

The Philippine Marine Protected Area (MPA) Database

Reniel B. Cabral^{*1,2,3}, Porfirio M. Aliño^{*1,2}, Adrian Chester M. Balingit^{2,3}, Christian M. Alis^{§3}, Hazel O. Arceo^{1,2}, Cleto L. Nañola Jr.^{1,4}, Rollan C. Geronimo¹, and MSN Partners¹

¹Marine Protected Area Support Network (MSN)

²Marine Science Institute, College of Science, University of the Philippines Diliman, 1101 Quezon City, Philippines

³National Institute of Physics, College of Science, University of the Philippines Diliman, 1101 Quezon City, Philippines

⁴College of Science and Mathematics, University of the Philippines Mindanao, Davao City, Philippines

[§]University College London, Gower Street, London WC1E 6BT, United Kingdom

We present the Philippine Marine Protected Area (MPA) database. The database contains 1,800 MPAs with vital information for coastal resource management, particularly MPA size, location, management effectiveness, and contact information. The database will be the source of up-to-date information on MPAs in the Philippines. The MPA database is seen to be the start of developing nationwide systems of biological databases where academic, government, and non-government institutions work together as integral parts of communities of practice.

INTRODUCTION

The Philippines is one of the world's centers of marine biodiversity and multitaxa marine endemism (Roberts et al. 2002). However, the marine resources of the Philippines are also experiencing the highest level of anthropogenic and climatic threats (Roberts et al. 2002, Burke et al. 2012). The anthropogenic threats include fishing overcapacity; overfishing and destructive fishing practices; increased domestic, agricultural, and

industrial runoff from a burgeoning population; poor land use; and increased sedimentation from forest deforestation and unregulated mining activities (Gomez et al. 1994, Coral Reef Information Network in the Philippines (PhilReefs) 2003, 2005, 2008, 2010, Nañola Jr et al. 2011, Burke et al. 2012, Cabral et al. 2012, 2013, 2014, National CTI Coordinating Committee 2013, Cruz-Trinidad et al. 2014, Geronimo and Cabral 2014).

One of the solutions being used to address the threats plaguing marine resources is the establishment of marine protected areas (MPAs). MPAs refer to “clearly defined geographical spaces, recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values” (IUCN definition by Dudley 2008). This is one of the most achievable modes of protection particularly in the Philippines in relation to coastal resource management (CRM) (White et al. 2002, Aliño 2008). In the Philippines, MPAs can be categorized into two governance levels: nationally established MPAs and locally established MPAs. MPAs in general take four forms: 1) Marine sanctuary or no-take marine reserve, where all forms of extractive activities are prohibited; 2) Marine reserve, where extractive and non-extractive activities are regulated; 3) Marine parks, where uses are designated into zones; and 4) Protected landscape and seascape, where protection may include non-

KEYWORDS

marine protected area, database, decision support system, coastal resource management, community of practice, monitoring and evaluation, communication tool

*Corresponding author

Email Address: reniel.cabral2013@gmail.com (R.B. Cabral)
alinoperry018@gmail.com (P.M. Aliño)

Submitted: May 30, 2014

Revised: July 12, 2014

Accepted: July 13, 2014

Published: September 8, 2014

Editor-in-charge: Eduardo R. Mendoza

marine resources (Mielat and Ingles 2004, White et al. 2014). The most common objectives for MPA establishment are biodiversity conservation, fisheries sustainability, and tourism and recreation, among others.

MPAs reduce human interaction with resources, thereby allowing the resources to replenish. Although MPAs cannot address all problems in the marine resources, especially continued perturbation beyond their boundaries (*e.g.*, overexploitation, destructive fishing activities, point and non-point pollution sources from industrial, agricultural and domestic runoffs, etc.), they help reduce some anthropogenic-related problems and may enhance the resiliency of marine resources to various stressors including climate impacts (Lubchenco et al. 2003). As such, MPAs have increasingly become a popular tool for CRM in the Philippines and around the globe.

Globally, there are 10,280 MPAs covering 2.3% of the world's ocean area; most of these MPAs are located in coastal and near-shore areas (2012 World Database on Protected Areas, Spalding et al. 2013). In the Philippines, 1,620 locally managed MPAs have been established as of 2011 (National CTI Coordinating Committee 2013). However, many MPAs in the Philippines are small and not effectively managed (Arceo et al. 2008).

Although there is substantial information on MPAs in the Philippines (*e.g.*, Haribon Foundation 2005, Alcala et al. 2008, Arceo et al. 2008), a centralized database that is accessible to government and non-government institutions remains a challenge. Here, we present the Philippine MPA database which aims to serve as a system where information can be accessible to local governments and policy makers to enhance planning and decision. Currently, there is no consistent MPA database in the Philippines, or in any country within the Coral Triangle (White et al. 2014). There have been previous attempts to consolidate MPA information, but many of these have become archiving systems with limited user interaction (Table 1). Over time, these databases were no longer updated and became static. The devel-

opment of an online Philippine MPA database can support initiatives at the local, national, and regional (*e.g.*, Coral Triangle Initiative) levels. The database can also be a tool for monitoring the progress of various MPA initiatives in the Philippines.

