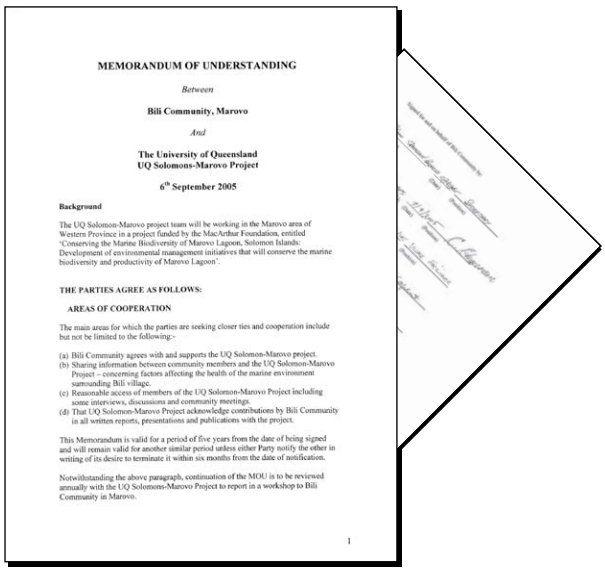
We look forward to working together with the UQ project and see more transfer of skills to the local counterparts, cultural exchange and of course a situation where all parties involved in the project get the maximum benefits.

Yours truly,

Patrick Mesia
National Coordinator - International Waters Program – Solomon Islands

International Waters Program
4 October 2006

Signatories:
Patrick Mesia
National Coordinator,
Solomon Islands



MEMORANDUM OF UNDERSTANDING

Between

Bili Community, Marovo

And

The University of Queensland
UQ Solomons-Marovo Project

6th September 2005

Background

The UQ Solomon-Marovo project team will be working in the Marovo area of Western Province in a project funded by the MacArthur Foundation, entitled 'Conserving the Marine Biodiversity of Marovo Lagoon, Solomon Islands: Development of environmental management initiatives that will conserve the marine biodiversity and productivity of Marovo Lagoon'.

THE PARTIES AGREE AS FOLLOWS:

AREAS OF COOPERATION

The main areas for which the parties are seeking closer ties and cooperation include but not be limited to the following:-

(a) Bili Community agrees with and supports the UQ Solomon-Marovo project.
(b) Sharing information between community members and the UQ Solomon-Marovo Project – concerning factors affecting the health of the marine environment surrounding Bili village.
(c) Reasonable access of members of the UQ Solomon-Marovo Project including some interviews, discussions and community meetings.
(d) That UQ Solomon-Marovo Project acknowledge contributions by Bili Community in all written reports, presentations and publications with the project.

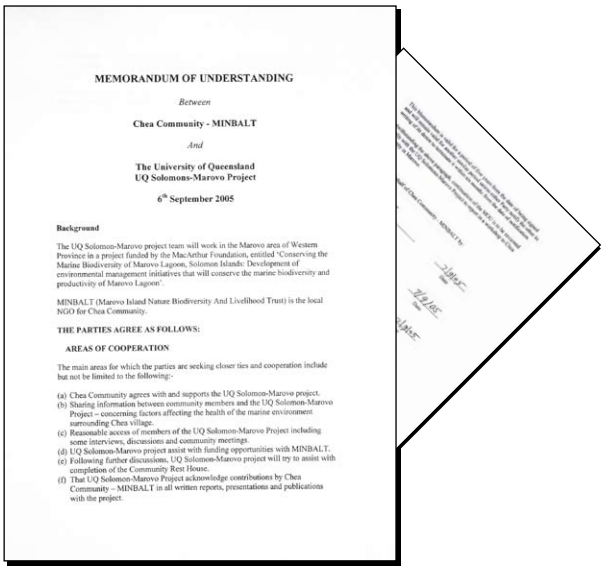
This Memorandum is valid for a period of five years from the date of being signed and will remain valid for another similar period unless either Party notify the other in writing of its desire to terminate it within six months from the date of notification.

Notwithstanding the above paragraph, continuation of the MOU is to be reviewed annually with the UQ Solomons-Marovo Project to report in a workshop to Bili Community in Marovo.

1

Bili Community Memorandum of Understanding
6 September 2005

Signatries:
Johnson Poghoso
James Siloko
Milton Luten
Willy Kay
Foxly Arthur
Luten Hilakolo
Raeboy Logara
Norm Duke



MEMORANDUM OF UNDERSTANDING

Between

Chea Community - MINBALT

And

The University of Queensland
UQ Solomons-Marovo Project

6th September 2005

Background

The UQ Solomon-Marovo project team will work in the Marovo area of Western Province in a project funded by the MacArthur Foundation, entitled 'Conserving the Marine Biodiversity of Marovo Lagoon, Solomon Islands: Development of environmental management initiatives that will conserve the marine biodiversity and productivity of Marovo Lagoon'.

