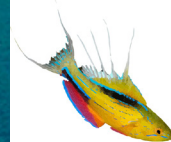


2016 STATE OF THE BIRD'S HEAD SEASCAPE MARINE PROTECTED AREA NETWORK



**BIRD'S HEAD
SEASCAPE**

Raja Ampat • Triton Bay • Cenderawasih Bay

SUGGESTED CITATION

Ahmadia, G.N., Awaludinnoer, L. Glew, F. Pakiding, J. Harris, N. Hidayat, E. Ihsan, M. Mascia, D. Matualage, P. Mohebalian, D. Pada, Purwanto.

State of the Bird's Head Seascape MPA Network Report, 2016. World Wildlife Fund, Conservation International, The Nature Conservancy, and Universitas Papua, Washington D.C., United States, Jakarta, Indonesia, and Manokwari, Indonesia.

Images: © Conservation International / photos by (from front to back) W. Turner, S. Zumbrunn, J. Yonover, K. Lawrence, K. Ellenbogen, A. Goram, K. Lawrence, J. Yonover, S. Zumbrunn, B. Jones and M. Shimlock, K. Ellenbogen, and W. Turner.

KATA PENGANTAR



Dengan penuh rasa syukur atas rahmat dan anugerah yang telah dilimpahkan oleh Yang Maha Kuasa pada Bentang Laut Kepala Burung, perkenankan saya mempersembahkan laporan kedua "Status Jejaring Kawasan Konservasi Perairan". Dokumen ini merupakan suatu bentuk pemberhentian sejenak yang penting dari suatu perjalanan panjang, melalui usaha bertahun-tahun oleh ratusan orang yang bekerja untuk melindungi keanekaragaman hayati laut yang unik, yang terdapat dalam wilayah Bentang Laut Kepala Burung Papua serta menjamin keberlanjutannya, dan menumbuhkan kehidupan masyarakat yang bermukim pada wilayah tersebut. Laporan ini disusun berdasarkan Laporan Status Jejaring Kawasan Konservasi Perairan Daerah Wilayah Bentang Laut Kepala Burung tahun 2015.

Selama dasawarsa terakhir, konservasi kelautan telah mengupayakan perlindungan pada lebih dari 3,5 juta hektar di wilayah Bentang Laut Kepala Burung, termasuk dengan hadirnya Balai Besar Taman Nasional Teluk Cenderawasih dan dua jejaring besar dari Kawasan Konservasi Laut: Jejaring Kaimana dan Jejaring Raja Ampat. Setiap Kawasan Konservasi Laut dari sembilan Kawasan Konservasi Laut yang ada di Bentang Laut Kepala Burung menampilkan suatu yang unik dari bentang-laut ini, dan secara bersama-sama, mereka mewakili hampir seperlima dari harta Kawasan Konservasi Laut Indonesia. Konservasi yang efektif pada skala ini tergantung pada penilaian kondisi ekologi dan sosial yang akurat, dan didukung oleh serangkaian kegiatan monitoring dan evaluasi yang menyeluruh. Dokumen ini merupakan produk dari kegiatan monitoring yang telah dirancang dengan baik disertai analisa ilmiah yang teliti, dan dilakukan oleh suatu tim kerja yang telah bekerja keras dengan dukungan dari berbagai pihak.

Dokumen ini memberikan gambaran mengenai kondisi setiap Kawasan Konservasi Laut di wilayah Bentang Laut Kepala Burung beserta penjelasan dan kecenderungan utama baik secara ekologi, sosial, tata-kelola dan juga mencakup indikator-indikator penilaian pengelolaan suatu kawasan. Harap dicatat bahwa bahwa perubahan (baik peningkatan atau penurunan) pada setiap variable yang dikaji dalam dokumen ini tidak dapat secara langsung dikaitkan dengan Kawasan Konservasi Laut tertentu, tetapi merefleksikan berbagai berbagai proses ekologi dan sosial. Dalam versi yang akan datang dari dokumen ini akan dipublikasikan secara rutin sehingga memungkinkan adanya pengelolaan laut yang adaptif untuk generasi mendatang.

Harapan kami, semoga dokumen ini tidak hanya menjadi sumber informasi yang sangat baik, tetapi juga akan mendukung proses penyesuaian pengelolaan Kawasan Konservasi Laut pada Bentang Laut Kepala Burung. Seiring dengan inisiatif-inisiatif lain yang juga penting, pengelolaan ini akan memastikan bahwa generasi yang akan datang di Tanah Papua akan menikmati secara terus-menerus berkat dari kekayaan laut yang terdapat pada wilayah Bentang Laut Kepala Burung di Papua Barat dalam wadah Provinsi Konservasi. Kami sampaikan apresiasi dan terima kasih yang sangat mendalam kepada semua pihak yang telah berkomitmen dan bekerjasama untuk menghasilkan dokumen yang penting ini.

Gubernur Papua Barat

Drs. DOMINGGUS MANDACAN

EXECUTIVE SUMMARY

The Bird's Head Seascape (BHS) of West Papua, Indonesia, is the global epicenter of marine biodiversity and a priority for conservation. Over the past decade, marine conservation efforts, led by the Indonesia government in partnership with civil society and local communities, have brought more than 3.6 million hectares under protection through the establishment and management of Marine Protected Areas (MPAs) in the Seascape.

Since 2008, local universities, government agencies, and non-governmental organizations (NGOs) have worked together to develop rigorous methods to monitor the ecological and social conditions of the BHS MPA network. This is the second annual BHS State of the Seascape report providing a scientific assessment of the status and trends of nine key ecological and social indicators across the BHS MPA Network for 2016. These indicators include standard scientific measurements of coral reef ecosystem health, marine fisheries, and human well-being (including economic well-being, health, empowerment, education, and culture). At the same time, the report also documents the management status and marine resource governance in each MPA.

At the Seascape level, all three ecosystem indicators (hard coral cover, key fisheries species, and fish functional group biomass) remain stable. While ecological indicator responses vary among the Seascape's MPAs, in general, hard coral cover, biomass of key fisheries species, and biomass of fish functional groups are being maintained. The stability of these key indicators of ecosystem health suggests that coral reefs of the BHS MPA Network are in better condition and may be more resilient to climate change than many coral reef ecosystems worldwide (e.g. Jackson et al., 2014). Continued progress in MPA management will be needed to sustain and improve ecological conditions across the Seascape.

Trends in human well-being are highly variable across the Seascape. Household food security and school enrollment rates are increasing across the Seascape, likely driven by government investment and improving market access. In contrast, household material assets and marine tenure are declining, likely due to fuel price inflation and a shift in the management authority over marine resources, respectively. Place attachment—the emotional connection to the marine environment—remains high and stable. Trends in human well-being are broadly consistent across the BHS MPAs, suggesting that regional-scale political, economic, or social processes may be driving these trends rather than local-scale dynamics. World Bank Scorecard management assessments indicate that in general, MPA management is continuing to improve. There is some variation among MPAs, with 2016 management effectiveness scores highest for Kofiau dan Pulau Boo MPA and a decline in management effectiveness reported in Teluk Cenderawasih National Park.

Government, civil society, and local communities need to build on their current successes in the BHS MPA Network by further mitigating manageable threats (e.g. destructive fishing), strengthening MPA management (e.g. ensuring participation of key stakeholders), and striving to improve human well-being (e.g. economic well-being). In so doing, this will foster sustainable development and support healthy, productive, resilient local communities and ecosystems across the Seascape.



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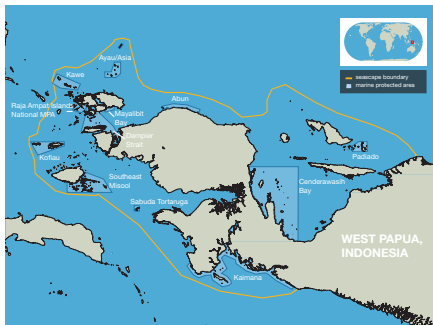
LIST OF ACRONYMS

BHS	Bird's Head Seascape
EKKP3K	Technical Guidelines for Evaluating the Management Effectiveness of Aquatic, Coastal, and Small Island Conservation Areas
IPCC	Intergovernmental Panel on Climate Change
MMAF	Ministry of Marine Affairs and Fisheries
MPA	Marine Protected Area
NGO	Non-governmental organization
UNIPA	University of Papua

1. INTRODUCTION



The Bird's Head Seascape is the global epicenter of marine biodiversity, supporting more than 600 species of coral and more than 1,700 species of coral reef fish.



Area: 22.5 million hectares

Key habitats: Coral reefs, mangroves, seagrass beds, marine lakes

Key species: Cetaceans, leatherback turtles, coral reef fishes

Population: ~350,000 individuals

Primary occupation: Agriculture, marine capture fisheries, wage labor

Threats: Destructive/illegal fishing, overharvesting, ecosystem impacts of fisheries, land-based development

Primary fishing gear: Hand-held gear (e.g. gleaning, hand-held line, spear gun)

1.1 BIRD'S HEAD SEASCAPE As the global epicenter of marine biodiversity, the Bird's Head Seascape (BHS) of West Papua, Indonesia, is a priority for international conservation efforts. The BHS, which encompasses more than 2,500 islands spread across 225,000 square km (or 22.5 million hectares), is home to approximately 75% of the world's scleractinian coral species (Veron et al., 2009; Wallace et al., 2011). At the same time, the waters of the BHS provide critical habitat for globally threatened sea turtles and cetaceans (Mangubhai et al., 2012). These natural riches support the livelihoods and food security of approximately 350,000 people in coastal communities (Badan Pusat Statistik, 2010). The coastal communities of the BHS are highly dependent on marine resources, with marine capture fisheries providing the main source of monetary income for almost a third of households and the majority of dietary protein for 69% of households (Glew et al., 2012). Consequently, it is critical to maintain the health and productivity of BHS coastal marine ecosystems to continue to sustain coastal livelihoods in the region.

1.2 MPA ESTABLISHMENT HISTORY

The globally unique marine biodiversity in the BHS has made the region a strategic conservation priority. Over the past decade, marine conservation efforts led by the Indonesian government in partnership with civil society and local communities have brought more than 3.6 million hectares under protection, through the establishment and management of Marine Protected Areas (MPAs). This effort began in 2004, when local communities, government, and nongovernmental organizations (NGOs) identified the BHS as a conservation priority and began the process of formally designating a network of MPAs across the region, to secure the long-term effective management of

marine resources to ensure food security, sustainable economic benefits, and conserve biodiversity. By 2009, 12 MPAs had been established, stretching from Teluk Cenderawasih National Park in the east of the Seascape, to the Raja Ampat MPA Network in the west. In 2010, a government decree designated Raja Ampat as a shark and ray sanctuary, the first of its kind in the Coral Triangle. **Following MPA establishment, management capacity continues to develop alongside the support of local communities to conserve their marine natural resources across the BHS.**

1.3 SOCIAL CONTEXT

Approximately 52,000 individuals are resident in more than 142 coastal communities within BHS MPAs. The population resident in each MPA varies, from approximately 1,500 in Buruway MPA to more than 26,000 in Teluk Cenderwasih National Park. Household heads range in age from 18 to 96 years old (averaging 44 years). Households are relatively large, compared to the Indonesian average of 3.9, with a typical household containing seven individuals. Communities are relatively stable, with households resident in the same settlement for an average of 29 years. Average household residency varies very little among the BHS MPAs, ranging from 25 years in Kofiau dan Pulau Boo MPA to 34 years in Teluk Cenderawasih National Park.

The population of the BHS MPA Network is predominantly Christian (75%) with a smaller minority of households identifying as Muslim (24%). The Seascape is ethnically diverse, with more than 145 distinct ethnic identities reported by individuals resident in the BHS MPAs between 2010 and 2015. Major ethnic groups include Wandamen (including Bintuni, Wamesa, Wandamen-Windesi, Windesi), Biak (including Biak-Numfor, Numfor), Maya (including Sailolof, Salawati, Samate) and Waigeo (including Ambel, Amber). There are small minorities of individuals reporting ethnic identities associated with elsewhere in Papua Barat, Papua and Maluku Provinces.

Many coastal households resident in the BHS MPA Network rely on agriculture as their primary occupation (39%), typically cultivating corn, soybeans, peanuts, cassava, and sweet potatoes on small plots for subsistence consumption, as well as to generate cash income (Firman & Azhar, 2006). Other primary occupations for households resident in the Seascape are wage labor (24%), marine capture fisheries (28%) or harvesting forest products (8%). The proportion of households reliant on fisheries as their primary income is highest in Teluk Cenderawasih National Park (44%)



and Teluk Mayalibit MPA (39%), and lowest in Kofiau dan Pulau Boo MPA (9%) and Misool Selatan Timur MPA (16%).

1.4 MARINE RESOURCE USE

Approximately one quarter (27%) of households in the BHS MPA Network rely on marine capture fisheries as their primary occupation (i.e., the most important way the household meets its needs). An additional 34% of households in the BHS MPA Network rely on fishing as a secondary occupation, supplementing other income-generating activities (e.g. agriculture), meaning that nearly two-thirds of coastal households in the MPA Network rely on marine fisheries to some extent to meet their needs.

Fishing activity is highly variable, with almost half (48%) of households fishing more than a few times per month, while only 7% of households fish infrequently (i.e., once in six months or never). Households in Selat Dampier MPA fish most frequently, with 14% of households resident in the MPA fishing more than a few times a week. Households resident in Teluk Cenderawasih National Park fish least frequently, with only 8% of households fishing more than a few times per week.

In 2010, a government decree designated Raja Ampat as a shark and ray sanctuary, the first in the Coral Triangle.

Hand-held gear (e.g., gleaning, hand-held lines, and spear guns) dominates the locally-based fishing fleet in the BHS MPA Network, with 61% of households identifying this as their primary gear type. Key target species, reported by settlement-level focus groups, include grouper (*Serranidae* spp.) and skipjack tuna (*Katsuwonus* spp.). Fishing effort varies with season depending on sea conditions. The low fishing season occurs in January through April due to the southeast monsoon season when sea conditions are rough, while the high fishing season occurs during the calmer months of October and November.

1.5 MARINE RESOURCE DEPENDENCE

Though the majority of coastal households in the BHS MPA Network does not fish as the primary occupation, marine resource dependence is relatively high. Most households (71%) rely on marine capture fisheries to some extent to meet their needs and fishing generates more than

half the cash income received by 30% of households in the Seascope. At the same time as providing a source of income, marine fisheries are also a substantial component of local diet. Almost two-thirds of households consume fish on at least a weekly basis (59%), and nearly a quarter do so daily (24%). Importantly, nearly two-thirds of households (61%) rely on marine fish for more than half dietary protein, suggesting either few dietary alternatives to marine protein or a strong cultural preference for the consumption of fish. The reliance of households in the BHS MPA Network on fish for their dietary protein is, however, variable among the Seascope MPAs. For example, fish represents more than half of the dietary protein for a minority of households in Teluk Etna MPA (36%), Buruway MPA (38%) and Teluk Triton MPA (39%), while for households in Teluk Mayalibit MPA and Kofiau dan Pulau Boo MPA the majority of households (62% and 86% respectively) rely on fish as their main source of protein.

1.6 ECOLOGICAL CONTEXT

The BHS MPA network supports extensive and highly diverse coral reef ecosystems, including more than 600 species of coral, and more than 1,700 coral reef fish species (Mangubhai et al., 2012). At the same time, the region also contains some of the world's most extensive mangrove forests and seagrass beds, as well as globally important leatherback turtle (*Dermochelys coriacea*) nesting beaches (Mangubhai et al., 2012).

The BHS MPA Network provides critical habitat for many species of conservation concern, including 17 recorded cetacean species and many species of shark and ray (Mangubhai et al., 2012). Of the 154,881 ha of coral reefs and 49,976 ha of mangrove habitats located within the BHS MPA Network, approximately 24% of coral reefs and 34% of mangroves are located within no-take zones. The BHS MPAs received an average critical habitat score of 88 (out of a possible 100), based on guidelines indicating that MPAs should target a minimum of 20% of critical habitat to be



protected within no-take zones (DeVantier et al. 2009). Critical habitat scores range from 36 to 100, with seven MPAs receiving scores of 100.