THE NEED FOR DEVELOPING A PHILIPPINE MPA DATABASE

The Philippines is a signatory to the United Nations Convention on Biological Diversity (CBD), of which one of the targets is to protect 10% of all marine and coastal habitats by 2020 (Table 2). This is in addition to various national, regional, and global initiatives of the Philippine government to protect marine resources, *e.g.*, the United Nations Development Programme Millennium Development Goals (UNDP 2013), the Coral Triangle Initiative, and Philippine Development Plans (Table 2). Aliño and colleagues showed that at the rate of increase in MPA establishment and given that many of the MPAs are small (half of the MPAs in the Philippines have sizes of less than 20 hectares, Cabral et al. submitted), it would take the Philippines a hundred years to fully protect 10% of its coral reef areas (Aliño et al. 2004). With the added threat of climate-related disturbances, such as massive coral bleaching due to increased ocean temperatures (Arceo et al. 2001, Peñaflor et al. 2009), or extreme weather events, it became clear that the protection of marine resources in the country would have to increase its pace significantly.

The total protected area effectively managed is a common metric used for international and even national biodiversity and conservation goals (Table 2). Estimating the status of the Philippines towards achieving these international conservation targets has so far been only partially achieved. Many of the 1,620 MPAs in the Philippines reported in 2011 are locally managed. There is no national agency assigned to track or monitor the progress of all these MPAs. Different organizations have attempted to establish the status of Philippine MPAs and MPA effectiveness, but so far have covered only specific areas of the country (Alcala et

Table 1. Comparison of the online database features of different organizations with Philippine MPA entries. Entries counted from their respective websites, as of 12 July 2014.

	Number of MPA Entries	Location	Coordinates	MPA Area	Establishing Ordinance	MPA Evaluation
WorldFish ReefBase ^{1,*}	294	-	Yes	Yes	Yes	-
MPAtlas ²	234	-	Yes	Yes	-	-
DENR ICRMP ³	149	Yes	-	Yes	Yes	-
BMB ACCCoast ⁴	139	Yes	-	Yes	Yes	Rating Only
CCEF Coast.ph ⁵	93	Yes	-	Yes	Yes	Rating Only**
Our Database	1800	Yes	Yes	Yes	Yes	Rating + Evaluation details

¹ WorldFish ReefBase – Global Database – Management: Protected Areas (Philippines) (http://www.reefbase.org/global_database/default.aspx?section=m2®ion=32&country=PHL/)

² MPAtlas – Marine Protected Areas in Philippines (<http://www.mpatlas.org/region/nation/PHL/>)

³ DENR Integrated Coastal Resources Management Project (ICRMP) – ICRMP Marine Protected Areas (<http://icrmp.denr.gov.ph/index.php/mpa-status-database>)

⁴ DENR-Biodiversity Management Bureau (BMB) Adaptation to Climate Change in Coastal Areas (ACCCoast) – MPA Database (<http://acc coast.bmb.gov.ph/database/mpa-database>)

⁵ Coastal Conservation and Education Foundation (CCEF) Inc. Coast.ph – MPA Database (<http://coast.ph/our-work/mpadatabase>)

* Contents based on NEP-WCMC World Database on Protected Areas, linked with MPAGlobal: <http://www.mpaglobal.org/home.html>

** Using CCEF's own MPA rating tool

Table 2. Conservation targets related to marine protected areas based on international agreement and plans of the Philippine government

Agreements / Plans	Conservation Targets
Convention on Biological Diversity (Aichi Biodiversity Targets) (CBD 2011)	Strategic Goal C, Target 11: <i>By 2020, at least 17 percent of terrestrial and inland water, and 10 percent of coastal and marine areas, especially areas of particular importance for biodiversity and ecosystem services, are conserved through effectively and equitably managed, ecologically representative and well-connected systems of protected areas and other effective area-based conservation measures, and integrated into the wider landscapes and seascapes</i>
United Nations Development Programme Millennium Development Goals (UNDP 2013)	Goal 7: <i>Ensuring environmental sustainability (one indicator on area of marine environment under protection)</i>
Coral Triangle Initiative (Republic of the Philippines 2009)	Goal 3: <i>MPAs established and effectively managed (percent or area of marine habitats in some form of protection; and, marine protected areas under "effective" management)</i>
Philippine Development Plan (2011-2016) (NEDA 2011)	Sector Outcome 10: <i>Natural resources conserved, protected, and rehabilitated</i> <i>Increased percentage of terrestrial, inland water, and coastal and marine areas important for biodiversity and ecosystem services effectively and equitably managed through NIPAS and other effective area-based conservation measures.</i> <i>Target: 0.62% marine areas are effectively and equitably managed through NIPAS.</i>

al. 2008, Arceo et al. 2008, Maypa et al. 2012). A complete and regularly updated MPA database can help the national government to regularly track progress towards conservation targets.

The Philippines has a long history in MPA establishment and management. No-take MPAs were introduced in the country in the 1970s through the establishment of the first municipal marine reserve in Sumilon Island, Cebu in 1974, and an increasing number of MPAs have been established since then (Arceo et al. 2013). Several reviews have been done to compile information on MPAs in the country and evaluate their management status (e.g., Pajaro et al. 1999, Aliño et al. 2002, Alcala et al. 2008, Arceo et al. 2008). However, data gained from these reviews are not really readily available to the local government unit (LGU), other concerned government agencies and institutions, and other interested development organizations; many more MPA data remain not well documented and archived, especially at the site level. Most MPA evaluations have been produced in print and only as unpublished reports with limited distribution and quantity. Oftentimes, these reports are misplaced or lost and the local government and stakeholders have to start anew with 'baseline' data collection. This slows down, or may even reverse, MPA effectiveness.