MINBALT (Marovo Island Nature Biodiversity And Livelihood Trust) is the local NGO for Chea Community.

THE PARTIES AGREE AS FOLLOWS:

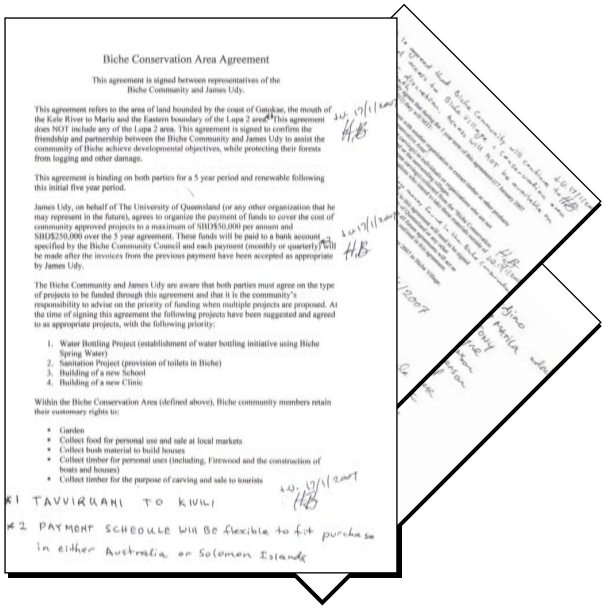
AREAS OF COOPERATION

The main areas for which the parties are seeking closer ties and cooperation include but not be limited to the following:-

(a) Chea Community agrees with and supports the UQ Solomon-Marovo project.
(b) Sharing information between community members and the UQ Solomon-Marovo Project – concerning factors affecting the health of the marine environment surrounding Chea village.
(c) Reasonable access of members of the UQ Solomon-Marovo Project including some interviews, discussions and community meetings.
(d) UQ Solomon-Marovo project assist with funding opportunities with MINBALT.
(e) Following further discussions, UQ Solomon-Marovo project will try to assist with completion of the Community Rest House.
(f) That UQ Solomon-Marovo Project acknowledge contributions by Chea Community – MINBALT in all written reports, presentations and publications with the project.

Chea Community Memorandum of Understanding
6 September 2006

Signatories:
Herrick Ragoso
Alrick Jimuru
Wilson Liligeto
Risley Amos
Norm Duke



Biche Conservation Area Agreement

This agreement is signed between representatives of the Biche Community and James Udy.

This agreement refers to the area of land bounded by the coast of Gatokae, the mouth of the Kele River to Mariu and the Eastern boundary of the Lupa 2 area. This agreement does NOT include any of the Lupa 2 area. This agreement is signed to confirm the friendship and partnership between the Biche Community and James Udy to assist the community of Biche achieve developmental objectives, while protecting their forests from logging and other damage.

This agreement is binding on both parties for a 5 year period and renewable following this initial five year period.

James Udy, on behalf of The University of Queensland (or any other organization that he may represent in the future), agrees to organize the payment of funds to cover the cost of community approved projects to a maximum of SHD$50,000 per annum and SHD$250,000 over the 5 year agreement. These funds will be paid to a bank account specified by the Biche Community Council and each payment (monthly or quarterly) will be made after the invoices from the previous payment have been accepted as appropriate by James Udy.

The Biche Community and James Udy are aware that both parties must agree on the type of projects to be funded through this agreement and that it is the community's responsibility to advise on the priority of funding when multiple projects are proposed. At the time of signing this agreement the following projects have been suggested and agreed to as appropriate projects, with the following priority:

1. Water Bottling Project (establishment of water bottling initiative using Biche Spring Water)
2. Sanitation Project (provision of toilets in Biche)
3. Building of a new School
4. Building of a new Clinic

Within the Biche Conservation Area (defined above), Biche community members retain their customary rights to:

- Garden
- Collect food for personal use and sale at local markets
- Collect bush material to build houses
- Collect timber for personal uses (including, Firewood and the construction of boats and houses)
- Collect timber for the purpose of carving and sale to tourists

