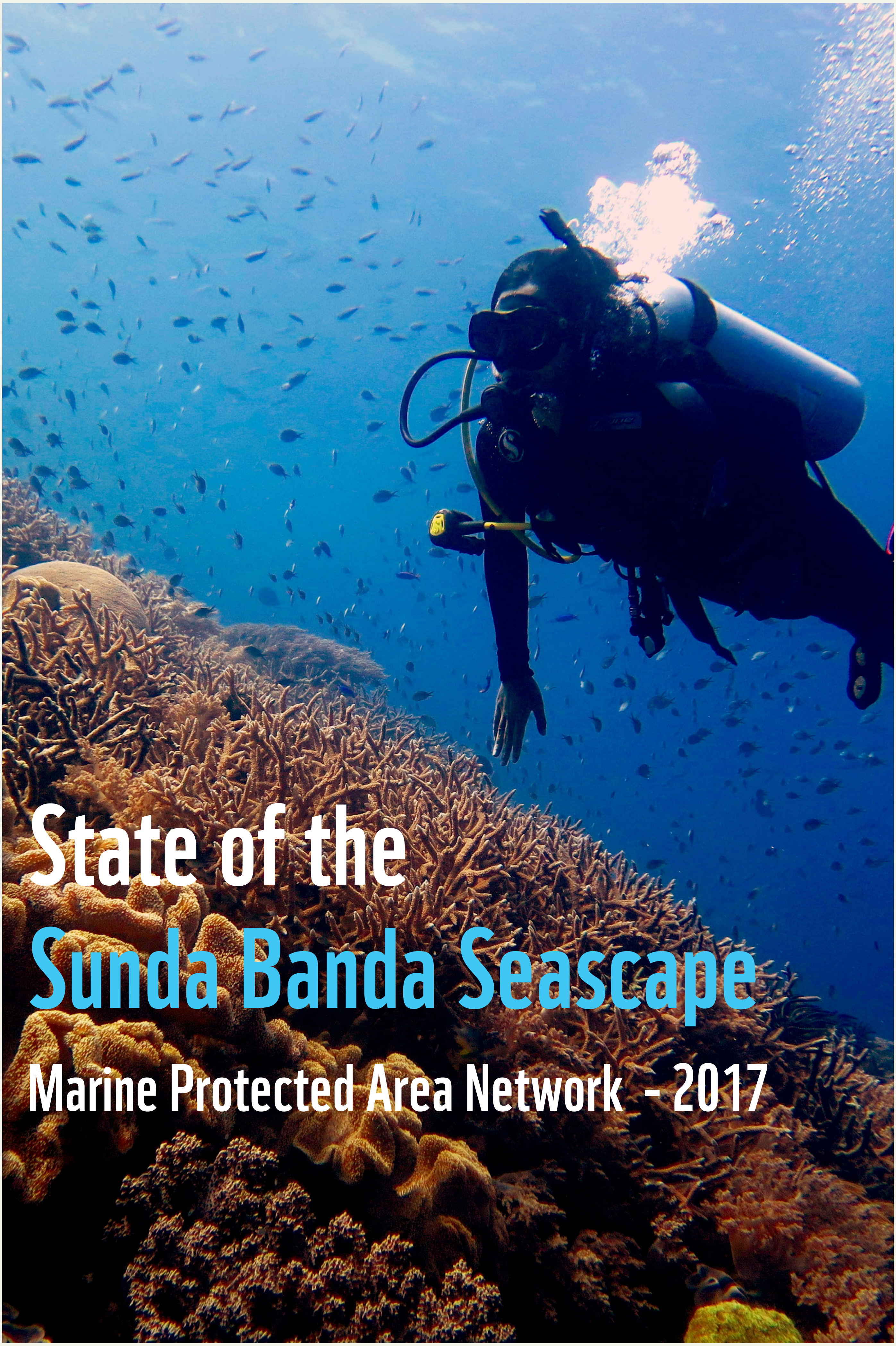

State of the
Sunda Banda Seascape
Marine Protected Area Network - 2017

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2018

State of the Sunda Banda Seascape
Marine Protected Area Network - 2017

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PREFACE

The Ocean fills up to two thirds of the Earth's surface and consists of abundant marine resources to support the global food supply and economic income. The ocean also protects coastlines from erosion and supports global transport systems. Yet, land-dwelling people like us are creating massive ecological and economic shifts on the oceans in the past few decades. Consequently, our oceans and their resources are in such a precarious state – with dwindling fisheries, soaring extinction rates, changing climate and concomitant increases in reef bleaching events and rising sea levels, and toxic algal blooms near coastal cities.

Our attention to address our ocean's problems has been increasing. Marine conservation efforts have been stepped up, as shown by the rapid growth of marine protected areas and other regulatory mechanisms, as well as invention of effective technologies, and these responses are occurring at all levels, from global collaborative efforts to achieve the Sustainable Development Goals (SGDs), down to local efforts such as community-initiated mangrove restoration project in Alor, Nusa Tenggara Timur. The future of our oceans is in our hands. It is our responsibilities to utilize and manage our oceans and its marine resources effectively and efficiently, so our future generations would still be able to enjoy and benefit from them.

We are currently in the midst of rapid ecological and economical changes, therefore careful policymaking needs to be supported by scientific evidences and recommendations to facilitate effective and efficient decision-making for adaptive management. The "State of the Sunda Banda Seascape Marine Protected Area Network - 2017" report is one of the few available scientific reports that explores the status of 22 inter-related indicators on Marine Protected Area (MPA) management in a regional scale, i.e. the Sunda Banda Seascape – a priority area for marine conservation, both at the global and the national level. It is a joint publication between World Wide Fund for Nature, University of Pattimura, Wildlife Conservation Society – Indonesia Program, Coral Triangle Center and Rare Indonesia. The report used the best and most current available data gathered from various sources which were then carefully standardized and analyzed. The report also presented a set of recommendations that were carefully formulated and can be used to inform policy making and adaptive MPA management in the region.

As 2018 has been set as an International Year of Coral Reefs, it is the right moment to celebrate and reflect on the marine conservation efforts that we have done in the past one decade. It is also a great momentum to look at the future and carefully plan our steps now towards future goals for better marine conservation in the SBS and Indonesia in general. This report hopefully can fill the conservation data gap in the region and help us, policy makers, academics, NGO people, community groups and public, to determine the best strategies for future effective MPA Network management. On behalf of the collaborating institutions and authors, I would like to extend my deepest gratitude to all people and institutions, as mentioned in the acknowledgement section, who have contributed to the development of this report.

With regards,

Wawan Ridwan

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LIST OF ACRONYMS

SBS	Sunda Banda Seascape
LSS	Lesser Sunda Subseascape
SESS	Southern-Eastern Sulawesi Subseascape
IBAS	Inner Banda Arc Subseascape
E-KKP3K	*Efektivitas Pengelolaan Kawasan Konservasi Perairan, Pesisir dan Pulau-pulau Kecil* (Technical Guidelines for Evaluating the Management Effectiveness of Aquatic, Coastal, and Small Island Conservation Areas)
EAFM	Ecosystem Approach to Fisheries Management
MMAF	Ministry of Marine Affairs and Fisheries
MoEF	Ministry of Environment and Forests
METT	Management Effectiveness Tracking Tool
MPA	Marine Protected Area
NGO	Non-Governmental Organization
BIG	Badan Informasi Geospasial (Indonesian Geospatial Information Agency)
SPAG	Fish Spawning Aggregation Site
SDG	Sustainable Development Goal
SE	Standard Error

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EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

The Sunda Banda Seascape (SBS) in Indonesia's Coral Triangle is considered one of the top priority marine ecoregions for conservation by the Indonesian government. The region is divided into three subseascapes, which includes the Lesser Sunda Subseascape (LSS), the Southern-Eastern Sulawesi Subseascape (SESS), and the Inner Banda Arc Subseascape (IBAS). The SBS dashboard provides a science-based assessment of the status of 22 indicators grouped within five domains, which includes: **(1) enabling conditions, (2) human well-being, (3) ecosystem health, (4) fish and fisheries**, and **(5) governance**, across marine protected areas (MPAs) in the SBS region for 2017. Each indicator is evaluated at MPA level and then scored at the subseascape level using three categories: 'above average/optimal', 'average/acceptable', and 'below average/below optimal'.

Enabling conditions

Marine conservation in the SBS led by the Indonesian government in collaboration with civil society and local communities has showed a positive trajectory through time with increasing MPA coverage and improvements in management. As of December 2017, there are 85 MPAs covering a total area of 9.64 million ha within the SBS region, equal to nearly 48% of the national target for 2020. These MPAs have provided adequate protection to seagrass and coral reef ecosystems which exceeded the national target to protect 30% of marine critical habitats within MPAs, except for mangroves (29.2%). Most of the MPAs (72%) in this region are within 100 km of at least three other MPAs, which increases ecological connectivity among MPAs.

Local communities identify destructive fishing practices as the most common threat to marine resources.

Of the 85 MPAs within the SBS, very few (17 MPAs) have implemented zoning systems to manage critical habitats within the MPAs. The average management capacity and resources of MPAs in the SBS is also relatively low (31%), which means most of these MPAs are still lacking capable staff and strong financial support for management. Destructive fishing, including bomb fishing and cyanide fishing, is the most common perceived threat to marine resources identified by local communities in Alor, Flores Timur, Koon, Kei Kecil and Yamdena MPAs. According to Burke et al. (2002), destructive fishing occurs throughout Indonesia and is one of the most severe threats to the health of coral reefs. The low number of MPAs with zoning systems and low management capacity and resources are both areas that need to be improved.

At the subseascape level, MPAs in the LSS are better able to provide favorable conditions to support MPA implementation. Most MPAs in the LSS have higher than average conditions, particularly in regards to critical habitat protection within no-take zones (NTZs), management capacity and resources and clearly defined boundaries. Meanwhile, MPA managers in the SESS and the IBAS need to use best-practices for marine spatial planning design as well as promote formal establishment of MPAs.

Human well-being

Human well-being indicators were assessed in a subset of MPAs: Flores Timur, Selat Pantar, Koon, Kei Kecil and Yamdena. Overall, the local communities in these five MPAs in the SBS region have high school enrollment rates, with 8 to 10-year-old school-aged children enrolled in formal education. This result is consistent with findings from a national evaluation on school-age children (7-18 years old) enrolled in formal education in Indonesia (Rachmawati et al. 2017). Local communities in these five MPAs are vulnerable to changes in marine resource use because they have very

Local communities of Flores Timur, Selat Pantar, Koon, Kei Kecil and Yamdena are vulnerable to marine resource changes due to their high dependency on these resources.

high dependency on marine resources (4.5 of 5.0). At the same time, communities in Koon, Kei Kecil and Yamdena MPAs, all located within Maluku Province, have less control over the resources upon which they depend. This is likely related to the social characteristics of Maluku, where the rules associated with marine resource use are often made by the village leader or king, and community members accept this as part of their culture. Based on field data and in line with national assessment on food security results (Badan Ketahanan Pangan and WFP Indonesia, 2015), all communities in sampled MPAs, except Flores Timur, are categorized as "food insecure without hunger"; therefore they have concerns about the adequacy of their food supply. Flores Timur MPA communities' ability to access nutritionally adequate and safe food is the highest of all sampled MPAs and is considered as food secure.

At the subseascape level, neither the LSS or the IBAS, where the MPA level data is available, perform better than the other. LSS has a higher than average marine tenure index while IBAS performs better at school enrollment rate. Moving forward, it is important for MPA managers in LSS to increase the performance in economic well-being, education and culture indicators, and MPA managers in IBAS to increase the performance in health and political empowerment indicators.

Ecosystem health

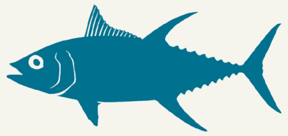
Of the 22 MPAs assessed, transect surveys showed the average hard coral cover in the SBS was 34.4%, with the highest coral cover observed in Gili Balu MPA (53.4%) and the lowest in Gili Matra MPA (9.8%). Using remote sensing, mangrove and seagrass cover were assessed across 72 MPAs. Mangroves were least protected, i.e. <30% protected within MPAs in Sulawesi Selatan, Sulawesi Tenggara, Sulawesi Tengah and Nusa Tenggara Barat Provinces. Also, Sulawesi Selatan and Sulawesi Tengah Provinces do not provide adequate protection of seagrass (>20%).

Mangrove forests in SBS require protection as significant declines have occured.

At the subseascape level, the SESS has a higher percentage of hard coral and seagrass cover within MPAs, and the LSS has better higher mangrove and seagrass cover within MPAs. Ensuring adequate protection, approximately 20-30% of each of marine critical ecosystem, as well as maintaining healthy ecosystem conditions are equally important to maintain marine ecological function and biological connectivity between coastal habitats (Moberg and Folke, 1999, Nagelkerken et al. 2000, Mumby et al. 2004). For future management measures, this emphasizes the need to increase the protection of mangroves in the SESS through establishment of MPAs and/or mangrove restoration within MPAs and to increase coral cover in LSS and IBAS by reducing threats to coral reefs through strengthened governance.

Fish and fisheries

Overall, from the 23 MPAs that were assessed, the biomass of key fisheries species (average SBS: 68.9 kg/ha), the biomass of herbivorous fish (average SBS: 226.5 kg/ha) and the 90th quantile of fish size (average SBS: 41.7 cm) varied significantly among MPAs in the SBS region. Compared to other MPAs, Koon MPA has extremely high biomass of key fisheries species, 6.5 times higher than the regional average biomass, and the Wakatobi MPA has exceptional high biomass of herbivorous fish, five times higher than the regional average biomass. Of the four MPAs that have data over time, a large increase (i.e. doubled to tripled from baseline data) in fish biomass was observed in the Wakatobi MPA for key fisheries species biomass and herbivorous fish biomass, and Flores Timur MPA for herbivorous fish biomass. Low fish biomass and relatively small size of fish in MPAs located in Nusa Tenggara Barat Provinces, such as Kabete MPA, Teluk Cempi MPA, Liang & Ngali MPA and Gili Banta MPA, as well as a decrease



Koon MPA has extremely high biomass of key fisheries species - 6.5 times higher than regional average biomass.

in key fisheries species biomass over time in Gili Matra MPA suggested that there is high fishing pressure on coral reef fish. This suggests that the MPA managers in Nusa Tenggara Barat Province need to develop specific management action to address overexploitation of fish.

At the subseascape level, IBAS has high baseline conditions for the fish and fisheries domain as noted by higher than average biomass of key fisheries species and a higher 90th quantile of fish size. Lower than average scores on all fish and fisheries indicators in LSS suggest that future improvement of MPA management targeting fisheries regulations and access is crucial and urgent to restore the fish populations in the subseascape.

Governance

Of the five MPAs in the SBS that were assessed, Flores Timur MPA and Kei Kecil MPA have stronger local community involvement in marine resource governance, showed by a higher proportion of user groups actively managing marine resources, higher average proportion of key species and habitat with rules associated with them, relatively low average time to resolve conflicts over marine resources and higher proportion of households who are members of organizations. In contrast, most local communities in Koon MPA are not involved in marine resource governance, likely related to the cultural system where King or village leaders are seen as the persons who have the authority to govern their areas. Despite the lack of community involvement in Koon MPA, interestingly, they have not had any conflicts over marine resources in the past 12 months, which suggests the local communities respected and obeyed any rules applied in their areas.

Increasing community ownership of marine resources will likely increase community participation in managing their marine areas.

From the two subseascapes where data are available (LSS and IBAS), both subseascapes need to increase the local community's involvement in marine resource governance. It is important to increase the sense of ownership of marine resources and thus increase the self-participation of local communities in managing their areas and marine resources. LSS slightly performs better than IBAS in user participation in monitoring and enforcement.

The high number of MPAs within the SBS region should be seen as a positive collaborative effort and commitment among governments, NGOs, academics and community groups and as a smart investment to manage the marine resources and to support sustainable fisheries in the region. In its current state, of 40 of 85 MPAs that have been evaluated using E-KKP3K (Indonesian MPA Management Effectiveness scores), only Nusa Penida MPA that has achieved the highest level, i.e. level 3 of 5, which means the MPA already has a management body, zoning system and management plan, and adequate management capacity such as human resources and infrastructure. A total of 65% of MPAs in the SBS region (25 MPAs) are still at level 1, where an MPA boundary is in place, and 35% of MPAs (14 MPAs) have reached level 2 which means MPA boundary, zoning system and management plan are in place. From the Ecosystem Approach to Fisheries Management (EAFM) assessment, using the aggregated data from five MPAs, the average SBS EAFM scores showed a positive trend through time, although the scores are still at a medium level. This shows improvement in fisheries management. Moving forward, the government and its partners need to improve MPA management and fisheries management effectiveness substantially through time by implementing adaptive management measures.

Chapter 1

INTRODUCTION

INTRODUCTION

Indonesia established it's first MPA in Kasa in 1978

Indonesia is located within the epicenter of global marine biodiversity, located in the East Indies Marine Ecoregion (Briggs 2005; Wang et al. 2015), and is home to over 2,100 reef fish species (Allen and Werner, 2002) and over 500 coral species (Veron et al. 2009). Unfortunately, Indonesia's marine resources face increasing natural and anthropogenic threats. Destructive fishing and overexploitation of marine resources are the primary drivers affecting the health of Indonesian coastal ecosystems (Burke et al. 2011). Indonesia has been estimated to lose economic benefits generated by coral reefs of up to US $270,000/km^2/year from reef degradation due to pollution, sedimentation, and overfishing and destructive fishing practices (Burke et al. 2012).

Traditional customary management of marine resources has been practiced for generations before Indonesia was declared as a country in 1945. Although many of the associated practices have been diminished in recent years, some continue to exist and play an important role in local marine resource management. Formal management began when Indonesia established its first marine protected area (MPA)[1] in Kasa in 1978. Since this landmark, the government of Indonesia has emphasized its commitment to protect 10% of its marine areas, the Aichi target for the country, when it announced a goal of 20 million ha of MPAs by 2020 at the World Ocean Conference in 2009 (Yudhoyono, 2009). By December 2017, Indonesia established 19.1 million ha with a total of 172 MPAs (Kementerian Kelautan dan Perikanan, 2018). The Ministry of Marine Affairs and Fisheries (MMAF), upon nearly reaching the original goal, is currently in process to set up a new target, i.e. 30 million ha of MPAs by 2030; in other words, 10% of Indonesia's marine areas will be protected.

Sunda Banda Seascape

The Sunda Banda Seascape (SBS; Fig. 1) is part of the global epicenter of tropical marine biodiversity, within the Coral Triangle in Indonesia. Along with Bird's Head Seascape (BHS), the SBS region is considered by the MMAF as one of the most important marine regions for biodiversity. The region is geographically delineated from two marine ecoregions, the Lesser Sunda marine ecoregion and Banda Sea marine ecoregion (Spalding et al. 2007). The SBS region, which covers a vast area of 151 million ha, comprised of approximately 5,000 small islands (BPS-Statistics Indonesia, 2017), consists of three subseascapes: Lesser Sunda Subseascape (LSS), Southern Eastern Sulawesi Subseascape (SESS), and Inner Banda Arc Subseascape (IBAS).

Consisting of around 5,000 small islands and three subseascapes, the SBS region covers 151 million ha of area.

The SBS contains high diversity and densities of coral and fish species, and also provides critical habitats and migration routes for many charismatic species like sea turtles and cetaceans (Rudolph et al. 1997, Mustika, 2006, Ningsih et al. 2013, Wang et al. 2015). These natural resources serve as a primary source of livelihoods and support the food security of millions of coastal communities across seven Indonesian provinces: Bali, Nusa Tenggara Barat, Nusa Tenggara Timur, Sulawesi Selatan, Sulawesi Tengah, Sulawesi Tenggara and Maluku. Similar to other areas in the Coral Triangle, natural resources in the SBS region are at risk from a number of anthropogenic threats due to coastal development and exploitation of marine resources. These include overfishing, illegal and unsustainable fishing practices and pollution (Burke et al. 2012).

1 The MPAs discussed in this section are MPAs that are listed under the MMAF database (http://www.kkji.kp3k.kkp.go.id/) of which most MPAs are managed by MMAF and a few are managed by the Ministry of Environment and Forestry (MoEF). Based on MMAF regulation, an MPA is defined as a marine and coastal area which is managed within a zoning system to sustain fisheries resources. Please note that the MPA definition used for other sections of this study is different and will be explained in Chapter 2

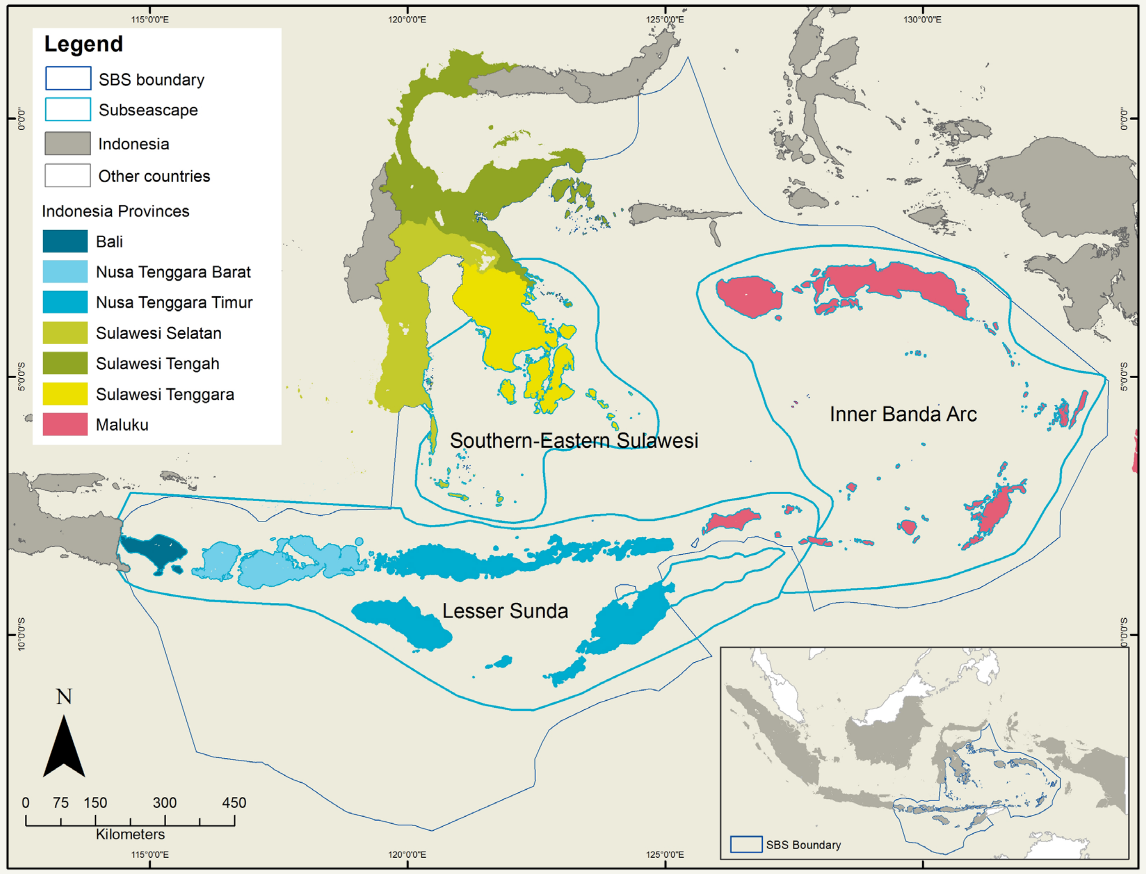


Figure 1. Sunda Banda Seascape (SBS) region in Central and Eastern Indonesia

MPA network in the SBS region

Promoting sustainable fisheries and livelihoods are an essential component of MPA design and management.

With its high biodiversity and abundance of marine resources, the SBS region is considered a top conservation priority in Indonesia. The Indonesian government in close collaboration with NGOs, civil societies, universities and private companies, has put substantial effort into protecting and managing this region over the last decade.

Since 2008 there has been a rapid increase in the number of Indonesian MPAs, driven by MMAF decree No. 4/2014. Establishing new MPAs is important to provide the spatial links needed to maintain ecological processes and connectivity, as well as improve resilience by spreading risk in the case of localized disasters, climate change, failures in management or other hazards, and thus help to ensure the long-term sustainability of populations better than single sites (NRC 2000). Collaboration between individual MPA managers through MPA networks is one recent approach to improve MPA effectiveness.

As of December 2017, a total of 85 MPAs has been initiated and established in the SBS region, covering a vast area of 9.6 million ha (Annex 1). These MPAs were developed with various objectives and functions, with shifting emphasis from initially protecting biodiversity to now promoting sustainable fisheries and livelihoods. Kasa Island, located in Maluku Province, was the first MPA established in the region. Of the 85 MPAs, 44 are managed by MMAF and 41 are managed by the Ministry of Environment and Forestry (MoEF). Between 2011 and 2017, the number of MPAs within SBS managed by MMAF rapidly increased, from 14 to 44; the number under the management of MoEF remained stable after 2011 (Fig. 2). The majority of these MPAs are located in the provinces of Nusa Tenggara Barat, Sulawesi Tenggara, and Maluku.

For the purpose of this report, MPAs included were those nearshore protected areas managed by MoEF and MMAF, following the MPA definition by IUCN "Any area of an intertidal or subtidal terrain, together with its overlying waters and associated flora, fauna, historical, and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment." MPAs managed by communities or not formally registered by law under MoEF and MMAF management, such as *Daerah Perlindungan Laut*, *sasi*, *awig-awig*, etc., are not included in this report.

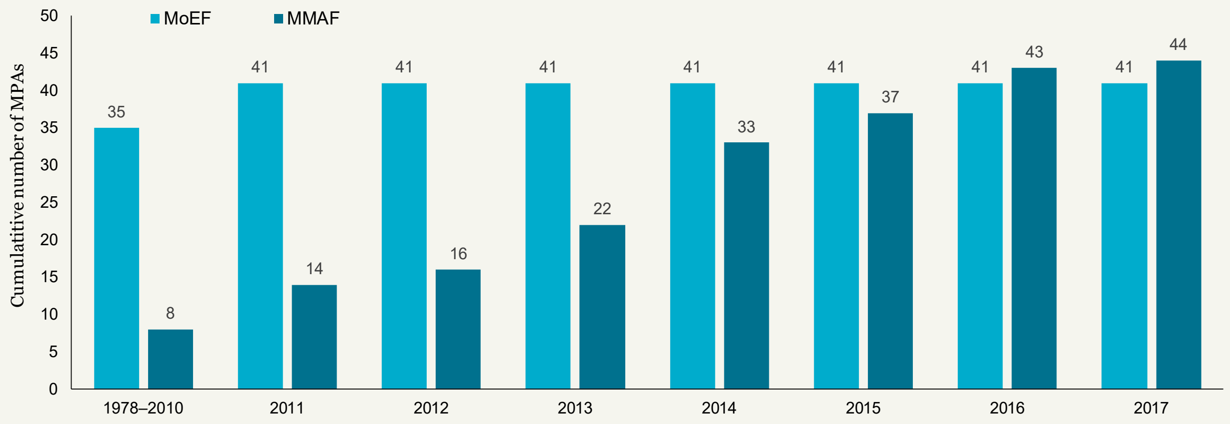


Figure 2. Total number of MPAs that have been initiated and established by MoEF and MMAF between 1978 and 2017

Management assessment tools in the Sunda Banda Seascape

Tracking management effectiveness is critical to highlight both challenges and progress in MPA management

Measuring the effectiveness of MPA management is critical to capture progress and highlight shortcomings that occur during MPA implementation. This can help guide efforts to improve management in the future. Three assessment tools are currently used by the Indonesian government for MPA and fisheries management: (1) Management Effectiveness of Aquatic, Coasts, and Small Islands Conservation Areas (E-KKP3K), (2) Ecosystem Approach to Fisheries Management (EAFM) and (3) Management Effectiveness Tracking Tools (METT).

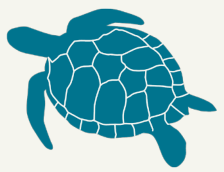
E-KKP3K was developed by the MMAF as a standardized assessment of MPA management effectiveness to assist in improving management and defining management strategies and priorities across MPAs in Indonesia. The assessment is biannually conducted and the results can be used for undertaking self-evaluation and making plans for improving the management of MPAs (MMAF, 2015). In E-KKP3K, MPAs are classified into five levels: Level 1 (Red), Level 2 (Yellow), Level 3 (Green), Level 4 (Blue) and Level 5 (Gold). The parameters used to evaluate this include MPA institutions and management, zoning plans, financial support and infrastructure. A total of 74 questions grouped in 17 criteria are used to measure the level of each MPA (MMAF, 2015).

The United Nations Food and Agriculture Organization defines EAFM as "an ecosystem approach to fisheries strives to balance diverse societal objectives, by taking account of the knowledge and uncertainties about biotic, abiotic and human components of ecosystems and their interactions and applying an integrated approach to fisheries within ecologically meaningful boundaries" (Garcia et al. 2003). EAFM has been initiated and established in Indonesia since 2010 in collaboration between MMAF, universities and NGOs. In EAFM, there are a total of 33 indicators grouped into six domains that are used to measure the performance of EAFM implementation, particularly in the Fisheries Management Areas in Indonesia. These domains consist of (1) fisheries resources, (2) habitats and ecosystems, (3) fishing methods, (4) economic, (5) social and (6) institution (National Working Group II EAFM, 2013).

Based on the evaluation of EAFM implementation, a fisheries management area is classified as one of five levels: (1) Red flag (hasn't implemented EAFM yet), (2) Light yellow flag (low implementation of EAFM), (3) Yellow (moderate implementation of EAFM), (4) Light green (good implementation of EAFM), and (5) Green (very good implementation of EAFM).

METT is a management tool used to measure the effectiveness of conservation areas (Direktorat Kawasan Konservasi - MoEF, 2016) under the management of MoEF in Indonesia, including MPAs in the SBS region. METT is an assessment based on a scorecard questionnaire that consists of six elements of management. E-KKP3K and METT tools have different evaluation systems. Of the three Indonesian government MPA assessment methods, this study only used E-KKP3K and EAFM to measure the status of the SBS MPA network, as they are the most commonly used approaches.