1.7 STATE OF THE BIRD'S HEAD SEASCOPE MPA NETWORK REPORT

This report provides a scientific assessment of the status and trends of key ecological and social conditions across the Bird's Head Seascope MPA Network, and documents the management status of each MPA. The first State of the Bird's Head Seascope MPA Network report was published in 2015 (Glew et al., 2015), and concluded that six of the nine key indicators of ecosystem health and human well-being with sufficient data (between 2010 and 2015) to allow the analysis of trends over time were either stable or increasing at the Seascope level. Similarly, World Bank Scorecard management assessments indicate that in general, management of MPAs is slowly improving over time. **The findings of the 2015 State of the Seascope report have also been communicated in a series of policy workshops for key decision-makers and at the 2016 BHS Annual Meeting. Detailed MPA summary reports are also being disseminated to complement Seascope overview provided here. These multi-scale reports are guiding MPA management strategies at both local and regional scales.** In this edition of the

report, we update our 2015 assessment, incorporating ecological and social data collected between 1st January 2015 and 31 December 2016.

FOOTNOTES

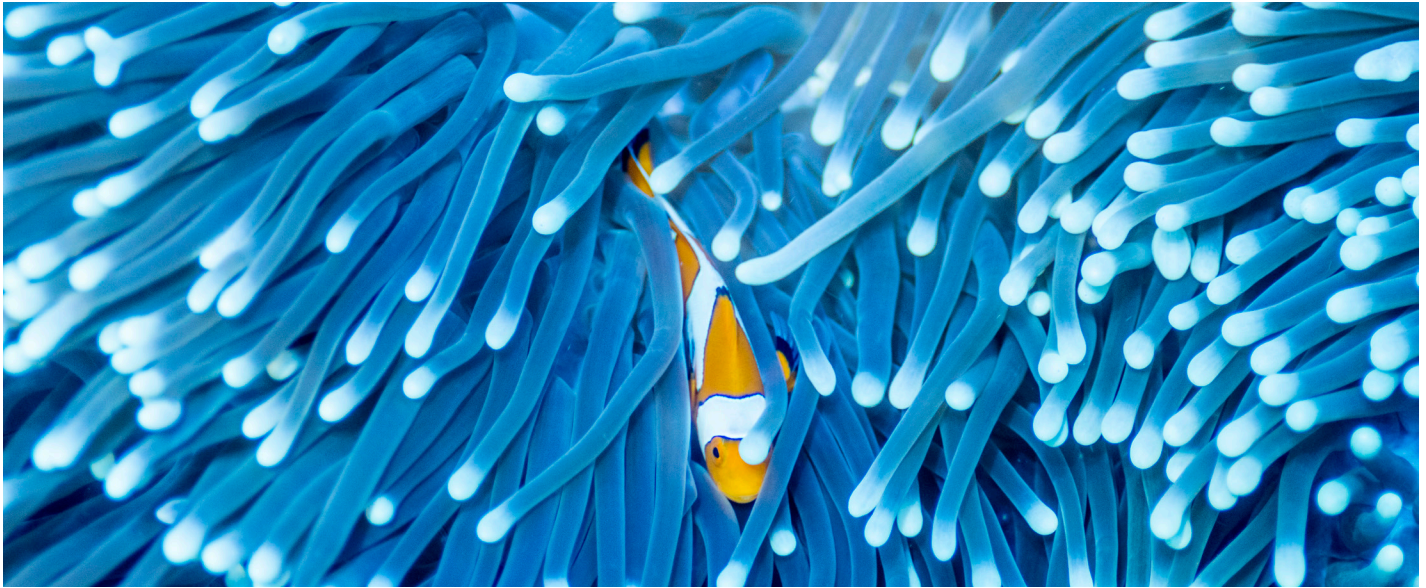
¹ More than 350,000 individuals are resident within the Seascope, in both coastal and inland communities (Mangubhai et al., 2012).

² Statistics in sections 1.3 - 1.5 are derived from the Bird's Head Seascope social monitoring program, unless otherwise stated.

The coastal and marine resources of the Bird's Head Seascope are effectively managed in a sustainable manner that incorporates the principles of ecosystem-based management and conserves the rich biodiversity of the Seascope while supporting the livelihoods of the Seascope's citizens.

- Bird's Head Seascope Vision

2. MONITORING THE BHS MPA NETWORK



A globally unique partnership among NGOs, academic scientists, and government officials monitors social and ecological conditions across the Bird's Head Seascape.

a scientific assessment of the current status and trends of key ecological and social conditions across the Seascape's MPA networks, and documents the management status of each MPA. In this section, we briefly outline the monitoring protocols used to generate the data synthesized in this report.

2.1 ECOLOGICAL MONITORING

The Bird's Head Seascape MPA ecological monitoring program is a partnership between Conservation International, Rare, The Nature Conservancy, World Wide Fund for Nature (ID), World Wildlife Fund (US), and Universitas Papua. Since 2010, the partnership (initially CI, TNC, WWF-ID) has implemented ecological monitoring in nine MPAs (Kaimana MPA Network: Buruway MPA and Triton Bay; Raja Ampat MPA Network: Ayau-Asia MPA, Kawe MPA, Kofiau dan Pulau Boo MPA, Misool Selatan Timur MPA, Selat Dampier MPA, and Teluk Mayalibit MPA; and Teluk Cenderawasih National Park). Ecological monitoring focuses on two components of the coral reef ecosystem: fish populations (density and biomass) and benthic cover (percent cover).

Since 2008, local universities, government agencies, and non-governmental organizations (NGOs) have worked together to develop rigorous methods to monitor the ecological and social conditions in the Bird's Head Seascape MPA Network. The partner organizations (Universitas Papua, Conservation International, Rare, The Nature Conservancy, and World Wildlife Fund) conduct scientific monitoring of coral reef conditions in nine MPAs, and human well-being in eight MPAs across the Seascape. The partners also monitor the management of 11 Bird's Head Seascape MPAs and document marine resource governance in eight MPAs. This report, which will be updated on a regular basis, provides

MPAs are monitored every 2-3 years using the Wilson and Green (2009) protocol and the updated version of the protocol. (Ahmadia et al. 2012)

In this report, we synthesize data on three ecological indicators selected to reflect management goals, inform policy, and be useful as indicators of ecosystem health and fish populations. These indicators align with indicators used in the Indonesian MPA Management Assessments (Directorate for Conservation of Area and Fish Species, 2012), including condition of the coral reef and populations of key fisheries species and non-target fish species. **Other indicator criteria** included characteristics of the ecological indicators (i.e. different trophic and functional groups, life-histories, and home-ranges).

The BHS ecological monitoring program focuses on:

Reef fisheries: artisanal, or small-scale fisheries, are traditional fisheries involving fishing households (as opposed to commercial companies), using a relatively small amount of capital and energy, relatively small fishing vessels (if any), making short fishing trips, close to shore, with fish catch consumed locally. Artisanal fisheries may also feed into commercial supply chains, through fish traders, providing products for local consumption or export (FAO, 2015).

Indicator: Key fisheries species: (Fish families: *Lutjanidae* (Snappers), *Haemulidae* (Sweetlips), and *Serranidae* (Groupers).

Reef resilience and ecosystem function:

ecological resilience can be defined as the capacity of an ecosystem to absorb recurrent disturbances or shocks and adapt to change while retaining essentially the same ecosystem function and structure (Holling 1973, McClanahan et al. 2012).

Indicator: Fish functional groups
Acanthuridae (Surgeonfish), *Scaridae* (Parrotfish), *Siganidae* (Rabbitfish).

Coral reef condition: the state of the composition or condition of the benthic community (reef surface) on a coral reef influences “bottom up ecological processes” and has cascading effects on the dynamics and function of the entire reef ecosystem. Stony or “hard” reef-building corals make up a substantial proportion of a coral reef’s three-dimensional structure providing critical habitat for many reef organisms.

Indicator: Hard coral cover

2.2 SOCIAL MONITORING

The Bird’s Head Seascape MPA social monitoring program is a partnership between Universitas Papua, Conservation International, and World Wildlife Fund. Since 2010, the partnership has monitored human well-being in eight MPAs (Buruway MPA, Kofiau dan Pulau Boo MPA, Misool Selatan Timur MPA, Selat Dampier MPA, Teluk Cenderawasih National Park, Teluk Etna MPA, Teluk Mayalibit MPA, and Teluk Triton MPA¹) across four Regencies in West Papua. Universitas Papua conducts household surveys in a representative, random sample of households resident within MPA boundaries, collecting data on economic well-being, health, empowerment, education, and culture. MPAs are monitored every two years, with baseline data collection occurring between 2010 and 2012.

In this report, we synthesize data on five attributes of human well-being commonly identified in human development policy goals, identifying one leading indicator for each of these dimensions:



Economic well-being: the resources people use to meet basic consumption and material needs, and access other sources of well-being (Sen, 1999).

Indicator: Household material assets

Health: the state of complete physical, mental, and social well-being, and not merely the absence of disease or infirmity (World Health Organization, 1946).

Indicator: Household Food Security

Empowerment: people’s ability to participate in the decision-making processes that affect their lives (United Nations Development Program et al., 1990).

Indicator: Household marine tenure

Education: the structures, systems, and practices used to transfer knowledge and skills in a society (Stephanson & Mascia, 2014).

Indicator: School enrollment rate

Culture: encompasses art, ways of living together, value systems, traditions, and beliefs (UNESCO, 2001).

Indicator: Place attachment

2.3 MANAGEMENT ASSESSMENTS

In the Bird’s Head Seascape, there are two tools currently used to assess MPA management: the World Bank Scorecard (World Bank, 2004) and the ‘E-KKP3K’: Technical Guidelines for Evaluating the Management Effectiveness of Aquatic, Coasts, and Small Islands Conservation Areas (Directorate for Conservation of Area and Fish Species, 2012). The World Bank Scorecard has been used to assess MPA management in the BHS MPA Network since its establishment, allowing users to track changes in MPA management over time and to make global comparisons among MPAs. The E-KKP3K was developed by the Indonesian Ministry of Marine Affairs and Fisheries (MMAF) in 2013. The E-KKP3K provides a standardized assessment across Indonesia to help guide management strategies and priorities of MMAF.

World Bank Scorecard: The World Bank Scorecard was specifically developed to assess progress in achieving management goals for marine protected areas. These management assessments are conducted annually in ten MPAs (Abun MPA, Kaimana MPA Network: Buruway MPA and Triton Bay;

Raja Ampat MPA Network: Ayau-Asia MPA, Kawe MPA, Kofiau dan Pulau Boo MPA, Misool Selatan Timur MPA, Selat Dampier MPA, and Teluk Mayalibit MPA; and Teluk Cenderawasih National Park).

In this report, we synthesize data on the six distinct stages of 'good protected area management': (1) context, (2) planning, (3) inputs, (4) processes, (5) outputs, and (6) outcomes. We report the total score across these elements.

E-KKP3K: The E-KKP3K was specifically developed to: (1) evaluate management of marine conservation across Indonesia; and (2) use the guidelines for self-evaluation of the management of a particular marine conservation area, and for making plans to improve management. These management assessments are conducted annually across Indonesia to help guide management strategies and priorities of MMAF.

In this report we synthesize data to determine the 'level' of management in each MPA. MPAs are classified into one of five levels: Level 1 (Red), Level 2 (Yellow), Level 3 (Green), Level 4 (Blue), and Level 5 (Gold). Classification is determined by the responses of 74 questions posed to managers. The parameters used include the status of the MPA's institutions, management and zoning plans, and infrastructure.

2.4 MARINE RESOURCE GOVERNANCE MONITORING

In addition to monitoring human well-being, the Bird's Head Seascape MPA social monitoring program monitors patterns and trends in marine resource governance in eight MPAs (Kaimana MPA Network, Kofiau dan Pulau Boo MPA, Misool Selatan Timur MPA, Selat Dampier MPA, and Teluk Mayalibit MPA, Teluk Cenderawasih National Park²) across four Regencies in Papua Barat.

Marine resource governance establishes the processes by which marine resources



are managed, including how authority for making decisions is allocated; how management decisions are made; and how management decisions are enforced (Mascia et al., in press). Resource governance can influence the social and ecological outcomes of policy interventions (Persha et al., 2011; Fox et al., 2012) such as MPAs, and successful governance regimes have been found to have shared characteristics (Ostrom et al. 1990). These include participatory decision-making arrangements, context-dependent rules, active and accountable systems for monitoring and enforcement, and accessible conflict resolution mechanisms (e.g., low-cost, local, and rapid process for resolving disagreements).

Universitas Papua conducts focus group discussions and key informant interviews in each monitored settlement to understand marine resource governance in each MPA. The focus groups and key informant interviews focus on 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.

Focus groups and key informant interviews are conducted in approximately half of the monitored settlements in each MPA every two years. This process provides a comprehensive assessment of marine resource governance every four years. Consequently, in this edition of the State of the Bird's Head Seascape MPA Network Report, we document the status of marine resource governance, drawing on more than 100 focus groups and key informant interviews conducted in eight MPAs across the Seascape. In future reports, we will report both governance status and trends. We synthesize data on four key attributes of marine resource governance in the Seascape:

Participation:

Indicator: User group participation in decision-making

Resource Use Rules:

Indicator: Context-dependent rules

Monitoring and Enforcement:

Indicator: Graduated sanctions

Conflict Resolution:

Indicator: Accessible conflict resolution mechanisms

2.5 INTERPRETING FINDINGS IN THIS REPORT

The State of the Bird's Head Seascape MPA Network report documents the status and trends in ecological and social conditions over time. Observed changes to ecological and social conditions over time may be caused by many different social and ecological processes. For example, a change in live coral cover (an important indicator of coral reef health) may be linked to changes in fishing pressure, natural variation in fish populations, the impacts of disturbance (e.g., coral bleaching), or MPA establishment -- or a combination of these factors. Similarly, changes in household food security may be due to economic growth, extreme weather events affecting the availability of key foods, fuel price fluctuations, MPA establishment, or a combination of these factors. Without additional data, these alternative explanations may be equally plausible.

In this report, we interpret the trends in ecological and social conditions by describing the possible explanations for the patterns observed in the data. As we only monitor conditions within MPAs, we cannot conclusively state that MPA establishment causes these trends. Instead, we provide subjective assessments to interpret our findings, based on expert judgment about the relative plausibility of alternative explanations for each trend. Consequently, **positive trends in ecological and social conditions should not be interpreted as positive MPA impacts.** Similarly, **negative trends should not be interpreted as negative MPA impacts.**

To understand whether MPAs cause the changes in social and ecological conditions, the Bird's Head Seascape monitoring program is also monitoring conditions in similar non-MPA controls (using the same standard protocols used in the MPAs). By monitoring changes over time both inside MPAs and in corresponding settlements and coral reef habitats not affected by MPA establishment, we will be able to determine which social and ecological changes are directly caused by MPA



establishment - and which changes are caused by other processes (e.g., market shifts, natural disturbances). We anticipate that data on the short-term social and ecological impacts (i.e., changes in social or ecological outcomes caused by MPA establishment or implementation) of the Bird's Head Seascape MPA network will be available in 2017.

2.6 UNDERSTANDING AND INTERPRETING UNCERTAINTY

CHARACTERIZING UNCERTAINTY³

Scientific monitoring always involves uncertainty. Uncertainty may occur at each step of the monitoring process - from developing methods to data collection, analysis, and interpretation. Some uncertainties (e.g., measurement error) are

easily documented and quantified, while others remain unknown (e.g., whether an indicator is an accurate representation of an unknown, true state). The relative magnitude of uncertainty can be quantified through statistical analysis or other techniques.

TREATMENT OF UNCERTAINTY IN THE STATE OF THE BHS MPA NETWORK

REPORT In this report, we adopt the Intergovernmental Panel on Climate Change's (IPCC) standard classification for describing quantified measures of uncertainty (IPCC, 2013). Based on statistical analysis of monitoring data, we express a probabilistic likelihood (i.e., the chance that a specific trend or outcome would occur) to describe the conditions and trends in the Bird's Head Seascape MPAs (see Table 2.1).

LIKELIHOOD TERMS | TABLE 2.1

Term	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 < 0.66
Unlikely	0 - 33% probability	$P > 0.66$
Very unlikely	0 - 10% probability	$P > 0.90$
Exceptionally unlikely	0 - 1% probability	$P > 0.99$

Note: The categories under 'Likelihood of the Outcome' are not mutually exclusive, and reflect standard scientific convention when reporting a probabilistic likelihood.

For each finding in this report, we provide the likelihood term in *italicized* font (e.g., *virtually certain*) and the exact probabilistic likelihood in parentheses. For example, if there is less than 1% chance that the trends documented for a specific indicator would arise by chance alone, we describe the trend as '*virtually certain* ($P = 0.01$)'.

Here, the P value expresses the probability of obtaining a result equal to, or more extreme than what was actually observed in the data.

2.7 UNDERSTANDING AND INTERPRETING DASHBOARDS

The State of the Bird's Head Seascape MPA Network Report synthesizes monitoring data on the status and trends over time for key ecological, social, and management conditions in the Seascape's MPAs. We summarize data into a one page 'dashboard' (see section 3), for the Seascape as a whole.

