



The Bird's Head Seascape of Papua:

One Ocean, Shared Future

Connecting Coastal Ecosystem, Community, and Conservation Partnerships
for a Better Future for Papua

2025

**State of the Bird's Head Seascape
Marine Protected Area Network**

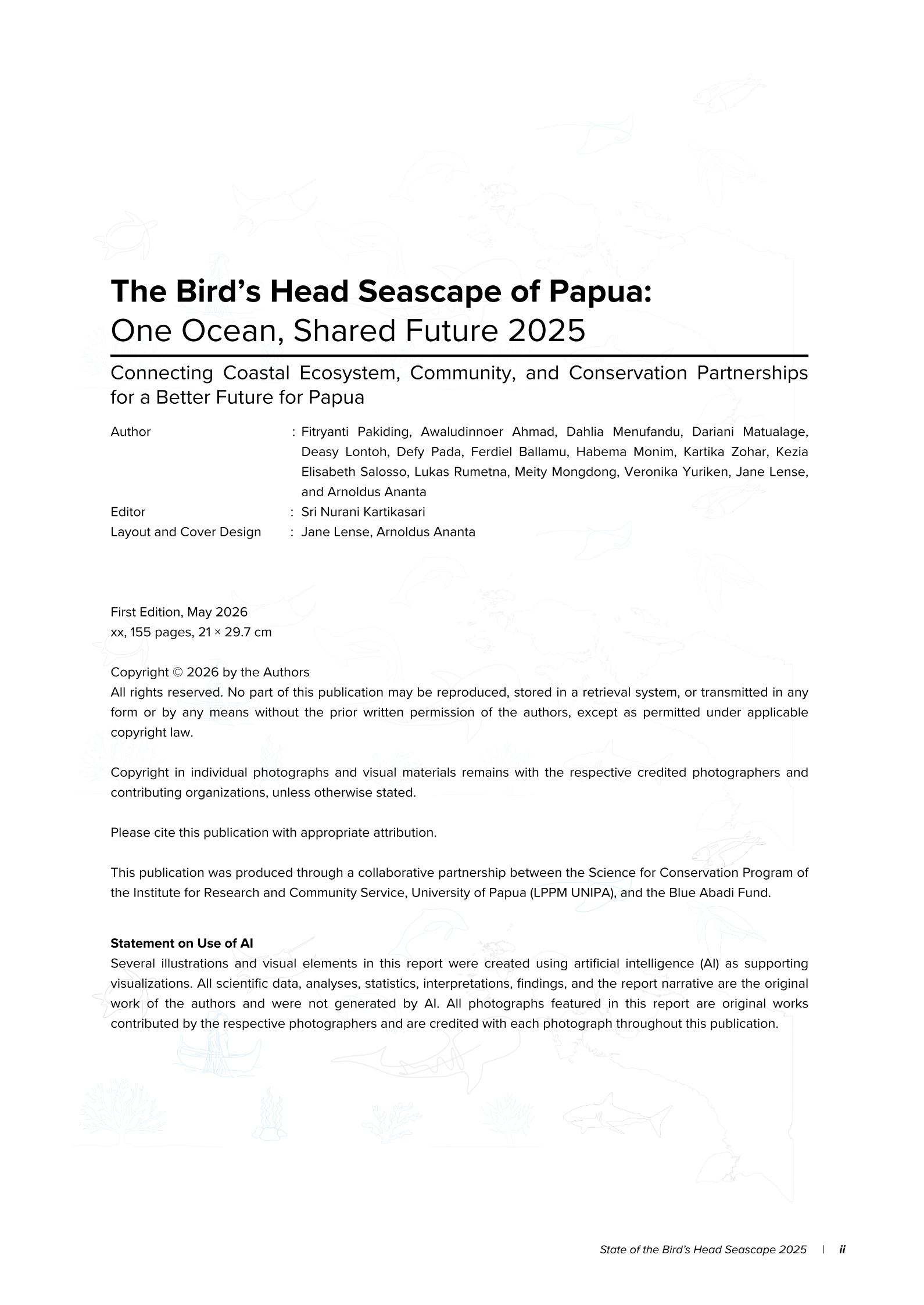
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Foreword

The Bird's Head Seascape (BHS) in Papua, Indonesia, is one of the most biologically diverse places in the world's oceans and is a key focus for conservation. Covering 22.5 million hectares from Cendrawasih Bay to Raja Ampat, it contains 75% of the world's coral species and over 1,800 types of coral fish. The area is also home to important species such as leatherback turtles, manta rays, dugongs, and whale sharks, which are recognized as symbols of global conservation. In addition, the BHS supports Papuan traditions that have protected these seas for thousands of years.

The State of the BHS Marine Protected Area (MPA) Network 2025, referred to as SOTS 2025, builds upon initiatives that began in 2008. In that year, the University of Papua, government agencies, local communities, and conservation partners established a collaborative monitoring system for the region. The inaugural BHS MPA Network Status Report was published in 2015 (Glew et al., 2015), using sufficient data to track trends in six of nine ecosystem health and welfare metrics from 2010 to 2015 and to report on the management performance of each MPA. The subsequent report, released in 2016, updated the findings and disseminated results at various forums, including policy workshops and the BHS annual meeting in 2018. Summaries for each MPA were included in the comprehensive report. This multi-scale approach, spanning from the entire sea to individual MPAs, informs management strategies at both local and regional levels. The 2016 report was further updated with ecological and social data collected between January 1, 2017, and November 30, 2019.

Currently, the monitoring system comprises a 15-year database encompassing 17 conservation regions and covering 5.2 million hectares. This represents the most extensive and comprehensive database for conservation areas in Indonesia. SOTS 2025 extends this series by incorporating the most recent data collected from December 2019 to December 2025.

Findings indicate that coral reefs and key fish biomass across the region remain stable, with several areas demonstrating signs of recovery. However, certain indicators raise concerns, including reduced public engagement in management, diminished cultural attachment to aquatic areas, and challenges in specific aspects of governance.

We compile this report guided by a single principle: data must underpin decision-making and remain accessible to all stakeholders, including government, central and regional managers, area partners, conservation groups, community leaders, and future generations. Every number, graph, and narrative in SOTS 2025 serves one purpose: to help ensure that the BHS remains a healthy and connected home for the sea, its dependent species, and the people of Papua.

Manokwari, May 2026

Fitryanti Pakiding, Ph.D

Science for Conservation Program Management Team
Institute for Research and Community Service
University of Papua



Foreword by the Director of LPPM UNIPA

We offer our utmost gratitude to the Almighty God, for by His grace and blessings, the compilation of this book entitled “One Ocean, A Shared Future – Connecting Coastal Ecosystem, Community, and Conservation Partnerships for a Better Future for Papua” has been successfully completed.

The Bird's Head Seascape (BLKB) in Papua is one of the world's richest centers of marine biodiversity. This region is not only an ecologically vital area for the planet but also a living space that supports the food security and cultural heritage of local indigenous communities. Recognizing its strategic position, the management of this region cannot be carried out unilaterally. Successful conservation must be rooted in a collaborative approach that places local communities as the primary subjects in managing their territory.

This book outlines various strategic steps and achievements in weaving connectivity between coastal ecosystem protection and community empowerment. Various partnership initiatives established between the government, non-governmental organizations, the private sector, and especially Indigenous Peoples and Customary Law Communities have proven that environmental sustainability and social welfare can go hand in hand.

We realize that these achievements would not have been possible without the support, hard work, and dedication of many parties. Therefore, we extend our highest appreciation and gratitude to:

1. The Central Government and Regional Governments for their commitment and policies supporting community-based conservation;
2. Traditional Leaders, Religious Leaders, and all Coastal Communities in the Bird's Head Seascape region who have preserved their cultural and natural heritage;
3. Partners and Donors, who have provided technical and financial support so that conservation programs can run optimally;
4. The entire editorial team who have devoted their time and energy to summarizing field data and lessons learned into this book.

We hope this book can serve as a basis for evaluation and learning, and as a reference for formulating future policies. We realize that this book is far from perfect. Therefore, we welcome any constructive criticism, suggestions, and input for future improvement.

May the partnerships outlined in this book continue to strengthen our collective efforts to protect the Bird's Head Seascape of Papua, for the sake of a better future for our Earth and the generations to come.

Manokwari, May 2026

Prof. Ir. Freddy Pattiselano, M.Sc., Ph.D.

Director, Institute for Research and Community Service
University of Papua

Acknowledgements

This SOTS 2025 is the result of work involving many parties, cross-institutional and cross-disciplinary science, and work across regions. We extend our deepest gratitude and appreciation to all the parties who have provided support, data, time, thoughts, and field experience in the drafting of this report. Every contribution plays an important role in building a clearer picture of the condition of the Bird's Head Seascape, from ecological, social, and governance aspects to the direction of conservation efforts.