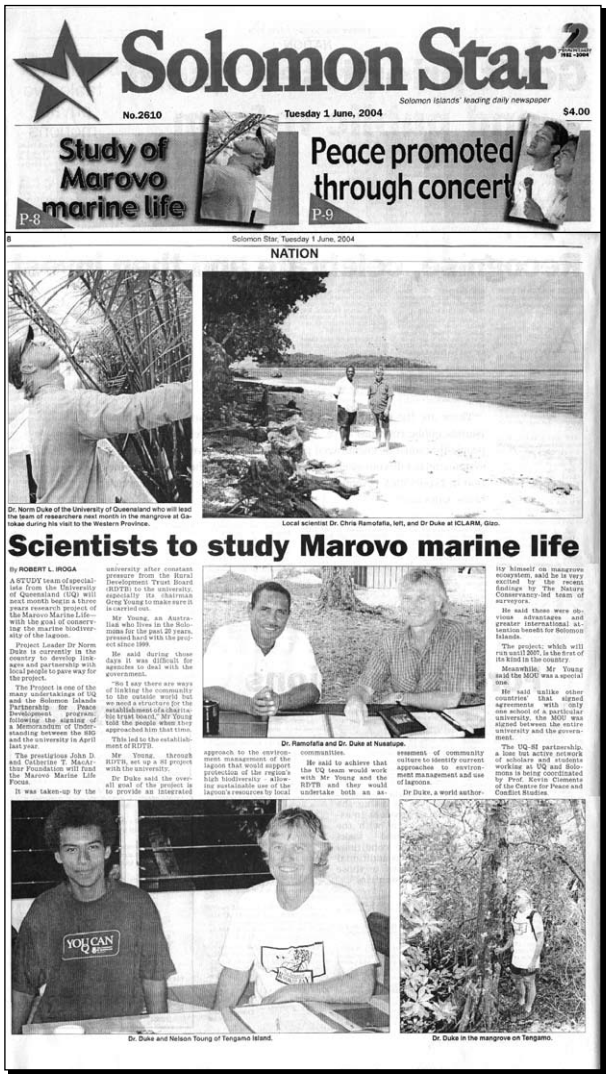
#1 TAVUIRUANI TO KIUKI

#2 PAYMENT SCHEDULE Will Be flexible to fit purcha... in either Australia or Solomon Islands

Biche Conservation Agreement
17 January 2007

Signatories:
James Udy
Haron Bilusu
Penpio Papae
Johenson Seala
Biche Community Committee Members

Media and Conference Seminar



Solomon Star
Solomon Islands' leading daily newspaper
No.2610 Tuesday 1 June, 2004 $4.00

Study of Marovo marine life P-8

Peace promoted through concert P-9

8 Solomon Star, Tuesday 1 June, 2004

NATION

Dr. Norm Duke of the University of Queensland who will lead the team of researchers next month in the mangrove at Gatokae during his visit to the Western Province.

Local scientist Dr. Chris Ramofafia, left, and Dr Duke at ICLARM, Gizo.

Scientists to study Marovo marine life

By ROBERT L. IROGA

A STUDY team of specialists from the University of Queensland (UQ) will next month begin a three years research project of the Marovo Marine Life with the goal of conserving the marine biodiversity of the lagoon.

Project Leader Dr Norm Duke is currently in the country to develop linkages and partnership with local people to pave way for the project.

The Project is one of the many undertakings of UQ and the Solomon Islands Partnership for Peace Development program following the signing of a Memorandum of Understanding between the SIG and the university in April last year.

The prestigious John D. and Catherine T. MacArthur Foundation will fund the Marovo Marine Life Focus.

It was taken-up by the university after constant pressure from the Rural Development Trust Board (RDTB) to the university especially its chairman Greg Young to make sure it is carried out.

Mr Young, an Australian who lives in the Solomons for the past 20 years, pressed hard with the project since 1999.

He said during those days it was difficult for agencies to deal with the government.

"So I say there are ways of linking the community to the outside world but we need a structure for the establishment of a charitable trust board," Mr Young told the people when they approached him that time.

This led to the establishment of RDTB.

Mr Young, through RDTB, set up a SI project with the university.

Dr Duke said the overall goal of the project is to provide an integrated approach to the environment management of the lagoon that would support protection of the region's high biodiversity - allowing sustainable use of the lagoon's resources by local communities.

He said to achieve that the UQ team would work with Mr Young and the RDTB and they would undertake both an assessment of community culture to identify current approaches to environment management and use of lagoons.

Dr Duke, a world author-ity himself on mangrove ecosystem, said he is very excited by the recent findings by The Nature Conservancy-led team of surveyors.

He said these were obvious advantages and greater international attention benefit for Solomon Islands.

The project, which will run until 2007, is the first of its kind in the country.

Meanwhile, Mr Young said the MOU was a special one.

He said unlike other countries that signed agreements with only one school of a particular university, the MOU was signed between the entire university and the government.

The UQ-SI partnership, a loos but active network of scholars and students working at UQ and Solomons is being coordinated by Prof. Kevin Clements of the Centre for Peace and Conflict Studies.

Dr. Ramofafia and Dr. Duke at Nusatupe.

Dr. Duke and Nelson Toung of Tengamo Island.

Dr. Duke in the mangrove on Tengamo.

Solomon Star Newspaper
June 1 2004

10 Solomon Star, Wednesday 2 June, 2004

ENVIRONMENT

Mangroves underwater.

Site of study for the project.

Scientists to study mangroves

A TEAM of scientists from University of Queensland who will carry out a three years research at the Marovo Lagoon hopes to find half of the world's mangrove population in the Solomon Islands.