Ecological conditions



Many transient (or highly mobile) marine wildlife species, including cetaceans, sea turtles, manta rays and sunfish, use the SBS for migration routes, nesting and aggregation sites.

The SBS region contains approximately 2,122 fish species, 574 coral species (across 1 million ha of reef) (Hoegh-Guldberg et al. 2009), 12 species of seagrass (Hernawan et al. 2017), and 47 species of mangrove (Estradivari et al. 2015). Within the seascape, reefs cover approximately 1,020,331 ha, seagrass covers 75,657 ha, and mangroves cover 191, 827 ha (Badan Informasi Geospasial, data year 2017). This region serves as a migration route for 19 cetacean species (Mustika, 2006) and nesting sites and feeding ground for sea turtles, including those in Kei Kecil and Buru Island, which are important for leatherback turtles (Hadinata, 2017, Vinanda, 2017). The SBS region also includes important aggregation sites for manta rays (Dewar et al. 2008, Germanov and Marshall, 2014), ocean sunfish *Mola alexandrini* (Ruchimat et al. 2013, Thys et al. 2016) and key fisheries species, such as the two-spot red snapper (*Lutjanus bohar*) in Wakatobi (Firmansyah et al. 2016) and Koon (Mous, 2011).

Social conditions

There are approximately 4,900 villages located in coastal areas, which equals 36% of total villages, in seven provinces in the SBS region (Fig. 1). Maluku has the most villages (84%) located in coastal areas. There are more than 27.6 million people in the SBS, with the number varying by province, from 1.5 million in Maluku to 8 million in Sulawesi Selatan. In the same provinces respectively, the number of households ranges from 355,000 to nearly 2 million. The average size of household within the SBS is 4.3, which is higher than the Indonesian average of 3.9. Though the size of household varies among provinces ranging from 3.6 (Nusa Tenggara Barat) to 4.8 (Maluku) (BPS-Statistics Indonesia, 2017).

The SBS is home to a culturally diverse population in terms of ethnicity and religion. For example, Bali is dominated by Hinduism, while the Sulawesi provinces and Nusa Tenggara Barat are predominantly Muslim. In other parts of the SBS region, like Nusa Tenggara Timur and Maluku, the populations are typically Christian and Muslim. Ethnically, in some MPAs, local communities belong to at least six to ten different ethnic groups (Mohebalian et al. 2016a, Mohebalian et al. 2016b). In most parts of Maluku, Ambonese and Kei are the primary groups in the communities (Mohebalian et al. 2017). In Sulawesi, the most dominant ethnic groups occupying coastal areas are Bajo, Bugis, Buton and Muna (Santiadji et al. 2017). In Bali and Nusa Tenggara Barat, the coastal communities are dominated by Sasak, Bali and Bima (Kartawijaya et al. 2014b).

Marine resource use

Handheld fishing gear is the most commonly used fishing method in the SBS.

The SBS region is dominated by coastal communities that are highly dependent on local marine resources, for both protein supply and income. Most coastal populations living in or around MPAs work as traditional or commercial fishers, either in marine capture fisheries or aquaculture. In addition, farming, like growing crops or livestock, has become the second alternative livelihood (Kartawijaya et al. 2014b, Kartawijaya et al. 2014c , Mohebalian et al. 2017, Putnarubun et al. 2017). In some MPAs, like Kei Kecil, farming is the main occupation. In the MPAs near Lombok and Sumbawa, the most common factors driving fishing as the primary livelihood include limited alternative livelihoods, limited skills, and the availability of marine resources. In these areas, fishing households fished for 13-25 years of their lives (Kartawijaya et al. 2014a , Kartawijaya et al. 2014b, Kartawijaya et al.2014c , Mohebalian et al. 2016a, Mohebalian et al. 2016b).

For much of the SBS region, fishing by hand is the dominant method, with hand-held lines and stationary nets, such as gill nets, most commonly used. Some fishers use other gear types, including: spear guns, mobile nets (such as trawl and purse seine), mobile lines (such as trawling) and stationary lines (such as long line). The selection of fishing gear depends on target species, fishing time and fishing target seasons. Mackerel, tuna, skipjack tuna, anchovies and milkfish are commonly targeted pelagic fish; groupers and snappers are commonly targeted reef fish. Fishing efforts occur year-round, but the target species vary with season. For example, squid season is between February and August, while fishing season for rays is from December to April. Fishing frequency is predominantly a few times a week or more (Kartawijaya et al. 2014a, Kartawijaya et al. 2014b, Kartawijaya et al. 2014c, Mohebalian et al. 2016a, Mohebalian et al. 2016b, Mohebalian et al. 2017).

Fishing seasons and gear selections greatly vary with target species

Children playing at a port in Labengki Kecil Island, Teluk Lasolo MPA.

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Box 1. Strengthening whale stranding documentation in Indonesia

A stranded short-finned pilot whale (*Globicephala macrorhynchus*) in Ohoililir, Southeast Moluccas. © Veronica Louhenapessy/WWF Indonesia

Contributed by: Dwi Suprapti

As of November 2013, Whale Stranding Indonesia (WSI) has been an effectively formed working group. The formation of the WSI community began with the first workshop on the handling of stranded marine mammals. WWF Indonesia actively participated in strengthening the development of WSI in collaboration with the Foundation of Cetacean Sirenian Indonesia (Cetasi).

In the last five years, WSI has accomplished a number of achievements. A nation-wide stranding network is now available across Indonesia with the Bali and Sulawesi networks among the most responsive. The network runs effectively on the strength of its communication system supported mainly by a Whatsapp group, called “Whale Stranding Network” that was initiated at the end of 2014. Until the end of 2017, there were 118 active members involved in the group. The members range from governments, NGOs, professionals, marine mammal enthusiasts and private sectors. In addition, the number of reported stranding events increased threefold from 13 reports in 2013 to 42 reports in 2017. This indicates an increase in the awareness of stakeholders and members to report any stranding to the WSI website, Facebook page and the Whatsapp group. A total of 217 individual marine mammals stranded in 131 stranding events between 2013 and 2017. Around 44% of the total number of individuals were set afloat back to the ocean. However, the survival rates of the animals are still unknown.

What’s more, the WSI website has been used as a reference for published and non-published cetacean-related discussions in Indonesia. In term of policy, WSI has provided a space for experts to give the Indonesian government input to improve cetacean conservation management in the country. As a result, one standard operating procedure for managing marine mammal stranding events has been created and is ready to be implemented across Indonesia.

Chapter 2

ASSESSING THE SBS MPA NETWORK

ASSESSING THE SUNDA BANDA SEASCAPE MPA NETWORK

This report provides a science based assessment of the management of MPAs and status of key ecological and social conditions across the SBS region as of 31 December 2017. It will be updated on a regular basis to examine trends over time in indicator performance at MPA level and seascape level.

To provide the baseline status of the SBS MPA network, we defined 22 indicators, classified into five domains: (1) Enabling Conditions, (2) Human Well-being, (3) Ecosystem Health, (4) Fish and Fisheries and (5) Governance. Each domain consists of multiple indicators and proxies that are used to assess status. The indicators vary at the scale they are measured: a subset of indicators are measured at the seascape level, while the majority are measured at the individual MPA level (aggregated at the subseascape and seascape levels when appropriate).

Interpreting the State of the SBS MPA Network Report

This report documents the status of ecosystem, fisheries, governance and social conditions. Changes to the status of these conditions can be influenced by one or a combination of a number of factors, including environmental, economic and social processes over time. In this report, we describe possible explanations for patterns observed in the data. Given that the monitoring results presented in this report are only generated from inside MPA boundaries, any trend or change in the conditions mentioned above cannot be directly attributed to the MPA establishment and therefore should be interpreted with caution (i.e. a negative trend may not mean the MPA is 'failing' because this could be caused by a number of reasons not captured in this report). Impact evaluation is being conducted in six MPAs to understand MPA impacts; however, this requires long-term data collection inside and outside of MPAs, which is currently underway.

Understanding and interpreting the Dashboard

The State of the SBS MPA Network Report synthesizes survey and monitoring data on the status and trends of the conditions mentioned above at MPA level and seascape level. The summary of the status of indicators at both levels is provided in a dashboard, including the current status and if available, the trends of each MPA determined by the classification approach adopted from Glew et al. (2015).

The status of each MPA and subseascape is classified into three categories (Fig. 3):

- **Above average:** conditions observed in an MPA or subseascape during the monitoring year are substantially higher than the average conditions observed at the seascape level. We define 'substantially higher' to be when the MPA or subseascape condition is greater than the average seascape condition by one standard error (SE).

- **Average:** conditions observed in an MPA or subseascape during the monitoring year are within the same range as the average conditions observed at the seascape level. We define this range as bound by the average seascape condition plus or minus one standard error.

- **Below average:** conditions observed in an MPA or subseascape during the monitoring year are substantially lower than the average conditions observed at the seascape level. We define 'substantially lower' to be when the MPA or subseascape condition is less than the average seascape condition by one standard error.

- **No data:** there are no or insufficient data available to examine status of an indicator.

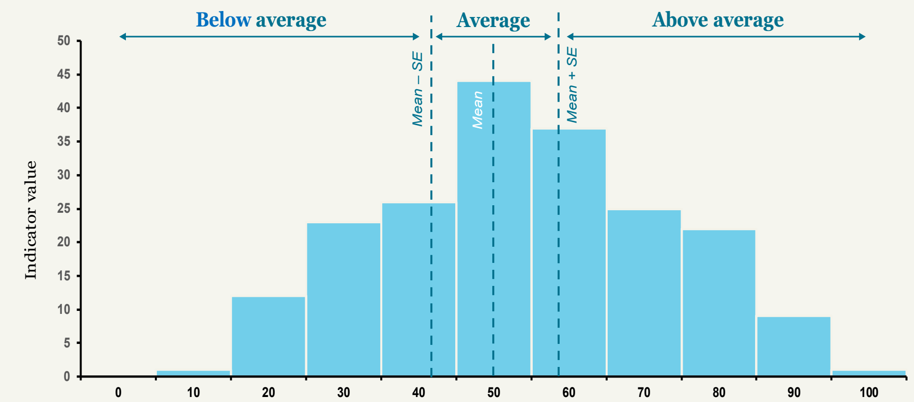


Figure 3. Classification of MPA and/or MPA network status

In some instances, there are clearly defined legal or conservation targets by the Indonesian government or there is good scientific justification for MPAs reaching certain targets. In these cases, the exact definition of each category is contained in relevant indicator definition table, and the summary categories used are:

- **Optimal:** substantially exceeds recommended target

- **Acceptable:** meets recommended target

- **Below Optimal:** fails to meet recommended target

If survey data are available from multiple time points within an MPA a trend for the indicator is presented. These are classified into three categories:

- **Increasing:** average condition observed in an MPA, during most recent monitoring year is significantly higher ($P<0.05$) than the average condition in the same MPA at baseline.

- **Stable:** average condition observed in an MPA, during most recent monitoring year is not significantly different ($P>0.05$) than the average condition in the same MPA at baseline.

- **Decreasing:** average condition observed in an MPA, during most recent monitoring year is significantly lower ($P<0.05$) than the average condition in the same MPA at baseline.

Understanding and interpreting the figures

This report presents data in a standard graphical format. In Figure 4, we describe how to understand and interpret data presented in this format (Glew et al. 2015). The last bar/column in each figure represents the average at seascape level. This was generated from the average MPA level **from the latest survey/monitoring period**. If an MPA has both baseline and repeat monitoring, the data from repeat monitoring was used to calculate the seascape average.

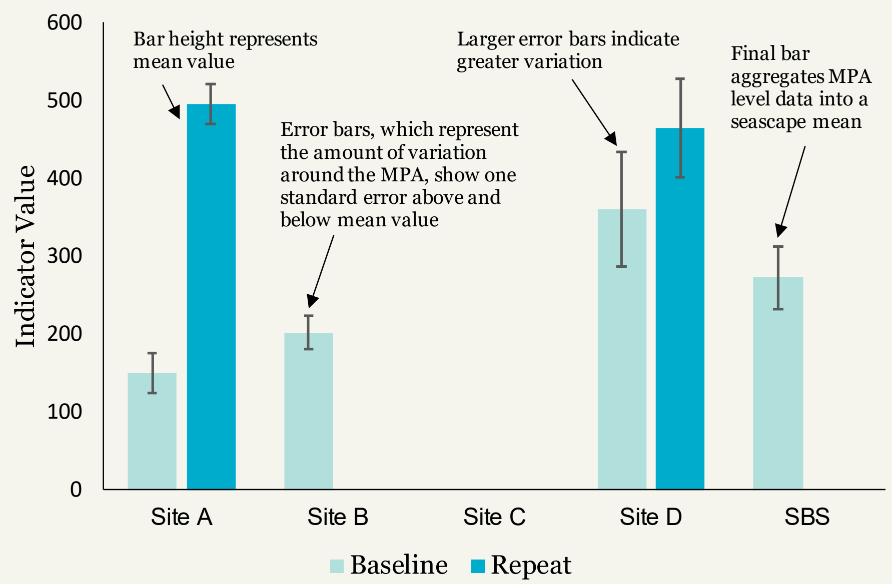


Figure 4. Graphical example on how to understand and interpret findings in this report

Note: Graph was adopted from Bird's Head Seascape Dashboard (Glew et al. 2015).

Understanding and interpreting uncertainty

Uncertainty in scientific monitoring is unavoidable and may occur at many steps during the monitoring process. The extent of the uncertainty can be quantitatively observed through statistical analysis (Glew et al. 2015). In this report, we adopt the standard classification used by Intergovernmental Panel on Climate Change (2014) to describe the level of uncertainty found in the statistical analysis of monitoring data in the SBS MPA network (Table 1).

For each finding in this report, we provide the likelihood term in italicized font (e.g., *extremely likely*) and the exact probabilistic likelihood in parentheses. For example, if there is less than a 5% chance that the trends documented for a specific indicator would arise by chance alone, we describe the trend as '*extremely likely* (P=0.05)'. Here, the P value expresses the probability of obtaining a result equal to, or more extreme than was actually observed in the data (Glew et al. 2015).

Table 1. IPCC's standard classification for describing quantified measures of uncertainty

Terms	Likelihood of the outcome	Associated probabilistic likelihood (P value)
Virtually certain	99–100% probability	P<0.01
Extremely likely	95–100% probability	P<0.05
Very likely	90–100% probability	P<0.10
Likely	66–100% probability	P<0.33
About as likely as not	33–66% probability	P<0.33 and P<0.66
Unlikely	0–33% probability	P>0.66
Very unlikely	0–10% probability	P>0.90
Exceptionally unlikely	0–1% probability	P>0.99

Enabling conditions

Enabling conditions can be defined as favorable conditions that must be in place for effective MPAs, including at the national and local level and spanning legal, ecological, institutional, financial and political aspects (Conservation and Community Investment Forum, 2013). The indicators of this domain, including their proxies and aligned indicators in E-KKP3K, EAFM and Sustainable Development Goals (SDGs) are available in Table 2. Data source and methods for analysis are available in Annex II (Tables 12, 13, 14).

Table 2. The indicators and proxies of the enabling conditions domain, including indicator alignments in E-KKP3K, EAFM and SDGs.

No	Indicators	Proxies	Score	Indicators		
				E-KKP3K	EAFM	SDG
1	Sufficient habitats in MPAs	**Critical habitat area (coral reef, seagrass and mangrove) within MPAs** as a proportion of total critical habitat area within the SBS.	• Optimal: more than 30% • Acceptable: between 20% and 30% • Below optimal: less than 20%	√	√	√
2	Spacing between MPAs within MPA network	**The number of MPAs within the MPA network located within 100 km**, measured from the MPA boundaries.	• Optimal: MPAs are connected to more than six MPAs within 100 km distance. • Acceptable: MPAs are connected to three to six MPAs within 100 km distance. • Below optimal: MPAs are connected to only maximum two MPA or even not connected to any MPA in SBS	–	–	√
3	Non-extractive critical habitats in MPAs	**The proportion of critical habitats within no take zones (NTZs) and take zones (TZs) in MPAs**. The critical habitats include mangroves, seagrass, and coral reefs. The NTZs include core zones, tourism zones, rehabilitation zones, and protection zones. The TZs include use zones, traditional use zones, commercial/general use zones and harbor zones.	• Optimal: more than 30% of total critical habitats in NTZs • Acceptable: between 20% and 30% of total critical habitats in NTZs • Below optimal: less than 20% of total critical habitats in NTZs	√	√	–
4	Perceived threats to marine resources	**Number of perceived threats to marine resources** identified by local communities at MPA level.	• Above average: below the range of SE. • Average: within the range of SE. • Below average: above the range of SE.	√	√	–
5	Management capacity and resources	**The proportion of fulfilled E-KKP3K indicators and questions related to management capacity, resources, and facilities** (Table 13).	• Above average: above the range of SE. • Average: within the range of SE. • Below average: below the range of SE.	√	√	–
6	Clearly defined boundaries	**The proportion of fulfilled E-KKP3K indicators and questions related to MPA zoning and management plan** (Table 13).	• Above average: above the range of SE. • Average: within the range of SE. • Below average: below the range of SE.	√	–	–

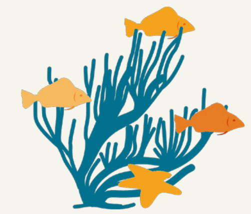
Human well-being

With regard to livelihoods and source of food, millions of local people living in coastal areas in the Coral Triangle, including in the SBS region, heavily depend on their surrounding marine environments (Foale et al. 2012).The benefits that local communities generate from their interactions with the marine environment significantly affect human well-being (Millennium Ecosystem Assessment, 2005). To measure the degree of human well-being of local communities living within MPAs, we measured five indicators of social well-beingbased on Glew et al. (2012) (Table 3). Data source and methods for analysis are available in Annex II (Table 13).

Table 3. The indicators and proxies of the human well-being domain, including indicator alignment in E-KKP3K, EAFM and SDGs

No	Indicators	Proxies	Score	Indicators		
				E-KKP3K	EAFM	SDG
7	Economic well-being	**Household asset index**. Material assets can be defined as physical possessions that are in working order, owned by a household, such as a TV, phone, boat, bicycle and motorcycle.	• Above average: above the range of SE. • Average: within the range of SE. • Below average: below the range of SE.	√	√	–
8	Health	**Food security index**. Food security can be defined as the ability of all people to access nutritionally adequate and safe food for an active and healthy life at all times in socially acceptable ways (Bickel et al. 2000).	• Above average: above the range of SE. • Average: within the range of SE. • Below average: below the range of SE.	√	-	√
9	Political empowerment	**Marine tenure index**. Marine tenure consists of (1) the right to determine who enters an MPA and who utilizes its specific resources; (2) the right to define when, where and how specific resources can be used; (3) the right to manage an MPA, including making decisions on how the resources are used; (4) the right to exclude others from an MPA, including making decisions on who can take advantage of the MPA and (5) the right to transfer marine resource management and exclusion rights to others (Mascia and Claus, 2009).	• Above average: above the range of SE. • Average: within the range of SE. • Below average: below the range of SE.	√	–	√
10	Education	**School enrollment rate**, which is the proportion of school aged children (between the ages of 5 and 18 years old) enrolled in formal education in each household within the MPA.	• Above average: above the range of SE. • Average: within the range of SE. • Below average: below the range of SE.	–	–	√
11	Culture	**Place attachment index**, which measures the emotional connection between an individual and his environment (Williams and Vaske, 2003).	• Above average: above the range of SE. • Average: within the range of SE. • Below average: below the range of SE.	–	–	√

Ecosystem health

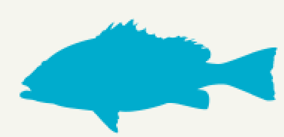


The health of an ecosystem is critical for maintaining the ecological functions of the ecosystem itself, which leads to benefits for users through ecosystem services (Haines-Young and Potschin, 2010). In this domain, we measured the coverage of three critical habitats in coastal areas: mangrove forest, seagrass beds, and coral reefs (Table 4). Data source and methods for analysis are available in Annex II (Table 11, 12).

Table 4. The indicators and proxies of the ecosystem health domain, including indicator alignments to E-KKP3K, EAFM and SDGs

No	Indicators	Proxies	Score	Indicators		
				E-KKP3K	EAFM	SDG
12	Hard coral cover	**Percentage of healthy hard coral cover (%) within MPA.**	• Above average: above the range of SE. • Average: within the range of SE. • Below average: below the range of SE.	√	√	–
13	Mangrove cover	**Change in mangrove habitat area between 2014 and 2016 within MPAs establish during or prior to 2014**.	• Optimal: increasing mangrove extent (>1% change increase) • Acceptable: stable mangrove cover • Below optimal: mangrove loss (>1% change decrease)	√	√	–
14	Seagrass cover	**Inclusion of seagrass beds in MPAs (%)**, as a proportion of total seagrass area in a subseascape or district.a subseascape or district.	• Optimal: increasing mangrove extent (>1% change increase) • Acceptable: stable mangrove cover • Below optimal: mangrove loss (>1% change decrease)	√	√	–

Fish and fisheries



Fish and fisheries are highly associated with food security, especially in coastal developing countries like Indonesia. Fish are a crucial source of animal protein for many coastal populations, who otherwise may be unable to secure nutritional food. Fisheries also provide various benefits like income, resulting in economic opportunities and improved food security (Foale et al. 2012). In this domain, we identified four indicators that represent the status of fish and fisheries in the SBS (Table 5). Data source and methods for analysis are available in Annex II (Table 12).

Table 5. The indicators and proxies of the fish and fisheries domain, including indicator alignment in E-KKP3K, EAFM and SDGs

No	Indicators	Proxies	Score	Indicators		
				E-KKP3K	EAFM	SDG
15	Biomass of key fisheries species	**Biomass of key fisheries species (kg/ha)**. The included families are Lutjanidae, Serranidae, and Haemulidae.	• Above average: above the range of SE. • Average: within the range of SE. • Below average: below the range of SE.	√	√	–

No	Indicators (continued)	Proxies	Score	Indicators		
				E-KKP3K	EAFM	SDG
16	Biomass of herbivorous fish	**Biomass of herbivorous fish (kg/ha)**. The included (sub-) families are Acanthuridae, Siganidae, and Scaridae.	• Above average: above the range of SE. • Average: within the range of SE. • Below average: below the range of SE.	√	√	–
17	Fishing pressure	**The 90th quantile of fish size (cm)**. Calculated for the above key fisheries families and function groups at each MPA.	• Above average: above the range of SE. • Average: within the range of SE. • Below average: below the range of SE.	√	√	–
18	Catch per unit effort	**Total catch divided by the total amount of effort used to catch the fish.**	• Above average: above the range of SE. • Average: within the range of SE. • Below average: below the range of SE.	√	√	–

Governance

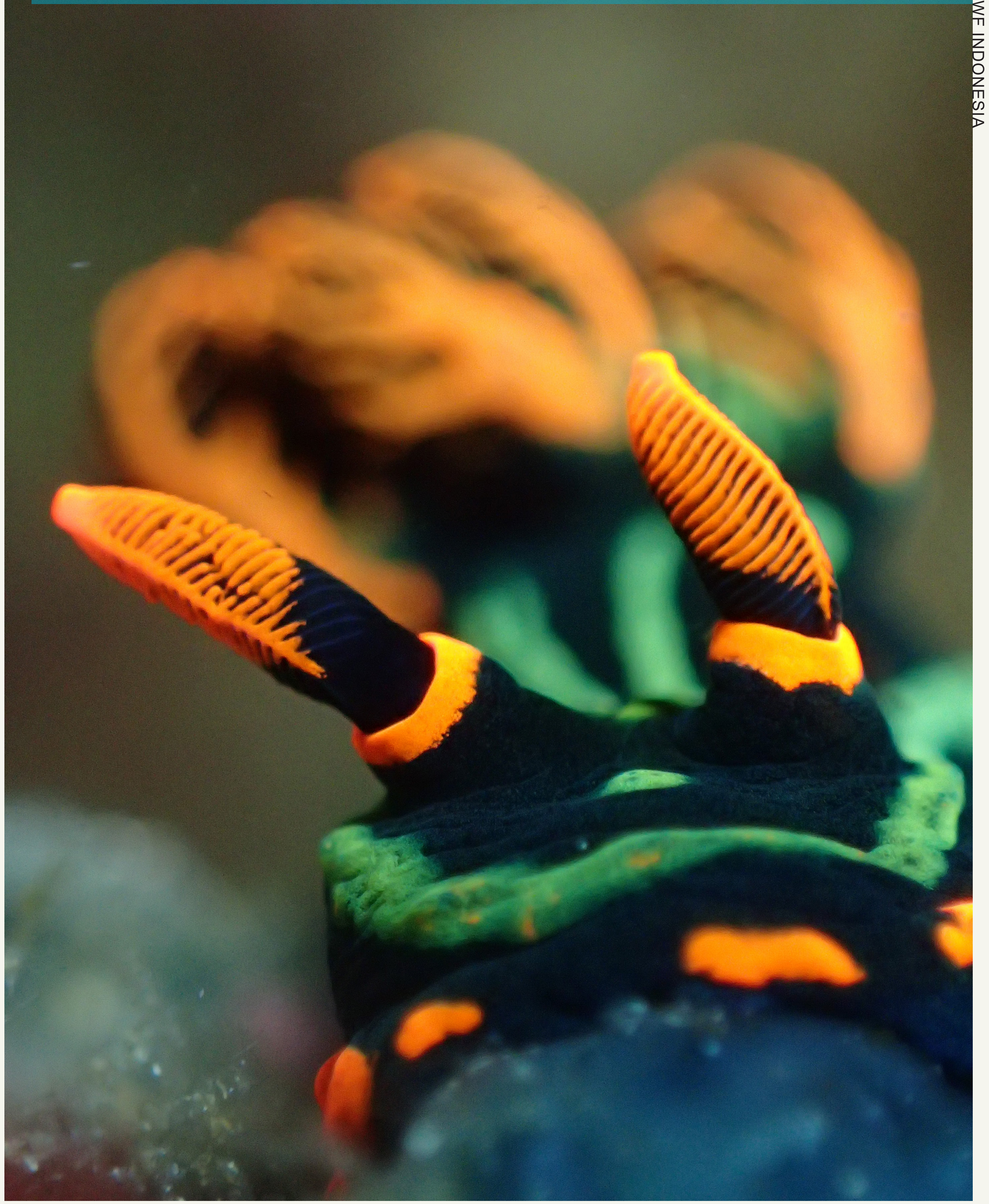
Marine resource governance covers any approach associated with the management of marine resources, including how management decisions are made, who is involved in decision making, how management decisions are enforced, and how rules for governing marine resources are created (Mascia et al. 2017). To monitor marine resource governance, focus group discussions and key informant interviews (KIIs) were conducted at randomly selected villages/settlements in each MPA. These focused on several aspects, including how decisions are made, the rules governing the use of marine resources, how the marine resource rules are monitored and enforced and how conflicts over marine resources are resolved. We assessed four indicators to measure the status of governance of MPAs in the SBS region (Table 6).

Table 6. The indicators and proxies of the governance domain, including indicator alignments in E-KKP3K, EAFM and SDGs

No	Indicators	Proxies	Score	Indicators		
				E-KKP3K	EAFM	SDG
19	Participation in decision making	Proportion of identified user groups who participate in establishing marine resource use rules within the MPA.	• Above average: above the range of SE. • Average: within the range of SE. • Below average: below the range of SE.	√	√	√
20	Resource Use Rules	The proportion of key species and habitats with rules associated with them.	• Above average: above the range of SE. • Average: within the range of SE. • Below average: below the range of SE.	–	√	–
21	Conflict Resolution	Time required to resolve conflict over local marine resources among users and between users and officials.	• Above average: above the range of SE. • Average: within the range of SE. • Below average: below the range of SE.	–	√	–
22	User participation in monitoring and enforcement	Proportion of households that are members of at least one organization participating in managing local marine resources.	• Above average: above the range of SE. • Average: within the range of SE. • Below average: below the range of SE.	√	√	–

Chapter 3

THE SBS MPA NETWORK: DASHBOARD



SBS MPA NETWORK: DASHBOARD

STATUS OF CONDITIONS 2017	LSS	SESS	IBAS
ENABLING CONDITIONS			
Sufficient habitats in MPAs Proportion of critical habitats protected within MPAs	Green	Green	Green
Spacing between MPAs within MPA network Number of MPAs within 100 km distance	Yellow	Blue	Green
Non-extractive critical habitats The proportion of critical habitats within NTZs in MPAs	Blue	Yellow	Green
Perceived threats to marine resource* Number of perceived threats to marine resource identified by locals	Green	—	Yellow
Management capacity and resources The proportion of fulfilled E-KKP3K indicators related to management capacity, resources, and facilities	Blue	Green	Yellow
Clearly defined boundaries Proportion of fulfilled E-KKP3K indicators related to zoning system and plan	Blue	Green	Blue
HUMAN WELL-BEING			
Economic well-being* Household asset index	Green	—	Yellow
Health* Food security index	Yellow	—	Green
Political empowerment* Marine tenure index	Blue	—	Green
Education* School enrolment rate	Green	—	Blue
Culture* Place attachment index	Green	—	Yellow

STATUS OF CONDITIONS 2017	LSS	SESS	IBAS
ECOSYSTEM HEALTH			
Hard coral cover Percentage of healthy hard coral cover (%)	Green	Blue	Green
Mangrove cover Coverage of mangrove cover within MPAs (ha)	Yellow	Yellow	Blue
Seagrass cover Coverage of seagrass cover within MPAs (ha)	Blue	Blue	Yellow
FISH AND FISHERIES			
Biomass of key fisheries species Biomass of key fisheries species (Lutjanidae, Haemulidae, and Serranidae)	Green	Green	Blue
Biomass of herbivorous fish Biomass of herbivorous fish (Siganidae, Scaridae, and Acanthuridae)	Green	Green	Yellow
Fishing pressure The 90th quantile of fish size in each MPA (cm)	Green	Yellow	Blue
CPUE Catch Per Unit Effort	—	—	—
GOVERNANCE			
Participation in decision making* Proportion of identified user groups who participate in establishing marine resource use rules within the MPA	Yellow	—	Green
Resource use rules* Number of rules associated to habitats and species	Green	—	Green
Conflict resolution* Time required to resolve conflict over local marine resource	Green	—	Yellow
User participation in monitoring and enforcement* Households that are member of organization in managing marine resources	Blue	—	Yellow

Blue: Above average/Optimal
Yellow: Average/Acceptable
Green: Below average/below optimal
—: No data

* Small sample size (5 MPAs)


Hawksbill turtles (*Eretmochelys imbricata*) are widely distributed on reefs in the SBS region.

