A FRAMEWORK FOR DESIGNING MARINE PROTECTED AREAS AND MARINE PROTECTED AREA NETWORKS IN INDONESIA

USAID SUSTAINABLE ECOSYSTEMS ADVANCED (SEA) PROJECT

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Cover Image: *Coastal communities benefit from well designed and managed MPAs through improved fishing near protected areas in Indonesia. Image: © Tommy Schultz.*

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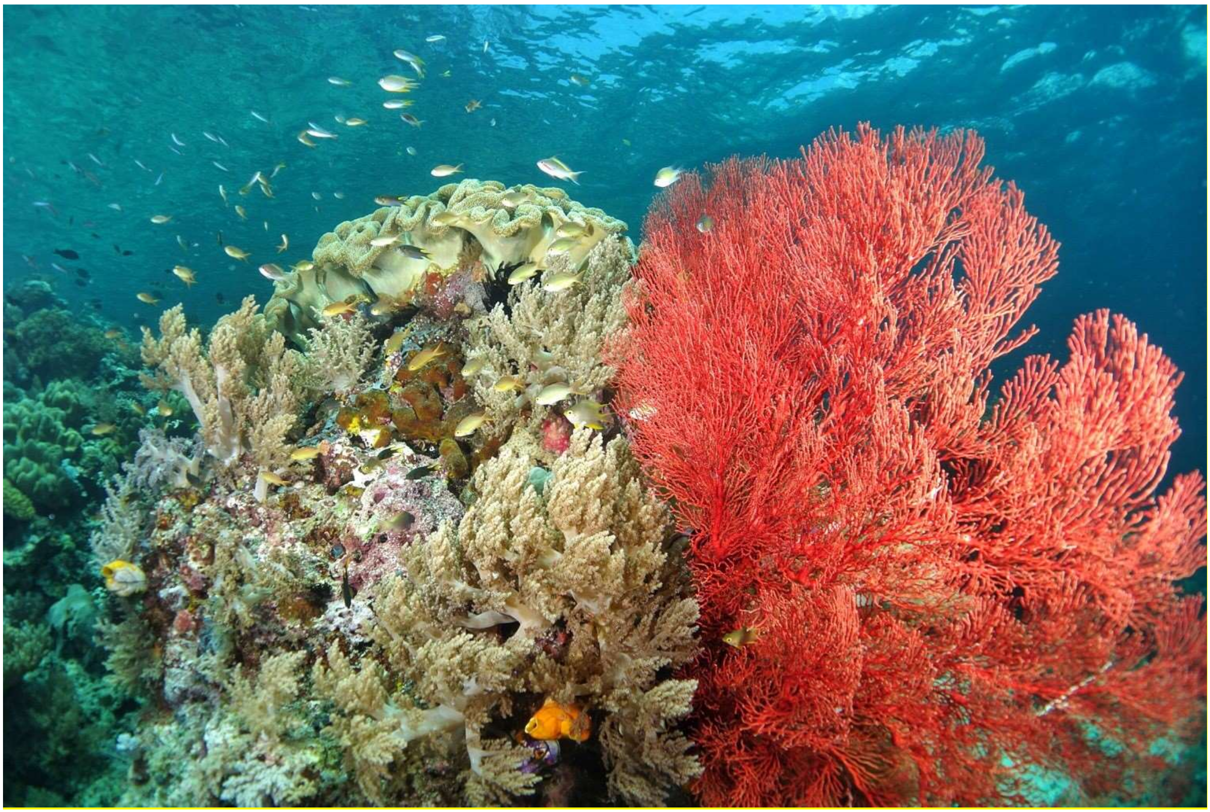

▲ *Healthy, high biodiversity coral reef in Misool MPA, Raja Ampat Islands. Image: © Awaludinnoer, TNC.*

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MPAs AND MPA NETWORKS IN INDONESIA

Context

Indonesia comprises some of the world's most diverse tropical marine ecosystems, which are a global priority for conservation (Allen and Erdmann 2012, Veron et al. 2015). These rich marine resources provide food security and livelihoods for coastal communities (ADB 2014). Unfortunately, many of these critically important resources, and the ecosystem services they provide, have been lost, seriously degraded or are threatened by a combination of local anthropogenic threats (i.e., destructive or overfishing, mass tourism, coastal development and land based runoff) and global changes in climate and ocean chemistry (Burke et al. 2012, ADB 2014).

Marine Protected Areas (MPAs), particularly no-take zones (NTZs), can be powerful tools to address local threats and enhance fisheries productivity, protect biodiversity and increase resilience to changes in climate and ocean chemistry (Green et al. 2014, Roberts et al. 2017). They can also enhance food security and sustainable livelihoods for communities and other stakeholders. MPA Networks can deliver additional benefits (e.g., by acting as mutually replenishing networks to facilitate recovery after disturbances: see review in Green et al. 2019a).

MPAs and MPA Networks play an important role in conservation and management in Indonesia. However, they can only achieve their objectives if they are well designed and effectively managed (Green et al. 2014, Gill et al. 2017, Giakoumi et al. 2018).

Definitions

In Indonesia, Marine Protected Areas (MPAs) are defined as *marine areas that are protected and managed by a zoning system to manage fish resources and the environment in a sustainable manner* (Ministry of Marine Affairs and Fisheries Regulation Number 13 Year 2014 and Number 30 Year 2010).

While an MPA Network is defined as *a management cooperation of 2 (two) or more MPAs in a synergistic manner that have biophysical linkages* (Ministry of Marine Affairs and Fisheries Regulation Number 13 Year 2014).

A Locally Managed Marine Area (LMMA) is defined as *an area of nearshore waters and its associated coastal and marine 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* (http://lmmanetwork.org).

Status

The Government of Indonesia is committed to establishing 20 million hectares of effectively managed MPAs by 2020, and 30 million hectares by 2030. To date, there are 177 existing national and local government MPAs (and no MPA Networks) established in Indonesia (Figure 1), covering an area of 22,786,183 hectares (updated from MMAF 2018: https://kkp.go.id/djprl/kkhl). These MPAs are managed at the national level by the Ministry of Marine Affairs and Fisheries (MMAF: 5,578,816 hectares) and the Ministry of Environment and Forestry (MOEF: 4,612,869 hectares), as well as by Provincial Governments (12,594,497 hectares). MMAF is now identifying and establishing new MPAs to achieve their target of 30 million hectares in MPAs by 2030, and is interested in reviewing the design of existing MPAs.

Coastal communities have also established LMMAs in many locations for conservation, fisheries management and environmental education (http://lmmanetwork.org). LMMAs are often used to enhance traditional conservation methods, particularly in Eastern Indonesia (e.g., sasi), where they are used to regulate the use of specific natural resources (i.e., giant clams, trochus, sea cucumbers and lobsters) by closing access to areas at a certain time or place (ADB 2014). At present, local communities have established 51 LMMAs in three eastern provinces: 29 in West Papua (Padaido Islands), 17 in Papua (Tanah Merah Bay) and 7 in Maluku (3 in the Banda Islands and 4 in the Kei Islands) Provinces[1].

Unfortunately, many of Indonesia's MPAs are not yet managed effectively. For example, Burke et al. (2012) estimated the effectiveness of 175 MPAs containing coral reefs in Indonesia. They found that less than 2% were fully effective at managing fishing pressure, 24% were partially effective, 34% were not effective, and the effectiveness of the rest was unknown.

Factors inhibiting effective management of MPAs in Indonesia may include a high population of low income people who depend on marine resources for their food and livelihoods, the lack of adequate community engagement and education in MPA establishment and management (leading to a lack of community support and compliance), inadequate institutional capacity, technical capacity and governance mechanisms (Lowry et al. 2009, Green et al. 2011, White et al 2014).

To respond to these challenges, the national government developed technical guidelines for evaluating and improving management effectiveness of MPAs (e.g., E-KKP3K: DCAFS 2013). Further scientific advice is also required to ensure that MPAs are well designed to achieve their goals and objectives (Green et al. 2014).

Legal Framework

In Indonesia, MPAs can be established by national and provincial governments under either fisheries legislation (Law 31/2004 or Law 45/2009) or coastal and small island management legislation (Law 27/2007 or Law 1/2014). These laws allow for multiple uses within MPAs through the application of zoning and management plans. MPAs can include zones with a variety of regulations and restrictions regarding access and activities (e.g., for fisheries or tourism). No take zones (NTZs) are usually core (no go areas) or limited utilization zones, where no extractive activities are allowed.

Currently, there are several Ministerial Regulations (PERMENs) that provide general guidance for establishing MPAs and MPA Networks in Indonesia including, but not limited to:

- PERMEN KP No. 17/MEN/2008 Coastal and Small Island MPAs;
- PERMEN KP No.02/2009 MPA Establishment;
- PERMEN KP No. 30/2010 MPA Zoning and Management Planning; and
- PERMEN KP No.13/2014 MPA Networks.

[1] See http://lmmanetwork.org/who-we-are/country-networks/indonesia/.

Figure 1. Marine Protected Areas in Indonesia (updated from MMAF 2018).

Each of these PERMENs provides information to guide the design and establishment of MPAs and/or MPA Networks. However, the advice they provide often focuses more on management processes, and they do not provide clear, consistent or easy-to-use technical advice for field practitioners to use to design MPAs and MPA Networks in Indonesia. Some of the PERMENs also acknowledge that their design criteria need to be refined using the best available science.

Furthermore, while there are some similarities in the scientific guidance provided in each of the PERMENs, each document also provides different advice and guidance. This is confusing for field practitioners who wish to design MPAs and MPA Networks in Indonesia. Also, most of the PERMENs do not yet include performance indicators for evaluating the design of these areas.[2]

Currently, MMAF [with technical assistance from the USAID Sustainable Ecosystems Advanced (SEA) Project and Partners] is addressing this by:

- Simplifying and unifying PERMEN 30/2010, PERMEN 2/2009 and PERMEN 17/2018 into one PERMEN on MPA management.
- Developing *Technical Guidelines of Ministerial Regulation No. 13/2014 on Establishing and Managing MPA Networks* (MMAF *in prep.)*.

This Document

Recently, with technical assistance from The Nature Conservancy through the USAID Sustainable Ecosystems Advanced (USAID SEA) Project, MMAF developed a clear, logical framework for field practitioners to use to design MPAs and MPA Networks in Indonesia. The framework was developed by:

- Reviewing the guidance in the PERMENS (see above), and updating and refining this guidance based on the latest science and best practices in Indonesia and worldwide (i.e., from the Savu Sea Marine National Park and Raja Ampat Islands MPA: TNC/SEA 2018a).
- Adapting and refining this guidance with input from 243 representatives from 69 national, provincial or local level governments, non-governmental organizations (NGOs) and university scientists at 12 national and provincial workshops (e.g., see TNC/SEA 2018a,b,c: see *Acknowledgements*).

This document provides the results of this process.

Here we provide, for the first time, a framework for designing MPAs and MPA Networks in Indonesia. The framework leads managers through a simple, easy-to-use scientific process for designing MPAs and MPA Networks, which takes the unique biophysical, socioeconomic and cultural considerations of Indonesia into account. It provides a logical framework (goals, objectives and design criteria) for designing new MPAs and MPA Networks, and provides a tool (with performance indicators) for evaluating the design of existing MPAs or MPA Networks. This framework will be provided as supplementary information to support the *Technical Guidelines of Ministerial Regulation No. 13/2014 on Establishing and Managing MPA Networks* (MMAF *in prep.*).