There are 70 species of mangroves in the world, and team leader Dr Norm Duke hopes they will find half of it in the country.

He said with new and exciting findings in the marine world in the Solomons already, he is looking forward for more new discovery in the Solomons.

The team of scientist with their local counterparts will next month begin a three years research project of the Marovo Marine Life with the goal of conserving the marine biodiversity of the lagoon.

Dr Duke will lead the overall project and conduct ecological assessment of intertidal mangrove wetland condition and health, including related field and remote sensing components.

He is an internationally recognised authority on mangrove forest ecosystems, with special interest in floristic, biogeography, evolution, genetics, productivity, plant-animal relations, as well as the effects of pollutant stress and change.

Proposal

The proposal will provide the scientific basis to support sustainable management of the Marovo Lagoon while maximising use of local marine resources for the benefit of local communities.

According to a summery report, the research hopes to achieve the health of coastal marine ecosystems in the lagoon, like many sites around the world, are risk due to inappropriate land use adjacent to coastal rivers and the lagoon.

The report said mangroves, seagrass and coral habitats would lead to significant losses in both physical and functional benefits derived from these coastal ecosystems.

Goals

The overall goal of the project is to provide an integrated approach to the environmental management of Marovo Lagoon that will support protection of the region's high biodiversity and allow sustainable use of the lagoon's resources to support the local communities.

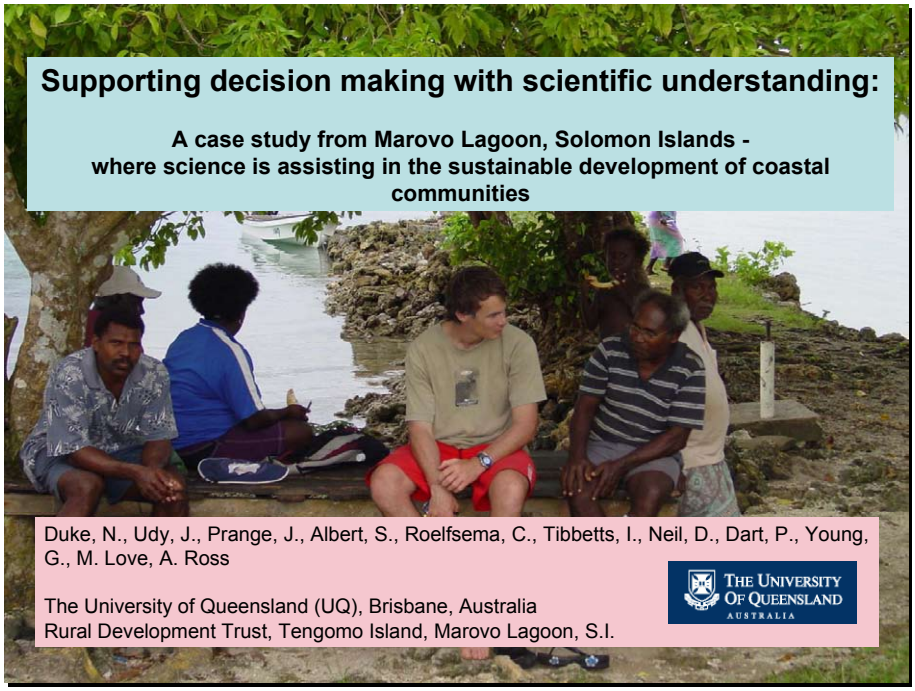
"To achieve that we will undertake both an anthropological study of the indigenous culture to identify their current approach to environmental management and use the lagoon's resources, as well as an inventory of marine ecosystems in the lagoon and various aspects of its current ecosystem health," said Dr Duke.

A conceptual model of transect across the Marovo Lagoon.

Dr Norm Duke among mangroves in the Western Province during his visit there recently.

Solomon Star Newspaper
June 2 2004

International Conference on Engaging Communities
Brisbane, Australia, August 14-17 2005



Dr Duke targets environmental hazards

UNIVERSITY RESEARCHERS ARE HELPING TO CONSERVE AND PROTECT THE SOLOMON ISLANDS.

UQ researchers are helping conserve and protect what some believe to be the eighth wonder of the world.

Marovo Lagoon, the centrepiece of the Solomon Islands' Western Province, is facing a significant environmental threat to the health of its marine ecosystems due to inappropriate land use.

But a unique multi-disciplinary approach involving 16 academics from scientific, anthropological, geographical, legal and socio-economic fields is developing environmental management initiatives to conserve the biodiversity of the lagoon while allowing for the sustainable use of its resources.

Headed by Dr Norm Duke from UQ's Centre for Marine Studies, the researchers are undertaking an integrated ecological assessment of the health of the lagoon's ecosystem.

Dr Duke, who will conduct an examination of the condition of intertidal mangrove wetland, said that just 15 years ago Marovo Lagoon was relatively pristine.