For each key ecological, social, and marine resource governance or management indicator, the dashboard provides an assessment of current status and trends.

MPA STATUS We document the status of each indicator in the most recent monitoring year, relative to the average conditions observed in monitored MPAs

across the Seascape at baseline (i.e., the time when the MPA was first monitored). We classify current status into three broad categories (see Figure 2.1):

High: conditions observed during most recent monitoring year are substantially higher than the average conditions observed in monitored Seascape MPAs at baseline. We define this as current conditions exceed mean Seascape baseline conditions plus one standard error⁴.

Medium: conditions observed during most recent monitoring year are within the same range as the average conditions observed in monitored Seascape MPAs at baseline. We define this as current conditions fall between the range bounded by mean Seascape baseline conditions plus or minus one standard error.

Low: conditions observed during most recent monitoring year are substantially lower than the average conditions observed in monitored Seascape MPAs at baseline. We define this as current conditions are less than the mean Seascape baseline conditions minus one standard error.

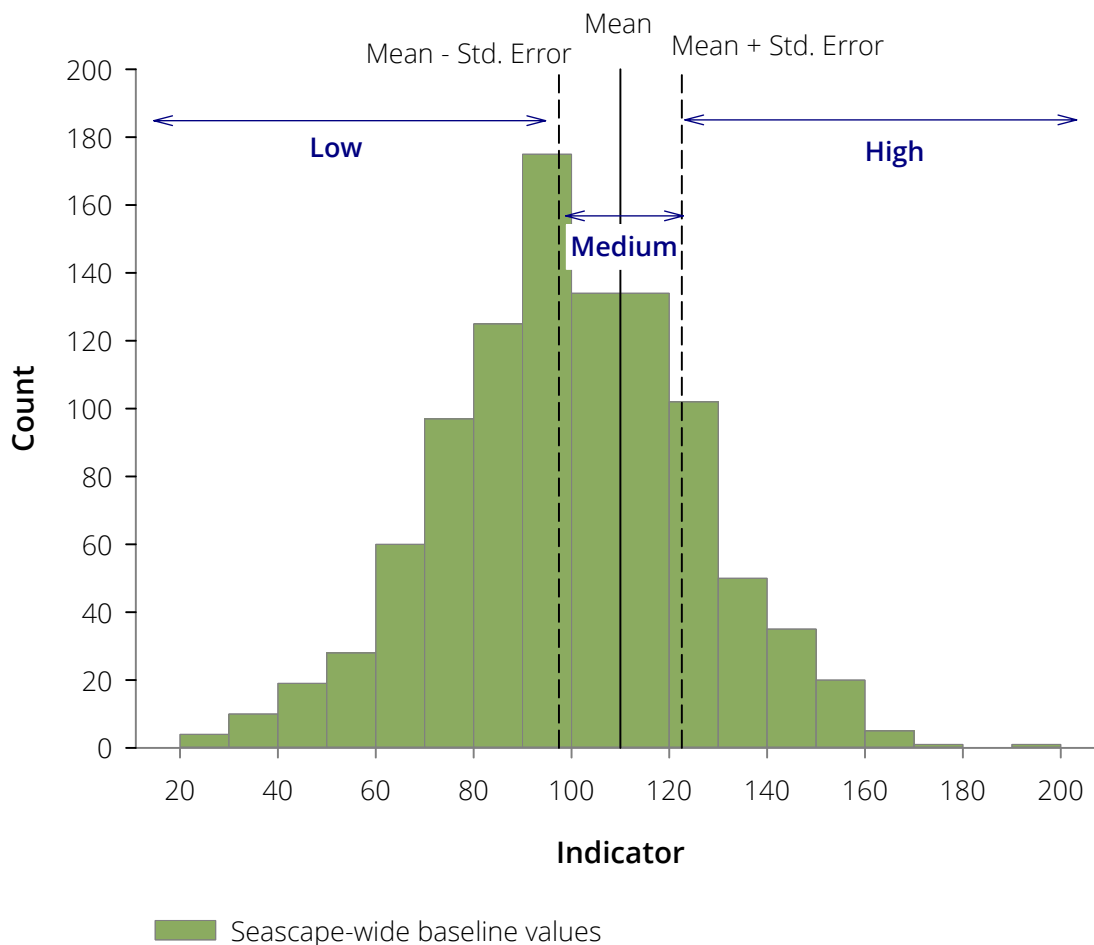
MPA TRENDS We conduct statistical analysis on the trends in key social, ecological, governance, and management conditions over time. We classify trends into four broad categories:

Increasing: average conditions observed in the particular MPA or MPA Network, during most recent monitoring year, are significantly higher ($P < 0.1$) than the average conditions in the same MPA or MPA network at baseline.

Stable: average conditions observed in the particular MPA or MPA Network, during most recent monitoring year, are not significantly different to the average conditions in the same MPA or MPA network at baseline.

Decreasing: average conditions observed in the particular MPA or MPA Network, during most recent monitoring year, are significantly lower ($P < 0.1$) than the average conditions in the same MPA or MPA network at baseline.

No data: there are no or insufficient time-series data available to detect trends in a particular condition.



We describe our confidence (i.e., the probabilistic likelihood) in the trends (Table 2.1) as:

Virtually certain: There is less than 1% probability ($P < 0.01$) that we would observe this pattern in our monitoring data, if there had been no change in the indicator over time.

Extremely likely: There is less than 5% probability ($P < 0.05$) that we would observe this pattern in our monitoring data, if there had been no change in the indicator over time.

Very likely: There is less than 10% probability ($P < 0.1$) that we would observe this pattern in our monitoring data, if there had been no change in the indicator over time.

2.8 UNDERSTANDING AND INTERPRETING FIGURES

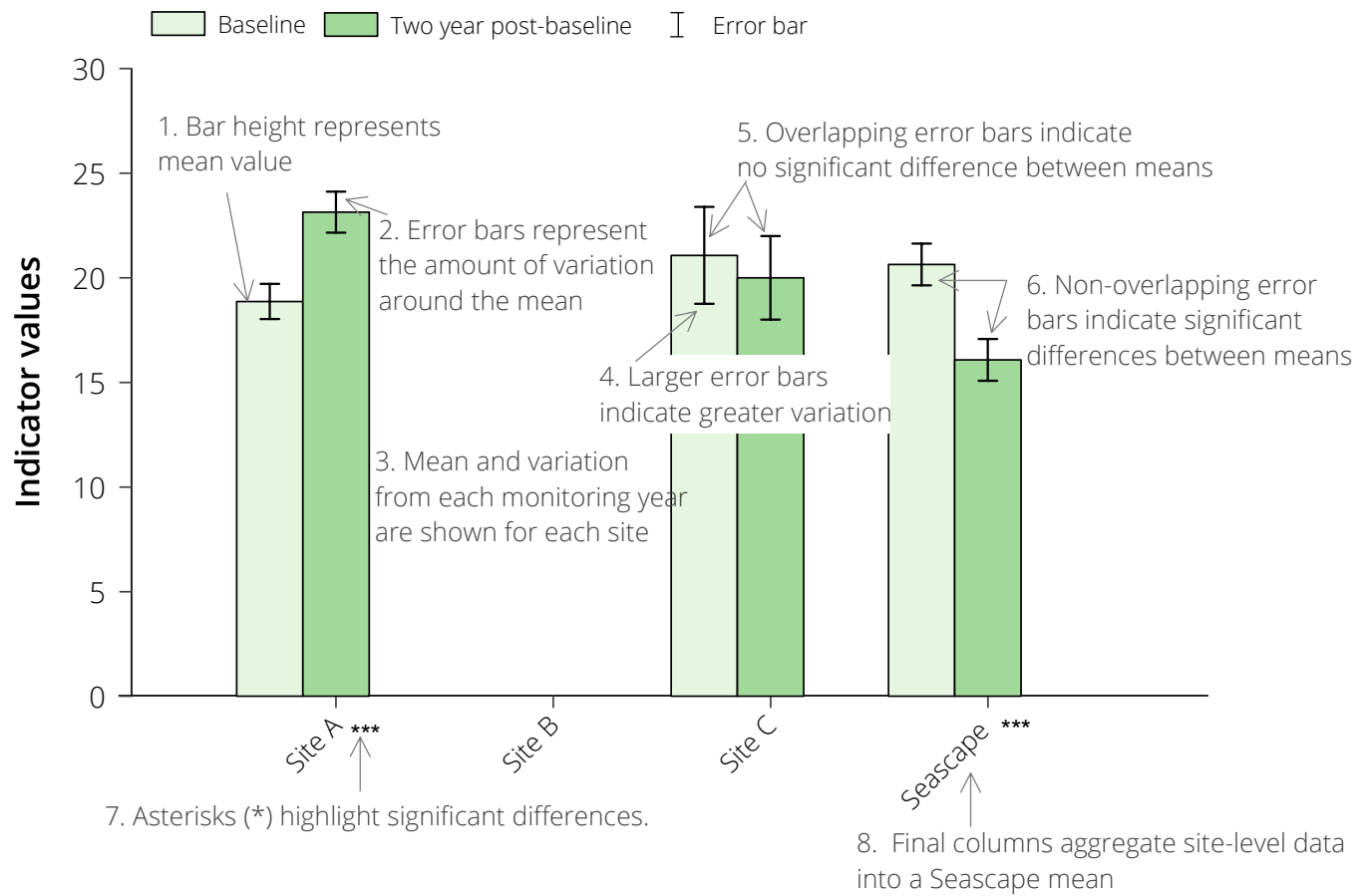
This report presents data in a standard graphical format. In Figure 2.2, we describe how to understand and interpret data presented in this format.

FOOTNOTES

^{1,2} Ayau and Asia MPAs, Abun MPA, and Kawe MPA are not included in the social monitoring program, due to limitations in identifying appropriate non-MPA control communities.

³ This paragraph draws directly on the language describing the treatment of uncertainty developed in IPCC 2013: 138.

⁴ Standard error is a measure of variation. It measures how much variation exists around a particular statistic. Larger standard errors indicate more variation; small standard errors indicate less variation.



3. BHS MPA NETWORK DASHBOARD

STATUS

RECENT TRENDS AND CONFIDENCE

ECOSYSTEM

Benthic Composition

Percentage live hard coral cover

M

—

Key Fisheries Species

Biomass of key fisheries species

M

—

Fish Functional Groups

Biomass of fish functional groups

M

—

HUMAN WELL-BEING

Economic Well-Being

Household material assets index

L

↓

**

Health

Food security index

H

↑

Political Empowerment

Household resource rights index

L

↓

**

Education

School enrollment rate

H

↑

Culture

Place attachment index

L

—

MANAGEMENT

World Bank MPA Score Card

World Bank MPA Management Effectiveness score

M

↑

**

EKKP3K

Indonesian Management Effectiveness score

M

N

GOVERNANCE

Participatory Decision-Making

Proportion of users actively participating in design of marine harvest rules

M

N

Resource Use Rules

Proportion of important habitats subject to appropriation rule

L

N

Monitoring and Enforcement

Number of sanctions employed to enforce compliance with appropriation rules

M

N

Conflict Resolution

Mean time required to resolve conflict between users or users and officials

M

N

STATUS SCORE

H High M Medium L Low N No Data

RECENT TRENDS

↑ Increasing — Stable ↓ Decreasing N No Data

CONFIDENCE LEVEL

*** Virtually Certain
** Extremely Likely
* Very Likely

*Status assessment: Ecosystem data collected 2013 - 2016 ; Human well-being and governance data collected 2012- 2016; Management assessment data collected 2016.

*Recent trends reflect change since baseline. Ecological baseline established 2010 - 2013 ; Human well-being and governance baseline established 2010 - 2012; Management assessment baseline established in 2012.

4. SYNTHESIS OF STATUS AND TRENDS IN THE BHS MPA NETWORK



4.1 SEASCAPE LEVEL STATUS AND TRENDS

The current status of ecosystem health, human well-being, MPA management, and marine resource governance - is variable in the Bird's Head Seascape MPA Network.

At the Seascape level, all four **ecosystem indicators remain stable**. While ecological trends vary among MPAs in the Seascape, in general, hard coral cover and the biomass of both key fisheries species and fish functional groups are being maintained. These trends suggest that coral reefs of the BHS MPA Network are on a better trajectory than many coral reef ecosystems globally (e.g. Jackson et al., 2014). Continued progress in MPA management will be needed to sustain and improve ecological conditions across the Seascape, with particular emphasis on developing strategies to both enhance fisheries management and mitigate the effects of climate change.

Trends in **human well-being are highly variable** across the Seascape. Household food security and school enrollment rates are increasing. In contrast, household material assets and marine tenure are declining, while place attachment remains stable. Trends in human well-being are broadly consistent among the BHS MPAs, suggesting that regional-scale

political, economic, or social processes may be driving these changes, rather than local-scale dynamics. For example, the **increasing ability of households to access safe, nutritious, and social acceptable foods** (as measured by food security) may be **linked to Provincial and Regency Government policies** (e.g., agricultural extension or school construction programs), as well as increasing market access that allows remote communities to maintain more consistent access to a diversity of foods. Similarly, **government policies and investments may be linked to rapid increases in school enrollment**, ranging from 3% in Selat Dampier MPA to 12% Teluk Mayalibit MPA between 2010 and 2016.

The **decline in economic well-being may be linked to rapid fuel price inflation** that occurred between 2010 and 2014. Since 2014, household economic well-being (measured as the number of assets owned by a household) has either stabilized or shown signs of recovery in households resident in the BHS MPAs. In two MPAs, Teluk Cenderawasih National Park and Teluk Mayalibit MPA, household material assets have increased since 2014, potentially due to increased Provincial level social assistance funds flowing into these communities.

In contrast to the stable trend in household marine tenure reported in the 2015 State of the Bird's Head Seascape MPA Network Report (Glew et al., 2015), **marine tenure** (measured as the number of rights a household exercises over marine resources in the 12 months prior to survey) **is now consistently declining in all BHS MPAs**, with a 20% decline in the proportion of households exercising the right to harvest marine resources since 2010. While we cannot conclusively identify the processes generating this trend, the reallocation of fishing rights linked to MPA establishment, or the gradual shift toward wage labor in the Seascape since 2010 may be responsible.

The status of some key indicators of human well-being (e.g., school enrollment) remains lower than the Indonesian national average. Moving forward, it will be critical that economic development efforts are designed to sustain and improve human well-being without compromising ecosystem health across the Seascape.

World Bank Scorecard management assessments indicate that in general, **MPA management is continuing to improve**, though the rate of improvement varies among MPAs. The highest scores were observed in the Raja Ampat MPA network, with Kofiau dan Pulau Boo MPA achieving the highest management score in the Seascape. The most substantial improvements in management scores between 2015 and 2016 were in Teluk Triton MPA and Kawe MPA. Management scores decreased in just one MPA, Teluk Cenderawasih National Park.

Marine resource governance is broadly consistent across the Seascape, with limited variation in the number of sanctions employed to enforce compliance with marine harvest rules, and a consistently low proportion of species and habitats subject to specific harvest rules. In

contrast, the participation of user groups in making decisions about marine resources varies among MPAs. Participation is highest in the Raja Ampat MPA Network (37.5%), and lowest in Teluk Cenderawasih National Park (3.3% of user groups).

4.2 SITE LEVEL STATUS AND TRENDS

While trends in ecosystem health are stable at the Seascope level, there is **substantial variation among the Seascope's MPA Networks**. While coral cover remained stable over time at many MPA sites, Kofiau dan Pulau Boo MPA showed a recovery in 2016, following an earlier decline in coral cover between 2010 and 2014. Coral cover is increasing in Selat Dampier MPA, with continual improvement in hard coral cover between 2010 and 2016.

Key fisheries species remained stable in most MPAs, although Ayau MPA continues to show increases in fish biomass since the 2010 baseline. In contrast, key fisheries species biomass decreased in Buruway MPA from its 2012 baseline (**though there has been no update since the 2015 Bird's Head Seascope MPA Network; (Glew et al. 2015)**). While, key fisheries species biomass in Selat Dampier MPA has decreased since baseline monitoring in 2010, biomass remained relatively stable between 2014 and 2016. Declines in fish functional group biomass were only observed in one MPA (Buruway MPA), with three MPAs (Teluk Cenderawasih National Park, Ayau MPA, and Kawe MPA) experiencing increases in fish biomass since baseline monitoring.

The substantial decrease in fish biomass in Buruway MPA (detected in both key fisheries species and fish functional groups) is a potential cause for concern. This decline may be associated with a combination of atypical environmental conditions during baseline monitoring that led to unusually high fish populations being recorded in the site, as well as a response to intense fishing pressure reported within the MPA.