KOON UNDERWATER

Yellow-tail fusiliers (*Caesio teres*) making their way across an *Acropora* spp. dominated reef on Koon Island, Central Moluccas.

Box 2. The development of an action plan on grouper and snapper fisheries management in Sumbawa, West Nusa Tenggara

Fish catch monitoring activity to obtain information on the status and stock of the fisheries in Saleh Bay
© WCS

Contributed by: Sukmaraharja A. Tarigan

West Nusa Tenggara province is one of the "top 10" provinces contributing to the national highest grouper and snapper fisheries production. On the ground, grouper and snapper fisheries are economically important for small scale fishermen. Given this, Directorate of Fish Resources – MMAF and Marine & Fisheries Agency – West Nusa Tenggara, in collaboration with Wildlife Conservation Society (WCS), initiated 'Grouper and snapper sustainable fisheries management program in West Nusa Tenggara. The objective of the program is to develop a document of strategic planning on grouper and snapper catch operation based on fisheries reference points. It was achieved through the following processes:

1. Identification of the characteristics of grouper and snapper fisheries.
2. Catch monitoring, which was done to obtain information on the status and stock of the fisheries.
3. Determining fisheries reference points to obtain information on the fish population that are required to manage the fisheries.
4. Public consultation at provincial and local levels.
5. Development of working group and action plan on grouper and snapper fisheries.

The document is now used to regulate the utilization of grouper and snapper fisheries, including activities in managing the fisheries in order to ensure the sustainability of fish resources.

Chapter 4

STATUS AND KEY DOMAIN INDICATORS

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STATUS AND TRENDS OF KEY DOMAINS AND INDICATORS

Enabling conditions

At subseascape level, MPAs in LSS performed best in providing favorable conditions to support MPA implementation. Most MPAs in LSS had above average or optimal status, especially in critical habitat protection within no-take zones (NTZs), management capacity and resources and clearly defined boundaries. MPA managers in SESS and IBAS need to optimize their marine spatial planning designs as well as promote formal establishment of MPAs to enhance enabling conditions that support better MPA management.

Indicator 1: Sufficient habitats in MPAs

Mangroves, seagrass and coral reefs play a significant role in coastal ecosystems, with these habitats ecologically connected by varying degrees. Coral reef fish often recruit into mangroves and seagrass beds to seek protection from predators and use these two coastal habitats as nursery grounds (Moberg and Folke, 1999, Nagelkerken et al. 2000, Mumby, et al. 2004). In order to maintain their ecological function and biological connectivity, approximately 20-30% of each of these coastal habitats should be included in an MPA (Green et al. 2009, McLeod et al. 2009, Krueck et al. 2017b).

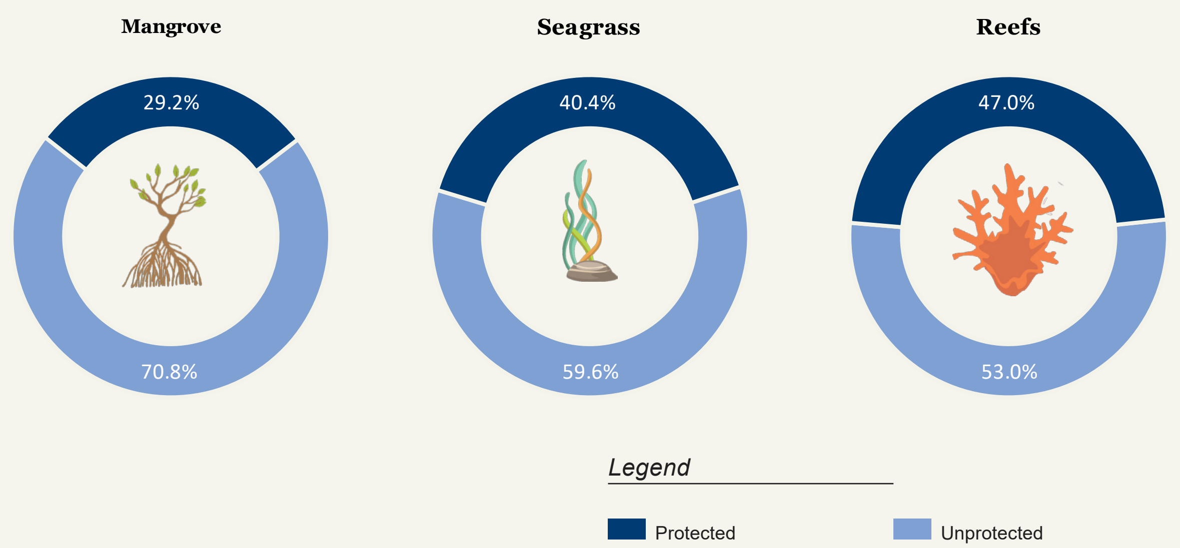


Figure 5. Proportion of protected and unprotected critical marine habitats within SBS by MPAs

Within the SBS boundary, coral reefs cover an area of 1,020,331 ha, while mangroves and seagrass only cover 191,827 ha and 75,657 ha respectively. In the SBS, 47% (479,580 ha) of coral reefs are already protected within MPAs. This is followed by seagrass, of which MPAs include 40.4% (30,535 ha). However, only 29.2% (56,007 ha) of mangrove habitat has been protected within MPAs (Fig. 5). Therefore, while mangroves meet the minimum 20% Indonesian protection target, we recommend that the areas of mangrove forest under effective management within the SBS MPA network should be increased. The coverage of mangroves, seagrass, and coral reefs in each MPA are listed in Table 9, Annex I.

Indicator 2: Spacing between MPAs within the MPA network

Connectivity between MPAs is important for both making sure that critical habitats and marine resources within a seascape have strong ecological resilience, and also for supporting food security (D'Agostini et al. 2015). Ecological connectivity is crucial in the establishment of an MPA network, particularly for supporting sustainable fisheries through fish migration and larval dispersal (Krueck et al.2017a). Ideally, the optimal distance between MPAs within an MPA network is approximately 10–100 km (UNEP-WCMC, 2008).

Most MPAs in the SBS are connected within 10–100 km (Fig. 6), although there are some 'blank' spots—coastal areas with no MPAs nearby—such as in Sula archipelago, Buru Island and Maluku Barat Daya archipelago. MPA connectivity was counted from 76 MPAs whose boundaries are already defined and are located within the three subseascapes. Overall, 23 MPAs had more than six other MPAs within 100 km, 32 had three to six MPAs within 100 km, and 21 only had two MPAs within 100 km (Fig. 6). For this indicator, the size of an MPA was not taken into account. Therefore, this calculation will be more important for smaller MPAs, which are more likely to rely on connectivity from outside their boundaries than larger MPAs.

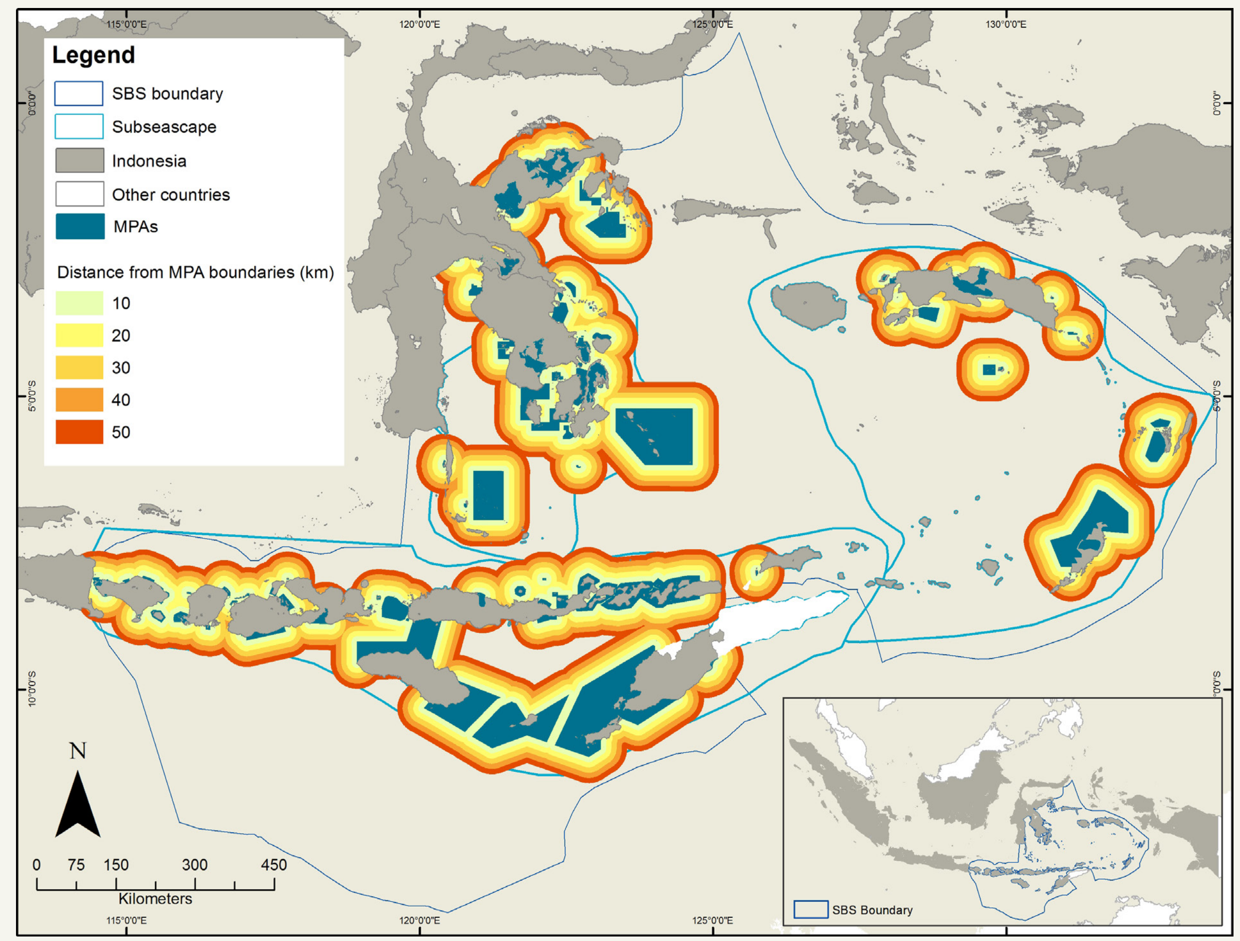


Figure 6. Distance between MPAs within the SBS region

Note: The distances between MPAs were measured from the edge of the boundary of each MPA in kilometer. The darker the color of the buffers, the further the distance from the MPA boundaries.

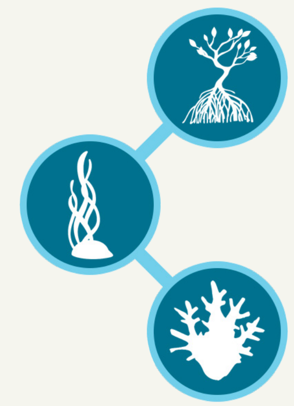
Indicator 3: Non-extractive critical habitats in MPAs

NTZs are an integral part of MPAs, in which no extractive activities are allowed. They have been widely used as tools for conservation and fisheries management (Halpern, 2003), and have been shown to increase fish abundance and biomass compared to those in take zones (TZs) in some parts of the world (Gill et al. 2017). NTZs can benefit their adjacent areas through spill-over (Ashworth and Ormond, 2005). The size of NTZs varies among MPAs. Based on MMAF regulation No. 30/2010, an NTZ must contain a minimum of 20% of critical habitats. However, if an NTZ covers 20-30% of the critical habitats, the MPA can help rebuild fisheries that might already be depleted due to overfishing (Krueck et al. 2017b).

Only 17 of the 85 MPAs within the SBS region had implemented NTZs in their management (Fig. 7). They include 10 MPAs in LSS (Bali Barat, Nusa Penida, Gili Matra, Gitanada, Gili Sulat and Lawang, Kabete, Gili Balu, Komodo, Laut Sawu and Selat Pantar), four MPAs in SESS (Wakatobi, Taka Bonerate, Lasolo and Padamarang), and three MPAs in IBAS (Kei Kecil, Laut Banda and Koon). It is critical to have a sufficient amount of critical habitats within NTZs to provide better opportunity for biodiversity conservation and increase, or at least maintain, catch (Krueck et al. 2017b). Overall, the proportion of critical habitats protected in NTZs ranged from 8.3 to 68.2% with an average of 29.1%. Koon had the smallest proportion of NTZs, while Komodo had the largest (Fig. 7). Within NTZs, mangroves are the least protected habitat compared to seagrass and coral reefs.

Figure 7. Percentage of three critical habitats (mangrove, seagrass, and coral reef) within no take zones (NTZ) and take zones (TZ) in 17 MPAs

Note: In this graph, no take zones (NTZs) mainly consist of a core zone, tourism zone, rehabilitation zone and protection zone. On the other hand, take zones (TZs) represent use zones, such as general use zone, commercial use zone, traditional use zone and harbor zone.

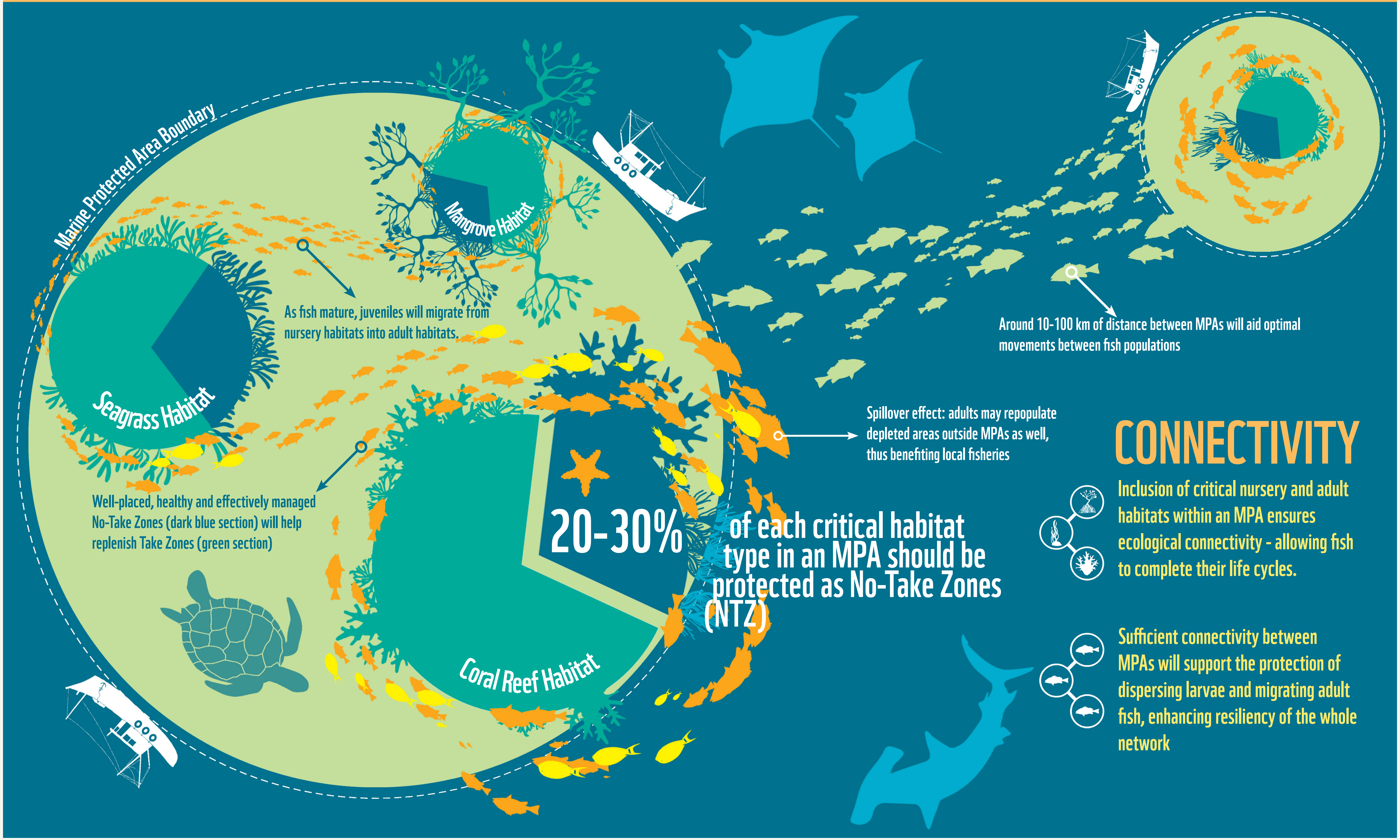


Protecting 20-30% of critical habitats in NTZs may help the recovery of depleted stocks

A mangrove nursery in Alor. Mangrove planting is intended to restore natural protection along coastlines and key habitats.

MULTI-USE MPAs AND FISH CONNECTIVITY:

IMPROVING ECOLOGICAL RESILIENCE AND FISHERIES BENEFITS IN AN MPA NETWORK



Indicator 4: Perceived threats to marine resources

This indicator represents the number of perceived threats identified by local communities living within MPAs. For this indicator, we calculated the average number of threats to marine resources identified by households at settlement and MPA levels. Overall, the threats could come not only from people living around MPAs, but also outsiders. It is *likely* (P=0.127) that the average number of threats to marine resources identified by locals at the five MPAs was different. The average number of identified threats in Kei Kecil (2.23) was higher than the average number at the SBS level (Fig. 8). In all MPAs, destructive fishing practices, such as blast fishing and the use of potassium cyanide, were the most common threats to marine resources identified by local communities, followed by trash and waste disposal (Fig. 9). Other types of threats identified include extraction of non-renewable marine resources (e.g. sand and coral mining), marine pollution, habitat destruction, natural processes, overfishing and other marine resource uses (e.g. tourism, aquaculture) (Mohebalian et al. 2016a, Mohebalian et al. 2016, Mohebalian et al. 2017). The number of perceived threats in an MPA is relative to local perception and awareness.

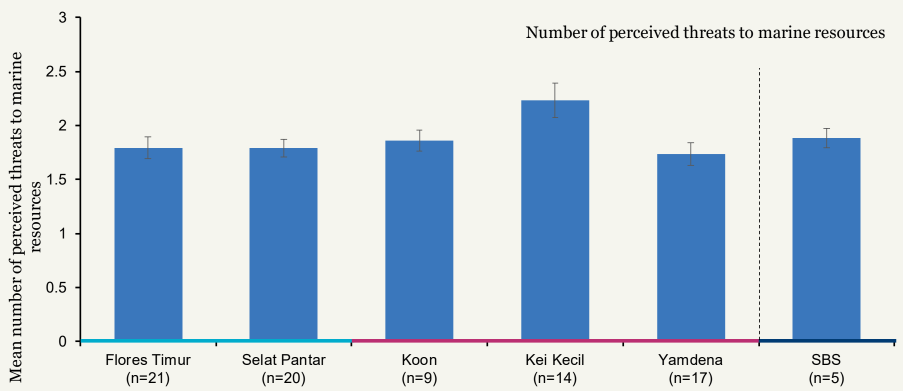


Figure 8. The average number of perceived threats to marine resources identified by local communities at each MPA

Note: Year of baseline monitoring at each MPA. Flores Timur: baseline 2014; Kei Kecil: baseline 2016; Koon: baseline 2016; Selat Pantar: baseline 2014; Yamdena: baseline 2017. At each MPA, n represents the number of settlements surveyed within the MPA boundaries. Colors in x-axis represent sub-seascape groups, i.e. LSS (blue), SESS (lime), IBAS (purple) and overall SBS level (indigo).

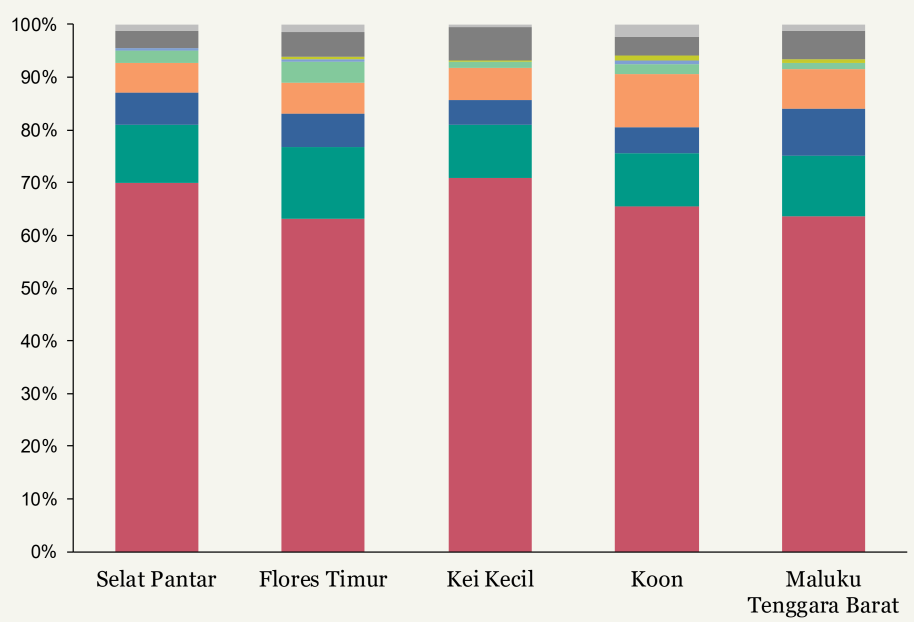


Figure 9. The percentage (%) of threat types to marine resources identified by local communities at each MPA

Box 3. Managing Household Waste in Labuan Bajo

Left: Making handicraft using recycled materials as part of an education for school aged children © WWF Indonesia. Right: Plastic bottle house that is used as education materials in Labuan Bajo © WWF Indonesia

Contributed by: M. Erdi Lazuardi, Kusnanto, Sus Yanti Kamil, Khaifin

Labuan Bajo, which is the entrance gate to the Komodo National Park World Heritage Site, produces 13 tons of household waste per day. This situation led to the establishment of the Komodo Waste Cooperative (KSU Sampah Komodo/KSK) in 2015 by local communities in Labuan Bajo, facilitated by WWF Indonesia.

KSK's activities include socialization and education, crafting of recycled products, waste collection service and waste trade activities. Currently there are 58 members that actively sort their waste; these members include hotels, tour operators, cruise ships, café and restaurants, shops, hospitals, schools, markets and government offices. KSK also encourages children to collect waste through the Waste Bank program. KSK also created 'plastic bottle houses' as education materials, placed in several areas throughout Labuan Bajo.

Since KSK started its operation, the level of waste received in Labuan Bajo's landfill has decreased. In three months, KSK has helped to manage and collect 29 tons of waste within three months, which means an average reduction of 9.7 tons of waste received by the landfill per month.

KSK's establishment has also triggered similar initiatives from other stakeholders. At the moment, there are five community groups in the Labuan Bajo area that shares the same concern. KSK has also become Komodo National Park's partner in collecting and managing waste from areas within the national park. In addition, KSK together with the other communities and the local government are actively involved in collaborative activities, such as beach clean-up events.

Indicator 5: Management capacity and resources

Management capacity and resources play a critical role in the effectiveness of MPA management in achieving conservation goals. MPAs with capable staff and strong financial support have higher ecological impact, particularly on fish populations, than those without (Gill et al. 2017). For this indicator, we calculated the number of indicators/questions in E-KKP3K evaluation forms associated with the management capacity and resources of MPAs (Table 14). These indicators/questions include those related to the facilities owned by the management authority of the MPAs, infrastructure and the skills and capacity of human resources.

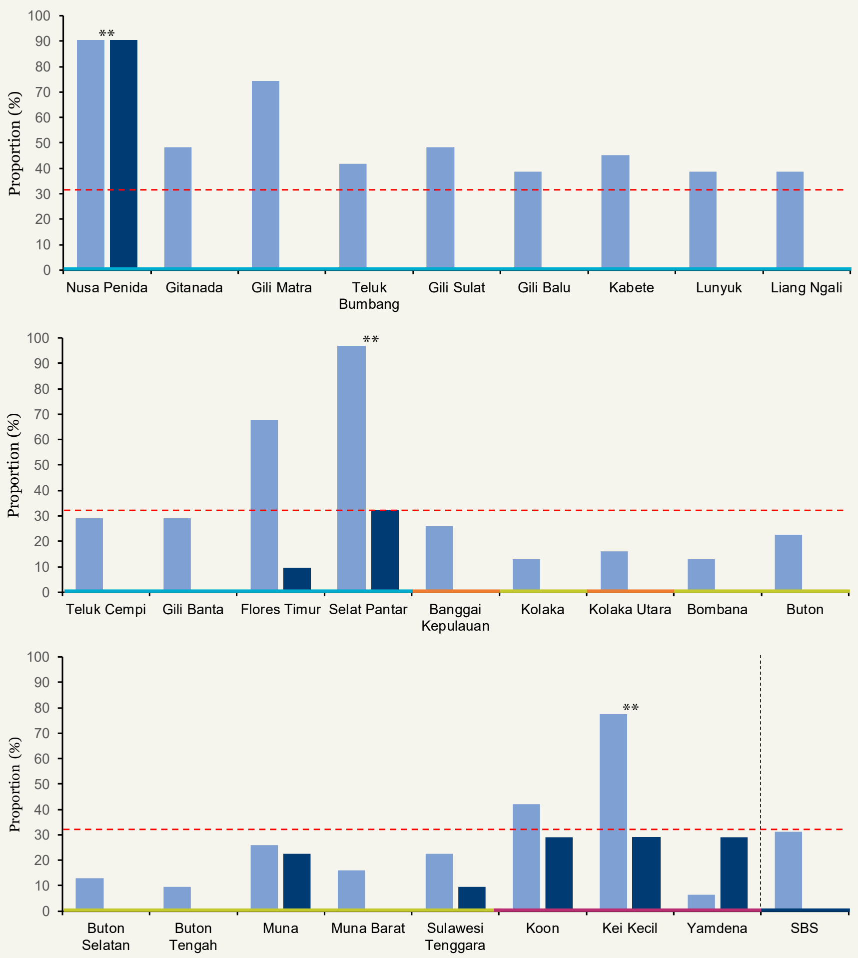


Figure 10. Level of management capacity and resources available (%) at 26 MPAs in the SBS region based on list of questions in the E-KKP3K evaluation forms

Note: Bars with asterisks represent MPAs that have been established, bars without asterisks represent MPAs that are already initiated. Year of baseline (first bar) and repeat (second bar) monitoring at each MPA. Nusa Penida, baseline 2015, repeat 2016; Gitanada, baseline 2017; Gili Matra, baseline 2017; Teluk Bumbang, baseline 2017; Gili Sulat & Lawang, baseline 2017; Gili Balu, baseline 2017; Kabete, baseline 2017; Lunyuk, baseline, 2017; Liang & Ngali, baseline 2017; Teluk Cempi, baseline 2017; Gili Banta, baseline 2017; Gili Banta, baseline 2017; Flores Timur, baseline 2016, repeat 2017; Selat Pantar, baseline 2016, repeat 2017; Banggai Kepulauan, baseline 2016; Kolaka, baseline 2015; Kolaka Utara, baseline 2015; Bombana, baseline 2015; Buton, baseline 2015; Buton Selatan, baseline 2015; Buton Tengah, baseline 2015; Muna, baseline 2015, repeat 2017; Muna Barat, baseline 2015; Sulawesi Tenggara, baseline 2016, repeat 2017; Koon, baseline 2016, repeat 2017; Kei Kecil, baseline 2016, repeat 2017; Yamdena, baseline 2016, repeat 2017. Colors in x-axis represent sub-seascape groups, i.e. LSS (blue), SESS (lime), IBAS (purple), overall SBS level (indigo) and outside SBS (orange).

Overall, the average proportion of fulfilled management capacity and resources-related indicators in E-KKP3K among all MPAs varied between 9.7 and 90.3% (mean ± SE : 31.3 ± 3.8) (Fig. 10). This suggests that there is still a lack of management capacity in the MPAs. This is likely related to the fact that most MPAs in the SBS region were recently initiated and established. The highest management capacity occurred in Nusa Penida at 90.3%. Conversely, the lowest occurred in three MPAs (Buton Tengah, Flores Timur, and Sulawesi Tenggara) with only 9.7%. The proportion of fulfilled management capacity in several MPAs decreased though time, likely related to the lack of human capacity following the change of management authority from local government to provincial government.

Indicator 6: Clearly defined boundaries

This indicator implies a spatially designated area with agreed and legislated borders (Day et al. 2012). An MPA needs to be geographically defined in order to ensure the enforcement of regulations within. The designation of MPA boundaries have a critical effect on success or failure. For this indicator, we evaluated questions in E-KKP3K evaluation forms that are associated with the zoning and management plans of MPAs (Table 10). Overall, we found that the indicator varied among MPAs from 12.5 to 100% (49 ± 5.8) (Fig. 11). Several MPAs already have clearly defined boundaries, including Gili Matra, Kei Kecil and Selat Pantar, for which the zoning and management plans have been established and legalized. Bombana, Kolaka Utara, Muna Barat and Teluk Cempi ranked the lowest with only 12.5%. These MPAs still have no clearly defined boundaries or zonation.