[2] Performance indicators for MPA management effectiveness are available in the *Technical Guidelines for Evaluating the Management Effectiveness of Aquatic, Coasts and Small Islands Conservation Areas (E-KKP3K:* DCAFS 2013). These guidelines do not include performance indicators for designing MPAs or MPAs networks, although they are currently being reviewed and revised.

Please note that there are also many governance factors that are important to consider when establishing MPAs and MPA Networks (Lowry et al. 2009, White et al. 2014). These are not included here, because they will be addressed elsewhere in the *Technical Guidelines of Ministerial Regulation No. 13/2014 on Establishing and Managing MPA Networks* (MMAF *in prep*.) in Indonesia.

A FRAMEWORK FOR DESIGNING MPAs AND MPA NETWORKS IN INDONESIA

A logical framework for designing MPAs and MPA Networks in Indonesia is provided in Figure 2. The process includes six steps in the scientific process that should take place in co-ordination with the MPA management process. Where: Steps 1-5 should take place during the Initiation Phase, and Step 6 should take place during the Management Phase (after the MPA or MPA Network has been established).

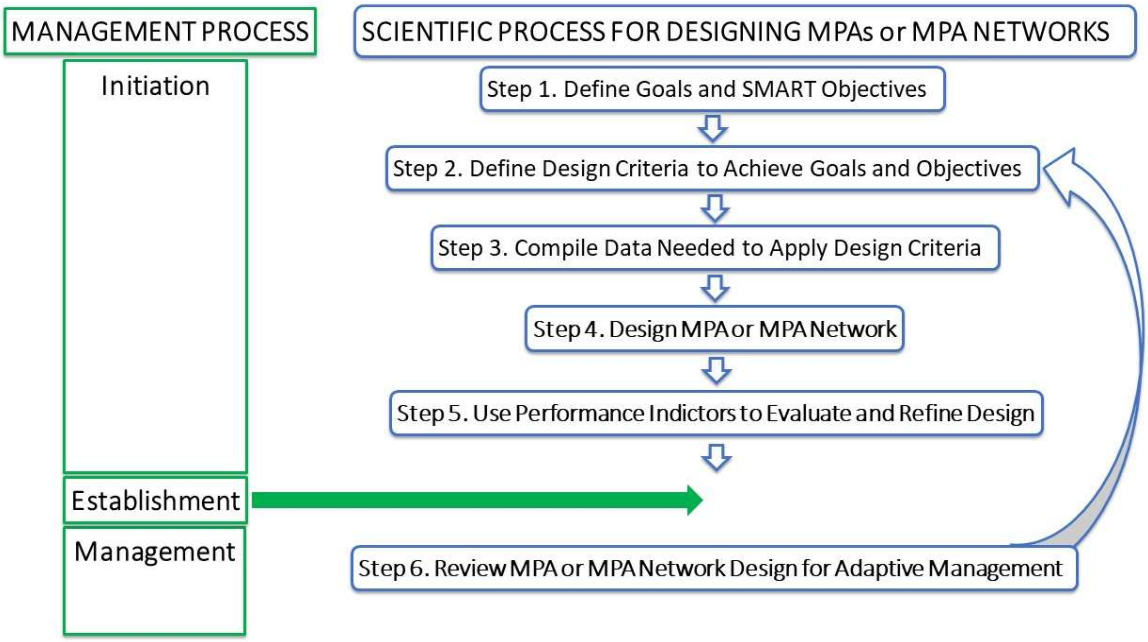

Figure 2. A logical framework for designing MPAs and MPA Networks in Indonesia, showing how the steps in the scientific process align with those in the management process.

The following provides an overview of each step in this process, and provides goals, objectives, design criteria and performance indicators for designing MPAs and MPA Networks in Indonesia.

The *Training Manual for Designing MPAs and MPA Networks in Indonesia* developed by The Nature Conservancy and the Coral Triangle Center through the USAID SEA Project, provides training for managers regarding how to use this process (TNC/CTC/SEA 2019).

Step 1. Define Goals and SMART Objectives

MPA goals and objectives should be clearly defined and compatible with one another, which helps facilitate broader acceptance of MPAs by a range of stakeholders who may have different objectives with respect to their interests (Giakoumi et al. 2018).

Therefore, the first step in designing MPAs or MPA Networks is to clearly identify the goals and SMART objectives. Where:

- *Goals* are what you want to achieve by establishing the MPA or MPA Network; and
- *Objectives* are specific plans of action or milestones needed to achieve your goals. Objectives should be SMART (Specific, Measurable, Achievable, Realistic and Time-bound).

Table 1 provides a summary of the goals, and some examples of SMART objectives for each goal, for MPAs and MPA Networks in Indonesia that address biophysical, socioeconomic and cultural considerations. Managers and key stakeholders should consider each of these goals, and then adapt and refine them to develop goals that suit their local context. Where one MPA may have multiple goals e.g., to protect biodiversity and enhance fisheries resources (biophysical goals), and to support sustainable community livelihoods and promote active community participation and support in MPA or MPA Network management (socioeconomic and cultural goals).

Step 2. Define Design Criteria to Achieve Goals and Objectives

The second step is to develop design criteria. These are guidelines that provide specific advice on how to design MPAs and MPA Networks to achieve their goals and objectives (Green et al. 2013).

There are two types of criteria for designing MPAs and MPA Networks in Indonesia:

- Biophysical design criteria aimed at achieving ecological objectives by taking key biological and physical processes into account (Table 2); and
- Socioeconomic and cultural design criteria aimed at maximizing benefits and minimizing costs to local communities and sustainable industries (Table 3).

Managers and key stakeholders should adapt and refine these design criteria to address the goals and objectives of their MPA or MPA Network (see *Step 1*), and to consider their local biophysical, socioeconomic and cultural context.

A detailed scientific rationale for each of the biophysical criteria for designing MPAs and MPA Networks in Indonesia is provided in *Biophysical Criteria for Designing Marine Protected Areas and Marine Protected Area Networks to Benefit People and Nature in Indonesia* (Green et al. 2019a: see Table 4, Annex 1). The rationale for the socioeconomic and cultural design criteria are also provided in Annex 1 (Table 5), based on input from workshop participants (see *Acknowledgements*).

Table 1. Biophysical, socioeconomic and cultural goals for MPAs and MPA Networks in Indonesia, and some examples of SMART objectives for each goal.

Biophysical Goals	**Examples of (SMART) Objectives**
Protect critical ecosystems, habitats, biodiversity, species, and abiotic resources.	• *Within 5-years of the MPA being established, at least 20% of critical habitats have been protected in NTZs.* • *Five years after the MPA is established, biodiversity and the status of biotic resources have been maintained relative to the 2019 baseline data.*
Maintain, enhance or restore productivity and biomass of coastal fisheries.	• *Five years after the MPA is established, at least 4 targeted grouper and snapper species (demersal fishes) have spawning potential ratios (SPRs) maintained at a level of 30% or above for healthy stocks and increased to above 20% for depleted stocks.* • *Five years after the MPA is established, at least 4 species of small pelagic fishes have SPRs maintained at a level of 30% or above for healthy stocks and increased to above 20% for depleted stocks.*
Rehabilitate ecosystems, habitats and populations of focal and protected species.	• *<u>For Coral Reefs</u>: Five years after the MPA is established, mean coral cover in the MPA is stable or has increased by 5% relative to the 2019 baseline data*[3]*.*
Adapt to and mitigate changes in climate and ocean chemistry.	• *Two years after the MPA is established, coral reefs that are likely to be more resilient to climate change have been identified within the MPA.* • *Five years after the MPA is established, at least 50% of resilient coral reefs are protected in NTZs.* • *Five years after the MPA is established, at least 75% of resilient reefs within the MPA that are in close proximity to (and being impacted by) high levels of land-based impacts, have a detailed land-based spatial plan that minimizes direct runoff (e.g., from sedimentation etc.) onto these reefs.*
Socioeconomic and Cultural Goals	**Examples of (SMART) Objectives**
Facilitate minimal or no conflicting use of marine resources and fisheries.	• *Three years after the MPA has been established, the number of cases of conflicting use between resource users has reduced by 50%.*
Support sustainable community livelihoods based on (biotic and abiotic) marine resources.	• *Three years after the MPA has been established, 20 home industries processing fish products in the MPA have been certified as sustainable.*
Promote active community participation and support in MPA or MPA Network management (including adat by acknowledging local wisdom in planning and implementation).	• *Three years after the MPA has been established, 50% of local wisdom is acknowledged and institutionalized in the MPA through formal recognition.* • *Two years after the MPA has been established, adat institutions have representatives in the collaborative management body of the MPA.*

[3] Although it is important to note that some factors may influence coral cover that are outside the control of MPAs i.e., coral bleaching.

Table 2. Biophysical criteria for designing MPAs and MPA Networks in Indonesia.

Please note that many of these criteria are designed to consider the ecology of focal species. They include: key fisheries species (fish and invertebrates); endangered, threatened and protected species and/or migratory marine biota (sea turtles, marine birds, cetaceans, dugong and crocodiles); large charismatic marine fauna (sharks, manta rays, whale sharks and Mola mola); species important for maintaining ecosystem function i.e., habitat forming species (e.g., corals) or species important for reef resilience (e.g., herbivores).

Consideration	Biophysical Design Criteria
Represent Habitats	*Protect at least 20% of each major habitat* in NTZs (*e.g., each type of coral reef, mangrove forest, estuary or seagrass bed).*
Replicate Habitats (Spread the Risk)	*Protect at least three examples of each major habitat in NTZs; and* *Spread them out to reduce the chances they will all be affected by the same disturbance (such as major storms, mass coral bleaching events and crown-of-thorns starfish outbreaks).*
Protect Critical, Special and Unique Areas	*Protect critical areas in the life history of focal fisheries species in NTZs (e.g., spawning and nursery areas).*
	Protect critical areas or habitats for charismatic, endangered, threatened or protected species (e.g., breeding, feeding or resting areas, or migratory corridors).
	Protect special and unique natural phenomena in NTZs [e.g., areas with very high biodiversity, high endemism, unique marine communities or high productivity (e.g., unique pelagic habitats i.e., upwelling, fronts, eddies)].
	Protect areas that are important at the national, international or global scale for conservation or management of focal species (e.g., World Heritage Areas, RAMSAR Sites, critical habitats for globally endangered species, or critical areas for maintaining connectivity of fisheries species across national boundaries).
Incorporate Connectivity: Abiotic Factors	*Consider variations in oceanography (i.e., currents, tides, temperature, salinity and acidity), substrate and, bathymetry that affect the spread of biological and non-biological material.*
Incorporate Connectivity: Biotic Factors *Movement of Adults and Juveniles*	*Ensure NTZs are large enough to sustain adults and juveniles of focal fisheries species within their boundaries.*
	Ensure NTZs are large enough to contain all habitats used by focal species throughout their life history (e.g., for home ranges, nursery grounds and spawning areas); or *Establish networks of NTZs close enough to allow for movements of focal species among protected habitats (e.g., through ontogenetic habitat shifts and spawning migrations).*
	Include whole ecological units (such as reefs or seamounts) in NTZs. If not, chose larger versus smaller areas.
	Use compact shapes (such as squares) for NTZs, except when protecting naturally elongated habitats.
Incorporate Connectivity: Biotic Factors *Larval Dispersal*	*Establish:* • *NTZs large enough to be self-sustaining for focal species; or* • *Networks of NTZs close enough to be connected by larval dispersal.*
	Protect spatially isolated areas in NTZs.
	Protect larval sources in permanent or seasonal NTZs or by using fisheries closures during spawning times.
	Locate more NTZs upstream relative to fished areas if there is a strong, consistent, unidirectional current.
Allow Time for Recovery	*Establish NTZs for the long term (>20 to 40 years), preferably permanently.*
	Use short term (<5 years) or periodically harvested NTZs in addition to, rather than instead of, long-term or permanent NTZs.
Protect Healthy Areas and Avoid Local Threats	*Protect areas where habitats and populations of focal species are in good condition with low levels of local threats (e.g., from overfishing, destructive fishing, coastal development, mass tourism, land-based runoff of sediments and nutrients, marine pollution, shipping, mining, oil and gas industries).*
	Avoid areas where habitats and populations of focal species are in poor condition due to local threats. If this is not possible: • *Reduce threats;*

Consideration	Biophysical Design Criteria
	• *Facilitate natural recovery (e.g., by protecting larval sources and species that play important functional roles in ecosystem resilience i.e., herbivores); and* • *Consider the costs and benefits of rehabilitating habitats and species (e.g., by restoring structures, transplanting corals, or facilitating population recovery of focal species by re-stocking or using temporary closures).*
Adapt to Changes in Climate and Ocean Chemistry	*Protect sites that are likely to be more resilient to global environmental change (refugia) in NTZs.*
	Protect ecologically important sites that are sensitive to changes in climate and ocean chemistry.
	Increase protection of species that play important functional roles in ecosystem resilience (i.e., herbivores).
	Consider how changes in climate and ocean chemistry will affect the life history of focal species.
	Address uncertainty by: • *Spreading the risk (see above); and* • *Increasing protection of habitats, critical areas and species most vulnerable to changes in climate and ocean chemistry.*

Table 3. Socioeconomic and cultural criteria for designing MPAs and MPA Networks in Indonesia.