Trends in social conditions vary among the Seascope's MPA Networks, as well as across different dimensions of human well-being. There are no consistent differences in human well-being among the BHS MPA Networks, with **broadly comparable social conditions observed in Kaimana MPA Network, Raja Ampat MPA Network, and Teluk Cenderawasih National Park**. This contrasts with the 2015 State of the Bird's Head Seascope MPA Network Report (Glew et al., 2015), which reported relatively higher human well-being in Teluk Cenderawasih National Park, compared to other MPA Networks in the Seascope.

Within individual MPA Networks, considerable variation in human well-being exists. For example, in the Raja Ampat MPA Network, household material assets and marine tenure are significantly above the Seascope average in Teluk Mayalibit MPA, but below average in Misool Selatan Timur MPA and Selat Dampier MPA respectively.

In seven BHS MPAs, social conditions are stable or increasing across three or more human well-being domains (most commonly health, education, and culture). In contrast, households in Kofiau dan Pulau Boo MPA are experiencing declines in the majority of human well-being domains, including economic well-being, political empowerment, and culture, but increases in health and education. The processes driving this variation among BHS MPAs may be linked to the underlying social and economic characteristics of each MPA.

4.3 CAVEATS AND LIMITATIONS

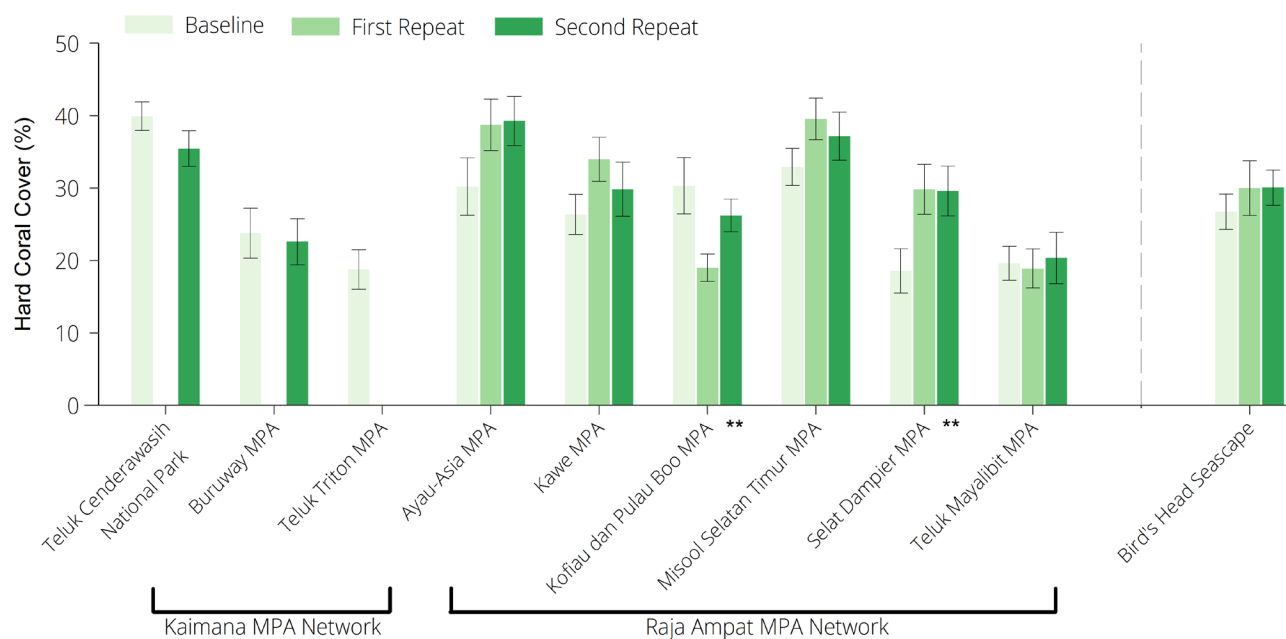
The Bird's Head Seascope MPA Network monitoring program continues to mature, however, limitations remain in our ability to detect change in social and ecological conditions. Monitoring of ecological conditions across the Seascope began in 2007, while social and marine resource governance began in 2010. Consequently, the available time-series of ecological and social data is short in comparison with the timescales over which many ecological, economic, political, and social processes occur. This, coupled with the natural variability of social and ecological systems can limit the ability to detect change within the BHS MPA Network. For example, the lag time needed to detect an ecosystem-level response to the establishment of MPAs exceeds the lifespan of the BHS monitoring program. Similarly, for long-lived marine species, we may not see changes in populations for as much as a decade or longer after protection began.

Monitoring populations of highly mobile fish species poses additional challenges. For example, reef areas with very high fish populations (often described as 'fishy sites') are often not monitored in the BHS ecological monitoring program because of the difficulty in accurately recording fish populations when they occur in large aggregations. However, we would expect to detect increases in fish biomass outside these 'fishy sites', due to the movement of fish to neighboring reef sites (a process known as spill-over).

5. STATUS AND TRENDS IN KEY INDICATORS

5.1 ECOSYSTEM HEALTH

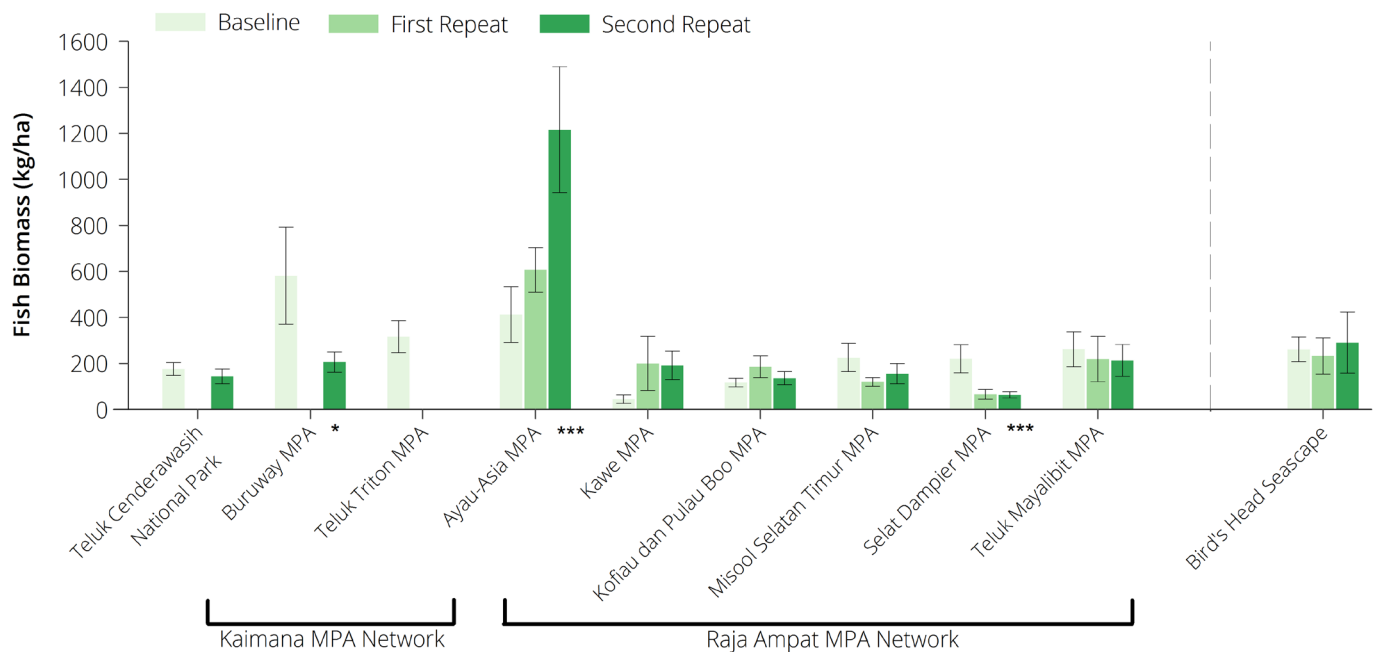
BENTHIC COMPOSITION | FIGURE 5.1 PERCENTAGE OF HARD CORAL COVER



Note: Year of baseline and repeat monitoring at each MPA. Teluk Cenderawasih National Park: 2011, 2016; Buruway MPA: 2012, 2015; Teluk Triton Bay: 2013; Ayau-Asia MPA: 2010, 2014, 2016; Kawe MPA: 2010, 2014, 2016; Kofiau dan Pulau Boo MPA: 2010, 2014, 2016; Misool Selatan Timur MPA: 2011, 2013, 2015; Selat Dampier MPA: 2010, 2014, 2016; Teluk Mayalibit MPA: 2012, 2014, 2016.

- It is *unlikely* ($P = 0.687$) that hard coral cover across the Bird's Head Seascape MPAs changed during the monitoring period. Stable coral cover is a good sign of ecosystem health in the Bird's Head Seascape. This contrasts with widespread declines in coral cover in many of the world's reefs (e.g., Jackson et al., 2014).
- It is *very likely* that hard coral cover increased in Ayau-Asia MPA ($P = 0.084$); while it is *extremely likely* that hard coral cover decreased in Kofiau dan Pulau Boo MPA ($P = 0.011$). The hard coral decrease in Kofiau may be attributed to a combination of factors based on observations that destructive fishing practices (e.g., blast fishing) are still occurring within the MPA and wave action from large storms has likely damaged many of the branching and table corals. In Ayau MPA, hard coral cover increases were more pronounced in the no-take zones. The increase in hard coral cover with a concomitant decrease in 'available substrate' suggests that corals are successfully recruiting and recolonizing hard bottom habitat.

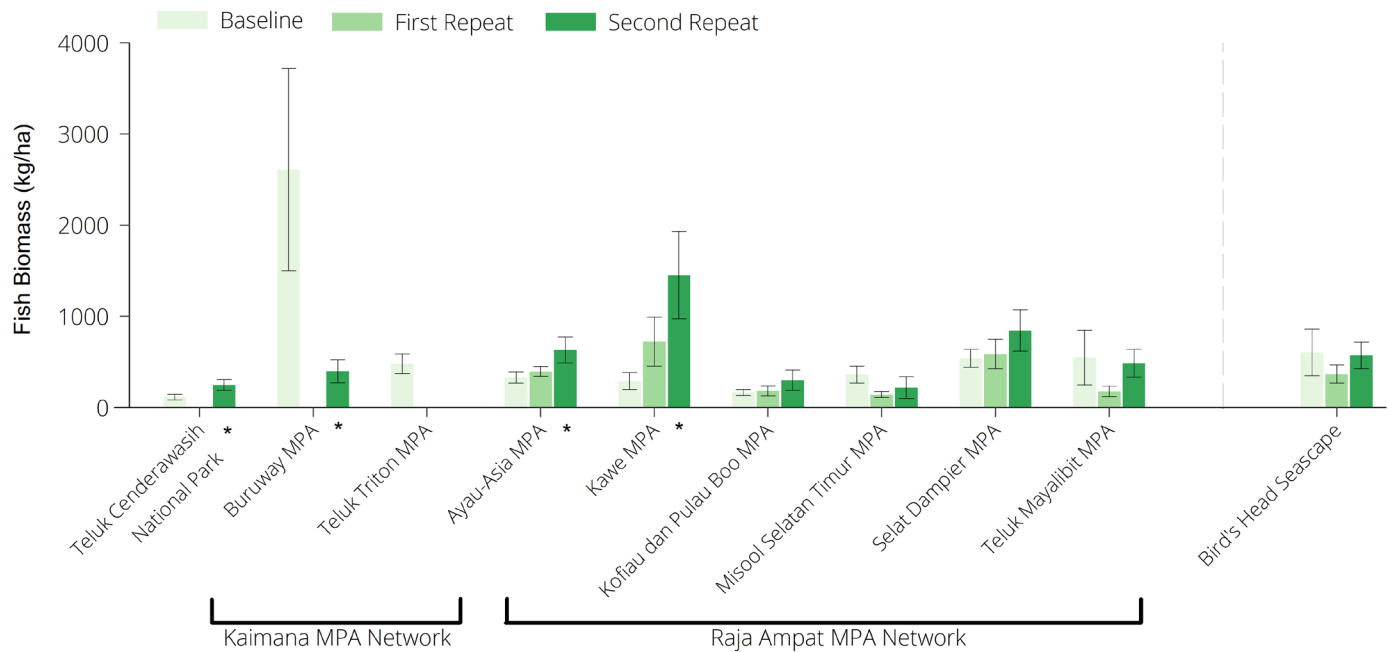
KEY FISHERIES SPECIES | FIGURE 5.2 BIOMASS OF KEY FISHERIES SPECIES



Note: Year of baseline and repeat monitoring at each MPA. Teluk Cenderawasih National Park: 2011, 2016; Buruway MPA: 2012, 2015; Teluk Triton Bay: 2013; Ayau-Asia MPA: 2010, 2014, 2016; Kawe MPA: 2010, 2014, 2016; Kofiau dan Pulau Boo MPA: 2010, 2014, 2016; Misool Selatan Timur MPA: 2011, 2013, 2015; Selat Dampier MPA: 2010, 2014, 2016; Teluk Mayalibit MPA: 2012, 2014, 2016.

- It is *unlikely* ($P = 0.670$) that key fisheries species biomass changed in the Bird's Head Seascope MPAs during the monitoring period. However, results are variable among MPAs. In four of the seven BHS MPAs with ecological trend data, key fisheries species biomass is increasing. Much of the Seascope-wide trend is driven by the substantial decrease in fish biomass in Buruway MPA; and if removed from analysis, trends indicate it is *likely* that key fisheries biomass is increasing in the remaining BHS MPAs ($P = 0.200$).
- Of the seven MPAs with data available over time, positive trends in key fisheries species are observed in four MPAs. It is *extremely likely* that key fisheries species biomass increased in Ayau-Asia MPA ($P = 0.029$), Kawe MPA ($P = 0.034$), and Selat Dampier MPA ($P = 0.050$); and *very likely* that key fisheries species biomass increased in Kofiau dan Pulau Boo MPA ($P = 0.077$). The increase in fish biomass in Ayau-Asia, Selat Dampier, Kawe, and Kofiau dan Pulau Boo MPAs is likely due to a decrease in fishing pressure allowing fish populations to recover. This decrease in fishing pressure in MPAs may, in turn, be a result of increased tourism and/or formalization of MPA management measures such as patrols and sanctions.
- It is *very likely* that key fisheries species biomass decreased in Buruway MPA ($P = 0.063$). In Buruway MPA, unusually high fisheries biomass was observed during baseline monitoring that may be attributed to atypical environmental conditions. Baseline monitoring in 2012 occurred shortly after a major storm in the region leading to torrential rains, excess run-off and other environmental anomalies (e.g., temperature, salinity), which may have temporarily favored schooling fish populations. Much of the biomass decline observed between 2012 and 2015 was due to the large decrease in schooling fish, together with a decrease in large fish (no fish greater than 60cm were observed in 2015). This suggests that both atypical environmental conditions in 2012 and high fishing pressure may be responsible for the decline in key fisheries biomass in the Buruway MPA.
- While fish biomass in Misool Selatan Timur MPA showed no significant changes over the duration of monitoring, anecdotal evidence does indicate that fish populations are increasing in many of the "fishy" sites located in the MPA's no-take zones.