"The chief problems include extensive and apparently uncontrolled logging of lush tropical rainforests"

"In recent years several exploitive industries have begun to impact on the health of the marine ecosystems," he said.

"The chief problems include extensive and apparently uncontrolled logging of lush tropical rainforests. Forests are also being cleared for oil palm plantations and there is widespread overfishing."

The Marovo Lagoon is one of the world's largest double barrier enclosed lagoons and is on the Pacific A list of areas of outstanding universal value for marine biodiversity.

The UQ researchers are working with the local communities, using educational aids such as posters, leaflets and maps. The Solomon Islands Government and UQ have also signed a Memorandum of Understanding.

"Developing countries, like the Solomon Islands, do not have the luxury of declaring large regions of the marine environment off limits to human use," Dr Duke said.

"It is urgent that the local community be supported in providing best management practices to preserve the current biodiversity and, if necessary, rehabilitate regions that have already been degraded."

The research, funded by the John D. and Catherine T. MacArthur Foundation in the US, involves interviews with people from the local communities, economic assessments and scientific studies.

The team are using state-of-the-art Geographic Information Systems and remotely sensed images of the lagoon to identify areas of concern.

UQ News Article
September 2005

ABC Radio Australia - Pacific Beat

January 2006

http://www.abc.net.au/ra/pacbeat/stories/s1545332.htm

SOLOMON IS: Australian experts to help protect lagoon

Australian marine environment experts from the University of Queensland are working with the Solomon Islands government to conserve and protect the Marovo Lagoon in the country's Western Province. The project kicked off two years ago, following concerns the lagoon had been facing a significant environmental threat due to excessive land use including unsustainable logging practices. The Marovo lagoon, often described as the "eighth wonder" of the world, is believed to be facing an environmental threat to the health of its marine ecosystems. However, Australia has now come to the rescue with a research team headed by the UQ's Centre for Marine Studies, Norm Duke.

Presenter/Interviewer: Caroline Tiriman

Speakers: Dr Norm Duke

Solomon Star Newspaper
June 26 2006

Solomon Star

No.3129 Monday 26 June, 2006 Solomon Islands' leading daily newspaper $5.00

COAST GUARD TRAINING CRUCIAL FOR SI: HILLY Page 4

ENVIRONMENT DAY MARKED IN MAROVO LAGOON Page 5

CALEDONIA, TAHITI TO BECOME ASSOCIATE MEMBERS OF FORUM Page 5

NATION

Large turn–out for Marovo Lagoon's Environment Day

Villagers from Marovo Lagoon attending the environment meeting.

THE big meeting hall in Batuna overflowed last Thursday when more than 300 people from over 30 villages across Marovo Lagoon met in a bold community-based initiative to protect the exceptional beauty and natural wonders of Marovo lagoon.

The lagoon is recognised as the largest double barrier lagoon, described by James A. Mitchener as the 8th natural wonder of the world – a site currently under consideration for World Heritage nomination.

The Marovo Environment Day meeting was supported by the University of Queensland's (UQ) Solomons-Marovo project, designed to assess the marine biodiversity in the lagoon.

Funded by the prestigious John D. and Catherine T. MacArthur Foundation, the programme commenced in 2004, and this initial phase will conclude early next year.

The project has been supported by the Western Province and the National Government departments of Education, Environment, and Marine Resources.

University of Queensland investigators have been busy working together with Marovo people, especially the communities of Uli and Chea.

The primary objective has been to assess the health of the lagoon and to identify local and culturally appropriate solutions to address the challenges facing the region.

A report of the UQ team's findings in Marovo and English language was given to attendees of Marovo Environment Day.

Copies will also be distributed to schools, government departments and NGOs.

The meeting was an opportunity for Marovo people from all parts of the lagoon, to learn about the findings of the UQ study, and provide a platform for people to comment on the report.

Communities were able to identify and debate common issues and concerns regarding the future of the lagoon.

UQ higher degree students Simon Albert and Mark Love have developed particularly strong links with communities in the lagoon.

Their knowledge of pidgin and Marovan languages was both vital to the study and to the conduct of the Environment Day meeting.

Working with both rural and urban Marovans, Mr Albert was instrumental in producing the report in the Marovan language, while Mr Love has been investigating changes in environmental parameters and community perceptions of resource issues.

Representatives from WWF, Tetepare Descendants Association, International Waters Project, Conservation International, and the World Fish Center also made important contributions to the day.

The day started with a prayer from Pastor Newton Oalo, followed by presentations from the UQ team and NGO representatives.

After lunch those gathered broke into six regional groups to independently discuss various key issues and challenges.

Representatives from each group then reported back to the full gathering.

Key issues included runoff from logging; diminishing size and number of fish; excessive bait fishing; dynamiting, netting and poisoning of fish; clearing of mangroves and foreshore erosion; dirty water in the lagoon affecting fish numbers and type.