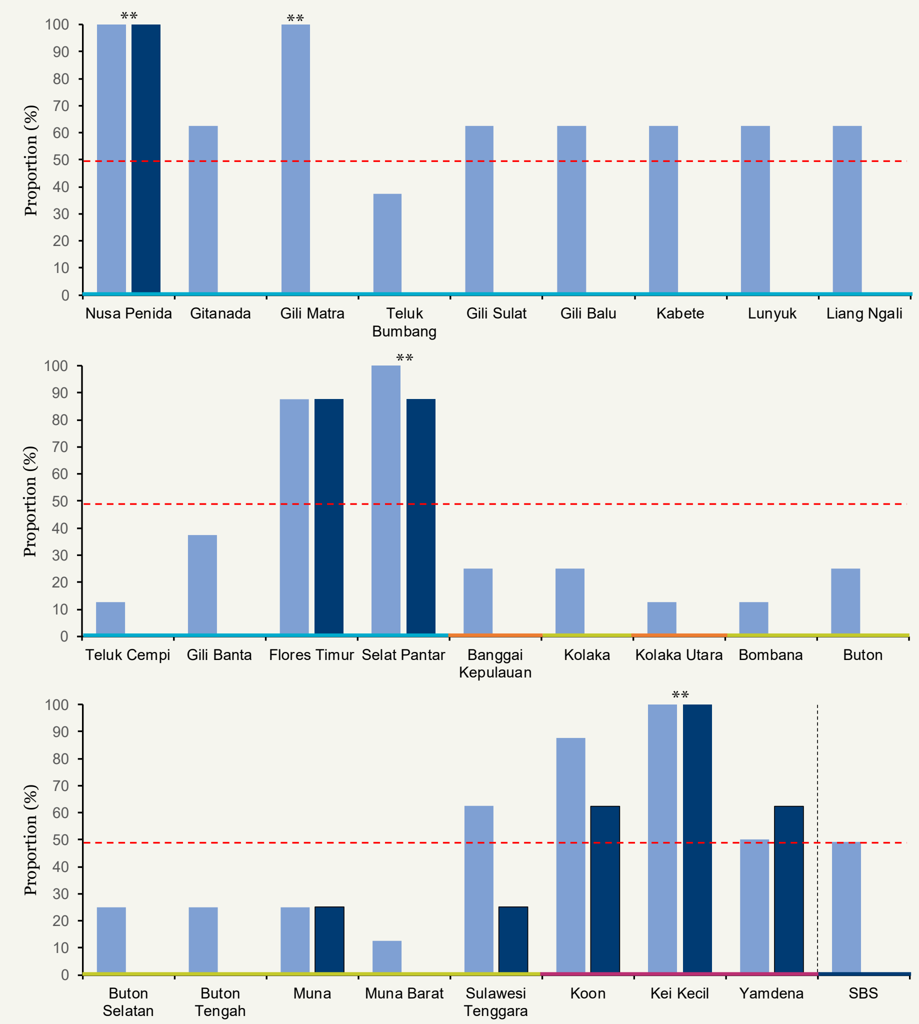


Figure 11. Level of clearly defined boundaries (%) of 26 MPAs in the SBS region based on list of questions in the E-KKP3K reports

Note: Bars with asterisks represent MPAs that have been established, bars without represent MPAs that are already initiated. Year of baseline (first bar) and repeat (second bar) monitoring at each MPA. Nusa Penida, baseline 2015, repeat 2016; Gitanada, baseline 2017; Gili Matra, baseline 2017; Teluk Bumbang, baseline 2017; Gili Sulat & Lawang, baseline 2017; Gili Balu, baseline 2017; Kabete, baseline 2017; Lunyuk, baseline, 2017; Liang & Ngali, baseline 2017; Teluk Cempi, baseline 2017; Gili Banta, baseline 2017; Gili Banta, baseline 2017; Flores Timur, baseline 2016, repeat 2017; Selat Pantar, baseline 2016, repeat 2017; Banggai Kepulauan, baseline 2016; Kolaka, baseline 2015; Kolaka Utara, baseline 2015; Bombana, baseline 2015; Buton, baseline 2015; Buton Selatan, baseline 2015; Buton Tengah, baseline 2015; Muna, baseline 2015, repeat 2017; Muna Barat, baseline 2015; Sulawesi Tenggara, baseline 2016, repeat 2017; Koon, baseline 2016, repeat 2017; Kei Kecil, baseline 2016, repeat 2017; Yamdena, baseline 2016, repeat 2017. Colors in x-axis represent sub-seascape groups, i.e. LSS (blue), SESS (lime), IBAS (purple), overall SBS level (indigo) and outside SBS (orange).

Human well-being

Surveys on human well-being were only conducted in five MPAs in LSS and IBAS. At subseascape level, neither LSS or IBAS were different overall. LSS had a higher than average marine tenure index while IBAS performed better in school enrollment rate. Moving forward, it is important for MPA managers in LSS to increase the performance in economic well-being, education and culture indicators, and MPA managers in IBAS to increase performance in health and political empowerment indicators

Indicator 7: Economic well-being

The economic well-being indicator is a measure of the material assets owned by households in each MPA. Management in the MPA may affect household income, therefore it may cause changes in the consumption and purchasing patterns of local communities, especially of material assets. The material assets consist of the following items: radio/stereo/CD player/DVD player, TV, satellite dish, phone (mobile or landline), generator, boat without a motor, boat with outboard motor, boat with inboard motor, bicycle, motorcycle and car/truck (Glew et al. 2012). These assets were weighted based on their price/value. For example, a motorcycle costs more than a TV or radio, therefore it ranked higher.

Overall, it is *virtually certain* (P<0.001) that the average household material assets varied significantly across the SBS region, with an average of 26.1. Kei Kecil scored highest with 32.1, while Selat Pantar ranked lowest with only 18.5 (Fig. 12). In short, local communities in Kei Kecil, Koon and Flores Timur can buy or acquire more material assets in terms of quantity and/or value than local communities in Yamdena and Selat Pantar.

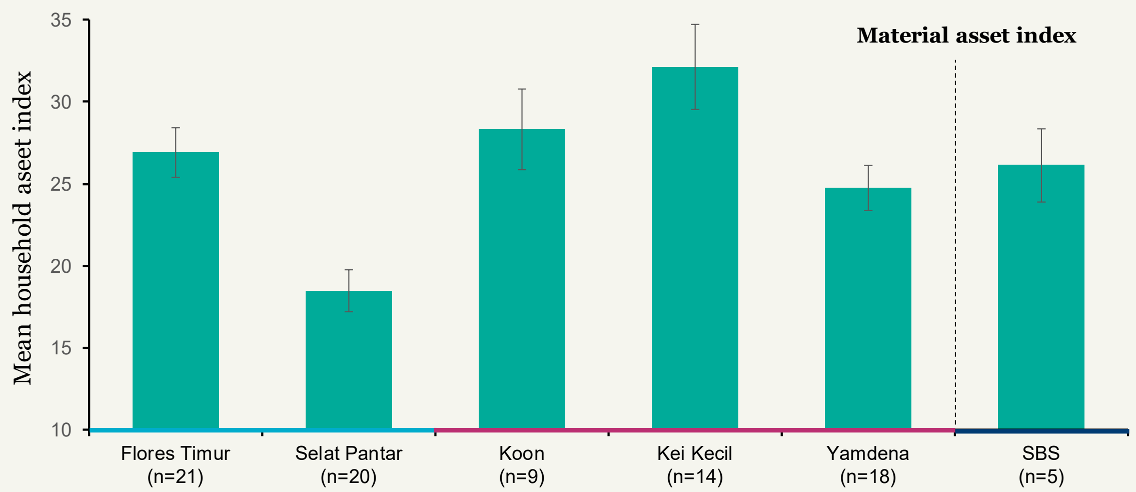
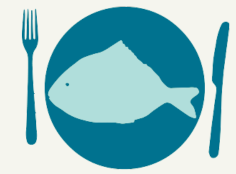


Figure 12. Average household material asset index at each MPA

Note: Year of baseline monitoring at each MPA. Flores Timur: baseline 2014; Kei Kecil: baseline 2016; Koon: baseline 2016; Selat Pantar: baseline 2014; Yamdena: baseline 2017. At each MPA, n represents the number of settlements surveyed within the MPA boundaries. Colors in x-axis represent sub-seascape groups, i.e. LSS (blue), SESS (lime), IBAS (purple) and overall SBS level (indigo).

Indicator 8: Health



For this indicator, we calculated the food security index as a proxy of the health of communities, representing people's ability to access sufficient food that is adequate nutritionally and acceptable socially (Bickel et al. 2000). MPA management may contribute to increases in fish biomass and catch, therefore reducing the likelihood of food insecurity (Glew et al. 2012). The level of food security is strongly linked with health conditions of individuals. People with food insecurity are more likely to suffer from illness. The results of the baseline monitoring suggest that it is *virtually certain* (P<0.001) that the average household food security varied significantly across the SBS region (Fig. 13). Overall, the average food security score fell into the category of 'food insecure without hunger' (3.09), meaning that local communities across all settlements had some concerns about the adequacy of their food supply, and adjusted their food management practices accordingly. These adjustments could be changes in portion size or food source. Among the five MPAs, Flores Timur's food security score was highest and is considered 'food secure' (4.17), meaning households on average had the ability to access enough food for active, healthy lives.

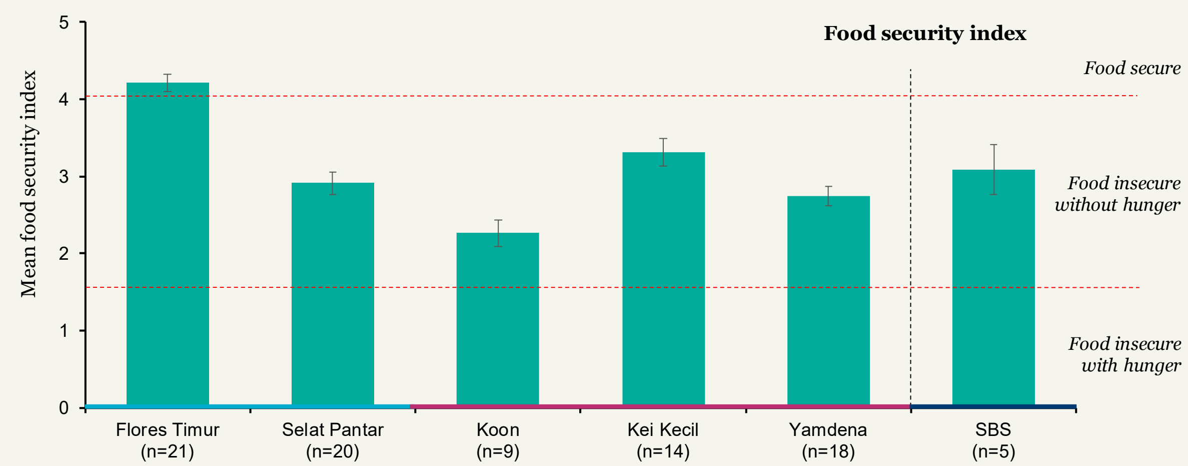


Figure 13. Average food security index at each MPA

Note: Year of baseline monitoring at each MPA. Flores Timur, baseline 2014; Kei Kecil, baseline 2016; Koon, baseline 2016; Selat Pantar, baseline 2014; Yamdena, baseline 2017. At each MPA, n represents the number of settlements surveyed within the MPA boundaries. Colors in x-axis represent sub-seascape groups, i.e. LSS (blue), SESS (lime), IBAS (purple) and overall SBS level (indigo).

Food security varied across the Seascape with most local communities in the 'food insecure without hunger' category

Indicator 9: Political empowerment

We measured the political empowerment indicator using a marine tenure index (Glew et al. 2012). Marine tenure plays a critical role for coastal communities in managing marine resources. It represents the extent to which local communities have control over the resources upon which they depend. Under marine tenure, access to inshore marine resources is often managed by social rules established by various levels in the communities like individuals, families, and village (Cinner, 2005). In this case, MPA establishment may restructure rights to marine resources, empowering or disempowering users depending on the MPA and pre-existing right structures (Glew et al. 2012).

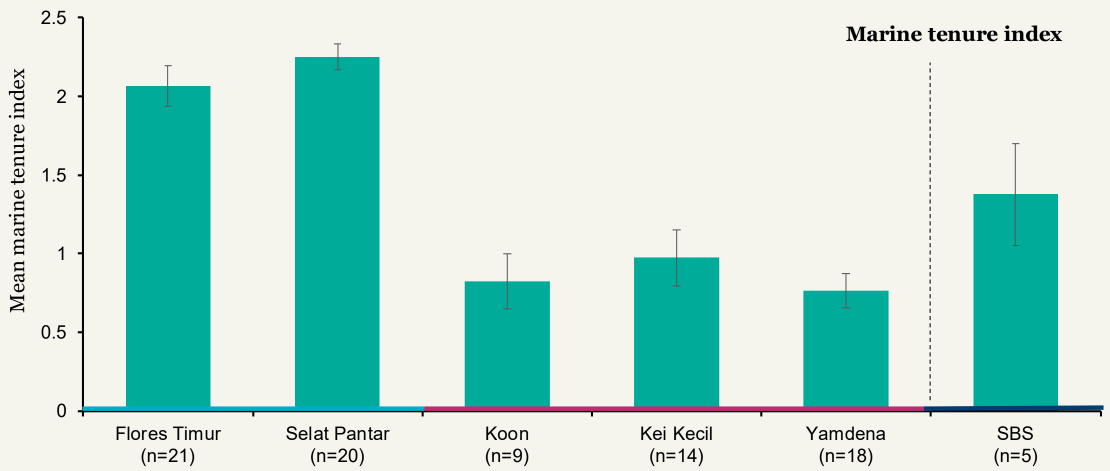


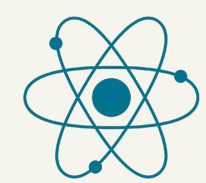
Figure 14. Average marine tenure index at each MPA

Note: Year of baseline monitoring at each MPA. Flores Timur, baseline 2014; Kei Kecil, baseline 2016; Koon, baseline 2016; Selat Pantar, baseline 2014; Yamdena, baseline 2017. At each MPA, n represents the number of settlements surveyed within the MPA boundaries. Colors in x-axis represent sub-seascape groups, i.e. LSS (blue), SESS (lime), IBAS (purple) and overall SBS level (indigo).

Overall, results of the baseline monitoring suggest that it is *virtually certain* (P<0.001) that the average marine tenure index significantly varied across the SBS region, with an average of 1.38 (Fig. 14). Yamdena ranked the lowest at 0.76, compared to Selat Pantar's 2.25. In general, local communities in IBAS, represented by Koon, Kei Kecil and Yamdena, had less control over their marine resources compared to local communities in LSS (Flores Timur and Selat Pantar). This is likely related to the social and cultural characteristics of Maluku Province, where the rules associated with marine resource use are often made by the community or village leaders or king, rather than collectively by community members.

Community, social and cultural characteristics affect the level of collective control over marine resources

Indicator 10: Education



The education indicator was measured using the proportion of school-aged children (5–18 years old) enrolled formally in school for each household across each settlement in each MPA. School enrollment is likely affected by families' wealth in communities through a direct factor (e.g. employment) or indirect factor (e.g. increased fish catch), which are linked to MPA establishment (Glew et al. 2012). It is *extremely likely* (P=0.037) that the average school enrollment rate varied significantly across the five MPAs.

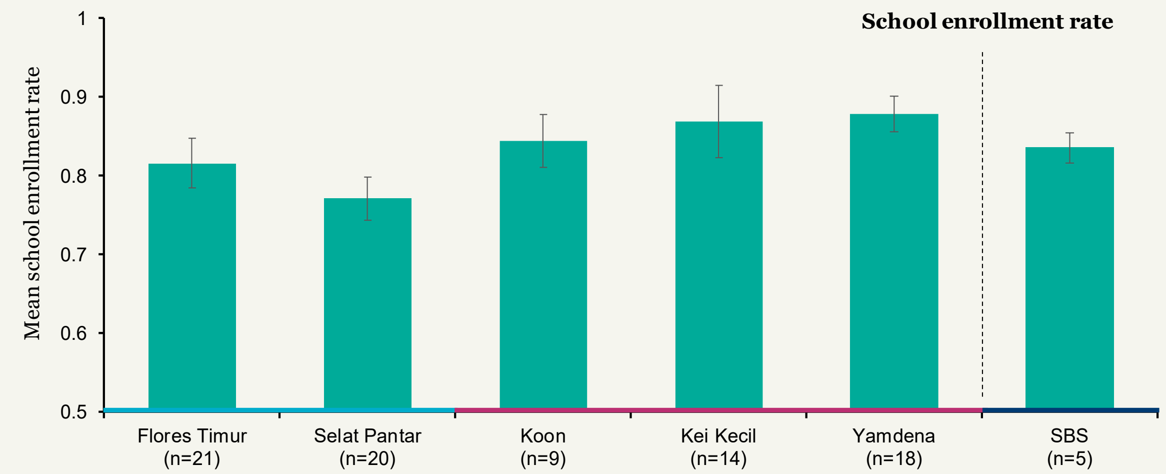


Figure 15. Average proportion of school aged children (5-18 years old) enrolled in school at each MPA

Note: Year of baseline monitoring at each MPA. Flores Timur, baseline 2014; Kei Kecil, baseline 2016; Koon, baseline 2016; Selat Pantar, baseline 2014; Yamdena, baseline 2017. At each MPA, n represents the number of settlements surveyed within the MPA boundaries. Colors in x-axis represent sub-seascape groups, i.e. LSS (blue), SESS (lime), IBAS (purple) and overall SBS level (indigo).

Overall, the results of the baseline monitoring suggest that the average proportion of school enrollment rate in all MPAs was 0.84, which means 84% of school aged children in SBS were enrolled in formal schools (Fig. 15). The high rate of school enrollment indicates that the majority of school aged children regularly attended local education facilities, including primary and secondary schools. Yamdena had the highest school enrollment rate (0.88), while the rate in Selat Pantar was the lowest (0.77). In one of the villages in Yamdena, children were forced to go to school; with a fine applied if they failed to attend (*pers. comm.*). School enrollment rates in Maluku were higher than those in Nusa Tenggara Timur Province, where Flores Timur and Selat Pantar MPAs are located, which means a greater proportion of children in Maluku were enrolled in schools.

MPAs may affect school enrollment via indirect mechanisms, as fish abundance and ecosystem health may influence the families' incomes

Indicator 11: Culture

Place attachment index measures the emotional connection between individuals and their environment (Williams and Vaske, 2003). MPA establishment may either create an alienation or attachment effect (Glew et al. 2012). In this report, household members were asked about the emotional connection with their local fishing grounds in MPAs. It is *virtually certain* (P<0.001) that the average place attachment index varied significantly across the SBS region. The averages in Flores Timur and Koon were among the highest of all MPAs with 4.83 and 4.73 respectively, while Selat Pantar ranked the lowest with 3.93 (Fig. 16).

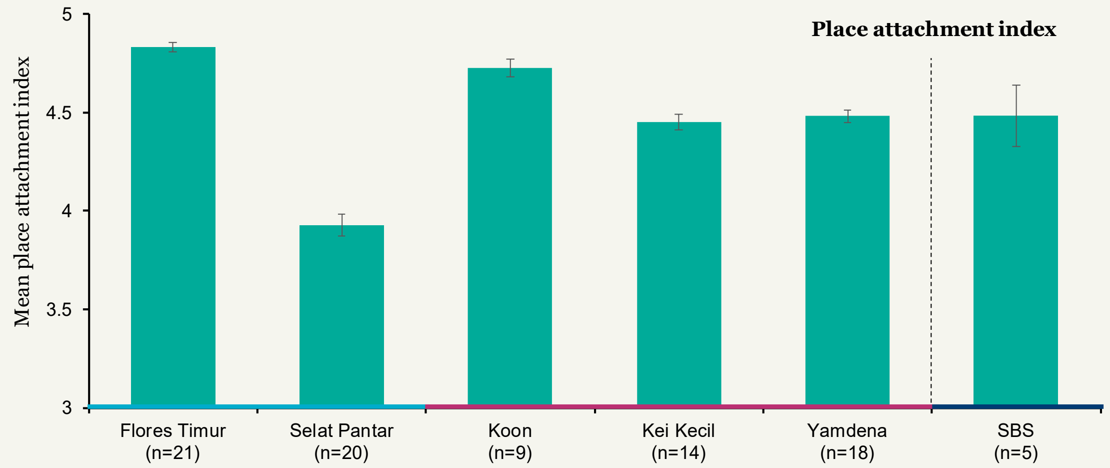
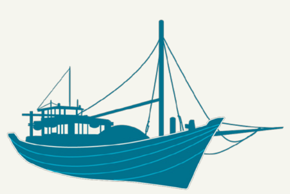


Figure 16. Average place attachment index at each MPA

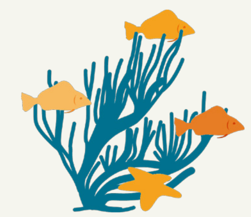
Note: Year of baseline monitoring at each MPA. Flores Timur, baseline 2014; Kei Kecil, baseline 2016; Koon, baseline 2016; Selat Pantar, baseline 2014; Yamdena, baseline 2017. At each MPA, n represents the number of settlements surveyed within the MPA boundaries. Colors in x-axis represent sub-seascape groups, i.e. LSS (blue), SESS (lime), IBAS (purple) and overall SBS level (indigo).

Overall, place attachment across all five MPAs was high (4.48 of 5.00), likely linked closely to the dependency of locals on their fishing grounds. Consequently, they are not only more vulnerable to changes in their fishing grounds, but also likely to receive more benefits from the enforcement of an MPA zoning system (Mohebalian et al. 2016a).



A strong connection between individuals and their environment was common in local communities across the MPAs monitored

Ecosystem health



SESS had a higher than average score in percentage of hard corals and seagrass cover within MPAs, while LSS had higher mangrove and seagrass cover. Ensuring adequate protection, approximately 20-30% of each of marine critical ecosystem, as well as maintaining healthy ecosystem conditions, are equally important to maintain marine ecological function and biological connectivity between coastal habitats (Moberg and Folke, 1999, Nagelkerken et al. 2000, Mumby et al. 2004). For future management measures, this emphasizes the need to increase the protection of mangroves in SESS through establishment of MPAs and/or mangrove restoration within MPAs and to increase healthy coral cover in LSS and IBAS by reducing threats to coral reefs and strengthening law enforcement.

Indicator 12: Hard coral cover

A researcher collecting data above staghorn corals (*Acropora*) on a Southeast Sulawesi reef.

An increase in hard coral cover may indicate a decrease in threats to reefs (Ahmadia et al. 2013). It is *virtually certain* (P<0.001) that the healthy hard coral cover among MPAs in the SBS region varied significantly among MPAs (Fig. 17). Overall, the average healthy hard coral cover in SBS was 35.9%, with the highest coral cover observed in Gili Balu (53.4%) and the lowest in Gili Matra (9.8%) during the latest year of monitoring. Of the five MPAs with repeat monitoring, there were no significant changes in hard coral cover, although the results were variable among MPAs. It is *about as likely as not* that the hard coral cover changed in Flores Timur (P=0.371), Nusa Penida (P=0.504) and Wakatobi (P=0.421). Moreover, the average hard coral cover in Selat Pantar has *unlikely* (P=0.749) changed over the monitoring period. In Gili Matra, it is *extremely likely* (P=0.012) that the average hard coral cover decreased over the monitoring period.

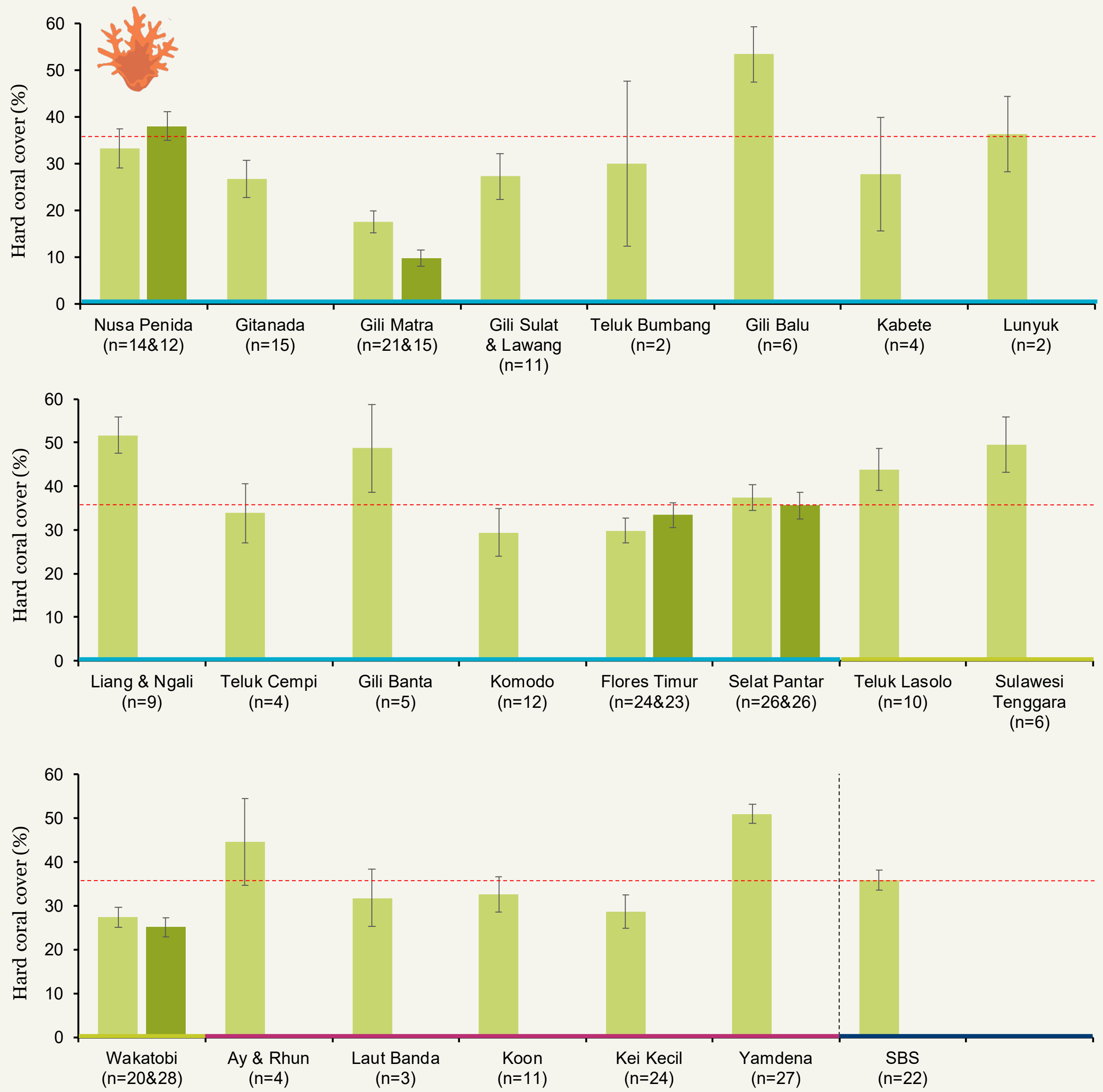


Figure 17. Percentage of coral cover in MPAs at baseline and repeat monitoring

Note: Year of baseline and repeat monitoring at each MPA. Nusa Penida, baseline 2016, repeat 2017; Gitanada, baseline 2013; Gili Matra, baseline 2012, repeat 2016; Gili Sulat & Lawang, baseline 2013; Teluk Bumbang, baseline 2013; Gili Balu, baseline 2014; Kabete, baseline 2014; Lunyuk, baseline 2014; Liang & Ngali, baseline 2014; Teluk Cempi, baseline 2015; Gili Banta, baseline 2015; Komodo, baseline 2016; Flores Timur, baseline 2014, repeat 2017; Selat Pantar, baseline 2014, repeat 2017; Teluk Lasolo, baseline 2016; Sulawesi Tenggara, baseline 2016; Wakatobi, baseline 2012, repeat 2016; Ay & Rhun, baseline 2017; Laut Banda, baseline 2017; Koon, baseline 2014; Kei Kecil, baseline 2015; Yamdena, baseline 2014. n represents the number of sites monitored within each MPA during the year of monitoring. Red horizontal dashed line represent the average at SBS level. The average percentage of coral cover at SBS level was calculated based on the most current monitoring data. Colors in x-axis represent sub-seascape groups, i.e. LSS (blue), SESS (lime), IBAS (purple) and overall SBS level (indigo).

Indicator 13: Mangrove cover

Indonesia has the largest mangrove forest in Southeast Asia with approximately 3.6 million ha (BIG 2016). It also has the greatest species diversity, with at least 48 of 52 known mangrove species found (Giesen et al. 2007). Within the SBS region, a total of 47 mangrove species were recorded in several studies (Estradivari et al. 2015). With regard to mangrove coverage, based on 2016 spatial data from Geospatial Information Agency (BIG), mangrove forest in the SBS region covers a total area of approximately 191,827 ha, representing 5% of total mangrove cover in Indonesia. Of this amount, 29.2% of the mangrove forests in SBS are protected within MPAs. In SBS, relatively vast areas of mangrove forests mostly occur in the Tanimbar Islands, Southeast Sulawesi and Nusa Tenggara, including Komodo Islands, Selat Pantar, Flores Timur and Rote (Fig. 18).

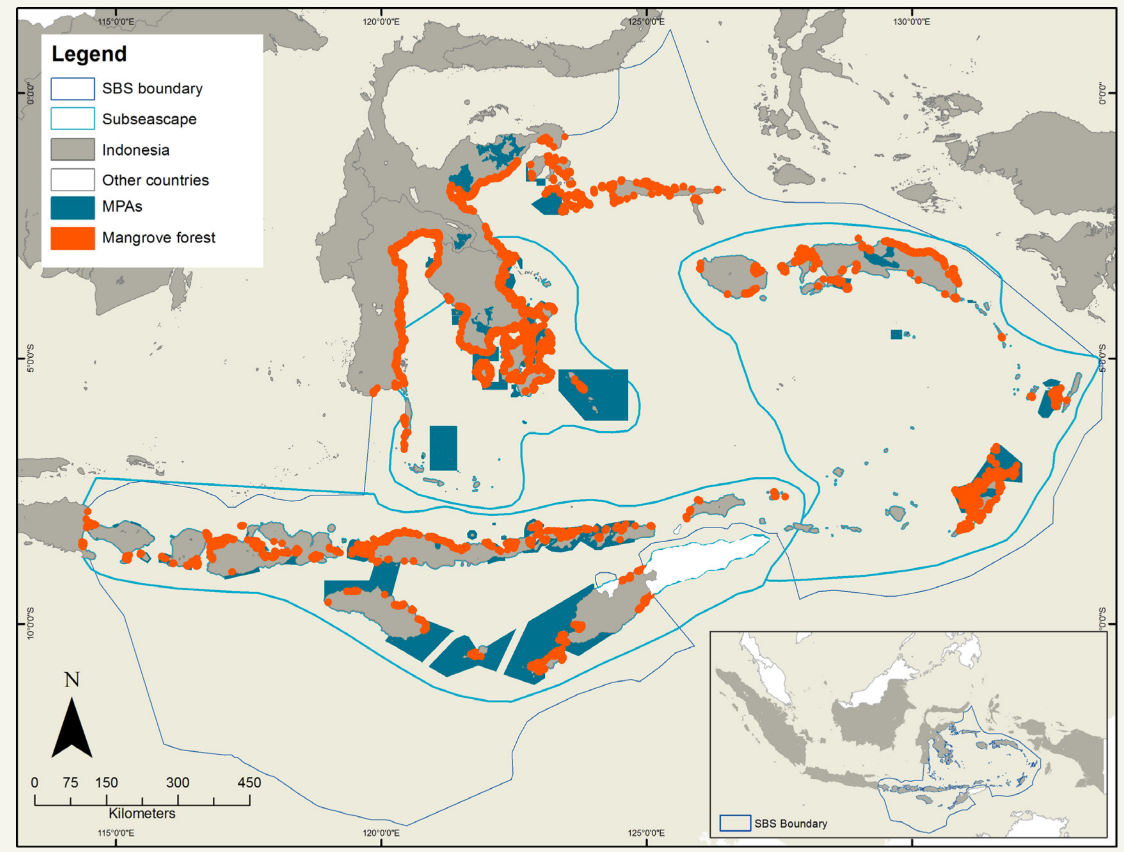


Figure 18. Mangrove cover across the SBS region

Note: Mangrove cover data were gathered from MoEF 2016 data. The areas of mangrove cover are buffered to make them appear larger so visible.