FISH FUNCTIONAL GROUPS | FIGURE 5.3 BIOMASS OF FISH FUNCTIONAL GROUPS

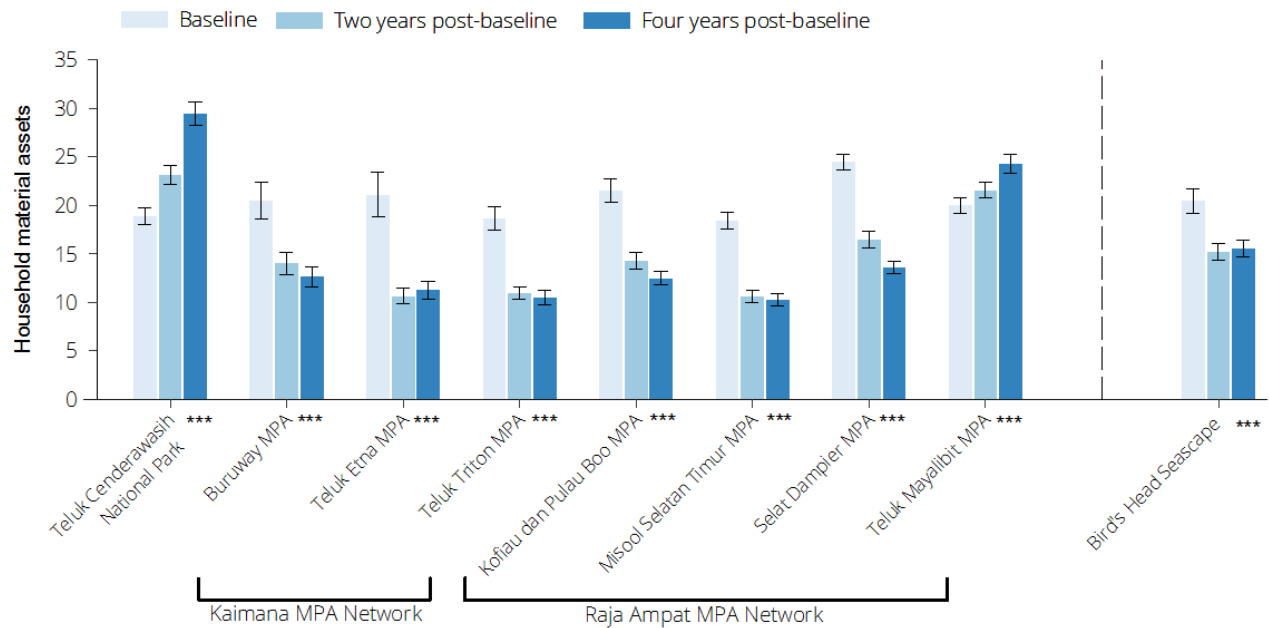


Note: Year of baseline and repeat monitoring at each MPA. Teluk Cenderawasih National Park: 2011, 2016; Buruway MPA: 2012, 2015; Teluk Triton Bay: 2013; Ayau-Asia MPA: 2010, 2014, 2016; Kawe MPA: 2010, 2014, 2016; Kofiau dan Pulau Boo MPA: 2010, 2014, 2016; Misool Selatan Timur MPA: 2011, 2013, 2015; Selat Dampier MPA: 2010, 2014, 2016; Teluk Mayalibit MPA: 2012, 2014, 2016.

- It is *unlikely* ($P = 0.881$) that fish functional group biomass changed overall across the Bird's Head Seascape MPAs during the monitoring period.
- Of the seven MPAs with trend data, fish functional group biomass increased in two of the MPAs. It is *extremely likely* that fish functional group biomass increased in Kawe MPA ($P = 0.027$), and *virtually certain* that fish functional group biomass increased in Selat Dampier MPA ($P = 0.001$). Increasing fish functional group biomass in Kawe and Selat Dampier MPAs may be linked to a decrease in fishing pressure in these sites, which has allowed fish populations to recover. The decline in fishing pressure may be a result of increased tourism as well as the formalization of MPA management (e.g., patrols and sanctions).
- It is *extremely likely* that key fisheries species biomass decreased in Buruway MPA ($P = 0.017$). Decreasing trends were observed in Buruway MPA; however, there were unusually high baseline conditions in 2012. This may be attributed in part to atypical environmental conditions during the baseline monitoring in 2012. Baseline monitoring occurred shortly after a major storm in the region leading to torrential rains, excess run-off, and other environmental anomalies (i.e. temperature, salinity), which may have temporarily favored fish populations. Interestingly, much of the biomass observed in 2012 was largely comprised of schooling fishes. However, the decline may also be due to fishing pressure, as no large fish (greater than 60 cm) were observed in the 2015 surveys (in contrast to the baseline surveys).
- No significant trends were observed in four of the MPAs, due to either too much variability in fish populations to detect change or fish populations remain relatively stable during the monitoring period.

5.2 HUMAN WELL-BEING

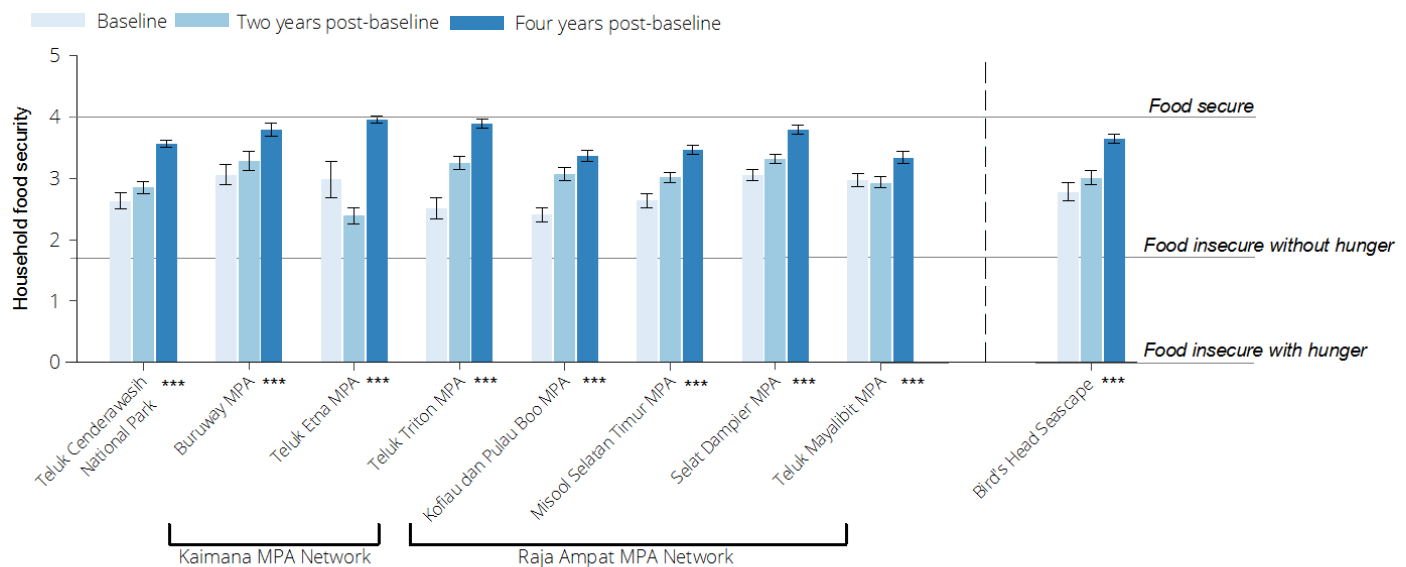
ECONOMIC WELL-BEING | FIGURE 5.4 HOUSEHOLD MATERIAL ASSETS INDEX



Note: Year of baseline and repeat monitoring at each MPA. Teluk Cenderawasih National Park: 2011, 2016; Buruway MPA: 2012, 2015; Teluk Triton Bay: 2013; Ayau-Asia MPA: 2010, 2014, 2016; Kawe MPA: 2010, 2014, 2016; Kofiau dan Pulau Boo MPA: 2010, 2014, 2016; Misool Selatan Timur MPA: 2011, 2013, 2015; Selat Dampier MPA: 2010, 2014, 2016; Teluk Mayalibit MPA: 2012, 2014, 2016.

- It is *virtually certain* ($P < 0.001$) that the material assets owned by the average household living in the BHS MPAs decreased during the monitoring period. While average household material assets in the BHS MPAs are *virtually certain* ($P < 0.001$) to have decreased between baseline and two years post-baseline, it is about *as likely as not* ($P = 0.332$) that further changes occurred two years post-baseline and four years post-baseline. While we cannot conclusively identify the processes driving this trend, the decline in household assets may be linked to fuel price inflation, which greatly increased the price of goods and services across the Seascope between the baseline and two-year repeat monitoring periods. While fuel price inflation continued between 2014 and 2016, the rate of increase slowed considerably, potentially enabling household material assets to stabilize between the two-year and four-year post-baseline monitoring efforts in each MPA.
- It is *virtually certain* ($P < 0.001$) that household ownership of material assets declined among the majority of MPAs in the BHS, including in the Kaimana MPA Network, Kofiau dan Pulau Boo MPA, Misool Selatan Timur MPA, and Selat Dampier MPA during the monitoring period. In MPAs where household ownership of material assets declined, it did so between baseline and two years post-baseline, and then stabilized or reversed trend by four years post-baseline in each MPA.
- In contrast to the Seascope mid trend it is *virtually certain* ($P < 0.001$) that household material assets increased among households in Teluk Cenderawasih National Park and Teluk Mayalibit MPA. The increase in household material assets in these sites in 2014 (four years post-baseline) may be linked to the recent increase in social assistance funds from the Provincial Government, enhancing the spending power of households within these MPAs. In Teluk Cenderawasih National Park, these social assistance funds have been used to support the purchase of boats and other machinery. The construction of a new road between Waisai and Warsamdin may also be linked to the marked increase in household material assets in Teluk Mayalibit MPA between 2012 and 2014.
- It is *virtually certain* ($P < 0.001$) that household ownership of material assets varied across the BHS MPAs during the most recent year of monitoring. The average household owned significantly more material assets in Teluk Cenderawasih National Park (mean: 29.4), and Teluk Mayalibit MPA (mean: 24.2) relative to households resident in Teluk Triton MPA (mean: 10.5), and Misool Selatan Timur MPA (mean: 10.2).

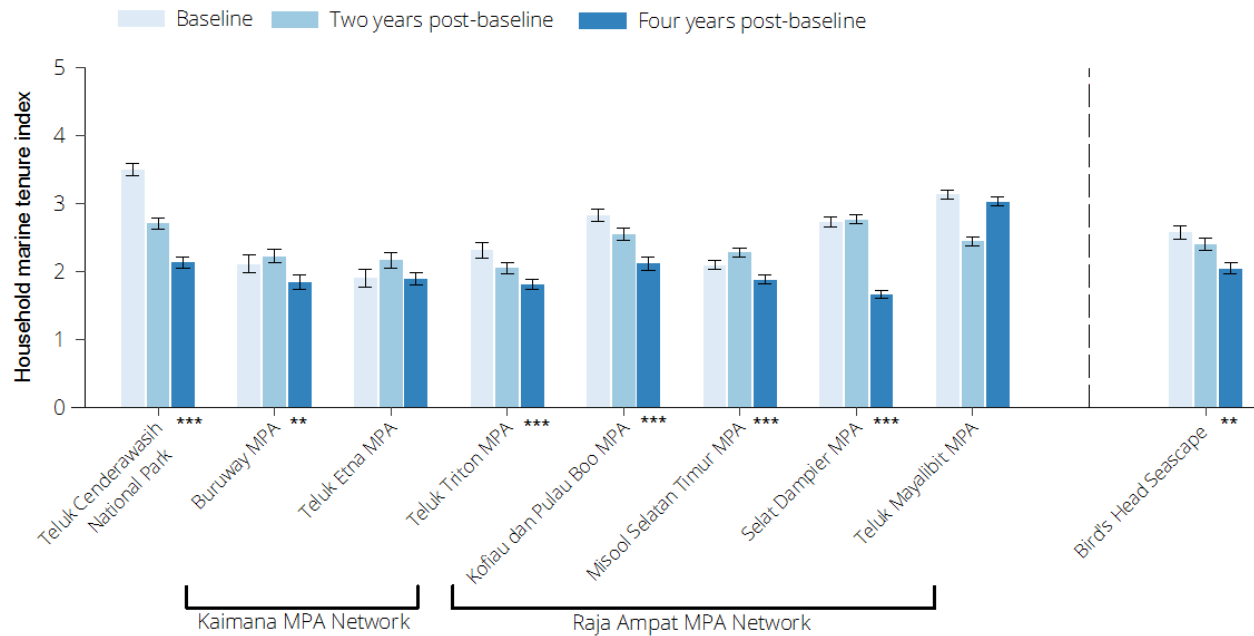
HEALTH | FIGURE 5.5 HOUSEHOLD FOOD SECURITY INDEX



Note: Year of baseline and repeat monitoring at each MPA: Teluk Cenderawasih National Park: baseline 2010, repeat: 2012, 2014; Kaimana MPA Network: baseline 2012, repeat: 2014, 2016; Kofiau dan Pulau Boo MPA: baseline 2011, repeat: 2013, 2015; Misool Selatan Timur: baseline 2011, repeat: 2013, 2015; Selat Dampier MPA: baseline 2012, repeat: 2014, 2016; Teluk Mayalibit MPA: baseline 2010, repeat: 2012, 2014.

- It is **virtually certain** ($P < 0.001$) that household food security (i.e., the ability of households to access safe, nutritious food in socially acceptable ways) increased for the average household living in the Bird's Head Seascope during the monitoring period. This increase in household food security may be linked to multiple factors, including the increasing availability of fish in the BHS MPA Network, as well as Provincial Government policies and programs (e.g., the provision of supplemental food for economically-deprived households, and agricultural extension programs). Other potential causes may include greater market access for households resident in remote communities, enabling households to obtain a broader range of foods on a more consistent basis.
- In most BHS MPAs, household food security has increased consistently since baseline. In Teluk Etna MPA, however, average household food security *likely* ($P = 0.124$) decreased between the 2012 and 2014, but is *virtually certain* ($P < 0.001$) to have increased between 2014 and 2016. The temporary decline in household food security may be linked to the timing of the two years post-baseline survey by the UNIPA team (in 2014), which coincided with longer than normal monsoon conditions in the region, as well as the observance of Ramadan. These factors, in combination, may explain why in that year households reported a decline in the availability of food, and an increase in concerns about having sufficient food to sustain their families.
- It is *virtually certain* ($P < 0.001$) that household food security varied between MPAs during the most recent year of monitoring. The average household had greater food security in Buruway MPA (mean: 3.8), Teluk Etna MPA (mean: 4.0), and Teluk Triton MPA (mean: 3.9) relative to households resident in Teluk Mayalibit MPA (mean: 3.4), Kofiau dan Pulau Boo MPA (mean: 3.4), Misool Selatan Timur MPA (mean: 3.5), and Teluk Cenderawasih National Park (mean: 3.6).

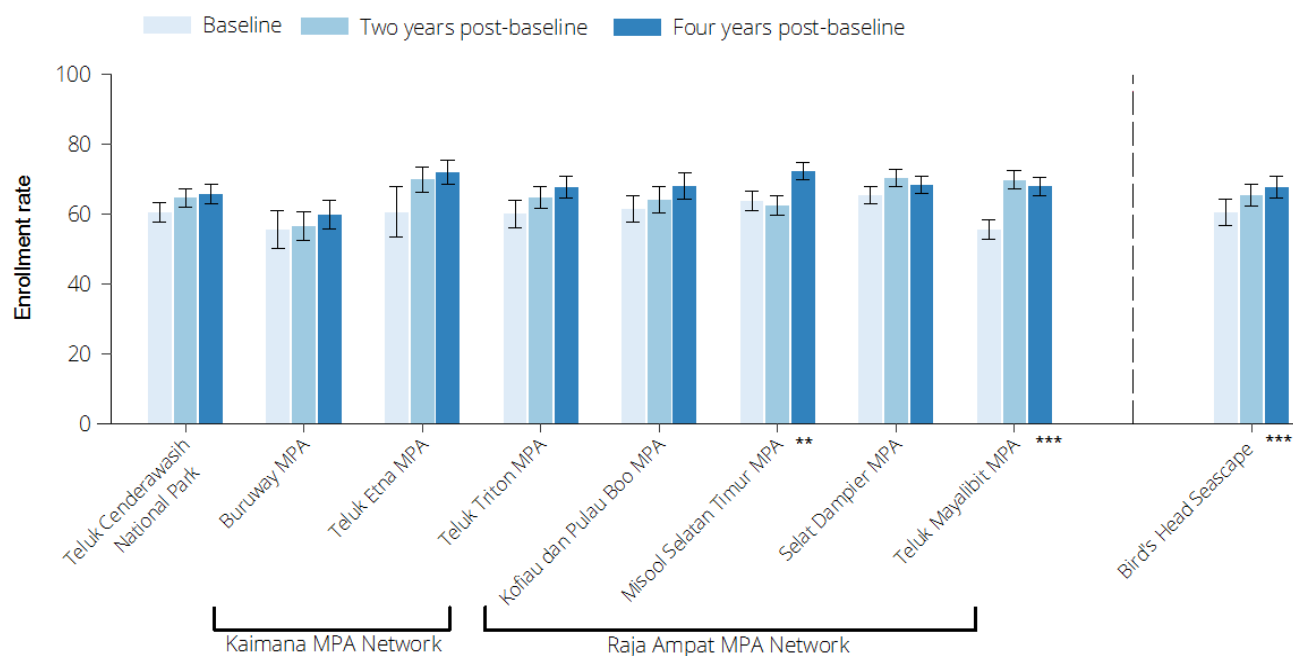
POLITICAL EMPOWERMENT | FIGURE 5.6 HOUSEHOLD MARINE TENURE



Note: Note: Year of baseline and repeat monitoring at each MPA: Teluk Cenderawasih National Park: baseline 2010, repeat: 2012, 2014; Kaimana MPA Network: baseline 2012, repeat: 2014, 2016; Kofiau dan Pulau Boo MPA: baseline 2011, repeat: 2013, 2015; Misool Selatan Timur: baseline 2011, repeat: 2013, 2015; Selat Dampier MPA: baseline 2012, repeat: 2014, 2016; Teluk Mayalibit MPA: baseline 2010, repeat: 2012, 2014.

