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# Integrating Fisheries, Biodiversity, and Climate Change Objectives into Marine Protected Area Network Design in the Coral Triangle

A Project of the Coral Triangle Support Partnership
Final Report
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**Cover photo:** Bigeye Trevally (*Caranx sexfasciatus*) in a 5.4 ha Balicasag Island Fish Sanctuary, central Philippines. © Aileen Maypa (CCE Foundation).

http://www.uscti.org/uscti/Resources/CTSP_Resilient%20MPA%20Design%20Project.pdf

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The project was supported by the CTSP Year 3 Work plan (GCP LWA Award #LAG-A-00-99-00048-00, October 1, 2010). It was led by the Nature Conservancy (TNC), in close partnership with CTSP Consortium members (WWF and CI), the national governments of the six Coral Triangle Countries (CT6), US Coral Triangle Initiative (USCTI) partners (National Oceanographic and Atmospheric Administration: NOAA, other local and international NGOs), and scientific experts from within the Coral Triangle region, and other countries (particularly Australia, USA, and Fiji).

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# EXECUTIVE SUMMARY

## Context

Stretching across six countries[1] in Southeast Asia and Melanesia, the Coral Triangle (CT) is the global center of marine diversity. In these countries, more than 120 million people depend directly on fish and other marine resources as their principle source of income, food, and livelihoods. Unfortunately, these resources are under significant and increasing threat by a range of direct and indirect human impacts.

In 2007, the six countries of the Coral Triangle (CT6) established the Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security (CTI[2]) to reduce threats to marine resources and protect the ecosystem services they provide.

In 2009, the CT6 developed a CTI Regional Plan of Action that includes five goals. Three of these are:

- Establish a functional region-wide Coral Triangle Marine Protected Area System (CTMPAS);
- Apply an ecosystem approach to management of fisheries (EAFM) and other marine resources; and
- Achieve climate change adaptation measures.

If well designed, marine protected areas (MPAs) can contribute to achieving all three of these goals.

The aim of this project is to assess the technical support required to design a region-wide CTMPAS that will maximize the contribution of MPAs and MPA networks towards achieving these goals. This will require identifying and conducting high priority science, and facilitating the application of this science to MPA network design to achieve fisheries, biodiversity, and climate change objectives at regional, national, and subnational scales in the CT.

Integrating fisheries, biodiversity, and climate change objectives into MPA network design requires a broad range of scientific expertise, some of which may not be readily available in the CT6. The Coral Triangle Support Partnership (CTSP), which is supported by the US Coral Triangle Initiative (USCTI), through the United States Agency for International Development (USAID), is well placed to provide these skills, since its member organizations (The Nature Conservancy: TNC, World Wildlife Fund: WWF, and Conservation International: CI) are recognized as leaders in this field. In addition, CTSP members have excellent working relationships with the CT6 and key partners (NGOs, key stakeholders, and scientists).

This report assesses the ability of CTSP to provide technical support for integrating fisheries, biodiversity, and climate change objectives in MPA network design in the CT, based on the results of a scoping study to assess the:

- Needs and interests of the CT6 and USCTI Implementation Partners[3] regarding technical support required for integrating multiple objectives into resilient MPA network design at a range of scales in the CT; and
- Expertise, interests, and capacity of technical experts to provide this support.

[1] Philippines, Malaysia (Sabah), Indonesia, Timor-Leste, Papua New Guinea and the Solomon Islands

[2] www.cti-secretariat.net

[3] Lead national agencies for MPAs, fisheries and environment (as appropriate), CTSP members and other NGOs, key academic and technical persons involved in setting policy for MPAs, fisheries and climate change, and CTSP field staff who lead projects in each country supported by the USCTI.

The intended target audiences of this report are national and local government planners and senior technical staff, NGOs, donors and scientists, who are also interested in providing technical support for this process. The following is a brief summary of the results.

## Integrating Fisheries, Biodiversity, and Climate Change Objectives into Marine Protected Area Network Design in the Coral Triangle

CTSP will provide technical support for integrating fisheries, biodiversity, and climate change objectives into resilient MPA network design at four scales in the CT: regional (CTMPAS), national, subnational, and transboundary (ecoregional).

In a series of workshops facilitated by the USCTI, the CT6 recognized that the development of the regional CTMPAS will be a long term undertaking. Therefore, while the CT6 representatives appreciated the benefits of collaborating on establishing an ecologically connected network of MPAs for the CT, they agreed that the current focus is to establish a CTMPAS where each country will contribute at least one well designed and effectively managed MPA/MPA network. Therefore, CTSP will focus primarily on providing technical assistance for high priority MPAs/MPA networks identified by the CT6 as USCTI Integration Sites (where integration of MPA, fisheries and climate change adaptation strategies are being planned and implemented).

USCTI Integration Sites were selected for technical support for MPA network design by CTSP in each country based on four criteria:

- They were identified as a high priority by CT6 governments and USCTI Implementation Partners;
- MPA network design processes are currently underway with good stakeholder support;
- They require technical assistance with MPA network design; and
- They offer excellent opportunities to provide demonstration of integrating multiple objectives into MPA network design.

Over the duration of the CTSP (until June 2013), this project will provide limited funding and technical support for integrating multiple objectives into MPA network design at three USCTI Integration Sites: 1) Tun Mustapha Park (Sabah, Malaysia), 2) Manus Province (Papua New Guinea), and 3) Ghizo Island and environs (Western Province, Solomon Islands).

Financial support may also be provided for technical assistance for MPA network design by CTSP at USCTI Integration Sites in the Philippines (Verde Island Passage), Indonesia (Savu Sea Marine National Park), and Timor-Leste (Nino Konis Santana National Park), if it is included in bilateral agreements by the countries with USAID. CTSP and partners will also provide technical advice for integrating multiple objectives into MPA network design at these and other high priority sites if requested by governments and partners. Other priority sites are likely to include Bali (Indonesia), Milne Bay (Papua New Guinea), Central and Isabel Provinces (Solomon Islands), and the Bohol Sea (Philippines).

If well designed, MPAs/MPA networks that comprise the CTMPAS can act as demonstration sites for integrating multiple objectives into MPA network design, and provide leverage to scale up to an ecologically connected network for the region, if and when the countries are willing to do so. To provide the basis for this, CTSP is working with the CT6 and local and international scientists to identify and provide the information and technical support required to design an ecologically connected MPA network for the CT by:

- Working with the CT6 towards developing shared goals and objectives for a CT wide network;

- Developing a region-wide GIS database of the best available biophysical and socioeconomic information required for MPA network design through the CT Atlas[4];
- Identifying and facilitating high priority science required to provide key information that is currently not available (e.g., ecological patterns of connectivity at multiple scales in the CT); and
- Working with scientific partners with expertise in conservation planning to facilitate a CT wide MPA system or network design if and when required.

A similar approach has also been taken in support of designing national and transboundary MPA networks in the CT.

## Addressing High Priority Science Needs

High priority science needs for integrating fisheries, biodiversity, and climate change objectives into MPA network design at multiple scales in the CT include both applied and strategic science. For the purposes of this study:

- Applied science refers to situations where the required methods and tools already exist, but field practitioners require assistance to apply them to MPA network design; and
- Strategic science refers to situations where new methods and tools are required to improve our ability to integrate multiple objectives into MPA network design.

CTSP will work with scientific partners to provide technical assistance to address the high priority applied science needs identified in the scoping study. This will include providing the assistance, advice and training required to assist field practitioners with:

- Conducting studies that will provide a good understanding of key biological, physical, socioeconomic, and cultural factors that need to be taken into account in MPA network design;
- Using conservation planning methods and tools (particularly marine reserve design software) to design MPA networks to achieve their objectives; and
- Monitoring, measuring success, and adaptive management to ensure MPA networks achieve their objectives, and to demonstrate the ecological and socioeconomic benefits and costs of MPAs.

CTSP will also work with scientific partners to address high priority strategic science needs related to conservation planning, understanding and incorporating ecological patterns of connectivity, and improving the information required to integrate fisheries and climate change objectives into MPA network design.

Of the 22 strategic science needs identified, 12 are currently being addressed. CTSP is playing a lead role in addressing five of these tasks regarding developing and applying:

- Biophysical design principles for integrating fisheries, biodiversity, and climate change objectives into resilient MPA network design.
- Models of ecological patterns of connectivity for MPA network design at regional, ecoregional, and subnational scales in the CT.
- Specific advice regarding MPA network configuration (size and spacing of individual MPAs) based on movement patterns and larval dispersal of coral reef and coastal pelagic fish species.
- A regional online database of GIS data layers required for MPA network design.
- A toolkit for field practitioners for integrating MPA, EAFM, and climate change adaptation strategies at sites.

CTSP is also contributing to the other tasks that are being addressed by scientific partners, by providing technical advice or opportunities to test new methods and tools at sites. Ten other high priority tasks still need to be addressed, and some will require funding to do so.

[4] http://ctatlas.reefbase.org/v2/).

## Expertise, Interests, and Capacity of Technical Experts

Approximately 70 scientific experts from 30 NGOs, scientific institutions, and consulting companies expressed an interest in providing technical assistance for integrating fisheries, biodiversity, and climate objectives into MPA network design in the CT. Scientific experts include scientists from the CT6, Australia, USA, and other countries, with expertise in marine conservation planning, biophysical and socioeconomic sciences, and integrated approaches to marine resource management. While not a comprehensive list of all the expertise available, the list provides a summary of the types of expertise that are available to provide technical assistance for MPA network design in the CT.

## Capacity Building

A major issue in all CT countries is the need to build in-country skills and expertise in marine resource management. Support for this is being provided by the CT6 and other governments (particularly Australia and the USA), development agencies, scientific institutions, local and international NGOs. CTSP is also providing support for this activity by catalyzing local people, practitioners, and organizations to build the skills and abilities needed to effectively and sustainably manage their natural resources.

# ACRONYMS & ABBREVIATIONS

| | |
|---|---|
| ADB/GEF | Asian Development Bank/Global Environment Fund |
| ACMCA | Arnavon Community Marine Conservation Area |
| AOIs | Areas of Interest |
| AusAID | Australian Government Overseas Aid Program |
| ARC CoE | Australian Research Council Center of Excellent for Coral Reef Studies |
| BFAR | Department of Agriculture's Bureau of Fisheries and Aquatic Resources |
| CBD | Convention on Biological Diversity |
| CBD PowPA | Convention on Biological Diversity Programme of Work on Protected Areas |
| CI | Conservation International |
| CSIRO | Commonwealth Scientific and Industrial Research Organization |
| CT | Coral Triangle |
| CT6 | Six countries of the Coral Triangle |
| CTC | Coral Triangle Center |
| CTI | Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security |
| CTMPAS | Coral Triangle Marine Protected Areas System |
| CTSP | Coral Triangle Support Partnership |
| DEC | Department of Environment and Conservation |
| DENR | Department of Environment and Natural Resources |
| DPANP | Department of Protected Areas and National Parks |
| EAFM | Ecosystem Approach to Fisheries Management |
| EBM | Ecosystem Based Approach to Management |
| ICM | Integrated Coastal Management |
| IMACS | Indonesia Marine and Climate Support Project |
| IUCN-WCPA | International Union for Conservation of Nature World Commission on Protected Areas |
| LGU | Local Government Unit |
| LMMA | Locally Managed Marine Areas |
| MAF | Ministry of Agriculture and Forestry |
| MMA | Marine Managed Areas |
| MMAF | Ministry of Marine Affairs and Fisheries |
| MPA | Marine Protected Area |
| MPAG | Marine Protected Area Governance Project |
| NFA | National Fisheries Authority |
| NIPAS | National Integrated Protected Areas System |
| NGO | Non-Government Organization |
| NOAA | National Oceanic and Atmospheric Administration |
| NKSNP | Nino Konis Santana National Park |
| NPoA | National Plans of Action |
| PA | Protected Area |
| PAN | Protected Area Network |
| PEMSEA | Partnerships in the Environmental Management for the Seas of East Asia |
| PNG | Papua New Guinea |
| SDS-SEA | Sustainable Development Strategy for the Seas of East Asia |
| SIMA | Solomon Islands Marine Assessment |
| SSME | Sulu Sulawesi Marine Ecoregion |
| SSMNP | Savu Sea Marine National Park |
| TMP | Tun Mustapha Park |
| TNC | The Nature Conservancy |
| UNESCO | United Nations Educational, Scientific and Cultural Organization |
| UQ EDG | University of Queensland Environmental Decisions Group |
| USCTI | United States Coral Triangle Initiative |
| USAID | United States Agency for International Development |
| VIP | Verde Island Passage |
| WWF | World Wildlife Fund |

# GLOSSARY OF TERMS

**Climate Change Adaption (CCA):** Climate change adaptation refers to the ability of society to plan for and respond to change in a way that makes it better equipped to manage its exposure and sensitivity to climate change. Adaptive capacity depends on economic well-being, ecological well-being, the extent of dependency on natural resources, infrastructure (human-built or natural), effectiveness of institutions and governance systems, insurance, secure land tenure and mediation measures, and information and communication systems. A community with the capacity to adapt is likely to be more resistant to impacts or able to recover from stressful events and conditions (USAID 2009).

**Customary Marine Tenure (CMT):** Where an identifiable groups of people have informal or formal rights to sea areas, where their rights to use and access resources are, in principle, excludable, transferable, and enforceable, either on a conditional or permanent basis (Ruddle 1996).

**Ecosystem Approach to Fisheries Management (EAFM):** The Food and Agriculture Organisation (2003) defines EAFM as "an approach to fisheries management and development that strives to balance diverse societal objectives, by taking into account the knowledge and uncertainties about biotic, abiotic, and human components of ecosystems and their interactions and applying an integrated approach to fisheries within ecologically meaningful boundaries." The purpose of EAFM is to plan, develop, and manage fisheries in a manner that addresses the multiple needs and desires of societies, without jeopardizing the options for future generations to benefit from the full range of goods and services provided by marine ecosystems.

**Ecosystem Based Management (EBM):** An integrated approach that considers the entire ecosystem (including humans), and aims to maintain an ecosystem in a healthy, productive and resilient condition so that it can provide the services humans require.

**Ecoregion:** A relatively large unit that contains a distinct assemblage of natural communities sharing a large majority of species, dynamics, and environmental conditions, and consequently functions effectively as a conservation unit (WWF 2004).

**Exclusive Economic Zone (EEZ)**: Under the law of the sea, an exclusive economic zone (EEZ) is a seazone over which a country has special rights over the exploration and use of marine resources. It stretches from the seaward edge of the country's territorial sea out to 200 nautical miles from its coast.

**Integrated Coastal Management (ICM)**: A mechanism that involves a systematic process for managing competing issues in marine and coastal areas, including diverse and multiple uses of natural resources. It puts into practice effective governance, active partnerships, practical coordinating strategies, sustainable financial resources and strengthened technical institutional capacities.

**Marine Protected Area (MPA)**: A clearly defined geographical space, recognized, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values (Dudley 2008). MPAs include a wide variety of governance types (including community-based areas), and include but are not limited to no-take areas.

**Marine Protected Area Networks (MPA Networks):** A collection of individual MPAs or reserves operating cooperatively and synergistically, at various spatial scales, and with a range of protection levels that are designed to meet objectives that a single reserve cannot achieve (IUCN 2008).

**Ocean Acidification (OA)**: Ocean acidification occurs when $CO_2$ in the atmosphere reacts with water to create carbonic acid, decreasing both ocean pH and the concentration of the carbonate ion, which is essential for calcification by marine organisms such as corals (Kleypas *et al.* 2006).

**Seascape**: Seascapes are large multiple use marine areas, defined scientifically and strategically, in which government authorities, private organizations and other stakeholders cooperate to conserve the diversity and abundance of marine life and promote human well-being (CI 2007).

**Transboundary Areas:** Areas of land and/or sea that straddle one or more borders between countries, subnational units such as provinces and regions, autonomous areas and/or areas beyond the limit of national sovereignty or jurisdiction, whose constituent parts are especially dedicated to the protection and maintenance of biological diversity, and of natural and associated cultural resources, and managed cooperatively through legal or other effective means (Sandwith *et al.* 2001).

**USCTI Implementation Partners**: Lead national agencies for MPAs, fisheries and environment, CTSP consortium members and other NGOs, key academic and technical persons involved in setting policy for MPAs, fisheries and climate change, and CTSP field staff who lead projects in each country supported by the US-CTI.

**USCTI Integration Sites:** Where integration of MPA, fisheries and climate change adaptation strategies are being planned and implemented.

**USCTI Priority Geographies**: Broad geographies within which are the project sites, where CTSP is providing technical and financial support for field conservation.

# INTRODUCTION

## The Coral Triangle

Stretching across six countries[5] in Southeast Asia and Melanesia, the Coral Triangle (CT) is the global center of marine diversity (Veron *et al.* 2009: Figure 1). Covering no more than one percent of the Earth's surface, it comprises over 30 percent of the world's coral reefs and 76 percent of the world's reef building coral species.

These unparalleled marine and coastal resources provide numerous socio-economic benefits to over 370 million people who reside there, along with benefits to millions more outside the region (Hoegh-Guldberg *et al.* 2009). One-third of CT inhabitants (more than 120 million people, particularly those living in coastal communities) depend directly on fish and other marine resources for their income, food, and livelihoods (Hoegh-Guldberg *et al.* 2009).

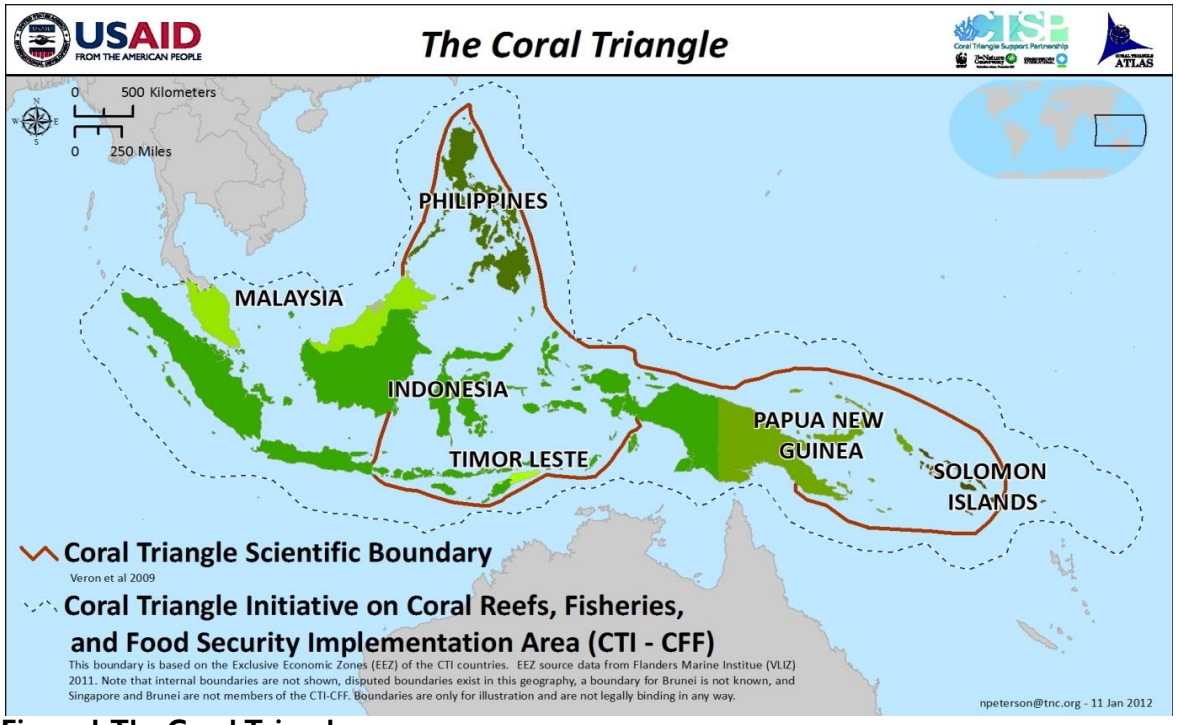


**Figure 1 The Coral Triangle**

These marine and coastal resources are under significant and increasing threat by a range of direct and indirect human impacts (Burke *et al.* 2011). Of particular concern are overfishing and the loss of key habitats due to unsustainable fishing practices, land based sources of pollution, and coastal habitat conversion, which are severely undermining the long term sustainability of these resources and the ecosystem services they provide (Hoegh-Guldberg *et al.* 2009, Burke *et al.* 2011). Climate change also represents a serious and increasing threat to marine ecosystems in the region (Hoegh-Guldberg *et al.* 2009, McLeod *et al.* 2010a,b).

Recently, a global assessment found that the coral reefs of Southeast Asia (particularly Indonesia and the Philippines) are among the most threatened in the world (Burke *et al.* 2011). In Melanesia, coral reefs that previously were under relatively low pressure are now also considered at medium to high threat

[5] Philippines, Malaysia (Sabah), Indonesia, Timor-Leste, Papua New Guinea and the Solomon Islands

levels from multiple sources of stress (Burke *et al.* 2011). This trend, if allowed to continue, will result in the loss of marine resources and a decline in fisheries production and food security in the region.

## The Coral Triangle Initiative on Coral Reefs, Fisheries, and Food Security

In response to the trend towards higher levels of threat, the six countries of the Coral Triangle (CT6) established the Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security (CTI) in 2007. Eighteen months later, the CTI approved a Regional Plan of Action (CTS 2009) that includes five goals, three of which are:

- Goal 2: Ecosystem approach to management of fisheries (EAFM) and other marine resources fully applied.
- Goal 3: Marine Protected Areas (MPAs) established and effectively managed.
- Goal 4: Climate Change Adaptation (CCA) measures achieved.

If well designed, MPAs (see Glossary) can contribute to the CTI achieving all of these goals. For example, well designed and managed MPAs are a critical component of an Ecosystem Approach to Fisheries Management (EAFM: see Glossary), since they function as reserves to enhance fish populations and productivity (Alcala and Russ 2006). Well-designed MPAs can also contribute to conserving biodiversity in the face of climate change (IUCN-WCPA 2008, McLeod *et al.* 2009).

The aim of this project is to conduct a scoping study of technical assistance required to design a region-wide Coral Triangle Marine Protected Areas System (CTMPAS) that maximizes the contribution of MPAs and MPA networks (see Glossary) to achieving these three goals. This will require designing MPAs/MPA networks that will simultaneously achieve fisheries, biodiversity, and climate change objectives at multiple scales in the CT.

## Integrating Fisheries, Biodiversity, and Climate Change Objectives into Resilient Marine Protected Area Network Design

In the past, MPAs in the CT have been designed primarily to achieve either biodiversity or fisheries objectives. For example, the scientific design of resilient networks of MPAs (particularly no-take areas) by NGOs and partners has tended to focus on conserving biodiversity in the face of climate change (e.g., Green *et al.* 2009, McLeod *et al.* 2009, Lipsett-Moore *et al.* 2010a, Wilson *et al.* 2011). Fisheries issues, while often considered, have not always been addressed adequately in the design process.

Conversely, many MPAs established by governments and local communities have focused primarily on fisheries management (Russ 2002, TNC *et al.* 2008). This has included establishing government led fisheries management areas and community-based MPAs. While many of these MPAs have achieved fisheries objectives, they are seldom designed in ways that maximize their contribution to protecting biodiversity in the face of climate change.

Since scientific approaches for designing MPA networks to achieve fisheries, biodiversity, and climate change objectives are different; there is a need to integrate these approaches to improve our ability to design MPAs that can simultaneously achieve all three objectives (Fernandes *et al.* 2012). Integrating multiple objectives into MPA design will require the following:

- Identifying and coordinating high priority science to improve our ability to integrate fisheries, biodiversity, and climate change objectives in MPA network design; and
- Facilitating the application of this science at the regional, national and subnational scales in the CT.

## The Role of the Coral Triangle Support Partnership

Integrating multiple objectives into MPA network design requires a broad range of scientific expertise, some of which may not be readily available in the CT6. The Coral Triangle Support Partnership (CTSP)[6] can provide these skills, since CTSP member organizations (The Nature Conservancy: TNC, World Wildlife Fund: WWF and Conservation International: CI) are recognized as leaders in these fields (White *et al.* 2010). In addition, CTSP members have excellent working relationships with the CT6 and key partners (NGOs, key stakeholders and scientists).

In 2010, CTSP agreed to support a three year project entitled "Providing Technical Support for Integrating Biodiversity, Fisheries and Climate Change Objectives into Resilient Marine Protected Area Network Design in the Coral Triangle" (White *et al.* 2010). The project will be accomplished through three parallel strategies:

1. Integrating biodiversity, climate change, and fisheries objectives into resilient MPA network design principles (completed: see Fernandes *et al.* 2012);
2. Conducting a scoping study to determine what technical assistance is required by the CT6 for integrating multiple objectives into resilient MPA network design in the CT, and how this can be provided most effectively; and
3. Providing technical assistance for resilient MPA network design, and information management support through the CT Atlas[7].

This report focuses on the results of the scoping study (Strategy 2, above), particularly regarding the ability of CTSP to provide the technical support required for integrating fisheries, biodiversity, and climate change objectives in MPA network design in the CT.

The intended target audiences of the report are national and local government planners and senior technical staff, NGOs, donors and scientists, who are also interested in providing technical support for this process.

# METHODS

The scoping study was conducted by:

- Assessing the needs and interests of the CT6 and USCTI Implementation Partners (see Glossary) regarding technical support required for integrating multiple objectives in resilient MPA network design at a range of scales in the CT;
- Assessing the expertise, interests, and capacity of technical experts to provide this support; and
- Analyzing results and making recommendations regarding how CTSP can provide the technical support required by the CT6 and USCTI Implementation Partners.

Methods used for each component of the scoping study are described below.

## Assessing the Needs and Interests of the CT6 and USCTI Implementation Partners

Two steps were taken to assess the needs and interests of the CT6 and USCTI Implementation Partners. First, we reviewed the advice they had provided previously regarding their priorities for establishing resilient networks of MPAs. Key reports evaluated included: the Regional Plan of Action, National Plans of Action, and outputs from CT MPA, EAFM and climate change theme workshops.

[6] http://www.worldwildlife.org/what/wherewework/coraltriangle/coral-triangle-support-partnership.html
[7] http://ctatlas.reefbase.org/v2/

Then we conducted interviews with CT6 National Coordinating Committees and other government representatives, USCTI Implementation Partners and key stakeholders in each country[8] (Appendix 3), using the following questions as a guide (White *et al.* 2010):

- What are your priority MPA networks, and what is their status regarding integrating multiple objectives (regarding fisheries, biodiversity and climate change) into resilient MPAs network design?
- What are your priorities for integrating multiple objectives into resilient MPA design for your priority MPA networks in future?
- Are there strategic science issues that need to be addressed to improve your ability to integrate multiple objectives into MPA network design?
- How can MPAs contribute to fisheries management objectives most effectively at regional, national and subnational scales in the Coral Triangle?

The results of the interviews were combined and analysed for each country.

## Assessing the Expertise, Interests, and Capacity of Technical Experts

Approximately 70 scientists from NGOs, scientific institutions, and consulting companies (Appendix 4) were interviewed to assess their technical skills, interests, and capacity to provide the technical support required by the CT6 and USCTI Implementation Partners. The following questions were used as the basis for either one-on-one discussion with the scientists, or by asking them to fill out a table in response to these questions:

- What is your general field of scientific expertise regarding resilient MPA network design (e.g., spatial planning; biophysical science; socioeconomic science)?
- What are your specific scientific interests regarding integrating multiple objectives into MPA network design in the CT?
- What experience do you have working in this field in the CT or elsewhere in the region?
- Do you have existing partnerships with CT6 government officials or scientists in the CT?
- Have you already discussed collaborating on a particular MPA network design with scientists or managers in the CT?
- Do you have a particular interest in a specific geographic area? And if so, where and why?
- What types of assistance are you interested in providing (e.g., technical advice, training/capacity building, or consultancies)?
- How much would it cost for you to provide that sort of assistance? Do you require consulting fees, or would you be willing to assist for no cost or if your expenses were covered?
- Do you have other resources you would be willing to contribute to these tasks (e.g., funds from existing grants)?
- Are there strategic science issues that need to be addressed to improve our ability to integrate biodiversity, fisheries and climate change objectives into resilient MPA network design?

Results were summarized in spreadsheets to demonstrate the range of scientific skills, interests, and available resources that are available, and the potential for collaborative partnerships in the CT.

## Analyzing Results and Making Recommendations

Based on the information collected in the literature review and interviews, the highest priority needs of the CT6 and USCTI Implementation Partners were matched with the technical skills and experience of the CTSP and other NGO partners, key stakeholders, and scientists interested in providing support for designing resilient MPA networks in the CT. This required analyzing resources available to support the work, and ensuring that existing partnerships are supported, where possible. This analysis provides the

[8] Except Timor-Leste where we relied on advice from USCTI Implementation Partners.

basis for making recommendations regarding the technical support that CTSP should provide for resilient MPA network design in the CT.

# RESULTS

The results of the scoping study are described below regarding how CTSP can address the needs and interests of the CT6 and USCTI Implementation Partners by:

- Providing technical support for integrating fisheries, biodiversity, and climate change objectives into resilient MPA network design at multiple scales in the CT; and
- Addressing high priority science needs for improving our ability to integrate multiple objectives into MPA network design.

Technical support may be provided either in terms of financial assistance or technical advice from CTSP and partners. The expertise, interests and capacity of technical experts who can provide this assistance is also described.

## Integrating Fisheries, Biodiversity, and Climate Change Objectives into Marine Protected Area Network Design at Multiple Scales in the Coral Triangle

Opportunities to provide technical support for integrating multiple objectives into resilient MPA network design were identified at four scales: regional, national, subnational, and transboundary (ecoregional). The CT6 have committed to establishing MPA networks at each of these scales since:

- All six countries have committed to contributing to a regional system of MPAs (the CTMPAS) through the CTI (CTS 2009).
- All six countries are signatories to the Convention on Biological Diversity (CBD), and are required to fulfil the CBD's Programme of Work on Protected Areas (CBD PowPA)[9] which includes setting aside at least 10 percent of their country in protected areas. Consequently, each country is obliged to conduct a national marine gap analysis to identify and fill gaps in their existing MPA network to ensure that all native species and ecosystems are represented in MPAs of sufficient size, number and distribution to guarantee their long-term survival (Dudley and Parris 2006).
- Each country has committed to contributing at least one well designed and effectively managed MPA/MPA network to the CTMPAs (CTSP 2010a).
- Some countries have also agreed to collaborate on establishing transboundary MPAs (see Glossary) that cross national boundaries.

Opportunities for CTSP to provide technical support for designing MPA networks at each of these scales are reviewed in the following three sections, which are organized to recognize national boundaries and interests: the regional CTMPAS; national and subnational MPA networks (for each country); and transboundary MPA networks.

### The Regional Coral Triangle Marine Protected Area System

The CT6 have committed to developing a regional system of MPAs (the CTMPAS) through the CTI Regional Plan of Action (CTS 2009) where:

- Goal 3 is that MPAs are established and effectively managed, and the target for that goal is that a region-wide CTMPAS is in place and fully functional (CTS 2009).

[9]A global action plan to address impediments to establishing protected areas: www.cbd.int/protected/pow/learnmore/intro/

- The CTMPAS is described as: a comprehensive, ecologically representative, and well-managed region-wide system composed of prioritized individual MPAs and networks of MPAs that are connected, resilient, and sustainably financed; which is designed to generate significant income, livelihoods and food security benefits for coastal communities, and conserve the region's rich biological diversity (CTS 2009).

The USCTI has already provided support for designing the CTMPAS by facilitating a priority setting workshop and a MPA theme workshop. In the first workshop[10], the CT6 agreed to prioritize Action 1 under the Goal 3 target to "Jointly establish overall goals, objectives, principles, and operational design elements for a CTMPAS centered around priority networks" (CTSP 2010a). While the second workshop[11], provided the first opportunity for the CT6 and partners to discuss and progress towards this goal (CTSP 2010a). The workshops resulted in:

- A collective review of current principles, objectives, and regional case studies of MPA networks;
- An agreement to apply network principles through parallel designs of MPA network learning sites in each country;
- A draft of priority benefits and objectives[12] for a CTMPAs that could eventually be managed cooperatively by the CT6; and
- The identification of next steps towards collective efforts on MPAs and MPA networks.

Workshop participants also recognized that the development of the CTMPAS would be a long term undertaking. So while they appreciated the benefits of collaborating on a CT-wide MPA network design based on biophysical and socioeconomic design principles, they agreed that their priority is the practical application of an agreed set of network principles through the design of MPAs/MPA networks at learning and other sites in each country. These sites will collectively and initially comprise the CTMPAS. The learning sites selected were:

- Verde Island Passage, Philippines
- Tun Mustapha Park, Malaysia
- Savu Sea Marine National Park, Indonesia
- Nino Konis Santana National Park, Timor-Leste
- Kimbe Bay, Papua New Guinea
- Central Province, Solomon Islands

All of these sites, except Kimbe Bay and Central Province, are USCTI Integration Sites (see National and Subnational Networks below).

If well designed and effectively implemented, the MPAs/MPA networks that will comprise the CTMPAS can act as demonstration sites for integrating multiple objectives into MPA network design, and provide leverage for scaling up to design an ecologically connected network of MPAs for the CT, when and if the countries are interested in doing so. This could be achieved by using these and other existing MPAs/MPA networks as the basis for conducting a CT-wide marine gap analysis based on principles for integrating fisheries, biodiversity, and climate change objectives into MPA network design (Fernandes *et al.* 2012). This would require defining the location and effectiveness of existing MPAs (a task currently underway by the CT Atlas), and using systematic conservation planning to identify new areas that may be required to achieve region-wide fisheries, biodiversity, and climate change objectives.

[10] CTI Regional Priority Actions and Coordination Workshop, May 2010.

[11] MPA Regional Exchange Workshop, June 2010.

[12] Including regional food security, management of migratory and threatened species, ensuring resilience of critical marine habitats and resources at the regional level, efficiencies of scale and opportunity for synergies, and knowledge of resource status and MPAs in the CT.

To facilitate a CT-wide marine gap analysis, if acceptable to the countries, CTSP will continue to focus on identifying and collecting regional scale information required to scale up from individual MPAs/MPA networks to design an ecological connected network for the CT. This will require:

- Developing a GIS database of the best available information regarding biophysical and socioeconomic characteristics, and the status of conservation and management, in the CT through the CT Atlas[13]; and
- Identifying and facilitating high priority science required to provide key information that is not currently available. In particular, CTSP has committed to supporting an application for an Australian Research Council Linkage Grant by the University of Queensland Environmental Decisions Group (UQ EDG). This project will focus on providing high priority information for integrating fisheries, biodiversity, and climate change objectives into MPA network design at multiple scales in the CT, with a particular focus on transboundary areas. A key component of the study will be to better understand ecological patterns of connectivity, and their implications for MPA network design (see Addressing High Priority Science Needs).

CTSP will also work with scientific partners with expertise in conservation planning to facilitate a CT-wide MPA gap analysis if and when required by the CT6. CTSP will also facilitate another regional MPA theme workshop in March 2012, which will focus on assisting the CT6 develop a framework for the CTMPAS.

## National and Subnational MPA Networks

The following sections provide a brief summary of the status of MPA network design for national and subnational MPA networks in the CT, and identify opportunities for CTSP to provide technical support for integrating fisheries, biodiversity, and climate change objectives into MPA network design in each country. A more detailed summary for each country is provided in Appendix 1.

Since CTSP can provide financial support for MPA network design at USCTI integration Sites (Table 1, Figure 2: see Glossary), this study focuses on those sites. However because the CT6 and USCTI Implementation Partners are also committed to MPA network design at other high priority sites (particularly Learning Sites: see Regional Coral Triangle Marine Protected Area System), opportunities to provide support (e.g., technical advice) to partners working at those sites is considered also.

