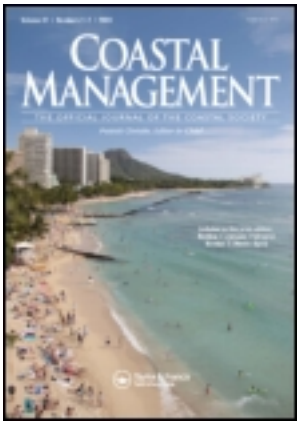

Coastal Management
Publication details, including instructions for authors and subscription information:
http://www.tandfonline.com/loi/ucmg20

Marine Protected Areas in the Coral Triangle: Progress, Issues, and Options

Alan T. White [a], Porfirio M. Aliño [b], Annick Cros [a], Nurulhuda Ahmad Fatan [c], Alison L. Green [d], Shwu Jiau Teoh [c], Lynette Laroya [e], Nate Peterson [d], Stanley Tan [c], Stacey Tighe [f], Rubén Venegas-Li [c], Anne Walton [g] & Wen Wen [h]

[a] Indo-Pacific Division, The Nature Conservancy, Honolulu, Hawaii, USA

[b] Marine Science Institute, University of the Philippines, Diliman, Philippines

[c] WorldFish, Penang, Malaysia

[d] Indo-Pacific Division, The Nature Conservancy, Brisbane, Queensland, Australia

[e] Protected Areas and Wildlife Bureau, Department of Environment and Natural Resources, Quezon City, Philippines

[f] Independent consultant, Jakarta, Indonesia and Honolulu, Hawaii, USA

[g] National Oceanic and Atmospheric Administration, Kauai, Hawaii, USA

[h] Indonesian Marine Program, The Nature Conservancy, Bali, Indonesia

Published online: 12 Feb 2014.

To cite this article: Alan T. White, Porfirio M. Aliño, Annick Cros, Nurulhuda Ahmad Fatan, Alison L. Green, Shwu Jiau Teoh, Lynette Laroya, Nate Peterson, Stanley Tan, Stacey Tighe, Rubén Venegas-Li, Anne Walton & Wen Wen (2014) Marine Protected Areas in the Coral Triangle: Progress, Issues, and Options, Coastal Management, 42:2, 87-106, DOI: 10.1080/08920753.2014.878177

To link to this article: http://dx.doi.org/10.1080/08920753.2014.878177

Coastal Management, 42:87–106, 2014

ISSN: 0892-0753 print / 1521-0421 online
DOI: 10.1080/08920753.2014.878177

Taylor & Francis
Taylor & Francis Group

Marine Protected Areas in the Coral Triangle: Progress, Issues, and Options

ALAN T. WHITE,[1] PORFIRIO M. ALIÑO,[2] ANNICK CROS,[1] NURULHUDA AHMAD FATAN,[3] ALISON L. GREEN,[4] SHWU JIAU TEOH,[3] LYNETTE LAROYA,[5] NATE PETERSON,[4] STANLEY TAN,[3] STACEY TIGHE,[6] RUBÉN VENEGAS-LI,[3] ANNE WALTON,[7] AND WEN WEN[8]

[1]Indo-Pacific Division, The Nature Conservancy, Honolulu, Hawaii, USA
[2]Marine Science Institute, University of the Philippines, Diliman, Philippines
[3]WorldFish, Penang, Malaysia
[4]Indo-Pacific Division, The Nature Conservancy, Brisbane, Queensland, Australia
[5]Protected Areas and Wildlife Bureau, Department of Environment and Natural Resources, Quezon City, Philippines
[6]Independent consultant, Jakarta, Indonesia and Honolulu, Hawaii, USA
[7]National Oceanic and Atmospheric Administration, Kauai, Hawaii, USA
[8]Indonesian Marine Program, The Nature Conservancy, Bali, Indonesia

The six Coral Triangle countries—Indonesia, Malaysia, Papua New Guinea, Philippines, Solomon Islands, and Timor-Leste—each have evolving systems of marine protected areas (MPAs) at the national and local levels. More than 1,900 MPAs covering 200,881 km^2 (1.6% of the exclusive economic zone for the region) have been established within these countries over the last 40 years under legal mandates that range from village level traditional law to national legal frameworks that mandate the protection of large areas as MPAs. The focus of protection has been primarily on critical marine habitats and ecosystems, with a strong emphasis on maintaining and improving the status of near-shore fisheries, a primary food and economic resource in the region. This article brings together for the first time a consistent set of current data on MPAs for the six countries and reviews progress toward the establishment of MPAs in these countries with regard to (i) coverage of critical habitat (e.g., 17.8% of the coral reef habitat within the region lies within an MPA), (ii) areas under effective management, and (iii) actions needed to improve the implementation of MPAs as a marine conservation and resource management strategy. The contribution of MPAs to the Coral Triangle MPA System as called for in the Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security Regional Plan of Action is clarified. Options for scaling up existing MPAs to networks of MPAs that are more ecologically linked and integrated with fisheries management and responsive to changing climate through the Coral Triangle MPA System development are discussed. A key point is the need to improve the effectiveness of existing MPAs, and plan in a manner leading to ecosystem-based management.

Address correspondence to Alan T. White, Indo-Pacific Division, The Nature Conservancy, 923 Nu'uanu Avenue, Honolulu, HI 96817-1539, USA. E-mail: alan_white@tnc.org

Keywords coastal management, Coral Triangle countries, marine protected areas, marine spatial planning

Introduction

Coastal habitats are being exploited beyond their capacity to recover as overfishing and destruction of coral reefs, mangroves, seagrasses, and estuaries continues in the Coral Triangle (CT) region (Burke et al. 2012; Wilkinson et al. 2006; Stobutzki et al. 2006). In response to a growing recognition of the loss of these valuable marine ecosystems, marine protected areas (MPAs) are being established in the six countries that comprise the Coral Triangle: Indonesia, Malaysia, Papua New Guinea, Philippines, Solomon Islands, and Timor-Leste (see Figure 1: Introduction, this issue).

Since the 1970s, the development of MPAs, and more recently MPA networks in these countries has been premised on basic criteria for selection of MPA sites that normally include one or more of the following considerations (Agardy 1997; Kelleher 1999; Salm, Clark, and Siirila 2000; White, Alino, and Meneses 2006; IUCN-WCPA 2008):

- Relative naturalness: Areas in good condition.
- Representativeness: Areas that are unique, and include important ecological functions such as spawning, nursery or feeding areas, and/or vulnerable species.
- Biodiversity: Areas with high diversity of species/ecosystems.
- Vulnerability: Areas with rich resources that are relatively vulnerable to disturbance.
- Fisheries value: Strategic areas to enhance fisheries.
- Tourism value: Areas that would enhance recreational uses and tourism revenues.
- Social acceptance: Acceptability of all or a majority of stakeholders.
- Practicality of management: Relative ease of management.

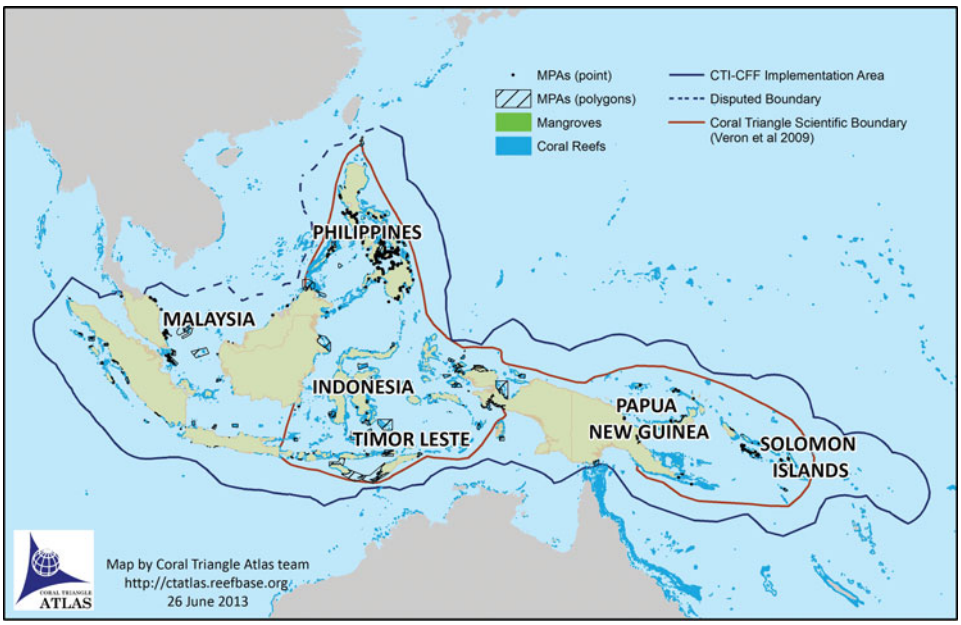

Figure 1. MPAs within the extended economic zones of the six CT countries.