We are deeply grateful to the authors and report contributors who have worked with full dedication, collecting and analyzing monitoring data, developing the narrative, verifying information, and bringing the material together into a coherent publication. It becomes a single document that all parties can read and use. We convey our appreciation specifically to the Science for Conservation Program of LPPM University of Papua, which has sustained long-term socio-ecological monitoring in the BHS, and encouraged scientific knowledge to serve as a basis for decision-making for the community, government, and management area.

We also extend our appreciation to the Governments of West Papua, Southwest Papua, Central Papua, and Papua Provinces, as well as to the district governments across the Bird's Head Seascape, for their support of conservation management, monitoring, and data provision. We express our sincere gratitude to the Marine and Fisheries Services, the BLUD UPTD Raja Ampat Conservation Area Management, BLUD UPTD Kaimana–Fakfak, the Cenderawasih Bay National Park Office, the Southwest Papua Natural Resources Conservation Agency (KSDA) Office, the Kupang Marine Conservation Area Management Office, and other relevant technical units and institutions that have contributed to the management, monitoring, protection, and conservation of the Bird's Head Seascape.

We extend our sincere appreciation to the conservation partners who have worked alongside us in the field, including the Nusantara Nature Conservation Foundation, Conservation International Indonesia, the Papua Turtle Foundation, the Misool Foundation, the West Papua Nazareth Foundation, WWF-Indonesia, and other partner institutions involved in ecological monitoring, social monitoring, species protection, area patrols, environmental education, community empowerment, and strengthening community-based governance. The support of these partners has strengthened conservation efforts across the Bird's Head Seascape and helped ensure that data, experiences, and lessons learned from the field are properly documented and shared.

We also express our sincere appreciation to Blue Abadi Fund for support for conservation work on the sea and coastline in the Bird's Head Seascape. This support has helped strengthen monitoring and empowerment programs for communities, species protection, environmental education, and other collaborative efforts that have become an important part of sustainable conservation in the management area.

We are grateful to researchers, staff, field enumerators, local patrol teams, community group supervisors, village youth, women facilitators, teachers, education facilitators, local guides, and all parties who have assisted with data collection and implementation activities in the field. Their meticulous efforts in recording data, making observations, maintaining monitoring sites, engaging in discussions with communities, and ensuring that activities proceeded smoothly despite the many challenges encountered in the field made the completion of this report possible.

Through these words, we express our deep gratitude and respect to the Indigenous peoples and coastal communities throughout the Bird's Head Seascape. From Raja Ampat, Tambrau, Sorong, Fakfak, Kaimana, Teluk Wondama, Biak Numfor, and Nabire to other coastal areas, local communities have long served as the primary stewards of the sea, islands, beaches, coral reefs, mangroves, seagrass meadows, turtles, fish, and the many forms of marine life that are integral to Papuan identity. Their knowledge, wisdom, *sasi* practices, participation in patrols, and willingness to share their stories and experiences form an important foundation for this report's content.

Finally, we hope this report will serve as a resource for shared learning. It is not the end of the process, but rather part of an ongoing journey to conserve the Bird's Head Seascape as a shared home for its ecosystems, species, and people. We hope that the data and lessons presented in this report will help strengthen policies, improve management, expand collaboration, and ensure that the benefits of conservation are shared equitably among present and future generations.

Partners Supporting Conservation Programs in the Bird's Head Seascape



Executive Summary

The Bird's Head Seascape (BHS) of Papua is recognized as one of the most significant marine regions globally. It extends from Cenderawasih Bay and Raja Ampat to Kaimana and Fakfak, encompassing a network of 17 conservation areas that cover more than 5.2 million hectares. The BHS supports a wide array of marine biological resources, including coral reefs, mangroves, seagrass beds, reef fish, turtles, sharks, manta rays, dugongs, whales, and dolphins. Additionally, the region is integral to the livelihoods, culture, and traditions of coastal communities, reflecting strong social, cultural, and economic ties to the sea.

The SOTS 2025 provides a comprehensive overview of the Bird's Head Seascape, detailing its formation, conservation history, ecosystem and species status, social welfare, governance structures, and collaborative partnerships. The report demonstrates that conservation successes in the BHS have resulted from sustained efforts involving government agencies, local communities, customary authorities, educational institutions, conservation organizations, and development partners. Collaborative partnerships have been fundamental in establishing monitoring systems, enhancing management, supporting species protection, and securing long-term conservation funding.

Monitoring results indicate that several ecological indicators are in good condition. Coral cover and functional fish biomass exhibit high and increasing trends, while key fishery biomass species remain at moderate and relatively stable levels. These findings suggest that portions of the BHS coral reef ecosystem retain strong resilience and capacity for recovery. However, conditions vary across the region due to differing conservation pressures, including sedimentation, physical damage, fishing pressure, tourism, coral bleaching, habitat degradation, and climate change.

The BHS remains a critical habitat for key species, including turtles, elasmobranchs, and marine mammals. Coastal areas such as Tambrauw, Raja Ampat, and Kaimana are vital for sustaining populations of leatherback, olive ridley, hawksbill, and green turtles. Raja Ampat and Misool are particularly important for reef sharks, manta rays, zebra sharks, and other elasmobranch species. The continued presence of dugongs, dolphins, and whales further underscores the BHS's significance for marine mammals. Effective species protection requires ongoing monitoring, habitat conservation, regular patrols, mitigation of bycatch, and strengthened compliance with conservation regulations.

The report highlights that ecological achievements do not necessarily lead to improved social outcomes. Indicators of human well-being, especially economic status and food security, remain low in many areas. Although education levels and community attachment to marine environments are relatively positive, significant challenges persist, including economic pressures, limited market access, high transportation costs, and restricted livelihood opportunities. These findings underscore the importance of continuing conservation efforts in the Bird's Head Seascape, with increased focus on enhancing livelihoods, food security, resilience, customary rights and institutions, and delivering tangible benefits to local communities.

The governance framework of the BHS is robust, supported by key institutions, a network of marine protected areas, the EVIKA mechanism, monitoring of marine resource governance, and customary practices such as sasi laut. Nevertheless, management effectiveness requires further improvement. Public participation is uneven, monitoring and enforcement mechanisms differ across regions, and coordination among authorities remains challenging. Sasi laut exemplifies the value of customary management in conservation. Its contribution can be enhanced through improved documentation, institutional strengthening, expanded data collection, and formal policy recognition by governments, conservation partners, and local communities.

Collaboration among key stakeholders—including conservation partners, government agencies, customary authorities, universities, local NGOs, community-based monitoring groups, and funding institutions—is a major strength of the BHS. These groups have implemented a range of activities, such as area patrols, species monitoring, environmental education, economic empowerment, waste management, and strengthening the sasi laut network. The existence of networks for turtle conservation, patrols, surveillance, and sasi laut demonstrates that effective conservation requires multi-stakeholder engagement. Future collaboration should focus on joint system reporting, data integration, clearly defined roles, enhanced technical capacity, and stronger policies.

The long-term security of the BHS cannot be ensured solely by designating conservation areas. These areas must function effectively to protect critical habitats, maintain key species populations, support food and livelihood resilience, and promote equitable and effective governance. The main report recommends reducing local pressures, protecting species and habitats, increasing public coastal awareness, securing sustainable funding, and utilizing data-driven decision-making. Initiatives such as blue carbon, OECM, ReShark, innovative funding mechanisms, and citizen science offer opportunities to position the BHS as a model for tropical conservation by aligning all efforts with community needs and management strategies.

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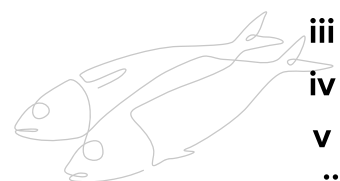
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List of Acronyms and Abbreviations