Within each country, sites were selected for technical support for integrating fisheries, biodiversity, and climate change objectives into MPA network design by CTSP because:

- They were identified as a high priority by CT6 governments and USCTI Implementation Partners;
- MPA network design processes are currently underway with good stakeholder support;
- They require technical assistance with MPA network design; and
- They offer excellent opportunities to provide demonstration sites for integrating multiple objectives into MPA network design.

Financial assistance from CTSP for USCTI Integration Sites can be provided via two mechanisms:

1. Through the USAID Regional Development Mission for Asia, which can provide both funding and technical support for the design of the regional CTMPAS (see The Regional Coral Triangle Marine Protected Area System), and for limited in-country work in Malaysia, Papua New Guinea, and the Solomon Islands; and
2. Through technical support for in-country projects identified in bilateral agreements between USAID and Indonesia, the Philippines, and Timor-Leste.

[13] http://ctatlas.reefbase.org/v2/

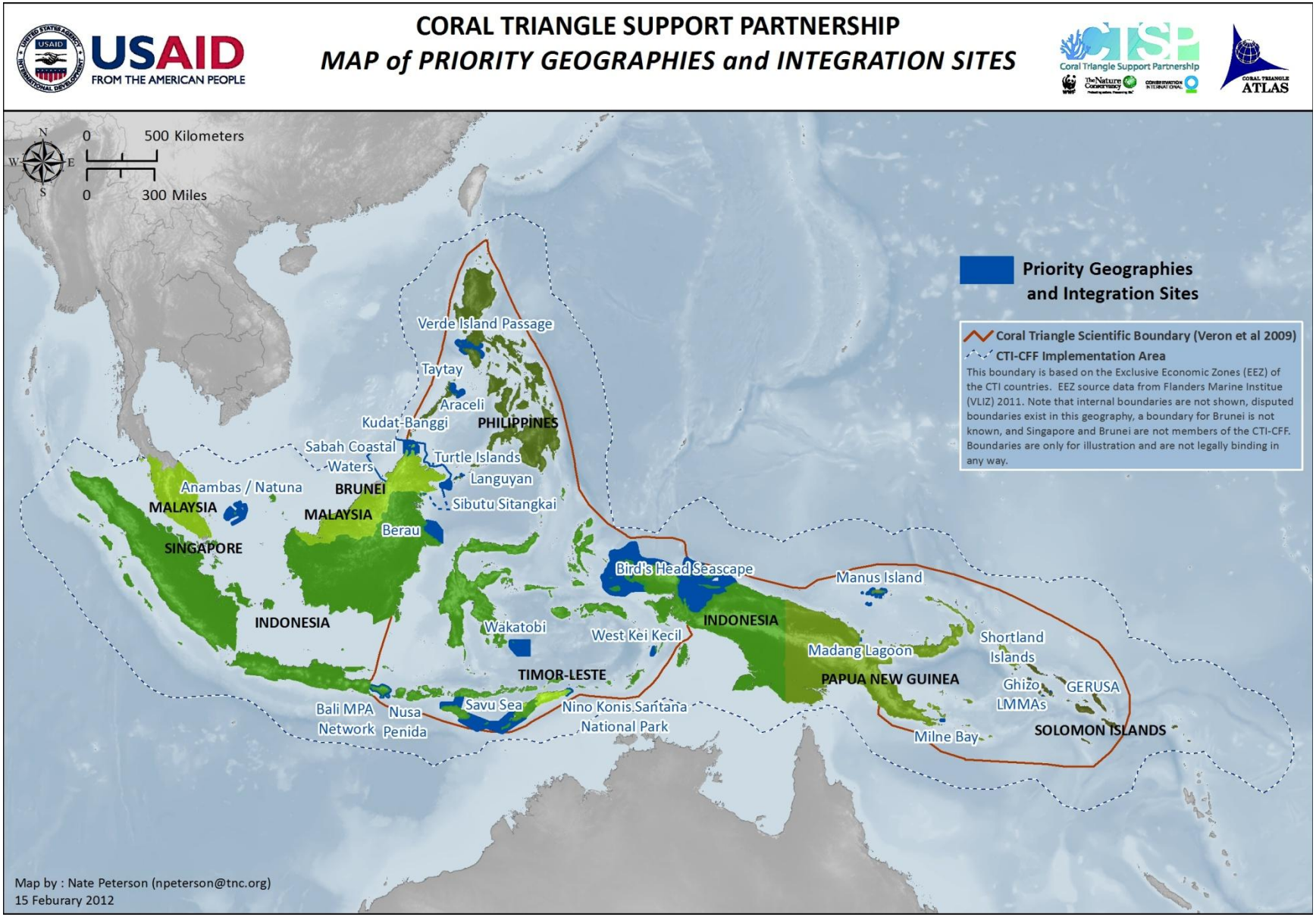


**Figure 2 USCTI Priority Geographies and Integration Sites**

**Table 1 USCTI Priority Geographies and Integration Sites**

| Country | Priority Geography | Integration Site |
|---|---|---|
| Indonesia | Lesser Sunda Ecoregion | Savu Sea Marine National Park |
| | Banda Sea Ecoregion | Sulawesi Tengarra Province, including Wakatobi Marine National Park |
| Malaysia | Kudat-Banggi | Tun Mustapha Park |
| | Sabah Coastal Waters | Sabah Coastal Waters |
| Papua New Guinea | Milne Bay Province | Nuakata-Labam-Phailele MPA |
| | Manus Province | Manus Island |
| Philippines | Palawan Province | Dumaran, Taytay and Araceli Municipalities |
| | Tawi-Tawi Province | Languyan, Sitangkai, and Sibutu Islands |
| | | Turtle Islands |
| | Verde Island Passage | San Juan, Lubang/Looc, and Calatagan Municipalities |
| Solomon Islands | Western Province | Ghizo Island and environs |
| Timor-Leste | Nino Konis Santana National Park | Nino Konis Santana National Park |

*Philippines*

The Philippines has completed a national marine gap analysis to assess ecological gaps in their protected area network (Alino *et al.* 2009). The gap analysis integrated best available information, and used existing targets as agreed during nationwide consultations and with the CTI. The gap analysis demonstrates the dearth of data, with implications for systematic MPA network design. For example, only half of the identified MPAs have coordinates and site descriptions, which is a result of decentralized planning efforts of local governments and communities. Furthermore, the gap analysis shows that some MPAs have been established without reference to marine biodiversity conservation and fisheries objectives.

Advancing systematic MPA network design will require coordinated and integrated efforts that address a combination of objectives from biodiversity protection to sustainable use. To do so, it will be necessary to build the capacity of local government units (LGUs)[14] to achieve their goals for subnational areas where MPA networks are being developed.

Current programs and efforts to refine MPA network design in the Philippines include:

- The Department of Environment and Natural Resources is supporting the National Integrated Protected Areas System (NIPAS) which includes 28 MPAs of national significance. Although not designed as an ecological network, these MPAs constitute a good representation of critical marine areas and habitats and threatened species in the Philippines. Current objectives are focused on monitoring and improving management effectiveness of these areas.
- The MPA Support Network of the Philippines is working on projects to coordinate the diverse community and local government programs to establish and manage MPAs/MPA networks. The Network links all members to evolving design principles, lessons learned, management effectiveness monitoring protocols, and opportunities for technical assistance in planning and management.

[14] A combination of municipal and city governments together with local communities

- Several foreign assisted programs have or are providing technical assistance to local governments in their design and implementation of MPAs/MPA networks. Projects include: the USAID supported Fisheries Improved for Sustainable Harvest Project, the Coastal Resources Management Project, and a MPA network development project in the Danajon Bank, Visayas; the Asian Development Bank (ADB) supported Integrated Coastal Resource Management Project; Partnerships in the Environmental Management for the Seas of East Asia (PEMSEA) and others.
- Several national assessments of marine biodiversity have also contributed to setting priorities for marine conservation and locating projects in areas of importance for marine diversity and fisheries production (Alino *et al.* 2009) e.g., in the Verde Island Passage (VIP); Calamianes Islands, northern Palawan Island; Danajon Bank, northern Bohol; Bohol Sea islands; Sulu Sea islands including Tubbataha Reefs, Tawi Tawi and connected areas; sites off Mindanao's eastern coastline.

CTSP is assisting with national level planning processes by addressing data deficiencies by collating high priority information through the CT Atlas, and providing technical support for MPA network design that incorporates principles for fisheries management and adaptation to climate change. CTSP is also providing technical support for several USCTI priority geographies as integration sites for management, including VIP (Figure 3), several areas in northern Palawan and the Tawi-Tawi area (Table 1, Figure 2). In the future, financial support for MPA network design by USAID nationally and at selected sites will need to be incorporated in ongoing and future projects of USAID or other donors, together with government programs. Potential areas for integrated management involving resilient MPA networks that include fisheries, biodiversity and climate change considerations include, the VIP, northern Palawan, areas in the Sulu Sea, the Bohol Sea including southern Cebu and Negros Islands, northern Bohol, and areas along the eastern coastline in Surigao Province.

A more detailed summary for the Philippines is provided in Appendix 1.

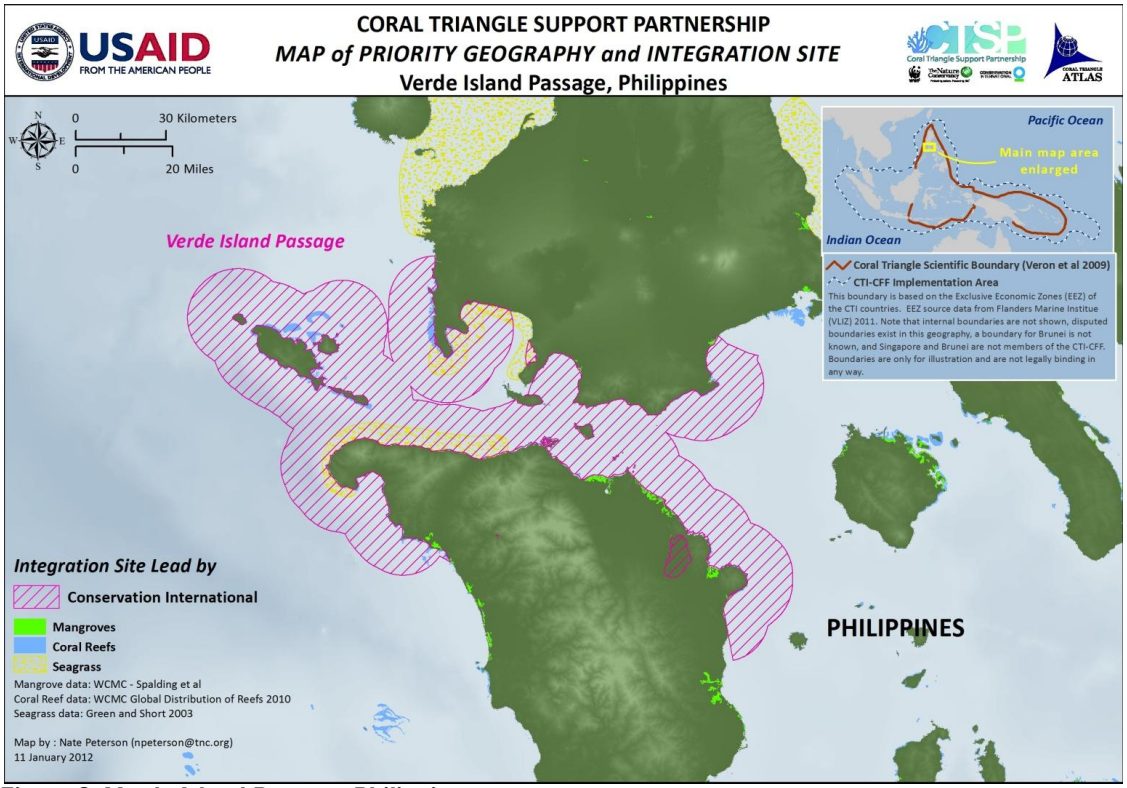

**Figure 3 Verde Island Passage, Philippines**

*Malaysia (Sabah)*

Malaysia has completed its national marine gap analysis (BMRI 2009), which includes an analysis of MPAs in Peninsular Malaysia and the two eastern states of Sarawak and Sabah in Borneo. The MPA gap analysis focuses on critical habitat coverage and their representation within MPAs, and addresses the extent that habitat of threatened species, particularly sea turtles, is represented within MPAs.

In future, Malaysia may require technical assistance for integrating fisheries, biodiversity, and climate change objectives into MPA network design at the national level, given that most MPAs were originally established to protect small island coral reefs and sea turtle nesting beaches. If so, CTSP will assist with that process by addressing data deficiencies and collating high priority information through the CT Atlas, and providing technical advice for MPA network design (if and when required).

Malaysia's highest priority MPA network is the proposed Tun Mustapha Park (TMP) in Sabah (Figure 4), which is partially supported by the USCTI as an Integration Site. Sabah Parks, with technical assistance from WWF Malaysia, are currently developing a draft zoning plan for the Park (to be completed in 2012). Recently, CTSP provided financial support for a zoning workshop held at the University of Queensland in Australia (January 2012), and provided technical advice regarding integrating fisheries, biodiversity, and climate change objectives into MPA network design (based on Fernandes *et al.* 2012). CTSP will continue to support the zoning process for Tun Mustapha Park in 2012.

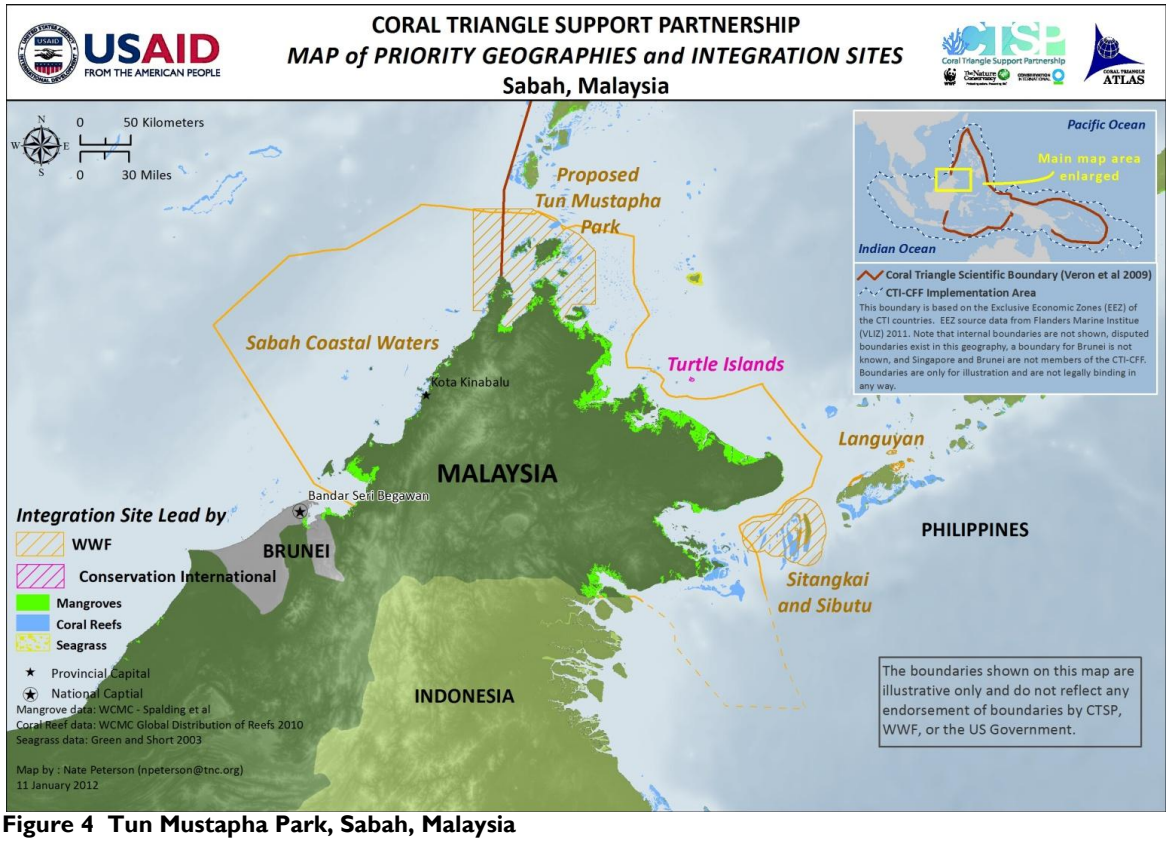


**Figure 4 Tun Mustapha Park, Sabah, Malaysia**

In addition to TMP, all of Sabah waters contain multiple and diverse nearshore marine ecosystems and fisheries that require a fully integrated and networked management framework. Thus, as TMP moves towards formal approval and implementation, and as baseline information on the marine area improves, the opportunity exists for an extensive and well planned MPA network to evolve that would include

some of the most biodiverse and relatively under-fished marine areas within the CT. If so, CSTP partners would be willing to provide technical advice for that process.

A more detailed summary for Malaysia (Sabah) is provided in Appendix 1.

*Indonesia*

Indonesia has completed a national gap analysis to assess ecological gaps in their protected area network (MF/MMAF 2010). The analysis includes several key results regarding the marine environment including:

- The Government of Indonesia has set a target for marine conservation of 20 million ha by 2020, with the current area under legal protection at 13.9 million ha.
- 18 to 22 percent of critical habitats (coral reefs, mangroves and seagrass beds) are currently within MPAs, and targets for protecting these have been achieved in at least 3 of the 12 ecoregions.
- Approximately 45 to 50 percent of prime dugong habitat and turtle nesting habitats are within protected areas.
- Large portions of legally declared MPAs are not effectively protected or managed, so that the actual protection of critical habitats is much less than the area of legally declared MPAs.
- The Halmahera region is underrepresented in the established MPAs.

However since the gap analysis focuses more on the terrestrial environment, further refinements are required to complete a full marine gap analysis. There are two processes currently underway aimed at refining the existing marine gap analysis:

1. The MPAG[15] (Marine Protected Area Governance Agreement 2011) is beginning to provide support for the Ministry of Marine Affairs and Fisheries (MMAF) to adopt a network approach to establishing MPAs in Indonesia, which will take ecological patterns of connectivity into account and transcend district and provincial borders.
2. A national MPA network design is also being developed incrementally based on political boundaries (province by province), by conducting marine spatial plans for each of the geographic priorities for marine biodiversity conservation (Huffard *et al.* 2009), generally supported by CTSP partners. To date, marine spatial plans have been completed by 5 of the 11 provinces, although they have not yet been legalized and decreed (T. Gunawan pers. comm.). However, provincial boundaries do not necessarily represent ecological boundaries, so there is a need to collaborate among provinces in some cases e.g., a scientific design of an MPA network design has been completed for three provinces in the Lesser Sunda Ecoregion (Wilson *et al.* 2011: see Lesser Sunda Ecoregion).

CTSP is providing technical support for both processes by addressing data deficiencies and collating high priority information through the CT Atlas. CTSP is also providing technical support for high priority science for MPA network design (including developing a more detailed connectivity model at multiple scales in the CT; see Addressing High Priority Science Needs).

For CTSP to provide financial support for MPA network design in Indonesia, funding needs to be programmed through current and future USAID supported projects in the country. In particular, financial support for MPA network design by CTSP, or USAID more generally, at sites must be incorporated in Indonesia's MPAG. Where possible, MPA network design should also be conducted

[15] USAID Indonesia changed its means of support for MPA work from CTSP to a new cooperative agreement mechanism in late 2011 with the same partners. Financial support for MPA network design from USAID in Indonesia now needs to be incorporated in the MPAG agreement.

collaboratively with USAID's Indonesia Marine and Climate Support (IMACS)[16] Project, which is expected to achieve transformational change in sustainable coastal/marine resource management and climate change adaptation in at least two demonstration areas (IMACS 2011) in Nusa Tenggara Barat and Nusa Sulawesi Tengarra Provinces. However, MPA network design is not currently part of the IMACS' work plan at either of these sites (IMACS 2011), probably because Nusa Tenggara Barat Province was included in the design of the Lesser Sunda MPA network (Wilson *et al.* 2011); and Nusa Sulawesi Tengarra includes Wakatobi Marine National Park (a USCTI Integration Site), which was rezoned in 2007 (BTNW/PKW 2007).

Although MPAG is not restricted to working at USCTI Integration sites in Indonesia (Table 1, Figure 2), an excellent opportunity exists for MPAG and CTSP to provide technical support for MPA network design at one of these sites: Savu Sea Marine National Park (SSMNP: Figure 5). In 2009, a CTSP partner (TNC) led the design of a resilient network of MPAs for the Lesser Sunda Ecoregion, which includes Savu Sea (Wilson et al 2011: see Transboundary MPA Networks). The Lesser Sunda MPA Network Design, and the accompanying database, is now being used to guide the zoning of SSMNP. CTSP is willing to provide technical support for integrating fisheries, biodiversity, and climate change objectives into MPA network design in SSMNP (if required). CTSP is also willing to provide technical advice for the design of the Bali MPA network, which is currently underway (if required).

A more detailed summary for Indonesia is provided in Appendix 1.

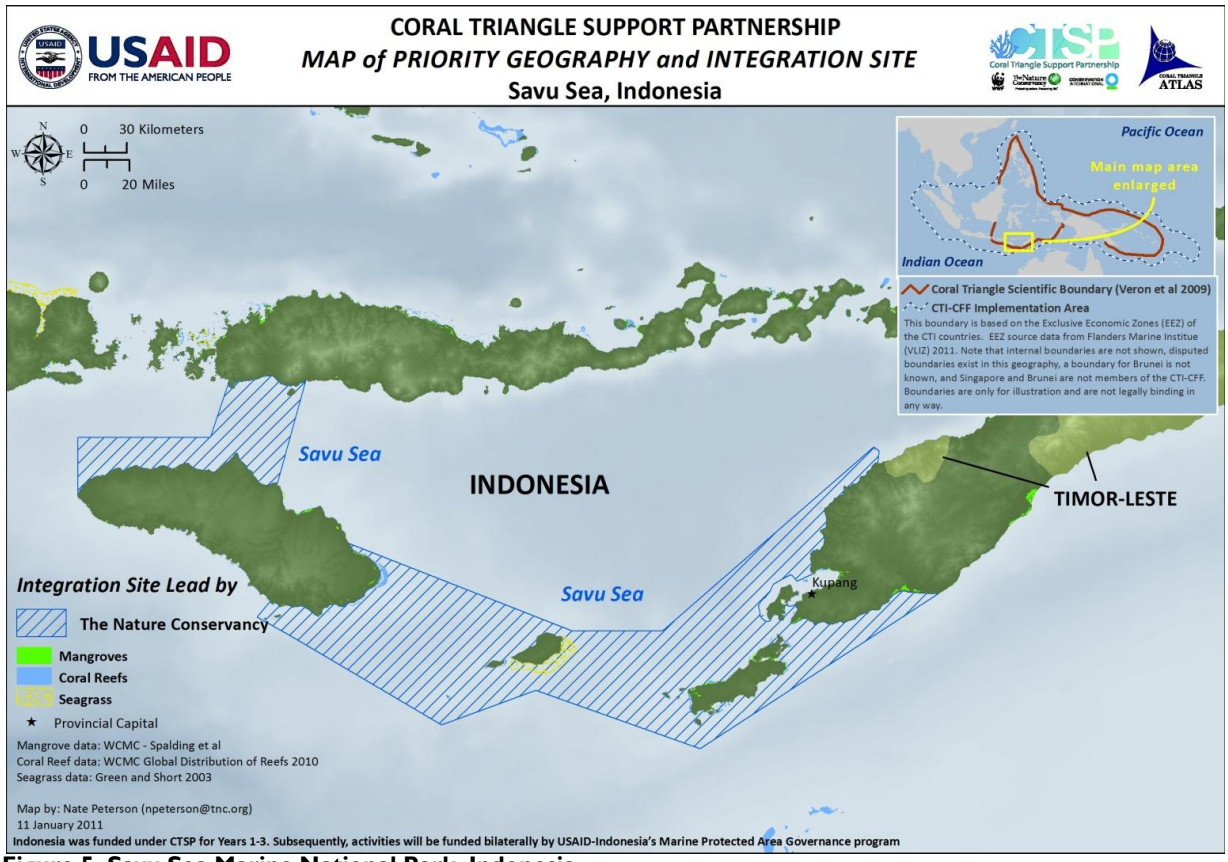


**Figure 5 Savu Sea Marine National Park, Indonesia**

[16] This USAID assistance program will support MMAF with their efforts to achieve sustainability in the marine and fisheries sector, and improve the response of coastal communities to near-term disasters and long-term impacts related to climate change.

*Timor-Leste*

Timor-Leste has completed a national ecological gap analysis (NEGA), which included an assessment of marine ecological gaps in their protected area network (Grantham *et al.* 2011). The marine component of the gap analysis was based on the scientific design of a resilient network of MPAs for the Lesser Sunda Ecoregion (Wilson *et al.* 2011: see Transboundary MPA Networks), which proposed a network of seven shallow and five deep-water MPAs for the country. Formal management designation has only happened so far in one of these areas, Nino Konis Santana National Park (NKSNP; Figure 6), and the USCTI Integration Site in Timor-Leste is the marine component of this Park.

CTSP's program in Timor-Leste is carried out through a partnership of CI and a local consulting firm, Rai Consultadoria, Their work is intended to meld with that of the Department of Protected Areas and National Parks (DPANP) of the Ministry of Agriculture and Forestry (MAF), who are responsible for all activities related to the protected areas network in Timor-Leste. Rai and CI have been working with communities, local, district, and national governments, towards establishing a network of Locally Managed Marine Areas (LMMAs) in NKSNP. This network is being designed primarily to support the community and government priorities of sustaining healthy coastal fisheries, supporting food security, and helping to sustain ecosystem health. Progress has included community-based participatory zoning, rule-making, and the development of management plans.

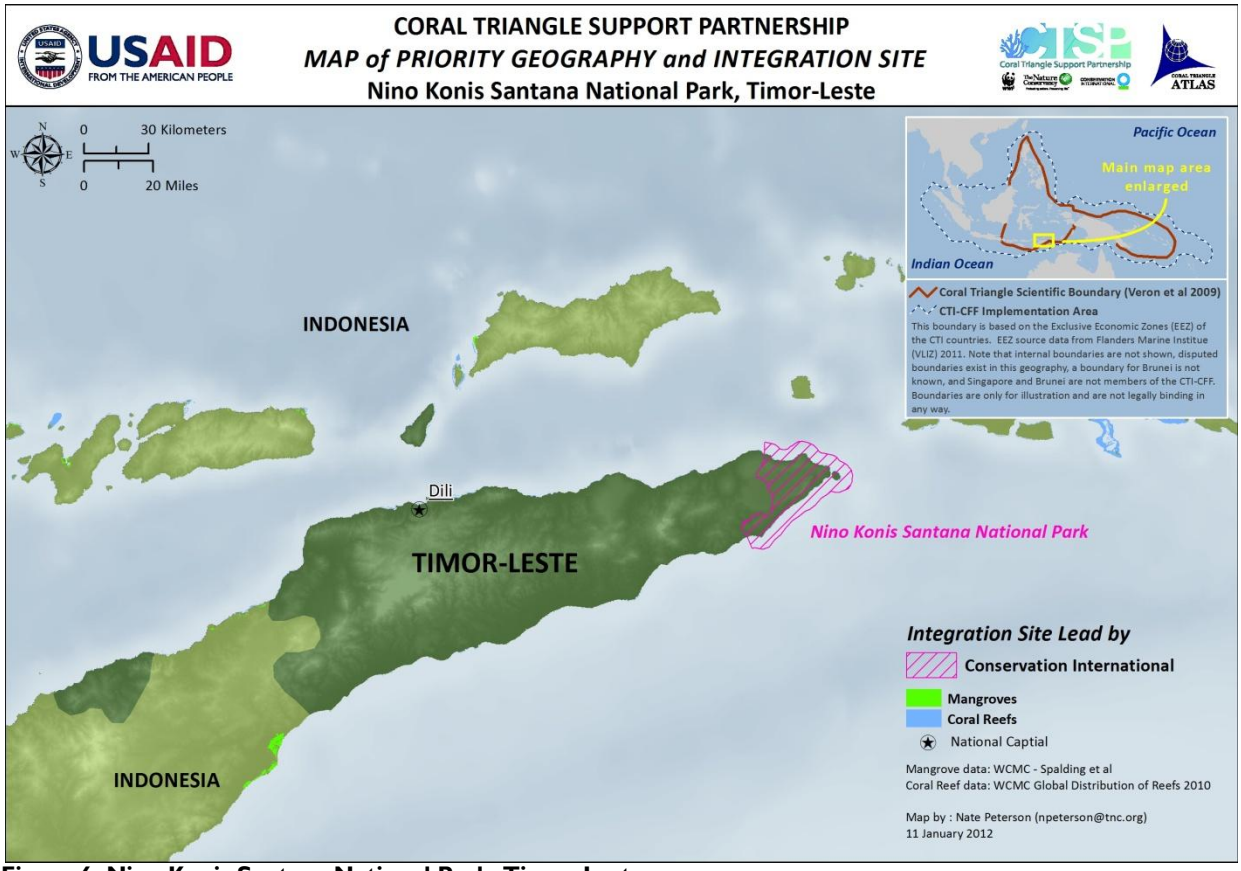


**Figure 6 Nino Konis Santana National Park, Timor-Leste**

CTSP is now building on the strong foundation they have built working with communities to introduce more scientific elements, including resiliency principles, into the design of the LMMA network. CTSP regional advisors, including CI and TNC staff, will continue to support this process by providing

technical assistance for developing and applying principles for maximizing the contributions of community-based MPAs to achieving fisheries, biodiversity, and climate change objectives. In doing so, it is important that this work builds on past, present, and future projects that provide an excellent basis for MPA network design in Timor-Leste (e.g., collaborative studies by the Timor-Leste government and Australian Institutions through the Arafura and Timor Seas Forum).

In November 2011, CTSP Timor-Leste staff also attended training on the USCTI Climate Change Adaptation toolkit. Since then they have introduced climate change outreach, vulnerability assessment, and climate adaptation planning at the community level in NKSNP. This will result in Local Early Action plans being completed for climate change adaptation in the marine and coastal environment, including consideration of resiliency principles in the design of the LMMA Network.

CTSP is also working with the government of Timor-Leste to coordinate a Rapid Assessment Program (RAP) of the marine environment of NKSNP in August 2012. The RAP will focus on assessing the biological diversity of NKSNP, assessing of the status of species with socio-economic importance, and the identifying areas that may help to meet resiliency principles in the design of the LMMA network.

Currently, the Timor-Leste CTSP office is focused primarily on assisting MAF and local communities to establish the LMMA network in NKSNP. With the combined capacity of the local CTSP staff and regional support from CI and TNC, CTSP has the necessary technical assistance for its current program. In mid-2012, CI will open an office in Timor-Leste and may be able to extend the focus of activities. This may include both additional activities within NKSNP and expansion to other areas. As appropriate, CI and CTSP will seek additional technical support as we work to support MAF and DPANP build an effective management system both in NKSNP and in other priority areas of the country.

A major issue in Timor-Leste is the need for capacity building to increase in-country skills and expertise in marine resource management, as part of the country's natural resource management platform. Support for this is being provided by CTSP (CTSP 2011), the Coral Triangle Center (CTC 2011), Australian governments and institutions, the UNDP, the Global Environment Facility, and others. A proposed capacity development action plan has also been developed to assist with the Timor-Leste Program of Work for Protected Areas (McIntyre 2011a), which includes marine areas.

A more detailed summary for Timor-Leste is provided in Appendix 1.

*Papua New Guinea*

As a signatory to CBD, Papua New Guinea (PNG) is obliged to complete a national gap analysis to assess ecological gaps in their existing protected area network. While a national terrestrial gap analysis has been completed (Lipsett-Moore *et al.* 2010b), the marine component still needs to be completed. This is not a priority for the national government, which is focused on implementing the PNG Marine Program (DEC and NFA 2010), completing the marine policy, and supporting community-based conservation (including LMMA networks) at the provincial and site level. Until a national marine gap analysis is completed, other regional and national marine assessments provide guidance regarding priority areas for marine conservation, including the national Conservation Needs Assessment (Alcorn 1993, Swartzendruber, 1993) and the Bismarck Solomon Seas Marine Ecoregional Assessment (Afzal *et al.* 2003).

At present, there are two USCTI Integration sites identified for PNG: Manus Island, Manus Province; and Nuakata-Labam-Phailele MPA, Milne Bay Province (Table 1, Figure 2).The national government also

selected a third site, Kimbe Bay, as a learning site for designing and operating MPA Networks in PNG (CTSP 2010: see The Regional Coral Triangle Marine Protected Area System).

Recently the Department of Environment and Conservation (DEC), confirmed that their current priority areas for integrating fisheries, biodiversity, and climate change objectives into MPA network design in PNG are Manus Province and Kimbe Bay. Therefore, CTSP will focus on assisting with a "ridges to reefs" planning process for designing a network of marine and terrestrial protected areas for Manus Province (Figure 7), and will identify ways to provide financial and technical support for this process.

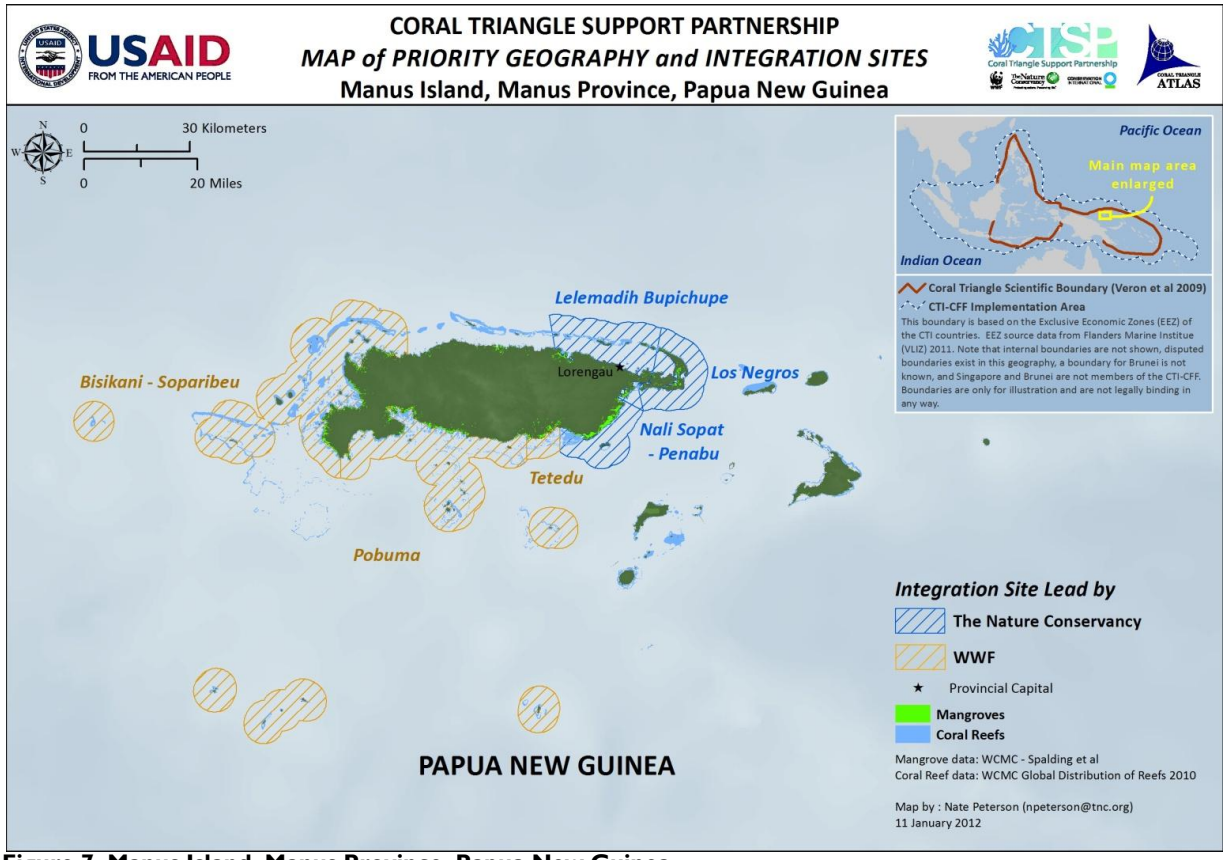


**Figure 7 Manus Island, Manus Province, Papua New Guinea**

Kimbe Bay is not a USCTI Integration Site, therefore CTSP cannot provide financial assistance for that site. However, CTSP will explore opportunities to provide technical advice to TNC and development partners (ADB/GEF and CSIRO) working in Kimbe Bay to integrate fisheries, biodiversity, and climate change objectives more explicitly into the MPA network design (see Green *et al.* 2007, 2009).