The changes in mangrove cover between 2014 and 2016 were measured using spatial mangrove data from MoEF. The total area of protected mangroves is affected by both changes in mangrove cover within MPAs, and the designation of new MPAs, which adds new areas of mangrove to protected areas. Analysis was restricted to MPAs established before or during 2014 to allow the changes in mangrove extent within MPAs to be assessed independently of newly designated MPAs that increased the overall protected mangrove area. At the subseascape level, the percentage change in mangrove extent within MPAs between 2014 and 2016 was: 18.1% in LSS, 0.3% in IBAS, and 0.2% in SESS. Overall mangrove cover within most provinces within SBS also unfortunately declined significantly (not shown in graph) between 2014 and 2016.

At the provincial level, Nusa Tenggara Barat showed the greatest loss of mangrove habitat within MPAs (-15.7%), with large areas also lost from Bali and Sulawesi Tenggara. In contrast, the mangrove cover in Nusa Tenggara Timur MPAs increased by 45.4%. The main reason for mangrove degradation is linked to mangrove conversion for aquaculture and other coastal development. Provincial governments need to prioritize mangrove forest protection within existing MPAs to prevent further loss.

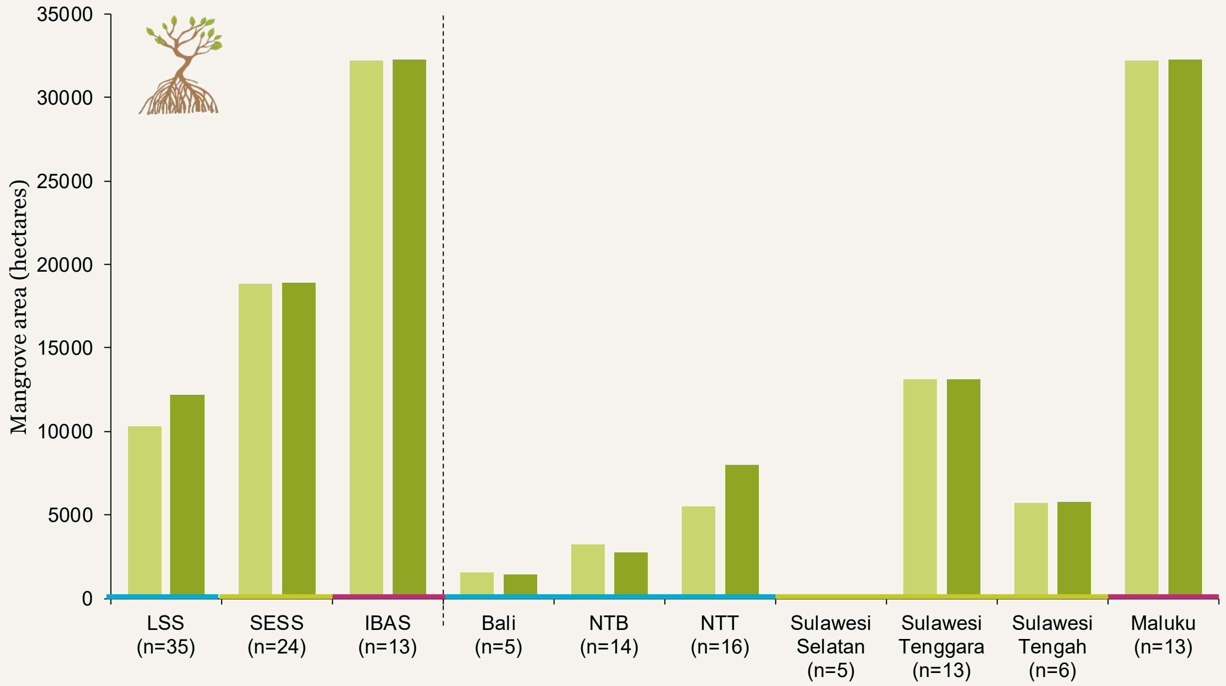
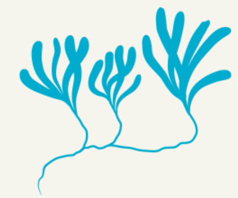


Figure 19. Area of mangrove cover (hectares) in 2014 (first bars) and 2016 (second bars) in MPAs that were established during or before 2014 at three subseascapes and seven provinces.

Note: The data were generated from MoEF 2016 mangrove data. Numbers in the subseascape and province names represent the number of MPAs that have been initiated and/or established before 2014. Only MPAs that were established during or before 2014 are included, to allow changes in mangrove area within MPAs to between 2014 to 2016 to be measured without the effects of new MPAs confounding these results. Between 2014 – 2016 many new MPAs were established in the SBS, increasing the total area of mangrove under protection. Colors in x-axis represent sub-seascape groups, i.e. LSS (blue), SESS (lime), IBAS (purple) and overall SBS level (indigo).

Substantial declines of mangrove cover occurred in the SBS between 2014 and 2016, with the greatest losses suffered by Nusa Tenggara Barat MPAs

Indicator 14: Seagrass cover



Seagrass beds in Indonesia cover an extensive area of 150,693 ha and are predominantly located in eastern Indonesia (Hernawan et al. 2017). Based on spatial data from BIG, seagrass beds in SBS cover an area of approximately 75,657 ha with 40.4% protected within MPAs. Most of these seagrass beds occur in Nusa Tenggara, including Lombok, Komodo Islands, Flores Timur, Selat Pantar and Rote as well as Wakatobi Islands, Tanimbar Islands and Kei Kecil (Fig. 20). There are 12 species of seagrass found in Indonesia, of which 12 species can be found in the SBS region (Kuo, 2007; Estradivari et al. 2015, Hernawan et al. 2017).

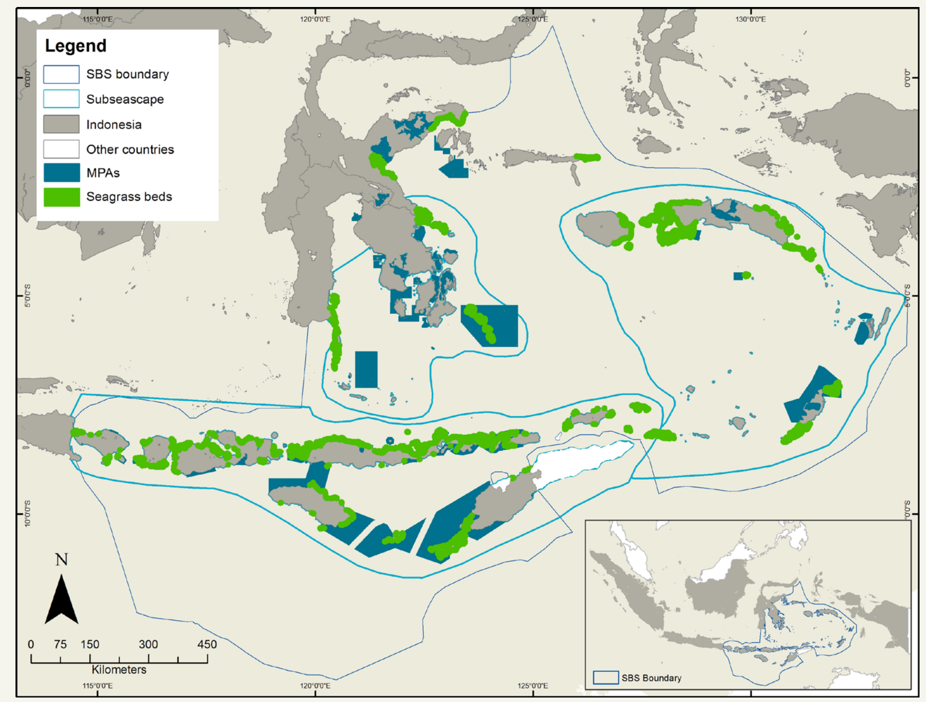


Figure 20. Seagrass cover across the SBS region

Note: Seagrass cover data were generated from One Map Policy published in 2016 by the Indonesian Spatial Information Agency (BIG). The areas of seagrass cover are buffered to make them appear larger so visible.

Among the three subseascapes, only LSS and SESS have protected more than 30% of their seagrass ecosystems in MPAs (Fig. 21). Seagrass protection in IBAS was slightly above 20%. Among the seven provinces, only Sulawesi Tenggara has protected 100% of its seagrass beds in MPAs. The other province nearly reaching the minimum target of 30% was Nusa Tenggara Timur. Sulawesi Selatan, Sulawesi Tengah and Maluku are still far from this goal.

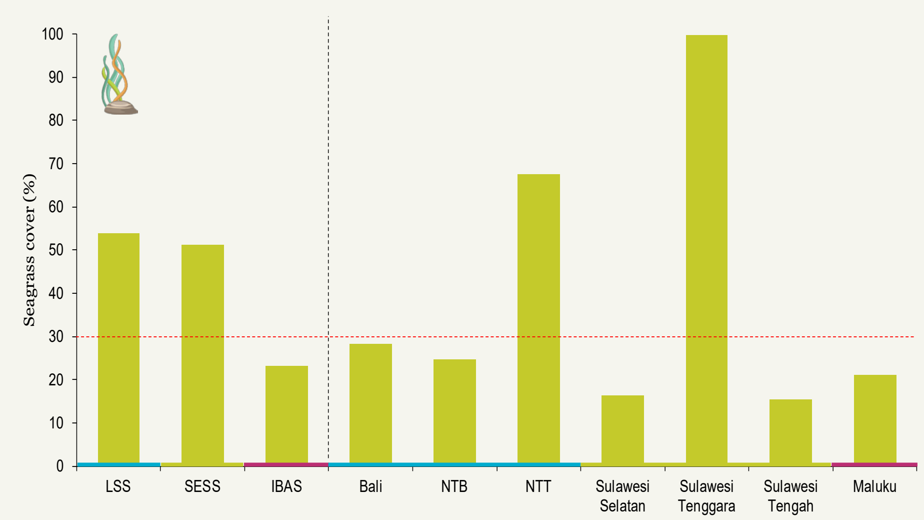
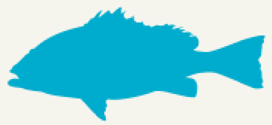


Figure 21. Percentage of seagrass cover (%) in MPAs in three subseascapes and seven provinces

Note: A red dashed line is the target set by the Indonesian government for protecting seagrass cover (30%). Colors in x-axis represent sub-seascape groups, i.e. LSS (blue), SESS (lime), IBAS (purple) and overall SBS level (indigo).

Fish and fisheries



For the fish and fisheries domain, IBAS had the best baseline condition noted by higher than average biomass of key fisheries species and a higher 90th quantile of fish size. Lower than average scores on all fish and fisheries indicators in LSS suggest that future improvement in MPA management is crucial and urgent to restore the fish condition in the subseascape, which can thereby support fisheries in the region.

Indicator 15: Biomass of key fisheries species

A school of bluestripe snappers (*Lutjanus kasmira*) on the reef.

Key fisheries species consist of fishes from families Lutjanidae (snappers), Haemulidae (sweetlips), and Serranidae (groupers). These fishes are important and targeted by subsistence, artisanal or commercial fishers (Ahmadia et al. 2013). It is *virtually certain* (P<0.001) that the biomass of key fisheries species among MPAs in the SBS region varied significantly. In general, the average biomass of key fisheries species was 68.8 kg/ha (Fig. 22). At MPA level, fish biomass in Koon during baseline monitoring ranked the highest of all MPAs with 462.4 kg/ha; Lutjanidae ranked the highest of the six families (272.2 kg/ha). It is believed there may be two fish spawning aggregation sites (SPAGs) in Koon with very high fish biomass (Mous, 2011). Koon and Wakatobi are the only MPAs in the SBS region that had SPAGs already identified and protected.

Fish spawning aggregation sites have been identified in Koon and Wakatobi within the SBS

Looking specifically at MPA level trends, it is *virtually certain* (P=0.003) that the average key fisheries species biomass in Wakatobi increased dramatically from 75.1 kg/ha to 185.7 kg/ha within four years. Of the 23 MPAs, only Flores Timur, Wakatobi, Kei Kecil, Ay and Rhun, Koon and Yamdena had a higher average biomass of key fisheries species than the average at seascape level. It is *very likely* and *about as likely as not* that the average biomass of key fisheries species in Flores Timur (0.046) and Selat Pantar (P=0543) changed over the monitoring period. In Gili Matra, it is *likely* (P=0.123) that the average biomass decreased over the period of monitoring.

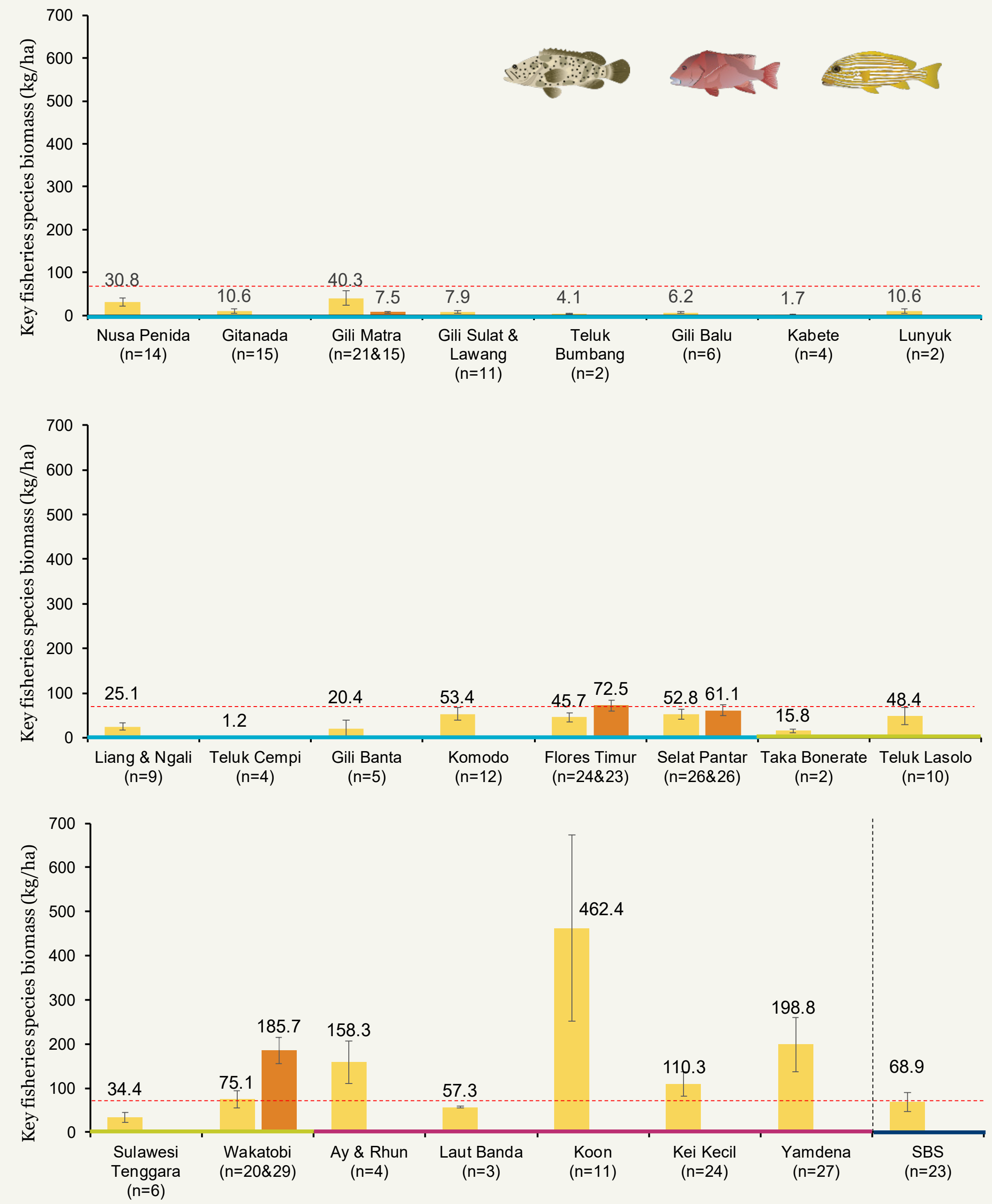
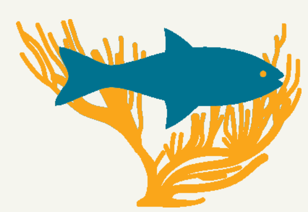


Figure 22. Biomass of key fisheries species (kg/ha) in the SBS MPAs at baseline and repeat monitoring

Note: Year of baseline and repeat monitoring at each MPA. Nusa Penida, baseline 2016, repeat 2017; Gitanada, baseline 2013; Gili Matra, baseline 2012, repeat 2016; Gili Sulat & Lawang, baseline 2013; Teluk Bumbang, baseline 2013; Gili Balu, baseline 2014; Kabete, baseline 2014; Lunyuk, baseline 2014; Liang & Ngali, baseline 2014; Teluk Cempi, baseline 2015; Gili Banta, baseline 2015; Komodo, baseline 2016; Flores Timur, baseline 2014, repeat 2017; Selat Pantar, baseline 2014, repeat 2017; Teluk Lasolo, baseline 2016; Sulawesi Tenggara, baseline 2016; Wakatobi, baseline 2012, repeat 2016; Ay & Rhun, baseline 2017; Laut Banda, baseline 2017; Koon, baseline 2014; Kei Kecil, baseline 2015; Yamdena, baseline 2014 n represents the number of sites monitored within each MPA during the year of monitoring. A red horizontal dashed line represents the average at SBS level. The average fish biomass at the SBS level was calculated based on the most current monitoring data. Colors in x-axis represent sub-seascape groups, i.e. LSS (blue), SESS (lime), IBAS (purple) and overall SBS level (indigo).



Biomass of key fisheries species more than doubled in the Wakatobi Marine National Park over four years

Indicator 16: Biomass of herbivorous fish

Herbivorous fish consists of fishes from families Acanthuridae (surgeonfish), Siganidae (rabbitfish), and Scaridae (parrotfish). These fishes are ecologically important to maintain coral reef resilience (Ahmadia et al. 2013). It is *virtually certain* (P<0.001) that the average biomass of herbivorous fish among MPAs in the SBS region varied significantly, with an average fish biomass from the most recent year of monitoring at 226.5 kg/ha (Fig. 23). Gitanada, Flores Timur, Selat Pantar, Teluk Lasolo, Wakatobi, Laut Banda, Koon and Yamdena are MPAs in which the average biomass of herbivorous fish was higher than the average across MPAs at seascape level.

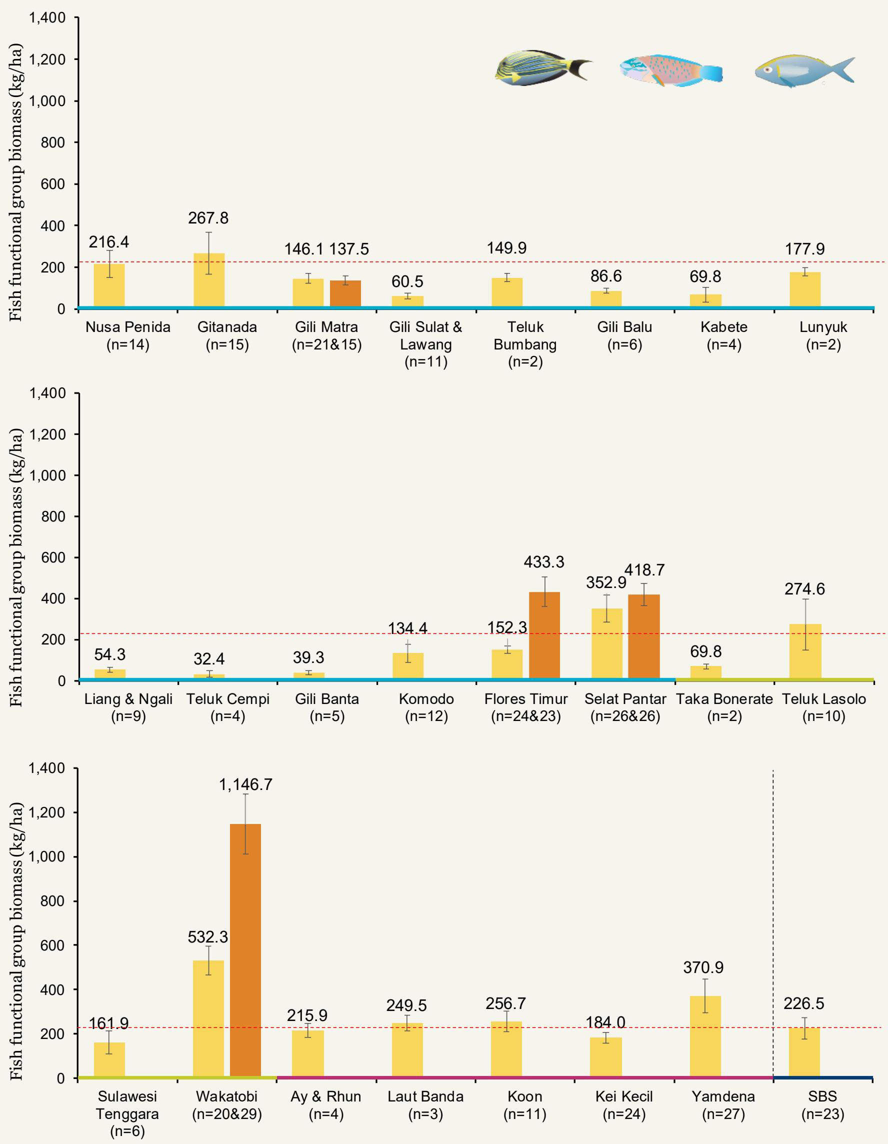
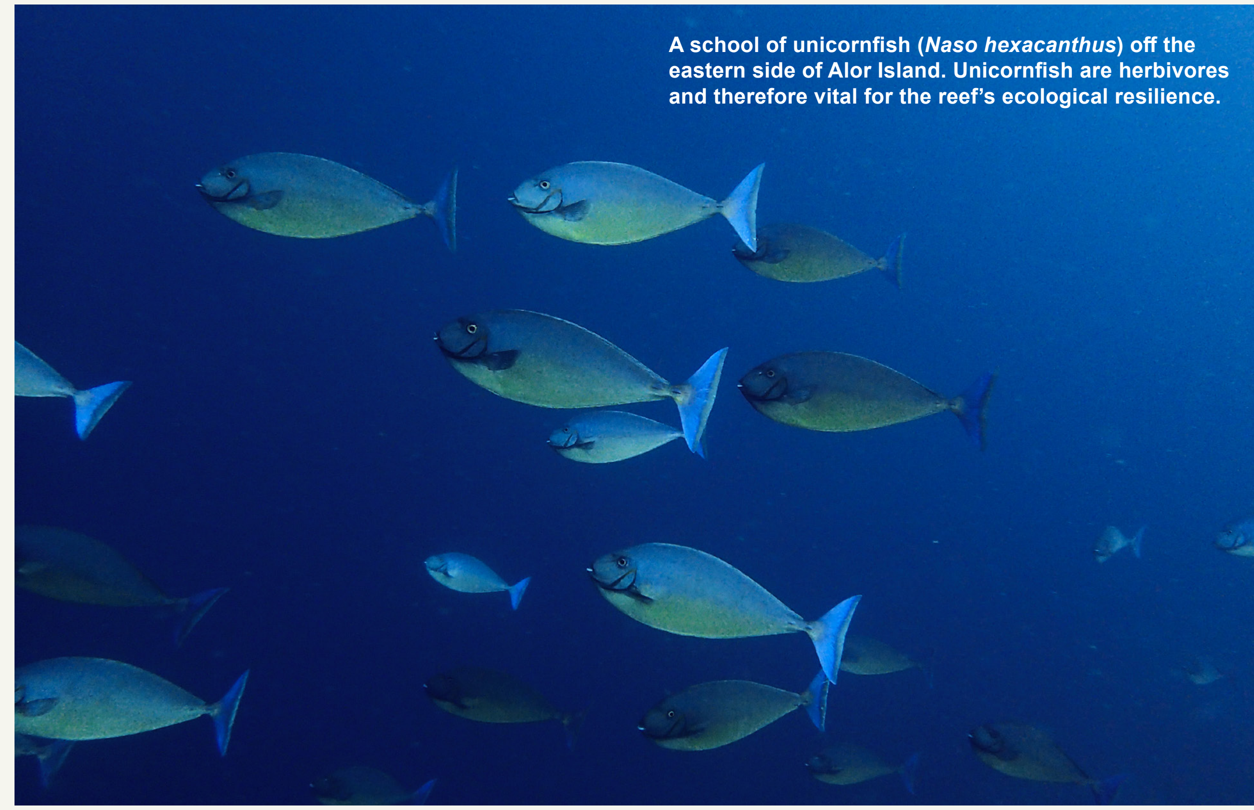


Figure 23. Biomass of herbivorous fish (kg/ha) in the SBS MPAs at baseline and repeat monitoring

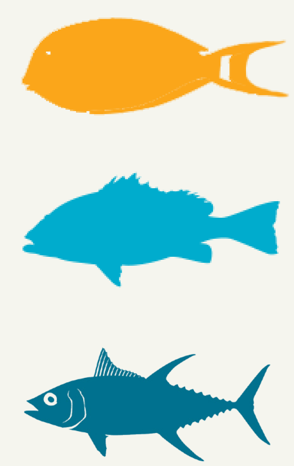
Note: The average fish biomass at SBS level was calculated based on the most current monitoring data. Year of baseline and repeat monitoring at each MPA. Komodo, baseline 2016; Flores Timur, baseline 2014, repeat 2017; Selat Pantar, baseline 2014, repeat 2017; Kei Kecil, baseline 2015, Koon, baseline 2014; Sulawesi Tenggara, baseline 2016; Teluk Lasolo, baseline 2016; Wakatobi, baseline 2012, repeat 2016; Gili Balu, baseline 2014; Gili Banta, baseline 2015; Gili Matra, baseline 2012, repeat 2016; Gili Sulat & Lawang, baseline 2013; Gitanada, baseline 2013; Kabete, baseline 2014; Liang & Ngali, baseline 2014; Lunyuk, baseline 2014; Teluk Bumbang, baseline 2013; Teluk Cempi, baseline 2015. n represents the number of sites monitored within each MPA during the year of monitoring. A red horizontal dashed line represents the average at SBS level. The average fish biomass at the SBS level was calculated based on the most current monitoring data. Colors in x-axis represent sub-seascape groups, i.e. LSS (blue), SESS (lime), IBAS (purple) and overall SBS level (indigo).

Of the four MPAs with trend data, the biomass of herbivorous fish increased in three MPAs. It is *virtually certain* that the fish biomass in Flores Timur (P<0.001) and Wakatobi (P<0.001) increased during the monitoring period. Herbivorous fish biomass in Flores Timur and Wakatobi were tripled and doubled respectively. In Selat Pantar, it is *about as likely as not* (P=0.091) that the average biomass of herbivorous fish increased. In Gili Matra, it is *unlikely* (P=0.975) that herbivorous fish biomass changed during the monitoring period. The most possible explanation for this is that the populations of herbivorous fish remained relatively stable during the monitoring period.

Indicator 17: Fishing pressure



A school of unicornfish (*Naso hexacanthus*) off the eastern side of Alor Island. Unicornfish are herbivores and therefore vital for the reef's ecological resilience.



Fishing pressure may indicate the level of fishing activity at certain fishing grounds. We estimated fishing pressure using the total fish length of six families, comprised of three families of key fisheries and three families of herbivorous fish. We calculated the 90th quantile of fish length to examine the minimum length of the largest 10% of fish observed during reef health monitoring at each MPA (Fig. 24). The higher the 90th quantile of fish length, the more larger fish are present at a site. The presence of larger fish is indicative of a lower level of fishing pressure.

It is *virtually certain* (P<0.001) that the average of the 90th quantile of fish size from the latest monitoring period was significantly different. Overall, the 90th quantile of fish at MPA level varied and the average at seascape level was 41.7 cm. In detail, the 90th quantile in Koon ranked the highest among all MPAs with 59.3 cm, suggesting that fish populations in this MPA had been exposed to the lowest fishing pressure. On the other hand, the smallest 90th quantile was observed in Kabete with only 25.5 cm, suggesting that larger fish are rarer in fish populations in Kabete.

In Flores Timur, it is *extremely likely* (P=0.022) that the 90th quantile of fish size increased significantly. This might suggest that the fish populations in Flores Timur are thriving and the fishing pressure is relatively low. In addition, it is *likely* that the 90th quantile of fish length in Selat Pantar increased (P=0.031), while it is *extremely likely* that it increased in Wakatobi (P<0.001) over time, though the increase in the 90th quantile was small. The average 90th quantile in Flores Timur and Selat Pantar slightly increased. In Gili Matra there was a decrease in the average 90th quantile of fish size, though it is *about as likely as not* (P=0.750) that this represented a significant change.