The challenges in documenting and archiving information are numerous and sometimes complex. These activities require

certain skills and appreciation that may not be well developed among existing personnel within the relevant management units. Frequent changes in the focal person responsible for these activities, as is the case for MPA management bodies and/or LGUs, can also hamper the continuity of use of information. This is particularly evident in local governments that spend substantial resources to collect basic information for their CRM programs or projects that have already been collected. An online MPA database can give local governments and managers the status of their MPAs in real time and allow them to timely respond to the threats or trends.

Given the substantial amount of information available and the challenges in initiating and sustaining proper documentation and archiving, the need to establish a system for consolidating these data that can be accessed by relevant users of such information became evident. A national online database of Philippine MPAs was developed to serve this purpose. The MPA database aims to provide the platform for easy exchange and validation of information, thus enhancing coastal resource monitoring in the country and proper archiving and analysis of information. Furthermore, the MPA database can promote continuity and connectivity of efforts (e.g., sharing good practices among neighboring towns and municipalities) as good governance requires a system of interacting people.

THE PHILIPPINE MPA DATABASE

The MPA database currently holds information for a total of 1,800 MPAs (as of 12 July 2014). Each MPA entry contains information about its complete name, short name, the year established, its size, and relevant legislation. The database classifies the MPAs into two major types: locally managed MPAs (LMPA), and nationally managed MPAs (*i.e.*, MPAs that are included in the National Integrated Protected Areas System (NIPAS) as stipulated in Republic Act 7586 and which are managed by the national government through the Department of Environment and Natural Resources in partnership with local stakeholders). LMPAs are further classified as a sanctuary (no-take marine reserve), a reserve, or a combination of both.

Philippine MPA Database MPA List What is MEAT? Acknowledgment Citation Search Add LMPA sample user

LMPA - Baler Marine Protected Area

Basic Information MEAT Results

Complete name Baler Marine Protected Area
Short name BMA
MPA type Combination
Year established 2006
Legislation Municipal Ordinance DO8 Series of 2006

Location
 • Zambal, Baler, Aurora

Contact
 • [Redacted]

Map [Map showing Baler Bay and surrounding areas]

The University of the Philippines Marine Science Institute MSN

Figure 1. Information page for an MPA (Baler Marine Protected Area), displaying basic information, location, and contact details.

Philippine MPA Database MPA List What is MEAT? Acknowledgment Citation Search Add LMPA sample user

Edit existing locally-managed MPA

Complete name San Isidro Marine Fish Sanctuary
Short name San Isidro MFS
MPA type Sanctuary
Year established 2008
Legislation Ord. No. 281 Series of 2008

Location
 Province: [Dropdown] Municipality: [Dropdown] Barangay: [Dropdown]

Contact Persons

Name	Position	Email address	Contact number

Core Zone
 Coordinates: 125.56555555555556, 9.7638888888889
 125.56703333333333, 9.7583888888889
 125.55944444444444, 9.7583888888889
 125.56533333333333, 9.76225

Buffer Zone
 Coordinates: [Empty]
 Core Area (hectares): 33.0
 Buffer Area (hectares): 0.0

Edit local MPA

Figure 2. Form for adding/modifying MPA information, including the location and contact persons for the MPA.

Geographic information about the MPAs includes location data and MPA zone areas (Figures 1 and 2). MPA location is identified to a particular province, municipality, and barangay. Partial or multiple locations may be provided for MPAs that span multiple barangays or an entire municipality. The total area of an MPA can be broken down to regions specific to the type of MPA. For LMPAs, the MPA total area is identified by the core zone and buffer zone. A core zone is a strict no-take area where all types of activities, except for monitoring and research, are prohibited; a buffer zone is an area often adjacent to, or sur-

rounding, the core zone where fishing activities and sea use are regulated. MPAs under the NIPAS are identified by the multiple-use and restricted areas. In certain cases, the coordinates that define the location and boundaries of the MPA are shown; those may also be provided for inclusion in the database. Contact persons for the MPA are also available.

Philippine MPA Database MPA List What is MEAT? Acknowledgment Citation Search Add LMPA sample user

Edit MPA MEAT evaluation

MPA San Isidro Marine Fish Sanctuary
Evaluation date 2014-05-28

Evaluators

Name	Affiliation	Email address(es)	Contact number(s)

Evaluation form
 Level 1 - Establishment Level 2 - Strengthened Level 3 - Sustainability Level 4 - Institutionalization

LEVEL 1 - MPA IS ESTABLISHED (17 Items, 27 Points)

1.1 Establishment based on Participatory Process (5/5)

MPA concept explained to stakeholders
 Was the MPA concept explained to the stakeholders?
 Attached publications have been created on MPA concepts and benefits

Supporting Documents
 • Minutes of consultations & public hearings: [Choose File] [No file chosen]
 • Activity report / proceedings of the consultation: [Choose File] [No file chosen]

Remarks

MPA accepted and approved by the community or local government
 Was the MPA accepted by the community (for local MPAs) or local governments (for NIPAS seascapes)?
 Public consultation or site selection should be conducted in order to gain community approval and acceptance

Supporting Documents
 • Resolution(s): [Choose File] [No file chosen]
 • Minutes of meeting: [Choose File] [No file chosen]

Remarks

Baseline assessment conducted
 Were the stakeholders engaged in baseline assessment using standard methods / any acceptable methods?

Supporting Documents
 • Biological assessment report: [Choose File] [No file chosen]

Remarks

Figure 3. Marine Protected Area Effectiveness Assessment Tool (MEAT) evaluation form for a particular MPA. The form provides a checklist of evaluation measures, upload button for supporting documents, and text box for remarks, as to be supplied by the evaluator.