Please note that many of these criteria refer to stakeholders, who include local, adat and traditional communities, governments, NGOs, civil society organizations, scientific institutions and industries (i.e., fisheries and tourism).

Consideration	Socioeconomic and Cultural Design Criteria
Involve stakeholders in establishing MPAs and MPA Networks. (MPA establishment includes developing zoning and management plans.)	*Involve all stakeholders in each step of the process of establishing MPAs and MPA Networks.*
	Prioritize establishing MPAs in areas supported by stakeholders
	Consider opportunities for collaborative management among all stakeholders and implement as appropriate.
	Provide capacity building for stakeholders to help them engage more effectively in establishing MPAs and MPAs Networks.
Ensure Stakeholder Compliance within MPAs.	*Involve local community in compliance and enforcement [e.g., by joint patrols among government institutions and communities, and POKMASWASs (community surveillance groups)].*
	Support MPA management actions that maintain or increase ecosystem goods and services for local communities.
Support multiple, environmentally-friendly uses in MPAs.	*Allow for multiple environmentally-friendly uses in MPAs (including sustainable fishing, tourism, aquaculture, education and research).*
Support community welfare (livelihoods and food supplies).	*Support environmentally-friendly livelihoods of local communities [i.e., community-based, environmentally-friendly fisheries, aquaculture and marine resource based tourism based on an areas' uniqueness (biotic and abiotic resources).]*
	Protect marine heritage sites (i.e., shipwrecks and airplane wrecks) that have important, archeological-historical value, and manage them for their potential to support community based tourism.
Ensure fair and equal access and use.	*Ensure local communities have fair and equal access to, and utilization of, marine and fisheries resources.*
	Maintain or improve access to resources and markets to support community economies that comply with MPA management plans.
Support local wisdom and practices.	*Protect adat, local wisdom, traditional law, and culture that support conservation and sustainable resource management, which are still acknowledged and applied by the existing adat community or institution.*
	Protect areas that have important traditional cultural value for local people/adat [including mystical (pamali) areas, and important sites for traditional medicine].

Step 3. Compile Data Needed to Apply Design Criteria

The third step is to compile the information and spatial data required to apply the biophysical, socioeconomic and cultural criteria to design the MPA or MPA Network to achieve its goals and objectives. Where the data required may vary depending on the specific goals, objectives and design criteria defined for the MPA or MPA Network in Steps 1 and 2. Some general advice is provided in Annex 2.

Step 4. Design the MPA or MPA Network

The next step is to design the MPA or MPA Network. This may require zoning an individual MPA (e.g., Savu Sea Marine Park: BKKPNK 2013) or designing a network of multiple MPAs (e.g., the Lesser Sunda Ecoregion MPA Network: Wilson et al. 2011).

There are several ways to design MPAs or MPA Networks:

- Ideally, the design criteria (defined in the Step 2) and the best available information and spatial data (compiled in Step 3) can be used to design MPAs or MPA Networks using systematic conservation planning tools (i.e., Marxan: Ball et al. 2009).
- Alternatively, MPAs or MPA Networks can be designed manually using the best available information and participatory expert mapping (e.g., see TNC/SEA 2019 a, b, c).

Both approaches allow managers to identify Areas of Interest for establishing new MPAs (e.g., Wilson et al. 2011, TNC/SEA 2019 a, b, c) or zones (e.g., core zones, no-take-zone or other types of utilization zones e.g., Grantham et al. 2013) to design the MPA or MPA Network to achieve its goals and objectives (see *Step 1*). Either way, the results should be ground-truthed (validated) to ensure that the Areas of Interest or zones will provide the expected benefits for the MPA or MPA Network (before proceeding with the proposed zoning or MPA initiation process).

There are many excellent systematic conservation planning tools available, each with their own training manuals or websites (e.g., http://marxan.net/). Therefore, information regarding how to use these tools will not be provided here. However, training in using Marxan or participatory expert mapping to design MPA or MPA Networks is provided in the *Training Manual for Designing Marine Protected Areas and Marine Protected Area Networks in Indonesia* (TNC/CTC/SEA 2019).

Step 5. Use Performance Indicators to Evaluate and Refine the Design

Once the MPA or MPA Network has been designed, you can use the *Evaluation Tool for Marine Protected Area and Marine Protected Area Network Design in Indonesia* (Annex 3) to evaluate and refine the design. This is a simple tool that uses performance indicators for the biophysical, socioeconomic and cultural design criteria (see *Step 2*) to help managers evaluate and refine the design to ensure the MPA or MPA Network will achieve its goals and objectives.

Steps 6. Review MPA or MPA Network Design for Adaptive Management

When the management plan (including the zoning plan) for the MPA or MPA Network is reviewed (which is required every five years), the *Evaluation Tool for Marine Protected Area* *and Marine Protected Area Network Design in Indonesia* (Annex 3) can be used again to refine the zoning plan for adaptive management.

USING THE FRAMEWORK TO DESIGN MPAs AND MPA NETWORKS IN INDONESIA

The framework for designing MPAs and MPA Networks provided in this document has already been used to design MPAs and MPA Networks at multiple scales in eastern Indonesia through the USAID SEA Project. It has been used to:

- Design a network of MPAs for Fisheries Management Area 715 and the associated six provinces in eastern Indonesia using the systematic conservation planning tool Marxan (Fajariyanto et al. 2019).
- Design networks of MPAs for each of three provinces (West Papua, North Maluku and Maluku) using participatory expert mapping (TNC/SEA 2018 b, c, 2019 a, b, c); and
- Develop, review and refine zoning plans for 14 individual MPAs in three provinces (TNC/SEA 2018d, 2019 b, c):
    - Seribu Satu Sungai Teo Enebekia (South Sorong) and Teluk Berau and Nusalasi Van den Bosch (Fakfak) in West Papua.
    - Pulau Rao – Tanjung Dehegila (Morotai), Pulau Mare, Kepulauan Sula, Kepulauan Guraici, Makian-Moti and Gugusan Pulau Widi in North Maluku.
    - Serutbar (Sawai), Koon, Ay/Rhun, Buano and Lease in Maluku.

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Annex 1: Rationale for Biophysical, Socioeconomic and Cultural Criteria for Designing MPAs and MPA Networks in Indonesia

Here we provide a rationale (and explanatory notes) for the biophysical, socioeconomic and cultural criteria for designing MPAs and MPA Networks in Indonesia. Where:

- Table 4 provides a summary of the scientific rationale for the biophysical criteria based on the best available science specifically adapted and refined for the unique biophysical environment in Indonesia, which is provided in *Biophysical Criteria for Designing Marine Protected Areas and Marine Protected Area Networks to Benefit People and Nature in Indonesia* by Green et al. (2019a).
- Table 5 provides the rationale for the socioeconomic and cultural design criteria based on input from the 243 participants from 69 institutions who contributed to developing the framework provided in this document (see *Acknowledgements*). This included experts and partners from government agencies (district, provincial, and national), universities, NGOs, and local communities.

Table 4. Scientific rationale (and explanatory notes) for the biophysical criteria for designing MPAs and MPA Networks in Indonesia.

Please note that many of these criteria are designed to consider the ecology of focal species including: key fisheries species (fish and invertebrates); endangered, threatened and protected species and/or migratory marine biota (sea turtles, marine birds, cetaceans, dugong and crocodiles); large charismatic marine fauna (sharks, manta rays, whale sharks and Mola mola); species important for maintaining ecosystem function i.e., habitat forming species (e.g., corals) or species important for reef resilience (e.g., herbivores).

Consideration	Biophysical Criteria for Designing MPAs and MPA Networks in Indonesia	Scientific Rationale and Explanatory Notes
Represent Habitats	*Protect at least 20% of each major habitat in NTZs.*	• Different species use different habitats, so examples of each major habitat (e.g., each type of coral reef, mangrove forest and seagrass bed) should be protected in NTZs. • Percent habitat representation will vary depending on several factors including fishing pressure and if there is effective fisheries management in place outside NTZs. In heavily fished areas where there is no effective fisheries management, $\geq$30% of each major habitat should be represented within NTZs to sustain populations of focal fisheries species. Where fishing pressure is low, or there is effective fisheries management outside NTZs, lower levels of protection in NTZs (20%) is needed. • Percent habitat representation should also consider the vulnerability, diversity or rarity of each habitat, and the ecosystem services it provides.
Replicate Habitats (Spread the Risk)	*Protect at least three examples of each major habitat in NTZs; and* *Spread them out to reduce the chances they will all be affected by the same disturbance.*	• Large scale disturbances (i.e., major storms, coral bleaching and crown-of-thorns starfish outbreaks) can cause serious impacts to major habitats, and it is difficult to predict which areas are most likely to be affected. • Therefore, it is important to protect at least three examples of each major habitat in widely separated NTZs to reduce the chance that they will all be impacted by the same disturbance (so damaged areas may be replenished by unaffected areas).