MPAs throughout the Coral Triangle in their various forms (e.g., no-take marine reserves, sanctuaries, local marine managed areas, national parks, and others) have been established to protect well-defined areas that contain critical habitats, productive fisheries, and other important socioeconomic and cultural values. When properly designed and well managed within broader and integrated management frameworks for coastal and marine areas, MPAs can meet various marine and coastal conservation and resource management objectives by protecting habitat, important species, ecological processes, and specific areas (Agardy 1997; Russ et al. 2004; PISCO 2007; White et al. 2005; White, Alino, and Meneses 2006). The model MPA in this region varies by country and ranges from large MPAs zoned for multiple uses to small locally managed marine areas (LMMAs), all of which should be consistent with the specific conservation and management objectives set for the area. In addition, empirical evidence suggests that every MPA design should include no-take zones and consider factors important for fisheries management and climate change to be effective in the long term (Green, White, and Kilarski 2013; Green et al. 2014). MPAs should also be integrated and harmonized with governance regimes so that ecosystem-based management is possible (Flower et al. 2013).

Lying at the global center of marine biodiversity, the countries in the Coral Triangle have similar coastal management issues to address (Burke et al. 2012). Threats to coral reefs and related habitats and ecosystems across the region are primarily from local and some trans-boundary sources that include: overfishing, destructive fishing, disturbances arising from coastal development, watershed-based pollution and to a small degree marine-based pollution, all compounded by climate-related thermal stress (see Figure 2: Introduction, this issue). The main strategy applied is the implementation of MPAs and MPA networks in combination with various forms of integrated coastal and fisheries management that include enforcing regulations and laws outside of MPAs (White, Eisma-Osorio, and Green 2005).

Since MPAs and networks of MPAs are considered one of the most effective tools for biodiversity conservation and natural resource management in the CT, the third of five goals of the Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security (CTI-CFF) Regional Plan of Action (CTI-CFF 2009, 53) is "Marine Protected Areas (MPAs)

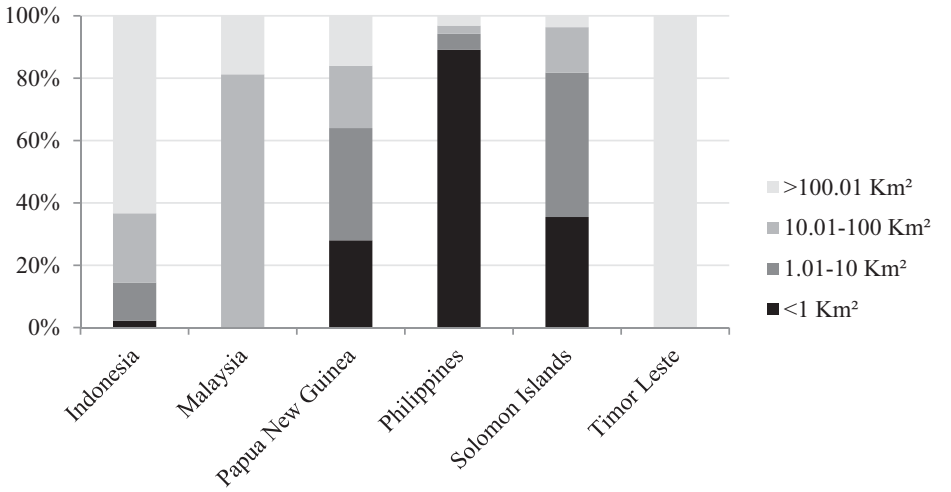

Figure 2. Relative size distribution of MPAs in each country.

Table 1
Indicators and targets for Goal 3 on MPAs in the CTI-CFF Regional Plan of Action[1]

Indicators	Description	Targets
Overall MPA Result/target	Regional-wide Coral Triangle MPA System (CTMPAS)[2] in place and fully functional	Completed by 2020
Indicator 1	CTMPAS Framework developed and adopted by Coral Triangle Countries	Adopted and launched in 2013
Indicator 2	Percent/area of total marine habitat area in CT region in marine protected or managed areas	20%[3]
Indicator 3	Percent/area of each major marine and coastal habitat type in protected "no-take replenishment zones"	10%[3]
Indicator 4	Percent/area of MPAs under "effective" management	25% applying criteria in CTMPAS[2]
Indicator 5	Percent/area of MPAs included in CTMPAS	All MPAs to be included by 2020

[1]Indicators determined by CTI-CFF MPA Technical Working Group in coordination with the CTI-CFF Monitoring and Evaluation Working Group in workshops in 2012 and 2013.
[2]For full description of CTMPAS, see Walton et al. (2014).
[3]Targets are consistent with those of CBD (2010) while setting a higher bar for area protected by any type of MPA.

established and effectively managed." In 2010, the CT6 developed indicators and targets for tracking progress against this goal (Table 1).

This article reviews the status of MPAs in the Coral Triangle region and progress toward the targets in Table 1. This data and analysis supports the CTI-CFF (www.coraltriangleinitiative.org) launched in 2009, in the development of a framework for the Coral Triangle MPA System (CTMPAS)[1] called for in the CTI-CFF Regional Plan of Action (CTI-CFF 2009).

This information will also provide the basis for developing, expanding, and refining the Coral Triangle MPA System (Walton et al. 2014) based on the latest ecological and social criteria (Green et al. 2014; Cruz-Trinidad et al. 2014) and using good case studies from the region (Weeks et al. 2014).

Methods to Compile MPA Data in the Coral Triangle

The six Coral Triangle countries each have evolving systems of MPAs but none of them have a complete and consistent database for MPAs in their country or one that is fully compatible with the other countries. The CTI-CFF inaugurated a regional program that provided a common set of goals and targets for marine conservation and food security. One of the mandates provided by the CTI-CFF was the formation of MPA, and Monitoring and Evaluation Technical Working Groups (TWGs) with representatives from each country.

The TWGs, under the coordination of the CTI Regional Secretariat, have supported the development of a CT Atlas database and information system (http://ctatlas.reefbase.org/). The initial focus of the CT Atlas has been to refine the MPA data layers so that a regional analysis can be accomplished in support of the development of the CTMPAS and to measure progress against the targets in Table 1. The CT Atlas is linked with ReefBase created and managed by the WorldFish in Penang, Malaysia and in agreement with the CTI-CFF Regional Secretariat provides database support services for tracking progress toward goals in the CTI-CFF Regional Plan of Action.

The data reported herein on the status of MPAs in the CT countries are the most current compiled within the CT Atlas. They have been provided by each country and checked against various sources to ensure accuracy. In the data gathering and checking process, it became evident that there are significant differences in summary MPA datasets entering the global databases such as that of the World Conservation Monitoring Centre (WCMC) for Protected Areas and used by the Regional Seas Programme of UNEP. In contrast, the data summarized in this article are derived directly from country sources and checked with government agency personnel in each country to ensure they represent the best statement on what exists in that country. A few variations in data reported by governments still exist. For a more in depth description of the data gathering and analysis process and discrepancies in data available, see Cros et al. (2014).