ABK	Workload Analysis
AI	Artificial Intelligence
APBD	Regional Income and Expenditure Budget
BAF	Blue Abadi Fund
BAPPEDA	Regional Planning and Development Agency
BBKSDA	Natural Resources Conservation Agency
BBTNTC	Teluk Cendrawasih National Park Authority Center
BBM	Fuel Oil
BHS	Bird's Head Seascape
BKKPN	National Marine Protected Areas Office
BLKB	Bentang Laut Kepala Burung
BLUD	Regional Public Service Agency
BRUV	Baited Remote Underwater Video
CA	Nature Reserve
CAL	Marine Nature Reserve
CBASS	Coral Bleaching Automated Stress System
CBO	Community-Based Organization
CCA	Crustose Coralline Algae
CI	Conservation International
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CKKD	Prospective Regional Conservation Areas
COTS	Crown-of-Thorns Starfish
CTI	Coral Triangle Initiative
DKP	Department of Marine Affairs and Fisheries
EBM	Ecosystem-Based Management
EVIKA	Evaluation of the Effectiveness of Conservation Area Management
FAO	Food and Agriculture Organization
FGD	Focus Group Discussion
FPIK	Faculty of Fisheries and Marine Sciences
IMMA	Important Marine Mammal Area
IPCC	Intergovernmental Panel on Climate Change
ISRA	Important Shark and Ray Areas
IUCN	International Union for Conservation of Nature
Kemenhut	Ministry of Forestry
KEPMEN-KP	Decree of the Minister of Marine Affairs and Fisheries
KII	Key Informant Interview
KK	Conservation Area
KKPD	Regional Marine Protected Areas
KKPN	National Marine Protected Areas
KLHK	Ministry of Environment and Forestry
KKP	Ministry of Marine Affairs and Fisheries
KPA	Nature Conservation Area
KSA	Nature Reserve Area
KSDA	Conservation of Natural Resources
LIPI	Indonesian Institute of Sciences
LPPM	Institute for Research and Community Service
LPSPL	Coastal and Marine Resources Management Office
METT	Management Effectiveness Tracking Toll
MHA	Customary Law Community
MPA	Marine Protected Area
MRAP	Marine Rapid Assessment Program
NGO	Non-Governmental Organization
NOAA	National Oceanic and Atmospheric Administration
NRM/EPIQ	Natural Resources Management Program/Environmental Policy and Institutional Strengthening IQC

NTZ	No- Take Zone
OECD	Other Effective Area-Based Conservation Measures
PAM	Passive Acoustic Monitoring
Perbup	Regent Regulation
Perda	Regional Regulation
PIT	Passive Integrated Transponder
PLH	Environmental Education
POKJA	Working Group
POKMAS	Community Group
POKMASWAS	Community-Based Fisheries Monitoring Group
PSAT	Pop-Up Satellite Archival Tag
PSDKP	Marine and Fisheries Resources Surveillance
RAP	Rapid Assessment Program
REA	Rapid Ecological Assessment
ReShark	Rewilding Sharks
RFID	Radio Frequency Identification
RHM	Reef Health Monitoring
RI	Republic of Indonesia
RPZ	Plan Management and Zoning
RTRW	Regional Spatial Planning
SAP	Marine Nature Reserve
SCUBA	Self-Contained Underwater Breathing Apparatus
HR	Human Resources
S4C	Science for Conservation
SK	Decree
SM	Wildlife Sanctuary
SOP	Standard Operating Procedure
SOTS	State of the Seascape/State of the Bird's Head Seascape
SSC	Species Survival Commission
SUOP	Organizational Unit Manager
TCBFM	Traditional Community-Based Fisheries Management
TFCCA	Tropical Forest and Coral Reef Conservation Act
TNC	The Nature Conservancy
TN	National Park
TNTC	Teluk Cendrawasih National Park
TP	Coastal Park
TWP	Marine Tourism Park
UBC	The University of British Columbia
UCLA	University of California, Los Angeles
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNIPA	University of Papua
UPTD	Regional Technical Implementation Unit
UVC	Underwater Visual Census
VBS	Visual Bleaching Score
WCPA	World Commission on Protected Areas
WIT	Eastern Indonesian Time
WSC	Whale Shark Center
WWF	World Wildlife Fund
WWF-ID	World Wildlife Fund Indonesia
WWF-US	World Wildlife Fund United States
YKAN	Indonesian Nature Conservation Foundation
YKI	Indonesian Conservation Foundation
YMER	Yayasan Misool Ekosistem Regenerasi/Misool Foundation
YNPB	West Papua Nazareth Foundation
YPP	Papua Turtle Foundation

BHS MPA Network Dashboard

2025

	STATUS	Current Trend and Confidence Level
ECOSYSTEM		
Benthic Composition Percentage of live coral cover	H	↑ ***
Key Fisheries Species Biomass of key fishery species	M	—
Functional Fish Biomass Biomass of fish functional groups	H	↑ ***
HUMAN WELL-BEING		
Economic Well-being Household material asset index	L	↓ ***
Health Household food security index	L	↑ ***
Political Empowerment Index of household rights fulfillment over marine resources	L	↓ ***
Education School participation rate	H	↑ ***
Culture Emotional attachment to marine areas	H	↑ ***
MANAGEMENT		
EVIKA Evaluation of the Effectiveness of Marine Conservation Area Management		
Padaido Islands Marine Tourism Park and Surrounding Seas in Papua Province	✓	
Parks in the Waters of the Western Waigeo Islands and Surrounding Seas	✓	
Parks in the Waters of the Raja Ampat Islands and Surrounding Seas	✓	
Parks in the waters of the Raja Ampat Islands in West Papua Province	✓	
Parks in the Waters of the North Misool Region of the Raja Ampat Islands, Southwest Papua Province	✓	
Berau Bay and Nusalasi–Van Den Bosch Bay Coastal Park, West Papua Province	✓	
Buruway, Arguni, Kaimana, Teluk Etna, and Surrounding Waters Conservation Area, West Papua Province	✓	
Jeen Womom Coastal Parks	✓	
Marine Parks in the Biak Numfor Region, Papua Province	✓	
Teoenebikia River Park in the South Sorong Waters	✓	
GOVERNANCE		
Community Participation Comparison of participation among marine resource user groups in the formulation of resource-use regulations	S	—
Resource-Use Regulations 1. Habitats protected under specific regulations 2. Species protected under specific regulations	T S	— —
Monitoring and Enforcement Number of sanctions issued to encourage compliance with regulations	R	—
Conflict Resolution Average time required to resolve conflicts between resource users and enforcement authorities	S	—

STATUS

H High	M Moderate	L Low
✓ Sustainable	✓ Optimum	✓ Minimum

CURRENT TREND

↑ Increasing	— Stable	↓ Decreasing
--------------	----------	--------------

CONFIDENCE LEVEL

*** Almost certain
** Very high
* High

CHAPTER 1

Blue Foundations: Early History and Partnerships in the Bird's Head Seascape

“Understanding the Bird's Head Seascape and Its Long Conservation Journey”

The Bird's Head Seascape (BHS), known in Indonesian as Bentang Laut Kepala Burung (BLKB), is one of the world's most significant marine areas. Located at the western tip of Papua and at the heart of the Coral Triangle, the seascape covers over 22.5 million hectares of waters. It is home to extraordinary biodiversity, including coral reefs, reef fish, marine mammals, mangroves, seagrass beds, and numerous threatened marine species.

The value of BHS extends beyond its extraordinary biodiversity; it also plays a crucial role in providing food, livelihoods, and cultural identity for Indigenous Peoples and local communities. Recognizing these ecological and social values sparked collaborative conservation efforts in the early 2000s. Since then, government agencies, indigenous communities, universities, and conservation organizations have joined forces to establish a marine protected area (MPA) network, which now safeguards over 5.2 million hectares of Papua's waters.

Coastal landscape of Kaimana
© Habema Monim (S4C LPPM UNIPA)

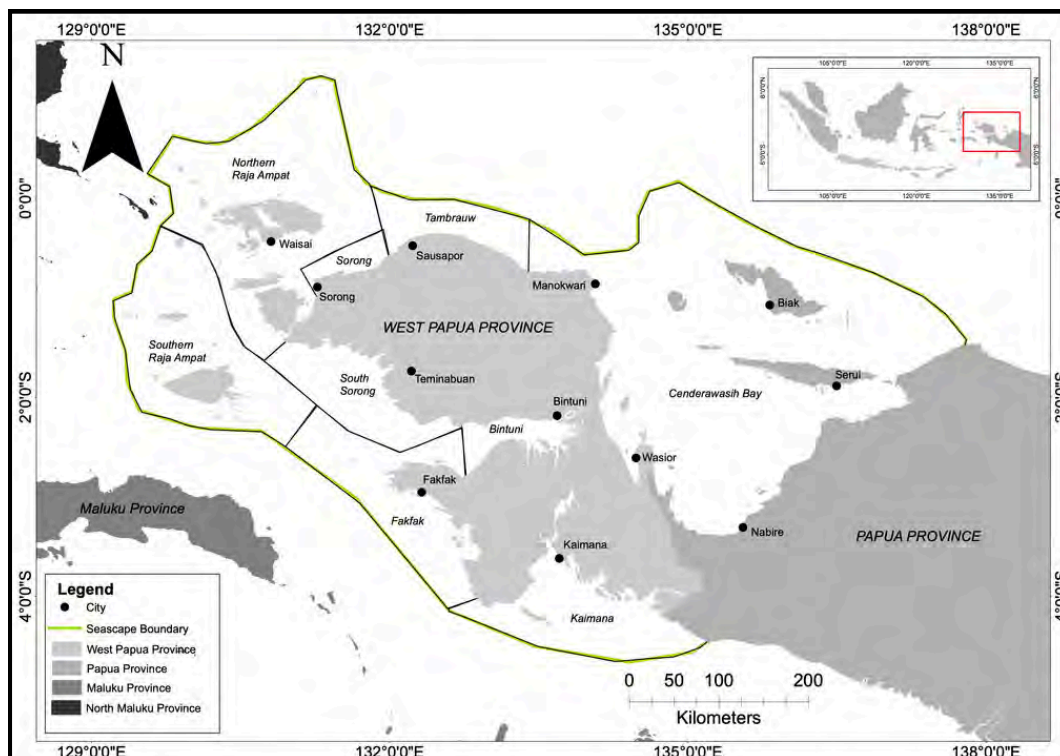


Figure 1.1 Boundary of the Bird's Head Seascape (BHS).