Furthermore, while CI and CSIRO are working towards integrating fisheries, biodiversity, and climate change objectives into MPA network design in Milne Bay, CTSP is unable to provide more financial support for that process due to a lack of resources. However if the situation changes, Milne Bay may be a good candidate for support because it provides an opportunity for learning how to integrate tourism with other objectives in MPA network design. In the meantime, CTSP is willing to provide technical advice for integrating multiple objectives into MPA network design in Milne Bay (if required).

A major issue in PNG is the need for capacity building to build in-country skills and expertise in marine resource management. Support for this is being provided by CTSP (CTSP 2011), the PNG Center for

Locally Managed Areas, the Coral Triangle Center (CTC 2011), the Australian Government, TNC and the CTI Alliance (TNC and ACTIA 2011), and other local and international NGOs.

A more detailed summary for Papua New Guinea is provided in Appendix 1.

*Solomon Islands*

A national conservation plan has been completed for the Solomon Islands, which includes a marine component (Kool *et al.* 2010). The conservation plan focuses on biodiversity objectives to fulfil the country's obligations under CBD. The plan has been tabled in Parliament, and needs to be reviewed to ensure that it is feasible, less complicated, and aligns with national and provincial government programs and community needs and interests. The government may require some assistance with this, but it is not currently a high priority.

A higher priority for the Ministry of Environment, Conservation and Meteorology is institutionalization of the MPA strategy, which is included in the Protected Area Act (2010). Now that the regulations for the Protected Area Act have been gazetted (February 2012), the government requires technical assistance to help reorganize protected area activities around the Act.

There is only one USCTI Integration Site in the Solomon Islands: Ghizo Island and environs, Western Province (Table 1, Figure 2). Limited funding is available from CTSP to provide financial and technical assistance for designing an MPA network for Ghizo Marine Conservation Area (Figure 8) with key partners (if required).

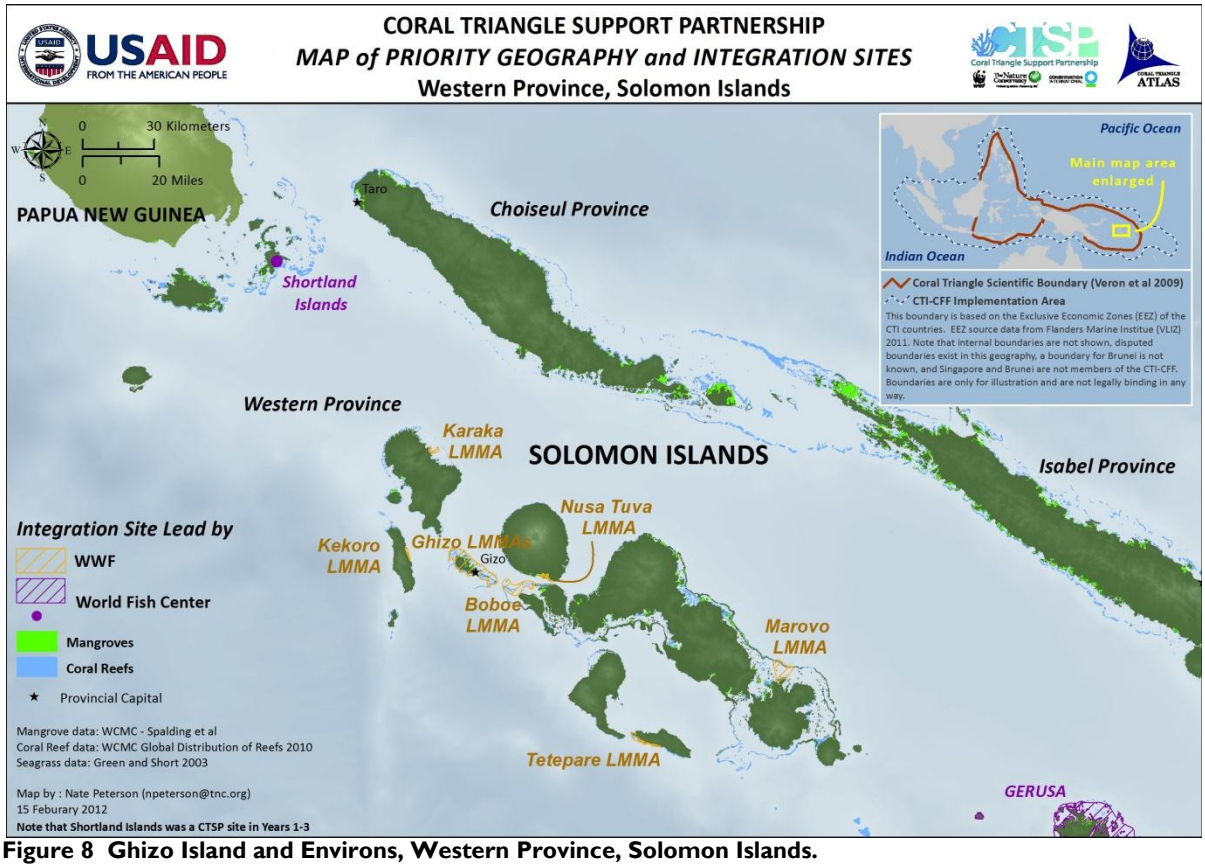


**Figure 8 Ghizo Island and Environs, Western Province, Solomon Islands.**

The national government is also committed to providing support for integrating fisheries, biodiversity, and climate change objectives into MPA network design at other sites in the Solomon Islands, particularly the Gella-Russell-Savo Natural Resource Management Network, Central Province. One CTSP Partner (TNC) is also working with a range of stakeholders to develop a conservation plan for Isabel Province, which is likely to provide a roadmap for developing a ridges-to-reefs Protected Area Network for the Province. While CTSP cannot provide financial support for these sites, we are willing to provide technical advice regarding integrating fisheries, biodiversity, and climate change objectives into MPA network design (if required).

A major issue in the Solomon Islands is the need to build in-country skills and expertise in marine resource management. Support for this is being provided by CTSP (2011), the SILMAA network, the Coral Triangle Center (CTC 2011), the Australian Government, TNC and the Australian CTI Alliance (TNC and ACTIA 2011), and other international and local NGOs.

A more detailed summary for the Solomon Islands is provided in Appendix 1.

## Transboundary MPA Networks

Two transboundary areas were identified as priorities by CTSP members in terms of MPA network design: the Sulu Sulawesi Marine Ecoregion (SSME) and the Lesser Sunda Ecoregion. The MPA network design processes in each of the two areas, and recommendations regarding how CTSP can provide technical assistance for those processes, are described in the following sections.

### *Sulu Sulawesi Marine Ecoregion*

One objective for the SSME (Figure 9) is to establish an integrated network of priority conservation areas that ensures ecological integrity of the Sulu Sulawesi Seas (WWF-SSME 2004, Miclat and Trono 2008). Two CTSP partners (WWF and CI) are providing technical support for this process, but feasibility for this task remains low because:

- It was not identified as a priority for MPA network design by the three national governments involved, which would prefer to focus on national or subnational MPA network designs;
- The transboundary issues remain an issue[17];
- There are substantial deficiencies in data required to design an MPA network at that scale; and
- Studies of ecological connectivity are required.

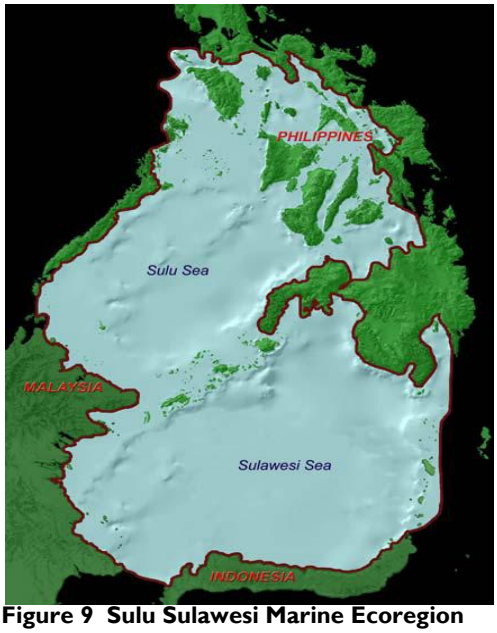

**Figure 9 Sulu Sulawesi Marine Ecoregion**

CTSP is providing technical support for this process by:

- Collating high priority information through the CT Atlas;
- Developing a detailed connectivity model for the SSME; and

[17] The three nations still do not agree on some historical issues such as boundaries (e.g., between Sabah and Philippines), although they have collaborated on a joint marine park in the Turtle Islands, with joint patrolling activities.

- Providing technical support for the design of priority MPA networks in the SSME, particularly Verde Island Passage (see Philippines, USCTI Integration Sites) and Tun Mustapha Park (see Malaysia (Sabah), USCTI Integration Sites).

A more detailed summary is provided in Appendix 2.

*Lesser Sunda Ecoregion*

A scientific design of a MPA network has been completed for the Lesser Sunda Ecoregion (Figure 10)), led by a CTSP partner (TNC: Wilson *et al.* 2011). The design, and the accompanying database, provides a starting point for the design of individual MPAs within the ecoregion in Indonesia and Timor-Leste (Wilson *et al.* 2011). This information is currently being used in the design of the Savu Sea Marine National Park (see Indonesia, USCTI Integration Sites), and will be used in the design of the LMMAs for the coastal and marine components of the NKSNP in Timor-Leste (see Timor-Leste, USCTI Integration Site). No further technical assistance is required for MPA network design at the ecoregional level.

A more detailed summary is provided in Appendix 2.

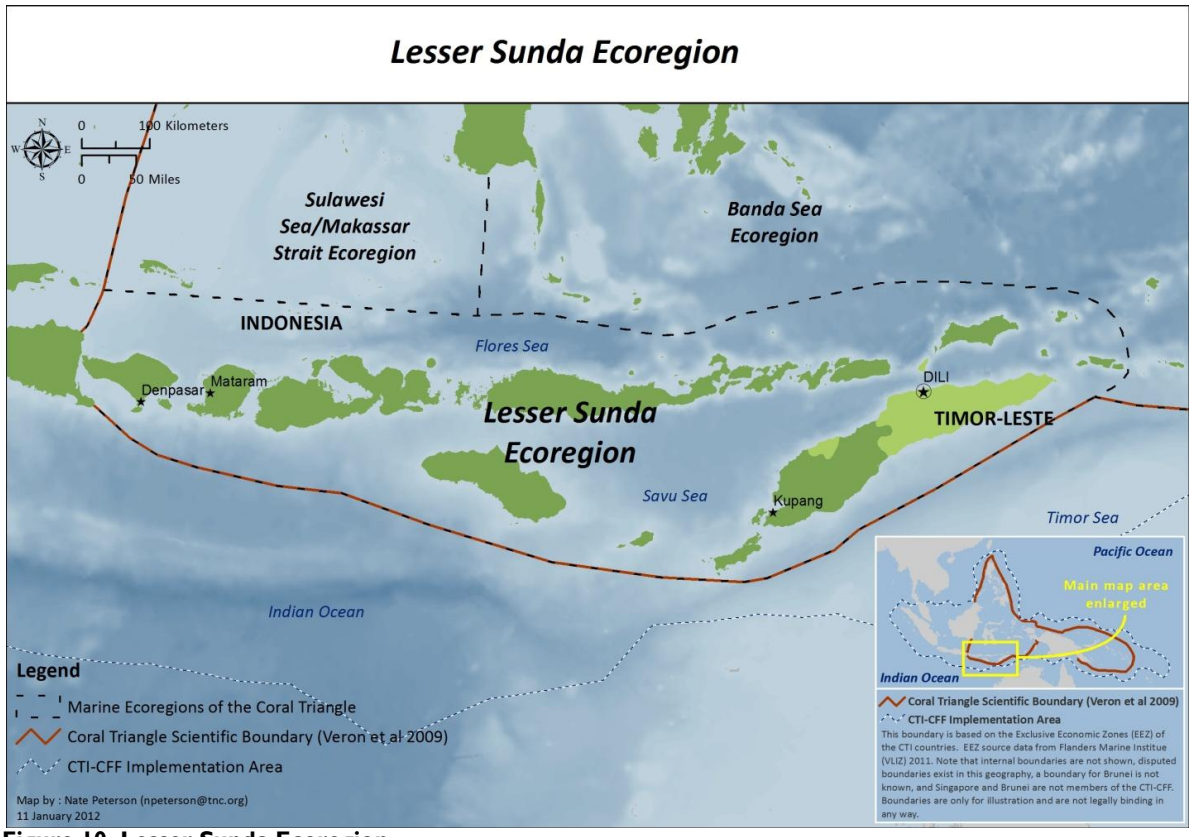


**Figure 10 Lesser Sunda Ecoregion**

## Addressing High Priority Science Needs

High priority science for integrating fisheries, biodiversity, and climate change objectives into MPA network design at multiple scales in the CT includes both applied and strategic science. For the purposes of this study:

- Applied science refers to situations where the required methods and tools already exist, but field practitioners require assistance to apply them to MPA network design; and
- Strategic science refers to situations where new methods and tools are required to improve our ability to integrate multiple objectives into MPA network design.

CTSP will work with scientific partners (see Expertise, Interests and Capacity of Technical Experts) to provide technical assistance to address the high priority applied science needs identified in the scoping study. This assistance will be provided on either a case-by-case basis (e.g., for individual MPAs/MPA networks) or by facilitating workshops (e.g., CTSP MPA Regional Exchanges) to assist field practitioners with:

- Conducting studies that will provide an understanding of key biological and physical factors that need to be taken into account in MPA network design. This includes:
    - Identifying, mapping, and assessing the status of biological resources (e.g., major habitat types, critical areas such as spawning, nesting, feeding and nursery areas, biodiversity, fisheries resources), and threats to the long term sustainability of these resources.
    - Mapping and developing models of physical features (e.g., bathymetry, ocean currents, upwellings etc.) and key ecosystem processes (e.g., connectivity).
- Conducting studies that will provide an understanding of key social factors that need to be taken into account in MPA network design. This includes studies concerning:
    - Attitudes, beliefs, and values regarding the marine environment;
    - Spatial and temporal patterns of use, and economic value of marine resources;
    - Livelihood diversity and dependency on marine resources;
    - Traditional ecological knowledge and customary marine tenure systems; and the
    - Broader political context.
- Identifying and applying locally appropriate methods and tools to facilitate MPA network design (e.g., using marine spatial planning software such as Marxan[18]).
- Conducting monitoring, measuring success, and adaptive management to ensure MPA networks achieve their goals, and to demonstrate the ecological and social benefits and costs of MPAs.

CTSP will also work with scientific partners to address high priority strategic science needs (Table 2), which address issues related to conservation planning, understanding and incorporating ecological patterns of connectivity, and improving the information required to integrate fisheries and climate change objectives into MPA network design.

Of the 22 strategic science needs identified, 12 are currently being addressed. CTSP is playing a lead role in addressing five of these tasks regarding developing and applying:

- Biophysical design principles for integrating fisheries, biodiversity, and climate change objectives into resilient MPA network design [Task CP1a];
- Models of ecological patterns of connectivity for MPA network design at regional, ecoregional, and subnational scales in the CT (Task C1c];
- Specific advice regarding MPA network configuration (size and spacing of individual MPAs) based on movement patterns and larval dispersal of coral reef and coastal pelagic species (particularly key fisheries species) [Task C1b];

[18] http://www.uq.edu.au/marxan/

- A regional online database of GIS data layers required for MPA network design [Task CP4]; and
- A toolkit for field practitioners for integrating MPA, EAFM and climate change adaptation strategies at sites [Task CP5].

CTSP is also contributing to the other tasks that are being addressed by scientific partners by providing technical advice or opportunities to test their application at sites. Ten other high priority tasks still need to be addressed, and some will require funding to do so (Table 2).

## Expertise, Interests and Capacity of Technical Experts

Approximately 70 scientific experts from 30 NGOs, scientific institutions, and consulting companies (Appendix 4) expressed interest in providing technical support for integrating fisheries, biodiversity and climate objectives into MPA network design in the CT. The scientists, from the CT6, Australia, USA, and other countries, have a range of expertise in marine conservation planning, biophysical and socioeconomic sciences, and integrated approaches to marine resource management (Appendix 5). Together, these scientists have the capacity to provide the technical assistance required by the CT6 and USCTI Implementation Partners (see Addressing High Priority Science Needs). Because of the large number of respondents, we were unable to provide all of their detailed responses in this document. Therefore we have provided:

- A summary of their technical expertise, geographic areas of interest, the type of assistance they can provide, and the cost of providing that assistance in Appendix 5; and
- Their names, institutions and contact details in Appendix 4.

While this is not a comprehensive list of all the expertise available, it does provide a summary of the types of expertise that are available to provide technical assistance for MPA network design in the CT. Together, these scientists have the capacity to provide the technical assistance required by the CT6 and USCTI Implementation Partners (see Addressing High Priority Science Needs).

**Table 2 High Priority Strategic Science Required for Integrating Fisheries, Biodiversity, and Climate Change Objectives into Marine Protected Area Network Design in the Coral Triangle.**

| Field | High Priority Science Required | Status |
|---|---|---|
| **Conservation Planning** | **CP1. Develop and apply biophysical and social design principles for integrating fisheries, biodiversity, and climate change objectives into resilient MPA network design.**<br>Rationale**:** Principles for MPA network design are guidelines that provide specific advice regarding how to design a network to achieve its objectives. In many situations, field practitioners have used two types of design principles: biophysical principles that are aimed at achieving biological objectives by taking key biological and physical processes into account; and social principles that are aimed at maximizing benefits and minimizing costs to local communities and sustainable industries (Fernandes *et al.* 2005, Green *et al.* 2009, Wilson *et al.* 2011). These principles need to be refined to maximize their contribution to achieving fisheries, biodiversity, and climate change objectives in MPA networks in the CT as follows:<br>**a) Biophysical design principles.**<br>Rationale: In the past, biophysical principles for MPA network design have tended to focus on achieving objectives related to fisheries management or biodiversity conservation (including resilience to climate change, e.g., I UCN-WCPA 2008, McLeod *et al.* 2009). While there are many similarities among these principles, there are some important differences. Consequently, there is a need to integrate these approaches to improve our ability to design MPAs that can simultaneously achieve all three objectives. In 2011, CTSP contracted a consultant to develop biophysical principles for integrating fisheries, biodiversity, and climate change objectives in MPA network design (Fernandes *et al.* 2012). In 2012, these principles will be applied at USCTI Integration Sites, starting with Tun Mustapha Park in Sabah, Manus, in PNG, and Nino Konis Santana, in Timor-Leste.<br>Contacts: Leanne Fernandes (Earth to Ocean Consulting), Alison Green and Alan White (TNC), Carissa Klein (UQ EDG),) and Scott Atkinson (CI).<br>**b) Social design principles.**<br>Rationale: While social design principles for MPA network design have been developed and applied in the CT (e.g., Mascia 2004, Green *et al.* 2009, Wilson *et al.* 2011, Fox *et al.* in press), they need to be refined to improve our ability to address fisheries, biodiversity, and climate change objectives simultaneously in MPA network design. Once the principles have been refined, they will be applied to MPA network design at USCTI Integration Sites. Since social factors are likely to vary across ecological and social domains, these principles should provide a framework that can be modified to suit local conditions, as required.<br>Contact: Alison Green and Supin Wongbusarakum (TNC), Patrick Christie (UW) and Leah Karrer (CI). | Completed<br><br>Proposed (funding required). |

| Field | High Priority Science Required | Status |
|---|---|---|
| **Conservation Planning** | **CP2. Develop and apply methods to address the mismatch between regional scale planning and local scale actions.**<br>Rationale. Systematic conservation planning is often considered an effective approach to designing MPA networks to achieve fisheries, biodiversity, and climate change objectives at large scales (e.g., regional, ecoregional, and national scales). However, in the CT, conservation action is most effective at the local scale (McClanahan *et al.* 2006). Therefore, it is important that regional and local scale initiatives inform each other to achieve success at multiple scales (Mills *et al.* 2010). However, that is not often the case, and methods are now required to address this mismatch in two ways:<br>**a) Develop and apply methods for scaling up small community-based MPAs to contribute to large scale networks that can achieve multiple objectives at regional, national, and local scales.**<br>Rationale: Marine conservation action commonly results from local or site based initiatives focused on the issues and values of one or a few communities (Mills *et al.* 2010). In many CT countries, community-based MPA systems are extensive or expanding (Govan 2009, Weeks *et al.* 2010) because they are often the most effective strategy for conserving nearshore resources in line of sight of local communities (McClanahan *et al.* 2006). While community-based MPAs may be successful in achieving local objectives (particularly regarding fisheries issues), they seldom form MPA networks that can achieve fisheries, biodiversity or climate change objectives at larger scales (Mills *et al.* 2010, Weeks *et al.* 2010). Methods for scaling up collections of community-based MPAs into larger networks of MPAs are required. This will necessitate integrating systematic conservation planning with community-based decision-making and developing methods for integrating policy and governance systems at different scales. These methods are being developed and applied in Fiji, the Philippines, PNG and Timor-Leste, and were discussed at a Marine Think Tank[19] at the International Congress of Conservation Biology (ICCB) in December 2011. A good example has also been provided in Choiseul Province in the Solomon Islands (Game *et al.* 2010, Lipsett Moore *et al.* 2010).<br>Contacts: Rebecca Weeks and Vera Horigue (ARC CoE), Stacy Jupiter (WCS), Richard Hamilton, Eddie Game, James Hardcastle and Alison Green (TNC), and Scott Atkinson (CI).<br>**b) Develop and apply methods for scaling down large scale MPA network designs to accommodate constraints and opportunities, and to achieve objectives, at the local scale.**<br>Rationale: Systematic conservation planning is often used to design MPA networks to achieve multiple objectives at large scales (e.g., Wilson et al 2011). However in many CT countries, the most effective governance structure is small, community-based MPAs (see above). Therefore, a key challenge is to develop methods for scaling down large scale MPA network designs to address important constraints and opportunities (e.g., customary marine tenure), and to achieve objectives, at the local scale. Methods for scaling down large scale MPA network designs are in the early stages of development, and further work and case studies are required. This was discussed at a symposium[20] at ICCB in December 2011.<br>Contact: Bob Pressey (ARC CoE). | In Progress.<br><br>Proposed. |

[19]Improving the effectiveness of community-managed MPAs for biodiversity conservation, fisheries management and climate change adaptation. http://www.conbio.org/Activities/Meetings/2011/program/mtt.cfm

[20]Adaptive conservation planning: rationale and requirements for adjustment of conservation designs to fit the real world. http://www.conbio.org/Activities/Meetings/2011/program/symposia.cfm

| Field | High Priority Science Required | Status |
|---|---|---|
| Conservation Planning | **CP3. Develop and apply methods for integrating multiple objectives into MPA network design using marine reserve software (including making trade-offs explicit).**<br>Rationale: Marine spatial planning software (Marxan with Zones) allows for MPA networks to be designed to achieve multiple objectives simultaneously. Case studies are required to develop and apply methods for: a) integrating fisheries, biodiversity, and climate change objectives into MPA network design; and b) integrating land and sea objectives into ridges to reefs protected area designs. Several opportunities exist in 2012, particularly regarding integrating multiple objectives into the design of a proposed ridges to reefs protected area design in Manus Province (see Papua New Guinea). There is also a good opportunity to learn from current and proposed land-sea conservation planning projects elsewhere (Alvarez-Romero *et al.* 2011).<br>Contacts: Vera Agostini (TNC), Hedley Grantham (CI), Carissa Klein (UQ EDG) and Bob Pressey (ARC CoE). | Proposed. |
| | **CP4. Develop a regional online database of GIS data layers required for MPA network design.**<br>Rationale: MPA network design requires collecting, developing and applying many data layers regarding the biophysical and socioeconomic characteristics of the area. Therefore, it is important that the best available information available is collected and available to conservation planners designing MPA networks at regional, ecoregional, national, and subnational scales. This task is being conducted by the Coral Triangle Atlas[21].<br>Contacts: Annick Cros and Alan White (TNC). | In Progress |
| | **CP5. Develop and apply a toolkit for field practitioners for integrating MPA, EAFM and climate change adaptation strategies.**<br>Rationale: Various tools exist to apply MPA, EAFM or climate change adaptation strategies at sites (e.g., Reef Resilience Toolkit 2011, Secretariat of the Pacific Community 2011, US Coral Triangle Initiative Support Program in prep). Thus, a toolkit is required to assist field practitioners in integrating these tools at sites within an ecosystem based management approach. This task is currently underway by CTSP, and will be completed in 2012.<br>Contacts: Kathleen Flower and Scott Atkinson (CI), and Alan White (TNC). | In Progress |

[21] http://ctatlas.reefbase.org/

| Field | High Priority Science Required | Status |
|---|---|---|
| **Connectivity** | **C1. Develop and apply methods to improve our ability to incorporate biological patterns of connectivity into MPA network design.**<br>Rationale: Connectivity is the demographic linking of local populations through larval dispersal and movement patterns of adults and juveniles (Jones *et al.* 2009). Incorporating connectivity is one of the most important principles for integrating fisheries, biodiversity, and climate change objectives into MPA network design, since it is critical for maintaining ecosystem processes and facilitating recovery of damaged ecosystems after disturbances (McLeod *et al.* 2009, McCook *et al.* 2009, Fernandes *et al.* 2012). Several high priority tasks are required to improve our ability to incorporate connectivity into MPA network design in the CT. They include tasks aimed at: (a) improving our understanding of larval dispersal; (b) refining design principles based larval dispersal and adult movement patterns of key species; (c-e) developing and applying connectivity models where direct measurements of connectivity are not available; (f) and improving our ability to take movement of key species among habitats into account. These tasks are described in more detail below. | |
| | **a) Improve our understanding of larval dispersal of key species and the implications for MPA network design, particularly regarding spillover of fisheries species from MPAs to fishing grounds in the context of local governance systems.**<br>Rationale: Recently, new methods have been developed and applied to directly measure larval dispersal at ecological scales relevant for MPA network design (Jones *et al.* 2009). These studies have provided new insights into connectivity of coral reef fishes by demonstrating that local recruitment is more common than previously thought (Jones *et al.* 2005, Almany *et al.* 2007, Planes *et al.* 2009). Further studies are required for more species in more locations to improve our understanding of larval dispersal, particularly regarding the spillover of fisheries species from MPAs to fishing grounds. The results need to be considered in the context of local governance systems (e.g., customary marine tenure), and their implications for MPA network design.<br>Contacts: Glenn Almany (ARC CoE) and Richard Hamilton (TNC). | Still Required. |
| | **b) Refine biophysical design principles for MPA network configuration (size and spacing of individual MPAs) based on best available information regarding movement patterns and larval dispersal of coral reef and coastal pelagic species (particularly key fisheries species).** [Linked to Task CP1a.]<br>Rationale: The optimal size and spacing of individual MPAs will depend on network objectives, key species (and how far they move), and if there are other effective marine resource management methods in place (Fernandes *et al.* 2012). This task focuses on developing specific recommendations regarding size and spacing of MPAs to achieve fisheries, biodiversity, and climate change objectives based on movement patterns and larval dispersal of key species. The task will be completed based on the results of a three-step process. First, CTSP contracted a consultant to summarize best available information regarding movement patterns and larval dispersal of key species. This contract was completed in November 2011, and the results (Maypa *et al.* 2012) used to develop specific recommendations regarding size and spacing of no-take areas at a Marine Think Tank[22] at ICCB in December 2011. These recommendations are now being reviewed by scientists with expertise in fish movement and larval dispersal, and a scientific paper will be completed in 2012.<br>Contacts: Alison Green and Alan White (TNC), Aileen Maypa (UH), Glenn Almany (ARC CoE) and Rene Abesamis (SU). | In Progress |

[22]Improving the effectiveness of community-managed MPAs for biodiversity conservation, fisheries management and climate change adaptation. http://www.conbio.org/Activities/Meetings/2011/program/mtt.cfm

| Field | High Priority Science Required | Status |
|---|---|---|
| Connectivity | **c) Conduct a multi scale analysis (regional, ecoregional, and subnational) of ecological patterns of connectivity in the CT, and the implications for MPA network design.**<br>Rationale: An important requirement for designing ecologically connected networks of MPAs is an understanding of ecological patterns of connectivity, and the implications for achieving fisheries, biodiversity, and climate change objectives. In the CT, this requires developing connectivity models (based on hydrodynamic and larval dispersal models) to identify the degree of connectivity among areas. This is particularly important for transboundary areas where governments and communities may need to collaborate to design MPA networks to achieve their objectives (see Transboundary MPA Networks). CTSP is supporting an application by UQ EDG for an Australian Research Council Linkage Grant to develop models and conservation planning tools that will make better use of this information to achieve biodiversity, fisheries and climate change objectives in the CT. The study will focus on conducting a regional (CT-wide) analysis and identifying several areas where detailed analyses will be completed (including important transboundary and USCTI Integration Sites).<br>Contacts: Peter Mumby and Eric Treml (UQEDG), Alison Green and Alan White (TNC). | Proposed (subject to funding). |
| | **d) Develop a practical, user friendly web interface for field practitioners to use to model connectivity of coral reef species for MPA network design.**<br>Rationale: While incorporating ecological connectivity is a high priority for MPA network design, obtaining this information requires a high level of expertise. Consequently, this information is not available for many areas of the CT. With the development of new dispersal and connectivity models (including global oceanographic models with a resolution of 4km, and more detailed models in some locations: Paris et. al 2007; Kool, 2011), it is possible to automate the development of dispersal models using a web interface (where field practitioner can enter GPS coordinates for their areas of interest, name their species of interest, and the website will use the best available information to generate a dispersal model for their area). Funding is required to develop the web interface, which will cover consulting costs for a modeler, a web designer/programmer and a graphic user interface designer.<br>Contacts: Johnathan Kool and Bob Pressey (ARC CoE), and Alison Green (TNC). | Proposed (funding required). |
| | **e) Demonstrate how to use connectivity models for coral reef species for resilient MPA network design using Marxan, and the costs and benefits of this approach.**<br>Rationale: Recently, Marxan has been modified to take connectivity into account in MPA network design (Beger *et al.* 2010). Case studies are now required to demonstrate how connectivity models can be used in Marxan, the extent to which they modify the design (or not), and the costs and benefits of using this approach. Two opportunities exist in 2012: using hydrodynamic and dispersal models to refine the Palau Protected Area Design; and using global oceanographic and dispersal models to develop/refine MPA networks for key species at the regional, ecoregional (Sulu Sea) and local (Bohle Sea) scales in the Philippines. See also Task c above.<br>Contacts: Peter Mumby and Maria Beger (UQEDG), Alison Green (TNC), Jonathan Kool (ARC CoE), Perry Alino (MSI) and Rene Abesemis (SU). | Proposed. |

| Field | High Priority Science Required | Status |
|---|---|---|
| **Connectivity** | **f) Develop and apply methods for refining our ability to take connectivity of key species among habitats (e.g., coral reefs, mangroves, and seagrasses) into account in MPA network design.**<br>Rationale: Some coral reef species use different habitats throughout their lives. For example, mangrove jack (*Lutjanus argentimaculatus*) use offshore reefs as adults and coastal estuaries and freshwater streams as nursery habitats (Randall *et al.* 1997). The current approach to account for this in MPA network design is to rely on Marxan's tendency to select areas for inclusion in MPA networks where there is a high variety of habitat types in close proximity (i.e. adjacent areas of coral reef, mangroves, seagrasses, etc: Game and Grantham 2008). This approach needs to be tested to determine if it adequately addresses the movement patterns of key species (e.g., it assumes that mangrove jack use the coral reefs that are closest to their nursery habitats, which may not be the case).<br>Contacts: Bob Pressey (ARC CoE) and Peter Mumby (UQ). | Still required. |
| **Fisheries** | **F1. Develop guidelines for incorporating MPA networks within broader fisheries management frameworks for key species or species groups.**<br>Rationale: While MPAs can be designed to improve their contribution to achieving fisheries objectives, they also need to be integrated within a broader framework (e.g., EAFM) to maximize their contribution to fisheries management (Fernandes *et al.* 2012). This task focuses on providing specific recommendations on how MPA networks with different configurations can be integrated within broader fisheries management frameworks to better achieve fisheries objectives for key species or species groups. The task will be initiated in 2012 if funding is available to hire a consultant to lead the process and to hold at least one workshop for key experts (Linked to Tasks CP1a and C1b.).<br>Contact: Andrew Smith (TNC). | Proposed (funding required). |
| | **F2. Develop and apply methods for using satellite data to characterize and incorporate oceanographic influences on coastal fisheries production in MPA network design.**<br>Rationale: Oceanographic conditions influence the distribution of fish in coastal ecosystems, which have implications for fisheries production (Hamner *et al.* 2007). To inform MPA network design in the CT, there is a need to understand these influences and how they are likely to change. Several partners (TNC, CI, AIMS, and NOAA) are interested in collaborating on this project based on a case study area where there is support from local practitioners, variable oceanographic conditions, and high fishing pressure. However significant funding or in kind contributions from partners will be required to develop the oceanographic models required for this task.<br>Contacts: Hedley Grantham (CI) and Vera Agostini (TNC), Craig Steinberg (AIMS), Scott Heron and Mark Eakin (NOAA). | Proposed (funding required). |
| | **F3. Develop and apply a spatial fisheries assessment tool for small scale fisheries in data poor situations.**<br>Rationale: Small scale fisheries in the CT are complex, with many different fishers operating at a relatively small scale. These fisheries are difficult to assess and manage using traditional fisheries management controls (Berkes *et al.* 2001). Fisheries models can help inform fisheries management by providing an assessment of how management options might influence the fishery and ecosystem (Hilborn 2011). However, most fisheries models are not spatial, and few have been developed to inform spatial management regarding small scale fisheries (Berkes *et al.* 2001). Furthermore, these models need to be able to be developed in data poor situations, since little data is available in many locations in the CT. Thus, there is a need to develop fisheries models to evaluate the costs and benefits of alternative spatial management actions (e.g., no-take areas, temporary closures, gear restricted areas) for fisheries, communities and biodiversity conservation in data poor areas. These models could play a key role in integrating fisheries objectives more explicitly into MPA network design for the benefit of both people and nature.<br>Contacts: Hedley Grantham (CI), Hugh Possingham and Carissa Klein (UQ) and Vera Agostini (TNC). | Still required |

| Field | High Priority Science Required | Status |
|---|---|---|
| **Climate Change** | **CC1. Develop and apply methods for assessing ecological resilience and social vulnerability to climate change and other threats, and incorporating results in MPA network design.**<br>Rationale: Climate change and other threats represents a serious and increasing threat to coral reefs and associated ecosystems in the CT (Hoegh-Guldberg et al 2009, McLeod *et al.* 2010a,b). It is important to develop and apply methods to assess ecological resilience and social vulnerability to these threats and to use the results for MPA network design. This will require addressing three high priority tasks, as described below. | |
| | **a) Develop and apply a standard protocol for assessing ecological resilience of coral reefs and associated ecosystems to climate change and other threats.**<br>Rationale: Several protocols have been developed to assess ecological resilience to climate change and other threats (e.g., Obura and Grimsditch 2009, Green and Bellwood 2009, Maynard *et al.* 2010). Scientists are now developing a standard protocol to use as the basis for integrating ecological resilience into MPA network design.<br>Contacts: Tim McClanahan (WCS), Jeff Maynard (Consultant), Rod Salm and Lizzie McLeod (TNC), and David Obura (CORDIO). | In Progress |
| | **b) Develop and apply a framework for assessing social vulnerability (including exposure, sensitivity, and adaptive capacity of human communities) to climate change and other threats.**<br>Rationale: Several approaches have been developed to assess the vulnerability of communities to climate change and other threats (e.g., Marshall *et al.* 2009, Cinner *et al.* 2011, Wongbusarakum and Loper 2011). More work is required to develop a standardized framework for assessing social vulnerability, which can be used to support the integration of these factors into MPA network design.<br>Contacts: Josh Cinner (ARC CoE), Nadine Marshall (CSIRO), Supin Wongbusarakum and Lizzie McLeod (TNC), Lea Scherl (Consultant). | Still required. |
| | **c) Develop and apply methods for using the results of resilience assessments for MPA network design, particularly regarding developing methods that can be used for systematic conservation planning using marine reserve design software.**<br>Rationale: Some studies have made excellent progress regarding how to use the results of resilience assessments for marine conservation (including MPA network design) on a site by site basis on the Great Barrier Reef, West Indian Ocean and Indonesia (e.g., McClanahan *et al.* 2009, Maynard *et al.* 2010, Maynard *et al.* 2012). Further studies are required to determine how to use the results of site-based resilience assessments in combination with remote sensed data (e.g., McClanahan *et al.* 2009, Mumby *et al.* 2011) to develop GIS layers for systematic conservation planning with marine reserve design software (e.g., Marxan). This approach is currently being addressed through Peter Mumby's Pew Fellowship[23] based on two areas in the Caribbean (Bahamas and Belize). Another opportunity to apply this approach may be through the refinement of the Palau Protected Area design in 2012. The IUCN Climate Change and Coral Reefs Working Group are also applying this approach in the Red Sea and West Indian Ocean, and are interested in collaborating with projects in the Pacific (possibly Palau).<br>Contacts: Peter Mumby (UQ EDG), Eddie Game and Alison Green (TNC). | In Progress |