Global, Regional, and National Context for Establishing MPAs in the Coral Triangle

Global and Regional Commitments of the Coral Triangle Countries

The 2nd World Parks Congress (1972), the First Marine Parks Conference in Tokyo (1975), and other events in the 1970s brought attention to MPAs and helped catalyze the designation of national MPAs in one form or another in the 1970s and 1980s. During this period, Indonesia, Malaysia, and the Philippines initiated their MPA programs while Papua New Guinea and Solomon Islands initiated their programs in the late 1990s. Timor-Leste, a new country, began to establish MPAs in 2008. Conservation commitments for MPA development in the signatory countries (Indonesia, Philippines, Malaysia, and Papua New Guinea) are articulated within two international agreements:

1. The commitments at the 2002 World Summit on Sustainable Development (WSSD) set 2012 as a target for the establishment of representative MPA networks based on scientific information and consistent with international law.
2. Adopted during the IUCN World Parks Congress in 2003, the Durban Action Plan called upon nations to "establish by 2010 a global system of effectively managed, representative networks of marine and coastal protected areas, consistent with international law and based on scientific information. . ." that should ". . .include strictly protected areas that amount to at least 20–30% of each habitat, and contribute to a global target for healthy and productive oceans" (IUCN 2003, 53).

At the 7th meeting of the Conference of the Parties to the CBD (COP7) in 2004 signatories set a target, endorsed at COP8 in 2006, that there should be effective conservation of at least 10% of each of the world's ecological regions by 2010 (CBD 2006). In 2010, the CBD agreed on a target of 10% of marine areas to be effectively protected in a network of MPAs by 2020 (CBD 2010). Now, the six Coral Triangle countries have endorsed the CTMPAS Framework and Action Plan that sets targets (10% of critical marine habitats in

no-take marine reserves by 2020 and 20% of critical marine habitats in some form of MPA by 2020: CTI-CFF 2013). Also, within the Coral Triangle, Indonesia, Malaysia, and the Philippines have a formal agreement and approved plans to implement management of the Sulu Sulawesi Marine Eco-Region (SSME) and Seascape.[2]

Context for Development of MPAs in the Coral Triangle Countries

Each of the six countries of the CT has distinct ecological, social, cultural, and governance arrangements for establishing MPAs. The legal mandate and various titles for MPAs in each country are summarized in Table 2 and elaborated below.

Indonesia is the largest archipelagic nation in the world with a coastline of 95,181 km and 15.8% (19,868 km^2) of the world's coral reefs. As a result, its economy and food security are closely linked to marine and coastal resources (INCC 2012; UNEP-WCMC 2008; Burke et al. 2012). This has been recognized by the government, and in 2008, Indonesia fulfilled its commitment to the Convention on Biological Diversity'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 within the Lesser Sunda Ecoregion. Indonesia now has 108 MPAs covering 157,841 km^2, which contributes significantly to the Government of Indonesia's next goal of establishing 20 million hectares of MPAs by 2020 (Yudhoyono 2009).

Some of Indonesia's MPAs are combined terrestrial and marine parks, administered by the Ministry of Forestry. Many of these National Parks were designated in the 1980s. Recently, the Ministry of Marine Affairs and Fisheries took over the administration of marine (sub-tidal) protected areas, particularly National Marine Parks. And now with more decentralized authority, district and provincial governments can also declare and administer MPAs. There are also a growing number of community-level MPAs that are co-managed with the district and national governments. In addition to the 108 areas specifically designated to protect marine ecosystems, Indonesia has another 70 protected areas that include both terrestrial and marine ecosystems.

Monitoring of selected MPAs, by government agencies and nongovernmental organizations (NGOs) working in collaboration with the government management units, indicates that a few areas are showing positive impacts on fish stocks and coral reef condition (I-NCC 2012). However, it is estimated that less than 15% of Indonesia's MPAs are functionally meeting their management objectives (WorldFish 2007; UNEP-WCMC 2008; Burke et al. 2012). In response, Indonesian institutions have developed a MPA monitoring and management effectiveness system for national application (Carter et al. 2011; DCAFS 2012).

Malaysia has 4675 km of coastline and 1,698 km^2 of coral reef area (1% of global total), divided between Peninsular Malaysia and eastern Malaysia (Sabah and Sarawak States on Borneo Island). Malaysia has established 51 MPAs covering about 15,661 km^2 or about 3.5% of its exclusive economic zone (EEZ) that are managed under national and state agencies (Table 2). Mangroves and coral reefs are well represented in MPAs in Malaysia while seagrass beds are still under represented (Alino et al. 2009). Sabah State contains much of the reef habitat in Malaysia and is in the process of declaring Tun Mustapha Park (TMP) covering 10,200 km^2 (included in MPA area for Malaysia) which will be gazetted by 2015. The management effectiveness of MPAs in Malaysia is considered good by regional standards given that destructive fishing is not common in most MPAs and fishing effort is at least partially controlled. Nevertheless, there is no standard monitoring system that includes measures for management effectiveness being implemented at a state or national scale.

Table 2
Types, titles, and definitions of MPAs in the six Coral Triangle countries

Country	Designation types	IUCN category[f]
Indonesia[a]	***Marine Nature Reserve***: Strict protection area, with a specific flora and fauna or ecosystem which needs to develop naturally.	**Ia**
	National Park: An area with pristine ecosystem, managed using zones. Activities: research, education, culture support, recreation.	**II**
	Wildlife Sanctuary: A reserve area characterized by its biodiversity and or an area needed to sustain unique fauna.	**IV**
	Nature Recreation Park: An area used mainly for tourism and recreation, but which needs to be conserved.	**V**
	District Marine Conservation Area: Areas managed locally by the district government, and that can fall within the above categories.	**VI**
Malaysia[b]	***Marine Parks***: An area of protected sea zoned for management, one to two nautical miles from the shore at lowest low tide. The areas are created to protect, conserve and manage in perpetuity representative marine ecosystems. Scientific research, education, and recreation activities are generally allowed. Marine Parks are managed by the Department of Marine Parks Malaysia under the federal government.	**II**
	State Marine Parks: An area created to protect, conserve and manage in perpetuity representative marine ecosystems where scientific research, education, and recreation activities are generally allowed. These include MPAs in Sabah managed by the Sabah Parks Board of Trustees and in Sarawak managed under the National Park and Reserve Ordinance. These areas are managed by the state governments, not the federal government.	**II**
Papua New Guinea and Solomon Islands[c]	***Locally Managed Marine Areas:*** An area of near shore waters and coastal resources that is largely or wholly managed at a local level by the coastal communities, land-owning groups, partner organizations, and/or collaborative government representatives who reside or are based in the immediate area. National government does support selected LMMAs under national law. Management activities can include no-take areas, seasonal restrictions, gear restrictions, species restrictions.	**II, IV, VI**

(Continued on next page)

Table 2
Types, titles, and definitions of MPAs in the six Coral Triangle countries *(Continued)*

Country	Designation types	IUCN category[f]
Philippines[d]	There are two governance levels for MPAs: (a) National Integrated Protected Areas System (NIPAS Act, R.A. 7586, 1992) (b) Municipal and city (local) (Fisheries Code, R.A. 8580)	**Ia, VI**
	NIPAS: nationally established MPAs; if it has a core zone it is equal to a no-take zone; it should also have a buffer zone.	
	MPA: a defined area of the sea established and set aside by law, administrative regulation, or any other effective means, in order to conserve and protect a part of or the entire enclosed environment, through the establishment of management guidelines. It is considered a generic term that includes all declared areas governed by specific rules or guidelines in order to protect and manage activities within the enclosed area.	**II, VI**
	Sanctuary: Prohibits all extractive uses, and strictly regulates non-extractive uses. It may be located within a marine reserve/park.	**II**
	***Marine Reserve*:** Access and uses (whether extractive or non-extractive) are regulated or controlled for specific uses or purposes. A marine reserve may include a marine sanctuary within its boundaries.	
	***Marine Park*:** A type of marine reserve, in which multiple uses may be allowed through zoning regulations, and where conservation-oriented recreation, education and research are emphasized.	**II, V**
	Protected Landscape and Seascape: Under national law (NIPAS) and generally equates to a national park that includes marine and terrestrial areas.	
Timor-Leste[e]	***National Park:*** An area with valuable ecosystems, managed using zones that consider strict protection, traditional use, culture, research, education, and recreation.	**II, VI**

[a]Directorate General of Forest Protection and Nature Conservation, Indonesia (2008); [b]Marine Parks Department, Malaysia (2011); [c]Govan et al. (2009); [d]Miclat and Ingles 2004); [e]Ministry of Agriculture and Fisheries (2011); [f]Dudley (2008) used to estimate the IUCN category equivalent for MPA types in each country.