Consideration	Biophysical Criteria for Designing MPAs and MPA Networks in Indonesia	Scientific Rationale and Explanatory Notes
		• Spreading the risk also increases the chances that variations in communities and species within major habitats are represented in NTZs.
Protect Critical, Special and Unique Areas	*Protect critical areas in the life history of focal fisheries species in NTZs.* *Protect critical areas or habitats for charismatic, endangered, threatened or protected species.*	• Some focal species (i.e., fisheries, charismatic, endangered, threatened and protected species) concentrate in areas that are critically important for their population maintenance (i.e., spawning, nesting, breeding, calving or nursery areas) or habitats they use as migratory corridors, resting, feeding or cleaning areas. • While they use these areas, these species are particularly vulnerable to disturbance or overexploitation. Therefore, these areas should be protected in permanent or seasonal NTZs, in combination with other management approaches (i.e., fishing season or gear restrictions or tourism codes of practice).
	Protect special and unique natural phenomena in NTZs. *Protect areas that are important at the national, international or global scale for conservation or management of focal species.*	• Some areas may also have special and unique natural features that should be included in NTZs to ensure that all examples of biodiversity and ecosystem processes are protected. This may include areas with very high biodiversity, high levels of endemism, unique marine communities (i.e., marine lakes) or high productivity (e.g., unique pelagic habitats i.e., upwellings, fronts or eddies). • Some of these critical, special and unique areas may be important to protect biodiversity or manage fisheries at the national, international or global scale (e.g., World Heritage Areas, RAMSAR Sites, critical habitats for globally endangered species, or critical areas for maintaining connectivity of fisheries species across national boundaries).
Incorporate Connectivity: Abiotic Factors	*Consider variations in oceanography, substrate and bathymetry that affect the spread of biological and non-biological material.*	• Abiotic factors including substrate, bathymetry and oceanography (physical and biological properties of the ocean i.e., currents, tides, temperature, salinity and acidity) affect the spread of biological and non-biological material in the sea. These factors play important roles in determining the distribution and abundance of species, and the structure of biological communities. • Where there is little or no biological information available, unique combinations of these abiotic factors can be used as surrogates for protecting marine biodiversity in MPA Network design (to *Represent Habitats*). • Ocean currents can also play an important role in influencing larval dispersal, and should be considered when determining the location, size and spacing of NTZs (see *Larval Dispersal*).
Incorporate Connectivity: Biotic Factors	*Ensure NTZs are large enough to sustain adults and juveniles of focal fisheries species within their boundaries.*	• NTZs need to be large enough to allow for the maintenance of spawning stock, by allowing individuals to grow to maturity, increase in biomass and reproductive potential, and contribute more to stock recruitment and regeneration in NTZs and fished areas. • Different species move different distances as adults and juveniles e.g., for home ranges, ontogenetic habitat shifts (where juveniles use different habitats than adults) and spawning migrations.

Consideration	Biophysical Criteria for Designing MPAs and MPA Networks in Indonesia	Scientific Rationale and Explanatory Notes
Movement of Adults and Juveniles		• NTZs should be more than twice the size of the home range of adults and juveniles of focal species for protection. So NTZs of different sizes will be required depending on which species require protection, how far they move, and if other effective protection is in place outside NTZs. Larger NTZs will protect more species. • Recommendations regarding the minimum size of NTZs must be applied to the specific habitats that focal species use, rather than the overall size of the NTZs (which may include other habitats). • Species whose movement patterns are larger than the size of NTZs will only be afforded partial protection. So NTZs must be integrated with other fisheries management tools to manage wide ranging species.
	Ensure NTZs are large enough to contain all habitats used by focal species throughout their life history; or *Establish networks of NTZs close enough to allow for movements of focal species among protected habitats.*	• Some species use different habitats throughout their lives (e.g., for home ranges, nursery and spawning areas). • All habitats used by juveniles and adults of focal species should be protected within individual NTZs. • Where movement patterns among habitats (e.g., ontogenetic habitat shifts or spawning migrations) cover distances too great to be included in individual NTZs, different habitats used by focal species should be protected in multiple NTZs, provided that these NTZs are located to allow for movements of focal species among protected habitats.
	Include whole ecological units (such as reefs or seamounts) in NTZs. If not, chose larger versus smaller areas.	• Including whole ecological units in NTZs helps maintain the integrity of the NTZs, because many species are likely to stay within their preferred habitat type. • Where whole ecological units cannot be included, larger versus smaller NTZs should be used to accommodate movement patterns of more species (see above).
	Use compact shapes (such as squares) for NTZs, except when protecting naturally elongated habitats.	• Compact shapes minimize edge effects and limit spillover of adults and juveniles more than other shapes (such as long thin rectangles). This helps maintain the ecological integrity of the NTZs. • Therefore, compact shapes should be used for NTZs, except when protecting naturally elongated habitats (i.e., long narrow coastal reefs).
Incorporate Connectivity: Biotic Factors *Larval Dispersal*	*Establish:* • *NTZs large enough to be self-sustaining for focal species; or* • *Networks of NTZs close enough to be connected by larval dispersal.*	• Larval dispersal plays an important role in ensuring that marine populations persist through time. • NTZs should be designed to: ensure populations of focal species persist within NTZs; and maximize larval dispersal to support fisheries outside NTZs. • Where fishing pressure is high and fisheries are not well managed, it is important to take larval dispersal into account when designing NTZs, because most breeding adults are likely to be within well designed and managed NTZs. This may be less important in areas where there is less fishing pressure or fisheries are well managed (because a substantial proportion of larvae may come from fished areas).

Consideration	Biophysical Criteria for Designing MPAs and MPA Networks in Indonesia	Scientific Rationale and Explanatory Notes
		• In heavily fished areas, population persistence of focal species within NTZs will depend on recruitment to local populations through either: self-persistence where populations in individual NTZs are large enough to be self-sustaining through larval retention (this is more likely where NTZs are large); or network persistence where populations of focal species are sustained within a network of NTZs that covers an adequate fraction of the habitat (see *Represent Habitats*). • In heavily fished areas, larval dispersal patterns of focal species should be used to inform the size, spacing and location of NTZs.
	Protect spatially isolated areas in NTZs (i.e., remote atolls).	• Spatially isolated areas such as remote atolls are largely self-replenishing and may have high conservation value where they harbor endemic species and/or unique assemblages or populations. • Low connectivity with other areas makes these assemblages, species and populations less resilient to disturbance. • Protecting them in NTZs may be necessary to ensure their persistence.
	Protect larval sources in permanent or seasonal NTZs or by using fisheries closures during spawning times.	• A common recommendation is to protect larval "source" populations that can consistently provide larvae to other populations. • In practice, identifying source populations is difficult and typically relies on fine scale oceanographic modelling or empirical measurements of larval dispersal. • Larval sources can also vary over time, so that a location may act as a source in one year, but not another. • Where consistent and important larval sources for focal species are known (i.e., fish spawning areas), they should be protected in permanent or seasonal NTZs, or by fisheries closures during spawning times (see *Protect Critical, Special and Unique Areas*).
	Locate more NTZs upstream relative to fished areas if there is a strong, consistent, unidirectional current.	• Ocean currents are likely to influence larval dispersal patterns to some degree. • Therefore, in the absence of detailed larval dispersal studies for focal species, more NTZs should be located upstream relative to fished areas if there is a strong, consistent, unidirectional current. • However, in some areas, ocean currents change direction in different seasons, and focal species spawn at different times. Therefore, more NTZs should be located upstream of the direction of the predominant current during the spawning season of focal species.
Allow Time for Recovery	*Establish NTZs for the long term (>20 to 40 years), preferably permanently.*	• Populations of focal species recover at different rates in NTZs depending on their life history characteristics and other factors (e.g., habitat quality and the size of the remaining population). • Recovery of populations of all focal fisheries species may take decades (>20-40 years). Therefore, long term protection in NTZs is required for all species to grow to maturity, increase in biomass and contribute more robust eggs and larvae to replenish populations in NTZs, enhance adjacent fisheries, and maintain ecosystem health and resilience.

Consideration	Biophysical Criteria for Designing MPAs and MPA Networks in Indonesia	Scientific Rationale and Explanatory Notes
		• Permanent protection and strict enforcement of NTZs will ensure that these benefits are maintained in the long term.
	Use short term (<5 years) or periodically harvested NTZs in addition to, rather than instead of, long-term or permanent NTZs.	• Short term (<5 years) or periodically harvested NTZs only provide short-term benefits for some species. These benefits are quickly lost once these areas are reopened to fishing unless they are managed very carefully (which is seldom the case). Therefore, they have limited benefits for conserving biodiversity, enhancing fisheries or building ecosystem resilience. • Thus, short term (<5 years) or periodically harvested NTZs should be used in addition to, rather than instead of, long-term or permanent NTZs. Where periodic closures are used, the timing and intensity of harvesting must be carefully controlled. • The exception is seasonal closures that can be used to protect critical areas at critical times (e.g., spawning or nursery areas), which can be very important to protect or restore populations of focal fisheries species (see *Protecting Critical, Special and Unique Areas*).
Protect Healthy Areas and Avoid Local Threats	*Protect areas where habitats and populations of focal species are in good condition with low levels of threat.* *Avoid areas where habitats and populations of focal species are in poor condition due to local threats. If this is not possible:* • *Reduce threats;* • *Facilitate natural recovery; and* • *Consider the costs and benefits of rehabilitating habitats and species.*	• Marine ecosystems have been degraded by local threats in many locations, including by unsustainable fishing or tourism activities, destructive fishing practices, coastal development, land-based runoff and pollution. • These threats decrease ecosystem health, productivity and resilience to climate change, adversely affect many species, and severely undermine the long-term sustainability of marine resources and the ecosystem services they provide. • Therefore, it is important to minimize or avoid these threats in NTZs and prioritize areas for protection that are more likely to contribute to ecosystem health, fisheries productivity, and resilience to climate change. It is also important to consider the cumulative effects of multiple threats, and whether these "threats" are natural or exacerbated by human activities (e.g., sedimentation). • Where NTZs must be located in areas where habitats and populations of focal species are in poor condition due to local threats it is important to: reduce these threats as much as possible; facilitate natural recovery (i.e., by protecting larval sources and species that play important functional roles in ecosystem resilience i.e., herbivores); and consider the costs and benefits of rehabilitating habitats and species.
Adapt to Changes in Climate and Ocean Chemistry	*Protect sites that are likely to be more resilient to global environmental change (refugia) in NTZs.*	• Changes in climate (e.g., rising sea temperatures) and ocean chemistry represent a serious and increasing threat to major habitats (e.g., coral reefs, mangrove forests and seagrass beds) and focal species. • The effects of these changes will vary in space and time, and some areas will have habitats and species more likely to be resilient to changes in climate and ocean chemistry (refugia). Where resilience comprises two key components: resistance (the ability of an ecological community to

Consideration	Biophysical Criteria for Designing MPAs and MPA Networks in Indonesia	Scientific Rationale and Explanatory Notes
		resist or survive a disturbance) and recovery (the rate a community takes to return to its original condition). • Where refugia can be identified, they should be prioritized for protection in NTZs.
	Protect ecologically important sites that are sensitive to changes in climate and ocean chemistry.	• Some ecologically important sites have habitats and species that may be particularly sensitive to changes in climate and ocean chemistry. • These sites should be protected in NTZs integrated within broader management frameworks to promote ecosystem resilience by addressing local threats.
	Increase protection of species that play important functional roles in ecosystem resilience.	• Some functional groups play important roles in maintaining ecological resilience to local and global threats (i.e., herbivorous fishes on coral reefs). • These species should be protected in NTZs integrated within broader fisheries management regimes.
	Consider how changes in climate and ocean chemistry will affect the life history of focal species.	• Changes in climate and ocean chemistry are likely to affect the distribution, growth, abundance, reproduction, population connectivity and recovery rates of focal species, and modify ecosystem structure, function and dynamics. • These changes may require modifying the design criteria regarding habitat representation and replication, protecting critical, special and unique areas, incorporating connectivity and allowing time for recovery (see above) in future.
	Address uncertainty by: • *Spreading the risk; and* • *Increasing protection of habitats, critical areas and species most vulnerable to changes in climate and ocean chemistry.*	• There is a lot of uncertainty regarding the effects that changes in climate and ocean chemistry will have on major habitats, critical areas and focal species. • Until more information is available, it will be necessary to spread the risk by protecting multiple examples of each major habitat in NTZs (see *Replicate Habitats* above). • It may also be necessary to add a climate change buffer by increasing the level of protection of habitats in NTZs (see *Represent Habitats*), critical areas and species most vulnerable to changes in climate and ocean chemistry in NTZs.