The outer boundary of the BHS is defined based on biogeographic, oceanographic, and genetic connectivity among coral reef areas with similar ecological and environmental characteristics. (Green & Mous, 2008).

Map source:
Purwanto et al. (2021).

The Bird's Head Seascape (BHS)

A seascape refers to a marine management approach that views ecosystems, communities, economies, and governance systems as interconnected. Instead of focusing solely on protecting individual sites, this approach considers how various uses of marine resources can be managed in an integrated, fair, and sustainable manner.

The BHS is one of the world's most significant marine landscapes. It spans more than 22.5 million hectares of ocean, small islands, coral reefs, mangroves, and seagrass beds at the western tip of Papua, Indonesia (Veron et al., 2009; Wallace et al., 2011). Geographically, it includes Cenderawasih Bay to the east, the Raja Ampat Islands to the west, and the coastal areas of Kaimana and Fakfak to the south.

Administratively, the BHS spans several provinces in Tanah Papua, which include Southwest Papua, West Papua, Papua, and Central Papua. It covers significant areas, including Raja Ampat, Sorong, Tamrau, Kaimana, Fakfak, Teluk Wondama, Biak Numfor, and Nabire. Given this extensive and complex geography, managing BHS requires collaboration across various regions, sectors, and institutions.

The BHS is ecologically significant because it lies at the heart of the Coral Triangle, a region globally recognized for its rich marine biodiversity. The waters host over 1,800 species of reef fish (Allen & Erdmann, 2024) and more than 600 species of coral (Mangubhai et al., 2012), representing around 75 percent of all known coral species worldwide. This area also provides critical habitat for at least 18 species of marine mammals, as well as for threatened species such as manta rays, whale sharks, zebra sharks, endemic walking sharks, dugongs, and sea turtles (Veron et al., 2009; Wallace et al., 2011).

Beyond its coral reefs, BHS features extensive mangrove forests and seagrass beds — vital ecosystems serving as spawning grounds, nursery areas, coastal buffers, carbon sinks, and sources of community livelihoods. The seascape is particularly significant for the Pacific leatherback turtle, as it hosts one of the species' largest nesting areas (Mangubhai et al., 2012).

The importance of BHS, however, extends beyond its ecological value. Approximately 1.6 million people live within this area, representing a rich diversity of cultures, languages, and traditions (Badan Pusat Statistik Provinsi Papua, 2023; Badan Pusat Statistik Provinsi Papua Barat, 2023). For many coastal communities, the sea is essential as a source of food, income, cultural practice, and social identity. Capture fisheries provide the primary source of income for nearly one-third of households, while most coastal households depend on marine resources as a primary source of protein.

For centuries, Indigenous Peoples and local communities in the BHS have managed marine resources using customary knowledge and local practices. A widely recognized practice is *sasi*, a customary system that regulates the use of natural resources, including temporary closures of specific areas or species to allow for recovery. Practices such as *sasi* show that conservation in the BHS has deep roots, evolving from a long-standing relationship between the communities and the sea.

However, the pressure on the BHS is steadily increasing. Destructive fishing practices, coral bleaching driven by climate change, coastal development, and rising demand for marine resources all pose significant challenges to the seascape's long-term sustainability. Therefore, the BHS needs a structured, collaborative, and science-based management approach that also respects the rights, knowledge, and contributions of Indigenous Peoples and local communities.



Group photo of several BHS partners in 2004
© Defy Pada

History of the Establishment of Marine Protected Areas in the BHS

The recognition of the BHS's extraordinary importance prompted many stakeholders to develop a more strategic conservation approach in the early 2000s. This initiative was motivated not only by the area's extraordinary biodiversity, but also by the need to safeguard food security, support community livelihoods, and ensure the long-term sustainability of marine resources.

In 2003, a significant milestone was achieved during a collaborative meeting that resulted in the Tomolol Declaration. This declaration marked a pivotal moment for the development of marine protected areas in Raja Ampat. It emphasized that effective marine protection would require cooperation among the government, indigenous communities, and conservation organizations.

In 2004, conservation efforts on the seascape began to take a more structured form. A collaboration emerged among Conservation International (CI), The Nature Conservancy (TNC), WWF-Indonesia, Universitas Papua, international academic partners, local governments, and other stakeholders to develop an ecosystem-based management approach for the BHS. This initiative eventually became widely known as the Bird's Head Seascape Initiative.

The initiative aimed to build an effective network of Marine Protected Areas while strengthening community-based management models. It sought to ensure that marine conservation would provide long-term benefits for Indigenous Peoples and local communities. From the outset, conservation efforts in the BHS were not solely focused on protecting species and habitats; they also emphasized the importance of sustaining the relationship among communities, marine resources, and effective governance.

As the BHS initiative advanced, it became increasingly evident that stronger coordination among partners was essential. In September 2006, multiple parties signed a Joint Agreement Charter to support ecosystem-based management in the BHS. The agreement involved provincial and national government

agencies, customary institutions, universities, and conservation organizations.

This charter became a key foundation for conservation collaboration within the BHS. Through this agreement, partners committed to using scientific data and information to guide policy development for coastal and marine resource management, while emphasizing the importance of Indigenous communities and local institutions as vital contributors to the seascape governance.

In the years that followed, this collaboration expanded to include various programs focused on conservation, research, education, and capacity-building. These initiatives encompassed marine biodiversity surveys, support for MPA establishment, environmental education, socioeconomic monitoring, and efforts to strengthen the governance of conservation areas.

In August 2009, CI, TNC, and WWF-Indonesia officially launched the BHS secretariat office in Manokwari. The secretariat enhanced coordination with the provincial government and improved communication among conservation organizations. It also served as an important symbol of shared commitment to protect the 'Crown Jewel of Cenderawasih Land' through a conservation network extending from Kaimana to Cenderawasih Bay.

By 2009, 12 MPAs had been established throughout the BHS, stretching from Cenderawasih Bay National Park in the east to the Raja Ampat MPA network in the west. Their establishment was supported by various legal instruments, including ministerial decrees that designated national conservation areas in the Raja Ampat Islands, West Waigeo, and their surrounding waters.

After the initial MPA network was established, the conservation focus in the BHS shifted from merely designating areas to enhancing management practices. This involved improving the capacity of site managers, strengthening patrol systems, monitoring ecosystems, supporting community education, and integrating customary practices such as sasi into marine resource governance.

In 2012, Raja Ampat reached an important milestone when it was declared the first shark and manta ray sanctuary in the Coral Triangle. This policy provided strict protection for all shark and ray species and strengthened protection for sea turtles, dugongs, and endemic fish in Raja Ampat. The decision showed that BHS was important not only as an MPA network, but also as a globally significant area for threatened marine species.

As the number and size of conservation areas increased, the need for long-term financing became more urgent. Managing MPAs requires sustained funding for patrols, monitoring, education, enforcement, institutional strengthening, and support for local communities. To respond to this need, the BHS coalition, together with government and partners, launched the Blue Abadi Fund (BAF) in 2017.

The Blue Abadi Fund was designed as a long-term financing mechanism to support the management of the BHS MPA network.

It helps close financing gaps and reduce reliance on short-term project funding. The BAF represents an innovative funding approach to marine conservation in Indonesia, as it connects ecosystem protection, sustainable financing, and community benefits.

The MPA network continued to expand and strengthen. By 2019, the number of MPAs in the BHS had increased to 17. This growth included the designation of conservation areas such as the Buruway, Arguni, Kaimana, Teluk Etna, along with coastal and small-island conservation areas in Teluk Berau and Teluk Nusalasi-Van Den Bosch.

Conservation in the BHS can no longer be viewed simply as a matter of establishing boundaries around protected areas. Instead, it illustrates how marine conservation should be approached as a long-term process that integrates science, public policy, customary governance, sustainable financing, and community participation.



Declaration charter of the Raja Ampat District Locally Managed Marine Conservation Area.
© Menteri Kelautan dan Perikanan 2007

Signing of the grant agreement between BLUD UPTD KKPD Raja Ampat and TNC, 6 March 2015.
© Nugroho Arif Wibowo (TNC)

Dissemination of environmental service fee regulations in Bali by BLUD UPTD KKPD Raja Ampat, 25 February 2015.
© Nugroho Arif Wibowo (TNC)

Chronological Timeline of MPA

Milestones in Conservation, Research,

1 Foundation Stage and Initial Knowledge Development (1990-2006)

1990
 WWF-Indonesia launched programs in Jamursba Medi (Leatherback Turtle) and Cenderawasih Bay (designated as a Marine National Park).