Papua New Guinea (PNG) contains rich marine systems that include 7,256 km^2 of coral reefs or about 6% of the global total and has at least 59 MPAs covering about 4558 km^2 (Table 3). In PNG the inshore marine ecosystems are not owned by the state, but by clans or tribes who claim customary ownership over the mangroves, lagoons, and reefs in their vicinity. This traditional form of communal ownership or customary marine tenure (CMT) (Ruddle, Hviding, and Johannes 1992) is recognized to varying degrees in national law in PNG (Fisheries Management Act 1998). Only a few MPAs are declared under national law since most are developed using ecological and socioeconomic design principles as part of the locally managed marine areas (LMMAs) Network that began in 2000 when the Minister for Environment and Conservation nationally declared 11.8 hectares of Sinub Island as a Wildlife Management Area (WMA) after community members collectively decided to set Sinub Island aside as a "tambu" (taboo or protected). Kimbe Bay hosts a large, well-designed MPA network that includes 9 LMMAs in the implementation stage. Of the 59 MPAs (including WMAs, Marine Parks, Historic reserves, and Provincial parks) 35 have documented boundaries that are recognized officially in PNG.

The Philippines is an archipelago rich in biodiversity with a coastline of 33,900 km that includes approximately 12,021 km^2 of coral reef systems (9% of the global total) (Table 3). The Philippines declared its first national marine park (Hundred Islands) in 1940. The Local Government Code of 1991 authorized local municipal and city governments to declare MPAs so that approximately 1,600 MPAs, covering[3] about 240 km^2, are managed by municipal and city governments through co-management arrangements. Most of these MPAs contain no-take areas surrounded by some form of managed fishing area. Under the National Protected Areas System (NIPAS) Act of 1992, 28 national MPAs have been proclaimed that cover about 14,500 km^2. The Tubbataha Reefs Natural Park and World Heritage Site was recently expanded and covers 968 km^2, all in no-take status. The Philippine Marine Sanctuary Strategy, endorsed in 2002, has a target of 10% of "marine waters" to be fully protected by 2020 in a MPA network. The Sulu-Sulawesi Marine Ecosystem area of the southern Philippines including Sabah and parts of northern Indonesia is the first "seascape" to be systematically planned at a large scale.

The Philippines has a national MPA database and evaluation system developed through the assistance of NGOs working with government, academic, and other organizations. Each member contributes to the database and has access to information that compares biophysical resources, status, and trends across all MPAs. This database has catalyzed the formation of a national social and institutional network of MPA practitioners (MPA Support Network [MSN]). Management status information extracted from the database indicates that about 30% of the MPAs are well managed nationwide (Maypa et al. 2012). Since MPAs in the Philippines include 409 km^2 of coral reef habitat or about 3.4% of its total reef area, it is estimated that slightly more than 1% of the coral reef area nationwide is effectively protected. Thus, while the percent of well-protected reef area is small, it represents progress through an increased number of MPAs and the significant improvements in management effectiveness (Arceo et al. 2008; Maypa et al. 2012).

Solomon Islands is also a large archipelago of 922 islands covering 1.6 million km^2 containing a wealth of marine resources that include 2,804 km^2 of coral reef systems (Table 3). Similar to PNG, the inshore marine ecosystems are owned by clans or tribes who claim customary ownership over the mangroves, lagoons, and reefs in their vicinity. This traditional ownership or customary marine tenure (CMT) is recognized in government law with explicit recognition in the recent 2010 Protected Area Act (Gazetted in 2012). The existence of robust CMT systems provides a platform for community based management

Table 3
Summary data for coverage of all recognized MPAs in the Coral Triangle countries

Marine Protected Areas (MPAs)	Indonesia	Malaysia[a]	Papua New Guinea	Philippines	Solomon Islands	Timor- Leste	Region
Number of MPAs (reported by government)[b]	108	51	59	1653	100	1	***1972***
Total MPA area (km^2) (reported by government)[b]	157,841	15,661	4,558	20,940	1,325	556	***200,881***
Number MPA records in CT Atlas (point or polygon format)	83	51	59	627	100	1	***920***
Number of MPAs with known boundaries in CT Atlas[c]	83	50	35	348	82	1	***599***
Total area of MPAs (km^2) with known boundaries	170,841	13,653	4,558	17,164	1,325	557	***208,152***
Percent MPA areal cover in EEZ[d]	2.7%	3.5%	0.2%	1.1%	0.1%	1.3%	**1.6%**
Percent MPA areal cover in territorial waters (12 n. miles)	13.1%	12.7%	1.3%	4.2%	0.9%	3.4%	***9.4%***
Average size of MPAs (km^2)	1461.5	270.4	130.2	12.7	16.0	556.0	**407.80**
Size range of MPAs (km^2)	0.9	11.83	0.04	0.02	0.02	—	***0.02***
Minimum	35,211	10,200	2334	2789	823	—	***35,211***
Maximum							
Coral Reefs[e]							
Coral reef area (km^2)	19,868	1,698	7256	12,021	2,804	35	***43,682***
Reef area in MPAs (km^2)	6,208	661	357	471	113	10	***7,757***
Reefs in MPAs (%)	31.2%	38.9%	4.9%	3.9%	4.0%	29.5%	***17.8%***
Mangroves[f]							
Mangrove area (km^2)	31,894	7,097	4,265	2,568	603	18	***46,445***

[a]Malaysia MPA number and area, as well as all the calculations made include the Tun Mustapha Marine Park (10,200 km^2), which will be fully gazetted by 2015. Pulau Yu Besar, Pulau Yu Kecil, and Pulau Sipadan still have no official area reported.
[b]Sources for MPA data: Indonesia: Ministry of Marine Affairs and Fisheries (2013); Malaysia: Department of Marine Parks (2009), Sabah Parks (2011), Sarawak Forestry Department (2012); Philippines: Protected Areas and Wildlife Bureau (2013), University of the Philippines Marine Science Institute database; Timor-Leste: Ministry of Agriculture and Fisheries (2011); no official government numbers were found for Solomon Islands and Papua New Guinea so data used is from the Coral Triangle Atlas (2013) and may underestimate the number and area of MPAs in those countries.
[c]Boundaries available through Coral Triangle Atlas (2013). These boundaries were used for the rest of the calculations presented in this table.
[d]Source of EEZ boundaries VLIZ (2012).
[e]Source of coral reef data UNEP-WCMC (2010).
[f]Source of mangrove data UNEP-WCMC (2010) and Spalding, Kainuma, and Collins (2010). Mangroves in the Coral. Triangle are not managed as MPAs, therefore the extent of this habitat within MPAs is not reported here.

but also means that any effort to form permanent marine reserves requires initiatives from the customary owners.

In the past decade many Solomon Islands communities have established MPAs on their reefs as a means of managing and conserving their marine resources. These MPAs are typically established in partnership with NGOs who provide scientific awareness and monitoring assistance. The vast majority of them are effectively conserved, as respect and adherence to community based regulations is typically high. The Arnavon Islands is the oldest (1995) and largest community managed MPA with national recognition in the Solomon Islands.