Community members expressed strong concerns about the sustainability of current resource use in the lagoon.

Each of the regional groups highlighted a general lack of local representation and control.

A solution suggested by Marovan people to address these challenges was to establish a common voice on environmental issues for all the communities of the lagoon.

The UQ team were impressed by the depth of understanding displayed by the broad cross-section of people including village leaders, Chiefs, Church leaders, teachers, men, women and children.

Dr James Udy, said the lagoon is healthy, but there are worrying indications of damage from recent clearing of the rainforest that may contribute to decreases fish populations, and increases in seaweed in some areas.

"Extra runoff of nutrients and sediments has increased algal growth in the lagoon limiting light resulting in coral death and changes in fish populations," he said.

Dr Ian Tibbetts highlighted that communication among groups within the lagoon was vital.

"By talking more about the health of the reef and its resources people are more likely to quickly identify problems and seek assistance in addressing them," he said.

In summing up, Dr Norm Duke, leader of the UQ Project, said "the way forward is to continue strengthening capacity at all levels, from the grassroots through to Provincial and Solomon Islands National Government levels, whereby local voices can be heard and issues addressed."

Villagers at the discussion meeting.

Solomon Star
Newspaper
October 4 2006

Solomon Star

No.3200 Wednesday 4 October, 2006 Solomon Islands' leading daily newspaper $5.00

Combating threats on Marovo Lagoon

By JOY A. RIKIMAE

PEOPLE of Marovo last week worked to combat the ongoing threats to the marine environment of Marovo Lagoon.

Their effort was supported through a workshop held at Seghe organised by the University of Queensland (UQ).

The workshop focused on Marovo environmental and socio economic pressures and ways to combat the pressures as part of the Queensland University Solomons - Marovo Project.

Three areas of focus were highlighted during the workshop.

The first focus was to inform Marovo participants of recommendations made at a Batuna meeting earlier.

These recommendations identified the need to combat growing environmental and social-economic pressures affecting Marovo people and their homes.

Specific problems highlighted then were the river systems and lagoon water which increasingly are dirty as a result of sediment run-offs from logging and algal growth from excess nutrients.

The participants were also informed that fish are smaller and harder to catch than before with coral reefs dying with increasing tension between families and communities as a result of logging.

It was found that there is also over harvesting of resources to use for carving and weaving. In some areas poisonous leaves used in fishing had damaged the coral and bait fishing is having an overall negative impact on fishery resources in the lagoon.

With these problems highlighted, the workshop participants seek solutions to the problems.

The identified solutions include the need to establish a Marovo Environment Association consisting of the six regional area groups within Marovo.

A part from that, the participants voiced the need for environmental education within villages and schools as well as to encourage or enforce the custom fishing management practises.

Participants said alternative livelihood strategies must also be recognised as an important part of any resource management initiative.

They said existing ecologies too need further support with international marketing and local capacity building.

Participants signing letter for a UQ future proposal.

Building on these identified issues and proposed solutions, the second objective of the Seghe meeting was to establish future points of contact for disseminating information.

Marovo is the largest double barrier lagoon in the world (over 700 square kilometers) with a population in excess of 12 000 people.

This had pose huge challenges for both the locals and for outside agencies to communicate and work within the lagoon.

During the workshop, the participants appointed six interim regional representatives to act as contact points across the lagoon.

This was the workshop's second focus.

This group's task is to distribute the final report of the UQ project, which will due early next year, to broader communities and other resource information supplied by the university.

In the third focus of the workshop, participants were consulted about what issues they would like UQ project to focus on in the future.

People advised the UQ team they wanted an increased focus on tangible outcomes like assistance with education, other capacity building opportunities and alternative incomes.

The UQ project has already developed a pilot Sabbath school project with the Seventh Day Adventist Church in Marovo.

The university had also recently offered two scholarships for diplomas in natural resources management for two secondary school teachers in the lagoon.

Dr. Norm Duke, the current UQ project leader had assured people at the meeting that 'education' would certainly continue to be a key focus area in any future project.

Curriculum development and village based awareness projects were highlighted as issues that needed particular attention.

Developing the linkages made over the last two years with local agencies and any further UQ project would harness these partnerships to build lasting collaborations with Solomon-based NGOs and SI Government agencies.

The project is funded by the John D. and Catherine T MacArthur Foundation and supported by Western Provincial - Government and the Solomon Islands government through the Departments of Education, Environment, Fisheries and Marine Resources.

Research outputs - completed and in preparation

Albert, S. (2005). Research into Action in the Solomon Islands. MelanesianGeo July-Dec Issue 2:10–12.

Albert, S., Udy, J., Tibbetts, I. Responses of algal communities to gradients in herbivore biomass and water quality in Marovo Lagoon, Solomon Islands. In review.