2001
 A Marine Rapid Assessment Program (MRAP) was conducted from March 27 to April 10, 2001, by Conservation International (CI), Cenderawasih University, the Indonesian Institute of Sciences (LIPI), the Australian Institute of Marine Science, and the Western Australian Museum. This MRAP was conducted in an area covering approximately 6,000 km², encompassing the reefs in the Dampier Strait between North Batanta and Waigeo. The survey area also included Pam Island and the Batang Pele island group, the western tip of Waigeo Island, including Alyui Bay, Kawe Island, and Wayag Island.

2002


- The MRAP, funded by the Henry Foundation and conducted from June 17–30, 2002, by The Nature Conservancy (TNC) in collaboration with the Natural Resources Management Program (NRM/EPIQ).
- A Rapid Ecological Assessment (REA) conducted by TNC in collaboration with WWF Sahul from October 30 to November 22, 2002, was carried out at 59 locations in the eastern and southern parts of the Raja Ampat Islands.

2003
 The Tomolol Declaration, a milestone marking the initial initiative for the establishment and development of the Raja Ampat Marine Protected Area (MPA).

2004
 The Ecosystem-Based Management (EBM) Program was implemented by CI, TNC, and WWF-ID in collaboration with UNIPA, The University of British Columbia (UBC), University of California, Los Angeles (UCLA), and the West Papua Provincial Government.

2005
 Launch of the Walton Family Foundation BHS Grant Phase I.

2006


- Cenderawasih Bay Marine RAP (CI, UNIPA, WWF-ID, BBTNTC).
- Kaimana-Fakfak: Marine RAP (CI, UNIPA, BBKSDA), an initial survey identifying ecological priority areas and serving as the scientific basis for establishing Marine Protected Areas (MPAs) in both districts.
- KONPERS (Papua Turtle Foundation/YPP) launched a sea turtle conservation program in Sayang-Piai.
- September 2006: Signing of the Joint Agreement Charter by BHS stakeholders (Governor IJB, relevant agencies, BBKSDA, TNC, CI, WWF-ID, UNIPA, Traditional Council) for ecosystem-based management in the BHS area.
- Waiwo Declaration: The traditional leaders of Raja Ampat handed over a mandate to the Raja Ampat Regency Government for the management of parts of the Sayang-Wayag marine area, Mayalibit Bay, Dampier Strait, Ayau-Asia, Kofiau-Boo, and Southeast Misool to the Raja Ampat Regency Government on December 15, 2006

2 Area Expansion and Program Strengthening (2007-2012)

2007


- Raja Ampat Regent Regulation No. 66/2007 on the Raja Ampat KKLD was launched by Minister Freddy Numberi.
- The Kaimana Program was launched.

2008


- Kaimana: Regent Decree No. 44/2008 (February), establishing the Kaimana MPA Development Team. Minutes of the Customary Declaration (April), Kaimana customary leaders mandate marine management to the regency government. Regent Regulation No. 4/2008 (July), official declaration of the 597,000-hectare Kaimana MPA. National launch (November 24) by Minister of Marine Affairs and Fisheries Freddy Numberi, attended by 500 people.
- Kalabia Education Program: "Sailing While Learning" launched.
- Walton BHS Phase II: three grant-receiving institutions (CI/TNC/WWF).

2009


- Workshop on Geographical Prioritization of Indonesia's Marine Biodiversity; BHS (Papua Marine Ecoregion) ranked highest in Indonesia.
- The BHS Secretariat was launched in Manokwari.
- The BHS MPA Capacity Building Program was launched.
- Ministry of Marine Affairs and Fisheries Decrees No. KEP.64/MEN/2009 and No. KEP.65/MEN/2009 regarding the designation of the Raja Ampat National Marine Protected Area.
- On March 4, 2009, the Ministry of Forestry transferred 8 Nature Reserves and Nature Conservation Areas to the Ministry of Marine Affairs and Fisheries via the Transfer of Custody Minutes No. BA. 01/Menhut-IV/2009 and BA.108/MEN.KP/III/2009. The two areas transferred are in the waters of Raja Ampat Regency, namely the Panjang Islands Wildlife Sanctuary and the Raja Ampat Islands Marine Wildlife Sanctuary. Following the handover, the Panjang Islands Wildlife Sanctuary became the Waigeo Islands Western Marine Nature Reserve and the surrounding waters (Decision of the Minister of Marine Affairs and Fisheries No. KEP.65/MEN/2009), while the Raja Ampat Islands Marine Wildlife Sanctuary subsequently became the Raja Ampat Marine Tourism Park (Decision of the Minister of Marine Affairs and Fisheries No. 36/KEPMEN-KP/2014). Both areas are managed by the National Marine Protected Areas Office (BKKN) in Kupang, while at the local level there are Field Units (Satker).

2010


- UNIPA/WWF-US launched a socio-ecological monitoring program for the Kepala Burung Marine Protected Area (Cenderawasih Bay and Mayalibit Bay).
- Kaimana: Regent's Decree No. 80/2010 on the re-establishment of the multi-stakeholder Kaimana Marine and Coastal Affairs Development Team, and the commencement of construction of the Marine and Coastal Affairs office and community patrol posts.

2011
 Kaimana: The principle of sustainability was incorporated into the regency's development agenda, with the Ministry of Marine Affairs and Fisheries (KKP) becoming central to the maritime economic and tourism strategy. The Triton Bay Customary Declaration (June 7): Four indigenous communities established the first No-Take Zone (NTZ) covering 2,345 hectares and a 663-hectare Limited Use Zone.

2012


- Raja Ampat was designated as the first shark and ray protection area in the Coral Triangle.
- Kaimana: The MPA system was reconfigured into a network of four zones (Arguni, Buruway, Etna, Triton Bay), covering 514,285 ha and protecting >50,000 ha of mangroves. The design was integrated into the Regional Spatial Planning (RTRW). Initiation of the Buruway Village Regulation for community-based fisheries management.

Network Development in BHS

Institutional Development, and Area Management



3

Legalization, Institutional Strengthening, and Funding (2014-2019)



4

Progress Toward Independent Management (2020-2025)



2014

- Kaimana–Fakfak: A joint agreement between the Kaimana and Fakfak District Governments to halt cross-district illegal fishing permits.
- Kaimana: Commitment to establish a Regional Technical Implementation Unit (UPTD) as the official MPA management body — the initial foundation for transferring management from NGOs to local government.
- Decision of the Minister of Marine Affairs and Fisheries No. 36/KEPMEN-KP/2014 on the Raja Ampat Islands Marine Conservation Area, West Papua Province, designating part of the Raja Ampat Islands' waters as a Marine Conservation Area.



2015

- Kaimana: Enactment of Local Regulation No. 11/2014 (early 2015) — legalizing the Kaimana MPA network (four sectors: Buruway, Arguni, Triton Bay, Etna), enabling conservation programs to be budgeted in the 2015–2016 Regional Budget. A series of Traditional Zoning Declarations in Namatota, Daramai Island, Kambala, and Tugarni (Arguni MPA, 35,000 ha).



2016

- Fakfak: October–November: a series of traditional meetings resulted in Traditional Declarations (Sinara) on Arguni Island (November 11) and in Antalisa Village (November 20), indigenous communities officially handed over traditional waters to be managed as an MPA.
- Kaimana: The community of Lakahia Village (Etna District) declared the zoning of Etna Bay. Finalization of the draft Kaimana UPTD Regent Regulation. Nusa Ulan Village Regulation for Sustainable Fisheries Zones.



2017

- CI, TNC, and WWF-Indonesia, together with the West Papua Provincial Government, launched the Blue Abadi Fund (BAF) as a long-term funding mechanism for the BHS MPA network.
- Fakfak: West Papua Governor's Decision No. 523/136/7/2017, designating the Berau Bay and Nusalasi-Van Den Bosch Bay MPA areas covering 350,000 ha. November: outreach to over 550 residents and government officials.



2018

- Fakfak: January: Formation of the Working Group (West Papua DKP Decree No. 01/2018) and training on sustainable fisheries. February: participatory mapping and Expert Mapping Workshop, 12 thematic maps, agreement to designate approximately 60,000 ha as the Core Zone. March: Biodiversity survey (9 new fish species, including *Chrysipetra uswanasi*). August: Formation of the Nusa Matan Community-Based Fisheries Monitoring Group (POKMASWAS) (DKP Decree No. 11/2018). November: Governor's Decision No. 523/239/11/2018 approved the Fakfak Marine Protected Area (MPA) covering 347,290 ha. December: E-KKP3K evaluation, 100% Red Level, beginning to meet Yellow Level indicators.