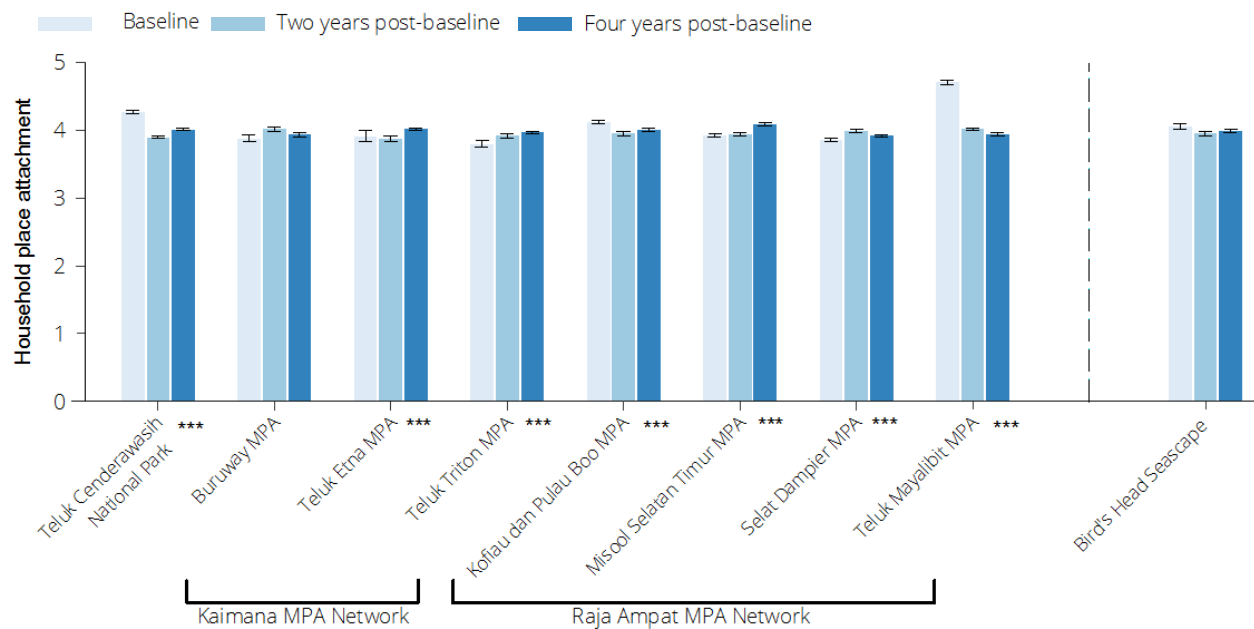
- It is *extremely likely* ($P = 0.014$) that household marine tenure in the Bird's Head Seascape decreased during the monitoring period. While we cannot conclusively identify the processes generating this trend, the decline in household marine tenure is largely driven by a marked decline (20%) in the proportion of households exercising the right to harvest marine resources. This may be linked to MPA establishment or shifting occupations in the Seascape.
- It is *virtually certain* ($P < 0.001$) that marine tenure decreased among more than half of MPAs in the Bird's Head Seascape, including in Kofiau dan Pulau Boo MPA, Selat Dampier MPA, Teluk Cenderawasih National Park, Misool Selatan Timur MPA, and Teluk Triton MPA. Similarly, marine tenure is *extremely likely* ($P = 0.012$) to have decreased in Buruway MPA. Marine tenure is *likely* to have decreased in both Teluk Mayalibit MPA ($P = 0.139$), and Teluk Etna MPA ($P = 0.162$). In three MPAs, household marine tenure has decreased consistently since baseline. In contrast, it about *as likely as not* ($P = 0.401$) marine tenure increased in Misool Selatan Timur MPA, Selat Dampier MPA, and Teluk Etna MPA between baseline and two years post-baseline, but it is *very likely* ($P = 0.067$) to have decreased between two years and four years post-baseline. The processes driving this initial increase and subsequent decrease in household marine tenure are unclear.
- It is *virtually certain* ($P < 0.001$) that household marine tenure varied between MPAs during the most recent year of monitoring. Average household marine tenure was greater in Teluk Mayalibit MPA (mean: 3.0) relative to Teluk Triton MPA (mean: 1.8), and Selat Dampier MPA (mean: 1.6).

EDUCATION | FIGURE 5.7 SCHOOL ENROLLMENT RATE



Note: Year of baseline and repeat monitoring at each MPA: Teluk Cenderawasih National Park: baseline 2010, repeat: 2012, 2014; Kaimana MPA Network: baseline 2012, repeat: 2014, 2016; Kofiau dan Pulau Boo MPA: baseline 2011, repeat: 2013, 2015; Misool Selatan Timur: baseline 2011, repeat: 2013, 2015; Selat Dampier MPA: baseline 2012, repeat: 2014, 2016; Teluk Mayalibit MPA: baseline 2010, repeat: 2012, 2014.

- It is **virtually certain** ($P < 0.001$) that school enrollment for the average household living in the Bird's Head Seascope increased during the monitoring period. While we cannot conclusively identify the processes generating this trend, it may be linked to government policies and initiatives intended to improve education in West Papua Province, as well as increasing community awareness of the importance of education across the Bird's Head Seascope.
- It is **virtually certain** ($P < 0.001$) school enrollment increased in Teluk Mayalibit MPA during the monitoring period. Similarly, it is **extremely likely** ($P = 0.023$) that school enrollment increased in Misool Selatan Timur MPA over the same time frame. It is **likely** ($P = 0.225$) that school enrollment increased in Teluk Cenderawasih National Park, Teluk Etna MPA, and Teluk Triton MPA. It is **about as likely as not** ($P = 0.396$) to have changed in Buruway MPA and Selat Dampier MPA during the monitoring period.
- It is **likely** ($P = 0.289$) school enrollment varied among MPAs in the Bird's Head Seascope during the most recent year of monitoring. Average school enrollment was greater in Misool Selatan Timur MPA (mean: 72.3) and Teluk Etna MPA (mean: 71.8) than in Buruway MPA (mean: 59.9).

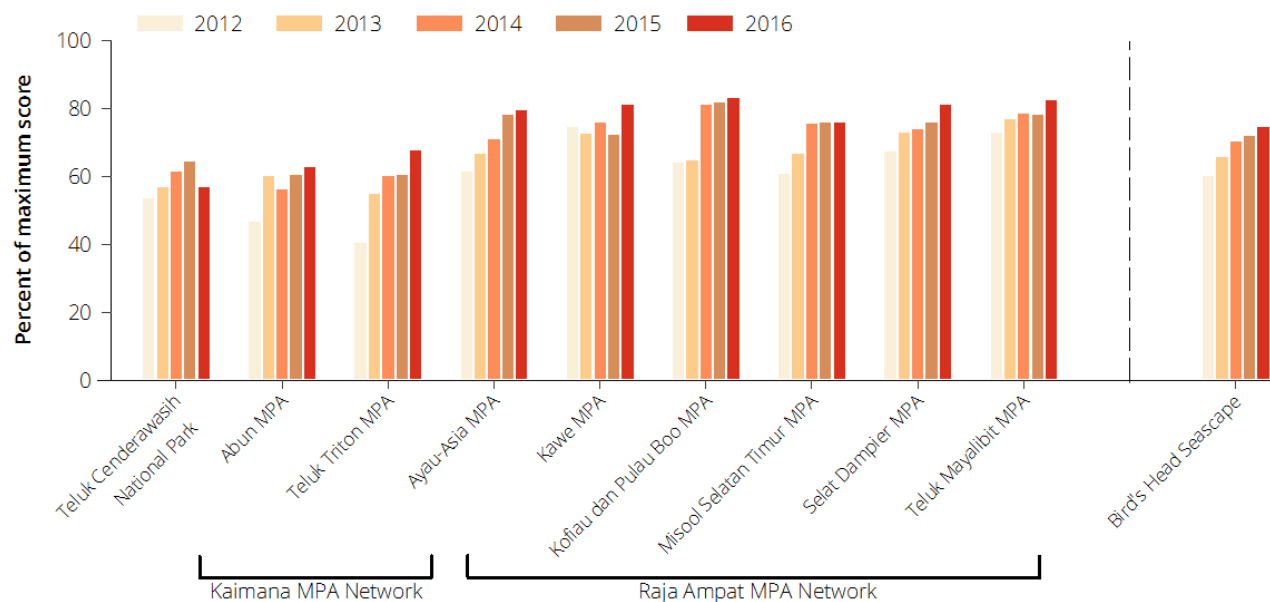


Note: Year of baseline and repeat monitoring at each MPA: Teluk Cenderawasih National Park: baseline 2010, repeat: 2012, 2014; Kaimana MPA Network: baseline 2012, repeat: 2014, 2016; Kofiau dan Pulau Boo MPA: baseline 2011, repeat: 2013, 2015; Misool Selatan Timur: baseline 2011, repeat: 2013, 2015; Selat Dampier MPA: baseline 2012, repeat: 2014, 2016; Teluk Mayalibit MPA: baseline 2010, repeat: 2012, 2014.

- It is *about as likely as not* ($P = 0.383$) that place attachment (i.e., the emotional connection of individuals to the MPA in which they are resident) decreased for the average household living in the BHS, during the monitoring period. While we cannot conclusively identify the processes generated by this trend, it may be linked to broader economic or demographic changes occurring across the Seascope.
- Trends in place attachment vary considerably among the BHS MPAs. For example, it is *virtually certain* ($P < 0.001$) that place attachment increased for the average household resident in Misool Selatan Timur MPA, Selat Dampier MPA, Teluk Etna MPA, and Teluk Triton MPA. In contrast, it is *virtually certain* ($P < 0.001$) that place attachment decreased in Teluk Cenderawasih National Park, Kofiau dan Pulau Boo MPA, and Teluk Mayalibit MPA since the baseline survey. The mechanism behind the variable trend in place attachment among the BHS MPAs remains unclear.
- During the most recent year of monitoring, it is *virtually certain* ($P < 0.001$) that place attachment varied among MPAs in the Bird's Head Seascope. Average place attachment in Misool Selatan Timur MPA (mean: 4.1) was greater than the average household resident in Buruway MPA, Selat Dampier MPA, or Teluk Mayalibit MPA (mean: 3.9).

5.3 MPA MANAGEMENT ASSESSMENTS

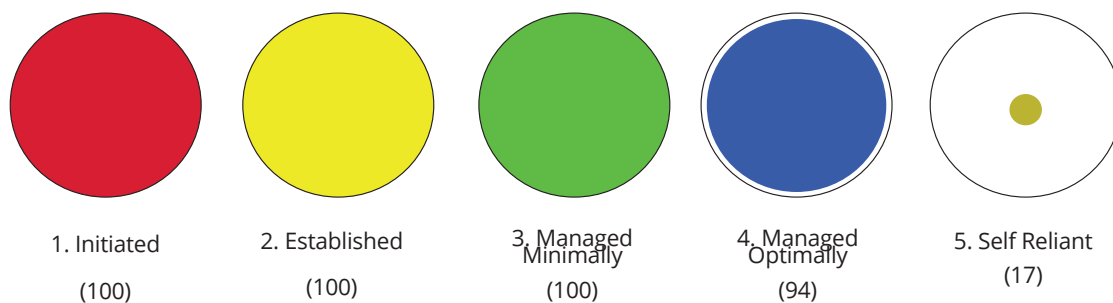
WORLD BANK SCORECARD | FIGURE 5.9 MPA MANAGEMENT EFFECTIVENESS SCORE



Note: World Bank Scorecard total scores include additional questions provided by the Walton Family Foundation

- **World Bank Scorecard management assessments indicate that, in general, management of MPAs is slowly improving over time.** In the most recent assessment (2016), the highest scores are observed in the Raja Ampat MPA Network. The most substantial improvements in management scores between 2014 and 2015 were observed in Abun MPA, Kofiau and Pulau Boo MPA, and Misool Selatan Timur MPA. It is important to note, however, that management scores for Abun MPA have fluctuated substantially between assessment years.

FIGURE 5.10 A: RAJA AMPAT MPA NETWORK

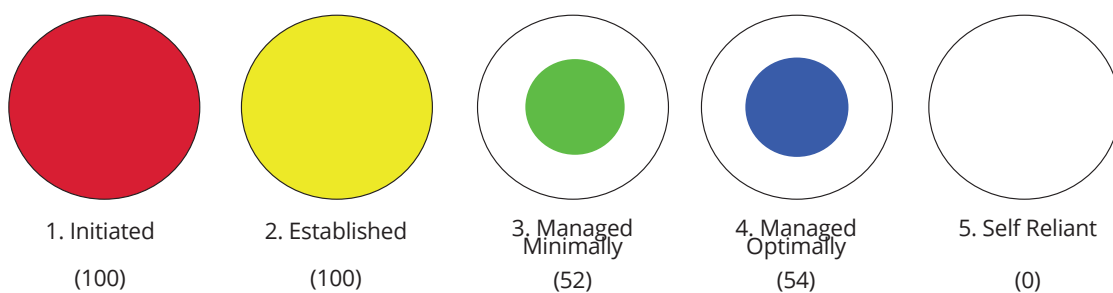


E-KKP3K Evaluation Stage: **Green**; Conservation Area Minimally Managed. The Raja Ampat MPA will move to Level Four (Blue) when zoning boundaries are installed.

Recommendations:

- Develop MPA boundaries in accordance with Marine and Fisheries Regulation No. 02 of 2009
- Assess marine resource use and its effects on marine habitats and populations in the MPA

FIGURE 5.10 B: KAIMANA MPA NETWORK



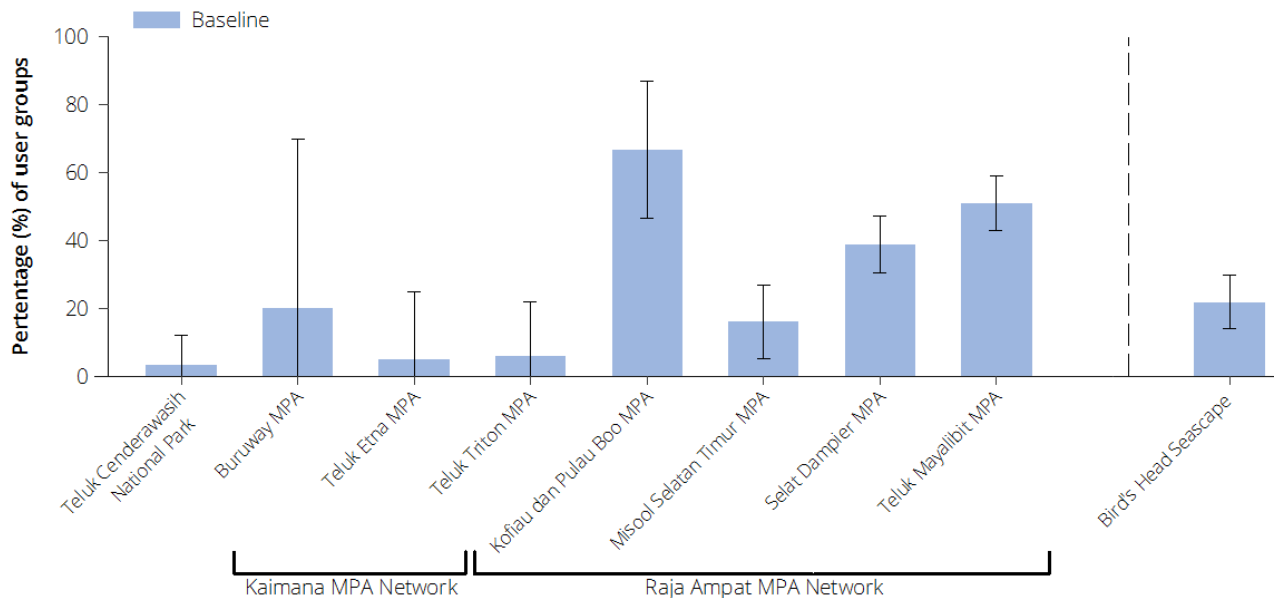
E-KKP3K Evaluation Stage: **Yellow**; Conservation Area Established.