For MPAs whose management effectiveness have been assessed using the MPA Effectiveness Assessment Tool (MEAT) (MPA Support Network 2010), the database enables the users to submit the results of the MPA MEAT evaluation online (Figure 3). Currently, MEAT forms are completed manually either on a printed form combined with supporting documents, or by encoding directly into the dynamic PDF form. The database includes the checklist and comment boxes from the MEAT form, and provides upload for submitting digital copies of the supporting

MPA MEAT Evaluation

San Isidro Marine Fish Sanctuary
 Report Completed: Dec. 18, 2013
 Download at: <http://mpa.msi.upd.edu.ph/mpa/eval/139/pdf>

MPA Information
 Short Name: San Isidro MFS
 Year Established: 2008
 Legislation: Ord. No. 281, series of 2008
 MPA Area (ha): 33.0

Location
 • San Isidro, Surigao City, Surigao Del Norte

Database URL: <http://mpa.msi.upd.edu.ph/mpa/mpa/143>

MPA Rating - Level 1 Score: 26/84 (Good)

Evaluator(s)
 [Redacted]

MPA Contact Persons
 No information available

The 48 questions of the MPA MEAT can be grouped into nine (9) Management Focus, corresponding to the axes of the spider chart. The chart can show which areas of management the MPA management body is strong at and which ones need significant improvement.

Management Focus

Management Focus	Score	Percentage
Management Plan	5/9	55.6%
Management Body	5/11	45.5%
Legal Instrument	5/5	100%
Community Participation	1/2	50%
Financing	3/12	25%
Information, Education, and Communication	1/7	14.3%
Enforcement	2/20	10%
Monitoring and Evaluation	4/16	25%
Site Development	0/2	0%

Thresholds

Achieved thresholds	Requirements for next level	Other thresholds to attain
1. Baseline assessment conducted	1. Patrolling and surveillance conducted regularly	1. Funds generated or accessed for last 2 years
2. Management plan adopted	2. Violations documented	2. Enforcement system fully operational in the last five consecutive years
3. Legal instrument approved	3. Cases filed or violations penalized	3. Performance monitoring of the management body conducted regularly
4. Management body formed and roles clarified		4. Regular participatory monitoring conducted
5. Budget allocated for at least one year		5. Violators prosecuted and sanctioned
		6. MPA management plan incorporated in broader development plans
		7. Ecological and socioeconomic impact assessment conducted
		8. Performance monitoring and evaluation system linked to an incentive system
		9. IEC sustained over seven years
		10. MPA financially self-sustaining in the last seven (7) consecutive years

Figure 4. PDF file of MPA Information and MEAT evaluation scores generated by the database. The file is designed to be printable for use in offline documentation.

MPA List

Province: Municipality: Barangay: Filter

Summary

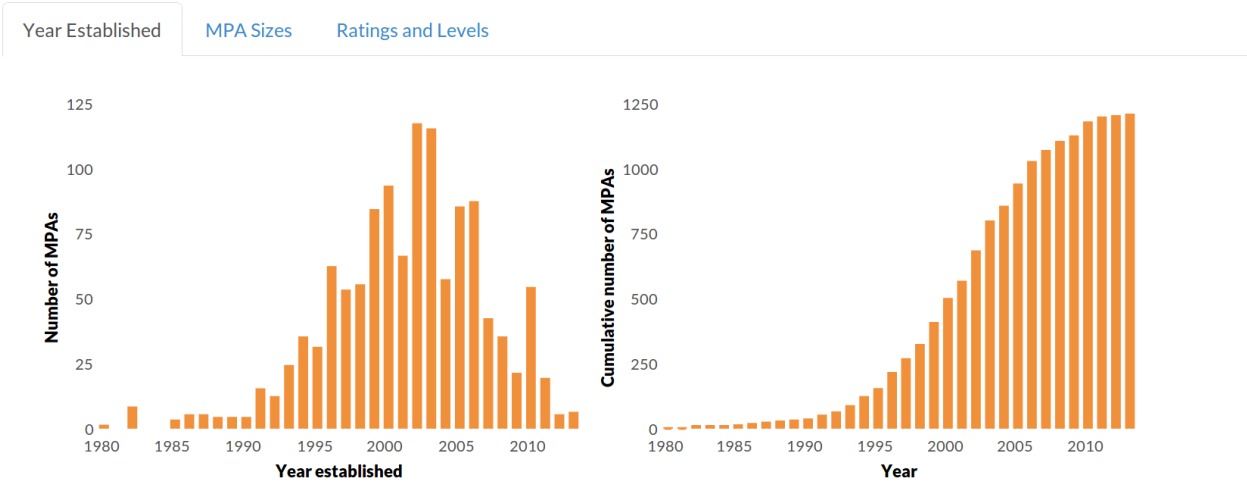


Figure 5. MPA listing, displaying a summary of the number of MPAs established per year.