2019

- Fakfak: January: POKMASWAS study visit to Raja Ampat, collaborative patrol training. March: BAF grant of Rp200 million for POKMASWAS Nusa Matan. May: approval of SOPs, installation of 30 information boards, and development of a Costing Model. October: 100% Yellow Level, 76% Green Level: Fakfak MPA is ready to be proposed for national designation.
- Kaimana: July: Ministry of Marine Affairs and Fisheries Decree No. 25/KEPMEN-KP/2019 on the definitive designation of 499,804.13 ha (Buruway, Arguni, Kaimana, Teluk Etna).
- Kaimana–Fakfak: September: West Papua Governor's Regulation No. 19/2019 on the establishment of the Kaimana Marine Protected Area Management UPTD, authorized to manage the four Kaimana Marine Protected Areas and the Berau Bay–Nusalasi-Van Den Bosch Coastal Park in Fakfak.



2020

Fakfak: July: Ministry of Marine Affairs and Fisheries Decree No. 79/KEPMEN-KP/2020 regarding the designation of the Berau Bay and Nusalasi-Van Den Bosch Bay Coastal Park covering an area of 346,807.87 ha.



2021

Kaimana–Fakfak: October: Governor's Decision No. 523/207/10/2021 regarding the establishment of UPTD management based on the BLUD (Regional Public Service Agency) model, providing financial management flexibility for area managers.



2022

Kaimana–Fakfak: May: West Papua Governor Regulation No. 20/2022 regarding the regulation of personnel mechanisms and the governance of the Kaimana UPTD BLUD (Regional Public Service Agency) for civil servants and non-civil servants, promoting the autonomy and effectiveness of the management.



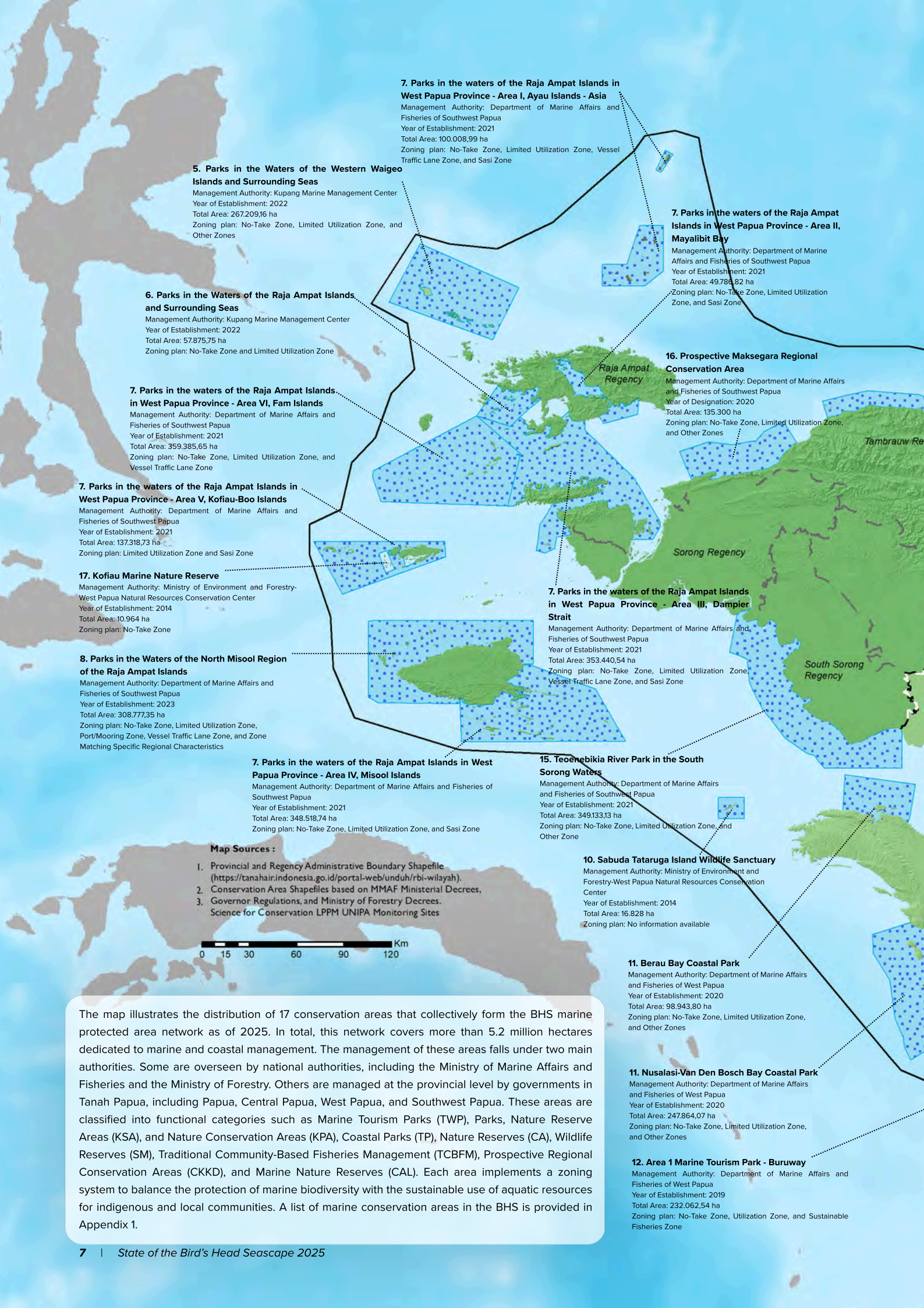
2023

Kaimana–Fakfak: November: West Papua Governor Regulation No. 30/2023 on the implementation of environmental service fees in conservation areas (ecotourism, research, facility rentals), creating self-sustaining and sustainable conservation financing.



2025

Kaimana: July: Sharing data from monitoring, evaluation, and lessons learned regarding marine conservation with the Kaimana local government and development partners.



7. Parks in the waters of the Raja Ampat Islands in West Papua Province - Area I, Ayau Islands - Asia
Management Authority: Department of Marine Affairs and Fisheries of Southwest Papua
Year of Establishment: 2021
Total Area: 100,008.99 ha
Zoning plan: No-Take Zone, Limited Utilization Zone, Vessel Traffic Lane Zone, and Sasi Zone

5. Parks in the Waters of the Western Waigeo Islands and Surrounding Seas
Management Authority: Kupang Marine Management Center
Year of Establishment: 2022
Total Area: 267,209.16 ha
Zoning plan: No-Take Zone, Limited Utilization Zone, and Other Zones

6. Parks in the Waters of the Raja Ampat Islands and Surrounding Seas
Management Authority: Kupang Marine Management Center
Year of Establishment: 2022
Total Area: 57,875.75 ha
Zoning plan: No-Take Zone and Limited Utilization Zone

7. Parks in the waters of the Raja Ampat Islands in West Papua Province - Area VI, Fam Islands
Management Authority: Department of Marine Affairs and Fisheries of Southwest Papua
Year of Establishment: 2021
Total Area: 359,385.65 ha
Zoning plan: No-Take Zone, Limited Utilization Zone, and Vessel Traffic Lane Zone

7. Parks in the waters of the Raja Ampat Islands in West Papua Province - Area V, Kofiau-Boo Islands
Management Authority: Department of Marine Affairs and Fisheries of Southwest Papua
Year of Establishment: 2021
Total Area: 137,318.73 ha
Zoning plan: Limited Utilization Zone and Sasi Zone

17. Kofiau Marine Nature Reserve
Management Authority: Ministry of Environment and Forestry-West Papua Natural Resources Conservation Center
Year of Establishment: 2014
Total Area: 10,964 ha
Zoning plan: No-Take Zone

8. Parks in the Waters of the North Misool Region of the Raja Ampat Islands
Management Authority: Department of Marine Affairs and Fisheries of Southwest Papua
Year of Establishment: 2023
Total Area: 308,777.35 ha
Zoning plan: No-Take Zone, Limited Utilization Zone, Port/Mooring Zone, Vessel Traffic Lane Zone, and Zone Matching Specific Regional Characteristics

7. Parks in the waters of the Raja Ampat Islands in West Papua Province - Area IV, Misool Islands
Management Authority: Department of Marine Affairs and Fisheries of Southwest Papua
Year of Establishment: 2021
Total Area: 348,518.74 ha
Zoning plan: No-Take Zone, Limited Utilization Zone, and Sasi Zone

7. Parks in the waters of the Raja Ampat Islands in West Papua Province - Area II, Mayalibit Bay
Management Authority: Department of Marine Affairs and Fisheries of Southwest Papua
Year of Establishment: 2021
Total Area: 49,788.82 ha
Zoning plan: No-Take Zone, Limited Utilization Zone, and Sasi Zone