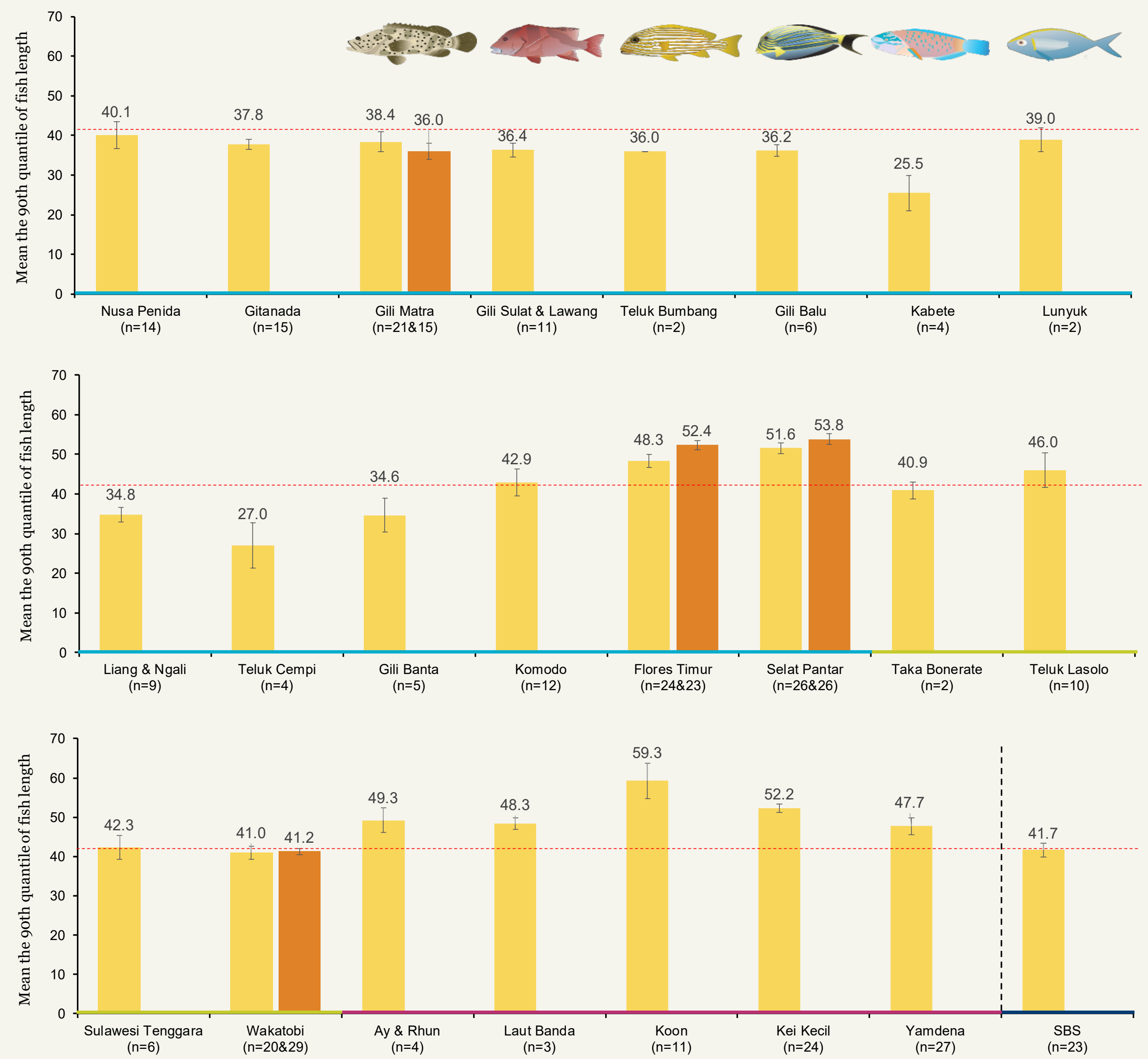


Figure 24. The average 90th quantile for fish length (cm) in the SBS MPAs

Note: Year of baseline and repeat monitoring at each MPA. Komodo, baseline 2016; Flores Timur, baseline 2014, repeat 2017; Selat Pantar, baseline 2014, repeat 2017; Kei Kecil, baseline 2015, Koon, baseline 2014; Sulawesi Tenggara, baseline 2016; Teluk Lasolo, baseline 2016; Wakatobi, baseline 2012, repeat 2016; Gili Balu, baseline 2014; Gili Banta, baseline 2015; Gili Matra, baseline 2012, repeat 2016; Gili Sulat & Lawang, baseline 2013; Gitanada, baseline 2013; Kabete, baseline 2014; Liang & Ngali, baseline 2014; Lunyuk, baseline 2014; Teluk Bumbang, baseline 2013; Teluk Cempi, baseline 2015. n represents the number of sites monitored within each MPA during the year of monitoring. A red dashed line represents the average at SBS level. Colors in x-axis represent sub-seascape groups, i.e. LSS (blue), SESS (lime), IBAS (purple) and overall SBS level (indigo).

Indicator 17: Catch per unit effort

Catch per unit effort (CPUE) provides a useful metric to investigate the changes and trends of fishery stocks. A decrease in the trend of CPUE likely indicates overfishing (National Working Group II EAFM, 2013). This indicator is aligned with EAFM (1.1) and E-KKP3K (B58C) indicators. Data on CPUE, which is based on fish landing surveys, are only available from a subset of MPAs. These include Flores Timur (pelagic fish), Kei Kecil (reef fish and pelagic fish) and Koon (reef fish). The monitoring periods moreover varied between MPAs ranging from a few months to four years. Therefore, we were not able to use this data for further analysis in the current dashboard.

Catch length frequency distribution in Kei Islands, Southeast Maluku

Examining the length-frequency distribution of fish catches is important to measure the impact of fisheries. Length-frequency distributions often allow identification of overexploitation of species before significant differences are detected in biomass. WWF conducted a study in the Kei Islands to investigate the status of key fisheries species through fish landing surveys (Damora & Fikri, 2017). The species observed include *Siganus lineatus*, *Caesio cuning* and *Lethrinus lentjan*.

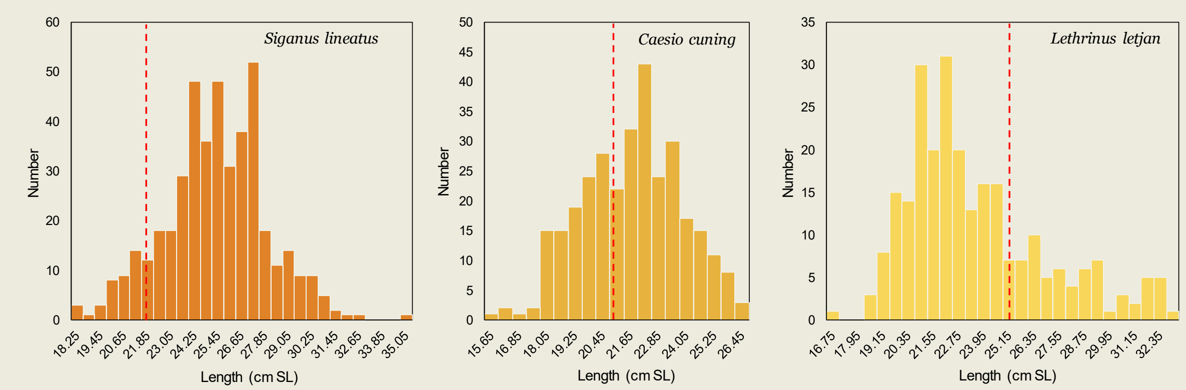


Figure 25. Size frequency distribution with length at maturity (L-mat)

Catch length frequency distribution of *S. lineatus* and *C. cuning* showed that a large percentage of the fish caught and removed by the fishery are mature. They were able to spawn and had approached full growth potential. This is an example of a more sustainable situation with the fisheries that mainly target adults. On the other hand, catch length frequency distribution of *L. lentjan* showed that a large percentage of the fish in the catch is still immature and was removed by the fishery before being able to spawn or reach full growth potential. This is an example of a situation of overfishing including the targeting of juveniles.

Governance

From the two subseascapes where MPA level data are available (the LSS and the IBAS), outcomes indicate that both subseascapes need to increase local community involvement in marine resource governance. This is important to increase the sense of ownership by communities of their marine resources and thus increase self-participation in managing their areas and marine resources. LSS performed slightly better than IBAS in user participation in monitoring and enforcement.

Indicator 19: Participation in decision-making

The establishment of an MPA may increase the engagement level of local communities in making decisions in relation to marine resource management (Glew et al. 2012). For this indicator, participation of user groups in establishing marine resource use rules within an MPA was measured from a focus group discussion in each settlement. At the seascape level, it is *extremely likely* (P=0.014) that the average proportion of user groups participating in managing resources varied significantly across the SBS region (Fig. 26). The proportion of user groups involved in making rules governing the MPA was highly variable among the five MPAs. Overall, only 16.7% of user groups in all MPAs took part in making rules. In this case, local communities do not play an important role in defining rules, especially those related to marine resource use in several MPAs.

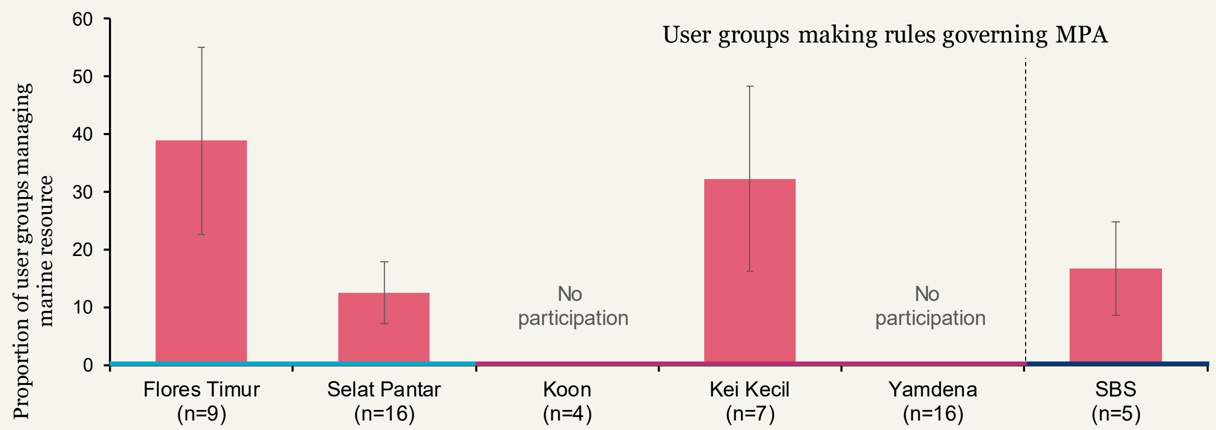


Figure 26. Proportion of user groups participating in managing local marine resources at each MPA

Note: Year of baseline monitoring at each MPA. Flores Timur, baseline 2014; Kei Kecil, baseline 2016; Koon, baseline 2016; Selat Pantar, baseline 2014; Yamdena, baseline 2017. At each MPA, n represents the number of settlements surveyed within the MPA boundaries. Colors in x-axis represent sub-seascape groups, i.e. LSS (blue), SESS (lime), IBAS (purple) and overall SBS level (indigo).

User groups in Koon and Yamdena did not participate in establishing marine resource use rules. In Koon, the formal rules were developed by local and national governments as well as local and international NGOs. There is an informal rule, *Sasi*, which is defined by the *King of Kataloka*, the leader in Koon (Nanlohy and Timisela, 2017). In Yamdena, marine resource use rules are established by the head of the village and the village representative body (*badan saniri*).

Box 4. Harmonizing the management of MPAs in West Nusa Tenggara

Stakeholder meeting to identify and inventory the management status of conservation areas in West Nusa Tenggara © WCS-Indonesia

Contributed by: Sukmaraharja A. Tarigan

The enactment of Law No. 23 2014 on Regional Government has created an opportunity for transferring management authority from local government to provincial government. In order to ease this process, West Nusa Tenggara provincial government and WCS are working together through the following steps:

1. Identify and inventory the management status of conservation areas; focusing on data collection and information on process of personnel delegation, funding, facilities/infrastructure and documents (P3D) related to the management of conservation areas.
2. Evaluate the management status of conservation areas using E-KKP3K tools. The evaluation results will provide guidance on management action needed by the provincial government after the harmonization process.
3. Transfer the legal status of reserved areas. Within the framework of transfer of authority, the adoption of the regulatory legal status of the Regent to the Governor should be done to ensure the next stage of management.
4. Develop a management institution. MPAs that have been transferred must have an institution that acts as a regional management unit to replace the institutions at the local level.

West Nusa Tenggara provincial government has now established a Regional Technical Implementation Unit (UPTD) named the Conservation and Supervision Board of Marine Resources and Fisheries as a technical implementer that is responsible for managing conservation areas in West Nusa Tenggara. This UPTD is responsible for the management of MPA and small islands in three regions, namely Lombok, Sumbawa and Bima-Dompu.

Indicator 20: Resource use rules

Resource use rules define the rights of individuals or groups in the community to access and appropriate marine resources (Glew et al. 2012). The distribution of marine resource use rules directly shapes MPA social impacts by structuring access to the well-being associated with marine resource uses (Mascia, 2000). For this indicator, we examined the type of rules existing through focus group discussion at each settlement and the number of key species and habitats with rules associated with them based on the KIIs. Focus group participants identified a variety of commercially and culturally important species, such as groupers, dolphins and sea turtles. They also identified critical habitats, including mangroves, seagrass and coral reefs (Mohebalian et al., 2017). It is *virtually certain* (P<0.001) that the average number of key species and habitats with rules associated was significantly different across the SBS region, with an average of 0.19 (Fig. 27). The highest was found in Flores Timur (0.37) followed by Kei Kecil (0.36). Koon and Selat Pantar ranked the lowest with 0.07.

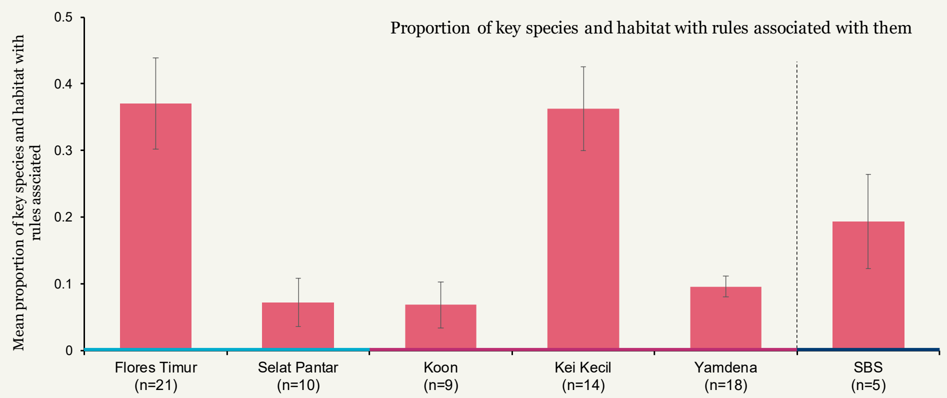


Figure 27. Average proportion of key species and habitats with rules associated with at each MPA

Note: Year of baseline monitoring at each MPA. Flores Timur, baseline 2014; Kei Kecil, baseline 2016; Koon, baseline 2016; Selat Pantar, baseline 2014; Yamdena, baseline 2017. At each MPA, n represents the number of settlements surveyed within the MPA boundaries. Colors in x-axis represent sub-seascape groups, i.e. LSS (blue), SESS (lime), IBAS (purple) and overall SBS level (indigo).

Rules related to marine resources that exist in the settlements within MPAs in SBS can be classified as formal and informal rules. These rules regulate a community's fishing activities on what to fish (species restriction), where to fish (location), how to fish (type of fishing gear) or who can fish (user groups). Each rule applied differently in each settlement according to the regulations acknowledged by the community. In Yamdena and Kei Kecil, the number of informal rules are double the amount of formal rules, which means informal agreement within the communities is strongly acknowledged and applied effectively to manage resource use. In Maluku, only Koon enforced more formal rules than informal rules.

Informal rules can be effective if widely supported - as in Yamdena and Kei Kecil, where the number of informal rules exceeds that of formal ones

Indicator 21: Conflict resolution

MPA establishment may decrease or increase conflict over marine resource use in certain areas (Glew et al. 2012). This indicator measures the length of time to resolve conflict over marine resource use, which occurs among users as well as between users and officials in MPAs. The shorter time to resolve conflict the better for the communities. The overall result of baseline surveys in the SBS region showed that it took longer time to resolve conflict over marine resource use among users than between users and officials with 6.28 days and 2.67 days, respectively (Fig. 28). It is *extremely likely* (P=0.041) that the average time to resolve conflict for the two categories was different.

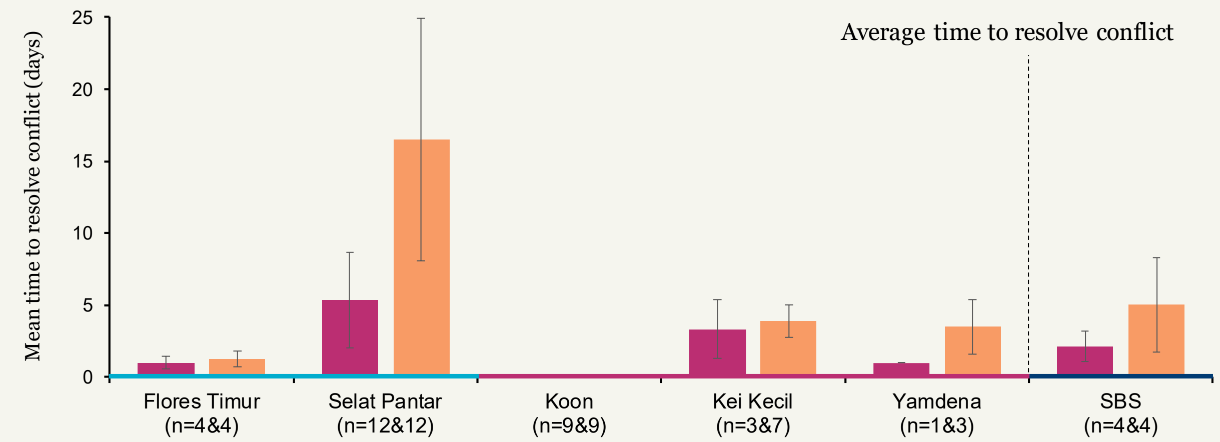


Figure 28. Average time to resolve conflict over marine resources among resource users (right bars) as well as between users and officials (left bars) in each MPA

Note: Year of baseline monitoring at each MPA. Flores Timur, baseline 2014; Kei Kecil, baseline 2016; Koon, baseline 2016; Selat Pantar, baseline 2014; Yamdena, baseline 2017. At each MPA, n represents the number of settlements surveyed within the MPA boundaries. Colors in x-axis represent sub-seascape groups, i.e. LSS (blue), SESS (lime), IBAS (purple) and overall SBS level (indigo).

At the SBS level, conflict resolution over marine resources between users often take longer than between users and officials.

At the MPA level, it is about *as likely as not* (P=0.630) that the average time to resolve conflict among users was significantly different between four MPAs. It took 16.5 days to resolve conflict in Selat Pantar, while in Kei Kecil, Flores Timur and Yamdena were 3.86 days, 1.25 days and 3.5 days respectively. In Koon, surprisingly, there were no reported conflicts over marine resources. With regards to conflict between users and officials, it is *unlikely* (P=0.688) that the average time to resolve conflict between users and officials was different. Among four MPAs, Selat Pantar ranked the highest with 5.33 days compared to 3.33 (Kei Kecil) and 1.00 days in both Flores Timur and Yamdena.

In terms of conflict resolution, this indicator is not applicable in Koon as no conflicts were reported. It is not clear why no conflicts were reported, but it could suggest that local communities around Koon and Neiden are aware of the importance of marine resource sustainability; therefore potential conflict among user groups and officials in marine resource use is lower than elsewhere in the SBS. Apart from this, there are no rules identified that arrange marine resource use and are made by village and local governments. The only rules that are available are those from national government and *Sasi* (Nanlohy and Timisela, 2017).

Indicator 22: User participation in monitoring and enforcement

MPA establishment may enhance local community participation in organizations focusing on marine resource management, which may support or oppose an MPA (Glew et al. 2012). This indicator is measured as the proportion of households that were members of at least one organization participating in managing marine resources in their respective MPA. This proportion doesn't represent the number of organizations in the MPA. Overall, the average proportion of households that are members of organizations helping to manage marine resources was only 13.04% (Fig. 29). It is *extremely likely* (P= 0.014) that the average proportion of households varied significantly across the SBS region. The proportion of household membership in Flores Timur was the highest with 18.76% of the sampled households that are member to at least one organization. Conversely, Koon ranked the lowest with only 2.36%. The low number of participation in an organization in Koon was related to the low number of organizations managing marine resources, compared to that in both Yamdena and Kei Kecil.

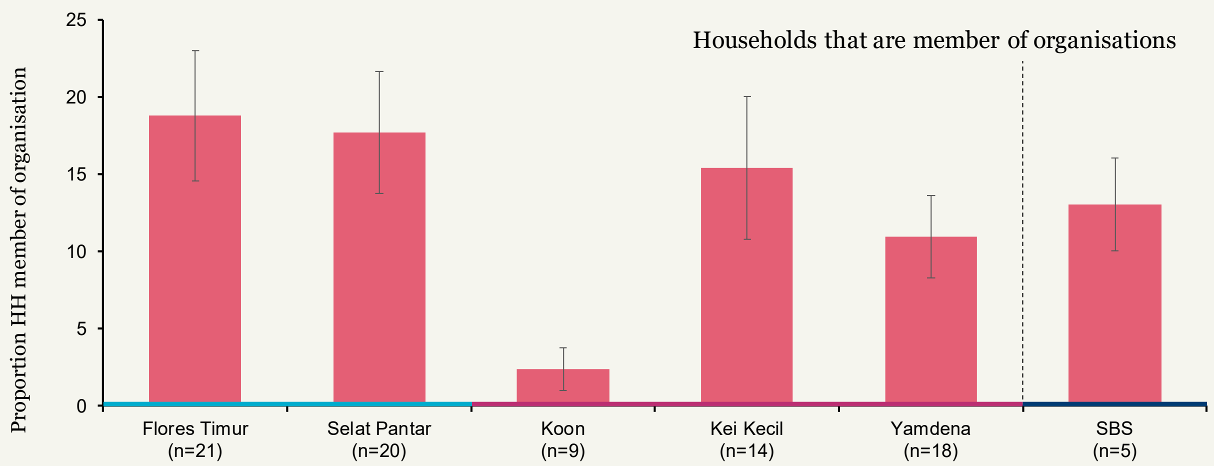


Figure 29. Proportion of households that are members of an organization at each MPA

Note: Year of baseline monitoring at each MPA. Flores Timur, baseline 2014; Kei Kecil, baseline 2016; Koon, baseline 2016; Selat Pantar, baseline 2014; Yamdena, baseline 2017. At each MPA, n represents the number of settlements surveyed within the MPA boundaries. Colors in x-axis represent sub-seascape groups, i.e. LSS (blue), SESS (lime), IBAS (purple) and overall SBS level (indigo).

Chapter 5

INDONESIAN GOVERNMENT MANAGEMENT TOOLS

INDONESIAN GOVERNMENT MANAGEMENT TOOLS

Apart from the domains and indicators in the dashboard, we also examined two management tools that are employed by the Indonesian government to measure the effectiveness of MPA and fisheries management in the SBS region. These tools are Management Effectiveness of Aquatic, Coasts, and Small Islands Conservation Areas (E-KKP3K) and Ecosystem Approach to Fisheries Management (EAFM).

E-KKP3K

In general, 40 of 85 MPAs in the SBS region have been evaluated using E-KKP3K (Indonesian MPA management effectiveness scores). Only four MPAs that are managed by MMAF have not undertaken the E-KKP3K evaluation. Some of the MPAs, including those previously managed by MoEF, were either not evaluated or evaluated their management effectiveness using the Management Effectiveness Tracking Tool (METT), of which scores were obtained from Direktorat Kawasan Konservasi - MoEF (2016).

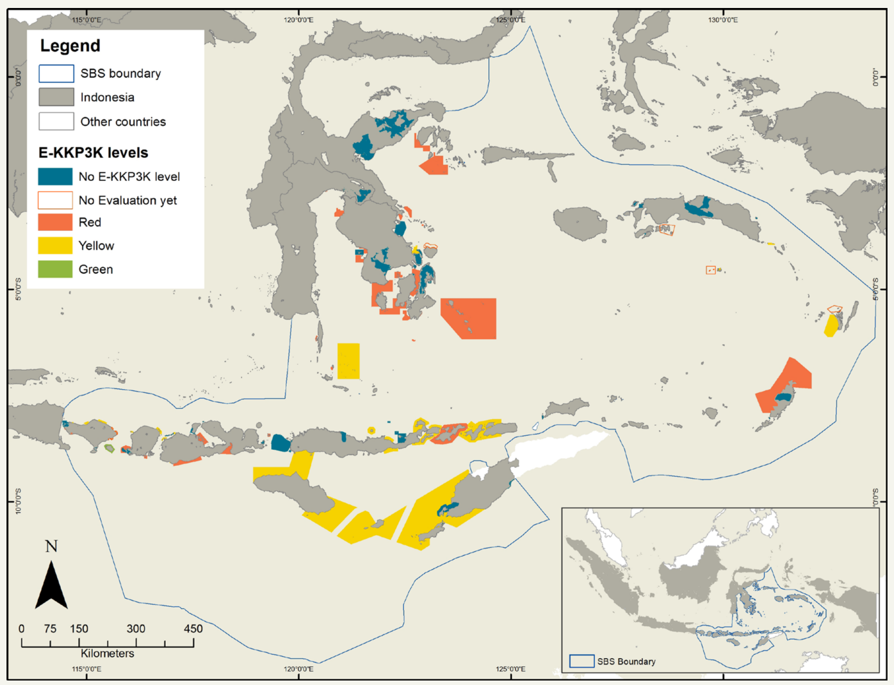


Figure 30. E-KKP3K levels for all MPAs within the SBS region in 2015

Note: The levelling of each MPA is based on the 2015 E-KKP3K evaluation.

Based on 2015 E-KKP3K evaluations, only Nusa Penida MPA was ranked as level three (green stage) (Fig. 30; Table 10). This means that the MPA has been established and met the following criteria: (1) management body has been established and functioning; (2) zoning system and management plan has been developed and implemented; (3) human resources for managing MPAs are available and sufficient and (4) infrastructure and tools for managing MPAs are sufficient.

Approximately half of the MPAs in LSS were at level two (yellow stage) (Fig. 31; Annex I), which means that the MPAs have been established, and the management body as well as zoning system and management plan have been established and implemented. Though many MPAs in LSS were at level one (red stage), meaning that the MPAs have been initiated and evaluated, but they are unlikely to have an effect. Most MPAs in LSS were established in the last seven years.

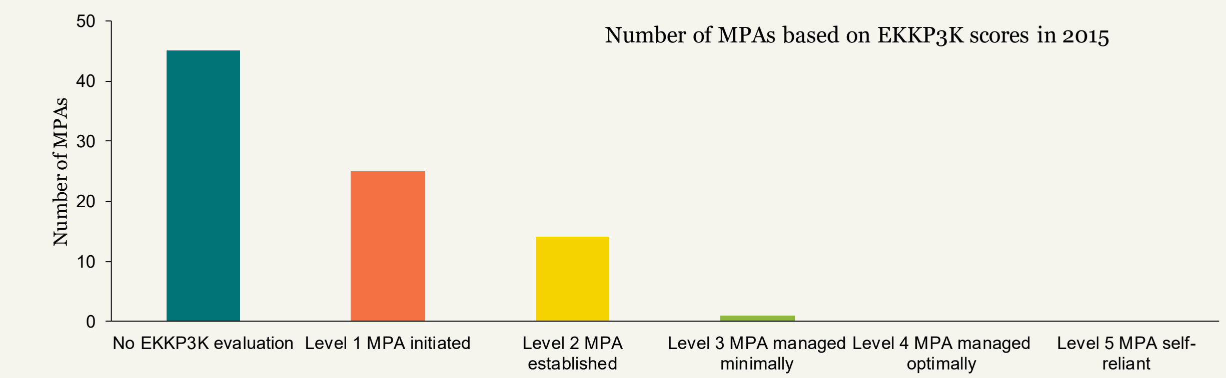


Figure 31. Number of MPAs based on EKKP3K scores in 2015

EAFM

EAFM can be defined as "*an ecosystem approach to fisheries strives to balance diverse societal objectives, by taking account of the knowledge and uncertainties about biotic, abiotic and human components of ecosystems and their interactions and applying an integrated approach to fisheries within ecologically meaningful boundaries*" (Garcia et al. 2003).

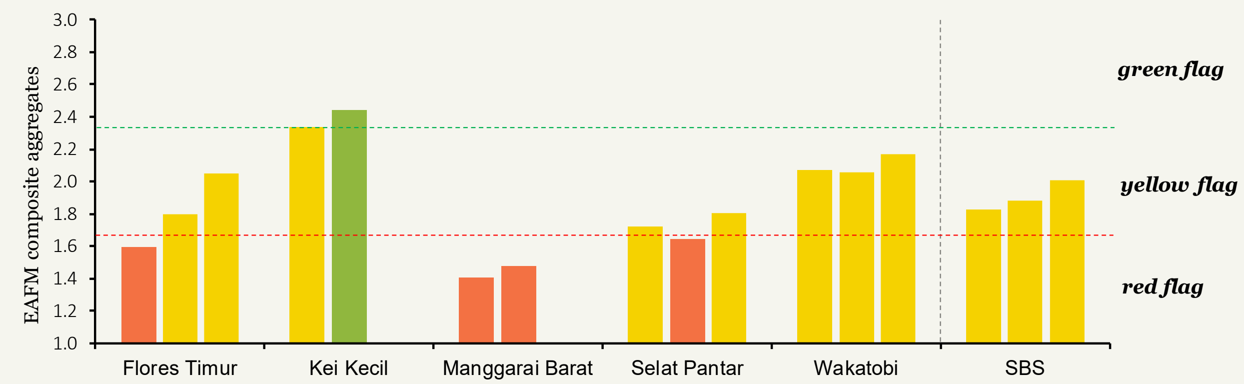


Figure 32. EAFM composite aggregates in MPAs and regency at baseline, first repeat, and second repeat

Note: At each MPA and regency, the first bar represents baseline, second bar first repeat, third bar second repeat. Year of baseline & repeat monitoring at each MPA and Regency. Flores Timur, baseline 2012, repeat 2014, 2016; Kei Kecil, baseline 2012, 2015; Manggarai Barat, baseline 2014, repeat 2016, Wakatobi, baseline 2012, repeat 2013, 2016. All sites are MPAs, except for Manggarai Barat regency, in which Komodo is located.