Timor-Leste on the eastern side of Timor Island has 700 km of coastline that includes several offshore islands. Its location in the Lesser Sunda Ecoregion is characterized by strong currents generated by the passage of the Indonesian Through-flow and has outstanding marine conservation value for its shallow coastal habitats which include 35 km^2 of coral reef systems adjacent to deep sea habitats with a high diversity and abundance of cetaceans (Kahn 2008; Wilson et al. 2011). Timor-Leste has completed an assessment of marine ecological gaps (Garantham et al. 2011). The marine gap analysis was based on the scientific design of a resilient network of MPAs for the Lesser Sunda Ecoregion that proposed a network of seven shallow and five deep-water MPAs for the country (Wilson et al. 2011). Formal management designation has begun in one of these areas, the Nino Konis Santana National Park with both marine and terrestrial components. Although not yet formally gazetted, management has started through a community-based approach in selected marine areas within the Park that includes 586 km^2 of marine area (1.3% of the national EEZ) and encompasses 29.5% of the coral reefs of Timor-Leste.

Status of MPAs in the Coral Triangle and Pending Issues

A consistent and the most accurate count and area of MPAs to date are recorded through various sources of information (Figure 1 and Table 3). The 1,972 MPAs (599 have known boundaries in the CT Atlas database) cover at least 200,881 km^2 of marine area and include 7,757 km^2 of coral reef habitat or 17.8% of the regional total (Cros et al. 2014).[4] At face value, this suggests that the regional target for critical habitats under some form of marine protected area (20%) is nearly achieved (Table 1). The reality is that this figure of 17.8% of coral reef habitat within MPAs is misleading and needs qualifying, since, for example, as shown for the Philippines, only about 1% of its reef area is under truly effective protection. The gap between nearly achieving 20% and only 1% of area effectively protected is the lack of "effectively managed MPAs." The other cause for this gap is the range of forms and sizes of MPAs in the region, many of which do not achieve their management objectives, and the small area covered by "no-take marine reserves" for which the regional target is 10% of critical habitat.

The differences in MPA numbers, size, and type of designation among the CT6 reflect the different context for establishing MPAs in each country as noted above. Some countries tend to establish large MPAs with zones (e.g., Indonesia, Malaysia, and Timor-Leste) while others tend to establish networks of small locally managed marine areas (e.g., PNG, Solomon Islands) or local government-based MPAs as in the Philippines (Figure 2). Overall progress toward the five CTI-CFF MPA indicators using data in Table 3 is estimated in Table 4.

While much progress is being made toward more effective marine conservation in the region, variations in understanding still persist regarding the establishment and function of MPAs. Challenges remain within the existing governance systems that hinder MPA

Table 4
Progress toward CTI-CFF MPA indicators

Indicator	Target	Status of target
1 CTMPAS Framework developed and adopted by CT Countries	Adopted and launched in 2013	Completed
2 Percent/area of total marine habitat area in CT region in marine protected or managed areas	20%	17.8% of coral reef habitat, 9.4% of territorial waters and 1.6% of EEZs
3 Percent/area of each major marine and coastal habitat type in protected "no-take replenishment zones"	10%	Approximately 2%[1]
4 Percent/area of MPAs under "effective" management	25% applying criteria in CTMPAS	Approximately 1%[2]
5 Percent/area of MPAs included in CTMPAS	All MPAs to be included by 2020	None, CTMPAS launched in 2013

[1]Data on percent coverage of no-take marine reserves is lacking for most countries except the Philippines where most of the local government MPAs are no-take and portions of the national MPAs are no-take. As more data on no-take reserves is provided to the CT Atlas, this calculation can be made more accurately.
[2]Burke et al. (2012) report that 1% of coral reefs in the region are effectively managed and 5% are under partially effective management. These estimates were derived through a simple rating system and survey. A recent Philippine study (Maypa et al. 2012) found about 30% of the MPAs effective at level 3 in a system with 4 levels.

establishment and effectiveness. MPAs often lack sufficient and meaningful participation. As one community person said in Indonesia: "We oppose the MPA only because they never asked our opinion on whether we wanted it or not." Thus a considerable amount of on-the-ground work and education prior to establishment of MPAs are essential (TNC et al. 2008; Green et al. 2011).

While Indonesia, Malaysia, and Timor-Leste have more than 10% of their coral reefs included within legally designated MPAs (Table 3), the real challenge of marine conservation in the region is to make the existing MPAs more effective in achieving their intended management objectives. The emerging efforts to monitor MPA effectiveness is showing that areas managed under a no-take regime or a regulated fishing area that are strictly enforced are woefully lacking with only about 1% of coral reefs within MPAs in the region rated as effectively managed (Table 4). This relatively low level of MPA management can be attributed to the combination of historical antecedents like the high population of impoverished people dependent on the coral reefs and inadequate or under-developed institutional and technical capacity as well as the need for more community support and compliance (Wilkinson et al. 2006; Green, White, and Tanzer 2012).

These results and issues show the strengths and weaknesses of the existing MPAs that can be used as the basis for developing and expanding the CTMPAS using key ecological and social considerations for MPA network design and management and best case examples (Walton et al. 2014; Green et al. 2014; Cruz-Trinidad et al. 2014; Weeks et al. 2014).

Recommendations for Improving and Expanding MPAs in the CT

Improving MPA Management Effectiveness

An ongoing challenge for MPAs, and especially no-take MPAs, is that they are often seen as incompatible with the traditional use patterns and for marginalizing people dependent on these areas for food and income. Thus, the planning, implementation, and management of MPAs, regardless of the level or type of management, must consider the human communities and institutions that are usually the default decision-makers for resource utilization and protection. The implementation of the CTI-CFF has confirmed that planning for MPAs needs to be sensitive to context (social, cultural, and environmental) and identified four interrelated factors essential to improve the overall capacity and effectiveness of MPAs in the region including the need for:

1. ***Well designed and effectively managed MPAs.*** For MPAs to contribute to the long-term success of marine conservation in the region, they must be well designed, contain enforced no-take areas of sufficient size, and be effectively managed in broad terms (Palumbi 2004; Green et al. 2014). No-take areas should ultimately cover at least 20% (>10% by 2020) of the critical habitat area and conform to reasonable minimum sizes that are feasible within the context for which they are planned (Kelleher 1999; Roberts et al. 2001; Green et al. 2014). A few key actions to improve overall effectiveness include:
   - Inventory existing MPAs and their no-take areas that have (or in partnership with) clear and accountable management bodies,
   - Identify no-take areas and their location relative to critical habitats, spawning sites, essential ecological processes, and the most valuable resource areas within an MPA, and identify areas that are most likely to be resilient to climate change,
   - Develop an accepted and implementable management plan at each MPA,
   - Develop and integrate professional management practices for law enforcement, visitor management, monitoring and adaptive planning, and
   - Assess the management effectiveness of MPAs and no-take areas.
2. ***Monitoring, evaluation, and response-feedback systems***. A system that can detect change in habitat and marine life parameters related to levels of protection and governance mechanisms is needed for monitoring MPAs and their no-take areas. Practitioners in the Philippines are learning from establishing a national MPA database and rating system (White, Meneses, and Ovenden 2004; 2006), the MPA Effectiveness and Assessment Tool (MSN 2010), which is linked to incentives, feedback, and response systems. A similar tool in Indonesia (Carter, Soemodinoto, and White 2011; DCAFS 2012) is in place for improving MPA management effectiveness while the other countries are currently developing similar systems.
3. ***Integration of socioeconomic factors supporting MPAs.*** Understanding the economic costs and benefits of MPAs is essential for making the case for MPAs, for financial planning and management, and for building sustainable capacity to manage MPAs. Direct costs and benefits, as well as the indirect and opportunity costs

incurred by communities in and around protected areas need to be considered (TNC et al. 2008; World Bank 2006; Agardy and Staub 2006). MPA planners should integrate the socioeconomic and cultural setting of an area to promote activities that maximize the positive benefits derived from MPAs, and to counter local socioeconomic costs (White and Cruz-Trinidad 1998; Christie and White 1997). While capacity in the CT for meaningful integration of socioeconomic and cultural factors in planning is still weak, several best practices include:

- Conducting socioeconomic and human perception surveys in every major MPA,
- Factoring results of surveys into adaptive management processes and MPA management plans (e.g., balance biophysical and social planning),
- Performing cost–benefit analyses on natural resource values and uses (e.g., fisheries and tourism) in relation to societal benefits and costs, and
- Including key stakeholders from the beginning in the establishment, zoning and management planning of new MPAs.