16. Prospective Maksegara Regional Conservation Area
Management Authority: Department of Marine Affairs and Fisheries of Southwest Papua
Year of Designation: 2020
Total Area: 135,300 ha
Zoning plan: No-Take Zone, Limited Utilization Zone, and Other Zones

7. Parks in the waters of the Raja Ampat Islands in West Papua Province - Area III, Dampier Strait
Management Authority: Department of Marine Affairs and Fisheries of Southwest Papua
Year of Establishment: 2021
Total Area: 353,440.54 ha
Zoning plan: No-Take Zone, Limited Utilization Zone, Vessel Traffic Lane Zone, and Sasi Zone

15. Teonebikia River Park in the South Sorong Waters
Management Authority: Department of Marine Affairs and Fisheries of Southwest Papua
Year of Establishment: 2021
Total Area: 349,133.13 ha
Zoning plan: No-Take Zone, Limited Utilization Zone, and Other Zone

10. Sabuda Tataruga Island Wildlife Sanctuary
Management Authority: Ministry of Environment and Forestry-West Papua Natural Resources Conservation Center
Year of Establishment: 2014
Total Area: 16,828 ha
Zoning plan: No information available

11. Berau Bay Coastal Park
Management Authority: Department of Marine Affairs and Fisheries of West Papua
Year of Establishment: 2020
Total Area: 98,943.80 ha
Zoning plan: No-Take Zone, Limited Utilization Zone, and Other Zones

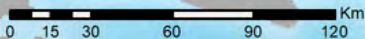
11. Nusalasi-Van Den Bosch Bay Coastal Park
Management Authority: Department of Marine Affairs and Fisheries of West Papua
Year of Establishment: 2020
Total Area: 247,864.07 ha
Zoning plan: No-Take Zone, Limited Utilization Zone, and Other Zones

12. Area 1 Marine Tourism Park - Buruway
Management Authority: Department of Marine Affairs and Fisheries of West Papua
Year of Establishment: 2019
Total Area: 232,062.54 ha
Zoning plan: No-Take Zone, Utilization Zone, and Sustainable Fisheries Zone

Map Sources :

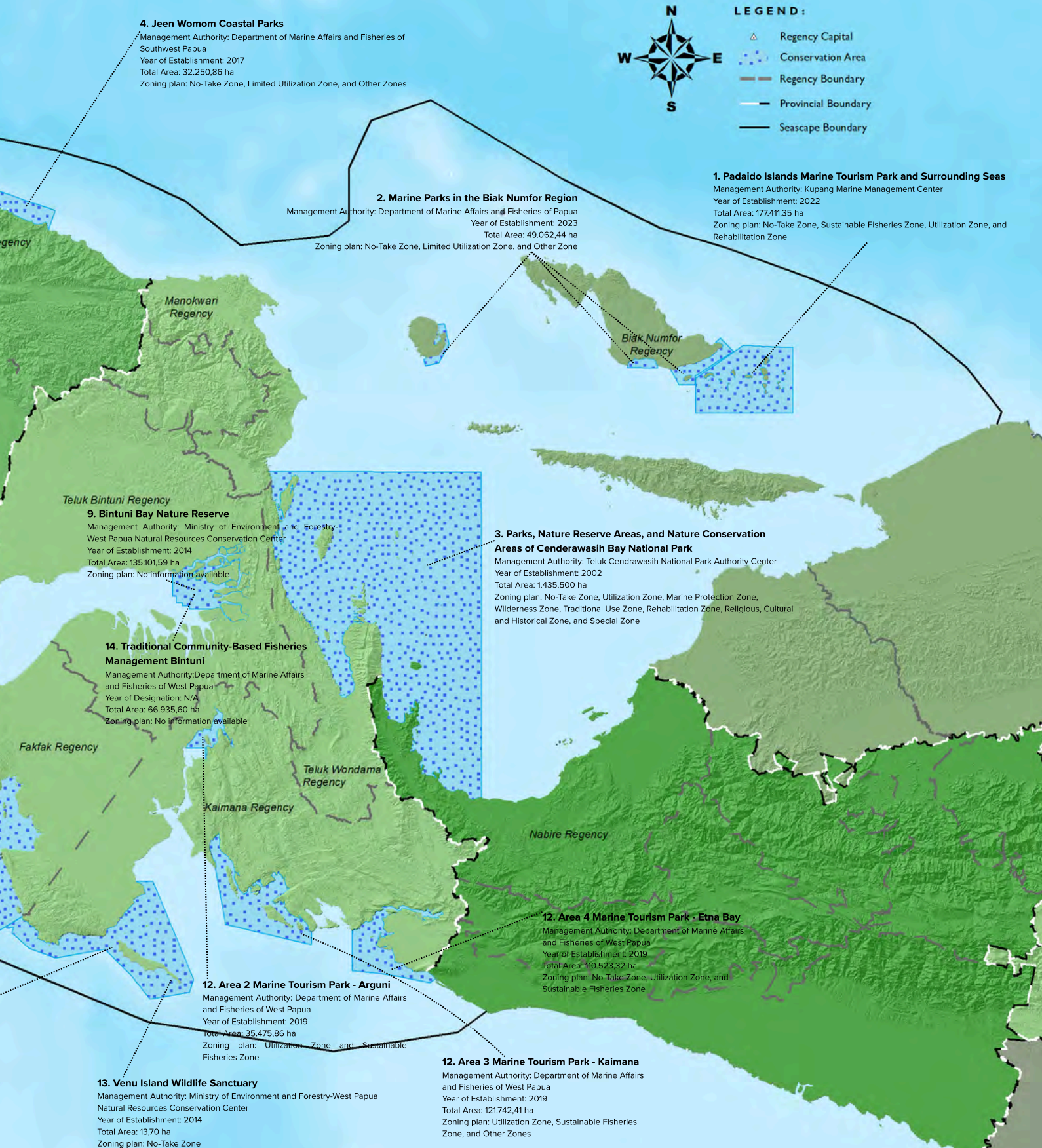
1. Provincial and Regency Administrative Boundary Shapefile (<https://tanahair.indonesia.go.id/portal-web/unduh/rbi-wilayah>).
2. Conservation Area Shapefiles based on MMAF Ministerial Decrees.
3. Governor Regulations, and Ministry of Forestry Decrees.

Science for Conservation LPPM UNIPA Monitoring Sites



The map illustrates the distribution of 17 conservation areas that collectively form the BHS marine protected area network as of 2025. In total, this network covers more than 5.2 million hectares dedicated to marine and coastal management. The management of these areas falls under two main authorities. Some are overseen by national authorities, including the Ministry of Marine Affairs and Fisheries and the Ministry of Forestry. Others are managed at the provincial level by governments in Tanah Papua, including Papua, Central Papua, West Papua, and Southwest Papua. These areas are classified into functional categories such as Marine Tourism Parks (TWP), Parks, Nature Reserve Areas (KSA), and Nature Conservation Areas (KPA), Coastal Parks (TP), Nature Reserves (CA), Wildlife Reserves (SM), Traditional Community-Based Fisheries Management (TCBFM), Prospective Regional Conservation Areas (CKKD), and Marine Nature Reserves (CAL). Each area implements a zoning system to balance the protection of marine biodiversity with the sustainable use of aquatic resources for indigenous and local communities. A list of marine conservation areas in the BHS is provided in Appendix 1.

Marine Protected Area Network in the Bird's Head Seascape



CHAPTER 2

The Papua BHS Socio-Ecological System

*“Ecosystems, Keystone Species, and Coastal Communities as
an Integrated System”*

The Papua BHS functions as a socio-ecological system in which the health of ecosystems, the survival of keystone species, and the well-being of coastal communities are interconnected. Mangroves, seagrass beds, and coral reefs contribute to biodiversity conservation, coastal protection, and fisheries productivity, while also providing habitat for marine megafauna... such as sea turtles, sharks, rays, dugongs, and dolphins. Moreover, the BHS is home to coastal communities with deep social, cultural, and economic ties to both land and sea. Therefore, managing the BHS requires balancing ecosystem protection, species conservation, and local communities' livelihoods.



*m*angroves, seagrass beds, and coral reefs in the BHS are crucial for coastal resilience, fisheries productivity, and biodiversity. They face significant pressures from coastal development, habitat degradation, sedimentation, and climate change.

Marine megafauna and keystone species — including sea turtles, sharks, rays, dugongs, and dolphins — indicate that the BHS still harbors vital habitat for high-conservation-value species. However, these groups remain vulnerable to habitat disturbances, bycatch, poaching, and human pressures.

Coastal communities in the BHS have strong social, cultural, and economic ties to both terrestrial and marine environments, making the sustainability of these ecosystems essential for food security, livelihoods, and local identity.

Coastal landscape of Raja Ampat
© Habema Monim (S4C LPPM UNIPA)

Key Coastal-Marine Ecosystems

Three interconnected habitats — extending from land to sea — form the foundation of life, act as a natural coastal barrier, and serve as a source of livelihood for communities. Together, they support the BHS coastal-marine system and the ecosystems described below.