Among five fisheries management areas that were observed at district level, Kei Kecil had better EAFM performance compared to other areas (Fig. 32). Overall, the average EAFM composite aggregates showed some increases at seascape level, despite its status of yellow (moderate) throughout three assessment periods. At fisheries management area level, three fisheries management areas exhibited some increases in the aggregates between baseline and repeats, except for Selat Pantar and Wakatobi, which decreased in the second repeat.

A SPINY HARVEST

Women process and de-spine *tetehe'* (sea urchins - *Tripneustes gratilla*), common invertebrates in seagrass beds and coral reefs. *Tetehe'* are sold in wet markets and traditionally consumed in Southeast Sulawesi.

Box 5. Strengthening customary systems for marine management through TURF-Reserve implementation at Wakatobi

Wakatobi fishermen butterflying and drying their catch under the sun prior to storage and consumption
© Kartika C. Sumolang/WWF Indonesia

Contributed by: Courtney Cox

Wakatobi District is a unique district in Indonesia; most of its administrative areas overlap with Wakatobi National Park areas. This makes management of marine areas and fisheries in this area challenging and in need of innovative approaches. Rare worked with La Ode Agusrianto (Agus), a staff member of the Wakatobi District Office for Fisheries and Marine Affairs, to establish TURF-Reserves (managed access) in Kadie Liya communities where customary systems are still practiced. As in many indigenous communities, customary systems need to be updated to meet current challenges including sustainable fishery management. The first step was to seek innovators who would market TURF-Reserve concepts to other people in the communities. Agus earned trust from Kadie Liya communities that value their adat (customary) systems and has now persuaded 100 fishers to adopt the TURF-Reserve approach. They are committed to improve marine conservation and fisheries management of 210 hectares of TURF-Reserve in these Kadie Liya communities. Ordainment of these TURF-Reserves is given by the Wakatobi National Park and there is now an initiative to get Kadie Liya customary communities a formal recognition from the government.

Chapter 6

MANAGEMENT RECOMMENDATIONS

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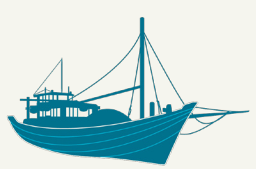
MANAGEMENT RECOMMENDATIONS

Enabling conditions

Good MPA design includes protection of critical habitats for fisheries species and high connectivity with other MPAs.

Although many of the indicators in the enabling conditions domain are in 'above average' conditions at seascape level, there remain areas for improvements. Many MPAs fall into the below optimal/below average category for indicators such as sufficient habitats within MPAs, spacing between MPAs within the MPA network, non-extractive critical habitats, perceived threats to marine resources and management capacity and resources. To improve the performance of these MPAs, we recommend the following:

1. Support and facilitate provincial governments to implement 'smart and effective' MPA design based on best available science, by protecting at least 30% of marine critical habitats, prioritizing areas with strong fisheries connectivity, ensuring the size of NTZs can provide adequate protection to fish species, as well as ensuring that each MPA is adequately connected to nearby MPAs within a network, either in existing MPAs or in new MPAs that will be initiated/established.
    a. Initiate and establish new MPAs in 'empty areas' to improve ecological connectivity in the Inner Banda Arc subseascape, especially between Koon and Kei as well as the southern Banda Sea.
    b. Increase the protection of mangrove habitats by 30%, primarily in the provinces within Sulawesi. Increase the protection of seagrass by 10 – 15% in Sulawesi Selatan, Sulawesi Tengah and Maluku Provinces. This can be achieved by prioritizing areas consisting of significant mangrove forest and seagrass meadows when establishing new MPAs in the future and/or supporting community-based mangrove restoration in degraded coastal areas within MPAs.
    c. Support provincial and local governments to plan coastal development and marine area utilization to mitigate and minimize threats to critical habitats in coastal areas. A comprehensive spatial marine plan should be integrated into RZWP3K (Coastal and Small Islands Zoning Plan) in each province.
2. Support and facilitate MPA managers to improve the management effectiveness of existing MPAs.
    a. Accelerate the formal establishment of MPAs as well as zoning system and management plans, particularly for MPAs that are recently initiated.
    b. Accelerate the establishment of provincially-managed MPA management units, and appoint site-based staff to manage these MPAs.
    c. Develop the capacity of local staff managing MPAs through shared learning and knowledge with other stakeholders and MPA managers, particularly those MPAs that are ecologically connected.
    d. Improve and strengthen the surveillance and law enforcement in MPAs to minimize illegal and destructive fishing activities.
3. Promote the development of formal MPA networks and collaborative MPA management plans among two or more provinces to maximize the benefits from connected MPAs.
4. Work closely with communities to implement sustainable practices and manage marine resources.
    a. Continue to work with communities on education of sustainable marine resource management practices and support implementation.
5. Increase the awareness of local communities on effective fishing that may contribute to sustainable fisheries. These include fishing only large fish, releasing fish or other catch containing eggs, where to fish, when to fish, who can fish, what to fish and how to fish.



Supporting law enforcement, surveillance and capacity of local staff will help MPAs achieve their conservation goals.

    a. Increase the capacity, skills and knowledge of local communities that support the implementation of sustainable practices, such as environmentally friendly fishing practices, responsible marine tourism, waste management, monitoring and evaluation, etc.

Human well-being

Social conditions of certain MPAs are markedly lower compared to others, thus requiring greater attention.

Many MPAs where social monitoring was conducted in SBS indicated that there were 'above average' conditions. However, the performance of a few MPAs, such as Selat Pantar, were particularly low and requires more attention. Although there is high marine tenure, the school enrollment rate and material asset index in Selat Pantar is low compared to others. Therefore, to achieve and maintain sustainable development across the SBS region, local government and civil society should:

1. Improve social conditions for local communities through, but not limited to:
    a. Improve basic support infrastructure (such as electricity, sanitation, roads, etc.) for communities living within MPAs. Infrastructure development should be targeted to specific community needs, and conducted in environmentally sensitive ways.
    b. Promote environmental education and integrate this into formal curriculum of primary and secondary schools. School aged children can be the agents of change and perhaps local champions who can contribute to the conservation of marine resources.
    c. Improve and maintain the food security of local communities, especially in Selat Pantar through programs ensuring access to basic food supplies during adverse weather conditions and promoting food diversification, particularly in remote areas.
    d. Expand market access for communities, especially in remote areas.
2. Continue to conduct regular monitoring of the socio-economic conditions of people living within MPAs to help inform priority areas of focus.

Ecosystem health

Although the majority of MPAs, some of the MPAs require adaptive management practices to ensure the sustainability of marine resources and critical habitats in the SBS region. To improve and maintain the ecological conditions in the region, we recommend governments and MPA managers to:

1. Continue and improve science-based regular monitoring and evaluation to inform adaptive management.
    a. Undertake regular and standardized ecological and social monitoring and evaluation for all MPAs in the region.
    b. Apply systematic documentation on fish landing data regularly in all MPAs to monitor fishing pressure and gather data on biology of key fisheries species, allowing the provision of scientific basis for regulating capture fisheries.
    c. Monitor SPAGs regularly to make sure that the number of fish aggregating during a particular season is stable and to identify other SPAG areas within the MPA. Currently, SPAG areas are identified in Wakatobi, Koon and Komodo, with possible additional SPAG areas to be identified.
2. Promote long-term community-based mangrove rehabilitation programs with support from various partners in degraded mangrove forests.
3. Implement comprehensive waste management system to reduce the amount of waste polluting the coastal areas and marine environment.

Fish and fisheries

A good amount of reef fish population within a reef is important to support coral reef health and fisheries. At SBS, IBAS performs better in "Fish and Fisheries" domain, dominated by "average" and "above average" scores. Meanwhile, LSS scores fall under "below average" for all categories. To improve the fish and fisheries condition in the seascape, we specifically recommend:

1. Reduce and manage threats as well as spread the risks to marine resources.
    a. Fully protect and improve law enforcement of SPAGs so that fish can recover and therefore provide larva and fish stock to adjacent areas.
    b. Strongly enforce fisheries rules, particularly in high fish biomass MPAs, such as Koon and Wakatobi, and in MPAs where fish biomass reduction through time occurred such as in Gili Matra, to mitigate overfishing of key fisheries species, maintain/reduce fishing pressures and maintain fish stocks.
    c. Diminish fishing pressure and promote sustainable fisheries by integrating capture fisheries rules, including allowable catch size, fishing gear and fishing grounds into MPA management plans.

Adaptive management practices rely on timely empirical data, which is only possible through systematic and regular monitoring of ecological and social processes occurring throughout the MPAs

Governance

To maintain and strengthen marine resource governance, we recommend MPA managers and local governments to increase local community awareness and involvement in managing their marine areas and resources. More specifically:

1. Increase local community awareness in marine resource governance
    a. Educate on protecting and managing coastal and marine ecosystems, including refraining from illegal and destructive fishing practices.
    b. Increase community awareness of MPAs and regulations in maintaining marine resources.
    c. Promote the implementation of good management, especially in managing critical habitats.
    d. Increase the involvement of local communities in the day-to-day management and running of the MPAs, as well their participation in decision making processes within the MPAs.
    e. Support the participation of local communities in local marine resource management through community organizations. This can also be done by involving community members in surveillance and education to minimize threats to the marine environment, and in making rules governing MPAs.
2. Socialize with local communities the rules, regulations and benefits of MPAs that are being/recently established.
    a. Facilitate local communities to develop formal rules on marine resource use and promote collaboration among settlements/villages within MPAs to optimize community-based management of marine resources.
    b. Acknowledge local marine management systems/tenures present within the MPAs, or integrate them into MPA management plans while involving the relevant communities in their management.
    c. Improve the accessibility and awareness of mechanisms for resolving conflicts over marine resources, particularly in Selat Pantar MPA. It is important to develop a mechanism at a local level allowing for discussion to resolve conflict among users over marine resources.

Unsold catches, such as octopuses, are often salted and dried for long term storage. Women play an active role in preserving protein sources in places where refrigeration is rare or absent.

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Box 6. Turning the tide: increasing the roles and involvement of Bajau communities in marine management

Community of Tanjung Bunga Village gathering after a hair cut ritual. This ritual is important for Bajau Tribe. © Irwan Hermawan/WWF-Indonesia

Contributed by: Courtney Cox

Due to their nomadic-life, Bajau communities have no (customary) ownership or marine tenurial right. In many areas where they live, including in Wakatobi National Park, these communities receive a stigma of being disobedient and practicing unsustainable fishing practices. After receiving a series of trainings from Rare staff in 2014, Ayub Gerit Polii (a park staff) and his team reached out to communities in five Mola Villages on Wangi-wangi Island and convinced them to adopt the TURF-Reserve concept and more sustainable fishing practices. The Bajau has agreed to adopt more sustainable fishing methods, a catch reporting system and a community-based surveillance and patrolling system. At the same time, he also persuaded Meantu'u Mandati, the indigenous group that has the ownership right, to grant use right to Bajau communities in those villages. By end of his Rare campaign in September 2017, approximately 10,000 hectares of marine areas at Kapota reefs were managed under the TURF-Reserve regime. He also facilitated the Bajau communities to establish a group, develop a management plan and get a formal MOU with the park.

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ANNEXES

ANNEXES

Annex I. MPA in the SBS region

Table 7. Detailed information of MPAs in the SBS region

No	MPA names	MPA official names	Provinces	Management body	WPP	Area (ha)	Year initiated	Initiation decree	Establishment decree
1	Bali Barat	Taman Nasional Bali Barat	Bali	MoEF	713	19,002.74	1999	-	433/Kpts-II/1999
2	Buleleng	Taman Wisata Perairan Buleleng	Bali	MMAF	713	14,041.13	2011	SK No.523/630/HK/2011	-
3	Jembrana	Kawasan Konservasi Perairan Jembrana	Bali	MMAF	573	3,532.52	2013	Kep. Bupati No. 778/DKPK/2013 - 30 Desember 2013	-
4	Karangasem	KKPD Karangasem	Bali	MMAF	713	5,856.31	2017	KepGub Bali 375/03-L/HK/2017,19 Januari 2017	-
5	Ngurah Rai	Taman Hutan Raya Ngurah Rai	Bali	MoEF	573	1,373.50	1993	-	433/Kpts-II/1999
6	Nusa Penida	Kawasan Konservasi Perairan Nusa Penida	Bali	MMAF	573	20,057.00	2010	Per Bupati No.12 Tahun 2010	Kepmen KP Nomor 24/KEP-MEN-KP/2014
7	Bangko-bangko	TWA Bangko-bangko	Nusa Tenggara Barat	MoEF	573	2,610.00	2009	-	598/Menhut-II/2009
8	Gili Balu	Taman Pulau Kecil Gili Balu dan Taman Pesisir Penyu Tatar Sepang	Nusa Tenggara Barat	MMAF	713	6,728.36	2014	SK Gubernur No.523-505 Tahun 2016	-
9	Gili Banta	Taman Wisata Perairan Gili Banta	Nusa Tenggara Barat	MMAF	713	40,500.00	2005	SK Gubernur No.523-505 Tahun 2016	-
10	Gili Matra	TWP Gili Ayer, Gili Meno, Gili Terawangan	Nusa Tenggara Barat	MMAF	713	2,954.00	2014	Keputusan Menteri Kelautan dan Perikanan No. 67/MEN/2009	Kep MenKP No. 67/Men/2009. Tgl 3 September 2009
11	Gili Sulat & Lawang	Taman Wisata Perairan Gili Sulat dan Gili Lawang	Nusa Tenggara Barat	MMAF	573	10,000.00	2014	SK Gubernur No.523-505 Tahun 2016	-
12	Gitanada	Taman Wisata Perairan Gili Tangkong, Gili Nanggu dan Gili Sundak	Nusa Tenggara Barat	MMAF	573	21,556.00	2014	SK Gubernur No.523-505 Tahun 2016	-
13	Kabete	Taman Pulau Kecil Pulau Keramat, Bedil dan Temudong	Nusa Tenggara Barat	MMAF	713	2,000.00	2011	SK Gubernur No.523-505 Tahun 2016	-
14	Liang & Ngali	Taman Wisata Perairan Liang dan Pulau Ngali	Nusa Tenggara Barat	MMAF	713	33,461.00	2015	SK Gubernur No.523-505 Tahun 2016	-
15	Lunyuk	Taman Pesisir Penyu Lunyuk	Nusa Tenggara Barat	MMAF	713	70,000.00	2014	SK Gubernur No.523-505 Tahun 2016	-
16	Moyo	TL Pulau Moyo	Nusa Tenggara Barat	MoEF	713	6,000.00	1986	-	Kep MenHut No. 98/Kpts-II/2001. Tgl 15 Maret 2001
17	Panjang	CA Pulau Panjang	Nusa Tenggara Barat	MoEF	713	-	2009	-	598/Menhut-II/2009
18	Satonda	TWA Pulau Satonda	Nusa Tenggara Barat	MoEF	713	2,600.00	1998	-	Kep Menhut No. 22/Kpts-II/1998, Tgl. 22 Jan 1998
19	Teluk Bumbang	Taman Wisata Perairan Teluk Bumbang	Nusa Tenggara Barat	MMAF	713	6,310.00	2013	SK Gubernur No.523-505 Tahun 2016	-
20	Teluk Cempi	Suaka Alam Perairan Teluk Cempi	Nusa Tenggara Barat	MMAF	713	39,000.00	2014	SK Gubernur No.523-505 Tahun 2016	-
21	Toffo	CA Toffo Kota Lambu	Nusa Tenggara Barat	MoEF	573	-	2009	-	598/Menhut-II/2009
22	Danau Tuadele	SM Danau Tuadale	Nusa Tenggara Timur	MoEF	573	-	1999	-	423/Kpts-II/1999
23	Flores Timur	Suaka Alam Perairan Kabupaten Flores Timur	Nusa Tenggara Timur	MMAF	714	150,000.00	2013	PerBup No 4 Tahun 2013	-
24	Harlu	SM Harlu	Nusa Tenggara Timur	MoEF	573	2.26	1999	-	423/Kpts-II/1999
25	Komodo	Taman Nasional Komodo	Nusa Tenggara Timur	MoEF	713	173,300.00	1992	-	KepMen Kehutanan No.306/Kpts-II/92

No	MPA names (continued)	MPA official names	Provinces	Management body	WPP	Area (ha)	Year initiated	Initiation decree	Establishment decree
26	Laut Sawu	TN Perairan Laut Sawu dan sekitarnya	Nusa Tenggara Timur	MMAF	573	3,355,352.82	2009	-	KepmenKP No. 5/Kepmen-KP/2014
27	Lembata	Suaka Perikanan Perairan Pulau Lembata	Nusa Tenggara Timur	MMAF	573	225,624.00	2012	SK Bupati Lembata No. 420 Tahun 2012	-
28	Maubesi	CA Maubesi (RTK 189)	Nusa Tenggara Timur	MoEF	573	3.25	1999	-	423/Kpts-II/1999
29	Perhatu	SM Perhatu	Nusa Tenggara Timur	MoEF	573	-	1999	-	423/Kpts-II/1999
30	Riung	Cagar Alam Riung	Nusa Tenggara Timur	MoEF	713	2,000.00	1996	-	Kep MenHut No. 589/Kpts-II/1996 Tgl. 16-9-1996
31	Selat Pantar	Kawasan Konservasi Laut Daerah Selat Pantar	Nusa Tenggara Timur	MMAF	573	276,693.45	2009	Keputusan Bupati Alor No 6 th 2009	KepmenKP No. 35/KEPMEN-KP/2015, 16 Juni 2015
32	Sikka	KKPD Sikka	Nusa Tenggara Timur	MMAF	713	42,250.00	2010	No. 260 /HK/ 2010	-
33	Teluk Kupang	TWA Teluk Kupang	Nusa Tenggara Timur	MoEF	573	50,000.00	1993	-	KepMen Kehutanan No.18/Kpts-II/1993
34	Teluk Maumere	TWAL Teluk Maumere	Nusa Tenggara Timur	MoEF	713	59,450.00	1987	-	Kep MenHut No.126/Kpts-II/1987. Tgl 21 April 1987
35	Tujuh Belas Pulau	TWA Tujuh Belas Pulau	Nusa Tenggara Timur	MoEF	713	9,900.00	1996	-	Kep Menhut No. 589/Kpts-II/1996. Tgl 16 Sept 1996
36	Wae Wuul	CA Wae Wuul	Nusa Tenggara Timur	MoEF	573	1,484.84	1999	-	423/Kpts-II/1999
37	Wolo Tadho	CA Wolo Tadho	Nusa Tenggara Timur	MoEF	713	-	1999	-	423/Kpts-II/1999
38	Liran	Hutan Lindung Pulau Liran	Maluku	MoEF	714	-	-	-	-
39	Kayuadi	KKPD Pulo Kauna Kayuadi	Sulawesi Selatan	MMAF	713	3,983.00	2011	Keputusan Bupati Nomor 465/IX/Tahun 2011	-
40	Pasi Gusung	Kawasan Konservasi Laut Daerah Pulo Pasi Gusung	Sulawesi Selatan	MMAF	713	5,018.00	2011	Keputusan Bupati Kepulauan Selayar 466/IX/2011	-
41	Taka Bonerate	TNL Taka Bone Rate	Sulawesi Selatan	MoEF	713	530,765.00	2001	-	Kep MenHut No. 92/Kpts-II/2001 Tgl 29 Feb 2001
42	Bombana	Kawasan Konservasi Perairan Daerah Kabupaten Bombana -TWP	Sulawesi Tenggara	MMAF	714	19,176.98	2011	SK Bupati Bombana No. 384 Tahun 2011	-
43	Buton	KKPD Kabupaten Buton	Sulawesi Tenggara	MMAF	714	10,129.60	2014	SK Bupati No.1024 Tgl 30-12-2014	-
44	Buton Selatan	KKPD Buton Selatan - Taman Wisata Perairan	Sulawesi Tenggara	MMAF	714	35,698.73	2016	KepBup Buton Selatan No. 143.A Tahun 2016	-
45	Buton Tengah	KKPD Buton Tengah - Taman Wisata Perairan	Sulawesi Tenggara	MMAF	714	109,069.55	2016	KepBup Buton No. 1024 Tahun 2014	-
46	Buton Utara	SM Buton Utara	Sulawesi Tenggara	MoEF	714	-	2011	-	465/Menhut-II/2011
47	Kolaka	Suaka Perikanan Kolaka	Sulawesi Tenggara	MMAF	714	60,400.00	2013	SK Bupati No.200 Tahun 2013	-
48	Konawe	Suaka Perikanan Konawe	Sulawesi Tenggara	MMAF	714	10,430.00	2013	Nomor 225/04.DKP/SK-PEN-CADANGAN/I/2013	-
49	Muna	KKPD Kabupaten Muna	Sulawesi Tenggara	MMAF	714	76,417.16	2015	SK Bupati No 508 tahun 2014	-
50	Napabalano	CA Napabalano	Sulawesi Tenggara	MoEF	714	-	2011	-	465/Menhut-II/2011
51	Padamarang	TWAL Kepulauan Padamarang	Sulawesi Tenggara	MoEF	713	36,000.00	2003	-	Kep MenHut No.94/Kpts-II/2003. Tgl 19 Maret 2003
52	Rawa Aopa	TN Rawa Aopa Watumohai	Sulawesi Tenggara	MoEF	714	105,194.00	2011	-	465/Menhut-II/2011
53	Selat Tiworo	Kawasan Wisata Laut Selat Tiworo dan Pulau-pulau sekitarnya	Sulawesi Tenggara	MMAF	714	27,936.00	2004	SK Bupati No.157 Tahun 2004 Tgl.3-5-2004	-
54	Sulawesi Tenggara	KKPD Sulawesi Tenggara (Kota Kendari, Kab. Konawe, dan Kab. Konawe Selatan)	Sulawesi Tenggara	MMAF	714	21,786.14	2014	SK Gubernur 324 Tahun 2014 Tgl 18 Juni 2014	-
55	Tanjung Amolengo	SM Tanjung Amolengo	Sulawesi Tenggara	MoEF	714	-	2011	-	465/Menhut-II/2011
56	Tanjung Batikolo	SM Tanjung Batikolo	Sulawesi Tenggara	MoEF	714	4,060.00	2011	-	465/Menhut-II/2011
57	Tanjung Peropa	SM Tanjung Peropa	Sulawesi Tenggara	MoEF	714	38,973.00	2011	-	465/Menhut-II/2011
58	Teluk Lasolo	TWA Teluk Lasolo	Sulawesi Tenggara	MoEF	714	81,800.00	1999	-	KepMen Hutbun No. 451/Kpts-II/1999
59	Wakatobi	TNL Wakatobi	Sulawesi Tenggara	MoEF	714	1,390,000.00	2002	-	Kep MenHut No. 7661/Kpts-VI/1996 Tgl 19 Agus 2002
60	Wawonii	Kawasan Konservasi Perairan Pulau Wawonii	Sulawesi Tenggara	MMAF	714	28,340.00	2016	SK Gubernur Sulawesi Tenggara No.725 Th 2016	-
61	Morowali	KKPD Morowali	Sulawesi Tengah	MMAF	714	41,342.00	2013	SK Bupati No.188.45/SK.0283/DKP/2013	-
62	Angwarmase	CA Pulau Angwarmase	Maluku	MoEF	714	-	1999	-	415/Kpts-II/1999

No	MPA names (continued)	MPA official names	Provinces	Management body	WPP	Area (ha)	Year initiated	Initiation decree	Establishment decree
63	Ay & Rhun	Kawasan Konservasi Perairan Pulau Ay-Pulau Rhun	Maluku	MMAF	714	47,968.74	2016	KepGub Maluku No. 388 Tahun 2016, 23 Nov 2016	-
64	Baeer	Taman Wisata Pulau Baeer	Maluku	MMAF	714	82.00	2015	KepBug Maluku No. 386 Tahun 2016, 23 Nov 2016	-
65	Buano	Hutan Lindung Pulau Buano	Maluku	MoEF	714	-	-	-	-
66	Kasa	TWAL Pulau Kassa	Maluku	MoEF	714	1,100.00	1978	-	KepMen Pertanian No. 653/Kpts/Um/10/1978
67	Kei Kecil	KKP Kabupaten Maluku Tenggara	Maluku	MMAF	714	150,000.00	2012	SK Bupati Nomor 162 Tahun 2012	KepmenKP No.6/KEPMEN-KP/2016 Tgl 5-2-2016
68	Koon	Kawasan Konservasi Perairan Kab Seram Bagian Timur	Maluku	MMAF	714	9,901.00	2011	Kep Bupati No. 523/189/KEP/2011	-
69	Laut Banda	TWP Laut Banda	Maluku	MMAF	714	2,500.00	2009	Keputusan Menteri Kelautan dan Perikanan No. 69/MEN/2009	Kep MenKP No. 69/Men/2009. Tgl 3 September 2009
70	Lease	Kawasan Konservasi pesisir dan pu-lau-pulau kecil kepulauan Lease	Maluku	MMAF	714	81,573.48	2016	KepGub Maluku No. 387 Tahun 2016, 23 Nov 2016	-
71	Manusela	TN Manusela	Maluku	MoEF	714	174,545.59	1999	-	415/Kpts-II/1999
72	Marsegu	TWA Pulau Marsegu	Maluku	MoEF	714	11,000.00	1999	-	Kep MenHut No.144/Kpts-II/1999. Tgl 5 Maret 1999
73	Nustaram	CA Pulau Nustaram	Maluku	MoEF	714	-	1999	-	415/Kpts-II/1999
74	Parang	Hutan Lindung Pulau Parang	Maluku	MoEF	713	-	-	-	-
75	Pombo	TW Pulau Pombo	Maluku	MoEF	714	998.00	1996	-	Kep Menhut No. 329/Kpts-II/1996. Tgl. 30 Juli 1996
76	Tanimbar (SM)	Suaka Margasatwa Tanimbar	Maluku	MoEF	714	65,671.00	1999	-	Keputusan Menhut No. 149/Kpts-II/1999
77	Yamdena	Kawasan Konservasi Pesisir dan Pulau-Pulau Kecil (KKP3K) Taman Pulau Kecil	Maluku	MMAF	714	783,806.00	2016	SK Bupati No.523-246 tahun 2016	-
78	Danau Towuti	TWA Danau Towuti	Sulawesi Selatan	MoEF	713	65.00	2009	-	434/Menhut-II/2009
79	Luwu Utara	Kawasan Konservasi Laut Kabupaten Luwu Utara	Sulawesi Selatan	MMAF	713	605.94	2010	Keputusan Luwu Utara No. 287 Tahun 2010	-
80	Bakiriang	SM Bakiriang	Sulawesi Tengah	MoEF	714	12,500.00	1999	-	757/Kpts-II/1999
81	Banggai	KKPD Banggai	Sulawesi Tengah	MMAF	714	11,500.00	2014	SK Bupati Banggai Nomor 615/1697/DISLUTKAN/2014	-
82	Banggai Kepulauan	Kawasan Konservasi Laut Daerah Banggai Kepulauan	Sulawesi Tengah	MMAF	714	57,859.42	2014	SK Bupati No. 5408 tanggal 20 September tahun 2007	-
83	Banggai Laut	KKPD Banggai Laut	Sulawesi Tengah	MMAF	714	-	2014	Kep Bupati Banggai Laut Nomor 125 Tanggal 1 Juli 2014	-
84	Morowali (CA)	CA Morowali	Sulawesi Tengah	MoEF	714	225,000.00	1999	-	757/Kpts-II/1999
85	Kolaka Utara	KKPD Kabupaten Kolaka Utara	Sulawesi Tenggara	MMAF	714	37,320.33	2015	SK Bupati No. 85 Tahun 2015	-

Table 8. Subseascapes, provinces, MPAs and the size of MPAs, mangrove, seagrass, and coral reef ecosystems in each MPA