4. ***Sustainable governance and financing mechanisms in place.*** Creating and maintaining representative, effectively managed MPAs and networks requires substantial funding and political support from local, national, regional, and international entities (IUCN-WCPA 2008). A key ingredient to catalyze sustainable financing is to build capacity for generating financial support for MPA management from the beginning stages of MPA planning (White et al. 2005). Experience in several CT countries has shown that determining all possible viable revenue streams associated with MPA management through user fees, return-on-investment of maintaining a viable fisheries' resource-base, tourism, and other economic activities needs to be factored into management planning to achieve long-term success (Dygico et al. 2013).

Scaling-Up to Resilient Networks of MPAs—Planning and Implementation

Scientists, governments, and many stakeholders in the CT recognize that well-planned, coordinated, and functional MPA networks provide important spatial links needed to maintain ecosystem processes and connectivity. Networks improve habitat resilience by spreading risk for localized disasters, failures in management or other hazards, and help ensure the long-term sustainability of populations better than single sites. In the CT countries, since economic use patterns and social, demographic, and political constraints make it challenging to create one single large reserve of sufficient size to support viable (self-sustaining) populations of all species, establishing networks of several to many small-to-moderately sized reserves (0.5 km to several km across) offers a good solution and helps to reduce the socioeconomic impacts without compromising conservation and fisheries benefits (PISCO 2007; Green et al. 2014). A major factor inhibiting the successful establishment and management of MPA networks is the lack of workable institutional and governance mechanisms across the networks (Lowry, White, and Christie 2009).

Filling Ecological Gaps—Increasing Resilience and Coverage of Protection

While a high priority for the CTMPAS is to improve the management and protection provided by the existing MPAs and MPA networks, significant gaps still exist in the coverage of marine habitat, ecosystems, and ecological processes needed to adequately protect these resources and to build resilience. There is a need to systematically assess these gaps in coverage using all existing data and state-of-the-art analysis tools (e.g., MARXAN and

other spatial analysis tools) to determine what needs to be protected and where. Filling ecological gaps is largely a process of creating a comprehensive geo-referenced database to aid in understanding the gaps and to inform decision-making on how to fill them. This role is currently being carried out by the CT Atlas spatial database and an initial regional gap analysis through the University of Queensland by Beger et al. (2013). Further actions required are:

- Develop a system to classify and record various governance regimes that extend or complement MPA management. Such a system will assist to simplify and clarify metadata on MPAs and their results so that measuring progress is more systematic. Other types of management regimes that are not strictly defined as an MPA constitute a level of protection such as integrated coastal management (ICM) systems that cover entire local government jurisdictions (e.g., Indonesia and Philippines), ICM regimes, or others are essential steps in the process of managing the resource base outside of MPAs and especially for managing fisheries (Licuanan et al. 2008). Such complementary efforts can be tracked in combination with MPAs to better understand the protection status (White, Eisma-Osorio, and Green 2005; White et al. 2005).
- Complete a regional gap analysis against the ecological guidelines in Green et al. (2014) which includes: connectivity of existing MPAs and what is lacking to complete connectivity for protected sites, consideration of oceanographic features, fisheries productivity, and resilience in design and placement of MPAs to identify highly productive areas, larval retention locations, spawning aggregations, critical habitat for pelagic fisheries, charismatic species, and their migratory corridors among others.
- Consider a multiple-objective priority-setting framework at the regional and site levels that includes planning and applying adaptation responses to climate change that supports integrated and ecosystem-based management regimes (Flower et al. 2013).
- Continue to build a comprehensive geo-referenced database through the CT Atlas.

Conclusion

The current data set on MPAs compiled for this article and the experience of the authors working in the CT countries suggests that the foundation for an effectively managed Coral Triangle MPA System is consolidating and evolving. The long-term efforts of the CT countries in developing MPAs of various types, sizes, and designs over the last 40 years are having major positive impacts. Now, under the guidance of the CTI-CFF Regional Plan of Action and the MPA TWG comprised of the representatives from the six countries plus technical partners, a logical and consistent framework for MPAs across the region has been finalized and endorsed by country leaders (CTI-CFF 2013). While a significant marine area is under protection as measured by the CTI-CFF MPA indicators, much work remains to augment the area of critical marine habitat under no-take marine reserves and under effective management regimes. One big step forward is having a monitoring and evaluation system in place to track progress toward the targets. A tool to assist in tracking progress is the CT Atlas database and information system that facilitates exchange of information in an efficient manner within and among the CT countries for analysis and design of MPAs. Lastly, scaling-up the implementation of the existing MPAs so that they will achieve their resource management objectives is of upmost importance. This can be accomplished through improved networking (ecological, governance, and social) and the use of consistent, functionally effective, and interoperable monitoring and evaluation

criteria across the region. Since this is being promoted through the adoption of the CTMPAS Framework and Action Plan which includes a strong emphasis on networking and on MPA management effectiveness, it bodes well for future progress.

Acknowledgments

The Interim Regional Secretariat of the Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security (www.coraltriangleinitiative.org) is thanked for overall support for generation of data through the cooperation of the six Coral Triangle Countries.

Funding

Funding for the preparation of this document was provided by the USAID-funded Coral Triangle Support Partnership (CTSP) through the USAID Project: GCP LWA Award # LAG-A-00-99-00048-00. CTSP is a consortium led by the World Wildlife Fund, The Nature Conservancy and Conservation International. Maps were created under the Coral Triangle Atlas by Nate Peterson (TNC). Spatial Data was compiled by the Coral Triangle Atlas team: Annick Cros (TNC), Nate Peterson (TNC), Wen Wen (TNC), Shwu Jiau Teoh (WorldFish), Nurulhuda Ahmad Fatan (WorldFish), Stanley Tan (WorldFish), Ruben Venegas (WorldFish/TNC), and Charles Huang (WWF-US). The database and maps can be accessed at http://ctatlas.reefbase.org/. The CT Atlas is hosted by WorldFish and in addition to USAID support has received matching funds from the CGIAR Research Program on Aquatic Agricultural Systems Program and from the Climate Change, Agriculture and Food Security Program of WorldFish.

Disclaimer: This document is made possible by the generous support of the American people through the United States Agency for International Development (USAID). The contents are the responsibility of Coral Triangle Support Partnership (CTSP) and do not necessarily reflect the views of USAID or the United States Government.

Notes

1. The CTMPAS Framework and Action Plan was endorsed by the CTI-CFF Senior Officials in November 2012 and is in early stages of implementation (CTI-CFF 2013) through the efforts of the CTI-CFF MPA Technical Working Group comprised of members from each country as well as several regional and international partners and scientists.

2. Seascape refers to large management areas defined by ecological and oceanographic affinities. The Sulu-Sulawesi Seascape in southern Philippines, Sabah Malaysia and Celebes Sea, Indonesia is the first in the Coral Triangle.

3. The exact area covered by all 1,600 local government MPAs in the Philippines is not known because polygon data only exists for about 1/3 of them. Thus an average size of 15 ha is used to calculate the total area covered.

4. The differences between area reported by governments and what the CT Atlas has calculated using the most current polygon data are explained by Cros et al. (2014). It is also noted that most of the MPAs without known boundaries are very small MPAs in the Philippines under local government without verified national records.

References

Agardy, T. 1997. *Marine protected areas and ocean conservation*. Dallas, TX: Academic Press.

Agardy, T., and F. Staub. 2006. Marine Protected Areas and MPA Networks, National Science Foundation United States Fish and Wildlife Service (Grant Agreement No. 9810-1G017).