Recommendations:

- Finalize a draft of the management plan and submit it to the district government for approval
- Submit the final management plan (approved by the district government) to the Ministry of Marine Affairs and Fisheries for approval
- Create a standard operating procedure for office administration and financial management

5.4 MARINE RESOURCE GOVERNANCE

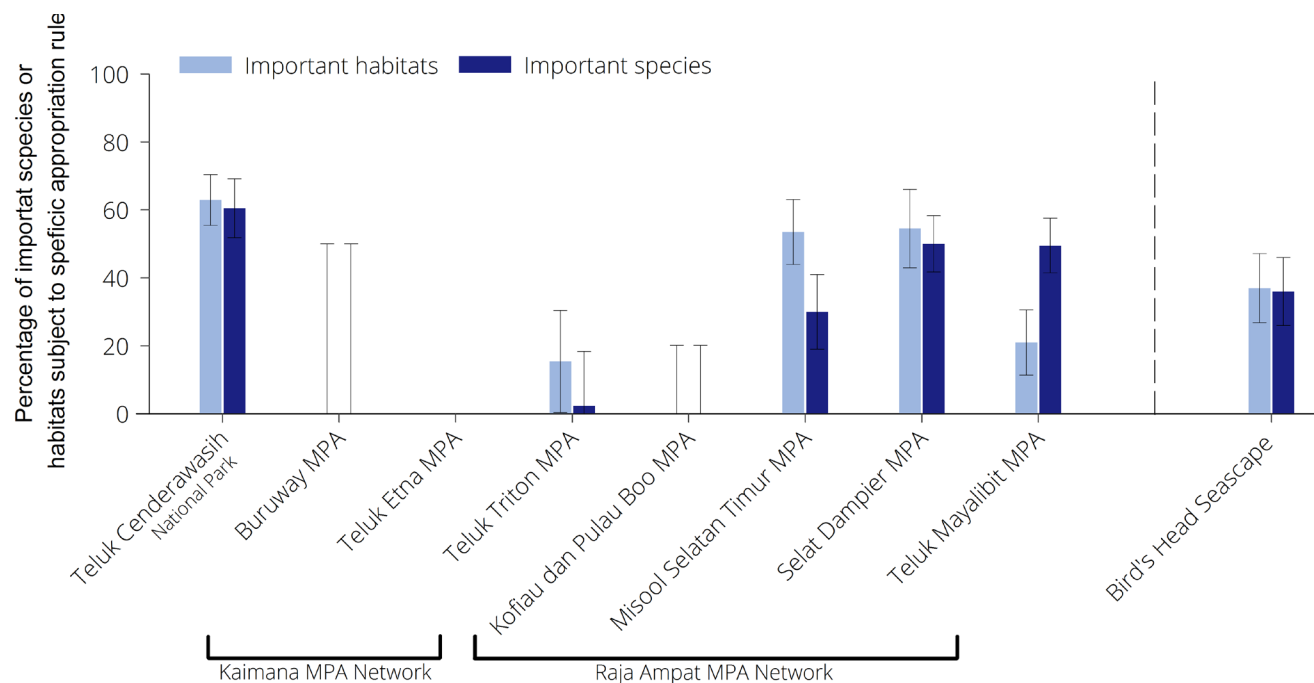
PARTICIPATION | FIGURE 5.11 PROPORTION OF USER GROUP PARTICIPATION IN DETERMINING USE RULES



Note: Year of baseline and repeat monitoring at each MPA: Teluk Cenderawasih National Park: baseline 2010-2012, repeat: 2015; Kaimana MPA Network: baseline 2012-2014; Kofiau dan Pulau Boo MPA: baseline 2011-2013, repeat: 2015; Misool Selatan Timur: baseline 2011-2013, repeat: 2015; Selat Dampier MPA: baseline 2012-2014; Teluk Mayalibit MPA: baseline 2010-2012, repeat: 2015.

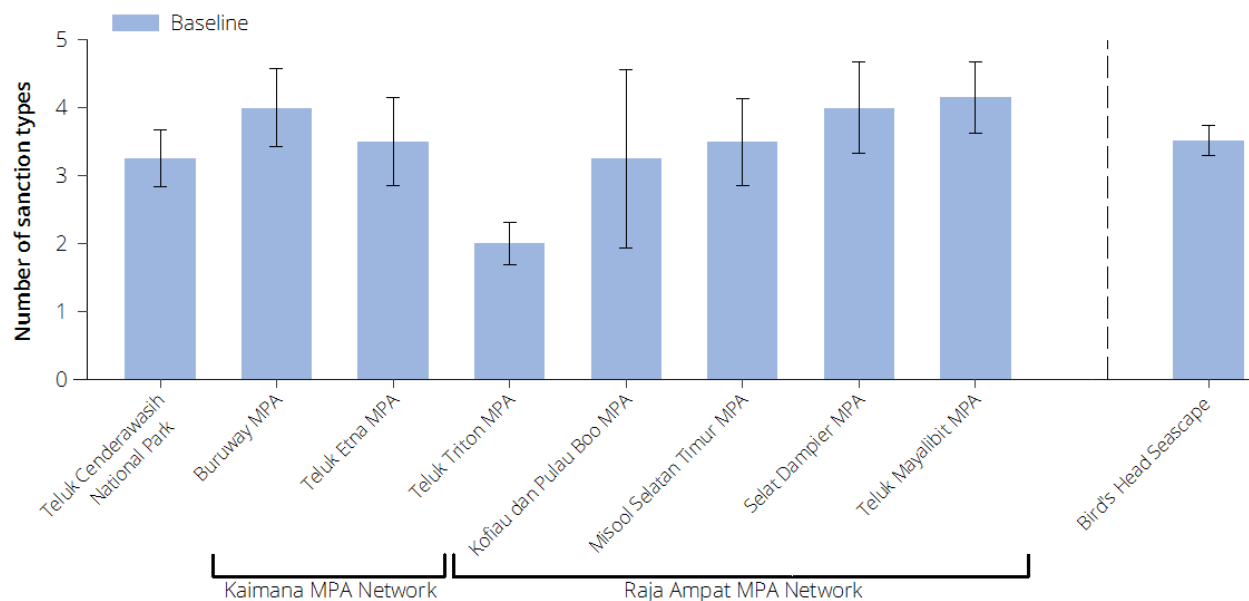
- It is *virtually certain* ($P = 0.002$) that user group participation in determining the marine harvest rules varied between the BHS MPA Networks during the monitoring period. On average, 21.9% of user groups participated in determining marine resource use rules across the Seascope. Variable participation in marine resource management may be linked to MPA size, the number of settlements within the MPA, and the intensity of community engagement efforts by civil society and local District or Regency governments.
- It is *virtually certain* ($P = 0.001$) that user group participation was higher in the Raja Ampat MPA Network (mean: 37.5%) than in Teluk Cenderawasih National Park (mean: 3.3%), and very likely ($P = 0.05$) higher than in the Kaimana MPA Network (mean: 9.2%). It is about as likely as not ($P = 0.49$) that user group participation varied between the Kaimana MPA Network and Teluk Cenderawasih National Park.
- It is *extremely likely* ($P = 0.03$) that participation varied among individual MPAs in the Seascope. For example, it is likely that user group participation was higher in Kofiau dan Pulau Boo MPA (mean: 66.7%) than in Misool Selatan Timur MPA (mean: 16.0%). The high participation rates in Kofiau dan Pulau Boo MPA may be linked to the small size of the MPA and the relatively small population, enabling greater participation in decision-making processes.

RESOURCE USE RULES | FIGURE 5.12 PROPORTION OF SPECIES & HABITATS SUBJECT TO A HARVEST RULE



Note: Year of baseline and repeat monitoring at each MPA: Teluk Cenderawasih National Park: baseline 2010-2012, repeat: 2015; Kaimana MPA Network: baseline 2012-2014; Kofiau dan Pulau Boo MPA: baseline 2011-2013, repeat: 2015; Misool Selatan Timur: baseline 2011-2013, repeat: 2015; Selat Dampier MPA: baseline 2012-2014; Teluk Mayalibit MPA: baseline 2010-2012, repeat: 2015.

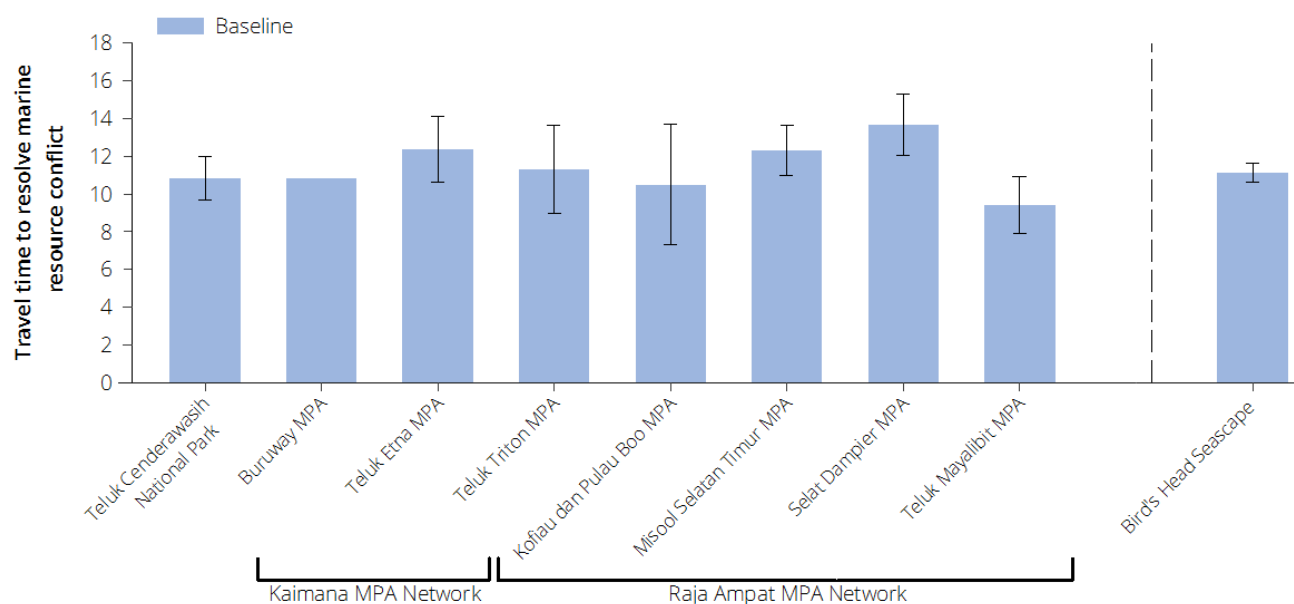
- It is *very unlikely* ($P = 0.93$) that the proportion of important habitats subject to a specific harvesting rule varied among the MPA Networks in the Bird's Head Seascope during the monitoring period. Similarly, it is about *as likely as not* ($P = 0.54$) that the proportion of species subject to a specific harvest rule varied among the MPA Networks.
- On average, 36.0% of important species and 37.0% of important habitats were subject to a specific harvest rule in the Seascope's MPAs during the monitoring period.
- The proportion of important species and habitats subject to a specific harvest rule was highest in Teluk Cenderawasih National Park, with an average of 60.5% of important species and 62.9% of important habitats identified in one or more resource use rules. The proportion of important species and habitats subject to specific harvest rules was lowest in Buruway MPA and Kofiau dan Pulau Boo MPA, where no species or habitat specific rules were reported by focus group participants. The variation in species or habitat specific harvest rules may be linked to local norms and customs, some of which may recognize particular species or places as holding religious or cultural significance.



Note: Year of baseline and repeat monitoring at each MPA: Teluk Cenderawasih National Park: baseline 2010-2012, repeat: 2015; Kaimana MPA Network: baseline 2012-2014; Kofiau dan Pulau Boo MPA: baseline 2011-2013, repeat: 2015; Misool Selatan Timur: baseline 2011-2013, repeat: 2015; Selat Dampier MPA: baseline 2012-2014; Teluk Mayalibit MPA: baseline 2010-2012, repeat: 2015.

- It is *about as likely as not* ($P = 0.35$) that the number of sanction types (e.g., warnings, fines, confiscation of equipment) varied between MPA networks or individual MPAs ($P = 0.49$) in the Bird's Head Seascope during the monitoring period. The number of sanctions and their use to enforce marine resource rules may reflect customary marine tenure practices in a community, the establishment of the MPA, or both.
- On average, 3.5 sanction types were employed to enforce compliance with marine resource use rules in the Seascope during the monitoring period. The most common types of sanctions were verbal warnings, fines, and incarceration, which were reported as possible penalties in 94%, 64%, and 24% of focus groups respectively.
- It is *about as likely as not* ($P = 0.33$) that the number of sanctions employed to enforce compliance with marine resource rules is the same in the Raja Ampat MPA Network (mean: 3.8) and the Kaimana MPA Network (mean: 3.1). It is *extremely unlikely* that the number of sanctions employed differs between the Raja Ampat MPA Network and Teluk Cenderawasih National Park (mean: 3.3).
- There is some evidence to suggest that the number of sanctions varies between individual MPAs. For example, it is *likely* that the number of sanctions employed to enforce compliance with marine resource use rules is higher in Teluk Mayalibit (mean: 4.2; $P = 0.24$) and Buruway MPA (mean: 4.0; $P = 0.24$) than in Teluk Triton MPA (mean: 2.0).

CONFLICT RESOLUTION | FIGURE 5.14 CONFLICT RESOLUTION TIME



Note: Year of baseline and repeat monitoring at each MPA: Teluk Cenderawasih National Park: baseline 2010-2012, repeat: 2015; Kaimana MPA Network: baseline 2012-2014; Kofiau dan Pulau Boo MPA: baseline 2011-2013, repeat: 2015; Misool Selatan Timur: baseline 2011-2013, repeat: 2015; Selat Dampier MPA: baseline 2012-2014; Teluk Mayalibit MPA: baseline 2010-2012, repeat: 2015.

- It is *very unlikely* ($P = 0.96$) that the travel time required to resolve conflicts over marine resources among users, or between users and officials, varied among MPA Networks in the Bird's Head Seascope during the monitoring period. There are both official conflict resolution mechanisms, which require travel to Regency capitals (e.g., Sorong, Manokwari), and local or customary mechanisms that occur in each settlement.
- On average, resolving a conflict over marine resources among users or between users and officials involved travelling for 11.0 hours. This value was broadly consistent across the Seascope, ranging from an average of 9.5 hours in Teluk Mayalibit MPA to 13.5 hours in Selat Dampier MPA.
- Similarly, it is *unlikely* ($P = 0.56$) that the travel time to resolve marine resource conflicts among users or between users and officials varied between individual MPAs across the Seascope.

6. MANAGEMENT RECOMMENDATIONS



6.1 ECOLOGICAL CONDITIONS

While there are indications that many of the coral reefs in the BHS are recovering, the conditions at some sites, as indicated by estimates of key fisheries species, suggest the need for adaptive management practices to ensure the long-term sustainability of the BHS MPA Network. Government, civil society, and local communities need to build on their current successes by further mitigating manageable threats (i.e., destructive fishing practices, poor land-use practices) to support healthy, productive, resilient ecosystems.

To achieve this goal, we recommend that MPA managers:

Sustain monitoring and enforcement

Prioritize patrols across the BHS MPA Network. Other important activities include the completion of the alignment of patrol effort with zone boundaries (with particular emphasis on no-take zones) and the socialization and declaration of customary ('adat') regulations where not yet undertaken. **In partnership with local communities.**

Mitigate the threat of blast fishing

Coral reef health monitoring

observations indicate a potential resurgence in destructive fishing practices (i.e., blast fishing) in the waters of Selat Dampier and around the island of Fam. Targeted management strategies, including an increase in patrol effort in affected areas, will be required to address this issue.

Increase enforcement activities in the Kaimana MPA Network

The recent zonation of the Kaimana MPA Network, which has been agreed by local stakeholders and recognized under customary ('adat') authority, is an important step in sustaining the important marine ecosystems in Kaimana Regency. To ensure the long-term health of marine ecosystems in the MPA Network, the local patrol team will need to enforce this zoning system effectively. The patrol team should record all fishing activity and any infringements of the customary ('adat') regulations.

Promote sustainable development planning in Kaimana Regency

Land-based activities can have substantial influence on the health and productivity of marine ecosystems. In the Kaimana Regency, there is a need to strengthen spatial

planning to ensure that infrastructure development is sustainable. In particular, there is a need to reduce illegal logging and to improve the design and construction of roads. Sound planning should ensure that land-based development does not result in excessive water run-off and sedimentation, which can affect the health of coral reef ecosystems.

Increase awareness of the impacts of coral mining in the Raja Ampat MPA Network

The extraction of coral for construction materials poses a substantial threat to coral reef ecosystems and to the fisheries supported by coral reefs. In the Raja Ampat MPA Network, there is a need to raise awareness among local stakeholders about the impacts of coral mining in the region. At the same time, local government and civil society should promote the use of viable alternative building techniques and materials that do not require the extraction of coral.