Table 5. Rationale (and explanatory notes) for the socioeconomic and cultural criteria for designing MPAs and MPA Networks in Indonesia.
Please note that many of these criteria refer to stakeholders, who include local, adat and traditional communities, governments, NGOs, civil society organizations, scientific institutions and industries (i.e., fisheries and tourism).

Consideration	Socioeconomic and Cultural Design Criteria	Rationale and Explanatory Notes
Involve stakeholders in establishing MPAs and MPA Networks (MPA establishment includes developing zoning and management plans.)	*Involve all stakeholders in each step of the process of establishing MPAs and MPA Networks*	• One key factor for ensuring the success of MPAs and MPA Networks is the buy-in and support from stakeholders. • Involving stakeholders in each step of the process ensures they have already raised and addressed their needs and concerns, and that they understand the MPA (e.g., the zoning). Stakeholders can then make informed decisions about their activities, and understand the tradeoffs (costs and benefits) of having an MPA in their area.
	Prioritize establishing MPAs in areas supported by stakeholders	• If there is support from stakeholders for establishing the MPA in their area, it is more likely to be successful because the stakeholders share the same objectives as the MPA.
	Consider opportunities for collaborative management among all stakeholders and implement as appropriate	• Almost all MPAs have more than one stakeholder group living near or within the MPA. • For the MPA to be successful, it needs to be managed effectively. This will be more likely if the MPA is co-managed with local stakeholders.
	Provide capacity building for stakeholders to help them engage more effectively in establishing MPAs and MPAs Networks.	• Not all stakeholders have the same capacity to express their opinions and engage effectively in establishing MPAs and MPA Networks. • This is especially true for women, youth and indigenous people/adat groups, who are often underrepresented in collaborative management (even though they are often the closest to, and rely the most on, marine resources). • Therefore capacity building is needed to make sure that their needs and interests are addressed e.g., by revitalizing local wisdom and empowering women and youth to speak up in meetings.
Ensure Stakeholder Compliance within MPAs	*Involve local community in compliance and enforcement [e.g., by joint patrols among government institutions and communities, and POKMASWASs (community surveillance groups)].*	• The success of the MPA or MPA Network will rely on compliance by stakeholders. • Compliance is not only influenced by the strength of enforcement, but by the good will of the people. • Enforcement by legal authorities is costly, unsustainable and unlikely to be effective in remote areas. • Involvement of local communities in enforcement is more likely to be successful.
	Support MPA management actions that maintain or increase ecosystem goods and services for local communities	• Local communities rely on marine resources for a range of ecosystem goods and services i.e,, providing food, livelihoods and coastal protection. • Therefore, MPA management actions should maintain or increase these services to benefit these communities.
Support multiple, environmentally-friendly uses in MPAs	*Allow for multiple environmentally-friendly uses in MPAs (including sustainable fishing, tourism, aquaculture, education and research).*	• Environmentally friendly uses in MPAs include a range of activities including sustainable fishing, tourism, aquaculture, education and research. • All of these activities should be accommodated within the MPA according to a zoning plan developed with input the community.

Consideration	Socioeconomic and Cultural Design Criteria	Rationale and Explanatory Notes
		• Although the activities that take place in each zone may differ. For example, some of these activities are complementary and can be conducted in the same zone i.e., tourism and education. While others should be conducted in different zones i.e., fishing, aquaculture and tourism.
Support community welfare (livelihoods and food supplies)	*Support environmentally-friendly livelihoods of local communities [i.e., community-based, environmentally-friendly fisheries, aquaculture and marine resource based tourism based on an areas' uniqueness (biotic and abiotic resources).]*	• Local communities depend on marine resources for their livelihoods. • Some of their livelihood strategies are environmentally friendly, while others are not. • Environmentally friendly livelihood strategies are compatible with the goals and objectives of the MPAs and should be supported e.g., by MPA managers facilitating new methods, skills, approaches and opportunities (i.e., training in seaweed aquaculture). • It will also be important to protect the unique biotic and abiotic resources that these livelihoods are based on i.e., sharks, *Mola mola*, manta rays and kaust limestone islands.
	Protect marine heritage sites (i.e., shipwrecks and airplane wrecks) that have important, archeological-historical value, and manage them for their potential to support community based tourism	• Some marine heritage sites are important for their archeological-historical value. • Some of these sites also have the potential to provide opportunities for community based tourism. • Therefore, where possible, they should be protected in MPAs.
Ensure fair and equal access and use	*Ensure local communities have fair and equal access to, and utilization of, marine and fisheries resources.*	• Local communities rely on access to, and utilization of, marine and fisheries resource for their food and livelihoods. • In many places, communities use different areas, often close to their villages. • Therefore, it is important to ensure each community continues to have fair and equal access to their resources, so some communities are not advantaged or disadvantaged more than others.
	Maintain or improve access to resources and markets to support community economies that comply with MPA management plans.	• Communities that rely on fisheries for their livelihoods, need to maintain access to markets. • Therefore, MPAs should support access to these markets and the associated infrastructure (e.g., by allowing shipping lanes to reach local jetties), provided the markets are sustainable and comply with MPA goals and objectives.
Support local wisdom and practices	*Protect adat, local wisdom, traditional law and culture that support conservation and sustainable resource management, which are still acknowledged and applied by the existing adat community or institution.*	• In some areas, local communities have used traditional methods and practices to conserve and manage their marine resources for generations. • Where these traditional practices are still acknowledged, applied and sustainable, they should be incorporated in the MPA, because these practices will support the goals and objectives of the MPA and the needs of the people.
	Protect areas that have important traditional cultural value for local people/adat [including mystical (pamali) areas, and important sites for traditional medicine].	• Some areas have important values for the traditional culture of the local people/adat. • These areas should be protected in MPAs, not only for their cultural value but because they are already protected by the communities.

Annex 2: Information and Data Needed for MPA and MPA Network Design in Indonesia

General advice regarding the information and spatial data required to apply the biophysical, socioeconomic and cultural criteria to design MPAs and MPA Networks in Indonesia to achieve their goals and objectives is provided in Tables 6 and 7. These information and data needs should be refined depending on the specific goals, objectives and design criteria defined for the MPA or MPA Network in Steps 1 and 2.

Table 6. Information and spatial data needed to apply biophysical criteria for designing MPAs and MPA Networks in Indonesia.

Consideration	Biophysical Design Criteria	Information and Spatial Data Needed
Represent Habitats	*Protect at least 20% of each major habitat in NTZs (e.g., each type of coral reef, mangrove forest, estuary or seagrass bed).*	Location and classification of major habitats (e.g., coral reefs, mangrove forests, estuaries and seagrass beds).
Replicate Habitats (Spread the Risk)	*Protect at least three examples of each major habitat in NTZs; and Spread them out to reduce the chances they will all be affected by the same disturbance (such as major storms, mass coral bleaching events and crown-of-thorns starfish outbreaks).*	Location and classification of major habitats (e.g., coral reefs, mangrove forests, estuaries and seagrass beds).
Protect Critical, Special and Unique Areas	*Protect critical areas in the life history of focal fisheries species in NTZs (e.g., spawning and nursery areas).*	Location of important: • Fish spawning aggregations. • Nursery areas (e.g., mangroves and seagrasses).
	Protect critical areas or habitats for charismatic, endangered, threatened or protected species (e.g., breeding, feeding or resting areas, or migratory corridors).	Location of important: • Turtle nesting beaches. • Seabird nesting areas. • Feeding grounds (turtles, dugong, whale sharks, etc.). • Resting areas (migratory birds, dolphins, dugong, etc.). • Migratory corridors (whales, dolphins, turtles, etc.). • Cleaning stations (manta rays, sharks, *Mola mola* etc.). • Breeding areas (whales, dolphins, turtles, etc.)
	Protect special and unique natural phenomena in NTZs [e.g., areas with very high biodiversity, high endemism, unique marine communities or high productivity (e.g., unique pelagic habitats i.e., upwelling, fronts, eddies)].	Location of areas with: • High biodiversity or endemism. • Unique marine communities (e.g., marine lakes i.e., Kakaban Lake). • High productivity (i.e., upwellings).
	Protect areas that are important at the national, international or global scale for conservation or management of focal species (e.g., World Heritage Areas, RAMSAR Sites, critical habitats for globally endangered species, or critical areas for maintaining connectivity of fisheries species across national boundaries).	Location of: • World Heritage Areas. • RAMSAR sites. • Important marine mammal areas (IMMAs) – IUCN. • Important Marine Bird Areas (Marine IBAs) - IUCN. Larval dispersal and movement patterns of focal fisheries species.

Consideration	Biophysical Design Criteria	Information and Spatial Data Needed
Incorporate Connectivity: Abiotic Factors	*Consider variations in oceanography (i.e., currents, tides, temperature, salinity and acidity), substrate and, bathymetry that affect the spread of biological and non-biological material.*	Spatial and temporal variations in oceanography, substrate and bathymetry.
Incorporate Connectivity: Biotic Factors	*Ensure NTZs are large enough to sustain adults and juveniles of focal fisheries species within their boundaries.*	Movement patterns of fisheries species (e.g., snapper, grouper, etc.). Size of existing and proposed MPAs (particularly NTZs).
Movement of Adults and Juveniles	*Ensure NTZs are large enough to contain all habitats used by focal species throughout their life history (e.g., for home ranges, nursery grounds and spawning areas); or* *Establish networks of NTZs close enough to allow for movements of focal species among protected habitats (e.g., through ontogenetic habitat shifts and spawning migrations).*	Location of habitats used by focal species throughout their life history. Movement patterns of focal fisheries species among habitats (e.g., snapper, grouper, etc.). Size and location of existing and proposed MPAs (particularly NTZs).
	Include whole ecological units (such as reefs or seamounts) in NTZs. If not, chose larger versus smaller areas	Location and size of whole ecological units (i.e., seamounts). Boundaries of existing and proposed NTZs.
	Use compact shapes (such as squares) for NTZs, except when protecting naturally elongated habitats.	Shape of habitats. Shape of existing and proposed NTZs.
Incorporate Connectivity: Biotic Factors	*Establish:* • *NTZs large enough to be self-sustaining for focal species; or* • *Networks of NTZs close enough to be connected by larval dispersal.*	Larval dispersal patterns of focal fisheries species.
Larval Dispersal	*Protect spatially isolated areas in NTZs.*	Larval dispersal patterns of focal fisheries species. Location of spatially isolated areas (e.g., remote atolls).
	Protect larval sources in permanent or seasonal NTZs or by using fisheries closures during spawning times.	Location and timing of fish spawning aggregations.
	Locate more NTZs upstream relative to fished areas if there is a strong, consistent, unidirectional current.	Current patterns relative to the location and timing of spawning areas.
Allow Time for Recovery	*Establish NTZs for the long term (>20 to 40 years), preferably permanently.*	Recovery times of populations of focal fisheries species protected in well designed and managed NTZs.
	Use short term (<5 years) or periodically harvested NTZs in addition to, rather than instead of, long-term or permanent NTZs.	Recovery times of populations of focal fisheries species when protected in short term NTZs (e.g., using local wisdom i.e., sasi, lilifuk, papadak, etc.).
Protect Healthy Areas and Avoid Local Threats	*Protect areas where habitats and populations of focal species are in good condition with low levels of local threats (e.g., from overfishing, destructive fishing, coastal development, mass tourism, land-based runoff of sediments and nutrients, marine pollution, shipping, mining, oil and gas industries).*	Location of: • Areas where habitats and populations of focal species are in good condition. • Areas where there are low levels of local threats (i.e., adjacent to well designed and managed conservation areas).