Name	Location	MEAT Level/Score	Latest MEAT		
Abung Marine Protected Area	<ul style="list-style-type: none"> Abung, San Juan, Batangas 	2 (80/84)	2012	EDIT	DELETE
Abung Marine Sanctuary	<ul style="list-style-type: none"> San Juan, Batangas 			EDIT	DELETE
Arthur's Rock Marine Sanctuary	<ul style="list-style-type: none"> Bagalangit, Mabini, Batangas 	3 (74/84)	2012	EDIT	DELETE
Balahibong Manok TZMR	<ul style="list-style-type: none"> Mabini, Batangas 			EDIT	DELETE
Balayan Bay Coastal Wetland	<ul style="list-style-type: none"> Balayan, Batangas 			EDIT	DELETE
Baruarte-Bataan-Nagsaulay-Subukin Man...	<ul style="list-style-type: none"> Bataan, San Juan, Batangas Barualte, San Juan, Batangas Nagsaulay, San Juan, Batangas Subukin, San Juan, Batangas 	0 (65/84)	2012	EDIT	DELETE
Batalang Bato Marine Sanctuary	<ul style="list-style-type: none"> Talahib, Tingloy, Batangas Santo Tomas, Tingloy, Batangas 	0 (54/84)	2012	EDIT	DELETE
Batong Buhay Marine Sanctuary	<ul style="list-style-type: none"> Ligaya, Mabini, Batangas 	0 (41/84)	2012	EDIT	DELETE
Bauan Divers Sanctuary	<ul style="list-style-type: none"> Bauan, Batangas 			EDIT	DELETE
Biga Fish Sanctuary and Refuge	<ul style="list-style-type: none"> Biga, Lobo, Batangas 	0 (68/84)	2012	EDIT	DELETE

Figure 6. MPA listing, filtered based on province (Batangas). Listing may be filtered down to a particular locality, i.e. provincial, municipality, and barangay level. User privilege is required to be able to add, modify, and delete MPA information and MEAT evaluation data.

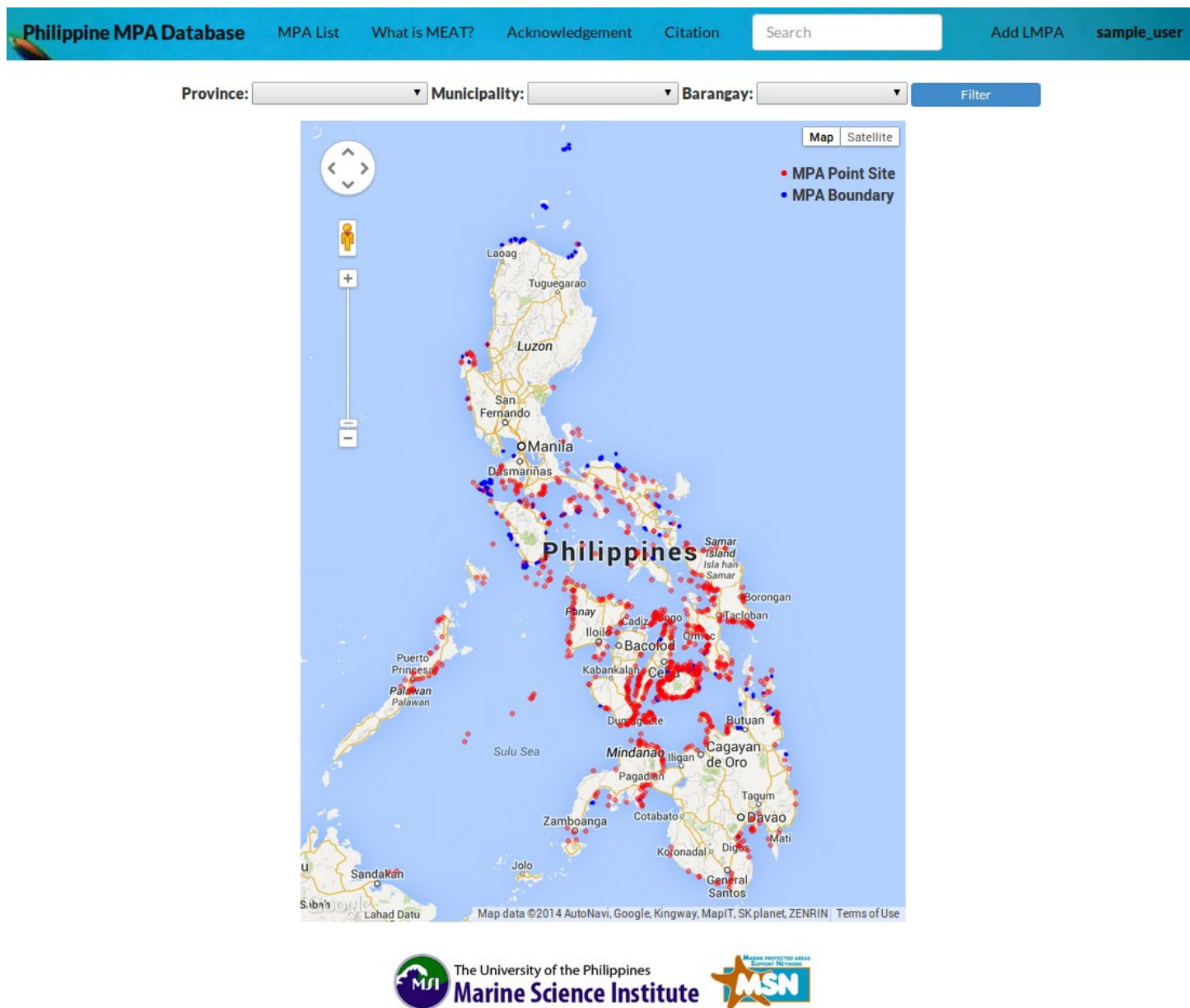


Figure 7. Homepage of the database, displaying the polygons and point locations of MPAs available in the database.

documents. The system currently outputs an “MPA Report Card” or a summary of MPA MEAT evaluation information about each MPA (Figure 4).