Manage increasing demand for high value species in the Raja Ampat MPA Network

Increasing prosperity in major urban centers (e.g., Sorong, Manokwari) is driving a growing demand for high-value reef species (e.g., grouper, *Serranidae* spp.). To ensure that these commercially important stocks are sustainable in the long-term, local government and civil society may need to develop stricter management of key fisheries species.

6.2 SOCIAL CONDITIONS

Social conditions vary across the BHS MPA Network, with local trends in human well-being nested within larger-scale trends that affect households across the Seascape. Between 2010 and 2014, a Seascape-wide decline occurred in several indicators of human well-being, including economic well-being, empowerment, and culture. In contrast, key indicators of health and education (i.e., food security and school enrollment rate, respectively) increased during the same time period. These trends are driven by multiple social, political, economic, and environmental processes.

To achieve sustainable development across the Seascape, we recommend that local government and civil society:

Strive to mitigate the recent decline in economic well-being across the Seascape

The recent decline in household material assets, which may have been caused by fuel price inflation acting in concert with other processes, could be mitigated by improving market access for settlements across the Seascape, improving access to financial institutions and services in more remote settlements, and facilitating improved communication about commodity prices for marine and agricultural products among local fishers and farmers.

Strive to further improve food security across the Seascape

Across the Seascape, food security is increasing, with more households gaining access to safe, nutritious, and socially acceptable foods. To sustain these improvements, there is a need to develop 'safety net' programs that ensure access to basic food supplies is maintained during adverse weather conditions, and to foster the diversification of foods available in more remote settlements.

Strive to foster community empowerment by inviting participation in marine resource management processes

There is a need to maintain and expand strategies to raise public awareness about how to appropriately manage marine resources, in particular among those individuals or groups with traditional tenure rights.

Strive to catalyze further improvements in education across the Seascape.

Since 2010, the school enrollment rate has increased among coastal communities in the Bird's Head Seascape. There is a need to integrate environmental education into the formal curriculum for primary and secondary school children to build long-term environmental stewardship among local communities.

6.3 MARINE RESOURCE GOVERNANCE

The management of MPAs can influence their ecological and social outcomes. Marine resource governance is variable across the Seascape, with some MPAs displaying many of the characteristics associated with successful and sustainable management of marine resources. To strengthen marine resource governance across the Seascape, we recommend that MPA managers and local government:

Foster participation by local communities, particularly in the Seascape's larger MPAs

Participation in the management of marine resources varies across the Seascape, with greater participation by important user groups in smaller MPAs. Targeted efforts are needed to ensure that important user groups have the opportunity and incentive to participate in MPA management in the long-term. For example, capacity development efforts could further support the creation of settlement-level regulations governing marine resource use that align with MPA management priorities.

Increase community awareness of marine resource regulations across the Seascape

Over the past few years, government, civil society, and local communities have made considerable progress in the development of appropriate zonation plans and in the enforcement of MPA regulations. Further dissemination efforts are needed to communicate these regulations to local communities, in particular to those user groups residing in towns outside of MPA boundaries.

Improve accessibility and awareness of mechanisms for resolving conflict over marine resources

Mechanisms for resolving disputes (among users, or between users and officials in the BHS MPA Network) are relatively inaccessible, frequently requiring individuals to travel considerable distances to reach an appropriate authority. There is a need to develop more accessible conflict resolution mechanisms or processes for disputes over marine resources in the Seascape.

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8. ANNEX 1. MONITORING METHODS

Since 2008, local universities, government agencies, and non-governmental organizations (NGOs) have worked together to develop rigorous methods to monitor the ecological and social conditions in the Bird's Head Seascape Marine Protected Area (MPA) Network. The partner organizations (Universitas Papua, Conservation International, Rare, The Nature Conservancy, and World Wildlife Fund) conduct scientific monitoring of coral reef conditions in nine MPAs across the Seascape and human well-being in eight MPAs. The partners also monitor the management of 11 Bird's Head Seascape MPAs and document marine resource governance in eight MPAs.

This report, which will be updated on an annual basis, provides a scientific assessment of the current status and trend of key ecological and social conditions across the Seascape's MPA networks, and documents the management status of each MPA. In this section, we briefly outline the monitoring protocols and methods used to generate the data synthesized in this report.

8.1 ECOLOGICAL MONITORING

The Bird's Head Seascape MPA ecological monitoring program is a partnership between Conservation International, Rare, The Nature Conservancy, World Wide Fund for Nature (ID), World Wildlife Fund (US), and Universitas Papua. Since 2010, the partnership (initially CI, TNC, WWF-ID) has been implementing ecological monitoring in nine MPAs (Kaimana MPA Network: Buruway MPA and Triton Bay; Raja Ampat MPA Network: Ayau-Asia MPA, Kawe MPA, Kofiau dan Pulau Boo MPA, Misool Selatan Timur MPA, Selat Dampier MPA, and Teluk Mayalibit MPA; and Teluk Cenderawasih National Park).

Ecological monitoring focuses on two components of the coral reef ecosystem: fish populations (density and biomass) and benthic cover (percent cover). MPAs are monitored every 2-3 years using the Wilson and Green (2009) protocol and the updated Ahmadi et al. (2012) version of the protocol.

In this report, we synthesize data on three ecological indicators selected to reflect management goals, inform policy makers, and be useful as indicators of ecosystem health and fish populations. These indicators align with indicators used in the Indonesian MPA Management Assessments (Directorate for Conservation of Area and Fish Species, 2012), including the condition of the coral reef, and populations of key fisheries species and non-target fish species. Other criteria included characteristics of the ecological indicators (i.e. different trophic and functional groups, life-histories, and home-ranges). Taking all of this information into consideration, we chose to include the following indicators:

REEF FISHERIES: artisanal, or small-scale fisheries, are traditional fisheries involving fishing households (as opposed to commercial companies), using a relatively small amount of capital and energy, relatively small fishing vessels (if any), making short fishing trips, close to shore, and mainly for local consumption. Artisanal fisheries may also feed into commercial supply chains, through fish traders, providing products for local consumption or export (FAO, 2015).

Indicator: Key fisheries species

Three representative fish families were selected as a proxy of the status of reef fisheries: *Lutjanidae* (Snappers).

Haemulidae (Sweetlips), and *Serranidae* (Groupers). These fish are often larger bodied and have a higher market value. Total biomass was calculated across species from the three families; biomass is a function of both the number of fish and their size.

REEF RESILIENCE AND ECOSYSTEM

FUNCTION: Ecological resilience can be defined as the capacity of an ecosystem to absorb recurrent disturbances or shocks and adapt to change while retaining essentially the same ecosystem function and structure (Holling 1973, McClanahan et al. 2012).

Indicator: Fish functional groups

Representative herbivorous fish families were selected as a proxy for the status of reef resilience and ecosystem function: *Acanthuridae* (Surgeonfish), *Scaridae* (Parrotfish), *Siganidae* (Rabbitfish). It has been shown that the level of redundancy within these functional groups can be a measure of reef assemblage stability and is ultimately a measure of reef resilience to perturbations. Total biomass was calculated across species from the three families; biomass is a function of both the number of fish and their size.

CORAL REEF CONDITION: the state of the composition or condition of the benthic community (reef surface) on a coral reef influences "bottom up ecological processes" and has cascading effects on the dynamics and function of the entire reef ecosystem. Stony or "hard" reef-building corals make up a substantial proportion of a coral reef's three-dimensional structure, providing critical habitat for many reef organisms.

Indicator: Hard coral cover

Hard coral cover is an indicator that is commonly used as a proxy for coral reef condition. Hard coral cover is a measure of the proportion of the reef surface covered by live stony or hard coral as compared to rubble, rocks, algae, sponges, or any other substrate.

8.2 SOCIAL MONITORING

The Bird's Head Seascape MPA social monitoring program is a partnership between Universitas Papua, Conservation International, and World Wildlife Fund.

Since 2010, the partnership has monitored human well-being in six MPAs (Buruway MPA, Kofiau dan Pulau Boo MPA, Misool Selatan Timur MPA, Selat Dampier MPA, Teluk Cenderawasih National Park, Teluk Etna MPA, Teluk Mayalibit MPA, and Teluk Triton MPA) across four Regencies in Papua Barat. Universitas Papua conducts household surveys in a representative, random sample of households resident within MPA boundaries, collecting data on economic well-being, health, empowerment, education, and culture. MPAs are monitored every two years, with baseline data collection occurring between 2010 and 2012.

In this report, we synthesize data on five attributes of human well-being commonly identified in human development policy goals, identifying one leading indicator for each of these dimensions:

ECONOMIC WELL-BEING: the resources people use to meet basic consumption and material needs, and access other sources of well-being (Sen, 1999).

Indicator: Household material assets

Material assets are a reliable and widely used indicator of economic well-being. We adopt a standard 'basket of goods' methodology that assesses whether or not a household owns a particular asset (e.g., car, boat, telephone, television).

The 11 item 'basket' includes a range of goods, from low cost items (e.g., mobile phones) to high cost items (e.g., cars, boats with inboard motors). Each asset type is weighted according to its cost, with high value items given greater weight. We calculate a weighted sum of all the assets each household owns.

HEALTH: the state of complete physical, mental, and social well-being, and not merely the absence of disease or infirmity (World Health Organization, 1946).

Indicator: Food security

Food security is the ability for all people, at all times, to access nutritionally adequate and safe food for an active, healthy life, in a socially acceptable way (Bickel et al. 2000). The Bird's Head Seascape social monitoring program adopts an internationally recognized standard scale that classifies households into one of three food security categories (Bickel et al. 2000):

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.

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.

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.

EMPOWERMENT: people's ability to participate in the decision-making processes that affect their lives (United Nations Development Program et al., 2005).

Indicator: Marine tenure

Marine resource rights can be classified into five functional types (Mascia & Claus, 2009), including the right to enter a MPA; the right to harvest fish or other resources from the MPA; the right to manage the MPA (i.e., make decisions about how resources are used); the right to exclude others from the MPA (i.e., make decisions about who can and cannot enter the MPA); and the right to transfer marine resource rights to others (i.e., the sale or lease of rights).

The Bird's Head Seascape social monitoring program uses a marine tenure index to measure the number of distinct marine resource rights each household has exercised in the 12 months prior to survey. The index, which ranges from zero to five, counts the number of distinct resource rights a household has exercised in the 12 months prior to survey.

EDUCATION: the structures, systems and practices used to transfer knowledge and skills in a society (Stephanson & Mascia, 2014).

Indicator: School enrollment rate

We measure the percentage of school age children (between the ages of 5 and 18 years old, inclusive) enrolled in formal education in each household.

CULTURE: encompasses art, ways of living together, value systems, traditions, and beliefs (UNESCO, 2001).

Indicator: Place attachment

Place attachment is "a positive connection or emotional bond between a person and a particular place."

place” (Williams & Vaske, 2003). Research suggests that place attachment is a strong predictor of environmentally responsible behavior and can influence environmental stewardship (Vaske & Kobrin, 2001; Gosling & Williams, 2010).

8.3 MANAGEMENT ASSESSMENTS

In the Bird's Head Seascape, there are currently two tools used to assess MPA management: the World Bank Scorecard (World Bank, 2004) and the E-KKP3K: technical guidelines for evaluating the management effectiveness of aquatic, coasts, and small islands conservation areas (Directorate for Conservation of Area and Fish Species, 2013). The World Bank Scorecard had been used to assess MPAs in the BHS since their inception, allowing users to track changes in MPA management over time and to make global comparisons among MPAs. The E-KKP3K was developed by the Indonesian Ministry of Marine Affairs (MMAF) in 2013, making it a relatively new tool for tracking MPA management. The E-KKP3K provides a standardized assessment across Indonesia to help guide management strategies and priorities of MMAF. In this report, we synthesize data on five attributes of human well-being commonly identified in human development policy goals, identifying one leading indicator for each of these dimensions:

WORLD BANK SCORECARD

The World Bank Scorecard was specifically developed to assess progress in achieving management goals for marine protected areas. These management assessments are conducted annually in ten MPAs (Abun MPA, Kaimana MPA Network: Buruway MPA and Triton Bay: Raja Ampat MPA Network: Ayau-Asia MPA, Kawe MPA, Kofiau dan Pulau Boo MPA, Misool Selatan Timur MPA, Selat Dampier MPA, and Teluk Mayalibit MPA; and Teluk Cenderawasih National Park).

In this report, we synthesize data on the six distinct stages of ‘good protected area management’: (1) context, (2) planning, (3) inputs, (4) processes, (5) outputs, and (6) outcomes. We report the total score across these elements.

E-KKP3K

The E-KKP3K was specifically developed to: (1) evaluate management of marine conservation across Indonesia; and (2) use the guidelines for self-evaluation of the management of a particular marine conservation area, and for making plans to improve management. These management assessments are conducted annually at the MPA network level, and are conducted annually for the Kaimana MPA Network and the Raja Ampat MPA Network.

In this report we synthesize data to determine the ‘level’ of management: starting from the lowest level of management: Level 1 (Red), Level 2 (Yellow), Level 3 (Green), Level 4 (Blue) and Level 5 (Gold). There are 17 different criteria that are evaluated, determined by the results of 74 questions targeted at managers. The parameters used include the status of the area's reserves, institutions, management, and zoning.

8.3 MARINE RESOURCE GOVERNANCE MONITORING

In addition to monitoring human well-being, the Bird's Head Seascape MPA social monitoring program monitors patterns and trends in marine resource governance in six MPAs (Kaimana MPA Network, Kofiau dan Pulau Boo MPA, Misool Selatan Timur MPA, Selat Dampier MPA, and Teluk Mayalibit MPA, Teluk Cenderawasih National Park) across four Regencies in Papua Barat.

Marine resource governance establishes the processes by which marine resources are managed, including how authority for making decisions is allocated, how management decisions are made, and how management decisions are enforced (Mascia et al., in prep). Resource governance can influence the social and ecological outcomes of policy interventions (Persha et al., 2011; Fox et al., 2012) such as MPAs, and successful governance regimes have been found to have shared characteristics (Ostrom et al. 1990). These include participatory decision-making arrangements, context-dependent rules, active and accountable systems for monitoring and enforcement, and accessible conflict resolution mechanisms (e.g., low-cost, local, and rapid process for resolving disagreements).

Universitas Papua conducts focus group discussions and key informant interviews in each monitored settlement to understand marine resource governance in each MPA. The focus groups and key informant interviews focus on how decisions are made about marine resource management, 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.

Focus groups and key informant interviews are conducted in approximately half of the monitored settlements in each MPA every two years. This process provides a comprehensive assessment of marine resource governance every four years. Consequently, in this first edition of the State of the Bird's Head Seascape MPA Network Report, we document the status of marine resource governance drawing on more than 100 focus groups and key informant interviews conducted in eight MPAs across the Bird's Head Seascape. In subsequent reports, we will report both governance status and trends. We synthesize data on four key attributes of marine resource governance in the Seascape:

PARTICIPATORY DECISION-MAKING

The participation of user groups in decision-making has been linked to positive social and ecological outcomes in different contexts (Ostrom et al., 1990; Persha et al., 2012). We monitor the proportion of user groups (i.e., a group of individuals who use marine resources in a similar way) actively participating in designing marine resource rules in each of the six monitored MPAs.

Indicator: Percentage of marine resource use groups involved in decision-making

RESOURCE USE RULES

Rules that define when, where, how, or by whom a resource may be used, based on local conditions, are more likely to result in positive social and ecological outcomes when compared to rules that are not based on local conditions (Ostrom et al., 1990). We monitor the proportion of important species and habitats (as specified by focus group participants) for which there are specific harvest rules in each of the six monitored MPAs. Species and habitats may be identified as 'important' based on their economic, cultural, or spiritual value.

Indicator: Context-dependent rules

MONITORING AND ENFORCEMENT

Governance systems that employ graduated sanctions (i.e., sanctions that increase in severity, often based on the nature of the offense) are more likely to result in positive social and ecological outcomes, relative to systems that do not sanction rule-breaking or those systems in which a single sanction is used for multiple types of infringement.

Indicator: Graduated sanctions

CONFLICT RESOLUTION

The ability of resource users and officials to rapidly resolve conflicts over marine resource use or management at low cost has been linked to positive social and ecological outcomes (Ostrom et al., 1990). We monitor the average time required to resolve conflict among users, or between users and officials in six MPAs across the Seascope.

Indicator: Conflict resolution time

BIRD'S HEAD SEASCAPE CONSORTIUM PARTNERS





CONSERVATION
INTERNATIONAL



The Nature
Conservancy