[23] http://www.pewenvironment.org/research-programs/marine-fellow/id/8589941249/project-details

| Field | High Priority Science Required | Status |
|---|---|---|
| **Climate Change** | **CC2. Develop and apply climate and ocean change vulnerability assessments for MPA network design.**<br>Rationale: Climate and ocean change vulnerability assessments are required to assess the impacts of rising sea levels, rising sea temperatures, and changing ocean chemistry on coral reefs and associated ecosystems. Several assessments have been developed for the CT, particularly for rising sea levels and sea temperatures (e.g., Hoegh-Guldberg *et al.* 2009, McLeod *et al.* 2010a,b; Peñaflor *et al.* 2009). Such outputs may be incorporated into MPA network design (e.g., to identify and protect areas that are at low risk or *refugia*), if they are developed at appropriate geographic scales and resolution. At present, these assessments have produced outputs to inform MPA design at a broad scale (e.g., regional or ecoregional), but they are too coarse to inform designs at local scales. Patterns of thermal stress and changes in seawater carbonate chemistry can also be used to inform conservation management decisions. McLeod *et al.* (submitted) provide advice regarding which climate models are currently available to model climate change impacts for MPA network design and management, and which ones need to be modified (and how) to improve their utility in future. McLeod *et al.* (submitted) also provide advice regarding how to use these models for MPA network design. The following tasks are now required to develop and apply these models for MPA network design in the CT:<br>**a) Rising sea levels:**<br>Rationale: The vulnerability of coastal communities and ecosystems to sea-level rise depends on the magnitude and rate of sea-level rise, and the degree to which communities can modify or adapt to these changes (e.g., Hoegh-Guldberg *et al.* 2009, McLeod *et al.* 2010b). Coastal impact models and tools exist that can provide scenarios of flood risk for coastal communities and ecosystems which can be used for protected area network design and integrated coastal zone management. (McLeod *et al.* submitted). Case studies are required for developing and applying these models to MPA network design in the CT. One opportunity exists through the AusAID project in Manus (Appendix 6), which will develop a sea-level rise vulnerability assessment for the Province and use the results to inform the design of a ridges to reefs protected area design (see Papua New Guinea, USCTI Integration Sites).<br>Contacts: Lizzie McLeod, Alison Green, Eddie Game and James Hardcastle (TNC) and Carissa Klein (UQ EDG).<br>**b) Rising sea temperatures:**<br>Rational: The vulnerability of ecosystems to rising sea temperatures depends on current patterns of thermal stress (e.g., frequency and magnitude of thermal stress events, and thermal variability) and climate projections. Currently, climate models do not exist that provide this information at the appropriate scale and resolution to identify coral reef communities at high and low risk (*refugia*), which can be used for MPA network design (McLeod *et al.* submitted) in the CT. Therefore, research priorities for the future include:<br>• Develop fine resolution models that combine historical patterns of thermal stress with climate projections to identify and predict areas likely to experience lower heat stress. Currently 4 km is the finest resolution sea-surface temperature (SST) data available, which can be used to inform MPA network design at large scales (e.g., CT-wide: McLeod *et al.* 2010a; although 1 km SST data is available for some areas such as the Great Barrier Reef). Since 4 km SST satellite data are too coarse for discerning patterns of thermal stress and identifying refugia for MPA network design at local scales (i.e. < 16 $km^2$), fine resolution satellite SST data and downscaled climate models are required for the CT.<br>• Identify thermal *refugia* by combining downscaled climate projections with fine resolution (< 4 km) historical SST data to identify patterns of thermal stress and documented ecological responses by ecosystems (e.g., coral bleaching and recovery data). Since this will only be possible in areas where ecological responses have been documented, it is likely to be possible at a few sites only.<br>Contacts: Lizzie McLeod (TNC), Scott Heron (NOAA), Janice Lough (AIMS) and Jeff Maynard (Consultant). | In Progress.<br><br>Still Required. |

| Field | High Priority Science Required | Status |
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| **Climate Change** | **c) Ocean acidification:**<br>Rationale: Changing seawater carbonate chemistry (ocean acidification: OA) represents a serious and increasing threat to marine organisms, particularly calcifying organisms such as corals (Kleypas *et al.* 2006). Currently, models used for projecting patterns of ocean acidification (coupled carbon cycle) do not exist that provide the information required at the appropriate scale and resolution to identify areas at high and low risk (*refugia*) to OA, needed for MPA network design (McLeod *et al.* submitted). Existing coupled carbon cycle models typically range from 1 to 3 degrees spatial resolution, which is too coarse for assessing patterns at the scale needed to inform MPA network design. These models have a number of limitations including uncertainties associated with model projections; the models do not include coastal processes; or and they do not adequately capture the ecological complexity needed to predict ecosystem response. Model validation is also limited by sparse observational records of ocean carbon chemistry, particularly in coral-rich regions (e.g., Southeast Asia). Furthermore, significant variation in seawater carbon chemistry exists at fine scales (e.g., across habitats and individual reefs), which suggests that coarse resolution studies are of limited use for designing MPAs. Research priorities required to develop models that can be used for MPA network design include:<br>• Develop reef-scale models to assess patterns and predict changes in seawater carbonate chemistry;<br>• Improve knowledge of ecological and oceanographic factors that affect seawater carbonate chemistry and their potential to buffer coral reef communities to the effects of OA;<br>• Improve understanding of the differences in sensitivity of marine species to OA; and<br>• Combine high resolution coupled carbonate chemistry models which project changes in ocean chemistry (aragonite and pH) at ocean basin scales with reef-scale models (ecological and hydrodynamic models: Anthony *et al.* 2011, Kleypas *et al.* 2011) at key sites.<br>Contacts: Lizzie McLeod and Rod Salm (TNC) and Ken Anthony (AIMS). | Still Required. |

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# APPENDIX 1 NATIONAL AND SUBNATIONAL MARINE PROTECTED AREA NETWORK DESIGN DETAILS

## Philippines

Context

The Philippines stretches 2,000 km from north to south and consists of more than 7,000 islands, with a total coastline of 36,289 km (TNC *et al.* 2008). It comprises an estimated 9 percent of the global coral reef area (Spalding *et al.* 2001, Weeks *et al.* 2010). In 2008, it was estimated that more than 60 percent of the nation's total population of 89 million lives in the coastal zone, many of who depend directly on fish and other coastal and marine resources for their livelihoods (TNC *et al.* 2008). The annual economic benefits from the Philippines' coastal ecosystems are estimated at US$3.5 billion (White and Cruz-Trinidad 1998; World Bank 2005).

The Department of Environment and Natural Resources (DENR) and the Department of Agriculture's Bureau of Fisheries and Aquatic Resources (BFAR) are the national government agencies primarily responsible for planning, policies and evaluation for the Philippine marine environment (TNC *et al.* 2008). DENR is the agency responsible for MPAs through its Protected Area and Wildlife Bureau, and BFAR is focused on fisheries management and aquaculture (including closures for fisheries management).

Much of the management authority and implementation of MPAs has been decentralized to LGUs for areas that fall within their areas of jurisdiction (out to 15 km offshore). At the national scale, Republic Act 7586 also provides for the establishment and management of the National Integrated Protected Areas System (NIPAS). The NIPAS Act under the DENR has a mandate to designate and protect ecologically important areas of national significance that require national legal, technical and financial support that cannot be adequately planned and managed by LGUs. The existing 28 marine NIPAS sites cover approximately 1.5 million ha that include representative critical marine habitats and threatened species (primarily coral reef, mangrove and wetland areas). DENR is mandated to maintain and enhance its existing system of protected areas. Therefore, its primary focus is to support marine conservation nationwide by improving management practices and enforcement in the existing NIPAS areas, and supporting LGUs in their planning and implementation of MPAs. DENR provides technical and policy assistance in all national marine conservation planning efforts, in close association with major NGO partners and local governments, with the aim of building a national system of MPAs that achieves the objectives and spatial targets set by the Philippine Marine Sanctuary Strategy (Areco *et al.* 2004).

In the past, BFAR has played a lead role in establishing no-take fish sanctuaries[24] in all 15 regions of the Philippines. These areas are now declared and managed by the LGUs, and BFAR provides technical assistance for the sanctuaries (e.g., for monitoring). However, BFAR continues to be interested in the scientific design of fish sanctuaries to preserve fish stocks and populations of charismatic species such as whale sharks, manta rays and napoleon wrasse. The design of these areas is based on specific social and ecological criteria, including criteria for resilient MPA network design in important fisheries management areas (BFAR in prep). Examples of fish sanctuaries include: the Southern Luzon Island Manta Bowl, which was established to protect manta rays and whale sharks; sanctuaries for reef and offshore fisheries species (tuna and sardines) in the Mindanao area where resources have declined; and seasonal closures for rabbitfish spawning areas based on local knowledge (e.g., Leyte Island, Visayas).

BFAR's future interests include: a national scale MPA network design for fisheries in waters within municipal jurisdictions (within 15 km of land) and a better design of fisheries management units particularly in the Sulu Sea[25]. Boundary issues remain a concern in offshore areas (more than 15 km from land), particularly in transboundary areas such as the Sulu Sulawesi Seas. Although there are good examples of collaboration in international transboundary areas, such as the Turtle

[24] Protected water areas where fish are able to spawn, feed and grow undisturbed and where fishing and other activities are absolutely prohibited (BFAR in prep.). The objectives of these areas are: to maintain or preserve marine aquatic resources; to rehabilitate or restore depleted areas; and to support fish populations in adjacent areas where fishing is allowed.

[25] To consider incorporating a tuna spawning area south of Mindanao, and areas where juvenile tuna transit to the South China Sea.

Islands Heritage Protected Areas (see Sulu Sulawesi Marine Ecoregion), where BFAR, DENR, and local government officials cooperate with similar government agencies in Sabah, Malaysia.

In response to intense use and dependence on marine resources, over 1,000 MPAs have been designated at the local government level, and 28 MPAs have been designated at the national level (under the NIPAS Act), covering approximately 16,000 $km^2$ (TNC *et al.* 2008, Weeks *et al.* 2010). Most (95 percent) are small local government and/or community-based MPAs (at least 945 are less than 1 $km^2$ in size), which are managed by municipal and city governments through co-management arrangements and cover approximately 100,000 ha. Targets for MPA coverage in the Philippines are specified in the 1998 Fisheries Code, which calls for 15 percent of coastal municipal waters (within 15 km of the coast) to be protected within no-take MPAs. The Philippine Marine Sanctuary Strategy also aims to protect 10 percent of coral reef area in no-take MPAs by 2020 (Areco *et al.* 2004).

Most MPAs (at least 942) have a no-take component with a combined no take area of 1,459 $km^2$ (Weeks *et al.* 2009). At present 4.9 percent of coastal municipal waters are protected within MPAs, with 0.5 percent within no-take areas. An estimated 2.7 to 3.4 percent of coral reef area is also protected within no-take MPAs. Most (85 percent) of the no-take areas are within two large MPAs (968 $km^2$ in Tubbataha Reef Natural Park and 275 $km^2$ in Apo Reef Natural Park). In addition, most community and local government managed areas contain no-take areas surrounded by some form of managed fisheries areas (Arceo *et al.* 2008).

Most MPAs in the Philippines are established for fisheries management purposes (see BFAR above; Arceo *et al.* 2004, Russ and Alcala 2004, White *et al.* 2006a), and many studies have shown that while many of these MPAs are small (less than 1 $km^2$) they demonstrate both ecological and socioeconomic benefits. In particular, many empirical studies have demonstrated fisheries benefits of individual reserves in terms of increasing the density and biomass of target and non-target species within MPAs, and enhancing surrounding fisheries by spill over from the MPAs into adjacent fished areas (Russ 2002, Russ *et al.* 2004, Alcala *et al.* 2005, Abesamis *et al.* 2004, 2005, 2006).

The Fisheries Improved for Sustainable Harvest Project (2004-2010) also demonstrated how MPAs can contribute to fisheries management through an ecosystem based approach to fisheries management in four ecological and economically significant marine ecosystems[26]. The project's primary objective was to increase fish biomass by at least 10 percent over baselines of 2004 in these systems by addressing a variety of fisheries management issues, particularly those related to overfishing, illegal fishing, and habitat destruction combined with increased demand for fish and high population growth.

To achieve this, national and local activities were implemented to build capacity, improve the national policy framework, and develop an informed constituency for fisheries management. A key component of the project was to protect critical habitats, migration routes, and spawning areas by establishing and improving the management of MPA networks. The project achieved significant fisheries enhancement as documented by Armada *et al.* (2009) and FISH (2010).

Other studies have also demonstrated socioeconomic benefits of MPAs in terms of providing food and livelihood opportunities for local communities (Leisher *et al.* 2007, Samonte *et al.* 2007, White and Trinidad 1998). For example at Apo Island, the MPA has provided security for residents though better health and stronger community life due to improved fish catches and tourism revenue (Raymundo and White 2004; Leisher *et al.* 2007).

Fisheries benefits of MPAs rely on effective enforcement and compliance (Alcala and Russ 2006, Samoilys *et al.* 2007), and the same is likely to be true for conservation benefits (see below: Weeks *et al.* 2010). In the last few years, a marine protected area management effectiveness assessment tool was developed and applied to evaluate the management effectiveness of individual MPAs in the Philippines (White *et al.* 2006b; Philippine CTI Coordinating Committee 2011). The rating system is designed to aid MPA managers evaluate MPA performance in terms of management, implementation, and enforcement. Results show that management effectiveness continues to be a major challenge for many MPAs in the Philippines, although the situation appears to be improving (TNC *et al.* 2008; Maypa *et al.* submitted).

[26] Calamianes Islands, Northern Palawan; Danajon Bank, Bohol; Lanuza Bay, Surigao del Sur; and Tawi-Tawi in the Sulu Archipelago.

The need to accelerate efforts to reduce threats and improve effectiveness also provided the stimulus to forge a MPA Support Network, which seeks to contribute to achieving the goals of the Philippine Marine Sanctuary Strategy and to improve management effectiveness by providing training and workshops. A recent management effectiveness survey by the MPA Support Network found that around 20 to 30 percent of the 200 MPAs surveyed were rated as effective (based on the level of enforcement), compared to 10 to15 percent a decade ago (TNC *et al.* 2008). Incentives through MPA awards have also promoted good practices among MPA practitioners.

A recent study evaluated the effectiveness of existing MPAs for marine biodiversity conservation at a national scale (Weeks *et al.* 2010). A gap analysis assessed the extent to which biodiversity was represented within existing MPAs, based on marine bioregions, conservation priority areas, and marine corridors identified by the Philippine Biodiversity Conservation Priority-Setting Program (Ong *et al.* 2002). The study revealed that the current extent, distribution and size of MPAs are not adequate to represent the outstanding marine diversity of the Philippines (Weeks *et al.* 2010). While MPAs are well represented in the Visayan Sea, they are poorly represented in the Sulu Sea. Although the distances between existing MPAs appeared to ensure larval connectivity between them, providing opportunities to develop regional scale MPAs networks.

Recommendations for MPAs in the Philippines include strategically expanding the area of no-take MPAs to address both fisheries sustainability and biodiversity conservation (Weeks *et al.* 2010). This will require continuing efforts to increase the number and size of community-based MPAs and designating additional large no-take areas specifically to address conservation goals where socioeconomic constraints (e.g., high dependence of stakeholders on the resources) allow.

It is also important to continue to build the capacity of local government supported MPAs, and national agency managed MPAs, to improve management effectiveness and governance of individual sites (TNC *et al.* 2008). The Philippines has also recognized the important role of assisting NGOs through the MPA Support Network. This body includes non-government conservation and academic organizations, as well as national and local government agencies, which are recipients of capacity building efforts to improve their abilities in these efforts.

### National Marine Gap Analysis

As a signatory to CBD, the Philippines completed a national marine gap analysis to assess ecological gaps in their protected area network in 2009, and submitted it to the Association of Southeast Asian Nations (ASEAN) Center for Biodiversity (Alino *et al.* 2009). The gap analysis integrated the best available information and utilized existing targets as agreed at various nationwide consultations, such as those in the Philippine Fisheries Code (Republic Act 8550), the Philippine Marine Sanctuary Strategy, and initial agreed targets of the CTI. The report collates the extent to which species-specific information has been collected by experts, and the degree to which this information was used in the identification of marine key biodiversity areas and to select MPAs.

A few key results of the gap analysis include estimates of the area of critical habitats in the country, and the portion of critical habitats within marine key biodiversity areas protected within MPAs, including:

- Coral reef area in the country: 10,750 $km^2$ based on satellite images (DENR 1988); or 25,000 to 33,500 $km^2$ based on varying assumptions of maximum depth limits of where coral reefs can be found (Gomez *et al.* 1994).
- Mangrove area in the country: 1,569 $km^2$ based on satellite images (DENR 1988), which reflects the decrease in mangrove area since 1918 (from 4,000 to 5,000 $km^2$: Brown and Fischer 1920).
- Estimated areas in Philippine waters: 2,200,000 $km^2$ in EEZ; and 679,800 $km^2$ in Territorial Sea.
- MPAs cover about 7,566 $km^2$ nationally[27] and overlap with about two percent of marine key biodiversity areas, while marine key biodiversity areas cover about 421,203 $km^2$ in total cover (about 19 percent of the Philippines EEZ.)

Primary design and management gaps highlighted in the report include the need to:

- Address ecological gaps (e.g., land-sea interfaces and biodiverse areas);
- Improve MPA management effectiveness including addressing gaps in the evaluation of MPA data (e.g., boundaries, management jurisdictions);

[27] Another source of information indicates that total MPA area in the Philippines is ~16,163.5 $km^2$ (Maypa *et al.* in press).

- Refine strategic design targets;
- Integrate social-ecological systems and consideration of poverty cycles; and
- Address gaps in good governance and the capacity of the management groups.

Short term recommendations are to establish sustainable management mechanisms within each seascape or biogeographic region, and determine how local actions can lead to scaling up at the municipal (or provincial) level within Marine Key Biodiversity Areas. Other recommendations include:

- Embed adaptive ecosystem-based management (EBM) within a social reform agenda;
- Facilitate an enabling learning environment and empowered constituency;
- Advocate for institutionalization of good governance;
- Build capacity among stakeholders; and
- Develop ways to leverage funds to sustain management.

A major finding of the MPA gap analysis was that gaps still need to be addressed (e.g.,, identifying additional sites, species and habitat requirements to achieve representation of the range of marine biodiversity in the Philippines and region). An imperative for improving management effectiveness in the MPAs was also highlighted.

Establishment of a coherent ecological framework, linked to realistic management considerations, is the next step. An opportunity to take the gap analysis process forward was noted to exist through the CTI process at national and regional scales through the development of CT MPA System framework, which is evolving through a series of regional exchange workshops for the CT countries and partners (see Regional Coral Triangle Protected Area System).

## USCTI Integration Sites

The USCTI priority geographies and integration sites in the Philippines are (Table 1, Figure 2):

- Verde Island Passage (VIP: San Juan, Lubang/Looc and Calatagan Municipalities).
- Palawan Province (Dumaran, Taytay and Araceli Municipalities); and
- Tawi-Tawi Province (Languyan, Sitangkai and Sibutu Islands; Turtle Islands).

VIP was also selected as a learning site by the Philippines at the MPA regional exchange and workshop in Phuket (CTSP 2010a), and is the highest priority for technical support from CTSP.

Outcomes from meetings with the national government, NGOs, scientists and PEMSEA (see list of key contributors in Appendix 3) have confirmed that all of these sites remain a priority for integrating fisheries, biodiversity, and climate change objectives into MPA network design. Of these, priority sites for CTSP members include Verde Island Passage for CI, and Palawan and Tawi-Tawi Provinces for WWF. TNC does not work at the site level in the Philippines.

Details are provided for each site below, including opportunities for CTSP and others to provide technical support for MPA network design. If the Philippines would like CTSP to provide financial assistance for integrating fisheries, biodiversity, and climate change objectives into MPA network design at USCTI Integration Sites, this must be programmed in the country work plan under USAID Philippines. CTSP Regional (USAID Regional Development Mission for Asia) can also provide technical advice for integrating multiple objectives into MPA network design at Integration Sites, particularly at VIP, since that was the learning site selected by the Philippines.

Another site that may offer a good opportunity for learning how to integrate multiple objectives into MPA network design in future may be the Bohol Sea since: Silliman University and partners (ARC CoE) are developing a biophysical model of larval connectivity to inform MPA network design; and the ARC CoE is working with the Coastal Conservation and Education Foundation (a Cebu-based NGO) to develop an MPA network in Siqujior Province.

### Verde Island Passage

VIP (Figure 3) Marine Biodiversity Conservation Corridor is located in the Sulu Sea, within the Sulu-Sulawesi Seascape. It is bound in the north by the province of Batangas, in the south by Oriental and Occidental Mindoro, in the west by the Lubang Islands and the Luzon Sea and in the east by Tayabas Bay. The passage is about 100 km long and 20 km across at its

narrowest point (CI VIP Factsheet). The channel is relatively deep with maximum depth of about 1000 m along the northwest coast of Mindoro. The South China Sea and Pacific Ocean waters converge in the passage, bringing nutrients that sustain the diversity of marine life in the area (Villanoy, *et al.* 2007).

VIP comprises one of the most diverse marine areas in the world, which some regard as the centre of marine shorefish biodiversity (Carpenter and Springer 2005). It is also one of the richest fishing grounds and top tourist destinations in the Philippines (CI VIP Factsheet). It is also a critical marine corridor, which is of high ecological importance to rare and threatened species (marine mammals, sea turtles, manta rays, and whale sharks).

Unfortunately, the area is threatened by coastal infrastructure development, shipping, pollution, and destructive fishing (CI VIP Factsheet). Of particular concern are rare and threatened species, which are commonly caught accidentally as by-catch by fishermen using drift gill nets and purse seine nets. VIP is also a major sea lane with commercial and fishing vessels passing through to reach the international ports of Batangas, Manila, and Subic Bay. Climate change also represents a serious and increasing threat to coral reefs and associated ecosystems (Hoegh-Guldberg *et al.* 2009, McLeod *et al.* 2010a,b).

VIP was one of four MPA networks identified in the Sulu Sulawesi Planning Process (see Sulu Sulawesi Marine Ecoregion) for biodiversity protection. It is now a special management area (under five provinces) of approximately 1.14 million ha. However the MPA network objectives are more holistic, and include a focus on declining fisheries and consideration of climate change impacts.

Fishing is one of the major activities of coastal communities in VIP. There are thousands of registered fisherman and fishing crafts in the various coastal municipalities, as well as registered commercial fishing vessels. VIP is an important area for small pelagic (e.g., sardines, *Decapterus*), demersal and reef associated (e.g., jacks and fusiliers) fisheries. Consequently one of the primary objectives of the MPA network is to improve fisheries management, including establishing large fisheries management areas for small pelagic fisheries. However, the challenge of managing a sustainable fishing industry remains, as destructive fishing methods and unsustainable harvests are still reported in the area. There is also a relatively new deepwater (200 to 300 m deep) fishery for large squid, where fishers are using new gear (lights and floats). This seasonal fishery (during the NE Monsoon from November to May[28]), is currently unmanaged.

Local governments have an active role in establishing the MPA network, since most of VIP is located within their jurisdiction. A signature campaign supported by eight municipalities and one city indicated local stakeholder support for the establishment of a MPA network in the VIP (CI VIP Factsheet). These municipalities established the Batangas Province Bay Watch Network, which now conducts regular enforcement and patrols. Several active municipalities (Mabini and Tingloy) also initiated community-based MPAs in the early 1990's, and have developed a sustainable scuba diving industry because of the relatively high quality coral reefs in their area.

To assure a consistent commitment to the area, an Executive Order[29] was signed in 2006, which ensures that national government agencies (primarily DENR and BFAR) focus on the VIP project, but do not supersede the role of the local government. The Executive Order also recognizes CI-Philippines as a member of the Task Force that drafted the VIP Framework Plan, which defines the extent of the VIP corridor wherein 1.14 million ha of coasts and waters are appropriately managed. Under the framework plan, a group was organized and tasked to implement management activities in the passage.

CI has played a lead role in designing and implementing the VIP MPA Network by working with other NGO partners and local governments, guided by resilience principles for MPA network design (IUCN-WCPA 2008). Key ecological criteria applied to the MPA network design included (Quibilan *et al.* 2008): representation and replication of major habitat types (including coral reefs and mangrove areas); protecting critical habitats for rare and threatened species; and taking habitat condition and key threats into account.

[28] There is also a fishery for large squid off southern Cebu.
[29] Exec. Order No. 578.

Since 2005, the MPA design has been revised to take the results of a connectivity study of the Sulu Sea (including VIP) into account (Quibilan *et al.* 2008). The work comprised two components:

1. Scientific studies regarding connectivity of fishes in the Sulu Sea (including the VIP), at both large and small scales (including some bays and basins): Scientific research from local universities was commissioned to complete physical, chemical and biological oceanographic studies[30]. Results were used to develop a passive dispersal model of connectivity to show general current patterns in different seasons and to identify larval sources and sinks. Results showed that the primary flow through Verde Channel is from east to west.
2. Based on the results of these studies, CI worked with local governments to establish new MPAs to take connectivity into account in VIP: Maps were developed to show MPAs before and after the VIP was declared, and the existing configuration of MPAs in municipalities. The design was reviewed to determine the changes required to take new information on connectivity into account (to maximize connectivity among MPAs). This resulted in new MPAs being established in the east and west, including a new 9 km no-take area in the west.

Currently there are 69 MPAs in the VIP covering an area of ~17,000 ha. Most are small, although one is more than 1000 ha, and fisheries management areas are up to ~ 13,000 ha. The size and number of MPAs is increasing, with site selection guided by the results of the connectivity study. Three social networks have also been established to share ideas among networks: Batangas MPA network (36 MPAs); Oriental Mindoro Network (18 MPAs); and Occidental Mindoro (15 MPAs).

The current focus of the VIP project is to: conduct an independent evaluation of management effectiveness (using the system adopted by the MPA Support Network: White *et al.* 2006b); share the results with locals; and use the results to improve management. Areas of success include: establishing an enabling legal framework; providing social and political support; applying ecosystem based management (including MPAs); and providing adequate support in terms of institutions and capacity. This has led to a recovery of food fishes/target species in some MPAs (increased biomass), anecdotal evidence of increasing fish outside MPAs, and recovery of threatened species (particularly turtles). More detailed fisheries monitoring will be conducted in future, along with reef assessments.

Incorporating climate change into MPA planning in VIP is also being considered. A NOAA supported workshop initiated the process to: incorporate climate change into marine planning; develop a process to assess ecological and human vulnerability to climate change impacts; and start a project to incorporate climate change impacts and adaptation strategies for fisheries in the MPA strategy. In addition, efforts to discuss fisheries management areas with fishers, including the idea of a resilient MPA network using IUCN WCPA (2008) principles as the basis for the discussion, was initiated.

A Hearst Expedition[31] to survey marine diversity in the VIP was also completed in 2011. Knowledge gained from the study will be used to further educate the public and decision makers to inform public policy and individual choices regarding conservation and development.

The VIP is a high priority for technical support from CTSP because it is an important area for biodiversity conservation, tourism, and fisheries (including offshore commercial fisheries), and it was identified as a USCTI integration and learning site by the Philippines. It also offers an excellent opportunity to develop a demonstration site for integrating fisheries, biodiversity, and climate change objectives into MPA network design. Opportunities for CTSP to provide support for resilient MPA network design in the VIP include providing technical support for:

- Integrating fisheries, biodiversity, and climate change objectives into MPA network design, including conducting a gap analysis to determine how well the network complies with ecological and socioeconomic[32] principles for MPA network design;
- Demonstrating ecological and socioeconomic benefits of MPAs to LGUs and communities;
- Developing and applying fisheries models using oceanographic data, and using results for MPA network design;
- Determining how to use climate change vulnerability assessments for MPA design;

[30] Including studies of: fish larvae distribution and dispersal patterns (based on simulations to derive information on major currents); simulations/validations of physical oceanography; and biological oceanography showing areas of high plankton concentrations.
[31] http://www.calacademy.org/science/hearst/
[32] Particularly regarding food security and ecosystems services (for fisheries and tourism).

- Identifying and incorporating fish spawning aggregation sites in the design;
- Developing indicators for measuring success against MPA network objectives;
- Fisheries management for small pelagic fishes and squid fisheries (linked to EAFM group); and
- Identifying how to achieve effective enforcement, political support, and sustainable financing for the MPA network.

If financial support is required from CTSP for these tasks, this would need to be included in the Philippines USAID work plan. However, technical advice may be provided without additional funding (if required).

There may also be an opportunity for CI to collaborate with PEMSEA (Appendix 6) to use the Integrated Coastal Management (ICM: see Glossary) plan for Batangas Bay (PEMSEA 2006) to inform marine planning in the VIP.

Palawan Province (Dumaran, Taytay and Araceli Municipalities)

WWF is the only CTSP member currently working in Palawan Province. Since this area is the source of live reef food fish trade in the Philippines, and stocks are either under threat or already depleted, WWF's current focus is working with local partners to manage the grouper fishery. Since local communities have not responded well to the existing fisheries quotas in this area, no-take MPAs tend to be more successful for protecting critical areas, particularly fish spawning aggregation sites.

The current objective of the proposed MPA network in Dumaran, Taytay and Araceli municipalities (with CTSP support) is to protect fish spawning aggregation sites in locally managed MPAs. The first MPA is in Taytay, where spawning aggregations have been identified and are in the process of being protected. This effort has been expanded to the other two municipalities. Technical support for identifying and protecting fish spawning aggregation sites is provided by the Society for the Protection of Fish Spawning Aggregations[33])

To date, less than 100 ha are in no-take MPAs at these three sites. However, the live reef food fish trade in these municipalities is primarily focused on growing juveniles for export, and there is not much fishing for adults since fish sanctuaries are in place to protect key fish spawning aggregation sites. There is some fishing outside of these areas, although pressure is not high.

Since the proposed MPA network is currently focused on protecting fish spawning aggregation sites and not other objectives, a broader MPA network design may be necessary (after the MPA network has been established to protect fish spawning aggregation sites). When designed, the MPA network will need to consider fisheries management outside of no-take areas within a broader EBM approach, based on lessons learned from the Fisheries Improved for Sustainable Harvest Project. The proposed MPA network will also need to respond to requests for assistance by local municipalities regarding adaptation to climate change, based on experience in other areas.

Tawi-Tawi Province (Languyan, Sitangkai and Sibutu Islands; and Turtle Islands)

The islands of Tawi-Tawi are near the center of the SSME and at the interface of the Celebes and Sulu Seas, providing an essential ecological link within the ecoregion. Thus they represent an important area for protection within MPA networks in the area. Since 2004, work in Tawi-Tawi has focused on identifying priority sites for establishing MPAs to protect important coral reef sites, which can simultaneously enhance nearshore fisheries for communities.

Several MPA network design processes have occurred in the Province, including:

- Developing a framework for a network of MPAs in the SSME (Miclat 2008: see Sulu Sulawesi Marine Ecoregion); and
- Developing a draft design of a network of protected areas to safeguard marine turtles in the Sulu Sulawesi Sea (Pitcher 2008).

CTSP is providing technical support for MPA network design in the SSME (see Transboundary MPA Networks).
The Fisheries Improved for Sustainable Harvest project also worked in Tawi-Tawi from 2004 to 2010 to build capacity among communities and local governments. Presently CTSP supports continued capacity building in the area for both coral reef conservation for fisheries, and the protection of sea turtle nesting sites.

[33] http://www.scrfa.org/

## Malaysia (Sabah)

### Context

Malaysia contains two separate and distinct marine ecoregions, Peninsular Malaysia comprises one, and the two states of Sarawak and Sabah in Borneo the other. The eastern shoreline of Peninsular Malaysia is dominated by sandy beaches that host sea turtle nesting sites, as well as numerous small, high islands that are mostly declared marine parks. Western Peninsular Malaysia is dominated by low-lying wetland and mangrove areas and few small islands with coral habitat. Sarawak and Sabah, in the center of the Sulu Sulawesi Marine Ecosystem (see Transboundary MPA Networks) host the majority of diversity and abundance of marine ecosystems and species in Malaysia, with wide shallow coral reefs, seagrass beds and mangroves in many areas, and some of the highest recorded marine diversity in the CT.

Malaysia is a sparsely populated country, with 28.8 million people in 2011. With a population growth rate of 1.58 percent and a median age of 26.8 years, it has the slowest growth and oldest population among the CT countries. The Malaysian government considers natural resource areas, especially coral reefs, beneficial for tourism development. This presents both an opportunity for sustainable protection as well as a threat in some areas from coastal resort development. For example, some of the most pristine and interesting dive sites in the world occur in Sabah waters (e.g., Sipidan and Semporna).

The largest threat to marine resources in Sabah is destructive and overfishing. A priority strategy to minimize these impacts is to set aside critical areas in no-fishing zones and to implement fisheries regulations in the wider areas.