The MPA list page (Figures 5 and 6) displays a paginated list of all the MPAs available in the database, with location and MEAT level and score summarized for each MPA. The page also displays summary graphs that describe the year of establishment of the MPAs, the size, and MPA ratings and levels (Figure 5). The MPAs, with the displayed summary, can be filtered down to a particular locality, *i.e.* at the provincial, municipal, and even the barangay level.

Maps are very effective communication tools. As shown in Figure 1, the exact polygon of an MPA is mapped provided that the MPA boundary coordinates are available. This spatial information is critical for initiating other uses of the website and database as decision support tools. Polygon and point representation of the MPAs in the entire Philippines is shown on the main page of the site (Figure 7). The MPA polygons/points can be filtered down to a particular locality.

For database security, a user system is implemented for the site. Although most of the data in the database are publicly accessible, user login is required to be able to add, modify, or delete MPA information in the database. User privileges for adding and modifying are therefore limited to officials who manage the sites at a geographic (barangay, municipality, or provincial) level. Only the site administrator who confirms the identity of the user provides these privileges.

Instead of being the usual standalone application, the database is hosted as a web application. Besides the immediate advantage of the data being publicly accessible, hosting the application online enables the management of data over the Internet using a web browser. For example, MEAT forms may be completed by the evaluator directly on the database site, without the need for passing documents across institutions. Part of the process of determining the functionalities, features, and access protocols of the database has been done through several consultations with the target audience of the database in various MPA Support Network (MSN) meetings that have been attended by representatives from non-government organizations (NGOs), local government units, national government agencies, and the academe, and by MSN members who are also part of various organizations.

The MPA database is now online. It is being hosted by the Marine Science Institute of the University of the Philippines, Diliman (<http://www.mpa.msi.upd.edu.ph>). Publicly hosting the database follows and supports the open data initiative of the Philippine government. Clearly, our MPA database has more entries and features compared to other existing online databases where Philippine MPAs are included (Table 1). Summary data of all the MPAs and data per MPA are available online. However, part of the protocol that has been agreed upon by the members of the MSN is to require written requests, if the complete tabled dataset is needed by partner institutions, or by national or international agencies. The request should specifically state their

purpose, for proper guidelines on the use of the data and proper attribution.

RECOMMENDATIONS AND FUTURE DIRECTIONS

With access protocols currently being set up, the national government agencies can co-manage the database in the future and provide access to their different regional centers to improve database content and user-friendly utility. Future plans include the training of the target users, which should result in a systematic evaluation of the database application’s usability. The database, as a decision support system (DSS), can be seen as a hub to support the fisheries monitoring program of the Bureau of Fisheries and Aquatic Resources, including the CRM activities supported by the Biodiversity Management Bureau of the Department of Environment and Natural Resources (BMB-DENR).

Based on the experience of previous organizations that attempted to put together an MPA database for the country, a major challenge for these types of information systems is keeping them alive and up-to-date. As mentioned earlier, previous MPA databases remained static and were no longer updated. They did not have features to allow for user inputs or uploading of information. User interaction and transforming the MPA database to address the needs of the country and communities are key to ensuring the sustainability of the database. Together with MSN and its partners, the current initiative hopes to build a community of practice using many of the communication tools and knowledge products available, and the lessons learned through the years.

The MPA database will be linked to various incentive systems for effectively managed MPAs, such as the biennial Para El MAR (MPA Awards and Recognition) event that seeks to recognize the best-performing MPAs in the country. This would encourage local governments to conduct management-performance evaluations at least every other year. Since these performance evaluations are self-assessments, the database can enhance transparency and the data verification process, since supporting documents can be submitted and stored in the database.

The information available in the MPA database can already be used as decision-support information such as monitoring MPA sizes and locations at the municipal, provincial, and national levels. In fact, the information from the MPA database has been used already to guide the Philippine National Police’s ‘Adopt-an-MPA’ program and for the selection of project sites by one of MSN’s partner non-governmental organizations (NGOs). The database will eventually feature a list of various agencies, organizations, and institutions that can provide assistance to local MPAs on various aspects of MPA management (*e.g.*, MPA design and planning, monitoring, enforcement, financing, communications, etc.). This ‘Find support’ feature will give MPA managers direct access to various organizations and to information that could enhance the effectiveness of their MPAs.

Through partnerships and dialogue with the national and local governments, the MPA database will eventually feature other query systems relevant to their use (*e.g.*, area of habitats

protected, analysis of trends for MPAs with multi-year management evaluations, etc.). For it to be a tool to actively increase MPA effectiveness, the MPA database will also be linked to MPA support information through the MSN.

The MPA database will also eventually be integrated with biophysical and socioeconomic information. This will transform the database from measuring only management performance to also include the other critical parameters that complete a holistic assessment of MPA effectiveness. The system will track not only outputs but also outcomes, such as improvements in benthic and fish communities (*e.g.*, fish biomass, fish abundance, species richness, and quality of coral cover), as well as human well-being indicators. A platform for analyzing raw monitoring data of reef fish and reef benthos is actively being developed by the MSN. The platform will be integrated with the MPA database in the coming months. Consistencies in reef-fish and reef-benthos monitoring data will be enhanced, as a standard and consistent analysis and collection-method protocol will be promoted in the database. Moreover, stakeholders can also archive basic fisheries-monitoring information and coastal profiles through the MPA database. The availability of information will allow LGUs to access long-term information on their management progress. Since the MPA information and the corresponding biophysical and social information can be represented spatially, future DSS applications will involve marine spatial planning and modeling.