Alino, P. M., S. Vergara, W. Licuanan, R. Grace-Ambal, J. Marie Acebes, A. Uychiaoco, M. J. Palomar, J. Basconcillo, and R.O. Gonzales. 2009. Philippine MPA Gap Analysis (Section with "Marine Protected Areas [MPA] Gap Analysis for Philippines and Malaysia"), submitted by Marine Environment and Resources Foundation, Inc. and Conservation International-Philippines and Borneo Marine Research Institute University Malaysia Sabah, to ASEAN Center for Biodiversity, Manila.

Arceo, H. O., P. M. Alino, and R. O. M Gonzales. 2008. Where are we now with marine protected areas? In Coral Reef Information Network of the Philippines (PhilReefs) Reefs through time: initiating the state of the coasts reports, pp. 145–151. PhilReefs, MPA Support Network, Marine Environment and Resources Foundation and Marine Science Institute, University of the Philippines, Quezon City, Philippines. 152 p.

Beger, M., J. McGowan, S. F. Heron, E. A. Treml, A. Green, A. T. White, N. H. Wolff, et al. 2013. Identifying conservation priority gaps in the Coral Triangle Marine Protected Area System. Coral Triangle Support Partnership of USAID, The Nature Conservancy and The University of Queensland, Brisbane, Australia. 55 p.

Burke, L., K. Reytar, M. Spalding, and A. Perry. 2012. Reefs at Risk Revisited in the Coral Triangle. Washington, DC: World Resources Institute, 72 p.

Carter, E., A. Soemodinoto, and A. White. 2011. Guide for Improving Marine Protected Area Management Effectiveness in Indonesia. Bali, Indonesia: The Nature Conservancy Indonesia Marine Program, xi + 53 p.

Christie, P., and A. T. White. 1997. Trends in development of coastal area management in tropical countries: From central to community orientation. *Coastal Management* 25:155–181.

CBD (Convention on Biological Diversity). 2006. Decisions Adopted by the Conference of the Parties to the Convention on Biological Diversity at its Eighth Meeting (Decision VIII/15, Annex IV). Convention on Biological Diversity, Curitiba, Brazil.

Convention of Biological Diversity (CBD). 2010. Strategic Plan for Biodiversity 2011-2020, including Aichi Biodiversity Targets. Conference of the Parties to the Convention on Biological Diversity. October 29, in Nagoya, Japan.

Coral Triangle Atlas. 2013. Marine Protected Area Database. http://ctatlas.reefbase.org/mpadatabase.aspx (accessed June 3, 2013).

Cros, A., R. Venegas, S. J. Teoh, N. Peterson, W. Wen, and N. A. Fatan. 2014. Spatial data quality control for the Coral Triangle Atlas. *Coastal Management*, 42:128–142.

Cruz-Trinidad, A., P. M. Aliño, R. C. Geronimo, and R. B. Cabral. 2014. Linking food security with coral reefs and fisheries in the CTI. *Coastal Management*, 42:160–182.

CTI-CFF (Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security). 2009. Regional Plan of Action, Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security, Interim Regional CTI Secretariat, Jakarta, Indonesia, 87 p.

CTI-CFF. 2013. Coral Triangle Marine Protected Area System Framework and Action Plan. CTI-CFF Marine Protected Area Technical Working Group and the Coral Triangle Support Partnership of USAID, Cebu City, Philippines, 95 p.

Department of Marine Parks Malaysia. 2009. Compendium Data and JTLM Information 2009. Department of Marine Parks Malaysia.

Directorate for Conservation of Area and Fish Species (DCAFS). 2012. Technical Guidelines for Evaluating the Management Effectiveness of Aquatic, Coasts and Small Islands Conservation Areas (E-KKP3K). Jakarta: Directorate for Conservation of Areas and Fish Species, Directorate General of Marine, Coasts and Small Islands, Ministry of Marine Affairs and Fisheries, Government of Indonesia, ix + 61 p.

Directorate General of Forest Protection and Nature Conservation, Ministry of Forestry Indonesia. 2008. Information of Conservation Areas in Indonesia. Indonesia. 130 p

Dudley, N. (ed.). 2008. Guidelines for Applying Protected Area Management Categories. Gland, Switzerland: IUCN. x + 86 p.

Dygico, M., A. Songco, A. T. White, and S. J. Green. 2013. Achieving MPA effectiveness through application of responsive governance incentives in the Tubbataha Reefs. *Marine Policy* 41: 87–94.

Flower, K. R., S. R. Atkinson, R. Brainard, C. Courtney, B. A. Parker, J. Parks, R. Pomeroy, and A. White. 2013. Toward Ecosystem-Based Coastal Area and Fisheries Management in the Coral Triangle: Integrated Strategies and Guidance. Jakarta, Indonesia: Coral Triangle Initiative Support Program for the U.S. Agency for International Development.

Grantham, H. S., J. E. M. Watson, M. Mendes, F. Santana, G. Fernandez, P. Pinto, L. Riveiro, and C. Barreto. 2011. National Ecological Gap Assessment for Timor-Leste, 2010. Prepared on behalf of the United Nations Development Program and the Department of Protected Areas and National Parks of Timor-Leste by CNRM Solutions Pty Ltd, Byron Bay, New South Wales. http://www.cbd.int/protected/collaboration/?threadid=983 (accessed January 22, 2014).

Green, A., A. White, and J. Tanzer. 2012. Integrating Fisheries, Biodiversity, and Climate Change Objectives into Marine Protected Area Network Design in the Coral Triangle. Report prepared by The Nature Conservancy for the Coral Triangle Support Partnership, 105 p.

Green, A., A. White, and S. Kilarski (eds.). 2013. Designing Marine Protected Area Networks to Achieve Fisheries, Biodiversity, and Climate Change Objectives in Tropical Ecosystems: A Practitioner Guide. The Nature Conservancy, and the USAID Coral Triangle Support Partnership, Cebu City, Philippines. viii + 35 p.

Green, S. J., A. White, P. Christie, S. Kilarski, A. Blesilda, T. Meneses, G. Samonte-Tan, et al. 2011. Emerging marine protected networks in the Coral Triangle: Lessons and way forward. *Conservation and Society* 9 (3): 173–188.

Green, A. L. Fernandes, G. Almany, R. Abesamis, E. McLeod, P. Aliño, A. White, R. Salm, J. Tanzer, and R. Pressey. 2014. Designing marine reserves for fisheries management, biodiversity conservation and climate change adaptation. *Coastal Management*, 42:143–159.

Govan, H., A. Tawake, K. Tabunkawai, A. Jenkins, A. Lasgorceix, E. Techera, H. Tafea, et al. 2009. Community Conserved Areas: A review of status & needs in Melanesia and Polynesia. ICCA regional review for CENESTA/TILCEPA/TGER/IUCN/GEF-SGP. http://cmsdata.iucn.org/downloads/community_conserved_areas_melanesia_and_polynesia_govan_2009.pdf (accessed January 22, 2014).

Indonesia National Coordinating Committee for Coral Triangle Initiative on Coral Reefs, Fisheries and Food Security (I-NCC). 2012. The State of the Coral Triangle in Indonesia. I-NCC, Jakarta, 189 p.

IUCN World Commission on Protected Areas (IUCN-WCPA). 2008. *Establishing Marine Protected Area Networks—Making It Happen*. Washington, DC: IUCN-WCPA, National Oceanic and Atmospheric Administration and The Nature Conservancy. 118 p.

IUCN-World Conservation Union World Commission on Protected Areas 2003. 5th World Parks Congress Recommendation 5.22. http://www.iucn.org/themes/wcpa/wpc2003/pdfs/english/Proceedings/recommendation.pdf (accessed January 22, 2014).

Kahn, B. 2008. Lesser Sunda–Timor-Leste (East Timor) Ecoregional Planning: Deep-Sea yet Nearshore Habitats Associated with Oceanic Cetaceans. Apex International, 25 p.

Kelleher, G. 1999. *Guidelines for Marine Protected Areas*. IUCN, Gland, Switzerland and Cambridge.