Consideration	Biophysical Design Criteria	Information and Spatial Data Needed
	Avoid areas where habitats and populations of focal species are in poor condition due to local threats. If this is not possible: • *Reduce threats;* • *Facilitate natural recovery (e.g., by protecting larval sources and species that play important functional roles in ecosystem resilience i.e., herbivores); and* • *Consider the costs and benefits of rehabilitating habitats and species (e.g., by restoring structures, transplanting corals, or facilitating population recovery of focal species by re-stocking or using temporary closures).*	Location of: • Areas where habitats and populations of focal species are in poor condition. • Areas where there are high levels of local threats (see above). • Fish spawning aggregation sites. Larval dispersal patterns of focal fisheries species. Distribution and biomass of herbivore reef fishes. Costs and benefits of rehabilitating habitats and species in Indonesia.
Adapt to Changes in Climate and Ocean Chemistry	*Protect sites that are likely to be more resilient to global environmental change (refugia) in NTZs.*	Location of: • Coral reefs that are likely to be more resilient to rising sea temperatures and/or changes in ocean chemistry. • Mangrove and turtle nesting beaches that have room to move to higher ground as sea levels rise.
	Protect ecologically important sites that are sensitive to changes in climate and ocean chemistry.	Location of ecologically important sites particularly vulnerable to changes in sea temperature, sea level rise and ocean chemistry.
	Increase protection of species that play important functional roles in ecosystem resilience (i.e., herbivores).	Distribution and biomass of herbivore reef fishes.
	Consider how changes in climate and ocean chemistry will affect the life history of focal species.	How changes in climate and ocean chemistry will affect the life history of focal species.
	Address uncertainty by: • *Spreading the risk (see above); and* • *Increasing protection of habitats, critical areas and species most vulnerable to changes in climate and ocean chemistry.*	See *Habitat Representation* and *Risk Spreading* above. Location of habitats, critical areas and species most vulnerable to changes in climate and ocean chemistry.

Table 7. Information and spatial data needed to apply socioeconomic and cultural criteria for designing MPAs and MPA Networks in Indonesia.

Consideration	Socioeconomic and Cultural Design Criteria	Information and Spatial Data Needed
Involve stakeholders in establishing MPAs and MPA Networks (MPA establishment includes developing zoning and management plans)	*Involve all stakeholders in each step of the process of establishing MPAs and MPA Networks*	Stakeholders that may be affected by establishing the MPA or MPA Network (i.e., local, adat and traditional communities, governments, NGOs, civil society organizations, scientific institutions and industries i.e., fisheries, tourism etc.). A process for involving stakeholders in each step of the process (i.e., in data gathering and public consultation to develop zoning and management plans).
	Prioritize establishing MPAs in areas supported by stakeholders	Location of areas where stakeholders support establishing MPAs, particularly NTZs.
	Consider opportunities for collaborative management among all stakeholders and implement as appropriate	Opportunities, costs and benefits of collaborative management with stakeholders.
	Provide capacity building for stakeholders to help them engage more effectively in establishing MPAs and MPAs Networks.	Capacity building needs for stakeholders to engage effectively in planning and implementation of MPA management.
Ensure Stakeholder Compliance within MPAs	*Involve local community in compliance and enforcement [e.g., by joint patrols among government institutions and communities, and POKMASWASs (community surveillance groups)].*	Opportunities, costs and benefits of involving communities in compliance and enforcement of management plans.
	Support MPA management actions that maintain or increase ecosystem goods and services for local communities	Management actions that will maintain or increase ecosystem goods and services for local communities.
Support multiple, environmentally-friendly uses in MPAs	*Allow for multiple environmentally-friendly uses in MPAs (including sustainable fishing, tourism, aquaculture, education and research).*	Location of: • Sustainable fishing grounds (eg. demersal, pelagic, etc.). • Fishing pressure. • Fish landing sites. • Boat docking locations. • Boat shelter locations. • Environmentally friendly aquaculture areas (seaweed farming, pearl farming, sea cucumber, etc.). • Ecofriendly tourism areas (surfing, snorkeling, dive site, parasailing, sport fishing, beach recreation, etc.). • Education and research locations.
Support community welfare (livelihoods and food supplies)	*Support environmentally-friendly livelihoods of local communities [i.e., community-based, environmentally-friendly fisheries, aquaculture and marine resource based tourism based on an areas' uniqueness (biotic and abiotic resources).]*	Location of: • Sustainable fishing grounds (eg. demersal, pelagic, etc.) • Fishing pressure • Fish landing sites • Boat docking locations • Boat shelter locations

Consideration	Socioeconomic and Cultural Design Criteria	Information and Spatial Data Needed
		• Environmentally friendly aquaculture areas (seaweed farming, pearl farming, sea cucumber, etc.) • Environmentally tourism areas based on an areas' uniqueness.
	Protect marine heritage sites (i.e., shipwrecks and airplane wrecks) that have important, archeological-historical value, and manage them for their potential to support community based tourism	Location of shipwrecks or airplane wrecks of archeological-historical (e.g., from World War II, etc.).
Ensure fair and equal access and use	*Ensure local communities have fair and equal access to, and utilization of, marine and fisheries resources.*	Location of important fishing grounds for each community.
	Maintain or improve access to resources and markets to support community economies that comply with MPA management plans.	Location of areas where communities require access to resources and markets to support their economies that comply with MPA management plans.
Support local wisdom and practices	*Protect adat, local wisdom, traditional law, and culture that support conservation and sustainable resource management, which are still acknowledged and applied by the existing adat community or institution.*	Location of local wisdom and practices that support conservation and sustainable resource management that are still active within the MPA (e.g., sasi, keruga, lilifuk, hoholok, papadak, panadahi, etc.).
	Protect areas that have important traditional cultural value for local people/adat [including mystical (pamali) areas, and important sites for traditional medicine].	Location of: • Mystical (pamali) areas. • Important sites for traditional medicine.

Annex 3: Evaluation Tool for MPA and MPA Network Design in Indonesia

Recently, The Nature Conservancy through the Sustainable Ecosystems Advanced (SEA) Project, developed an *Evaluation Tool for Marine Protected Area and Marine Protected Area Network Design in Indonesia* (Green et al. 2019b). This annex provides excerpts from that tool. For more information regarding when and how to use this tool, see Green et al. 2019b.

Introduction

Here we provide a simple tool that uses performance indicators for the biophysical, socioeconomic and cultural design criteria to help managers evaluate and refine the design of a MPA or MPA Network to ensure it will achieve its goals and objectives. The tool provides simple scoring criteria to evaluate progress towards applying each design criteria, and to develop an overall evaluation score for the MPA or MPA Network design.

Please note that there also many governance factors that are important to consider when establishing MPAs and MPA Networks, which are not included here (see *MPAs and MPA Networks in Indonesia*). For guidelines to evaluate and improve management effectiveness of MPAs in Indonesia, please see *Technical Guidelines for Evaluating the Management Effectiveness of Aquatic, Coasts and Small Islands Conservation Areas (E-KKP3K:* DCAFS 2013).

Who Should Use This Tool and When?

This evaluation tool should be used by field practitioners responsible for designing MPAs and MPA Networks, or for helping local communities establish Locally Managed Marine Areas (LMMAs), in Indonesia. This may include representatives of national, provincial or local level governments, non-governmental organizations (NGOs) and university scientists.

The tool can be used to evaluate the design (zoning plan) of existing or proposed MPAs, and will be particularly useful when reviewing management plans (including zoning plans) for existing MPAs (which is required every five years).

This tool will also be useful when developing zoning plans for new or proposed MPAs. It can be used multiple times throughout the zoning process (e.g., every few months), so managers can demonstrate how their zoning plan has improved and identify actions still needed for adaptive management. The tool can also help managers develop a clear rationale to explain the design of the zoning plan to communities in a way that they are more likely to understand and accept the plan.

The tool will be most useful for evaluating and refining zoning plans when the relevant information and spatial data (see Annex 2) and knowledgeable experts are available to assist with the evaluation. It may be more difficult to use this tool when a new or proposed MPA is at a very early stage in the design process, and there is no zoning plan to evaluate and/or if the necessary information or expertise is not available to assist with the evaluation. In that situation, it may be better to use the framework for designing MPAs and MPA Networks in Indonesia provided in this document to guide the initial design of a draft zoning plan (see *A Framework for Designing MPAs and MPA Networks in Indonesia*).

Once a draft zoning plan has been developed, this tool can be used to evaluate the design for adaptive management before the plan is completed.

Using The Tool

Before Using This Tool

Before using this tool you should:

- Identify the goals and SMART objectives for the MPA or MPA Network (see *Step 1 Define Goals and SMART Objectives*).
- Identify the high priority targets to conserve and manage in the MPA (i.e., focal habitats and species, livelihoods and local wisdom), and the threats to these targets that need to be addressed.
- Assemble a team to compile the best available spatial data and other information required (see *Annex 2*) and complete the evaluation. Since the tool requires an understanding of the biophysical, socioeconomic and cultural context for designing the MPA, it is important to conduct the evaluation with people who have the relevant knowledge of the area. This may include biological and social scientists, managers (e.g., fisheries agents), local communities and other stakeholders.

How to Use This Tool

Performance indicators are provided for biophysical, socioeconomic and cultural design criteria for MPAs and MPA Networks in Indonesia in Table 8 and Table 9. Use these performance indicators and the following steps to evaluate the MPA or MPA Network design.

Step 1. Evaluate How Each Criteria Has Been Applied to Design the MPA or MPA Network

Go through each of the design criteria in Table 8 and Table 9 one at a time. Make sure you understand the design criteria and review the rationale (justification) for the criteria if necessary (see *Annex 1*).

Determine if the design criteria is needed to achieve the MPA or MPA Network goals and objectives. If so:

- Read the performance indicator for that design criteria, discuss it with your colleagues and assign a score regarding how well that criteria has been applied in the zoning plan. The tool provides simple scoring criteria to evaluate progress towards applying each design criteria to assign a score from 0-3. This provides a better indication of progress than simply assessing if the design criteria have been applied fully or not (i.e., 0 or 1).
- Provide the rationale or evidence to justify the score, and notes for improving the score in the Action Plan (see Step 3 below) if necessary.

If the design criteria is not needed to achieve the MPA or MPA Network goals and objectives, select "Not Applicable (NA)" instead of assigning a score. Do not score it as 0 (to distinguish it from criteria that need to be applied, but which have not been applied as yet).

Step 2. Evaluate the Overall Design of the MPA or MPA Network

The scoring system can be used to develop an overall evaluation score for the MPA or MPA Network design (zoning plan). Once you have completed both Table 8 and Table 9, add up the scores and calculate the percentage (%) of the total maximum score achieved for the design criteria that apply to the MPA or MPA Network. All design criteria are considered of equal importance in the overall evaluation score to avoid subjective decisions about the relative importance of the design criteria, which will vary in different MPAs or MPA Networks that have different goals and objectives (see *Refining the Tool for Specific MPAs or MPA Networks*).

If you use the tool multiple times (e.g., every few months when developing a new zoning plan, or before and after an existing zoning plan has been revised), you can use the change in the overall score to track progress towards adaptive management.

Different MPAs may have different scores, because their total maximum score may vary if they have different goals that require different design criteria. Therefore, comparisons among MPAs should be based on the percentage (%) of the total maximum score achieved for each MPA (e.g., where poor is <20%, fair is 20-40%, moderate is 41-60%, good is 61-80%, and excellent is >80%).