The MPA system in Malaysia is well developed, with MPAs in most areas of the country. In 1994, the total number of islands included in the marine park system of federal Malaysia increased to 38 from 22 in 1985 (DMPM 2008). Currently, 42 MPAs are managed by the Department of Marine Parks, Malaysia. The mandate for establishing federal marine parks is under the legislation of the Fisheries Act 1985 (BMRI 2009).

In Sabah, four MPAs (Turtle Island Park, Tundu Abdul Rahman Park, Pulau Tiga Park, and Tun Sakaran Marine Park) are managed by Sabah Parks; the Suguds Island Marine Conservation Area is privately managed. In Sarawak, there are five national parks that primarily conserve coral reefs and marine life. In Sabah, all MPAs contain a small portion of the shoreline. Other MPAs have been established as bird sanctuaries and mangrove forest reserves. Proposed MPAs in various stages of development and planning include: Tun Mustapha Park (TMP: see below) and Sipadan Island in Sabah, Layang Layan in the Spratly Islands, and Luconia submerged reefs in Sarawak.

Although Malaysia has an array of well managed MPAs throughout the country, gaps still exist in coverage of critical areas as noted in the MPA gap analysis (BMRI 2009: see below). One habitat that is underrepresented is seagrass beds in Sabah and Sarawak. Certain threatened species are also not fully represented. Furthermore, MPAs in Malaysia have not been located to form an ecological network. Thus an opportunity exists to design a MPA network that incorporates fisheries management concerns as well as climate change factors in Sabah, based on the foundation of established MPAs.

### National Marine Gap Analysis

As a signatory to CBD, Malaysia completed a national marine gap analysis in 2009 (BMRI 2009)[34], and submitted it to the ASEAN Center for Biodiversity. The analysis collates the extent to which species-specific information has been collected by experts, and the degree to which this information has been used to identify marine key biodiversity areas and to select MPAs. The analysis also attempts to analyze ecological and management gaps, based on the information obtained from agencies that participated in the gap analysis workshop.

The information on Malaysia's marine ecosystem is extensive, and the country's MPA system is relatively well developed. For example, all of the reported MPAs and marine parks have known sizes. This information helps estimate the total area to

[34] The Ministry of Natural Resources and Environment is the National Secretariat for CBD, through the Undersecretary of Conservation and Environment Management Divisioni n the Ministry. The marine gap analysis was done in coordination with the Department of Marine Parks, Malaysia under the direction of Dr. Sukarno Wagiman.

target for protection. Despite having over 524,965 ha of marine parks for coral reefs and 689,067 ha of mangrove reserves established, there is still a gap in protecting seagrass habitats. A lack of information and understanding of species diversity is also evident, particularly for species such as marine mammals, whale sharks and sea turtles. Consequently, little emphasis has been given to the protection of large migratory or highly mobile species. There are also scale mismatches between the geopolitical scale at which a resource or species is managed, and the biological scale at which it functions. Thus in the future, more emphasis should be on establishing larger MPAs.

The Malaysian process of prioritization has achieved considerable headway based on broad conservation targets (e.g., considerable areas of coral reef and mangrove habitat are already under good management). This is due to strong integrated support from both federal and state governments. However, grassroot and local participation is identified as a gap. Other management gaps include:

- Insufficient funding;
- Insufficient biodiversity inventories in marine parks and threat classifications of species;
- Lack of adequate management guidelines;
- Lack of NGO and community involvement in MPA management;
- Need for regional management of certain migratory species;
- Lack of critical self-evaluation of management plans;
- Enforcement problems;
- Overlapping jurisdiction of legislation between state and federal governments; and
- Cross-border issues with marine parks located near international borders.

Next steps are to identify and/or refine targets for biodiversity conservation. This will require conducting a comprehensive literature review on the biodiversity and marine habitats in Malaysia, compiling an inventory of biodiversity in existing marine protected areas, and identifying keystone species, threats to these species and their critical habitats. There should also be: a review and harmonization of overlapping legislation between state and federal government in relation to the conservation of species identified in the inventory; a review of MPA management plans and their effectiveness; and a push to gazette proposed key biodiversity areas and identify new key biodiversity areas. Lastly, the impacts of climate change must be included in the future planning and management to build a resilient network of MPAs.

The USCTI assistance to Malaysia through the CTSP and WWF Malaysia in Sabah is providing targeted assistance in the planning and development of TMP, and to some degree for Sabah coastal waters overall (see below). CTSP is also providing technical support for refining the marine gap analysis by addressing data deficiencies by collating high priority information through the CT Atlas, and providing technical support for high priority science including developing a more detailed connectivity model at multiple scales in the CT (see Addressing High Priority Science Needs).

## USCTI Integration Sites

The USCTI Integration Sites for Malaysia (Sabah) are TMP, and Sabah coastal waters (Table 1, Figure 2). At the MPA regional exchange workshop in 2010 (CTSP 2010a), national government representatives also selected TMP as a learning site for designing and operating MPA networks in Malaysia (see The Regional Coral Triangle Marine Protected Area System).

Recent discussions with Malaysian officials and implementation partners (primarily WWF Malaysia: Appendix 3) also confirm that the highest priority for technical assistance for resilient MPA network design in Sabah is the proposed TMP, and there are no current plans to develop a MPA network design for Sabah Coastal Waters (which would include all of Sabah's MPAs). Therefore, this report focuses on TMP.

### Tun Mustapha Park

In 2003, the Sabah Government approved the intention to gazette TMP (Figure 4), which will be the largest MPA (1.02 million ha) in Malaysia. TMP will also be the country's first MPA to include a comprehensive and resilient zoning plan.

The zoning process for the proposed park is currently underway led by the TMP Interim Steering Committee's working group for zoning[35]. The working group is supported by a secretariat housed within the Sabah Park's office.

One CTSP partner, WWF-Malaysia, is providing technical support for the proposed TMP by supporting the establishment of a management mechanism for the Park, gathering key biological and socioeconomic data required for the zoning process, and providing technical support for developing a draft zoning plan using marine reserve design software (Jumin *et al.* 2011). Once a draft zoning plan has been completed (early to mid-2012), WWF Malaysia will also assist with a consultation process to provide stakeholders with an opportunity to provide input into the draft plan, facilitate a transparent zoning process, and build support for gazetting the Park.

WWF Malaysia requires technical assistance to help Sabah Parks complete a draft zoning plan for TMP. This is a high priority for technical support from CTSP because:

- TMP is the highest priority USCI Integration Site for in Malaysia.
- The zoning process is well underway, with strong support from key stakeholders (including state and district governments).
- The Kudat-Banggi Priority Conservation Area, which includes the proposed Park, has been identified as a globally significant priority area in the SSME, due to its high biodiversity and rich natural resources (WWF 2004).
- The area is home to more than 80,000 coastal dwellers that depend on healthy marine resources for their livelihoods (Jumin *et al.* 2011). Due to the large number of people living within the proposed park (and the diverse economic activities they are involved in), TMP will be established as a multiple-use park with different zones for different purposes (preservation (no-take) zones, community managed areas, and general use zones). Where the objectives of the Park include: a) sustainable use of resources, and b) protection of biodiver*sity* (Jumin *et al.* 2001).
- *Sci*entists from the UQ EDG are providing technical support for developing the zoning plan using marine reserve design software (Marzone[36]), who are leaders in this field.

Thus TMP provides an excellent opportunity to develop a demonstration site for integrating fisheries, biodiversity, and climate change objectives into MPA network design in the CT.

Recently, CTSP provided technical support *f*or developing a draft zoning plan for TMP by providing:

- Financial support to increase the GIS and spatial planning capacity of WWF Malaysia to process and prepare data for the Marzone analysis.
- Financial support for technical staff from WWF-Malaysia and Sabah Parks to attend a workshop in Australia (January 2012) where scientists from the UQ EDG (Appendix 5) provided technical assistance to develop a draft zoning plan for the Park using Marzone.
- Technical advice regarding integrating fisheries, biodiversity, and climate change objectives into the draft zoning plan (based on Fernandes *et al.* 2012).

UQEDG and CTSP will continue to provide technical support for the zoning process until it is completed in 2012.

## Indonesia

### Context

Indonesia is the world's largest archipelago, with more than 17,000 islands[37], 81,000 km of coastline, 3.2 million km$^2$ of ocean and 86,700 km of coral reefs (Huffard *et al.* 2009, IMACS 2011). The archipelago comprises about one fifth of the world's coral reefs (UNEP/WCMC 2008).

Indonesia's fisheries play an important role in national food security, since fishery products are generally consumed by poor households and other social communities (FAO 2009). Approximately 237 million people live in Indonesia (CIA 2008) of

[35] Members include Sabah Parks, Sabah Fisheries Department, Forestry Department, Town and Regional Planning Department, Land & Survey Department, Sabah Museum, three district offices of Kudat, Kota Marudu and Pitas and other departments.
[36] Marxan with zones http://www.uq.edu.au/marxan/index.html?page=77640&p=1.1.2.1
[37] This commonly quoted number of "islands" includes approximately 3534 islets and rocks so that there are 13,466 full "islands".

which up to 154 million (65 percent: Dahuri, 1999) live in coastal communities and rely on coral reef fisheries for their livelihoods (Cesar 1996). Presently about 70 percent of the country's protein sources come from fish (in some poor coastal communities this figure approaches 90 percent), while nearly 20 percent of the country's Gross Domestic Product is derived from fisheries and other marine related industries (Huffard *et al.* 2009, IMACS 2011)[38].

Coral reefs also provide the basis for coastal protection, marine tourism and biodiversity (Cesar 1997, CI 2008), and their annual economic benefits have been estimated at US$1.6 billion per year (Burke *et al.* 2002). Health, nutrition, food security, economic growth, and community welfare in Indonesia all depend upon sustainable use of these marine resources (IMACS 2011).

The coral reefs of Indonesia, and the ecosystem services they provide, are threatened by a variety of direct and indirect anthropogenic threats (Burke *et al.* 2011). Of immediate concern are threats to ecosystem health from overexploitation of marine resources, destructive fishing practices, coastal development, and runoff from poor land use practices (Burke *et al.* 2011). Climate change also represents a serious and increasing threat to coral reefs and associated ecosystems (Hoegh-Guldberg *et al.* 2009, McLeod *et al.* 2010a,b, Burke *et al.* 2011). The diversity, frequency, and scale of these threats have increased to the extent that many coral reefs have already suffered severe, long-term declines in their diversity, habitat structure and abundance of key species (Burke *et al.* 2011). Consequently Indonesia's reefs are among the most threatened in the world (Burke *et al.* 2011), and urgent action is required to halt or reverse these declines in coral reef health.

MPAs can reduce threats and create enabling conditions for sustainable industries such as tourism, sustainable fisheries, and aquaculture (Wilson *et al.* 2011). For example, well designed and managed MPAs are a critical component of fisheries management, since they function as reserves to enhance fish populations and productivity (IMACS 2011). An effective MPA system can also protect ecosystems and habitats most important to the health of the fishing sector (e.g., fish spawning aggregation sites: IMACS 2011).

An important aspect of MPA design and implementation in Indonesia is to conserve coral reefs and coastal habitats, not only for their biodiversity values, but also to support sustainable resource use for the benefit of local people (Wilson *et al.* 2011). In Indonesia, local people rely heavily on fishery resources as a source of daily protein and cash income (Wilson *et al.* 2011). Therefore it is important that MPAs accommodate sustainable fisheries for local communities and support increased fisheries productivity by improving or maintaining healthy, diverse coastal ecosystems.

The Ministry of Marine Affairs and Fisheries (MMAF) has institutional oversight of marine resources in Indonesia (Huffard *et al.* 2009). This includes ensuring that marine resources are used sustainably, while also increasing the value of the marine and fishery sector with the ultimate goal of increasing the quality of life for all Indonesian citizens. MMAF has increasingly sought to achieve these objectives by including MPAs as a key tool in its national fisheries and biodiversity management plans.

The Government of Indonesia has also demonstrated its commitment to establishing a regional network of MPAs through its leadership in the CTI. In 2008, Indonesia fulfilled its commitment to the CBD's Program of Work on Protected Areas to create 10 million hectares of MPAs by 2010, with the declaration of the 3.5 million hectare Savu Sea Marine National Park (Numberi 2009). The Government of Indonesia has also committed to establishing 20 million hectares of MPAs by 2020 (Yudhoyono, 2009).

In Indonesia, MPAs can be established by national, provincial and/or district governments under either Law 31/2004 (fisheries) or Law 27/2007 (spatial planning: Wilson *et al.* 2011). These laws allow for multiple uses within the MPA through the application of zoning and management plans, where zones include no go, no-take, and sustainable use zones. Community-based MPAs are also established by coastal communities in some areas (Glaser *et al.* 2010). Of the current total of 13.9 million ha of MPAs in Indonesia, 5.4 million ha are currently managed under the Indonesia Ministry of Forestry, and

[38] In 2008, Indonesia's fisheries accounted for $2.6 billion in exports with the catch composed primarily of tuna (17%), other marine fishes (70% including reef fishes), shrimp (6%) and other aquatic organisms (7%: IMACS 2011)

8.5 million ha are managed by the MMAF, local governments and communities (MPAG 2011). This distribution will change as more MPAs are transferred to MMAF jurisdiction, and more local MPAs are established.

An issue of major concern actively recognized by the Government of Indonesia and partners is the need to improve the management effectiveness of existing declared MPAs. In response to this need, the MMAF, in partnership with the Ministry of Forestry, has endorsed a MPA management effectiveness monitoring system for MPAs throughout Indonesia (Carter *et al.* 2011). This system was tested in three national MPAs prior to its finalization and publication in 2011. It is now being conducted in selected MPAs with the intent of addressing internal management gaps in enforcement and overall effectiveness more aggressively than in the past.

## National Marine Gap Analysis

As a signatory to CBD, Indonesia has completed an initial national gap analysis to assess ecological gaps in their protected area network (MF/MMAF 2010). The marine gap analysis includes several key results regarding the marine environment:

- The Government of Indonesia has set a target for marine conservation of 20 million ha by 2020, with the current area under legal protection at 13.9 million ha.
- A survey of critical habitats nationwide in relation to legally declared protected areas shows that 22 percent of coral reefs, 22 percent of mangrove and 18 percent of seagrass beds fall within MPAs of one type or another.
- Targets for critical habitat protection that surpass 30 percent of the area within each ecoregion have been achieved in at least 3 out of 12 ecoregions for the primary habitats of coral reef, mangrove and seagrasses.
- Approximately 50 percent of prime nesting habitats for sea turtles fall within protected areas, and about 45 percent of prime dugong habitat is protected.
- Large portions of the legally declared MPAs are not effectively protected or managed so that the actual protection of critical habitats is much less than the area of legally declared MPAs.
- The Halmahera region of northern Indonesia is underrepresented in currently established MPAs, where almost no critical habitat is protected.

However since the national gap analysis focuses more on the terrestrial environment, further refinements are required to complete a full marine gap analysis for Indonesia. There are two processes underway aimed at completing a national marine gap analysis: designing an ecologically connected national system of MPAs and designing a national system of MPAs incrementally based on political boundaries. Both of these processes are described below.

CTSP is providing technical support for both of these processes through the following projects:

- Addressing data deficiencies by collating high priority information through the CT Atlas; and
- Providing technical support for high priority science (see Addressing High Priority Science Needs) including: developing a more detailed connectivity model at multiple scales for the CT; and developing scientific methods for integrating fisheries, biodiversity, and climate change objectives into MPA network design.

### Designing an Ecologically Connected National System of MPAs

The USAID supported Marine Protected Area Governance Project (MPAG) has identified an opportunity to provide support for building a national system of MPAs in Indonesia, based on MMAF's interest in adopting a network approach to MPAs (MPAG 2001). This will require accounting for ecological patterns of connectivity among MPAs/MPA networks (MPAG 2011), which will allow for the development of a national system of MPAs/MPA networks that transcends district and provincial borders. MPAG plans to provide support to MMAF to expand this approach, as feasible.

A National MPA system would require many components, including a marine spatial plan that incorporates best available scientific information, locally and nationally integrated laws and regulations, reliable data, and information for decision-making, sustainable financing, and capacity development for management competency (MPAG 2011). This is a relatively new approach in Indonesia, and guidelines for the establishment and legal process at the local and national level are yet to be developed. Lessons learned from national conservation prioritizations and establishing subnational MPA networks (e.g., in the Bird's Head Seascape) will be used for establishing and institutionalizing the MPA network concept in Indonesia.

The agreement to highlight scientific inputs also presents an opportunity to use systematic conservation planning to prioritize geographies at a national scale, based on principles of irreplaceably, vulnerability and representativeness (MPAG 2011). This approach can provide a framework to ensure the marine spatial planning process is inclusive, evidence-based and effective.

MPAG is planning to help MMAF work towards developing a sustainable National MPA System by: developing MPA policies, regulations, and guidelines; strengthening national and local capacity for sustainable MPA management; developing decision support systems; integrating MPAs into an EAFM and marine spatial planning; and developing sustainable finance mechanisms.

Designing a National System of MPAs Incrementally Based on Political Boundaries

The second process is to develop a national system of MPAs incrementally (Province by Province), based on prioritizations of geographic areas for marine biodiversity conservation. The first comprehensive conservation prioritization of Indonesia's marine resources was the Indonesia Marine Conservation Data Atlas (Salm and Halim 1984), which categorized 179 sites and provided recommendations to guide the development of a national MPA system in Indonesia. This analysis provided a blueprint for marine conservation in Indonesia for three decades. In 1989, Djohani refined Salm and Halim's (1984) prioritization to focus on 17 sites for immediate conservation investment.

In 2009, the assessment was revised (Huffard *et al.* 2009)[39] to provide guidance on marine biodiversity conservation priorities required to design an effective and representative national system of MPAs/MPA networks. The study was based on the 12 Indonesian marine ecoregions defined in the Marine Ecoregions of the World (Spalding *et al.* 2007), and used expert opinion to prioritize ecoregions for conservation and identify priority areas that lack MPA coverage. Results include:

- Marine ecoregions (in order of conservation priority) are: Papua, Banda Sea, Lesser Sundas, Sulawesi Sea/Makassar Strait, Halmahera, Palawan/ North Borneo, West Sumatra, Southeast Sulawesi/Tomini Bay, Sunda Shelf/Java Sea, Arafura Sea, South Java, and Malacca Strait.
- A comparison of the priority ranking of ecoregions with current MPA coverage, identified several important gaps in MPA coverage that should be considered top priorities for new MPAs including (in order of priority): Halmahera, Western Sumatra, Sulawesi Sea/Makassar Strait, Papua, Arafura Sea, Lesser Sundas and Banda Sea.

The results of this study are being used to help the government achieve their goals. For example MMAF have used the results to direct their focus on where to establish new MPAs to achieve their target of 20 million ha of MPAs by 2020.

Marine spatial planning is also being done incrementally (Province by Province) in the priority geographies (generally supported by CTSP partners). Marine spatial plans have been completed by five of the eleven provinces (East Java, Jambi, North Maluku, Maluku and West Nusa Tenggara), although they have not yet been legalized and decreed (T. Gunawan pers. comm.**)**. In addition, zoning plans are being finalized for a regency in Papua Province (Raja Ampat: Grantham and Possingham 2010, Grantham *et al.* submitted), and an MPA network design has been completed for the Lesser Sunda Ecoregion that includes three provinces (Bali, West Nusa Tenggara and East Nusa Tengarra: Wilson *et al.* 2011).

While good progress has been made using this approach, provincial boundaries do not necessarily represent ecological boundaries, so there's a need to collaborate among provinces in some cases (e.g., the Lesser Sunda Ecoregion: Wilson et al 2011). Therefore, it is important that marine spatial planning is informed by information regarding ecological patterns of connectivity (e.g., genetic studies) within and across provincial boundaries (see Huffard *et al.* 2009).

## USCTI Integration Sites

Since USAID Indonesia will continue MPA work under MPAG (2011)[15], they are not restricted to supporting the USCTI integration sites: Savu Sea Marine National Park and Sulawesi Tengarra Province (including Wakatobi Marine National Park: see Table 1, Figure 2). However an excellent opportunity exists for CTSP to work with governments, MPAG, and partners

[39] Regarding biogeography; species richness; endemism; population genetics, significant aggregations of or essential habitats for globally threatened or restricted range species; unique areas (including the presence of rare species or unique habitats); and other important consideration such as unique ecosystem services provided, vulnerability and/or resilience to climate change, and conservation opportunities.

to develop a demonstration site for integrating multiple objectives into MPA network design for the Savu Sea Marine National Park, and also for the Bali MPA Network (as described below). Although where possible, USAID financial support for sites should be in collaboration with the Indonesia Marine and Climate Support Project (IMACS 2011) demonstration areas described below.

Savu Sea Marine National Park

Encircled by chains of islands, the Savu Sea lies within the heart of the Lesser Sunda Ecoregion (see Transboundary MPA Networks: Wilson *et al.* 2011). Since this area lies at the intersection of the Pacific and Indian Oceans, it experiences dynamic oceanographic conditions including upwellings and the exceptionally strong currents of the Indonesian Throughflow (Setasih *et al.* 2010, Wilson *et al.* 2011). The area also comprises both shallow and deep-sea habitats, which support diverse and highly productive reef and pelagic biota (DeVantier *et al.* 2008, Setasih *et al.* 2010), as well as critical habitats for rare and threatened species (including cetaceans, sea turtles, and other marine megafauna: Kahn 2008, 2009, Setasih *et al.* 2010, Wilson *et al.* 2011).

The rich waters of the Savu Sea are also the primary source of food and resources for the millions of people living in the area (Numberi 2009), since these waters support abundant fisheries that provide the foundation of local livelihoods and economies (Setasih *et al.* 2010). Marine tourism is also growing rapidly (Setasih *et al.* 2010). Consequently, about 78 percent of the population is dependent on natural resources for their income, particularly fisheries (see Setasih *et al.* 2010).

Unfortunately, demands from the world's fish market, in tandem with growing populations in the coastal communities, has resulted in unsustainable fishery harvests, illegal fishing and bycatch of marine mammals and turtles[40]. Destructive fishing practices, like dynamite and cyanide fishing, also occur along with other localized threats including pollution from marine debris, runoff from poor land use practices, loss of habitat through coastal development, and threats from shipping in the area (Setasih *et al.* 2010, TNC 2010). These threats are causing serious damage to marine systems and coastal habitats.

Climate change also represents a serious and increasing threat to coral reefs of the Savu Sea (Hoegh-Guldberg *et al.* 2009, McLeod *et al.* 2010a, Burke *et al.* 2011). While this area may be less susceptible to the threat of rising sea temperatures than others in the CT (McLeod *et al.* 2009, Hoegh-Guldberg *et al.* 2009), some impacts due to rising sea temperatures, rising sea level, and ocean acidification are inevitable (Setasih *et al.* 2010; Hoegh-Guldberg *et al.* 2009).

In response to these growing threats, and the global importance of the Savu Sea, MMAF declared Savu Sea Marine National Park (SSMNP: Figure 5) in Nusa Tenggara Timur Province in 2009 (Numberi 2009). The SSMNP covers 151 coastal villages in two MPAs[41] and 28 sub-districts. Encompassing an area of 3.5 million hectares, the SSMNP is the largest marine protected area in the CT. In 2009, the government also declared the Alor District Conservation Area in the Savu Sea, which encompasses 400,008 ha around Pantat and Alor (TNC 2010). Currently it does not include the areas around Solor and Lembata (TNC 2010) where whales are harvested by villagers from Lamalera in Lembata (Kahn 2009, Setasih *et al.* 2010). WWF is currently working with local and regional governments to support MPA development and sustainable economic development in the Alor-Solor Seas[42].

If managed well, the SSMNP has the capacity to support sustainable fisheries and ensure food security of local communities (Numberi 2009). Thus the provincial government is looking to use the MPA as the foundation for the province's economic development through sustainable fisheries and marine-based tourism, international shipping, science and learning activities, transboundary cooperation, and coastal zone management.

Even though the SSMNP has been declared, the MPA 20 year management plan still needs to be developed. The management plan must include a multiple objective zoning plan that shows areas of importance for conservation values (e.g., coral reefs, cetaceans, tourism), balanced with the socioeconomic needs of local communities and other key stakeholders. When the management plan has been gazetted, park staff and planners will focus on zoning the areas of importance, which

[40] http://www.nature.org/ourinitiatives/regions/asiaandthepacific/indonesia/placesweprotect/savu-sea.xml
[41] Sumba Strait Marine Area and surroundings (567,170 ha) and Tirosa-Batek Marine Area and surroundings (2.95 million ha).
[42] http://www.worldwildlife.org/what/wherewework/coraltriangle/marineprotectedareas.html

can be completed within the five year management plan. Identifying the areas of importance and zoning these areas, will build on the results of the Lesser Sunda Ecoregion MPA design, which included SSMNP (see Transboundary MPA Networks: Wilson *et al.* 2011). However since the Lesser Sunda Ecoregion MPA design was a broad scale analysis, zoning the areas of importance in SSMNP will require refining and ground-truthing key data layers at a finer scale (e.g., showing the location of important fishing grounds, and the location and condition of coral reefs etc).

Zoning SSMNP will require integrating fisheries, biodiversity, and climate change objectives into the zoning plans. Of particular importance will be maximizing the contribution of MPAs to fisheries management, by identifying and protecting areas that are important to fisheries production. Thus the SSMNP provides an excellent opportunity to establish a demonstration site for integrating multiple objectives into MPA network design in Indonesia. However, since the SSMNP is so large, the best option may be to develop a demonstration site within one of the areas of importance. Rote Island may provide a good opportunity to develop a demonstration site in the SSMNP because:

- There is a diverse range of shallow and deepwater habitats, including important habitats for rare and threatened species (including cetaceans: Wilson *et al.* 2011). A preliminary assessment has also indicated that many of the coral reefs appear to be in good condition (J. Wilson pers. comm.).
- There is a diverse range of uses. The area has good tourism potential, but there are fishing issues that need to be addressed. There is also good potential to integrate the MPA network design with other strategies for fisheries management, including the potential for collaboration with the Lesser Sunda Sustainable Fisheries Project[43].

MPAG (2011) will provide support for specific site-based activities in SSMNP through 2014 that will reinforce MPA establishment, operations, and management effectiveness. By the end of the project, it is anticipated that the SSMNP will be formally managed by a collaborative management body led by MMAF (MPAG 2011). MPAG will also provide support for developing zoning plans (including 30 percent of critical habitats in no take zones) to be aligned with national, provincial and district spatial plans, and will ensure that sustainable fisheries plans and sustainable financing schemes are in place.

For USAID to provide financial support for MPA network design in Savu Sea, it will need to be included in the MPAG agreement. TNC is also considering allocating funding to develop a demonstration site for integrating fisheries, biodiversity, and climate change objectives into MPA network design at Rote Island in 2013. If that proceeds, CTSP may be able to provide technical advice for this process based on design principles for integrating multiple objectives into MPA network design (Fernandes *et al.* 2012) and lessons learned from other demonstration sites.

Bali MPA Network

The Bali MPA network is in the early stage of development, but has a high level of support from provincial, local and district governments. The network will include and build on the success of the TNC/CTC led process to design and implement the 20.057 ha Nusa Penda MPA network[44] (see below), which is located within the broader Bali MPA network area. CI is the CTSP partner leading the design of the Bali MPA network, based on lessons learned from Nusa Penida and the Bird's Head. One key lesson from the Bird's Head was that building institutional arrangements, capacity development for local managers, and scientific design of the MPA network all need to be completed at the same time. This approach is being taken in Bali.

The Bali MPA network will focus on developing an ecologically connected MPA network that will address biodiversity, fisheries, and tourism objectives, and consider resilience to climate change. The ecologically connected MPA network approach is relatively new in Indonesia, and at this stage, guidelines for the establishment and legal protocols at the local and national level are yet to be developed (MPAG 2011). Work in the Bali MPA network (and the Bird's Head) will be used as the basis for establishing and institutionalizing this approach in Indonesia.

The scientific design of the Lesser Sunda Ecoregion includes Bali, and identifies 28 areas proposed to be developed into a network of MPAs for the Province: 25 shallow coastal and 3 deep-sea areas (see Lesser Sunda Ecoregion; Wilson *et al.* 2011). The Lesser Sunda ecoregional design will provide a starting point to complete a more detailed assessment and MPA

[43] http://www.allfish.org/whitepapers/01Oct10%20LSSFI%20Overview.pdf
[44] Decreed by the Head of Klungkung District in 2010.

network design for Bali. This will require more consultations with local communities and key stakeholders, and more detailed scientific assessments to ground truth and refine data layers used in the Lesser Sunda design.

In 2011, a marine rapid assessment program[45] was completed for Bali (requested by the Provincial Government, and led by CI) to: assess biodiversity, reef health and populations of commercially important reef fishes; and provide management recommendations for 25 shallow coastal areas proposed to be developed into a MPA network for Bali (see above). Recommendations from the assessment include: areas that need immediate protection; using spatial planning to reduce the clash between marine tourism and unsustainable fishing practices; committing to enforcement and public funding to manage MPAs; and putting strict measures in place to manage pollution from plastics, sewage, and agricultural runoff.

For USAID to provide financial support for MPA network design in the Bali MPA network, it needs to be included in the MPAG agreement. Currently, support for the Bali MPA network in the MPAG agreement (2011) includes the following objectives:

- Year 1 will focus on accumulating baseline data, mobilizing the government and community in support of the project, and outlining the area proposed by local government.
- Year 2 will focus on completing and adopting zoning and management plans.
- Year 3 will focus on ensuring that the proposed area is decreed by the Minister, a management unit and infrastructure are established, and management effectiveness work is supported.

By the end of the project, it is expected that a MPA network covering approximately 60,000 ha will be established for the marine and coastal waters of Bali Island (MPAG 2011). MPAG will provide support so that this network is fully aligned with the Bali Island marine spatial plan, and includes no-take zones covering at least 30 percent of critical habitats. MPAG will also assist in the development of effective and sustainably financed governance systems at all levels of government to manage the Bali MPA network for biodiversity conservation and sustainable resource use (such as tourism and responsible fisheries) for the benefit of local communities.

MPAG also provided support for the development of a zoning plan for the Nusa Penida MPA Network (MPAG 2011), which was facilitated by the Coral Triangle Center (CTC) based on: Indonesian government policy and regulations; biological, socio-economic and oceanography surveys; and monitoring of key habitats and species. MPAG will also assist with the drafting of a management plan for the Nusa Penida MPA, the establishment of a management unit, and the development and implementation of monitoring protocols. It is anticipated that the community-based patrol system in Nusa Penida will be used as a model for a similar patrol system in the Bali MPA Network.

The Bali MPA network is a priority for scientific support, since it is likely to provide an example of integrating tourism objectives with fisheries, biodiversity, and climate change objectives in the CT. Technical support by CTSP partners for MPA network design in the Bali MPA network will need to be included in the MPAG proposal. In Year 2, CI will consider including resources required for designing the Bali MPA network in the proposal. This is likely to include developing and refining key biophysical and socioeconomic data layers required for the design. In Year 1, CI will invite CTSP partners with technical expertise in MPA network design to participate in relevant workshops in Bali.

The Bali MPA network design will also benefit from lessons learned in the MPA network design of Raja Ampat, particularly regarding how to integrate fisheries objectives into MPA network design (Grantham and Possingham 2010). There may also be an opportunity for CI to collaborate with PEMSEA (see Appendix 6) regarding integrating marine and land use planning in Bali, particularly regarding integrating climate change into sustainable development plans in the province.

IMACS Demonstration Areas

IMACS demonstration areas, where they are expected to achieve transformational change with respect to coastal/marine resource management and climate change adaptation, are Nusa Tenggara Barat Province and Sulawesi Tengarra Province (Southeast Sulawesi: IMACS 2011). Where MPAG (2011) is planning to promote the use of an EAFM.

[45] http://www.conservation.org/newsroom/pressreleases/Pages/New_Marine_Species_Bali.aspx

If required, CTSP could provide technical advice for integrating fisheries, biodiversity and climate change impacts into MPA network design in these areas. However, this is not currently part of the IMACS work plan (IMACS 2011). Furthermore, MPA network design is not likely to be a priority for these areas in the near future because:

- A MPA network design was recently completed for Nusa Tengarra Barat Province as part of the Lesser Sunda Ecoregion MPA Network Design (see Transboundary MPA Networks: Wilson *et al.* 2011); and
- Wakatobi Marine National Park in Sulawesi Tengarra Province was rezoned based on resilience principles for MPA network design in 2007 (BTNW/PKW 2007)[46].

Wakatobi Marine National Park is located off the southeast tip of Sulawesi and is the third largest marine park in Indonesia. In 2007, Wakatobi Marine National Park and the local government, supported by TNC and WWF, developed a management plan and rezoning system (BTNW/PKW 2007) that is currently being implemented. The rezoning system was one of the first to incorporate resilience principles for MPA network design (TNC *et al.* 2008), including protecting representative examples of key habitats (coral reefs, mangroves, and seagrasses) and critical areas (fish spawning aggregation sites, turtle and seabird nesting sites) in no-take zones (TNC *et al.* 2008). The rezoning plan was approved by both the central and local governments as well as communities living within the park. The rezoning plan did not achieve all of the resilience principles for MPA network design (e.g., minimum levels of protection of coastal habitats) due to socioeconomic considerations, but the new zoning plan represents a major improvement in the design. There are no immediate plans to revise it. If the design is revised in future, stakeholders should consider taking advantage of recent advances in conservation planning to integrate fisheries, biodiversity, and climate change objectives more explicitly in the design (e.g., Grantham and Possingham 2010), and to integrate terrestrial and marine conservation planning (e.g., Lipsett-Moore *et al.* 2010a).

Through 2014, MPAG (2011) will provide assistance to focus on strengthening the management structure and management effectiveness of Wakatobi Marine National Park. By the end of the project, it is anticipated that the established no-take zones will be enforced and supported by 80 percent of residents in the park, and that hard coral cover and commercially important fish populations will have stabilized.

## Timor-Leste

### Context

Timor-Leste is located on the eastern and northwestern sides of Timor Island, including several offshore islands (Grantham *et al.* 2011: Figure 6). The marine environment encompasses over 700 km of coastline including the islands of Atauro and Jaco (Boggs *et al.* 2009), and is part of the Lesser Sunda Ecoregion (see Transboundary MPA Networks). This ecoregion is characterized by exceptionally strong currents generated by the passage of the Indonesian Throughflow (Wilson *et al.* 2011), and is of outstanding marine conservation value for its shallow coastal habitats (including coral reefs, mangroves, and seagrass), deep sea habitats near the shoreline, and populations of endangered turtles and cetaceans (Kahn 2008, Wilson *et al.* 2011).

The marine environment along the north coast of is highly valued for its contribution to local livelihoods through fisheries based activities and ecotourism[47] (Boggs *et al.* 2009), yet there is only a limited extent of coral reef, seagrass and mangrove habitats. This imposes limits on available marine resources and harvest levels. Significant and ongoing loss of coastal habitats (including an 80 percent loss of mangroves since 1940: Boggs *et al.* 2009), and increases in sedimentation and nutrient pollution in estuaries and the adjacent coastal zone from land based activities, has been observed (Alongi *et al.* 2009). In the light of increasing human resource use, these studies underscore the urgent need for precautionary and effective management in this area (Boggs *et al.* 2009).

Timor-Leste also faces major development challenges (Boggs *et al.* 2009, TLSDP 2011-2030). The current population is around 1.1 million, and population growth is among the highest in the world (3.2 percent per year; Boggs *et al.* 2009,

[46] http://www.reefresilience.org/Toolkit_Coral/C8_Wakatobi.html

[47] Several studies have noted the value of these marine ecosystems and megafauna for ecotourism (Edyvane et al 2009b, Dethmers et al 2009).

Grantham *et al.* 2011, TLSDP 2011-2030). Due to a high birth rate and low life expectancy, 54 percent of the rural population is under 19 years old (TLSDP 2011-2030).