Licuanan, W. R. Y., S. S. Mamauag, R. O. M. Gonzales, and P. M. Aliño. 2008. The minimum sizes of fish sanctuaries and fishing effort reductions needed to achieve sustainable coastal fisheries in Calauag and Tayabas Bays. *The Philippine Agricultural Scientist* 91 (1): 51–59.

Lowry, G. K., A. T. White, and P. Christie. 2009. Scaling up to networks of marine protected areas in the Philippines: Biophysical, legal, institutional, and social considerations. *Coastal Management* 37:274–290.

Maypa, A. P., A. T. White, E. Caňares, R. Martinez, R. L. Eisma-Osorio, P. Aliňo, and D. Apistar. 2012. Marine protected area management effectiveness: Progress and lessons in the Philippines. *Coastal Management* 40 (5): 510–524.

Miclat, E., and J. Ingles. 2004. Standardized terms and definitions for use in marine protected area management in the Philippines, In *Proceedings of the Workshop Toward the Formulation of the Philippine Marine Sanctuary Strategy*, eds. H. O. Arceo, W. L. Campos, F. Fuentes, and P. M. Alino, 3–8. Quezon City: Marine Science Institute, University of the Philippines.

Ministry of Agriculture and Fisheries. 2011. The Agriculture and Land Use Geographic Information System (ALGIS), National Parks of Timor-Leste (Cartographic boundary file). Dili, Timor-Leste.

MPA Support Network (MSN). 2010. Marine Protected Area Management Effectiveness Assessment Tool (MPA-MEAT). Coral Triangle Support Partnership of USAID, Department of Environment and Natural Resources, and the MPA Support Network Philippines, Quezon City, 15p.

Palumbi, S. R. 2004. Marine reserves and ocean neighborhoods: The spatial scale of marine populations and their management. *Annual Review of Environment and Resources* 29:31–68.

Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO). 2007. *The science of marine reserves*. 2nd edition, United States Version. Santa Barbara, CA: The Partnership for Interdisciplinary Studies of Coastal Oceans (PISCO) in collaboration with the Communication Partnership for Science and the Sea (COMPASS, www.compassonline.org).

Roberts, C. M., B. Halpern, S. R. Palumbi, and R. R. Warner. 2001. Designing marine reserve networks: Why small, isolated protected areas are not enough. *Conservation Biology In Practice* 2 (3): 12–19.

Ruddle, K., E. Hviding, and R. E. Johannes. 1992. Marine resources management in the context of customary tenure. *Marine Resource Economics* 7:249–273.

Russ, G. R., A. C., Alcala, A. P. Maypa, H. P. Calumpong, and A. T. White. 2004. Marine reserve benefits local fisheries. *Ecological Applications* 14:597–606.

Sabah Parks. 2011. Marine Protected Areas of Sabah, Malaysia (Cartographic boundary file). Kota Kinabalu, Malaysia.

Salm, R. V., J. R. Clark, and E. Siirila. 2000. *Marine and Coastal Protected Areas: A Guide for Planners and Managers*. Washington, DC: IUCN. 371 p.

Sarawak Forest Department. 2012. National Parks of Sarawak. http://www.forestry.sarawak.gov.my (accessed December 13, 2012).

Spalding, M., M. Kainuma, and L. Collins. 2010. World Atlas of Mangroves. A collaborative project of ITTO, ISME, FAO, UNEP-WCMC, UNESCO -MAB, UNU-INWEH and TNC. Earthscan, London. 319 p.

Stobutzki, I. C., G. T. Silvestre, A. Abu Talib, A. Krongprom, M. Supongpan, P. Khemakorn, N. Armada, and L. R. Garces. 2006. Decline of demersal coastal fisheries resources in three developing Asian countries. *Fisheries Research* 78:130–142.

TNC (The Nature Conservancy), WWF (World Wildlife Fund), CI (Conservation International), and WCS (Wildlife Conservation Society). 2008. Marine Protected Area Networks in the Coral Triangle: Development and Lessons. TNC, WWF, CI, WCS and the United States Agency for International Development, Cebu City, Philippines. 106 p.

United Nations Environment Program (UNEP) and World Conservation Monitoring Centre (WCMC). 2008. Establishing National and Regional Networks of MPAs—A Review of Progress with Lessons Learned. UNEP and WCMC, draft report, 106 p.

UNEP and WCMC. 2010. World Database of Protected Areas. http://www.wdpa.org/Download.aspx (accessed June 2, 2013).

UNEP-WCMC, WorldFish Centre, WRI, and TNC. 2010. Global Distribution of Warm-Water Coral Reefs, Compiled from Multiple Sources, including the Millennium Coral Reef Mapping Project. UNEP World Conservation Monitoring Centre. Cambridge (UK). http://data.unep-wcmc.org/datasets/13 (accessed June 3, 2013).

VLIZ. 2012. Maritime Boundaries Geodatabase, version 7. http://www.marineregions.org/. (accessed June 19, 2013).

Walton, A. A, White, S. Tighe, P. Aliño, L. Laroya, A. Dermawan, A. Kasasiah, et al. 2014. Establishing a functional region-wide Coral Triangle marine protected area system. *Coastal Management*, 42:107–127.

Weeks, R., P. M. Aliño, S. Atkinson, P. Beldia II, A. Binson, W. L. Campos, R. Djohani, et al. 2014. Developing marine protected area networks in the Coral Triangle: Best practices for expanding the Coral Triangle marine protected area system. *Coastal Management* 42:183–205.

WFC (WorldFish Center). 2007. *Coral Reef MPAs of East Asia and Micronesia*. World Fish Center (REEFBASE Project), Sea Around Us Project, Japan Wildlife Research Center. CD.

White, A. T., and A. Cruz-Trinidad. 1998. *The Values of Philippine Coastal Resources: Why Protection and Management Are Critical*. Cebu City, Philippines: Coastal Resource Management Project, 96 p.

White, A.T., P. Christie, H. d'Agnes, K. Lowry, and N. Milne. 2005. Designing ICM projects for sustainability: Lessons from the Philippines and Indonesia. *Ocean and Coastal Management* 48:271–296.

White, A. T., R. L. Eisma-Osorio, and S. J. Green. 2005. Integrated coastal management and marine protected areas: Complementarity in the Philippines. *Ocean and Coastal Management* 48:948–971.

White, A. T., A. T. Meneses, and M. F. Ovenden. 2004. Management Rating System for Marine Protected Areas: An Important Tool to Improve Management. In *DA-BFAR (Department of Agriculture—Bureau of Fisheries and Aquatic Resources). In Turbulent Seas: The Status of Philippine Marine Fisheries*. Cebu City, Philippines: Coastal Resource Management Project, 378 p.

White, A. T., P. M. Alino, and A. T. Meneses. 2006. Creating and Managing Marine Protected Areas in the Philippines. Fisheries Improved for Sustainable Harvests Project, Coastal Conservation and Education Foundation, Inc., and Marine Science Institute—University of the Philippines, Cebu City, Philippines. 83 p.

Wilkinson, C., A. Caillaud, L. DeVantier, and R. South. 2006. Strategies to reverse the decline in valuable and diverse coral reefs, mangroves and fisheries: The bottom of the J-curve in Southeast Asia? *Ocean and Coastal Management* 49:764–778.

Wilson, J., A. Darmawan, J. Subijanto, A. Green, and S. Sheppard. 2011. Scientific Design of a Resilient Network of Marine Protected Areas for the Lesser Sunda Ecoregion of the Coral Triangle. Asia Pacific Marine Program. Report 2/11. 96.

World Bank. 2006. *Scaling up Marine Management: The Role of Marine Protected Areas*. Report no. 36635-GLB. Environment Department/Sustainable Development Network. World Bank, Washington, DC. 100 p.

Yudhoyono, S. B. 2009. Speech by Dr. Susilo Bambang Yudhoyono, President of the Republic of Indonesia, at the Coral Triangle Initiative Summit, Manado, 15 May 15.