Step 3. Develop an Action Plan to Improve the Design of the MPA or MPA Network

Once you have completed the evaluation tool (Steps 1 and 2 above), develop an action plan to improve the design of the MPA or MPA Network (if necessary). The action plan should:

- Clearly identify the next steps required to improve the MPA or MPA Network design (e.g., by addressing information/data needs, or revising the zoning plan to address the design criteria more effectively), the responsible/lead person for each task, and the timeline for completing each task. It will also be important to note how each of these steps will align with the zoning and adaptive management phases for the MPA or MPA Network.
- Develop a schedule to repeat the evaluation tool to track progress over time.

Refining the Tool for Specific MPAs or MPA Networks

If you have the relevant expertise on your evaluation team, you can modify the tool based on the MPA or MPA Network goals and objectives, and biophysical, socioeconomic and cultural characteristics of the area (e.g., by defining the major habitats, critical areas, focal species, threats, stakeholders, environmentally friendly uses and livelihoods, local wisdom and practices etc.).

You may also wish to define the relative importance of each design criteria to achieving the MPA or MPA Network goals and objectives, and take this into account when calculating the overall score for the MPA or MPA Network design.

Table 8. Evaluation tool for the biophysical criteria for designing MPAs and MPA Networks in Indonesia.
This tool provides each of the biophysical criteria for designing MPAs and MPA Networks in Indonesia, performance indicators and a scoring system (criteria and scores) to evaluate how each criteria has been applied to design an MPA or MPA Network, and space to provide the rationale (or evidence) to justify the score and to identify an Action Plan (if needed to improve the score). *Please note that the design criteria and performance indicators are numbered so they are easy to refer to while using this evaluation tool. These numbers do not reflect the order of importance of the design criteria, which will vary depending on the MPA or MPA Network goals and objectives.*

Please note that many of these criteria are designed to consider the ecology of focal species. They include: key fisheries species (fish and invertebrates); endangered, threatened and protected species and/or migratory marine biota (sea turtles, marine birds, cetaceans, dugong and crocodiles); large charismatic marine fauna (sharks, manta rays, whale sharks and *Mola mola*); species important for maintaining ecosystem function i.e., habitat forming species (e.g., corals) or species important for reef resilience (e.g., herbivores).

Consideration	Design Criteria	Performance Indicator (Output)	Performance Indicator Scoring Criteria	Score	Rationale or Evidence to Justify Score & Action Plan
Represent Habitats	*1. Protect at least 20% of each major habitat in NTZs (e.g., each type of coral reef, mangrove forest, estuary or seagrass bed).*	*1a. Major habitats for protection identified, mapped and classified (e.g., each type of coral reef is both mapped and classified).*	Most (76-100%)	3	
			Many (51-75%)	2	
			Some (26-50%)	1	
			None or a few (0-25%)	0	
			Not Applicable	NA	
		1b. At least 20% of each type of major habitat protected in NTZs.	≥ 20% of each in NTZs.	3	
			15-20% of each in NTZs	2	
			5-15% of each in NTZs	1	
			<5% of each in NTZs	0	
			Not Applicable	NA	
Replicate Habitats (Spread the Risk)	*2. Protect at least three examples of each major habitat in NTZs; and* *Spread them out to reduce the chances they will all be affected by the same disturbance (e.g., major storms, coral bleaching and crown-of-thorns starfish outbreaks).*	*2a. At least three examples of each major habitat protected in NTZs.*	Most (76-100%)	3	
			Many (51-75%)	2	
			Some (26-50%)	1	
			None or a few (0-25%)	0	
			Not Applicable	NA	
		2b. Examples of each major habitat protected in NTZs are spread out to reduce the chances they will all be affected by the same disturbance.	Most (76-100%)	3	
			Many (51-75%)	2	
			Some (26-50%)	1	
			None or a few (0-25%)	0	
			Not Applicable	NA	
Protect Critical, Special and Unique Areas	*3. Protect critical areas in the life history of focal fisheries species in*	*3. Critical areas in the life history of focal fisheries species identified and protected in NTZs.*	Most (76-100%)	3	
			Many (51-75%)	2	
			Some (26-50%)	1	

Consideration	Design Criteria	Performance Indicator (Output)	Performance Indicator Scoring Criteria	Score	Rationale or Evidence to Justify Score & Action Plan
	NTZs (e.g., spawning and nursery areas).		None or a few (0-25%)	0	
			Not Applicable	NA	
	4. Protect critical areas or habitats for charismatic, endangered, threatened or protected species (e.g., breeding, feeding or resting areas, or migratory corridors).	*4. Critical areas or habitats for charismatic, endangered, threatened or protected species protected.*	Most (76-100%)	3	
			Many (51-75%)	2	
			Some (26-50%)	1	
			Few (0-25%)	0	
			Not Applicable	NA	
	5. Protect special and unique natural phenomena in NTZs [e.g., areas with very high biodiversity, high endemism, unique marine communities or high productivity (e.g., unique pelagic habitats i.e., upwelling, fronts, eddies)].	*5. Special and unique natural phenomena protected in NTZs.*	Most (76-100%)	3	
			Many (51-75%)	2	
			Some (26-50%)	1	
			Few (0-25%)	0	
			Not Applicable	NA	
	6. Protect areas that are important at the national, international or global scale for conservation or management of focal species.	*6. Areas important at the national, international or global scale for conservation or management of focal species are protected (e.g., World Heritage Areas, RAMSAR Sites, critical habitats for globally endangered species, or critical areas for maintaining connectivity of fisheries species across national boundaries).*	Most (76-100%)	3	
			Many (51-75%)	2	
			Some (26-50%)	1	
			Few (0-25%)	0	
			Not Applicable	NA	
Incorporate Connectivity: Abiotic Factors	*7. Consider variations in oceanography (i.e., currents, tides, temperature, salinity and acidity), substrate and bathymetry that affect the spread of biological and non-biological material.*	*7. Variations in oceanography, substrate and bathymetry used to identify habitats for representation where biological information is not available.*	Most (76-100%)	3	
			Many (51-75%)	2	
			Some (26-50%)	1	
			Few (0-25%)	0	
			Not Applicable	NA	
Incorporate Connectivity: Biotic Factors *Movement of Adults and Juveniles*	*8. Ensure NTZs are large enough to sustain adults and juveniles of focal fisheries species within their boundaries.*	*8. NTZs are large enough to sustain adults and juveniles of focal fisheries species within their boundaries (based on their movement patterns).*	Most (76-100%)	3	
			Many (51-75%)	2	
			Some (26-50%)	1	
			None or a few (0-25%)	0	
			Not Applicable	NA	

<table>
<tr><th>Consideration</th><th>Design Criteria</th><th>Performance Indicator (Output)</th><th>Performance Indicator Scoring Criteria</th><th>Score</th><th>Rationale or Evidence to Justify Score & Action Plan</th></tr>
<tr><td rowspan="15"></td><td rowspan="5">9. Ensure:
• NTZs are large enough to contain all habitats used by focal species throughout their life history (e.g., for home ranges, nursery grounds and spawning areas); or
• Establish networks of NTZs that are close enough to allow for movements of focal species among protected habitats (e.g., through ontogenetic habitat shifts and spawning migrations).</td><td rowspan="5">9. NTZs are designed to protect focal species throughout their life cycles in either individual MPAs or MPA Networks.</td><td>Most (76-100%)</td><td>3</td><td rowspan="5"></td></tr>
<tr><td>Many (51-75%).</td><td>2</td></tr>
<tr><td>Some (26-50%).</td><td>1</td></tr>
<tr><td>No or a few (0-25</td><td>0</td></tr>
<tr><td>Not Applicable</td><td>NA</td></tr>
<tr><td rowspan="5">10. Include whole ecological units (such as reefs or seamounts) in NTZs. If not, chose larger versus smaller areas.</td><td rowspan="5">10. Whole ecological units are included in NTZs. If not, NTZs protect larger versus smaller areas.</td><td>Most (76-100%)</td><td>3</td><td rowspan="5"></td></tr>
<tr><td>Many (51-75%)</td><td>2</td></tr>
<tr><td>Some (26-50%)</td><td>1</td></tr>
<tr><td>None or a few (0-25%)</td><td>0</td></tr>
<tr><td>Not Applicable</td><td>NA</td></tr>
<tr><td rowspan="5">11. Use compact shapes (such as squares) for NTZs, except when protecting naturally elongated habitats (i.e. long narrow coastal reefs).</td><td rowspan="5">11. NTZs are compact shapes except when protecting naturally elongated habitats.</td><td>Most (76-100%)</td><td>3</td><td rowspan="5"></td></tr>
<tr><td>Many (51-75%)</td><td>2</td></tr>
<tr><td>Some (26-50%)</td><td>1</td></tr>
<tr><td>None or a few (0-25%)</td><td>0</td></tr>
<tr><td>Not Applicable</td><td>NA</td></tr>
<tr><td rowspan="10">Incorporate Connectivity: Biotic Factors

Larval Dispersal</td><td rowspan="5">12. Establish:
• NTZs large enough to be self-sustaining for focal species; or
• Networks of NTZs close enough to be connected by larval dispersal.</td><td rowspan="5">12.
• NTZs are large enough to be self-sustaining; or
• Networks of NTZs are close enough to be connected by larval dispersal (depending on dispersal distances of focal species).</td><td>Most (76-100%)</td><td>3</td><td rowspan="5"></td></tr>
<tr><td>Many (51-75%)</td><td>2</td></tr>
<tr><td>Some (26-50%)</td><td>1</td></tr>
<tr><td>None or a few (0-25%)</td><td>0</td></tr>
<tr><td>Not Applicable</td><td>NA</td></tr>
<tr><td rowspan="5">13. Protect spatially isolated areas in NTZs (i.e., remote atolls).</td><td rowspan="5">13. Spatially isolated areas are protected in NTZs.</td><td>Most (76-100%)</td><td>3</td><td rowspan="5"></td></tr>
<tr><td>Many (51-75%)</td><td>2</td></tr>
<tr><td>Some (26-50%)</td><td>1</td></tr>
<tr><td>None or a few (0-25%)</td><td>0</td></tr>
<tr><td>Not Applicable</td><td>NA</td></tr>
</table>

Consideration	Design Criteria	Performance Indicator (Output)	Performance Indicator Scoring Criteria	Score	Rationale or Evidence to Justify Score & Action Plan
	14. Protect larval sources in permanent or seasonal NTZs or by using fisheries closures during spawning times.	*14. Larval sources (i.e., fish spawning aggregations) are protected in permanent or seasonal NTZs or by using fisheries closures during spawning times.*	Most (76-100%)	3	
			Many (51-75%)	2	
			Some (26-50%)	1	
			None or a few (0-25%)	0	
			Not Applicable	NA	
	15. Locate more NTZs upstream relative to fished areas if there is a strong, consistent, unidirectional current.	*15. More NTZs are located upstream relative to fished areas if there is a strong, consistent, unidirectional current.*	Most (76-100%)	3	
			Many (51-75%)	2	
			Some (26-50%)	1	
			None or a few (0-25%)	0	
			Not Applicable	NA	
Allow Time for Recovery	*16. Establish NTZs for the long term (20-40 years), preferably permanently.*	*16. NTZs are in place permanently or for the long term (extended at each 5-year review of zoning and management plans).*	Most (76-100%)	3	
			Many (51-75%)	2	
			Some (26-50%)	1	
			No or a few (0-25%)	0	
			Not Applicable	NA	
	17. Use short term (<5 years) or periodically harvested NTZs in addition to, rather than instead of, long-term or permanent NTZs.	*17. Short term (<5 years) or periodically harvested NTZs are used in addition to, rather than instead of, long-term or permanent NTZs.*	Most (76-100%)	3	
			Many (51-75%)	2	
			Some (26-50%)	1	
			None or a few (0-25%)	0	
			Not Applicable	NA	
Protect Healthy Areas and Avoid Local Threats	*18. Protect areas where habitats and populations of focal species are in good condition with low levels of local threats.*	*18. NTZs protect habitats and populations of focal species in good condition with low levels of threat.*	Most (76-100%)	3	
			Many (51-75%)	2	
			Some (26-50%)	1	
			None or a few (0-25%)	0	
			Not Applicable	NA	
(Such as overfishing, destructive fishing, coastal development, mass tourism, land-based runoff	*19. Avoid areas where habitats and populations of focal species are in poor condition due to local threats. If this is not possible:* • *Reduce these threats;* • *Facilitate natural recovery (e.g., by protecting larval sources and*	*19a. Where NTZs have to be located in areas where habitats and populations of focal species are in poor condition due to local threats:* • *Local threats have been reduced;* • *Natural recovery has been facilitated; and/or*	Most (76-100%)	3	
			Many (51-75%)	2	
			Some (26-50%)	1	
			None or a few (0-25%)	0	
			Not Applicable	NA	