This population is highly dependent on natural resources to sustain their livelihoods (Boggs *et al.* 2009), since approximately 75 percent of people live in rural areas where most practice subsistence agriculture (TLSDP 2011-2030). Just under 45 percent of the population also lives below the poverty line (World Fact Book 2010), making Timor-Leste one of the poorest countries in the world. Poverty levels are higher among the rural population than in urban areas (Ministry of Agriculture *et al.* 2003), since rural people are more reliant on natural resources for their livelihoods. Consequently, rural development is a priority concern for the country (TLSDP 2011-2030).

Development and expansion of commercial and subsistence fisheries are top priorities for economic development in Timor-Leste, and plans are in place to develop the fisheries sector so that it contributes to economic growth, income, employment and export earnings (Grantham *et al.* 2011, TLSDP 2011-2030). In the short term, the north coast of Timor-Leste will be the main focal area for industry development (Grantham *et al.* 2011). Consequently, there is a high risk of overfishing if fisheries are developed too quickly, with increased capacity of local and foreign fishermen (Grantham *et al.* 2011).

Climate change also represents a serious and increasing threat to coral reefs and associated ecosystems (Hoegh-Guldberg *et al.* 2009, McLeod *et al.* 2010a, Burke *et al.* 2011). While the Lesser Sunda Ecoregion (including Timor-Leste) may be less susceptible to threats such as rising sea temperatures than other areas (McLeod *et al.* 2009, Hoegh-Guldberg *et al.* 2009), some impacts due to rising sea temperatures, rising sea level, and ocean acidification are inevitable (Setasih *et al.* 2010; Hoegh-Guldberg *et al.* 2009). If well designed, MPAs can play an important role in marine biodiversity conservation, poverty reduction and the development of local sustainable livelihoods and employment in Timor-Leste, particularly in remote coastal areas (Edyvane *et al.* 2009a).

The MAF has the general mandate for biodiversity conservation in Timor-Leste, but other ministries are also involved, particularly the Ministry of Development and Environment (Grantham *et al.* 2011). Within the MAF is the DPANP, which has the mandate for all protected areas planning, implementation, and management. The National Directorate for Fisheries and Aquaculture is also committed to establishing Marine Managed Areas (MMAs) and MPAs for the protection of critical fish habitats with support of the local community. It is essential that this work is tied to that of the DPANP to ensure consistency and coordinated and concerted effort, since disparate activities will only confuse communities on the ground.

Coastal communities maintain strong cultural connections, traditional practices and management aspirations for coastal and marine environments, through a system of customary law and ownership (reviewed in Edyvane *et al.* 2009a). These customary systems and traditions regulate the use of natural resources, within an area collectively owned by a community through imposing ritual prohibition under threat of spiritual sanctions. Even though many of these traditional practices have been weakened by a long history of colonization and occupation, customary systems for resource management are still robust, and the LMMA model of marine conservation is currently being used as a management tool to assist with reinvigorating these customary practices.

In terms of marine conservation and management, the National Directorate for Fisheries and Aquaculture's primary goal is to advance community-based spatial planning in NKSNP (Grantham *et al.* 2011). This should be integrated with the DPANP's efforts to further the terrestrial side of spatial planning to assist in the generation of the NKSNP Conservation Environmental Management Plan. Among other elements of management, the beneficial use of customary management approaches will be a critical component of the plan. Once completed, DPANP intend to use this plan as the model for the other 29 Protected Areas recently nominated by the Government. The National Directorate for Fisheries and Aquaculture have also identified two other priority areas (Atauro Island and Batugede), and have already engaged with communities in these areas. Local and international NGOs have also been working closely with coastal communities to revive local knowledge and tradition customs and laws to protect natural resources, including community-based MPAs (see Nino Konis Santana Park below).

One pressing priority is capacity building aimed at building expertise of staff within local institutions and government agencies who have responsibility for designing, establishing and managing MPAs (Grantham *et al.* 2011). A capacity development action plan was developed recently to assist with the Timor-Leste Strategic Action Plan produced under the CBD PowPA (McIntyre 2011a). This should provide a platform for nurturing and coordinating capacity building across the government and communities.

Currently, capacity building in Timor-Leste is being provided by many organisations including the:

- UNDP with Global Environment Facility (GEF) funds for the CBD PowPA;
- UNESCO with small grants to the DPANP to assist with basic capacity to police existing protected areas;
- CTSP, which is providing support for capacity development for marine conservation, by catalyzing local people, practitioners and organizations to build the skills and abilities needed to effectively and sustainably manage their natural resources (CTSP 2011); and
- Coral Triangle Center (CTI 2011), which has established a learning network for MPAs in the CTI that aims to strengthen capacity to use proven methods, tools, strategies or approaches, and to create best practices for how to use them.

Other recent projects have also included capacity building components for natural resources managers, including those involved in the marine sector. For example, the Timor-Leste National Ecological Gap Assessment (Grantham *et al.* 2011) and the Strategic Action Plan for Protected Areas (McIntyre 2011b) provided training for the DPANP and MAF staff to develop and explore options for establishing and managing protected areas, and take ownership of the final products of the assessment and strategic planning. Capacity building in marine resource assessment was also a key component of several collaborative studies by the Timor-Leste Government and Australian Institutions through the Arafura and Timor Seas Forum[48].

The following sections of this report provide a summary of the status of MPA network design at the national and subnational scale, and opportunities for CTSP to provide technical assistance with integrating fisheries, biodiversity, and climate change objective into MPA network design.

## National Marine Gap Analysis

As a signatory to CBD, Timor-Leste has completed a national ecological gap analysis, which included an assessment of marine ecological gaps in their protected area network. All of Timor-Leste (together with parts of Indonesia) was included in the scientific design of a resilient network of MPAs for the Lesser Sunda Ecoregion (Wilson *et al.* 2009: see Transboundary MPA Networks). The MPA network design, led by TNC, was essentially a gap analysis based on a detailed scientific assessment and an extensive stakeholder consultation process. Government representatives from Timor-Leste (including the Secretary of State for Environment and representatives from the Ministry of Agriculture and Fisheries) provided input to the design.

The gap analysis included existing and proposed MPAs, and identified Areas of Interest (AOIs) that should be considered for the development of new MPAs (Wilson *et al.* 2011). The MPA network design for Timor-Leste includes:

- Seven shallow water MPAs: one existing conservation area (NKSNP), four proposed conservation areas (Batu Gede, Behau, Atauro Island, and Lamsanak) and two new AOIs (Suai and Manufahi); and
- Five deepwater MPAs: two AOIs in Timor-Leste (Manufahi and Nino Konis Santana) and three transboundary AOIs with Indonesia (Ombai, Liran-Atauro and South Wetar).

Following an agreement from the DPANP, the UNDP (using GEF funding) contracted consultants to help undertake a national ecological gap assessment for Timor-Leste. The completed national ecological gap assessment of the protected area network (Grantham *et al.* 2011) outlines recommendations for future activities to aid in the implementation and building of a marine and terrestrial protected areas network. The MPAs and AOIs used in the national gap analysis were based on those identified in the scientific design of the Lesser Sunda Ecoregion (Wilson *et al.* 2011: see above).

[48] http://www.cdu.edu.au/research/atsef/

The national ecological gap assessment found that the total area of the marine protected area network is ~3200 km$^2$, and that while seagrasses and most coral reef types have achieved their target levels for inclusion in the network, mangroves and estuaries have not (Grantham *et al.* 2011). Following on from this assessment, the Strategic Action Plan completed under the same program of UNDP GEF, recommends the development of management plans for all protected areas, (Grantham *et al.* 2011 & McIntyre 2011b). These plans should incorporate an integrated land use planning component given that many of the nominated Protected Areas and AOI have ecosystems within them that are critical to the livelihoods and lifestyle of local communities.

The implementation of the Strategic Action Plan, supported by the capacity development action plan (McIntyre 2011a), should build on the recommendations of the national ecological gap analysis to assist with the following: filling gaps in the protected area network (e.g., by establishing new protected areas in AOIs); improving knowledge of species and communities; providing better legislative platforms and policy for the implementation of sound management practices; providing a platform for cohesive community inputs to implementation and management decisions; coordinating extensions to nominated protected areas to ensure connectivity among protected areas (e.g., to assist with increasing the protection of mangroves and estuaries); providing a protected areas network to help species and ecosystems adapt to climate change; and increasing the budget for protected area implementation.

## USCTI Integration Site

The USCTI integration site in the Timor-Leste is NKSNP (Table 1, Figure 2). At the MPA regional exchange workshop in 2010, national government representatives also selected NKSNP as a learning site for designing and operating MPA Networks in Timor-Leste (CTSP 2010a, see The Regional Coral Triangle Marine Protected Area System).

### Nino Konis Santana National Park

Nino Konis Santana National Park (NKSNP: Figure 6) was declared in 2007 and is the first national park in Timor-Leste (Edyvane *et al.* 2009a). The park is 125,699 ha in area, including both terrestrial and marine components. The marine component of the park, off the easternmost tip of Timor-Leste, covers an area of 55,600 ha (Edyvane *et al.* 2009a).

NKSNP was established because of the area's significant natural and cultural value, its importance to local livelihoods, and concerns regarding impacts of fishing on the marine resources of the area (Edyvane *et al.* 2009a). Key coastal-marine values include highly scenic coastal vistas, pristine beaches, relatively intact coral reefs, diverse marine megafauna, and numerous sacred sites (Edyvane *et al.* 2009a).

The vast majority (>90 percent) of marine habitats in the park are deepwater (>100 m depth), due to the very steep coastal gradient in the region (Edyvane *et al.* 2009). The north coast of the park is rocky and steep, with a narrow continental shelf, so coastal marine habitats are limited (Edyvane *et al.* 2009). In contrast, the low profile, extensive coastal margin and plains of the southern coast provide for greater development of nearshore coastal habitats including estuaries, mangroves, seagrasses and coral reefs. The two areas also vary in terms of exposure, with the sheltered waters of the north coast calmer, deeper and clearer than the exposed waters of the south coast.

These coastal and inshore marine habitats are subject to high levels of human use (including artisanal and subsistence fishing) and impacts (Edyvane *et al.* 2009a). If these threats can be managed more effectively, NKSNP has the potential to become a major national focal point for ecotourism (Edyvane *et al.* 2009b, TLSDP 2011-2030).

CTSP and partners are supporting the MAF, through DPANP and the National Directorate for Fisheries and Aquaculture, to lead co-management processes with local communities toward establishing MPAs in Timor-Leste. Some of these may include key components of the 30 Protected Areas recently nominated by the Government. At present, they are providing technical support to help National Directorate for Fisheries and Aquaculture achieve their primary goal for 2011 - advancing community-based spatial planning of coastal and marine resources in NKSNP.

One CTSP partner (CI), in partnership with a local consulting firm, Rai Consultadoria, has also been working with the National Directorate for Fisheries and Aquaculture and local communities towards establishing community-based networks of LMMAs in NKSNP by:

- Designing and implementing a community outreach, engagement, and planning process to help communities identify the resources to manage, identify basic threats, and develop actions required to manage those threats;
- Helping communities conduct basic assessments of marine areas and identify important areas for protection;
- Introducing climate change concepts, vulnerability assessment, and local early action planning for climate change adaptation;
- Introducing and applying resiliency principles in LMMA design; and
- Supporting Government and local communities to undertake community-based zoning, LMMA designation, and management planning.

It is essential that CTSP's work in Timor-Leste coincides with the efforts of the DPANP to produce a Conservation Environmental Management Plan for NKSNP, and that the outcomes of CTSP's work on marine resources be incorporated into the plan (which will include both terrestrial and marine components). Not only will this respect the responsibility of the DPANP for all protected areas, but it will ensure that there are not disparate processes and products developed.

Now that a strong basis for working with communities has been developed, Rai Consultadoria, CI and the National Directorate for Fisheries and Aquaculture are introducing more scientific elements into the design of an LMMA network for NKSNP. This includes introducing resiliency principles into the process of supporting communities undertake zoning and management planning, and undertaking a rapid assessment program (RAP) in 2012. The RAP will assess biological diversity in NKSNP, assess the status of species of socio-economic importance, and identify areas that may help to meet resiliency principles in the design of the LMMA network. Once the RAP has been completed, discussions with communities will be held to provide adjustments to their proposed LMMAs (if required) based on the results of the assessment. Since the communities are highly motivated in the park, there will likely be interest in discussing these changes once the assessment has been completed.

The DPANP, Rai Consultadoria, CI and the National Directorate for Fisheries and Aquaculture are also interested in working with other CTSP partners (particularly TNC) towards developing and applying principles for maximizing the contribution of community-based MPAs to achieving fisheries, biodiversity, and climate change objectives in NKSNP, and for integrating traditional and modern approaches to conservation planning (based on lessons learned from elsewhere in the CT (e.g., Game *et al.* 2010). WCS has also worked with CTSP toward developing a profile document for NKSNP, which details existing laws, uses and resources.

Timor-Leste receives considerable support for marine resource management from NGOs, multi-lateral and bilateral aid agencies for their work. However, the broader DPANP suffers from very limited resources and a low current capacity level for planning, implementing and managing the Protected Areas Network. While the marine sector does not have the capacity to receive any more resources at present, much benefit would prevail from supporting the DPANP and its endeavours with local communities. Therefore, it is important that CTSP's support for MPA network design is complimentary with other plans and projects that involve NKSNP including the:

- Strategic Action Plan in support of Timor-Leste's CBD PowPA (McIntyre 2011b);
- Capacity Development Action Plan which provides the pathway for capacity development across MAF and the community (McIntyre 2011a);
- Timor-Leste Strategic Development Plan 2011-2030 (TLSDP 2011-2030);
- UNESCO Environmental Science Programme and Department of Forestry project to increase the management capacity of NKSNP, with active participation of local stakeholders in its effective protection;
- Project by a Spanish NGO (working with the Haburas Foundation[49]) to strengthen the management of NKSNP;
- Community tourism development project supported by the Haburas Foundation (P. Hunnan pers. comm.); and
- Australian Museum's planned expedition for marine and land areas.

[49] http://haburas.org/

Other projects in Timor-Leste that may provide valuable lessons learned for MPA network design may also include:

- Several collaborative studies by the Timor-Leste Government and Australian Institutions through the Arafura and Timor Seas Forum regarding marine and coastal habitat mapping of the north coast (Boggs *et al.* 2009), conservation values, issues and planning in NKSNP (Edyvane *et al.* 2009a), coastal and marine ecotourism values, issues and opportunities on the north coast (Edyvane *et al.* 2009b), marine megafauna in Timor-Leste and opportunities for ecotourism (Dethmers *et al.* 2009), fisheries development in the Com-Tutuala-Jaco Island area (Lloyd *et al.* 2008), and river catchments and marine productivity in Timor-Leste (Alongi *et al.* 2009).
- The identification of important bird areas (and associated vegetation) by Birdlife International (Trainor *et al.* 2007).
- The ADB/GEF's Regional Project (Appendix 6), where Atauro Island and Batugede[50] have been identified as demonstration sites for defining and introducing EBM for coastal ecosystems.
- The PEMSEA Project (Appendix 6), which is providing technical support for ICM, including establishing two demonstration sites for ICM in Manatoto and Liquica Districts.
- The AusAID funded project "TL Resilience. Water security and disaster response for a changing Timor-Leste climate" (Oxfam *et al.* 2011).
- A partnership between MAF and the Australian Center for International Agriculture Research (ACIAR) called the Seeds for Life Program[51], which aims to improve food security by releasing staple food crop varieties so farmers can produce more food.

## Papua New Guinea

Context

Papua New Guinea (PNG) comprises the eastern half of the island of New Guinea, several large archipelagos, and many small islands. The marine and coastal resources associated with these islands are the most extensive in the South Pacific (TNC *et al.* 2008), comprising a coastline of 20,197 km and an area of over 1.6 million km$^2$ (EarthTrends 2003).

The marine environment in PNG comprises a wide range of shallow and deepwater habitats (including coral reefs, seagrass beds, mangroves, estuaries, oceanic waters, and seamounts: DEC and NFA 2010). These habitats provide vitally important ecosystems services for communities, including support for their traditional culture and livelihoods (DEC and NFA 2010). Coral reef fisheries also provide an important source of food and income for coastal communities, and reefs provide physical barriers to ocean swells and storm surges (protecting the shoreline against erosion). Behind the reefs, sheltered lagoons provide habitats for a variety of important coastal species, notably seagrass beds and mangrove forests, which also provide food and stabilize the shoreline.

These important marine habitats and associated resources are threatened from overharvesting, habitat destruction and runoff from land based sources of pollution (DEC and NFA 2010, Burke *et al.* 2011), and a rapidly growing population (DEC and NFA 2010, Sabetian and Foale 2006, Foale and Manele 2004). This is linked to the increasing demand by communities to participate in a cash economy, as opposed to living a subsistence way of life (DEC and NFA 2010).

Climate change also represents a serious and increasing threat to coral reefs and associated ecosystems (Hoegh-Guldberg *et al.* 2009, McLeod *et al.* 2010a,b, Burke *et al.* 2011), and some impacts due to rising sea temperatures, rising sea level and ocean acidification are inevitable (Hoegh-Guldberg *et al.* 2009). For example, a study of potential vulnerability to thermal stress found that reefs in the Bismarck Sea are likely to experience high vulnerability to thermal stress, while those in the rest of PNG are likely to experience medium vulnerably to thermal stress (McLeod *et al.* 2010a).

A recent global assessment also found that while PNG's coral reefs have long experienced relatively low pressure on coral resources, many are now considered at medium to high threat (Burke *et al.* 2011). This trend, if allowed to continue, will result in an escalating loss of marine resources and a decline in fisheries production and food security in the region.

[50] Two areas identified as proposed MPAs in the Lesser Sunda MPA Network Design (Wilson et al 2009)
[51] http://www.seedsoflifetimor.org/

In the past, customary knowledge and ownership (customary marine tenure) were applied in the daily management of marine resources (Hamilton *et al.* 2009, DEC and NFA 2010). Customary marine tenure is complex and varied (Alcorn 1993, Swartzendruber, 1993), and ownership of and access to coastal areas in PNG depends on a range of culturally defined variables, including descent and local socioeconomic conditions (Koczberski *et al.* 2006, Cinner 2005, 2007, Cinner *et al.* 2007, Hamilton *et al.* 2009). Today over 90 percent of coastal and near shore resources remain under customary resource ownership (DEC and NFA 2010), Where customary marine tenure remains strong, LMMAs can be the most effective strategy for conserving near shore marine resources in line of sight of local communities (McClanahan *et al.*, 2006, Hamilton *et al.* 2009).

In some situations, customary marine tenure is not compatible with modern approaches to fisheries management and conservation, due to a mismatch of scales and objectives (Foale and Manele 2004). Several examples of customary marine tenure achieving conservation and fisheries objectives do exist (e.g., the commitment of communities in Manus and New Ireland to protect reefs where groupers aggregate to spawn: Hamilton *et al.* 2009, 2011). Other contemporary community-based fisheries management initiatives include restricting access to traditional fishing grounds, placing *tambus* (temporary closures) on reefs to allow valuable stocks to recover, banning destructive fishing practices and placing gear restrictions on certain important stocks (Cinner *et al.* 2005, Hamilton *et al.* 2009).

The importance of natural resources and the environment is recognized in PNG's National Constitution, which states that they are to be conserved and used for the collective benefit of all and replenished for future generations (DEC and NFA 2010). Unlike other countries, PNG national and provincial governments also recognize customary resource ownership in which clans living near and using marine resources are considered legal owners of the resource (Alcorn 1993, Swartzendruber, 1993, Macintyre and Foale 2007).

Many government organizations are also responsible for the use and protection of the marine environment in PNG (DEC and NFA 2010) including Department of Environment and Conservation (DEC), National Fisheries Authority (NFA), Office of the Climate Change and Development, National Maritime Safety Authority, and all maritime Provincial Authorities through the Organic Law on Provincial and Local Level Governments.

DEC is mandated to protect the marine environment and ensure the protection and sustainability of its biodiversity through provisions contained in several pieces of legislation[52]. One of their main objectives is to develop policies, indicators and a reporting framework to ensure effective implementation of the Government's Environmentally Sustainable Economic Growth Initiative (DEC and NFA 2010). This initiative promotes mainstreaming environmental sustainability into all resource sectors including fisheries, where fisheries are viewed as valuable renewable resources, capable of creating sustainable wealth for the country.

DEC's MPA objectives remain focused on sustaining biological diversity and community livelihoods (for food security). To date approximately 22 MPAs (Wildlife Management Areas, marine parks historic reserves and provincial parks) have been designated nationally in PNG, which were created in collaboration with local communities (TNC *et al.* 2008). DEC's highest priority is to develop a marine policy framework, which will focus on developing an integrated approach to sustainable development (consistent with Vision 2050[53] and the Millennium Development Goals[54]), which will accommodate development, industry, and conservation goals. Support for developing this policy is being provided by consultants and Environment Australia.

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[52]Including the Environment Act 2000, National Parks Act 1984, Conservation Areas Act 1978, Fauna (Protection and Control) Act 1966, and the International Fauna and Flora Trade Act 1978

[53]The PNG Vision 2050 (previously the National Strategic Plan) seeks to address PNG's low social & economic indicators despite being blessed with an abundance of wealth in natural resources. The seven pillars that provide the foundation for development plans are: Strategic Planning, Integration & Control; Institutional Development & Service Delivery; Human & Social Capital Development; Wealth Creation; Security & International Relations; Climate Change & Environmental Sustainability; and Churches & Development. http://www.treasury.gov.pg/html/publications/files/pub_files/2011/2011.png.vision.2050.pdf

[54] http://www.un.org.pg/index.php?option=com_content&view=article&id=50&Itemid=23

NFA is a statutory authority, which was established and operates under the Fisheries Management Act 1998 and related regulations. NFA has jurisdiction over all commercial fisheries and other fisheries in PNG's EEZ (since jurisdiction over coastal subsistence fisheries resides with communities). NFA is mandated to implement government policies for managing and developing these fisheries as a national asset, while ensuring the sustainability of the fisheries and the associated economic well-being of communities. Recently, NFA widened its scope to focus on supporting livelihoods through the establishment of LMMAs, promoting small scale coastal fisheries, and adopting an EAFM.

DEC and NFA share a common interest in the role of MPAs in biodiversity protection and fisheries management. The role of MPAs in fisheries management has long been acknowledged in PNG, since the primary reason for establishing community-based MPAs is usually to achieve fisheries management objectives. NFA also uses spatial approaches to fisheries management (including no-take areas) for fisheries management[55]. Furthermore, NFA is interested in applying an EAFM (which is likely to include MPAs), and a pilot study is underway in Manus (see USCTI Integration Sites below). However, an EAFM policy still needs to be developed and embedded in legislation.

Currently, the national government is focused on implementing the PNG Marine Program, which comprises the CTI National Plan of Action (DEC and NFA 2010). This program incorporates priority actions from all responsible agencies in an integrated manner to manage PNG's marine habitats and resources sustainably. Since DEC and NFA recognize the rights of coastal resource owners, this program will ensure that the customary needs of coastal communities are recognized and respected in all transactions affecting resources or in the areas in which they operate. NGOs[56] will also play an important role in supporting these activities at the national, provincial and local level.

At a recent National Coordinating Committee meeting, the committee endorsed merging the five PNG Marine Technical Working Groups previously established for each of the five CTI goals (see CTS 2009). The new working group, led by DEC, will provide a forum for DEC, NFA and other organizations to discuss integrating their objectives regarding MPAs, EAFM and other issues regarding marine resource management in future (including climate change adaptation).

One outcome of the marine policy will be the development of a MPA policy to guide the development of a system of MPAs, including support for the LMMA network, within a broader framework (DEC and NFA 2010). Once the policy is in place, DEC plans to develop legislation that will allow for a new "Authority" to be established for environmental protection, which will progress developing and passing conservation legislation by 2014. This will include developing new legislation that will allow for MPAs to be established by the national government (DEC and NFA 2010). Since the government acknowledges customary marine tenure, MPA planning, design and implementation will need to address community needs and interests. Therefore, the government is more interested in providing support for establishing community-based MPAs than in establishing more MPAs at the national level. So when this legislation is passed, it will be used to support community-based MPA network initiatives.

A major issue in PNG is the need for capacity building to build in-country skills and expertise in marine resource management. Support for this is being provided by many organizations including:

- CTSP, which is providing support for capacity development for conservation by catalyzing local people, practitioners, and organizations to build the skills needed to effectively and sustainably manage their natural resources.
- The PNGCLMA which is empowering local communities to achieve marine resource management goals by: building capacity in key LMMA management skills; providing a mechanism for sharing their stories and lessons; and supporting the establishment of key partnerships.
- The Coral Triangle Center (CTI 2011), which has established a learning network for MPAs in the CTI that aims to strengthen capacity to use proven methods, tools, strategies or approaches, and to create best practices for how to use them.

[55] E.g. the Live Reef Food Fish Trade Management Plan closes fish spawning aggregation sites to fishing, and the bêche de mer fishery has been closed in PNG for three years.

[56]Including TNC, WWF, CI, WCS and the PNG Centre for Locally Managed Areas (PNGCLMA). Where PNGCLMA is a member of the LMMA network whose focus is helping local communities establish LMMAs. http://lmmanetwork.dreamhosters.com/papuanewguinea

- The Australian Government[57], which has funded a project led by TNC and the Australian CTI Alliance to strengthen in-country marine resource management training in PNG and the Solomon Islands (TNC and ACTIA 2011).
- Other local and international NGOs that provide training and capacity building regarding marine resource management for governments, partners and communities.

National Marine Gap Analysis

As a signatory to CBD, PNG is obliged to set aside at least 10 percent of their country in protected areas to slow the global loss of biodiversity (Lipsett-Moore *et al.* 2010b). This will require completing a national gap analysis to assess ecological gaps in the existing protected area network.

In 2010, TNC worked with DEC to complete a national terrestrial gap analysis (Lipsett-Moore *et al.* 2010b) that included:

- An assessment of the effectiveness of the existing protected area system in representing PNG's biodiversity;
- Identification of potential protected areas systems that best capture representative samples of PNG's ecosystems and plant and animal species;
- Identification of areas that have the potential to serve as climate refugia for the biodiversity of PNG; and
- Building the capacity of DEC staff to conduct the analyses, interpret results, and refine a process to enable the effective implementation of the results.

The marine component of the gap analysis has not been completed. This is not a priority for DEC, which is focused on supporting community-based conservation at the provincial and site level. However until a national marine gap analysis can be completed, other regional and national marine assessments provide guidance regarding priority areas for marine conservation in PNG including:

- The Conservation Needs Assessment, which was requested by the national government and implemented by a USAID funded consortium of WWF, World Resources Institute and TNC. This process identified 30 marine and coastal high biodiversity areas, and 5 watersheds critical to the health of these areas (Alcorn 1993, Swartzendruber, 1993). Several of the marine biodiversity areas identified include areas identified as USCTI Integration and Learning Sites (Manus and some areas of Milne Bay and Kimbe Bay).
- The WWF led plan for the Bismarck Solomon Seas Marine Ecoregion (Afzal *et al.* 2003), which identified 48 priority areas for marine conservation in PNG, the Solomon Islands and Indonesia, including six globally, 24 ecoregionally and 18 subregionally outstanding areas. Several of the globally or ecoregionally outstanding areas in PNG include USCTI Integration and Learning Sites in Milne Bay, Manus Island and Kimbe Bay.

USCTI Integration Sites

In 2011, two USCTI Integration sites were identified for PNG (Table 1, Figure 2): Manus Island, Manus Province; and Nuakata-Labam-Phailele MPA, Milne Bay Province. At the MPA regional exchange workshop, DEC and NFA also selected Kimbe Bay as a learning site for designing and operating MPA Networks in PNG (CTSP 2010a, see The Regional Coral Triangle Marine Protected Area System). Recent discussions with DEC (July 2011) also confirmed that the priority areas for integrating fisheries, biodiversity, and climate change objectives into MPA network design in PNG are Manus and Kimbe Bay. While priority sites for CTSP partners are Manus and Kimbe Bay for TNC, Manus for WWF, and Milne Bay for CI.

These sites are also priorities for development by partner projects including:

- PNG is one of three CT countries that are the focus of ADB/GEF's Regional Project 'Strengthening Coastal and Marine Resources Management in the Coral Triangle of the Pacific' (Appendix 6). DEC is the host implementation agency in PNG, and selected Kimbe Bay and Manus as demonstration areas for implementing improved management systems and tools.
- AusAID/The Australian Government is supporting two projects in Manus: "Building the resilience of communities and their ecosystems to the impacts of climate change in the Pacific" (led by TNC: Appendix 6); and "Strengthening the ability of vulnerable island communities in PNG to adapt to climate change" (led by WCS).

[57] Department of Sustainability, Environment, Water, Population and Communities.

- AusAid/The Australian Government is supporting two CSIRO projects in Kimbe Bay and Milne Bay: "Climate futures, ecosystem services, and livelihood adaptation strategies in West New Britain Province, PNG"; and working with CI to provide a demonstration site in Milne Bay for integrating planning for natural resource management, human well-being, livelihoods and adaptation to climate change.

Further details are provided in the summary for each site below.

Manus Province

Manus Province (Figure 7) provides an excellent opportunity for CTSP to provide technical support for integrating fisheries, biodiversity, and climate change objectives into MPA network design by building on several key projects including:

- The Northern Bismarck Sea Marine Assessment (Hamilton *et al.* 2009), led by TNC, WWF and NFA, which confirmed that the coral reefs of Manus and offshore islands support high species diversity, are in good to excellent condition, and are a high priority for conservation. The study also provided valuable information regarding patterns of biodiversity, and identified five priority areas for conservation.
- CTSP members and partners (TNC, WWF and WCS) are working with the provincial government and LLGs to support community-based conservation in most of the priority areas for conservation identified by the marine assessment. This includes providing technical support for facilitating the establishment of LMMAs, EAFM and climate change adaptation strategies, protecting fish spawning aggregation sites and rare and threatened species (e.g., turtles), developing effective environmental legislation to protect and manage LMMAs, providing technical assistance to NFA for the formalization of a community-based fish aggregation device deployment policy, and investigating sustainable financing mechanisms for effective management activities.
- Manus is one of three regions included in the AusAID/Australian Government funded partnership: 'Building the resilience of communities and their ecosystems to the impacts of climate change in the Pacific" (Appendix 6). This project, led by TNC, is an official collaboration of many partners (including WWF, Mama Graun Conservation Trust Fund, SeaWeb, UQ EDG and Partners with Melanesians). Manus was selected for this study because these partners have strong relationships with the provincial government and communities. Work has focused on reviewing existing information regarding climate change vulnerability, undertaking scenario modeling on the impacts of different sea level rise projections, and studying the economics of climate change impacts relating to ecosystem services. Outcomes will be used to inform policy makers and assist governments to better understand and respond to climate change impacts.
- NFA is promoting the operation of a community-based EAFM (CEAFM: SPC 2010), and has identified Manus as a pilot site for this study (Lokani and Kas in prep.). In 2010, TNC in partnership with NFA and the Provincial Government, initiated a project "Application of CEAFM in Manus Province, PNG", where the concept of CEAFM was introduced through two workshops. One outcome was strong interest in CEAFM from community leaders, fisheries and government officers, NGOs, community-based organizations, NFA and DEC. Another outcome was the decision to develop a process for resource planning for Manus (a reef to ridges approach) to be used by all NGO's, community-based organizations and communities in the province.
- The PNG Coastal Fisheries Management and Development Project completed in 2006 by Gillett, Preston and Associates[58] also included Manus Province. The aim of this project was to institute sustainable marine resource use practices, which provided technical inputs to develop fisheries research and management arrangements and construct maritime infrastructure.

As a result of widespread engagement with local communities in these projects, support by communities and key stakeholders[59] for a MPA network design at the provincial level has been generated. Future work will require effectively integrating the MPA network design within the reef to ridges process, and working closely with LLGs and communities (with a strong component of capacity building).

[58] http://www.gillettprestonassociates.com/

[59] National, Provincial and relevant District Level Governments, USCTI Implementation Partners (WWF, TNC, WCS, and local NGOs), and development partners (ADB, Australian Government).

Since most land and coastal marine areas are under customary ownership, any protected area network design must be led by local communities. One way in which ownership of the protected area network design process by local communities was achieved was through participatory spatial planning and awareness-raising. Recently, an innovative 'participatory 3D modeling' workshop was held in Manus Province in September 2011 as part of the AusAID Project (Appendix 6), with participation from the all level of government (national, provincial and local government), community representatives, and local and international NGOs (Hardcastle 2011). The participatory 3D modeling demonstrated that existing protected areas cover only a fraction of the province, and there is little connectivity or networking between them. Several vulnerable areas were also identified that are currently under no protection, which are facing increasing pressures from development and climate change.

In 2012, the Manus government, local stakeholders and partner conservation and development agencies agreed to develop and connect a network of LMMAs and terrestrial protected areas, named the Manus Management of Strategic Areas for Impacts of Climate Change Project, in 2012. This project will provide a firm basis for integrating fisheries, biodiversity, and climate change objectives into a ridges to reefs protected area network design (including both terrestrial and marine priorities), which will be implemented in Manus over the next few years.

TNC, WWF and partners will work with local stakeholders to define a process for the Manus Management of Strategic Areas for Impacts of Climate Change Project over the next 1to 2 years. CTSP will assist with this process and identify how to provide financial and/or technical support for the MPA network design component through 2013. The involvement of the UQ EDG in the AusAID project will also provide much needed technical support for developing and applying innovative approaches to integrating multiple objectives into the design.

Two new projects are also planned for the next few years to provide additional inputs into the design of the Manus Management of Strategic Areas for Impacts of Climate Change Project:

1. The AusAID funded WCS project "Strengthening the Ability of Vulnerable Island Communities in PNG to Adapt to Climate Change" will address the need to reinforce ecological resilience through effective resource management, and strengthen capacity within local social systems to better enable communities to adapt to the impacts of climate change. This will be accomplished by a collaborative effort among local and international partners who will: develop tools and information to augment existing resource management and help communities prepare for and adapt to climate change; increase capacity for subnational government and civil society to incorporate climate change adaptation into planning activities; and undertake activities in villages to increase food security and improve coastal protection.
2. Manus Province is also one of ADB/GEF's two priority sites in PNG for their regional project "Strengthening Coastal and Marine Resources Management in the Coral Triangle of the Pacific" (Appendix 6). This project will provide support to extend a coastal EAFM through demonstrating wider habitat mapping and zonal management systems that link to the Government community fisheries program in the Province.

<u>Milne Bay Province</u>

CI is working with island communities to design resilient LMMA networks in Milne Bay, which will consider climate change impacts, as well as EAFM through 2013. CI is also working with island communities towards improving management capacity by: providing technical support for monitoring marine resources and the effectiveness of their no-take areas, confirming boundaries and durations of community managed marine areas, and reviewing management rules and penalties for managed areas (CI 2011, Isaac and Wangunu 2011).

Several earlier projects have also provided an important basis for integrating fisheries, biodiversity, and climate change objectives into MPA network design in Milne Bay including:

- Two rapid biodiversity assessments of Milne Bay Province (Werner and Allen 1998, Allen *et al.* 2003) led by CI. These surveys provided valuable information regarding patterns of biodiversity, and found that most coral reefs were in good condition with exceptionally high marine diversity.
- The Sustainable Futures for Milne Bay Project (based on collaboration between CSIRO and CI), which demonstrated integrated planning for natural resource management, human well-being, livelihoods, and adaptation to climate change. This project completed an integrated planning exercise for the terrestrial and marine areas of Upper Milne

Bay with the local government, industry and community stakeholders. Through this process, key linkages between ecosystem services and human well-being, trends and conditions of these services, trade-offs between them, and adaptation strategies were identified (Butler *et al.* 2009). They also linked with an AusAID-CSIRO project "Melanesian Marine Ecosystem Assets" to apply the same approach to the whole of the Province. Together with stakeholders, the most vulnerable islands and communities and appropriate adaptation strategies tailored to specific impacts on ecosystem services, were identified (Butler & Skewes 2010).