Albert, S., Love, M., Udy, J., Prange, J., Jimuru, M., Tawake, A., Ross, A. Community perceptions of environmental change on Melanesian coral reefs. In preparation.

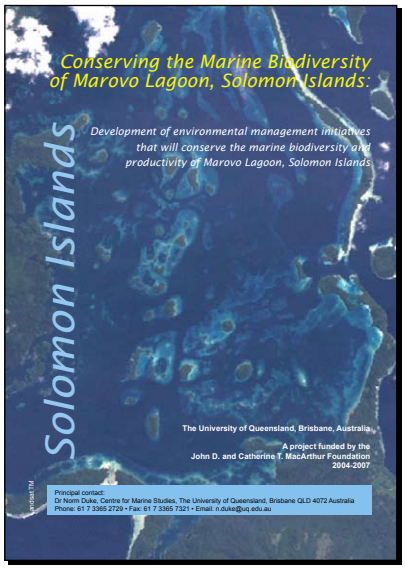
Aswani, S., Albert, S., Sabetian, A. Precautionary and adaptive management for protecting coral reefs in oceania. In review.

Duke, N.C. Mangroves, their uses and benefits in Marovo Lagoon, Solomon Islands. In preparation.

Albert, S. 2005

General products of the project

Many of these products can be found on our website:
http://www.marine.uq.edu.au/marbot/Solomons/publications.htm