No	Subseascape, Provinces, MPAs	Management body	Mangrove (ha)	Seagrass (ha)	Reef (ha)
	Lesser Sunda Subseascape				
	Bali				
1	Bali Barat	MoEF	520.28	212.99	949.64
2	Buleleng	MMAF	-	11.47	323.44
3	Jembrana	MMAF	-	-	-
4	Karangasem	MMAF	-	-	393.08
5	Ngurah Rai	MoEF	818.45	3.44	86.56
6	Nusa Penida	MMAF	5.49	103.90	1,730.79
	Nusa Tenggara Barat				
7	Bangko-bangko	MoEF	32.06	0.09	18.32
8	Gili Balu	MMAF	24.58	143.38	2,023.25
9	Gili Banta	MMAF	-	-	1,161.70
10	Gili Matra	MMAF	-	195.62	711.38
11	Gili Sulat & Lawang	MMAF	19.30	198.69	2,176.65
12	Gitanada	MMAF	4.06	288.73	2,358.99
13	Kabete	MMAF	28.34	97.77	1,533.03
14	Liang & Ngali	MMAF	51.44	241.30	8,355.31
15	Lunyuk	MMAF	-	-	1,140.53
16	Moyo	MoEF	-	5.93	413.88
17	Panjang	MoEF	2,518.62	31.31	272.89
18	Satonda	MoEF	-	-	167.29
19	Teluk Bumbang	MMAF	0.22	118.98	468.34
20	Teluk Cempi	MMAF	61.83	-	3,693.88
21	Toffo	MoEF	20.61	1.78	77.67
	Nusa Tenggara Timur				
22	Danau Tuadele	MoEF	65.70	-	3.40
23	Flores Timur	MMAF	30.69	527.70	9,605.37
24	Harlu	MoEF	0.57	1.61	12.53
25	Komodo	MoEF	702.82	1,584.24	14,208.68
26	Laut Sawu	MMAF	328.55	5,254.40	65,043.36
27	Lembata	MMAF	83.25	1,169.94	10,177.35
28	Maubesi	MoEF	3,022.67	-	-
29	Perhatu	MoEF	21.48	-	0.49
30	Riung	MoEF	0.39	0.11	19.87
31	Selat Pantar	MMAF	44.82	1,984.59	10,391.50
32	Sikka	MMAF	3.05	204.58	3,208.43
33	Teluk Kupang	MoEF	57.16	223.36	8,335.68
34	Teluk Maumere	MoEF	15.48	567.80	7,129.09
35	Tujuh Belas Pulau	MoEF	23.62	247.83	2,631.91
36	Wae Wuul	MoEF	0.20	-	-
37	Wolo Tadho	MoEF	98.69	0.44	52.71
	Maluku				
38	Liran	MoEF	29.51	74.46	38.14
	Southern-Eastern Sulawesi Subseascape				
	Sulawesi Selatan				
39	Kayuadi	MMAF	-	-	836.72
40	Pasi Gusung	MMAF	2.59	148.80	1,898.30
41	Taka Bonerate	MoEF	-	-	58,553.93
	Sulawesi Tenggara				
42	Bombana	MMAF	8.47	-	17,934.42
43	Buton	MMAF	0.03	-	826.91
44	Buton Selatan	MMAF	-	-	2,538.84
45	Buton Tengah	MMAF	21.57	-	14,711.93
46	Buton Utara	MoEF	2,025.93	-	17.94
47	Kolaka	MMAF	4.41	-	2,209.18
48	Konawe*	MMAF	#N/A	#N/A	#N/A
49	Muna	MMAF	1,696.17	-	11,999.20
50	Napabalano	MoEF	0.41	-	-
51	Padamarang	MoEF	-	-	1,722.79

No	Subseascape, Provinces, MPAs (continued)	Management body	Mangrove (ha)	Seagrass (ha)	Reef (ha)
52	Rawa Aopa	MoEF	6,544.69	-	16.05
53	Selat Tiworo	MMAF	116.25	-	2,461.91
54	Sulawesi Tenggara	MMAF	46.93	-	2,275.06
55	Tanjung Amolengo	MoEF	228.40	-	20.34
56	Tanjung Batikolo	MoEF	25.94	-	0.15
57	Tanjung Peropa	MoEF	81.20	-	23.00
58	Teluk Lasolo	MoEF	70.56	-	2,345.64
59	Wakatobi	MoEF	742.53	9,388.23	67,372.12
60	Wawonii	MMAF	14.50		1,457.71
	Sulawesi Tengah				
61	Morowali	MMAF	239.75	2,368.31	11,174.42
	Inner Banda Arc Subseascape				
	Maluku				
62	Angwarmase	MoEF	17.28	0.69	15.58
63	Ay & Rhun	MMAF	-	-	297.85
64	Baeer	MMAF	-	-	4,705.57
65	Buano	MoEF	191.82	-	-
66	Kasa	MoEF	50.53	-	-
67	Kei Kecil	MMAF	1,073.22	-	13,760.07
68	Koon	MMAF	-	114.87	3,114.52
69	Laut Banda	MMAF	-	40.76	346.07
70	Lease	MMAF	651.61	852.55	2,288.39
71	Manusela	MoEF	919.80	-	2.81
72	Marsegu	MoEF	27.50	1,532.38	1,483.32
73	Nustaram	MoEF	3.69	-	-
74	Parang	MoEF	299.68	-	2.15
75	Pombo	MoEF	-	0.43	-
76	Tanimbar (SM)	MoEF	264.93	-	-
77	Yamdena	MMAF	27311.95	2,571.27	62,204.63
	Outside subseascape				
	Sulawesi Selatan				
78	Danau Towuti	MoEF	37.54	-	-
79	Luwu Utara*	MMAF	-	-	145.24
	Sulawesi Tengah				
80	Bakiriang	MoEF	24.08	-	-
81	Banggai*	MMAF	#N/A	#N/A	#N/A
82	Banggai Kepulauan	MMAF	491.55	-	31,477.43
83	Banggai Laut*	MMAF	#N/A	#N/A	#N/A
84	Morowali (CA)	MoEF	4,136.11	20.51	1.99
	Sulawesi Tenggara				
85	Kolaka Utara	MMAF	1.88	-	423.38

Note: The MPA names used in the table are simplified from the official names based on the governmental decrees (See Annex I, Table 10. The '' sign means that there is no boundary or MPA coordinates available in the MPA formal agreement, therefore calculation on the critical habitat coverage could not be done.*

Table 9. E-KKP3K scores for each MPA within the SBS region in 2015

No	Subseascape, Provinces, MPAs	Year initiated	Initiated	Established	Managed minimally	Managed optimally	Self- reliant	METT (%)
	Lesser Sunda Subseascape							
	Bali							
1	Bali Barat	1999	-	-	-	-	-	73
2	Buleleng	2011	100	100	71	40	33	-
3	Jembrana	2013	100	0	0	0	0	-
4	Karangasem	2017	-	-	-	-	-	-
5	Ngurah Rai	1993	-	-	-	-	-	59
6	Nusa Penida	2010	100	100	100	75	0	-
	Nusa Tenggara Barat							
7	Bangko-bangko	2009	-	-	-	-	-	47
8	Gili Balu	2014	100	100	71	18	17	-
9	Gili Banta	2005	100	36	5	14	17	-
10	Gili Matra	2014	100	100	90	18	0	-
11	Gili Sulat & Lawang	2014	100	100	71	29	0	-
12	Gitanada	2014	100	36	29	21	17	-
13	Kabete	2011	100	100	71	18	17	-
14	Liang & Ngali	2015	100	0	0	0	0	-
15	Lunyuk	2014	100	27	18	0	0	-
16	Moyo	1986	-	-	-	-	-	55
17	Panjang	2009	-	-	-	-	-	-
18	Satonda	1998	-	-	-	-	-	52
19	Teluk Bumbang	2013	100	36	19	21	17	-
20	Teluk Cempi	2014	100	9	5	18	16	-
21	Toffo	2009	-	-	-	-	-	-
	Nusa Tenggara Timur							
22	Danau Tuadele	1999	-	-	-	-	-	-
23	Flores Timur	2013	100	100	71	74	33	-
24	Harlu	1999	-	-	-	-	-	44
25	Komodo	1992	-	-	-	-	-	69
26	Laut Sawu	2009	100	100	90	39	0	-
27	Lembata	2012	100	35	0	0	0	-
28	Maubesi	1999	-	-	-	-	-	44
29	Perhatu	1999	-	-	-	-	-	-
30	Riung	1996	-	-	-	-	-	35
31	Selat Pantar	2009	100	100	90	69	0	-
32	Sikka	2010	100	100	71	29	0	-
33	Teluk Kupang	1993	-	-	-	-	-	-
34	Teluk Maumere	1987	-	-	-	-	-	-
35	Tujuh Belas Pulau	1996	-	-	-	-	-	-
36	Wae Wuul	1999	-	-	-	-	-	47
37	Wolo Tadho	1999	-	-	-	-	-	44
	Maluku							
38	Liran	-	-	-	-	-	-	-
	Southern-Eastern Sulawesi Subseascape							
	Sulawesi Selatan							
39	Kayuadi	2011	100	64	29	0	0	-
40	Pasi Gusung	2011	100	64	14	0	0	-
41	Taka Bonerate	2001	100	100	95	73	17	-
	Sulawesi Tenggara							
42	Bombana	2011	100	9	14	12	0	-
43	Buton	2014	100	55	10	14	0	-
44	Buton Selatan	2016	100	23	10	8	0	-
45	Buton Tengah	2016	100	27	10	5	0	-
46	Buton Utara	2011	-	-	-	-	-	-
47	Kolaka	2013	100	9	10	13	0	-
48	Konawe	2013	100	0	0	0	0	-
49	Muna	2015	100	36	19	37	0	-
50	Napabalano	2011	-	-	-	-	-	-
51	Padamarang	2003	-	-	-	-	-	-

No	Subseascape, Provinces, MPAs	Year initiated	Initiated	Established	Managed minimally	Managed optimally	Self- reliant	METT (%)
52	Rawa Aopa	2011	-	-	-	-	-	61
53	Selat Tiworo	2004	100	9	14	10	0	-
54	Sulawesi Tenggara	2014	100	100	71	19	0	-
55	Tanjung Amolengo	2011	-	-	-	-	-	-
56	Tanjung Batikolo	2011	-	-	-	-	-	46
57	Tanjung Peropa	2011	-	-	-	-	-	47
58	Teluk Lasolo	1999	-	-	-	-	-	-
59	Wakatobi	2002	100	91	38	18	0	74
60	Wawonii	2016	-	-	-	-	-	-
	Sulawesi Tengah							
61	Morowali	2013	100	0	0	0	0	
	Inner Banda Arc Subseascape							
	Maluku							
62	Angwarmase	1999	-	-	-	-	-	-
63	Ay & Rhun	2016	-	-	-	-	-	-
64	Baeer	2015	-	-	-	-	-	-
65	Buano	-	-	-	-	-	-	-
66	Kasa	1978	-	-	-	-	-	44
67	Kei Kecil	2012	100	100	71	76	0	-
68	Koon	2011	100	100	71	47	50	-
69	Laut Banda	2009	100	100	43	22	0	-
70	Lease	2016	-	-	-	-	-	-
71	Manusela	1999	-	-	-	-	-	68
72	Marsegu	1999	-	-	-	-	-	46
73	Nustaram	1999	-	-	-	-	-	-
74	Parang	-	-	-	-	-	-	-
75	Pombo	1996	-	-	-	-	-	52
76	Tanimbar (SM)	1999	-	-	-	-	-	-
77	Yamdena	2016	100	0	0	0	0	-
	Outside subseascape							
	Sulawesi Selatan							
78	Danau Towuti	2009	-	-	-	-	-	49
79	Luwu Utara	2010	100	0	0	0	0	-
	Sulawesi Tengah							
80	Bakiriang	1999	-	-	-	-	-	51
81	Banggai	2014	100	0	0	0	0	-
82	Banggai Kepulauan	2014	100	36	0	0	0	-
83	Banggai Laut*	2014	-	-	-	-	-	-
84	Morowali (CA)	1999	-	-	-	-	-	46
	Sulawesi Tenggara							
85	Kolaka Utara	2015	100	9	10	13	0	-

Annex II. Survey and assessment methods

There are several methods that were used to assess the state of MPAs in the SBS region. This includes spatial analysis, ecological monitoring, social monitoring, marine resource governance monitoring and management tool assessment. In this section, we outline the monitoring protocols and methods used to generate the data synthesized in this report.

Spatial analysis

In general, spatial analysis was used to analyze the coverage data of mangrove, seagrass, and coral reef ecosystems obtained from the Indonesian Geospatial Information Agency (Badan Informasi Geospasial – BIG) One Map Policy version 2016. It was employed using ArcMap to generate data and information in the following indicators (Table 10).

Table 10. Indicators of which the data were analyzed using spatial analysis, including the methods and data sources in the analysis

Indicator No.	Indicators	Methods	Data source	E-KKP3K, EAFM, and SDG indicators
1	Sufficient habitats in MPAs	Percentage of critical habitats within MPAs to those in the SBS region (critical habitats are mangroves, seagrass, coral reefs).	BIG – One Map Policy 2016; MPA shapefiles from the Directorate of Conservation and Biodiversity	EAFM (2.5), E-KKP3K (B57, B57B), SDG (14.5.1)
2	Spacing between MPAs within the MPA network	MPAs spread out at distances that ensure ecological connectivity and the spreading of risk. Distances were measured by digitizing the line of an MPA to other MPAs. If distances were less than 100 km then MPAs are considered connected. Connectivity was classified into three classes (0 - 2, 2 – 6, >6 MPA connections).	MPA shapefiles from the Directorate of Conservation and Biodiversity	SDG (14.5.1)
3	Non-extractive critical habitats in MPAs	Percentage of critical habitats within no take zones (NTZs) and take zones (TZs) in MPAs (critical habitats are mangroves, seagrass, coral reefs). NTZs include core zones, tourism zones, rehabilitation zones and protection zones. Especially for this calculation, we only used MPAs that are located in coastal areas. This means some MPAs under the management of MoEF that are located mainly in the mainland are not included in the calculation.	BIG – One Map Policy 2016; MPA shapefiles from the Directorate of Conservation and Biodiversity	EAFM (2.5), E-KKP3K (B57, B57B)
13	Mangrove cover	Mangrove cover (ha) in MPAs across the SBS region.	2014 and 2016 mangrove cover data from MoEF; MPA shapefiles from the Directorate of Conservation and Biodiversity	E-KKP3K (B57, B57B), EAFM (2.3)
14	Seagrass cover	Seagrass cover (ha) in MPAs across the SBS region.	BIG – One Map Policy 2016; MPA shapefiles from the Directorate of Conservation and Biodiversity	E-KKP3K (B57, B57B), EAFM (2.2)

Ecological monitoring

In SBS, reef health is often monitored by various partners and stakeholders working in the region. Most stakeholders conducted the ecological monitoring programs in collaboration with various partners, including universities, local governments and other NGOs. In total, there were 279 sites within 23 MPAs that have been surveyed and monitored in the SBS region (Fig. 33).

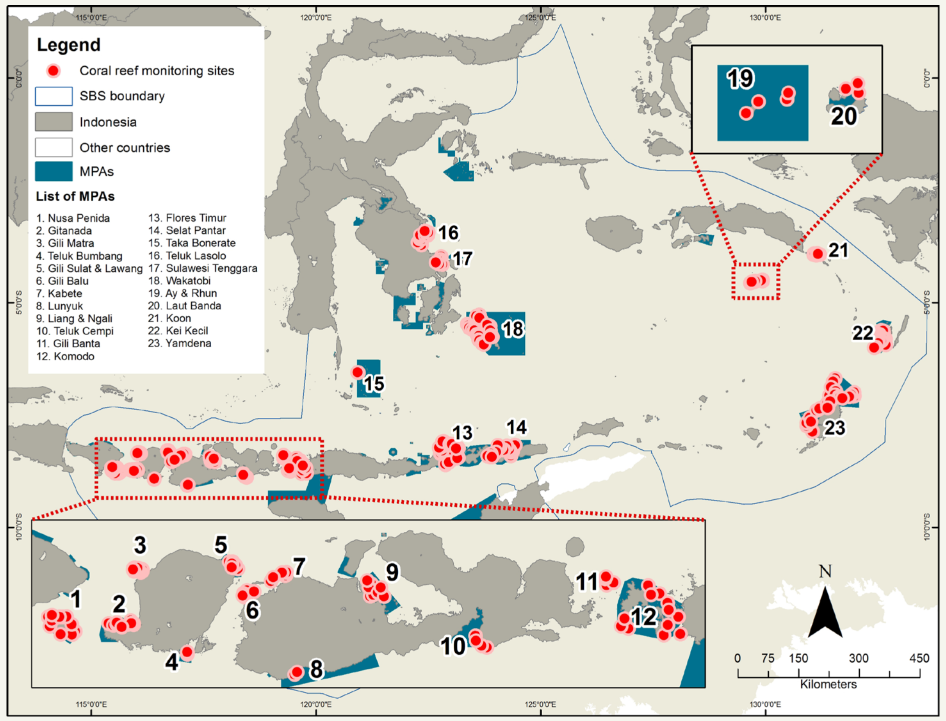

Figure 33. Monitoring sites within MPAs in which ecological surveys were conducted

There are three different ecological monitoring protocols used to collect benthic and fish data in this dashboard. The Ahmadia et al. (2013) and Amkieltiela and Wijonarno (2015) ecological monitoring protocols were used to survey and monitor MPAs in Komodo, Flores Timur, Selat Pantar, Teluk Lasolo, Sulawesi Tenggara, Wakatobi, Koon, Kei Kecil and Yamdena. In addition, Gili Matra, Gili Balu, Gili Banta, Gili Sulat and Lawang, Gitanada, Kabete, Liang and Ngali, Lunyuk, Teluk Bumbang and Teluk Cempi were surveyed/monitored using Yulianto et al. (2012) technical guidelines on coral reef, seagrass, and mangrove monitoring. Nusa Penida, Laut Banda and Ay and Rhun were surveyed based on Wilson and Green (2009)'s ecological monitoring protocol. Overall, the ecological monitoring was mainly focused on examining two main components in coral reef ecosystems, including benthic cover (healthy hard coral cover) and fish populations (biomass). Benthic cover may indicate the impact of MPA management in relation to the health of the ecosystem, e.g. an increase in macroalgae cover may indicate the presence of nutrient pollution or the loss of herbivorous fish. Fish populations observed include six main families (Table 11) that are economically important for artisanal or commercial fishers and are ecologically important for maintaining coral reef resilience (Ahmadia et al. 2013).

Data were collected using 50 m transects with three to five replications at each site. To cope with the differences of protocols in collecting ecological data, we only used data that were collected from approximately 8-12 m depths, except for those from Gili Balu, Kabete, Liang and Ngali and Lunyuk, in which the data were collected from 3-6 m depths. Fish data were limited to only fish sized 10 cm and larger.

In this report, we synthesize data via three ecological components to assess some indicators, which are parts of the 'ecosystem health' domain and 'fish and fisheries' domain. Three indicators included in these domains are hard coral cover, key fisheries species biomass, and herbivorous fish biomass (Table 11).

Table 11. Indicators of which the data were collected using ecological monitoring, including the methods and data sources in the analysis

Indicator No.	Indicators	Methods	Data source	E-KKP3K, EAFM, and SDG indicators
12	Hard coral cover	Underwater transect surveys using point intercept transect (PIT). Hard coral cover was calculated from the average percentage of healthy hard coral cover across sites in each MPA.	Reef health monitoring data	E-KKP3K (B57, B57A), EAFM (2.4)
15	Biomass of key fisheries species	Underwater transect surveys using belt transect. Three fish families that were observed are Lutjanidae (snappers), Haemulidae (sweetlips), and Serranidae (groupers). The total biomass was calculated across species from the three families in each MPA.	Reef health monitoring data	E-KKP3K (B58, B58A, B58B); EAFM (1.7)
16	Biomass of herbivorous fish	Underwater transect surveys using belt transect. Three fish families that were observed are Acanthuridae (surgeonfish), Siganidae (rabbitfish), and Scaridae (parrotfish). The total biomass was calculated across species from the three families in each MPA.	Reef health monitoring data	E-KKP3K (B58, B58A, B58B), EAFM (1.7)
17	Fishing pressure	The average 90th quantile of fish size observed across sites in each MPA.	Reef health monitoring data	EAFM (1.2), E-KKP3K (B58, B58B)

Social well-being surveys

In the SBS region, until early 2017, social well-being surveys had been conducted in five MPAs to collect baseline data on human well-being (Fig. 34). In Selat Pantar and Flores Timur, the survey was undertaken by University of Nusa Cendana (UNDANA) in 2014 (Mohebalian et al. 2016a, Mohebalian et al. 2016b). In addition, University of Pattimura (UNPATTI) conducted social surveys in Kei Kecil and Koon, both in 2016 as well as in Yamdena in 2017 (Mohebalian et al. 2017).

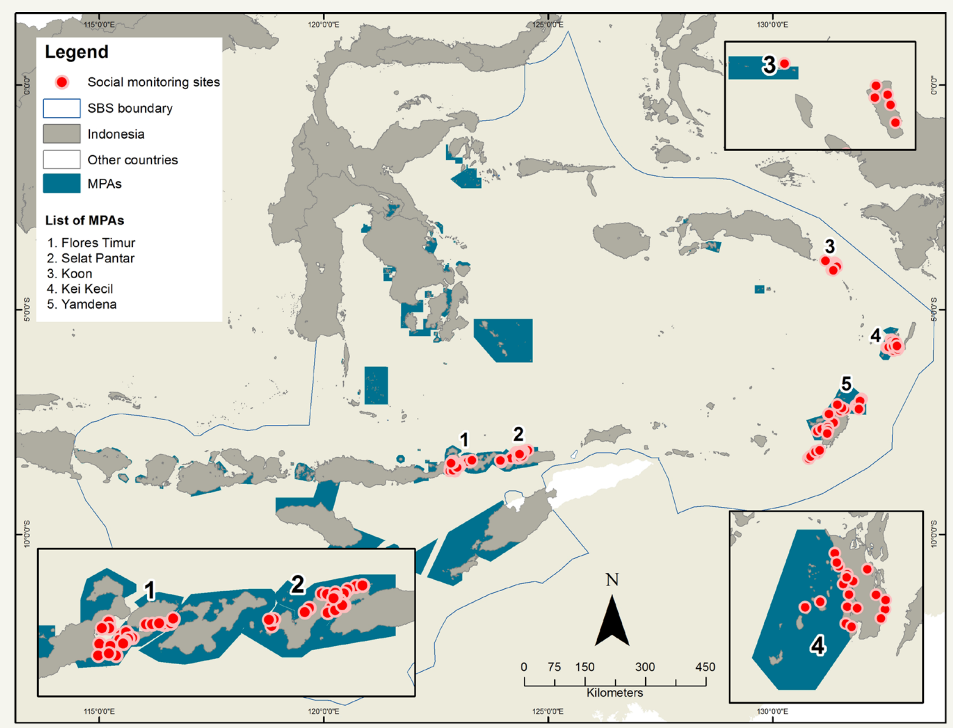

Figure 34. Settlements in MPAs in which socio-economic surveys were conducted

In practice, the social well-being survey includes surveys of households that are residents at settlements within MPA boundaries. Settlements include villages (*desa/kampung/negeri*) and subvillages (*dusun*). Overall, a total of 1,124 households were interviewed and 82 settlements were surveyed, consisting of 284 households and 21 settlements in Flores Timur; 133 households and 20 settlements in Selat Pantar; 214 households and nine settlements in Koon; 249 households and 14 settlements in Kei Kecil and 244 households and 18 settlements in Yamdena (Mohebalian et al. 2016a, Mohebalian et al. 2016b, Mohebalian et al. 2017).

The household samples were determined using random sampling and power analysis according to the social impact monitoring field manual (Glew et al. 2012). In this report, we synthesize five indicators in the human well-being domain:

1. **Economic well-being**, which is defined as the resources people use to meet basic consumption and material needs, and access other sources of well-being (Sen, 1999). This indicator aligned with EAFM (5.1) and E-KKP3K (B68).

The proxy for this indicator is **material asset index**. Material assets can be defined as a physical possession that is in working order, owned by a household. They include the following eleven items: radio/stereo/CD player/ DVD player, TV, satellite dish, phone (mobile or landline), generator, boat without a motor, boat with outboard motor, boat with inboard motor, bicycle, motorcycle and car/truck. Each of these items is then weighted based on cost, whereby a high cost item is given greater weight. The weighted sum of all items that each household owns is then calculated.

2. **Health**, which can be defined as the state of complete physical, mental and social well-being, and not merely the absence of disease or infirmity (World Health Organisation, 1995). This indicator aligned with E-KKP3K (B68) and SDG (2.1.1, 2.1.2).

The proxy for this indicator is **food security index**. Food security can be defined as the ability of all people to access nutritionally adequate and safe food for an active and healthy life at all times in socially acceptable ways (Bickel et al. 2000). In this report, we use the level of food security adopted from Bickel et al. (2000) and United States Department of Agriculture (USDA), which classify food security into three categories, including:

a. **Food Secure**: Households show no or minimal evidence of food insecurity, meaning that they are able to access sufficient nutritionally adequate and safe food, in a socially acceptable way.

b. **Food insecure without hunger**: Food insecurity is evident in household members' concerns about adequacy of the household food supply and in adjustments to household food management, including reduced quality of food and increased unusual coping patterns. Little or no reduction in members' food intake is reported.

c. **Food insecure with hunger**: Food intake for household members has been reduced to an extent that implies that household members have repeatedly experienced the physical sensation of hunger.

3. **Political empowerment**, which represents people's ability to participate in the decision-making processes that affect their lives (Rowlands, 1995). This indicator aligned with E-KKP3K (B61) and SDG (1.4.1).

The proxy for this indicator is **marine tenure index**. Mascia and Claus (2009) classify marine resource rights into five categories, consisting of (1) the right to determine who enters an MPA and who utilizes its specific resource; (2) the right to define when, where and how specific resources can be used; (3) the right to manage an MPA, including making decisions on how the resources are used; (4) the right to exclude others from an MPA, including making decisions on who can take advantage of the MPA; and (5) the right to transfer marine resource management and exclusion rights to others, such as selling or leasing rights. In this report, we use marine tenure index, which ranges from zero to five, to measure the number of specific marine resource rights that each household had exercised in the last 12 months prior to the survey.

4. **Education**, which can be defined as the structures, systems and practices used to transfer knowledge and skills in a society (Stephanson and Mascia, 2014). This indicator is aligned with SDG (4.3.1, 4.6.1, 4.7.1).

The proxy for this indicator is school enrollment rate. In this report, we measure the proportion of school aged children (between the ages of 5 and 18 years old) enrolled in formal education in each household within the MPA.

5. **Culture**, which encompasses art, ways of living together, value systems, traditions and beliefs (UNESCO, 2001). This indicator is aligned with SDG (1.4.1).

The proxy for this indicator is **place attachment index**, which measures the emotional connection between an individual and his environment (Williams and Vaske, 2003). In the survey, respondents were asked about their personal emotional connection to their local fishing grounds.

Marine resource governance surveys

In addition to the monitoring on human well-being, the social surveys also examine the status of marine resource governance in five MPAs: Selat Pantar, Flores Timur, Kei Kecil, Koon and Yamdena. Marine resource governance covers any approach associated with the management of marine resources, which includes how management decisions are made, who is involved in decision making, how management decisions are enforced and how rules for governing marine resources are created (Mascia et al. 2017).

To monitor marine resource governance, focus groups and key informant interviews (KIIs) were done at each randomly selected village/settlement in each MPA. Overall, a total of 62 focus groups were conducted in all MPAs and 112 key informants were interviewed. These consisted of 21 focus groups and 21 key informants in Flores Timur; 21 focus groups and 19 key informants in Selat Pantar; nine focus groups and 19 key informants in Koon; 14 focus groups and 36 key informants in Kei Kecil; and 18 focus groups and 38 key informants in Yamdena (Mohebalian et al. 2016a, Mohebalian et al. 2016b, Mohebalian et al. 2017). The focus groups and key informant interviews focused on several aspects, including how decisions are made, the rules governing the use of marine resources, how the marine resource rules are monitored and enforced, how conflicts over marine resources are resolved and threats to marine resources. We synthesized the following five aspects with specific indicators in the governance domain in Table 12.

Table 12. Indicators of which the data were collected in the governance monitoring, including the methods and data sources in the analysis

Indicator No.	Indicators	Methods	Data source	E-KKP3K, EAFM, and SDG indicators
4	Perceived threats to marine resources	Number of perceived threats to marine resources identified by locals at the MPA level.	Households surveys	EAFM (6.1), E-KKP3K (B64)
19	Participation in decision making	The average proportion of group members participating in managing local marine resources, both in formal or informal groups.	Household surveys	EAFM (4.1, 6.2, 6.3)
20	Resource use rules	Average proportion of the number of key species and habitat with rules associated with them.	Focus groups	EAFM (4.3)
21	Conflict resolution	Average time required to resolve conflict over local marine resources among users and between users and officials.	Key informant interview	EAFM (4.2)
22	User participation in monitoring and enforcement	Average proportion of households that are members of at least one organization participating in managing local marine resources.	Household surveys	E-KKP3K (B62, B63), EAFM (4.1)

At each settlement, focus groups were done with at least 6-12 participants facilitated by a field coordinator. The participants of focus groups should be knowledgeable about the status, use, and management of local marine resources. Participants came from a various range of people using MPAs with all social backgrounds. Key informant refers to individuals who have specific, detailed knowledge about how marine resources are used and managed in the MPA. Potential key informants were identified through multiple approaches, which include consulting knowledgeable local residents, identifying 'stand-out' participants in focus groups and asking existing key informants to recommend other potential interviewees. In these studies, key informants include members of specific local groups (including fishers and non-fishers), local leaders and officials, academic or technical professionals who work in marine environments and government officials (Glew et al. 2012).

Management tool assessment

The assessment on management tools, specifically the E-KKP3K, is conducted to examine the status of two indicators: (1) management capacity and resources and (2) clearly defined boundaries (Table 13). We specifically filtered out some indicators and questions in the E-KKP3K evaluation forms which related to the intended dashboard indicators, and then calculated the proportion of fulfilled questions and indicators from each MPA.

Table 13. Indicators of which the data were collected by assessing E-KKP3K evaluation forms, including the methods used in the analysis

Indicator No.	Indicators	Methods	Data source	E-KKP3K, EAFM, and SDG indicators
5	Management capacity and resources	The average proportion of fulfilled E-KKP3K indicators related to management capacity, resources and facilities.	E-KKP3K evaluation forms submitted by each collaborating partner	EAFM (6.6), E-KKP3K (K9, K10, K11, K12, K15, K16, K17, K18, K19, H20, H21, H22, H23, H24, H25, H26, H27, H30, H31, H32, H33, H35, H37, B41, B42, B43, B44, B45, B46, B47, B53)
6	Clearly defined boundaries	The average proportion of fulfilled E-KKP3K indicators related to MPA zoning and management plans.	E-KKP3K evaluation forms submitted by each collaborating partner	E-KKP3K (K13, H28, H29, H34, H36, H39, H40, B49)

A fluted giant clam (*Tridacna squamosa*) on a reef off East Flores.

The Sunda Banda Seascape (SBS) in Indonesia's Coral Triangle is considered one of the top priority marine ecoregions for conservation by the Indonesian government. The region is divided into three subseascapes, which includes the Lesser Sunda Subseascape (LSS), the Southern-Eastern Sulawesi Subseascape (SESS), and the Inner Banda Arc Subseascape (IBAS). The SBS dashboard provides a science-based assessment of the status of 22 indicators grouped within five domains, which includes: **(1) enabling conditions**, **(2) human well-being**, **(3) ecosystem health**, **(4) fish and fisheries**, and **(5) governance**, across marine protected areas for 2017.

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