- The PNG Coastal Fisheries Management and Development Project completed in 2006 by Gillett, Preston and Associates[60] also included Milne Bay Province. The aim of this project was to institute sustainable marine resource use practices, which required providing technical inputs to develop fisheries research and management arrangements and construct maritime infrastructure.

While CI and CSIRO are working towards integrating fisheries, biodiversity, and climate change objectives into MPA network design in Milne Bay, CTSP is unable to provide financial support for that process due to lack of resources. However if that changes, Milne Bay may be a good candidate for support in future, since it provides a good opportunity for learning how to integrate tourism with the other objectives in MPA network design. However, CTSP is willing to provide technical advice for this project (if required).

Kimbe Bay, West New Britain Province

Kimbe Bay continues to play a lead role in integrating fisheries, biodiversity, and climate change objectives into MPA design in PNG through the following projects:

- "Designing and Implementing a Resilient Network of MPAs in Kimbe Bay": TNC has been working in Kimbe Bay for the last 15 years. Work has included conducting marine assessments, raising awareness of the need for marine conservation, supporting local communities establish LMMAs, and assisting three LLGs create and pass legislation to protect and manage the marine environment (Green *et al.* 2007). In 2006, TNC led the design of a resilient network of MPAs for Kimbe Bay, which was the first in the CT and one of the first worldwide (Green *et al.* 2007, 2009). The scientific design was based largely on a scientific assessment of biodiversity values, and identified 14 Areas of Interest (AOIs) that, if effectively conserved, will achieve the network objectives of conserving biodiversity and sustainable resource management. Since the development of the design, TNC has focused on implementing the MPA network by supporting local communities to establish and manage LMMAs in the AOIs (through a community-based planning approach). To date, 8 LMMAs have been established in 6 of the AOIs, and others are midway through the process in 5 other AOIs. TNC is also: working with the provincial government, LLGs and other key stakeholders towards establishing a governance and management structure to manage the area (now known as the Kimbe Bay Marine Managed Area); working with the Provincial Fisheries Division to incorporate EAFM principles in the bay; and conducting awareness raising to increase the understanding of, and maintain long term support for, conservation by local communities and other stakeholders. They are also working with national and provincial government to develop and apply new legislation to declare the Kimbe Bay Marine Managed Area.
- "Strengthening Coastal and Marine Resources Management in the Coral Triangle of the Pacific" (Appendix 6). In Kimbe Bay, this ADB/GEF project will seek to: build on coastal management with a focus on managing land based threats; identify opportunities for ecologically sustainable economic development to support livelihood development; and network LMMAs into a wider marine managed area.
- "Climate futures, ecosystem services and livelihood adaptation strategies in West New Britain Province, PNG." In this project, CSIRO (funded by the Australian Government) will analyze the potential impacts of future change (including climate change) on ecosystem services and livelihoods of communities in Kimbe Bay. It will also inform government policy and management by assessing the current and future value of ecosystem services, the potential impacts on these services and vulnerable communities, and appropriate adaptation planning. To do so, CSIRO will partner with TNC and the PNGCLMA network to facilitate participatory scenario planning with provincial government stakeholders and local communities. This participatory approach will empower local communities to prepare and adapt proactively to potential future change.

[60] http://www.gillettprestonassociates.com/

Kimbe Bay also remains a priority for technical support by DEC, TNC and other partners. Since Kimbe Bay is not a USCTI Integration site, CTSP is unable to provide financial support for this project. However CTSP will continue to provide technical advice for MPA network design in the Bay.

## Solomon Islands

Context

Dotting the South Pacific in a double chain of 922 islands, the Solomon Islands cover more than two million km$^2$, making it one of the largest archipelagos in the world (Green *et al.* 2006a). The Solomon Islands Marine Assessment (SIMA) led by TNC in 2004, provided the first broad scale survey of marine resources in the area (Green *et al.* 2006a). The survey provided an assessment of the biodiversity and status of coral reefs and seagrass beds, the status of populations of key fisheries species, and the diversity and abundance of cetaceans. The SIMA revealed that the Solomon Islands is an area of high conservation value where marine diversity is exceptionally high (Green *et al.* 2006a). Thus, the Solomon Islands were included in the Coral Triangle (Veron *et al.* 2009) and the CTI.

The Solomon Islands has a population of about 538,000 people, with an annual growth rate of 2.8 (Green *et al.* 2006a). Most (85 percent) of the people live in rural village communities, many of whom are dependent on marine resources. Like other Pacific island nations with fast growing populations, the Solomon Islands is rapidly depleting its natural resources to obtain food and generate income for basic necessities.

The SIMA found that threats were generally low in remote areas where marine resources were in good condition, but high close to the heavily populated areas of Guadalcanal and Malaita (Green *et al.* 2006a). The results also indicate that overfishing of coral reef species may be occurring in some areas because (Green *et al.* 2006b, Ramohia 2006):

- Large vulnerable reef fishes, particularly those targeted by the live reef food fish trade, were rare or uncommon (except for a few places in the north western provinces).
- In general, healthy populations of food fishes were found in areas with small human populations[61], but not in areas close to Guadalcanal and Malaita[62].
- Commercially important invertebrates (sea cucumber, *Trochus* and giant clam etc) were rare or absent, except for in the Arnavon Community Marine Conservation Area (ACMCA: see below). The green snail (*Turbo marmoratus*), which once supported a large export industry in the Solomon Islands, was not seen at all.
- There was evidence of destructive fishing methods being used in some areas, particularly close to heavily populated areas.

Other studies have reported that the domestic coral reef finfish fishery has depleted vulnerable coral reef fishes and other species in some locations, particularly in areas close to major towns and markets (Hamilton 2003, Sabetian and Foale 2006, Aswani and Sabetian 2009, Brewer *et al.* 2009, Brewer 2011). The live reef food fish trade has also sporadically depleted vulnerable species by targeting fish spawning aggregations, and shark fishing also occurs throughout the Solomons (Kool *et al.* 2010). Concerns about runoff from poor land use practices (particularly logging, mining, and industrial agriculture; Kool *et al.* 2010, Lipsett-Moore *et al.* 2010a) have also been raised, and seismic activities (including a tsunami and uplift of reefs and islands by up to three meters) have also caused considerable damage in the Western Provinces in 2007 (Burke *et al.* 2010).

Climate change also represents a serious and increasing threat to coral reefs and coastal communities in the Solomon Islands, due to rising sea temperatures, rising sea levels and ocean acidification (Hoegh-Guldberg *et al.* 2009, McLeod *et al.* 2010a,b, Burke *et al.* 2011). Local communities are concerned about rising sea levels, which has led to a project to build the resilience of communities and ecosystems to the impacts of climate change in Choiseul (see Appendix 6 and below).

A global assessment of coral reefs also found that while some of the reefs are considered at low threat from human impacts, some are considered at medium to high threat from overfishing, runoff from poor land use practices and climate

[61] Central (Russell Islands), Choiseul, Isabel (particularly the Arnavon Islands), Makira (Makira Island) and Western Provinces
[62] Central (Florida Islands and Savo Island), Guadalcanal, Makira (Three Sister Islands and Ugi Island) and Malaita Provinces

change (Burke *et al.* 2011). This trend, if allowed to continue, will result in an escalating loss of marine resources and a decline in fisheries production and food security in the region.

In response to the threats, the SIMA offered a range of recommendations for conservation and sustainable use of marine resources including: establishing networks of locally managed marine conservation areas (MCAs), management of important reef fisheries, protection of key habitats (coral reefs, seagrasses and mangroves), and the conservation of cetaceans and associated habitats (Green *et al.* 2006a,b, Ramohia 2006, Kahn 2006).

In the Solomon Islands, marine resources are governed by coastal communities through customary marine tenure (Hviding 1998: see Glossary), where communities have traditional user rights over reef and coastal areas (Green *et al.* 2006a). Successful marine resource management at the local scale is linked to the strength of traditional resource governance, and the lack of conflict around customary marine tenure boundaries (Foale and Macintyre 2000, Aswani and Hamilton 2004, Aswani and Sabetian 2009). In some areas, traditional ownership and management of marine resources remains strong, and communities maintain control of their traditional sea areas (e.g., in Choiseul Province: Lipsett-Moore *et al.* 2010a). In these areas, customary marine tenure provides a culturally recognized ownership structure around which community-based conservation can be based (Lipsett-Moore *et al.* 2010a). Although there is evidence that local knowledge is eroding with increased cultural and economic influence from outside in some areas (Kool *et al.* 2010).

One of the most common forms of customary management in the Solomon Islands is community-based MPAs, where communities ban the harvest of marine resources on a reef for a period of time (months to years). Closures are declared by chiefs and church leaders, and once closed reefs are consider *tambu* (sacred or off limits) until reopened by the leaders. In areas where customary marine tenure is still strong, fishers often adhere closely to closures out of respect and also out of fear, as it is widely believed that it would be very bad luck to break the *tambu*. When customary closures are lifted, marine resources are usually harvested intensively (Lipsett-Moore *et al.* 2010a). Thus in most cases, customary closures represent stockpiling of community resources for cultural or fisheries management purposes, as opposed to the western concept of biodiversity conservation (Foale and Manele 2004, Lipsett-Moore *et al.* 2010). This customary approach to marine resource management has provided the basis for establishing community based MPAs, which comprise the majority of MPAs in the Solomons (see Govan 2009).

However, some community based MPAs do have conservation objectives and benefits. For example in 1995, the ACMCA was established, which protects 15,800 ha of islands and marine areas, including one of the largest remaining rookeries of endangered hawksbill turtles in the world (Lipsett-Moore *et al.* 2010a). The SIMA showed that while large, vulnerable reef fishes and commercially important invertebrates are overfished throughout most of the Solomon Islands, these species (and other reef food fishes) were abundant in the ACMCA where commercial fishing and collecting is banned, and only subsistence collecting of some reef fish species is allowed (Green *et al.* 2006a,b, Ramohia 2006). In fact, the ACMCA supports one of the highest abundances and biomass of food fishes in the Solomon Islands (Green *et al.* 2006b), which shows that it has been effective in achieving its goal of protecting marine resources. Recent monitoring has also confirmed that there has also been a ten-fold increase in hawksbill turtle nesting since the early 1990s (J. Pita unpubl. data). In 2007 the ACMCA, with assistance from TNC, also became the first MPA in the Pacific to ensure its long term financial sustainability by securing funds for an endowment[63].

The success of the ACMCA has inspired other traditional owners to develop community-based MPAs, including developing a community driven ridges to reef protected area network for Choiseul Province (Lipsett-Moore *et al.* 2010a: see below). Many other community-based MPAs have also been established in other provinces, including Western, Central, Isabel and Guadalcanal Provinces (see below and Green *et al.* 2006a). TNC, WWF, WorldFish, and the Solomon Islands LMMA Network have played an important role in helping communities establish and monitor effectiveness of MPA in the Solomon Islands, particularly in Choiseul and Western Provinces. Results show that LMMAs are achieving their goals regarding recovery of commercially important macroinvertebrates and food fishes, and there is widespread perception of benefits outside of MPAs through spillover of food fish leading to higher catch rates (R. Hamilton unpubl. data).

[63] http://www.nature.org/ourinitiatives/regions/asiaandthepacific/solomonislands/placesweprotect/arnavon-islands.xml

A national framework for conservation is also provided under CBD, which the Solomon Islands are signatory to (Lipsett-Moore *et al.* 2010a). The Ministry of Environment, Conservation and Meteorology provides the leadership necessary to oversee work pertaining to the conservation of biological diversity in the country. The development of the Solomon Islands National Biodiversity Action Plan (SINBSAP 2008) is a response to the CBD commitment, and provides constructive direction for conservation in the country. The Solomon Islands National Biodiversity Action Plan outlines the framework to ensure long term sustainability of biodiversity in the Solomon Islands, where responsibility for achieving the goals of the plan rest with the national government, provincial authorities, communities and resources owners, and NGOs.

At the national level, several acts of Parliament and policy documents relate to natural resource management and exploitation (Kool *et al.* 2010). The national government's strategy for MPAs is included in the Protected Areas Act (2010)[64], which covers both marine and terrestrial areas. The regulations for this act have been passed by Cabinet, and will come into force now they have been gazetted (February 2012). The Solomon Islands government now requires technical assistance to help institutionalize the PA Act (e.g., by reorganizing protected area activities around the act)[65].

The Ministry of Environment, Conservation and Meteorology is also working with the Ministry of Fisheries and Marine Resources to ensure that the draft Fisheries Act and the PA Act are complimentary. Currently, high seas MPAs and fisheries reserves can be established under the draft Fisheries Act (A. Vave-Karamui pers. comm.), and they can apply for MPA status under the PA Act. Together, both Ministries are interested in strengthening the function of MPAs to address objectives related to food security and climate change.

The PA Act does not provide guidance regarding prioritization of sites, instead the focus is on assisting local communities establish community-based networks of MPAs. This approach is reflected in the goal of the Solomon Islands National Plan of Action (MECM/MFMR 2010), which is to ensure food security, sustainable economic development, biodiversity conservation, and adaptation to emerging threats, through community-based resource management approaches supported by government agencies and other partners.

While most fisheries management is decentralized to the community level, there are a number of national regulations regarding the exploitation of marine species, predominantly those that are of high economic value and low resilience to exploitation. For example, the SIMA provided a scientific basis for the national government to reassess the status of bêche-de-mer stocks, which led to a national moratorium on the harvest, possession or sale of sea cucumbers (Green *et al.* 2006a).

Since resource management takes place at the local scale, large permanent MPAs are not common in the Solomon Islands. However, there are some large MPAs including the East Rennell World Heritage Site, which includes the southern third of Rennell Island and marine areas extending three nautical miles to sea[66]. Marovo Lagoon and Tetepare Island have also been nominated for World Heritage Status[67].

In the Solomon Islands, there is the need for capacity building to build in-country skills and expertise in marine resource management. Support for this is provided by many organizations including:

- CTSP, which provides support for capacity development for conservation, by catalyzing local people, practitioners, and organizations to build the skills and abilities needed to effectively and sustainably manage their natural resources (CTSP 2011).
- The Solomon Islands LMMA Network[68], which empowers local communities to achieve marine resource management goals by building their capacity to establish and manage LMMAs.

[64] An act for the declaration and management of protected areas or areas where special measures need to be taken to conserve biological diversity and the regulation of biological diversity and prospecting research and for related matters.
[65] While CTSP provided funding to develop the legislation, no funding has been allocated to this task.
[66] http://whc.unesco.org/en/list/854
[67] http://whc.unesco.org/en/tentativelists/5414/
[68] http://lmmanetwork.dreamhosters.com/solomonislands

- The Coral Triangle Center (CTI 2011), which has established a learning network for MPAs in the CTI that aims to strengthen capacity to use proven methods, tools, strategies or approaches, and to create best practices for how to use them.
- The Australian Government[69], which has funded a project led by TNC and the Australian CTI Alliance to strengthen in-country tropical marine resources management training capacity in PNG and the SI (TNC and ACTIA 2011).

National Marine Gap Analysis

As a signatory to CBD, the Solomon Islands completed a national gap analysis to assess ecological gaps in their protected area network (Kool *et al.* 2010). This was the first nation-wide assessment of biodiversity distribution, threats to biodiversity, and current efforts to manage both terrestrial and marine biodiversity in the Solomon Islands.

The national gap analysis builds on the results of the Solomon Islands State of Environment Report (PHCH 2008) which identified the following marine areas of interest: Shortland Islands; inside barrier reefs in Northern Choiseul; Manning Strait between Choiseul and Isabel, and extending along the southern coastline of Isabel; Gizo and Marovo, Vonavona and Roviana Lagoons in Western Province; Lau Lagoon in Malaita; and Marau Sound on Guadalcanal.

Kool *et al.* (2010) used systematic conservation planning to conduct a gap analysis of the natural resources, and the degree to which they fall under existing conservation management. The analysis also assessed priorities for conservation based on biodiversity and socioeconomic factors that represent either a threat to biodiversity or an opportunity to implement a conservation action plan. Results were used to identify potential areas for action based on two divergent scenarios: avoiding conflict and seeking areas requiring imminent action. Report recommendations include: if the goal is to minimize conflict with potential development activities, then western Malaita, eastern Guadalcanal, and central Choiseul are good candidates for conservation action; but if the intent is to target areas of greatest value that are under imminent threat, then western Guadalcanal and southern Makira (eg. Makira Bauro highlands) are areas of concern that require imminent action. Under both scenarios, areas in Choiseul and Central provinces, Northern Isabel, Marovo Lagoon, Tetepare and Rendova are areas of concern that require conservation action. Other recommendations include reinforcing and maintaining existing managed areas, and activities and increasing effectiveness of conservation efforts by coordinating local management activities.

Since resource management is at the local scale (Hviding 1998), another challenge for the Solomon Islands is reconciling decentralised local management structures with the need to meet large scale (national) conservation objectives (Kool *et al.* 2010). Some recommendations to improve the ability of the Solomon Islands to do this include (Kool *et al.* 2010): developing mechanisms for improved data collection/management, conducting a comprehensive analysis of watershed based threats, investigating potential effects of climate change, and evaluating results through community consultation.

While the best available data was used for the gap analysis, there were some limitations that should be considered:

- This was a scientific analysis that did not involve consultation with local communities; therefore, the results provide initial guidelines regarding the degree of attention an area may warrant. Local considerations and customs still need to be considered and incorporated for each area (Kool *et al.* 2010).
- The plan needs to be reviewed to ensure that it is feasible, straight forward, and aligns with National and Provincial Government Programs (A. Vave-Karamui pers. comm.), particularly the Solomon Islands National Biodiversity Action Plan (SINBSAP 2008).
- The results make no claim for or against the benefits, effectiveness or sustainability of existing managed areas. Even if an area does not appear to have strongly attractive features based on the results of this assessment, there may be other compelling reasons for pursuing conservation management beyond the criteria used here. Some factors might include: the presence of rare species; the presence of habitat types that were not included in this analysis but which provide critical ecosystem services (such as seagrasses); and factors relating to other socioeconomic issues not addressed here (e.g., fisheries issues and climate change adaptation).

Thus the national conservation plan requires further refinements to adequately focus on achieving biodiversity objectives at the national level. Additional work is also required to address other objectives (e.g., fisheries and climate change adaptation)

[69] Department of Sustainability, Environment, Water, Population and Communities.

at the national level. Given the decentralized nature of the Solomon Islands, a better approach may be to use the gap analysis and other national and provincial government plans to identify broad areas that require conservation action, and to provide support for community-based planning approaches to help local communities achieve their objectives in those areas (e.g., see Lipsett-Moore *et al.* 2010a).

USCTI Integration Sites

In the National Plan of Action, the Solomon Islands developed a staged approach for engagement at the provincial level (MECM/MFMR 2010), which included provincial planning for four provinces (Malaita and three provinces in the Western Block: Western, Choiseul and Isabel Provinces) within the first three years. The Western Block (Isabel, Choiseul and Western Provinces) and Central Province were also identified as USCTI priority sites (CTSP 2010b).

While the national government (Ministry of Environment, Conservation and Meteorology) is committed to using all of these provinces as priority sites for integrating fisheries, biodiversity, and climate change objectives in the Solomon Islands, the number of USCTI integration sites was reduced to two (CSTP 2010c): Ghizo[70] Islands, Western Province; and Gella-Russell-Savo Natural Resource Management Network, Central Province. Central Province was also selected as a learning site by the Solomon Islands at the MPA regional exchange and workshop (CTSP 2010a: see The Regional Coral Triangle Marine Protected Area System). In 2011, the USCTI Integration Sites were revised again to focus on one site in the Solomon Islands: Ghizo Island and environs in Western Province (Figure 8: CTSP 2011).

Opportunities for CTSP to provide technical support for MPA network design in the Solomon Islands are described below. They include opportunities to provide financial support and technical advice for MPA network design for Ghizo Island in the Western Province, and opportunities to provide technical advice for MPA network design in Central and Isabel Provinces. Choiseul also provides an opportunity for lessons learned regarding how to conduct a conservation planning process, which reconciles community driven conservation with systematic conservation planning (see below).

Ghizo Island, Western Province

The Gizo Marine Conservation Area was established by Ghizo Islands' marine stakeholders with assistance from WWF-Solomon Islands (WWF-SI) in 1998, and a management plan produced in 2006 (Manele and Wein 2006). The program reactivated traditional marine resource management practices, and combined traditional knowledge and practice with current conservation methodologies. This includes the establishment of community-based MPAs to promote conservation of marine biodiversity and maintain subsistence resources.

The Gizo Marine Conservation Area is an integrated network of LMMAs aimed at protecting islands and coral reef ecosystems (Manele and Wein 2006). It covers an area of 42.6 $km^2$ including Ghizo Island and surrounding islets, and a wide range of marine and coastal habitats and critical marine areas (spawning aggregation sites, nursery areas, and important habitats for rare and threatened sea turtles, dugong and cetaceans). One site, Njari Island, has one of the highest diversities of coral reef fishes in the world (Allen 2006).

The Gizo Marine Conservation Area uses a variety of management tools including 8 permanent (no-take) MPAs and 15 multiple-use MPAs (which include seasonal/rotational closures, gear restrictions and selective use: Manele and Wein 2006). Permanent MPAs aim to safeguard areas of high biodiversity and fish spawning aggregation sites, while multiple use areas allow more flexible management options (including controlled harvesting practices, aquaculture developments and subsistence harvesting for food and income generation) [71].

The human influences on the marine environment and its resources are diverse in terms of resource use patterns, and the cultural and social practices that guide resource use (Manele and Wein 2006). This has placed key marine resources that support the majority of local people at risk from overharvesting and other threats (e.g., coral mining, habitat destruction, and improper waste management: Manele and Wein 2006, Sabetian and Foale S. 2006).

[70] Note the difference in spelling between Gizo town, and Ghizo Island (Sabetian and Foale 2006).

[71] WWF-SI has also been working with communities in other locations in the Western Province (Tetepare, Marovo, Heleba, Boboe, Nusa Tuva, Karaka, Rananga and Kekoro) to improve fisheries management, including the use of eight other LMMAs.

The majority of people living in and around the Gizo Marine Conservation Area (about 6000 people) are dependent on its marine resources for daily subsistence (Manele and Wein 2006). However, a marine survey conducted in 2005 found an overall low abundance of important fish species in the area (Hughes *et al.* 2005). Thus, the management plan was designed to help protect both the marine ecosystem and the marine resources that sustain the livelihoods of local people.

The focus of the Gizo Marine Conservation Area project shifted following the earthquake and tsunami which hit the Western Solomons in April 2007 (WWF-SI), since the communities and marine resources of Ghizo were among the worst affected in terms of livelihoods and resource impairment. Thus, the focus shifted to supporting livelihoods and monitoring critical areas (fish spawning aggregation sites: WWF-SI). One outcome has been the inclusion of a lunar sale and fishing ban in the recently revised Western Province Fisheries Ordinance (2011), which is awaiting final Government approval (A. Hughes pers. comm.). The ban applies to four large, rare and vulnerable species that aggregate to spawn.[72]

WWF-SI has completed habitat mapping for the area and is planning to revise the Gizo Marine Conservation Area regarding where the MPAs should be located (taking the impacts of the tsunami into account). Preliminary discussions with key stakeholders regarding what factors to consider and areas to include have taken place. WWF-SI now needs to consult widely and incorporate scientific principles for MPA network design. This will require the Solomon Islands LMMA Network taking a lead role in the process.

CTSP is willing to provide limited financial and technical assistance for a workshop with key stakeholders to develop a scientific design of a MPA network for the Gizo Marine Conservation Area (if required), which will achieve fisheries, biodiversity, and climate change objectives.

Gella-Russell-Savo Natural Resource Management Network, Central Province

The islands of the Russell Group, Gela and Savo make up the Central Province, spanning approximately 8,117 km$^2$ of ocean. The Province comprises a variety of marine habitats (including coral reefs, mangrove forests, seagrass communities, lagoons and channels,), which provide important benefits for local communities, including providing cash and food for daily survival.

Since 2004, the Foundations of the South Pacific International have been working with the communities of Sandly and Longana in Gela to help manage their marine and coastal resources. Using governance and alternative livelihood approaches, the work has focussed on providing capacity building for communities to strengthen their ability to manage their own development and resource management programs, and to strength the capacity of institutions that work with communities (e.g., the provincial government).

The communities of Sandfly and Longan have developed management plans and established six LMMAs. The project is now scaling up to develop a provincial network, a process whereby the provincial government is involved in community based resource management. Recently, a Gela, Russells, Savo Natural Resource Management Network was established to support community-based management/action plans, and to spread community-based management approaches from Gela to other islands in the province (the Russells and Savo).

This project remains a high priority for the National Government, since it aims to provide a model for developing provincial networks of MPAs by collaboration among communities in three areas, the Provincial and National Governments (Ministry of Environment, Conservation and Meteorology and MFMR) and NGOs (Foundations of the South Pacific International and WorldFish). Thus, the Gella-Russell-Savo Natural Resource Management Network provides a good opportunity for CTSP to provide technical advice regarding integrating fisheries (food security), biodiversity and climate change objectives into MPA network design (if required).

Choiseul Province

Choiseul is a remote north western Province with a low human population (~30,000: Lipsett Moore *et al.* 2010a). Over 90 percent of households have subsistence gardens, and over 86 percent are engaged in subsistence capture of finfish (National Census 1999). There are no commercial fisheries, and only one operational fisheries center purchases fish from local fishers

[72] Three groupers (*Plectropomus areolatus, Epinephalus fuscoguttatus* and *E. polyphekadion)* and the humphead wrasse (*Cheilinus undulatus)*.

(Lipsett Moore *et al.* 2010a). A lack of local markets, coupled with extended distances to other markets, means that in many communities fishing for reef fish remains predominantly for food only. Consequently fishing pressure for finfish is relatively low, although valuable marine invertebrates are overexploited (Ramohia 2006).

Virtually all land and shallow seas are traditionally owned by customary tenure (Lipsett Moore *et al.* 2010a), and many communities continue to retain strong control over their traditional land and sea areas. The customary closures are primarily for stockpiling valuable community resources, rather than for biodiversity conservation. Although to date, all LMMAs have been established as permanent closures, which will have some biodiversity benefits.

In 2009, a ridges to reef protected area network (PAN) plan was completed for the province which includes all lands, waters and seas out to a depth of 200m (the approximate extent of the area used by local communities). This is the first PAN proposed in the Solomon Islands. The plan is based on a community driven process by the Lauru Land Conference of Tribal Communities, which harmonized local knowledge with a modern conservation planning approach that accounts for biodiversity, threats and opportunities (Lipsett-Moore *et al.* 2010a, Game *et al.* 2010). In line with the Solomon Islands' commitment under CBD, they set a target representation of 10 percent of the total area of each conservation feature (habitat type: Lipsett Moore *et al.* 2010b). They also developed a climate change scenario where the representation of each conservation feature was increased to 20 percent. Sites of critical importance were also given elevated targets: 50 percent of the total area for fish spawning aggregation sites and 95 percent of the turtle nesting beaches. Fisheries objectives were not taken into account since the human population and fishing pressure is generally low.

Thus, the Lauru Protected Areas Network process provides an opportunity for lessons learned regarding how to conduct a conservation planning process, which reconciles community driven conservation with systematic conservation planning (Lipsett Moore *et al.* 2010a). During this process, a method for using sophisticated prioritization software collaboratively in a community setting was developed to dynamically assess and guide conservation opportunities as they arise (Game *et al.* 2010). This method has great potential to facilitate community-based planning processes elsewhere.

In 2009, the Lauru Land Conference of Tribal Communities committed to establishing a Lauru Protected Areas Network, where each of the 12 wards will establish at least one MPA and one terrestrial PA within two years. They also agreed that the implementation of the network will remain a community driven process guided by the plan.

The AusAID/Australian Government Project "Building the Resilience of Communities and Their Ecosystems to the Impacts of Climate Change in the Pacific" (Appendix 6) is now underway in the province. This project will focus on strengthening the capacity of local communities to adapt to climate change impacts by understanding the likely impacts of climate change, their resilience and vulnerability to these impacts, and potential adaptation solutions. Once this has been completed, the community may wish to refine the Lauru Protected Areas Network design to account for this information.

Furthermore as the Solomon Islands national government moves towards developing a set of conservation criteria for the nation, this will need to be incorporated in future analyses (Lipsett Moore *et al.* 2010a). This may include criteria to address climate change adaptation, climate change mitigation, and evaluating conservation priority areas regarding options for payments for ecosystem services. The Lauru Protected Areas Network provides a starting point for these discussions, and as new info becomes available it is likely to be modified (e.g., if areas are identified as unsuitable for community-based conservation). When and if the Lauru Protected Areas Network is refined in the next few years, CTSP may be able to provide technical advice for this process concerning the latest scientific advice regarding integrating fisheries, biodiversity, and climate change objectives into designing community based networks of MPAs.

Isabel and Malaita Provinces

The Solomon Islands was one of three CT countries selected for ADB/GEF's Regional Project "Strengthening Coastal and Marine Resources Management in the Coral Triangle of the Pacific" (Appendix 6). In the Solomon Islands, the host implementation agency for the project (Ministry of Environment, Conservation and Meteorology), identified Isabel and Malaita Provinces as the demonstration sites for the implementation of improved management systems and tools. The project will complete ecoregional assessments at the provincial level and introduce both ICM and EBFM into priority zones within the existing Community-Based Natural Resource Management Program. The project will integrate data on habitats,

resource status, and the expected climate change scenarios into the ecoregional assessment using Marxan. Priority areas for management will be supported through community management planning, monitoring, and alternative livelihood development.

TNC is also working with a range of stakeholders to develop a conservation plan for Isabel Province, which is likely to provide a roadmap for developing a ridges-to-reefs Protected Area Network for the Province.

# APPENDIX 2 TRANSBOUNDARY MARINE PROTECTED AREA NETWORK DESIGN DETAILS

## Sulu Sulawesi Marine Ecoregion

The Sulu Sulawesi Seas are located between the three populous nations of Indonesia, Malaysia and the Philippines (see Figure 9, from Pitcher 2008) and span an area of almost one million $km^2$. The area is exceptionally high in marine biodiversity (Carpenter and Springer 2005), and marine resources provide livelihoods and food (via fisheries and tourism) for over 30 million people (Pitcher 2008).

The region has one of the highest population densities in the world, and marine species are threatened by overfishing, overharvesting of marine turtles, pollution, coastal development and sedimentation (Pitcher 2008). In addition, livelihoods are threatened as fish stocks decline and commercial fishing increases. Climate change is also beginning to impact the area with increased ocean temperature and coral bleaching. Sea level rise and ocean acidification, although not yet measured in Sulu Sulawesi Seas, are of concern in planning for long-term protection and management.

In 2001, Indonesia, Malaysia and the Philippines formed a 50 year vision for biodiversity and sustainable productivity in the Sulu Sulawesi Seas (Miclat and Trono 2008). The vision consists of 58 priority conservation areas that represent the known range of biodiversity and ecological and evolutionary processes that maintain biodiversity. From the vision, an ecosystem-wide conservation plan for the SSME was developed through a participatory process with key stakeholders (Miclat and Trono 2008). The plan consists of country and ecoregional level actions plans based on shared objectives, one of which is to establish a functional integrated network of priority conservation areas to ensure ecological integrity.

The SSME Ecosystem-wide Conservation Plan was ratified by all three countries in 2004, and it is now jointly managed by the Tri-National Sulu Sulawesi Sea Commission under a Memorandum of Understanding (Miclat and Trono 2008). These countries, in partnership with local governments, communities, scientific institutions, international NGOS, donors and the business sector, are in the process of building capacity required to implement the plan.

The Sulu Sulawesi Committee is composed of three subcommittees to respond to major issues in the ecoregion regarding (Miclat and Trono 2008):

1. Sustainable fisheries, aquaculture, living aquatic resources use, trade and livelihood systems;
2. Identification, establishment, and management of MPAs and MPA networks; and
3. Protection and management of endangered charismatic and migratory species.

The goal of the MPAs and networks subcommittee is the conservation and sustainable management of biodiversity in the SSME through the establishment and effective management of MPAs and networks (Miclat and Trono 2008). Two CTSP members have transboundary programs that focus on MPA network design in the Sulu Sulawesi Seas: WWF's SSME Program; and CI-Philippines Sulu-Sulawesi Seascape (see Glossary) Program. The following sections provide a description of their work in this area.

Sulu Sulawesi Marine Ecoregion Program

In 2003, WWF-SSME convened a workshop of MPA experts and practitioners to develop a framework for a network of MPAs in the Sulu-Sulawesi Seas to achieve three objectives: protection of species of special concern; management of the integrated coastal ecosystem; and fisheries management (WWF-SSME 2004, Miclat 2008). Since it was not possible to design an MPA network using marine spatial planning due to insufficient and scattered data, they developed a framework based on expert opinion and best available biophysical information (Miclat 2008). The framework comprises a set of ecological, socioeconomic and cultural guidelines for planning MPA networks (WWF-SSME 2004, Miclat 2008), which include many resilience principles for MPA network design (McLeod *et al.* 2009, IUCN WCPA 2008). Different criteria were initially developed to achieve each of the three objectives, so a general framework was developed by combining all three sets of criteria. The framework now provides guiding principles and biophysical and socioeconomic decision rules for establishing MPA networks in the SSME, and was used to refine the design of a network of protected areas for marine

turtles in the Sulu Sulawesi Seas (Pilcher 2008: see below). The framework has also been incorporated in the work plan of the Tri-national subcommittee for MPAs and networks.

Since 2001, WWF has focused on building local capacity for designing and implementing protected area networks and finding alternative livelihood strategies for local communities (WWF SSME 2011[73]). A primary focus has been to ensure the viability and effectiveness of the initial MPAs in the Sulu Sulawesi Seas, comprised mostly of Tubbataha Natural Park in the Philippines, and the jointly managed Turtle Islands National Marine Park (lying on the border between Philippines and Sabah, Malaysia). In addition, an effort to develop alternative sources of income for the residents of the Cagayancillo Islands (the traditional resource users of the Tubbataha reefs) and residents in the Turtle Islands has been successful.

WWF's current interests in MPA network design in the Sulu Sulawesi Seas include designating new parks in priority conservation areas and ensuring that MPA networks are created in ways that allow for connectivity between sites (WWF SSME 2011). One of WWF's priority sites for MPA network design in the Sulu Sulawesi Seas is TMP within Kudat-Banggi priority conservation area in Sabah (see Malaysia, USCTI Integration Sites). CTSP is providing financial and technical support for integrating fisheries, biodiversity, and climate change objectives into the zoning plan for Tun Mustapha Park (see Malaysia, USCTI Integration Sites).

Sulu Sulawesi Seascape Program

One aim of CI's Sulu Sulawesi Seascape Program is to provide a scientific basis for establishing MPAs and MPA networks within marine biodiversity conservation corridors[74] (MBCCs) in the Sulu Sulawesi Seas (Quibilan *et al.* 2008). Where the three priority MBCCs identified for the first phase of implementation are:

1. Verde Island Passage and Balabac Strait that links the Sulu Sea and South China Sea;
2. The Tri-National Sea Turtle Corridor that links the Sulu Sea with the Sulawesi Sea; and
3. Cagayan Ridges (comprising Tubbataha MPA and the Cagayancillo Islands), which helps maintain connectivity of marine populations within the central Sulu Sea and beyond.