The database is seen to be the basis for monitoring the progress of local, national, regional, and global targets with regards to marine protected areas. Eventually, data interoperability at the regional and global scales should be set up, provided that proper attribution is exercised. Finally, information from the database could be used to prioritize sites for management intervention. For example, government and non-government institutions could determine strengths and gaps in MPA management through the MEAT results. The information on MPAs can be useful also in developing networks of MPAs in the Philippines as part of the scaling-up process (Ecogov Project 2011, Horigue et al. 2012).

ACKNOWLEDGEMENTS

We thank Laurence Robles for enhancing the quality of the MPA database entries. The MPA database receives continued support from the Marine Science Institute of the University of the Philippines and the Marine Environment and Resources Foundation Inc. Initial versions of the database have been supported also by USAID-CTSP through Conservation International - Philippines and the Biodiversity and Management Bureau - Department of Environment and Natural Resources. Entries in the MPA database have come from various MSN partners and directly from local governments of coastal municipalities. A more comprehensive acknowledgement can be found in the website mentioned above.

CONFLICTS OF INTEREST

There are no conflicts of interest.

REFERENCES

- Alcala AC, Bucol AA, Nillos-Kleiven P. Directory of Marine Reserves in the Visayas, Philippines. Foundation for the Philippine Environment and Silliman University-Angelo King Center for Research and Environmental Management (SUAKCREM). Dumaguete City, Philippines. 2008.
- Aliño PM, Palomar NE, Arceo HO, Uychiaoco AT. Challenges and opportunities for marine protected area (MPA) management in the Philippines. In: Kasim Moosa M, Soemodihardjo S, Soegiarto A, Romimohtarto K, Nontji A, Soekarno, Suharsono, eds. Proceedings of the 9th international coral reef symposium. Bali, Indonesia: Ministry for the Environment, Indonesian Institute of Sciences, International Society for Reef Studies, 2002:635-640.
- Aliño PM, Arceo HO, Uychiaoco AJ. Marine Protected Areas. In: Silvestre G, Green S, White AT, Armada N, Luna C, Cruz-Trinidad A, Carreon MF, III, eds. Turbulent Seas: The Status of Philippine Marine Fisheries. Manila, Philippines: Department of Agriculture-Bureau of Fisheries and Aquatic Resources, 2004:219-222.
- Aliño PM. Effective Coastal Zone Management Practices in the Philippines. In: Mimura N, ed. Asia-Pacific Coasts and Their Management, States of Environment Series: Coastal Systems and Continental Margins 11 (XVI). Netherlands:Springer, 2008:217-223.
- Arceo HO, Quibilan MC, Aliño PM, Lim G, Licuanan WY. Coral bleaching in Philippine reefs: coincident evidences with mesoscale thermal anomalies. Bulletin of Marine Science 2001; 69(2):579-593.
- Arceo HO, Aliño PM, Gonzales ROM. Where are we now with marine protected areas? In: Reefs through time: initiating the state of the coasts reports. Coral Reef Information Network of the Philippines (PhilReefs), MPA Support Network, Marine Environment & Resources Foundation, Inc. and the Marine Science Institute, University of the Philippines. Quezon City, 2008:145-152.
- Arceo HO, Cazalet B, Aliño PM, Mangialajo L, Francour P. Moving beyond a top-down fisheries management approach in the northwestern Mediterranean: Some lessons from the Philippines. Marine Policy 2013; 39:29-42.
- Burke L, Reyter K, Spalding M, Perry AL. Reefs at Risk Revisited in the Coral Triangle. World Resources Institute, The Nature Conservancy, WorldFish Center, International Coral Reef Action Network, UNEP World Conservation Monitoring Centre and Global Coral Reef Monitoring Network. Washington, D.C. 2012.
- Cabral RB, Cruz-Trinidad A, Geronimo R, Aliño P. Opportunities and challenges in the Coral Triangle. Environmental Science & Technology 2012; 46:7930-7931.
- Cabral RB, Cruz-Trinidad A, Geronimo R, Napitupulu L, Lokani P, Boso D, Casal CM, Fatan NA, Aliño P. Crisis sentinel indicators: Averting a potential meltdown in the Coral Triangle. Marine Policy 2013; 39:241-247.
- Cabral RB, Aliño PM, Pomeroy R, Jatulan W. Assuring Sustainable Fisheries Development. In: Asian Development Bank 2014: Economics of Fisheries and Aquaculture in the Coral Triangle. Asian Development Bank, Mandaluyong