Introductory brochure explaining project

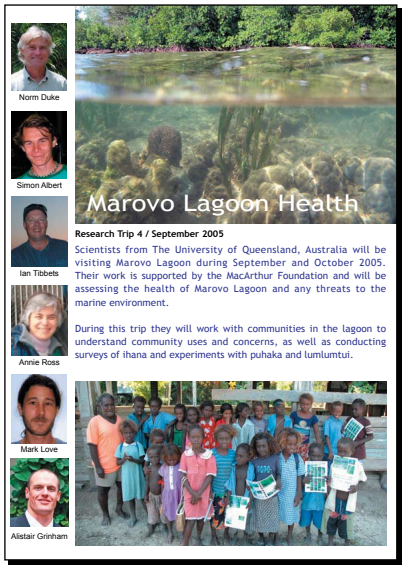
Mangroves of Marovo Lagoon

Coral, Seagrass and Algae of Marovo Lagoon

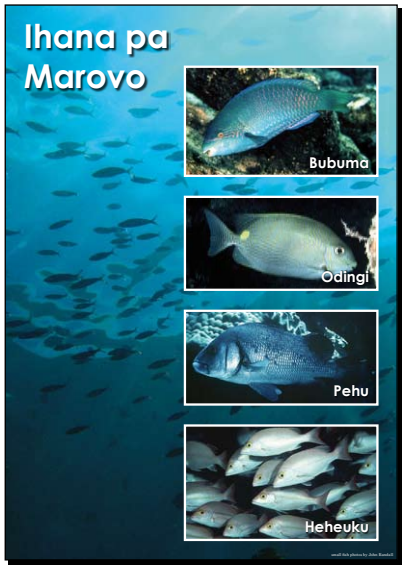
Fish of Marovo Lagoon

Field trip handout
January 2005

Field trip handout
June 2005



Field trip handout
September 2005

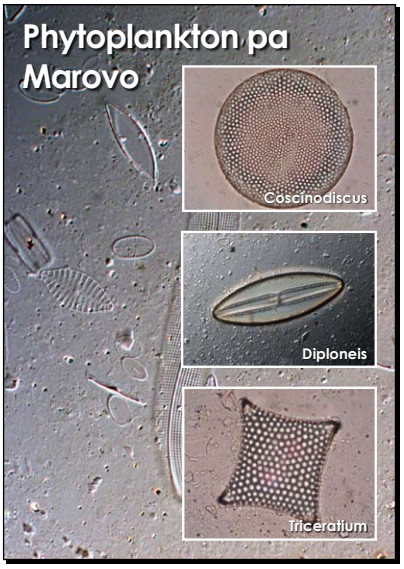


Fish of Marovo Poster

Mangroves of Marovo Poster

Coral of Marovo Poster

Seagrass of Marovo Poster



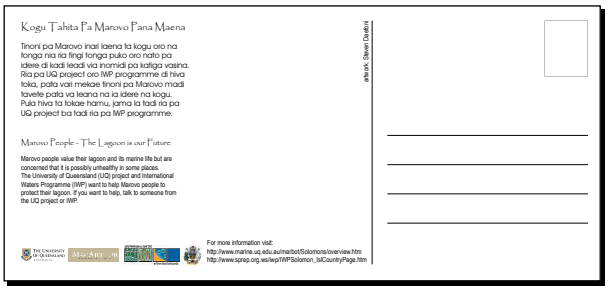
Phytoplankton of Marovo Poster

Marovo Logo
Various versions

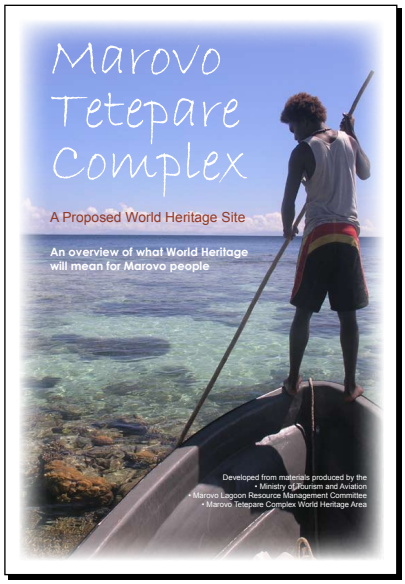
Marovo Bag

Calendar - 2006

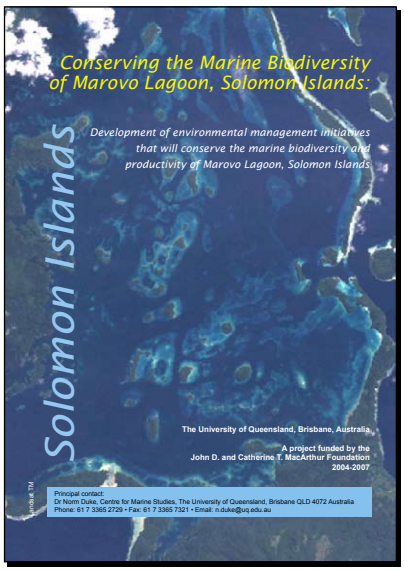
Postcards



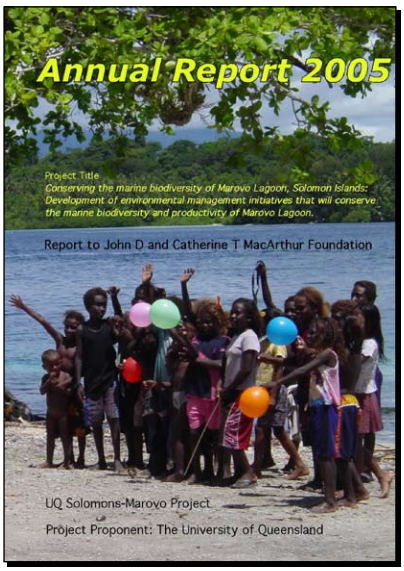
Community Report
Written in both Marovo language and English



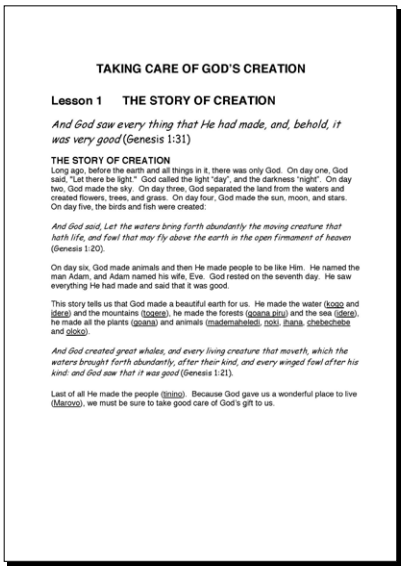
World Heritage Booklet
Written in both Marovo language and English



2004 Annual Report to MacArthur Foundation



2005 Annual Report to MacArthur Foundation



TAKING CARE OF GOD'S CREATION

Lesson 1 THE STORY OF CREATION

And God saw every thing that He had made, and, behold, it was very good (Genesis 1:31)

THE STORY OF CREATION

Long ago, before the earth and all things in it, there was only God. On day one, God said, "Let there be light." God called the light "day", and the darkness "night". On day two, God made the sky. On day three, God separated the land from the waters and created flowers, trees, and grass. On day four, God made the sun, moon, and stars. On day five, the birds and fish were created:

And God said, Let the waters bring forth abundantly the moving creature that hath life, and fowl that may fly above the earth in the open firmament of heaven (Genesis 1:20).

On day six, God made animals and then He made people to be like Him. He named the man Adam, and Adam named his wife, Eve. God rested on the seventh day. He saw everything He had made and said that it was good.

This story tells us that God made a beautiful earth for us. He made the water (koqo and idere) and the mountains (togere), he made the forests (goana piru) and the sea (idere), he made all the plants (goana) and animals (mademaheledi, noki, thana, chebechebe and oloko).

And God created great whales, and every living creature that moveth, which the waters brought forth abundantly, after their kind, and every winged fowl after his kind: and God saw that it was good (Genesis 1:21).

Last of all He made the people (tinino). Because God gave us a wonderful place to live (Marovo), we must be sure to take good care of God's gift to us.

Sabbath School education kit

THE UNIVERSITY OF QUEENSLAND
AUSTRALIA

MACARTHUR
The John D and Catherine T. MacArthur Foundation