A key component of CI's work in the Sulu Sulawesi Seas is designing MPA networks for the priority MBCCs (Quibilan *et al.* 2008). CI aims to conserve important species and habitats while sustaining people's need for the products and services derived from the ocean. CTSP is providing technical support for integrating fisheries, biodiversity, and climate change objectives into MPA design at Verde Island Passage MBCC (see Philippines, USCTI Integration Sites).

Since 2009, WCS has also been involved in the area, working with local communities and governments to strengthen the management of one of the largest networks of community based MPAs in north Sulawesi. Initially established by the USAID Coastal Resources Management Program, the network consists of 31 MPAs that provide ecological connectivity and support to other highly diverse MPAs such as Bunaken National Park.

Over the last few years, CI's Sulu Sulawesi Seascape Program has been focused on gaining a better understanding of connectivity between populations of marine organisms within and across the MBCCs (Quibilan *et al.* 2008). This involved supporting a study regarding mapping larval fish distribution and modeling dispersal by seasonal currents (Campos *et al.* 2007, Villanoy *et al.* 2007). An initial connectivity model exists for the Sulu Sea (see Quibilan *et al.* 2008), and studies are required to fill gaps, identify replenishment sites, and broaden the model to incorporate more species (particularly food species such as small pelagic species).

CI's Sulu Sulawesi Seascape Program has also been working on designing a network of protected areas for marine turtles (Pilcher 2008). A draft design has been completed that includes all three countries, which has been approved by the Sulu

[73] wwf.panda.org/about_our_earth/blue_planet/publications/?6689/Fact-Sheet-Sulu-Sulawesi-marine-ecoregion

[74] The Sulu Sulawesi Marine Ecoregion is composed of three biogeographic regions of the Philippines: Sulu, Visaya and Sulawesi Seas. The interfaces or 'marine corridors' between these regions were identified as priority areas for protection, since maintaining these connections enables sub-populations to converge and replenish each other ensuring that their network remains robust against extinctions (Ong et al 2002).

Sulawesi Commission. CI and partners are now focusing on implementing the network. Sites in the network include (Pilcher 2008):

- Malaysia: Sipidan Island Protected Area, Sugud Islands Marine Conservation Area, Tun Sakaran Marine Park, and Tun Mustapha Marine Park;
- Indonesia: Berau Marine Conservation Area and Bunaken National Marine Park;
- Philippines: Balabac Strait Corridor and El Nido Marine Reserve together with continuing management support for Tubbataha Natural Park; and
- The transboundary Turtle Islands Heritage Protected Areas, which comprises the key nesting sites for green and hawksbill turtles in the Sulu Sulawesi Seas: In a historic bilateral agreement, the Governments of the Philippines and Malaysia established the Turtle Islands Heritage Protected Areas, the first and only transboundary protected area for marine turtles in the world (Pitcher 2008). The protected areas agreement covers nine islands (six in southwestern Philippines and three in Sabah, Malaysia) which lie adjacent to the international treaty limits that separate the two countries. Management is shared by both countries, making possible the conservation of habitats and sea turtles over a large area independent of their territorial boundaries (Pitcher 2008).

CI's long term interests in MPA network design include designing and implementing MPA networks for the greater Sulu and Sulawesi Seas, which will address the security of ecosystem services (particularly food security), and achieve cultural and tourism objectives. To improve the scientific basis for the design, they are interested in improving connectivity models of the Sulu Sulawesi Seas (see above).

## Lesser Sunda Ecoregion

The Lesser Sunda ecoregion (Figure 10) encompasses the chain of islands and surrounding waters from Bali, Indonesia to Timor-Leste, (Wilson *et al.* 2011). This region is of outstanding marine conservation value for shallow coastal habitats, including coral reefs, mangroves and seagrass, as well as for endangered turtles and cetaceans (DeVantier *et al.* 2008, Kahn 2008). Coastal habitats are highly diverse with the seafloor dropping steeply from shallow coral reefs to depths of up to 2000 m. Deep sea habitat features, like seamounts and underwater canyons; occur within kilometers of the coast, creating deep sea habitats near the shoreline. The region is also characterized by exceptionally strong currents generated by the passage of the Indonesian Throughflow through the narrow channels between islands (Wilson *et al.* 2011).

Coastal reefs and associated ecosystems of the ecoregion have long been threatened by destructive fishing, overfishing, pollution and coastal development (Wilson *et al.* 2011). They are now also threatened by climate change impacts including increased sea temperatures, sea level rise, extreme weather and ocean acidification.

Creating MPA networks is a key strategy to increase the resilience of these ecosystems to climate change by identifying and protecting areas that are more resilient to climate change and reducing stresses caused by other anthropogenic threats (Wilson *et al.* 2011). An equally important strategy for the ecoregion is to plan and implement fisheries management strategies.

In 2009, TNC led the design of a resilient network of MPAs for the Lesser Sunda Ecoregion (Wilson *et al.* 2011). The design was based on a detailed scientific assessment and an extensive stakeholder consultation process. Some key features of the design include:

- The MPA network was designed to meet resilient MPA network design criteria while minimizing impacts on local communities.
- It is one of the first demonstrations of the application of resilience principles to MPA network design at the ecoregional level.
- It demonstrated innovative approaches to the challenge of conducting large-scale marine spatial planning in a data deficient area.
- An extensive stakeholder consultation ensured that government representatives and stakeholders were able to provide inputs into the design.

- It was essentially a gap analysis that included 37 existing and 19 proposed MPAs in the design, including the 3.5 million ha Savu Sea Marine National Park (SSMN). It also identified 44 Areas of Interest (AOIs) to consider as new MPAs. The design incorporates coastal, shallow marine and deep sea yet near shore habitats. It includes 100 protected areas (covering 9.7 million ha) including 85 shallow marine and coastal reserves and MPAs for coral reefs, mangroves and seagrass (covering 2 million ha), and the SSMNP which includes both shallow coastal and deep sea habitats (3.5 million ha), and 14 larger offshore MPAs (covering 4.2 million ha) that encompass deep sea yet near shore habitats critical for the highly diverse assemblage of marine mammals that occur in this region.

The design of the Lesser Sunda MPA network represents the views of scientists and key stakeholders based on best available information in a data deficient area (Wilson *et al.* 2011), and does not yet fully include design aspects required to maximize the benefits to fisheries production in the area. Also, since the AOIs identified for potential new MPAs have not been endorsed by local governments and communities, the boundaries of the AOIs, or even their location, may shift as the result of more detailed discussions with governments, local communities and other stakeholders when considering locations and boundaries that may be affected by fisheries considerations. Thus the present design allows for some flexibility in the size and location of final MPA boundaries in relation to the AOIs based on what will be acceptable in the local socioeconomic context.

The scientific design of the Lesser Sunda MPA network, and the accompanying database, provide valuable resources for national, provincial and district government agencies to guide coastal and marine planning. Since the design was completed: the Ministry of Marine Affairs and Fisheries in Indonesia has agreed to adopt the design as the primary reference for establishing MPAs in the ecoregion, and for marine and coastal spatial planning at district, provincial and national levels (Wilson *et al.* 2011); and Timor-Leste has used the results as the basis for the marine component of their National Ecological Gap Assessment (Grantham *et al.* 2011).

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Technical expertise of scientists, geographic areas of interest, the type of assistance, and the cost of providing that assistance.

| Institutions & Individuals[77] | AIMS | ARC CoE | | | CDU | CI | | | | | CU | Consultants | | | | | | | | CSIRO | | DEC | JCU | NOAA | | | PEMSEA | | RARE | | SU | TNC | | | | | | | | | | UH | UQ EDG | | UQ GCI | UP MSI | UW | WCS | | WWF |
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| | KA, JL, CS | SF, JC | GA | BP, JK, RW | KE | LK | TG | AM | SA | HG | GK | JM | HG | ET, LD | LS | KC | LF | HS | JB | NM | KF | AH | RB | AW | SH | Org. | AU | EC | SG | RA | RS, EM, AC | EB, AH | AS | RH, SV | SM, JW | SW | EG | VA | MG, AW, AG | JH | AM | HP, CK, MB | PM, ET | OHG, MK | PA | PC | SJ | SC | HF, AL, MM, JTL |
| **TECHNICAL EXPERTISE & INTERESTS** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Marine Spatial Planning** | | | X | X | X | | X | | | X | | | | X | X | | X | | X | | | | | | | X | X | X | | | | | X | X | | X | X | X | | | X | X | | | X | X | X |
| Developing and applying decision support tools | | | X | | | | | | | X | | X | | | | | | | | | | | | | | | | | | | X | | | | | | X | X | X | | | X | X | | | | | X |
| Building GIS databases | | | | | X | | | | | X | | | | | | | | | | | | | | | | | | | | | X | | | | | | | | | | | | | | | | X | | X |
| **Achieving Multiple Objectives** | | | | X | | | | | | X | | | | X | | | X | | | | | | | | | | | | | | X | | | X | X | | X | X | X | | | X | X | | X | | | X |
| Biodiversity | | | | X | | | | | | X | | | | X | | | X | | | | | | | | | | | | | | X | | | X | X | | X | X | X | | | X | X | | | | | X |
| Fisheries | | X | | X | | | | | | X | | | | | | | X | | | | X | | | | | | | | | | | X | X | X | X | X | | X | X | X | | X | X | X | | | | | X |
| Climate Change | | | | X | | | | | | X | | X | | | | | | | X | | | | | | X | | | | | | X | | | X | X | | X | X | X | | | X | X | X | X | | | X |
| **Refining Design Principles** | | | X | X | | | | | | | | | | | | | X | | | | | | | | | | | | | | X | | | | | | X | X | X | | | | | | | | | X |
| Refining biophysical design principles | | | | X | | | | | | | | | | | | | X | | | | X | | | | | | | | | | X | | X | | | | X | | X | | X | X | | | | | | | |
| Refining socioeconomic design principles | | | | X | | | | | | | | | | | | | X | | | | | | | | | | | | | | | | | | | | | X | | X | | | X | | | | X | | | |
| Integrating multiple objectives in design principles | | | | X | | | | | | | | | | | | | X | | | | | | | | | | | | | | X | | X | | | | X | X | X | | | X | | | | | | | |
| **Developing and Applying Biophysical Models** | X | | | X | | | X | | | X | | X | | | | X | | | X | | | | X | | X | | | | | X | X | | X | X | | X | X | X | | | X | X | X | | | X | | |
| Ecological/ biological | X | | | X | | | X | | | | | | | | | | | | | | | | | | | | | | | | | X | | | | X | | X | | | X | X | | | | | | |
| Connectivity | | | | X | | | X | | | | | | | | | | | | | | | | | | X | | | | | | | | | X | | | | | X | | | X | X | | | | | | |

[77] Full name of experts found in Appendix 4.

| Institutions & Individuals[77] | AIMS | ARC CoE | | | CDU | CI | | | | | | CU | Consultants | | | | | | | | CSIRO | | DEC | JCU | NOAA | | | PEMSEA | | RARE | | SU | TNC | | | | | | | | | | UH | UQ EDG | | UQ GCI | UP MSI | UW | WCS | | WWF |
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| | KA, JL, CS | SF, JC | GA | BP, JK, RW | KE | LK | TG | AM | SA | HG | GK | JM | HG | ET, LD | LS | KC | LF | HS | JB | NM | KF | AH | RB | AW | SH | Org. | AU | EC | SG | RA | RS, EM, AC | EB, AH | AS | RH, SV | SM, JW | SW | EG | VA | MG, AW, AG | JH | AM | HP, CK, MB | PM, ET | OHG, MK | PA | PC | SJ | SC | HF, AL, MM, JTL |
| Fisheries | | | | X | | | | | | X | | | | | | | | | | | | | | | | | | | | X | | X | | | | | X | | | | | | | | | | | |
| Stressors | | | | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Climate change | X | | | X | | | | | | | | X | | | | | | | X | | | | | | X | | | | | | X | | | X | | | X | X | X | | | | X | X | | | | |
| Physical oceanography | X | | | X | | | | X | | | | | | | | X | | | | | | | X | | X | | | | | | | | | | | | X | X | X | | | | X | | | | | |
| Patch dynamics | | | | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Using remote sensing/satellite data | X | | | | | | | | | | | X | | | | | | | | | | | X | | X | | | | | | X | | | | | | X | | | | | | X | | | | | |
| **Incorporating Biological Considerations** | X | X | X | X | X | X | | X | | X | | X | | X | | | X | | | | X | X | X | | | | | X | X | X | X | X | X | X | | | | | | | X | X | X | X | | X | X | X |
| Population/ community ecology | | X | X | | | | | X | | | | X | | X | | | X | | | | X | X | | | | | | | | X | X | | X | X | X | | | X | | | X | X | X | X | | X | X | X |
| Populations of key species (e.g., fisheries species) | | X | X | | | | | | | | | | | X | | | | | | | X | X | X | | | | | | | | X | X | X | X | | | X | X | | | X | X | X | | | X | X | X |
| Ecosystem function and coral reef resilience | X | | X | | | | | X | | | | X | | X | | | | X | | | X | | | | | | | | | X | X | | | X | | X | | X | | | | X | X | | X | X | |
| Connectivity | | | X | X | | | | | | | | | | X | | | | | | | | | | | | | | | | X | | | | X | | | | X | | | X | X | | | | | | X |
| Biodiversity & habitat classification | | | | X | X | | | | | X | | | | X | | | X | | | | | X | | | | | | | | X | | | | X | | | | X | | | X | X | | X | | | X | |
| Using surrogates for biodiversity | | | | X | | | | | | | | | | | | | | | | | | | X | | | | | | | | | | | | | | | X | | | | | | | | | | |
| Protecting critical habitats (e.g., fish spawning aggregation sites) | | | X | | | | | | | X | | | | | | | X | | | | | X | | | | | | | | | | X | X | X | | | | X | | | | X | | | | | X |
| Protecting rare and threatened species (cetaceans, turtles etc) | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | | | X | X | | | | X | | | | | | | | | | |
| Pelagic ecosystems | | | | X | | | | | | X | | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | | | | | | | | | | |

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| | KA, JL, CS | SF, JC | GA | BP, JK, RW | KE | LK | TG | AM | SA | HG | GK | JM | HG | ET, LD | LS | KC | LF | HS | JB | NM | KF | AH | RB | AW | SH | Org. | AU | EC | SG | RA | RS, EM, AC | EB, AH | AS | RH, SV | SM, JW | SW | EG | VA | MG, AW, AG | JH | AM | HP, CK, MB | PM, ET | OHG, MK | PA | PC | SJ | SC | HF, AL, MM, JTL |
| Vulnerability, adaptive capacity and resilience to climate change | X | | | X | X | | | | | | | X | | | | | | | X | | | | | | X | | | | | | X | | | | | | | | | | | | | | | | X | | X | |
| Reef restoration | | | | | | | | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **Incorporating Socio-economic Considerations** | | X | | X | X | X | | | X | X | X | | X | | X | | X | X | X | X | | | | | | | | X | X | | X | X | X | X | | X | | | X | | | X | | | X | | X | | X | |
| Ecosystem services | | | | | | | | | | | | | | | X | | | | X | | | | | | | | | | | | | X | | | X | | | | | | | | | | | | | | |
| Livelihoods/resource dependency | | | | | X | | | | X | | X | | X | | X | | | | X | X | | | | | | | | | | | | X | X | | | | | | | | | | | | | | | | |
| Fisheries | | X | X | | | | | | | X | X | | X | | | | X | | | | | | | | | | | | X | X | | X | X | X | X | | | X | X | | | X | | | | | | X |
| Tourism | | | | | | | | | | | | | | | | | X | | | | | | | | | | | | | | | | | | X | | | | | | | | | | | | | |
| Economics | | X | | X | | | | | | | | | | | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Social vulnerability, adaptive capacity and resilience | | X | | | | | | | | | | | | | X | X | | | X | X | | | | | | | | | | | X | | | | X | | | | X | | | | | | | | X | |
| Adaptation to climate change | | | | X | | | | | | | | | | | | | | | X | | | | | | | | | X | | | X | | | X | X | | X | X | | | | | | | | | |
| Cultural Issues | | X | | | | | | | | | X | | | | X | | | | | | | | | | | | | | | | | | X | X | | | | X | | | | | | | | | |
| Customary Marine tenure | | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | | | | | X | | | | | | | | | |
| Understanding and incorporating traditional/local knowledge | | X | | | | | | | | | | | | | | X | | | X | | | | | | | | | | | | | | X | X | | X | X | | X | X | | | | | | | | |
| Policy/ governance | | X | | | | X | | | | | | | X | | X | X | | X | X | | | | | X | | | | X | X | | | X | X | | | | | | X | | | | | | X | | | X |
| Stakeholder engagement | | | | | | | | | | X | | | | | X | | X | | | | | | | | | X | | | | | | | | X | | | | | X | X | | | | | | X | | | |
| Reducing conflict | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | | | |
| **Application at Multiple Scales** | X | | | X | | | | | | X | | | X | X | | | X | X | | | | | | X | X | X | | | | | X | X | X | X | | | X | | X | | | | X | X | X | X | | X |
| Regional and ecoregional | X | | | X | | | | | | | | | X | X | | | X | | | | | | | X | X | X | | | | | X | X | X | | | | X | | X | X | | | X | X | X | | | X |

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| | KA, JL, CS | SF, JC | GA | BP, JK, RW | KE | LK | TG | AM | SA | HG | GK | JM | HG | ET, LD | LS | KC | LF | HS | JB | NM | KF | AH | RB | AW | SH | Org. | AU | EC | SG | RA | RS, EM, AC | EB, AH | AS | RH, SV | SM, JW | SW | EG | VA | MG, AW, AG | JH | AM | HP, CK, MB | PM, ET | OHG, MK | PA | PC | SJ | SC | HF, AL, MM, JTL |
| National and subnational | X | | | X | | | | | | X | | X | X | X | | | X | | X | | | | X | | X | X | | | | X | X | X | X | X | | X | X | X | X | | X | X | | X | | | | X |
| Community-based approaches | | X | X | X | | | | | X | | X | | X | | | | | | X | | | | | | | | | | | | | X | X | X | | X | | X | X | X | | | | X | | | X | X |
| Temporary closures | | | | | | | | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Scaling up and down from community-based MPAs to MPA networks | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | | | | | | | X | | | X | | | | | | | | | |
| **Integrating Shallow and Deep Sea MPAs** | | | | X | | | | | | X | | | | | | | | | | | | | | | | | | | | | | | | | X | | X | | X | | | | | | | | |
| **Integrating Land and Sea Conservation Planning** | | | | X | | | | | | X | | | | | | | | | | | | | | | | | | | | | | | | X | | | X | | X | X | | X | | | X | | |
| **Integrated Approaches to Marine Resource Management (EBM, ICM, EAFM)** | | | X | X | X | | | | | | | | X | | X | X | X | | | | | | X | X | | X | X | X | X | | | X | X | X | | | X | | X | | | | | X | | |
| **Conservation Resource Allocation** | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | | | | | | | |
| **Capacity Building and Training in MPA Design** | X | | | | | | | | | X | | | | | | | | | | | | | | X | | | | | | X | | | | | | X | | X | X | | X | | | | | | |
| **Science communications, education and outreach** | | X | | | | X | | | | | | X | | | | | | | | | X | X | | | | | | | | | | | | | | | | | | | | X | | | | | | | |
| **GEOGRAPHIC AREAS OF INTEREST IN CT** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Indonesia | | | | | | | | | X | | | X | | | | | | X | | | | | X | | | | | X | | | | X | X | | X | | | | X | X | | | X | | | X | X |
| Malaysia | | | | | | | | | | | | | | | | | | X | | | | | | | | | | | | | | | | | | | | X | | | | | | | | | | X |

| Institutions & Individuals[77] | AIMS | ARC CoE | | | CDU | CI | | | | | CU | Consultants | | | | | | | | CSIRO | | DEC | JCU | NOAA | | | PEMSEA | | RARE | | SU | TNC | | | | | | | | | | | | UH | UQ EDG | | UQ GCI | UP MSI | UW | WCS | | WWF |
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| | KA, JL, CS | SF, JC | GA | BP, JK, RW | KE | LK | TG | AM | SA | HG | GK | JM | HG | ET, LD | LS | KC | LF | HS | JB | NM | KF | AH | RB | AW | SH | Org. | AU | EC | SG | RA | RS, EM, AC | EB, AH | AS | RH, SV | SM, JW | SW | EG | VA | MG, AW, AG | JH | AM | HP, CK, MB | PM, ET | OHG, MK | PA | PC | SJ | SC | HF, AL, MM, JTL |
| Papua New Guinea | | | X | | | | | | X | | | | | | | | | | | | | | X | | | | | | | | | | X | X | | | | X | X | | | X | | | | | | |
| Philippines | | | | | | | | | | | | | | | | | | | | | | | | | | X | | | X | | | | | | | | X | | | | X | | | | X | | X |
| Solomon Islands | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | | | | | X | X | | | X | | | | | | |
| Timor-Leste | | | | | | | | | X | | | | | | | | | | | | | | X | | | X | | X | | | | | | | | | | | | | | X | | | | | | |
| Pacific Islands | | | | | | | | | | | | X | | | | | | | | | | | X | | | | | | | | | X | | | | X | | X | X | | | | | | | | |
| Southeast Asia | | | | | | | | | | | | X | | | | | | | | | | | X | | | X | | | | | | | | | | | | X | | | | | | | | | | |
| South China Sea | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | | | | |
| Sulu Sea | | | | | | | | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | | | | | | X | | | | |
| All CT countries | | | | X | | | | | | | | | | | X | | | | | X | | | | | | | X | X | | | | X | | | | | X | | X | | | X | | | X | | | |
| Other | X | | | | | | | | X | X | | | | | | | X | | | X | | | | X | | | | | | | X | | | | | X | | | | | X | X | | | | | |
| **EXPERIENCE WORKING IN THE CT** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Indonesia | | | | | | | X | | X | X | | X | | X | | | | X | | | | | | X | | X | X | X | X | | X | X | | | X | | X | X | X | | | | X | | X | X |
| Malaysia | | | | | | | | | X | | | | | | | | | X | | | | | | | | | | | X | | | | | | | | | | | | | X | | | | | X |
| Papua New Guinea | X | | X | | | | | | | | | | | X | | | X | | | | | | | | | | | | | X | | X | X | | X | X | | X | X | | | X | | | | |
| Philippines | | | | X | | | | X | | | | | | X | | | | X | | | | | | X | | X | X | | X | | | | | | | | | X | | X | X | | | X | X | | X |
| Solomon Islands | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | | X | X | | X | X | | X | X | | | | | | | |
| Timor-Leste | | | | | | | | | X | X | | | | X | | | | | | | | | | | | X | | X | | | | | | | | | | | | | | | | | | | |
| All CT countries | | | | | | | | | | | | | | | X | | | | | | | | | | | | | X | | | X | | | | | | | | X | | | X | X | X | | | | | |
| **EXISTING CONTACTS WITH CT GOVERNMENTS, NGOs AND SCIENTISTS** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Indonesia | | | | | | | X | | X | | | X | | X | | | X | X | | | | | X | X | | | | | | | | X | X | | X | | X | | X | | | X | | | X | | X | X |
| Malaysia | | | | | | | | | | | | | | | | | | X | | | | | | | | | | | | | | | | | | | | X | | | | X | | | | | X |
| PNG | X | | X | | | | | | X | | | | | | | | X | | | | | | | | | | | | | | | X | X | X | | X | | X | X | | | | | | | X |
| Philippines | | | | X | | | | | | | | | | X | | | X | X | | | | | | | | | X | | | | | | | | | | | X | | | X | X | | X | | | | X |
| Solomon Islands | | | | X | | | | | | | | | | | | | X | | | | | | | | | | | | | | | X | X | | | X | | X | X | | X | | | | | | |
| Timor-Leste | X | | | | | | | | X | | | | | | | | | | | | | | X | | | | | | | | | | | | | | | | | | | | | | | | | |
| All CT countries | | | | | | | | | | | | | | | X | | | | | | | | | | | | | | | | | | | | | | | X | | | X | | | | | | | |
| None | | | | | | | | | | | | | | | | | | | | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| **TYPE OF ASSISTANCE** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Technical advice | X | | X | | | | X | X | X | X | | X | | | X | | | | | | | | X | X | | X | X | X | X | | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X | X |
| Training | | | | | | | | | X | | | X | | | X | | | | | | | | | X | | X | X | X | | | X | X | | X | X | X | | X | X | | | X | | | | X | | |

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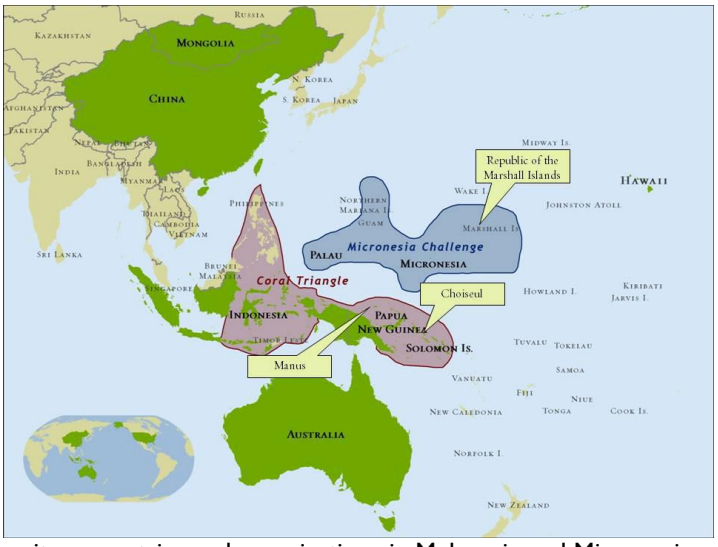
| | KA, JL, CS | SF, JC | GA | BP, JK, RW | KE | LK | TG | AM | SA | HG | GK | JM | HG | ET, LD | LS | KC | LF | HS | JB | NM | KF | AH | RB | AW | SH | Org. | AU | EC | SG | RA | RS, EM, AC | EB, AH | AS | RH, SV | SM, JW | SW | EG | VA | MG, AW, AG | JH | AM | HP, CK, MB | PM, ET | OHG, MK | PA | PC | SJ | SC | HF, AL, MM, JTL |
| Monitoring and evaluation | | | | | | | | | | | | | | | | | | | | | | | X | | | | | | | | | | | X | | | | X | | X | | | | | X | | | | |
| Capacity building | | | | | | | X | X | X | X | | | | | X | | | | | | | | | X | | X | X | X | | | X | | X | | X | | | X | | X | | X | | | X | X | | | X |
| Consulting | | | | | | | | X | | | | X | | | X | | | | | | | | | | | X | X | X | | | | | | | | | | | | | | X | | | | | | |
| All of the above | | | | X | | | | | | | | | | X | | | X | | | | | | | | | | | | | | | | | | | | | | | | X | | | | | | X | |
| **COST OF PROVIDING ASSISTANCE** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Full costs | | | | X | | | | X | | | | | | X | X | | X | X | | | | | | | | | | | | | X | | | | | | | | | | X | | | | | | | X |
| Partial costs | | | | | | | | | X | | | | | | | | | | | X | | | | | | | | | | | | | | | | | | | | | X | | | | | | X | |
| Travel costs | | | X | X | | | | | | | | | | | | | | X | | | | | | X | | | | X | | | X | X | X | X | X | X | | | X | | X | X | | | | | X | |
| Negotiable | | | | | | | | | | | | X | | | | | | | | | | | | | | X | | | | | | | | | | | | | | | | | | | | | | | |
| Nil if consistent with research program | | | X | | | | | | | | | | | | | | | | | | | | X | | | | | | | | | X | X | X | X | | X | | X | X | | X | X | | | | | |
| Review on case by case basis | X | | | X | | | | | | | | | | | | | | | | X | | | | | | X | X | X | X | | | | | | | | X | X | | | X | X | X | X | | | | |
| **RESOURCES TO CONTRIBUTE** | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Yes | | | | | | | | | | | | | | | | | | | | | | | X | | | | | | | | | | | | | | | | | | | | | | | | | X | |
| No | | | | | | | | X | | | | X | | X | | | X | X | | X | | | | | | | X | | | | | | | X | | X | | | | | X | | | | | | | |
| Possibly | | | X | | | | | | | | | | | | X | | | | | | | | | X | | X | | | | | X | X | X | | | | X | | X | | | | X | | | | X |
| Case by case basis | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| Time | | | | | | | | | | | | | | | | | | | | | | | X | | | | | | | | | X | | | | | X | | | | X | | | | | | | |
| Research grants | | | | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | | | | | |
| Students/post docs | | | | X | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | X | | | | | |
| In kind (staff, skills) | X | | | | | | | | X | | | | | | | | | | | | | | X | X | | | | | | | | | | | | | | X | | | X | X | X | | | | | |
| Travel costs | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | X | | | |

# APPENDIX 6 REGIONAL PROJECTS BY DEVELOPMENT PARTNERS

## Australian Government Overseas Aid Program (AusAID): Building the Resilience of Communities and Their Ecosystems to the Impacts of Climate Change in the Pacific

The "Building the resilience of communities and their ecosystems to the impacts of climate change in the Pacific" project recognizes the critical role that ecosystems services play in supporting communities in the Pacific. Led by TNC and involving a broad range of partners, this project aims to bring science, economic and cultural heritage information together with on-ground experience to better understand climate change vulnerability and responses. This project will focus principally on strengthening the capacity of five target communities in Papua New Guinea (Manus Province) and Solomon Islands (Choiseul Province), and one community in the Marshall Islands to adapt to climate change impacts. These three countries have declared their commitment to the sustainable use and conservation of marine and coastal resources, and their commitment to address the impacts of climate change, at the highest level through the recent CTI, Coral Triangle Ministerial Communiqué on Climate Change, and 'Reimaanlok' (or 'Way Forward').

The project will build upon a foundation of existing commitments, tools and strategies for community-based adaptation action at the local level. These include the commitment by the Council of Chiefs of Choiseul Province to implement an island-wide program of community conserved protected area networks, and the establishment of the Manus Provincial Environment and Climate Change Council to integrate climate change impacts into the provincial development planning process. The project will engage and support local and provincial level planning, and finance and administrative arrangements to effectively integrate adaptation options adopted by these communities into development planning, national adaptation plans and programs.




Project objectives address three components:

- Understanding climate change risk;
- Demonstrating community-based adaptation; and
- Decision-making and leverage.

Key outcomes will include:

- Partner communities are able to 'visualize' the likely impacts of climate change, their resilience and vulnerabilities, and potential adaptation solutions;
- Locally relevant incentives are in place for community-based adaptation;
- Local and provincial leaders integrate adaptation into development strategies; and
- National government adaptation plans are strengthened.

The project will allow for cross learning by partners across sites, countries and organizations in Melanesia and Micronesia.

For more information see: http://community.eldis.org/?233@@.59df6091!enclosure=.59df6092&ad=1

## Asian Development Bank/Global Environment Fund (ADB/GEF): Strengthening Coastal and Marine Resources Management in the Coral Triangle of the Pacific

The "Strengthening coastal and marine resources management in the CT of the Pacific" project, still under development, is in response to concerns regarding effective management of coastal and marine resources raised by five Pacific countries (PNG, Solomon Islands, Timor-Leste, Fiji and Vanuatu), which lie within or border the CT (ADB 2010). Once implemented, it will focus on ensuring food security for local populations by supporting more effective management of coastal and marine resources, especially those associated with coral ecosystems, to build their resilience to increased threats arising from human induced and climate change impacts. It will therefore assist in fulfilling CTI-related objectives, and in engaging other countries in these efforts.

In each CT country, approval will be obtained prior to the project starting with in-country decisions being ratified by CTI National Coordinating Committees. Each committee identified demonstration sites for implementation of improved management systems and tools. Site selection was based on criteria including existing programs, data availability, subnational support, ease of access and importance of coastal ecosystems. Sites include Kimbe Bay and Manus Province (PNG); Isabel and Malaita Provinces (Solomon Islands); and Atauro Island and Batugede (Timor-Leste); and the details of the work to be conducted at each site is provided in the summary for each country in Appendix 1.

The focus of demonstration sites is to design, implement and evaluate processes, tools and impacts relating to ICM and EBM, especially with respect to coastal fisheries and biodiversity conservation prioritization. All management systems will be integrated within existing community-based management regimes, which will ensure the integration of contemporary and traditional management systems.

The project will focus on overcoming key issues facing inshore fisheries, marine managed areas, and land-based pollution affecting coastal waters. It is structured around four outputs for building more effective coastal and marine resource management and effective program management: 1) strengthening management capability and capacity; 2) experimental learning to develop best management practices for ICM and EBFM and applying them at demonstration sites; 3) building supporting institutional frameworks including developing and adapting necessary systems and processes to ensure an effective enabling environment for undertaking ICM and EBFM best management practice in all five countries; and 4) effective management of the project across five countries.

Outputs of defining best management practice through experimental learning at sites that relate to integrating fisheries, biodiversity, and climate change objectives into resilient MPA network design will include:

- Identifying future climate change risks, and including climate risk scenarios and vulnerability data layers in an adaptation program within wider integrated coastal resource management (by WorldFish).
- Identifying an appropriate development strategy to respond to future and projected impacts of climate change on the key coastal and marine resources, with emphasis on the population dependent on the coastal and marine resources of the Coral Triangle (based on a study of the economic impacts of climate change by The International Food Policy Research Institute).
- Identifying priority responses to both ICM/EBFM and Climate Change using new technology, techniques or overall management approaches.

For more information see: http://pid.adb.org/pid/TaView.htm?projNo=43427&seqNo=01&typeCd=2;%20ADB%202010=

## Partnerships in the Environmental Management for the Seas of East Asia (PEMSEA)

PEMSEA is a partnership arrangement involving various stakeholders of the Seas of East Asia, including national and local governments, civil society, the private sector, research and education institutions, communities, international agencies, regional programs, financial institutions and donors. It is also the regional coordinating mechanism for the implementation of the Sustainable Development Strategy for the Seas of East Asia (SDS-SEA).

Tasked to facilitate the realization of the SDS-SEA shared vision, mission, action programs and desired changes, PEMSEA gathers the stakeholders to work together and act dynamically and in a coordinated manner, within the SDS-SEA and the Sustainable Development of Coastal Areas framework. Their objectives are to:

- Strengthen consensus among partners on approaches and strategies for addressing the identified threats to the environment and sustainable development of the Seas of East Asia;
- Build confidence among partners through collaborative projects and programs;
- Achieve synergies and linkages in implementing the SDS-SEA among partners; and
- Reduce in-country and regional disparities in capacities for sustainable coastal and ocean development and management.

In supporting governments and stakeholder partners to realize their shared vision and mission, PEMSEA implements various programs with a focus on:

- Partnerships and Management**:** consisting of activities that point to the establishment of long-term, self-sustaining regional mechanisms, which lead to approved partnership programs for effective SDS-SEA implementation.
- Core Operations**:** consisting of activities that directly assist countries on national policy reforms, scaling up of ICM programs at the national and local government levels, technical cooperation in integrated and EBM of watersheds, estuaries and adjacent coastal seas.
- Supporting Activities: consisting of activities related to the development of core human, financial, scientific, technical, legal and information resources, which are necessary for the satisfactory performance of the programs, and those that facilitate sustainability of the SDS-SEA initiatives.

PEMSEA has site based programs in the CT including:

- Several locations in the Philippines, including Batangas Bay and Manila Bay;
- Several locations in Indonesia including in Bali and in three provinces in Java (including Jakarta); and
- Two sites in Timor-Leste.

While it is not their focus, there are opportunities to collaborate with PEMSEA regarding integrating multiple objectives into MPA network design (particularly regarding ICM, sustainable fisheries and integrating climate change within the context of sustainable development). PEMSEA also has experience in marine spatial planning to reduce conflicting use that they can contribute (e.g., in China: Ruan and Yu 1999).

For more information see: http://beta.pemsea.org/