Consideration	Design Criteria	Performance Indicator (Output)	Performance Indicator Scoring Criteria	Score	Rationale or Evidence to Justify Score & Action Plan
of sediments and nutrients, marine pollution, shipping, mining, oil and gas industries).	*species that play important functional roles in ecosystem resilience i.e., herbivores); and* • *Consider the costs and benefits of rehabilitating habitats and species (e.g., by restoring structures, transplanting corals, or facilitating population recovery of focal species by re-stocking or using temporary closures).*	• *The costs and benefits of rehabilitating habitats and species have been considered.*			
		19b. MPAs are integrated with other management approaches to reduce threats including: Integrated Coastal Zone Management (Marine and Land Spatial Planning); and an Ecosystem Approach to Fisheries Management.	Most (76-100%)	3	
			Many (51-75%)	2	
			Some (26-50%)	1	
			None or a few (0-25%)	0	
			Not Applicable	NA	
Adapt to Changes in Climate and Ocean Chemistry (Such as rising sea temperatures, rising sea levels and ocean acidification).	*20. Protect sites that are likely to be more resilient to global environmental change (refugia) in NTZs.*	*20. Sites that are likely to be more resilient to changes in climate and ocean chemistry (refugia) are protected in NTZs.*	Most (76-100%).	3	
			Many (51-75%)	2	
			Some (26-50%)	1	
			None or a few (0-25%).	0	
			Not Applicable	NA	
	21. Protect ecologically important sites that are sensitive to changes in climate and ocean chemistry.	*21. Ecologically important sites that are sensitive to changes in climate and ocean chemistry are protected in NTZs.*	Most (76-100%)	3	
			Many (51-75%)	2	
			Some (26-50%)	1	
			None or a few (0-25%).	0	
			Not Applicable	NA	
	22. Increase protection of species that play important functional roles in ecosystem resilience (i.e., herbivorous reef fishes on coral reefs).	*22. Protection has increased for species that play important functional roles in ecosystem resilience.*	Most (76-100%)	3	
			Many (51-75%)	2	
			Some (26-50%)	1	
			None or a few (0-25%)	0	
			Not Applicable	NA	
	23. Consider how climate and ocean change will affect the life history of focal species.	*23. Scientific studies are underway or have been completed to understand how climate and ocean change will affect the life history of focal species, and the implications for refining the design criteria above.*	Most (76-100%)	3	
			Many (51-75%)	2	
			Some (26-50%)	1	
			None or a few (0-25%)	0	
			Not Applicable	NA	

Consideration	Design Criteria	Performance Indicator (Output)	Performance Indicator Scoring Criteria	Score	Rationale or Evidence to Justify Score & Action Plan
	24. Address uncertainty by: • *Spreading the risk (see Replicate Habitats); and* • *Increasing protection of habitats, critical areas and species most vulnerable to changes in climate and ocean chemistry.*	*24a. Uncertainty has been addressed by: Spreading the risk.*	See *Replicate Habitats* above.	NA	
		24b. Uncertainty has been addressed by: Increasing protection of habitats (e.g., by increasing percent habitat representation), critical areas and species most vulnerable to changes in climate and ocean chemistry.	Most (76-100%)	3	
			Many (51-75%)	2	
			Some (26-50%)	1	
			None or a few (0-25%)	0	
			Not Applicable	NA	

Table 9. Evaluation tool for the socioeconomic and cultural criteria for designing MPAs and MPA Networks in Indonesia.
This tool provides each of the socioeconomic and cultural criteria for designing MPAs and MPA Networks in Indonesia, performance indicators and a scoring system (criteria and scores) to evaluate how each criteria has been applied to design an MPA or MPA Network, and space to provide the rationale (or evidence) to justify the score and to identify an Action Plan (if needed to improve the score). *Please note that the design criteria and performance indicators are numbered so they are easy to refer to while using this evaluation tool. These numbers do not reflect the order of importance of the design criteria, which will vary depending on the MPA or MPA Network goals and objectives.*

Consideration	Design Criteria	Performance Indicator (Output)	Performance Indicator Scoring Criteria	Score	Rationale or Evidence to Justify Score & Action Plan
Involve stakeholders in establishing MPAs and MPA Networks. (MPA establishment includes developing zoning and management plans.) (Stakeholders include local, adat and traditional communities, governments, NGOs, civil society organizations, scientific institutions and industries i.e., fisheries, tourism etc.)	*1. Involve all stakeholders in each step of the process of establishing MPAs and MPA Networks.*	*1. Stakeholders are involved in each step of the process of establishing MPAs and MPA Networks.*	Most (76-100%)	3	
			Many (51-75%)	2	
			Some (26-50%)	1	
			None or a few (0-25%)	0	
			Not Applicable	NA	
	2. Prioritize establishing MPAs in areas supported by stakeholders	*2. MPAs established in areas supported by stakeholders*	Most (76-100%)	3	
			Many (51-75%)	2	
			Some (26-50%)	1	
			None or a few (0-25%)	0	
			Not Applicable	NA	
	3. Consider opportunities for collaborative management among all stakeholders and implement as appropriate.	*3. Opportunities for collaborative management among all stakeholders considered and implemented as appropriate.*	Most (76-100%)	3	
			Many (51-75%)	2	
			Some (26-50%)	1	
			None or a few (0-25%)	0	
			Not Applicable	NA	
	4. Provide capacity building for stakeholders to help them engage more effectively in establishing MPAs and MPAs Networks.	*4. Capacity building provided for stakeholders to help them engage more effectively in establishing MPAs and MPAs Networks.*	Most (76-100%)	3	
			Many (51-75%)	2	
			Some (26-50%)	1	
			None or a few (0-25%)	0	
			Not Applicable	NA	
Ensure Stakeholder Compliance within MPAs.	*5. Involve local community in compliance and enforcement [e.g., joint patrols among government institutions and communities, and POKMASWASs (community surveillance groups)].*	*5. Local community involved in compliance and enforcement.*	Most (76-100%)	3	
			Many (51-75%)	2	
			Some (26-50%)	1	
			None or a few (0-25%)	0	
			Not Applicable	NA	

Consideration	Design Criteria	Performance Indicator (Output)	Performance Indicator Scoring Criteria	Score	Rationale or Evidence to Justify Score & Action Plan
	6. Support MPA management actions that maintain or increase ecosystem goods and services for local communities.	*6. MPA management actions that maintain or increase ecosystem goods and services for local communities are supported.*	Most (76-100%)	3	
			Many (51-75%)	2	
			Some (26-50%)	1	
			None or a few (0-25%)	0	
			Not Applicable	NA	
Support multiple, environmentally-friendly uses in MPAs.	*7. Allow for multiple environmentally-friendly uses in MPAs (including sustainable fishing, tourism, aquaculture, education and research).*	*7. MPAs allow for multiple environmentally-friendly uses.*	Most (76-100%)	3	
			Many (51-75%)	2	
			Some (26-50%)	1	
			None or a few (0-25%)	0	
			Not Applicable	NA	
Support community welfare (livelihoods and food supplies)	*8. Support environmentally-friendly livelihoods of local communities [i.e., community-based, environmentally-friendly fisheries, aquaculture and marine resource based tourism based on an areas' uniqueness (biotic and abiotic resources).]*	*8. Environmentally-friendly livelihoods of local communities supported.*	Most (76-100%)	3	
			Many (51-75%)	2	
			Some (26-50%)	1	
			None or a few (0-25%)	0	
			Not Applicable	NA	
	9. Protect marine heritage sites (i.e., shipwrecks and airplane wrecks) that have important, archeological-historical value, and manage them for their potential to support community based tourism.	*9a. Important marine heritage sites are identified and protected (e.g., in NTZs or local wisdom zones).*	Most (76-100%)	3	
			Many (51-75%)	2	
			Some (26-50%)	1	
			None or a few (0-25%)	0	
			Not Applicable	NA	
		9b. Marine heritage sites managed for their potential as community-based tourism sites.	Most (76-100%)	3	
			Many (51-75%)	2	
			Some (26-50%)	1	
			None or a few (0-25%)	0	
			Not Applicable	NA	
Ensure fair and equal access and use	*10. Ensure local communities have fair and equal access to, and utilization of, marine and fisheries resources.*	*10. Local communities have fair and equal access to, and utilization of, marine and fisheries resources.*	Most (76-100%)	3	
			Many (51-75%)	2	
			Some (26-50%)	1	
			None or a few (0-25%)	0	
			Not Applicable	NA	

Consideration	Design Criteria	Performance Indicator (Output)	Performance Indicator Scoring Criteria	Score	Rationale or Evidence to Justify Score & Action Plan
	11. Maintain or improve access to resources and markets to support community economies that comply with MPA management plans.	*11. Access to resources and markets maintained or improved to support community economies.*	Most (76-100%)	3	
			Many (51-75%)	2	
			Some (26-50%)	1	
			None or a few (0-25%)	0	
			Not Applicable	NA	
Support local wisdom and practices	*12. Protect adat, local wisdom, traditional law, and culture that support conservation and sustainable resource management, which are still acknowledged and applied by the existing adat community or institution.*	*12a. All local wisdom and practices in MPAs and MPA Networks that support conservation and sustainable resource use that are still acknowledged and applied by the existing adat community or institution are identified and mapped.*	Most (76-100%)	3	
			Many (51-75%)	2	
			Some (26-50%)	1	
			None or a few (0-25%)	0	
			Not Applicable	NA	
		12b. Traditional knowledge and practices are protected and integrated into MPA management.	Most (76-100%)	3	
			Many (51-75%)	2	
			Some (26-50%)	1	
			None or a few (0-25%)	0	
			Not Applicable	NA	
		12c. Adat leaders or institutions are acknowledged in MPA management plans and involved in collaborative management.	Most (76-100%)	3	
			Many (51-75%)	2	
			Some (26-50%)	1	
			None or a few (0-25%)	0	
			Not Applicable	NA	
	13. Protect areas that have important traditional cultural value for local people/adat [including mystical (pamali) areas, and important sites for traditional medicine].	*13. Important areas that have important traditional cultural value for local/adat people are identified, mapped and protected.*	Most (76-100%)	3	
			Many (51-75%)	2	
			Some (26-50%)	1	
			None or a few (0-25%)	0	
			Not Applicable	NA	

Healthy populations of fisheries species at Cape Kri, Dampier Strait MPA. Image: © Awaludinnoer, TNC.