- City, Philippines, 2014:141-172.
- Cabral RB, Mancao RH, Tirona RS, Atrigenio MP, Mamauag SS, Muallil RN, Martinez RJS, Panga FM, Deocadez MR, Aliño PM. Marine protected area challenges: finding hope from the Philippines' overfished, impoverished and highly populated coasts. (Submitted to Conservation & Society)
- CBD. United Nations Convention on Biological Diversity. Aichi Biodiversity Targets. 2011. <http://www.cbd.int/sp/targets/> (accessed May 20, 2014)
- Coral Reef Information Network of the Philippines (PhilReefs). Philippine Coral Reefs through Time: Workshop Proceedings. Second of the Atlas of Philippine Coral Reef Series. PhilReefs, University of the Philippines Marine Science Institute, Quezon City, Philippines and the Marine Park Center, Tokyo, Japan, 2003.
- Coral Reef Information Network of the Philippines (PhilReefs). Reefs Through Time: 2004 Biennial report on the status of Philippine coral reefs. PhilReefs and Marine Science Institute, University of the Philippines, Diliman, Quezon City, Philippines, 2005.
- Coral Reef Information Network in the Philippines (PhilReefs). Reefs Through Time 2008: Initiating the State of the Coasts Reports. PhilReefs, MPA Support Network, Marine Environment & Resources Foundation, Inc. and the Marine Science Institute, University of the Philippines, Diliman, Quezon City. 2008.
- Coral Reef Information Network of the Philippines (PhilReefs). State of the Coast: Promoting the State of the Coast Reporting. PhilReefs, MPA Support Network, Marine Environment & Resources Foundation, Inc. and the Marine Science Institute, University of the Philippines, Diliman, Quezon City. 2010.
- Cruz-Trinidad A, Aliño PM, Geronimo RC, Cabral, RB. Linking food security with coral reefs and fisheries in the Coral Triangle. *Coastal Management* 2014; 42(2):160-182.
- Dudley N, ed. Guidelines for Applying Protected Areas Management Categories. IUCN: Gland, Switzerland. 2008:8-9.
- Ecogov Project. Lessons from the Philippines: Achieving Synergies through Marine Protected Area Networks. Philippine Environmental Governance (EcoGov), Pasig City, Philippines. 2011.
- Geronimo RC, Cabral RB. Fish Production in the Coral Triangle: Status, Trends, and Challenges. In: Asian Development Bank 2014. Economics of Fisheries and Aquaculture in the Coral Triangle. Asian Development Bank, Mandaluyong City, Philippines. 2014:5-42.
- Gomez ED, Aliño PM, Yap HT, Licuanan WY. A review of the status of Philippine reefs. *Marine Pollution Bulletin* 1994; 29(1):62-68.
- Haribon Foundation. Atlas of community-based marine protected areas in the Philippines. Haribon Foundation for the Conservation of Natural Resources, Quezon City, and Pamana Ka Sa Pilipinas, Cebu City, Philippines. 2005.
- Horigue V, Aliño PM, White AT, Pressey RL. Marine protected area networks in the Philippines: trends and challenges for establishment and governance. *Ocean & Coastal Management* 2012; 64:15-26.
- Lubchenco J, Palumbi SR, Gaines SD, Andelman S. Plugging a hole in the ocean: the emerging science of marine reserves. *Ecological applications* 2003; 13(sp1):3-7.
- Maypa AP, White AT, Cañares E, Martinez R, Eisma-Osorio RL, Aliño P, Apistar D. Marine protected area management effectiveness: Progress and lessons in the Philippines. *Coastal Management* 2012; 40(5):510-524.
- Miclat E, Ingles J. Standardized terms and definitions for use in marine protected area management in the Philippines. In: Arceo HO, Campos WL, Fuentes F, Aliño PM, eds. Proceedings of the Workshop Toward the Formulation of the Philippine Marine Sanctuary Strategy. Quezon City: Marine Science Institute, University of the Philippines. 2004:3-8.
- MPA Support Network. 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, 2010.
- Nañola Jr. CL, Aliño PM, Carpenter KE. Exploitation-related reef fish species richness depletion in the epicenter of marine biodiversity. *Environmental Biology of Fishes* 2011; 90(4):405-420.
- National CTI Coordinating Committee. State of the Coral Triangle Report Philippines 2012, 2013: 136 p.
- NEDA. Philippine Development Plan 2011-2016 Results Matrix. National Economic Development Authority, Pasig City, Philippines, 2011: 99 pp.
- Pajaro M, Olano F, San Juan B, Nozawa CM. Inventory of marine protected areas in the Philippines. In: Uychiaoco AJ, Schoppe S, Aliño P, Hermes R, eds. Proceedings of the workshop on marine protected areas in the Philippines. Los Baños, Philippines: Philippine Council for Aquatic and Marine Resources and Development. 1999:1-13.
- Peñaflor EL, Skirving WJ, Strong AE, Heron SF, David LT. Sea-surface temperature and thermal stress in the Coral Triangle over the past two decades. *Coral Reefs* 2009; 28(4):841-850.
- Republic of the Philippines. National Plan of Action for the Coral Triangle Initiative on Coral reefs, Fisheries and Food Security. DENR-PAWB, Quezon City, Philippines, 2009: 88 pp.
- Roberts CM, McClean CJ, Veron JE, Hawkins JP, Allen GR, McAllister DE, Mittermeier CG, Wells F, Vynne C, Werner TB. Marine biodiversity hotspots and conservation priorities for tropical reefs. *Science* 2002; 295(5558):1280-1284.
- Spalding MD, Meliane I, Milam A, Fitzgerald C, Hale LZ. Protecting Marine Spaces: global targets and changing approaches. *Ocean Yearbook* 2013; 27:213-248.
- UNDP. (<http://www.ph.undp.org/content/philippines/en/home/mdgoverview/overview/mdg7/>)2013. (accessed May 20, 2014)
- White AT, Courtney CA, Salamanca A. Experience with marine protected area planning and management in the Philippines. *Coastal Management* 2002; 30(1):1-26.
- White AT, Aliño PM, Cros A, Fatan NA, Green AL, Teoh SJ, Laroya L, Peterson N, Tan S, Tighe S, Venegas-Li R, Walton A, Wen W. Marine protected areas in the Coral Triangle: progress, issues, and options. *Coastal Management* 2014; 42(2):87-106.