Ecosystem Connectivity

Mangroves, seagrass beds, and coral reefs form an interconnected, mutually supportive network of coastal and marine habitats. Mangroves trap sediment and protect the coast; seagrass beds stabilize the seabed and provide habitat for a variety of marine species; and coral reefs support marine biodiversity and fisheries productivity. Together, these ecosystems strengthen coastal resilience, sustain species life cycles, and underpin coastal livelihoods

| Carlson et al., 2021; Guannel et al., 2016; Salayan et al., 2024

Mangrove

Nature's Coastal Fortress



Mangroves along the coast of Raja Ampat.
© Habema Monim (S4C LPPM UNIPA)

Mangrove ecosystems across the four provinces of the BHS cover a total of 949,668 hectares (ha), making this one of the areas with the largest mangrove coverage in Indonesia (Ministry of Environment/Environmental Management Agency, 2025). Bintuni Bay holds the greatest concentration at 255,971 ha, followed by South Sorong (75,558 ha), Kaimana (52,728 ha), and Raja Ampat (26,910 ha). Approximately 40 species of mangrove are found in West Papua and Southwest Papua (Appendix 2).

The ecosystem plays a critical role as habitat for waterbirds, juvenile fish, and invertebrates. It also serves as a natural barrier against coastal erosion and seawater intrusion. However, the BHS's mangrove ecosystems are under increasing pressure from habitat degradation, land conversion for economic development, and illegal logging — all of which threaten the long-term integrity of its ecological functions (West Papua Provincial Government, 2009). Protecting these ecosystems is critical for maintaining environmental stability and supporting local livelihoods.

Seagrass

A Connecting Habitat



Seagrass meadows in the waters of Raja Ampat.
© Habema Monim (S4C LPPM UNIPA)

Seagrass beds are a vital ecosystem within the BHS habitat network, found across numerous conservation areas, including the Padaido Islands, Raja Ampat Islands, Western Waigeo Conservation Areas, and the Buruway, Arguni, Kaimana, and Etna Bay Conservation Areas, and the Berau Bay and Nusalasi-Van Den Bosch Bay Conservation Areas (Central Statistics Agency, 2023). In 2025, the total seagrass bed area across the four provinces in the BHS was recorded at 33,885.81 ha (Ministry of Marine Affairs and Fisheries, 2025a). Eleven seagrass species have been identified in the BHS (McKenzie et al., 2007; Appendix 3).

Seagrass plays several important roles in the marine ecosystem. It serves as a primary producer, provides habitat and nursery areas for marine life such as sea turtles and dugongs, and helps stabilize the seabed against erosion (Hemminga & Duarte, 2000; Hogarth, 2007). However, seagrass meadows in the BHS are degrading due to land clearing, coastal development, land reclamation, and increased sedimentation. These pressures diminish the ecosystem's ability to support marine life (Mangubhai et al., 2012).

Coral Reefs

Home to Marine Biodiversity

Coral reefs in the four provinces of the BHS cover a total area of 227,326.29 ha (Ministry of Maritime Affairs and Fisheries, 2025b), making this region a significant center of global marine biodiversity. It is home to nearly 600 species of coral, which represent 75 percent of all known coral species worldwide (Mangubhai et al., 2012). Raja Ampat, known as the "heart" of the Coral Triangle, contains over 500 coral species (Veron et al., 2009), while Cenderawasih Bay is notable for its unique value as a habitat for endemic species such as *Astreopora cenderawasih*, *Astreopora acroporina*, and *Astreopora montiporina*. A complete list of coral genera recorded during coral health monitoring is provided in Appendix 5.

These reefs are vital habitats for thousands of marine species and serve as an important economic foundation for local communities through sustainable fisheries and ecotourism. While the coral reefs in the BHS are generally considered healthy, they remain vulnerable to climate change, including bleaching driven by rising sea temperatures, and to physical damage from unsustainable human activities (Pakiding et al., 2020). Therefore, it is crucial to strengthen science-based conservation efforts and engage the community more broadly to maintain the region's resilience. This approach is essential for preserving the BHS's reputation as the "last bastion" of the world's marine biodiversity amid increasing global pressures.

Conservation Notes

Integrating the protection of mangroves, seagrass beds, and coral reefs is one of the most valuable long-term investments for the BHS. This approach not only safeguards biodiversity but also enhances coastal resilience and supports the well-being of current and future generations. By connecting the condition of each ecosystem to the broader socio-ecological system of which they are part, we can ensure a healthier environment overall.

The coral reefs of Raja Ampat represent some of the most biodiverse marine habitats globally and provide essential ecological functions within the Bird's Head Seascape (BHS).
© Jane Lense (S4C LPPM UNIPA)

Marine Megafauna and Key Species

The BHS is a critical habitat for marine megafauna, which play vital ecological roles and hold high conservation value. The discussion that follows synthesizes field observations, scientific studies, and monitoring reports to build a clear picture of species diversity, distribution, and ecological function.



Turtles

Sea turtles are long-lived, protected marine animals that inhabit a wide range of habitats—from nesting beaches and coastal waters to seagrass beds and the open ocean. Their presence in the BHS highlights the importance of this area as a habitat, foraging ground, migration corridor, and nesting site for several turtle species, effectively linking coastal and offshore environments.

Species Recorded

Recorded species in the BHS include the leatherback, olive ridley, hawksbill, and green turtle. Their presence indicates that the BHS contains crucial coastal and marine habitats for turtle survival in Papua (Mangubhai et al., 2012; Parinding, 2021).



Leatherback turtle
Dermochelys coriacea



Olive ridley turtle
Lepidochelys olivacea



Hawksbill turtle
Eretmochelys imbricata



Green turtle
Chelonia mydas

Ecological Significance

Turtles play a vital role in maintaining the balance of the marine ecosystem. Green turtles support seagrass dynamics, hawksbill turtles are closely associated with coral reefs, and leatherback turtles are wide-ranging, open-ocean species that connect key areas across the region. Due to their long life cycles and extensive ranges, turtles also serve as important indicators of the health of coastal and marine habitats.

Habitat and Distribution in the BHS

Nesting sites for turtles are located on several key beaches, including Jeen Yessa and Jeen Syuab in Tambrau; Morani Kaironi, Sidey Wibain, Warebar, Warwesun; as well as Piai and Sayang Islands in Raja Ampat; Venu Island in Kaimana; and Wairundi in Wondama Bay. Beyond nesting beaches, the surrounding coastal waters, seagrass beds, and coral reefs also provide important foraging and shelter habitat for these turtles.

Conservation Note

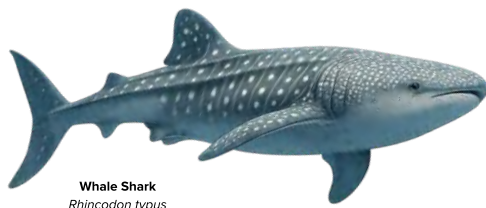
However, turtles face numerous threats, including disturbance of their nesting habitats, bycatch, egg poaching, plastic pollution, and changing coastal conditions. To help sustain turtle populations in the BHS, it is crucial to protect nesting beaches, minimize human disturbance, and conduct regular monitoring. Details on the monitoring of leatherback turtles in the BHS area are provided in Chapter 3.

Elasmobranch Group

Elasmobranchs — cartilaginous fish that include sharks and rays — play a vital role in maintaining the balance of marine ecosystems. In the BHS, this group includes notable species such as whale sharks and manta rays, which are flagship species of Cenderawasih Bay National Park and the Kaimana and Raja Ampat regions, respectively. Moreover, the BHS is home to reef sharks, wobbegongs, and walking sharks, all of which are associated with coral reefs, coastal waters, and the open ocean.

Species Recorded

Selected species recorded in the BHS include whale sharks, reef manta rays, oceanic manta rays, reef sharks, whitetip sharks, silvertip sharks, wobbegongs, walking sharks, and hammerhead sharks. Their presence confirms the BHS's significance as a key area for shark and ray diversity in the Indo-Pacific region.



Whale Shark
Rhincodon typus



Blacktip Reef Shark
Carcharhinus melanopterus



Gray Reef Shark
Carcharhinus amblyrhynchos



Walking Shark
Hemiscyllium spp.



Wobbegong Shark
Eucrossorhinus dasypogon



Giant Oceanic Manta Ray
Mobula birostris



Reef Manta Ray
Mobula alfredi

Ecological Significance

Sharks and rays are crucial to the marine ecosystem as apex predators, population regulators, and indicators of overall health. Reef sharks, for example, play a vital role in maintaining the structure of reef fish communities. Manta rays and whale sharks also hold significant ecological and socio-economic importance, particularly in relation to conservation-based marine tourism and their influence on local culture and the broader conservation efforts. Together, these species highlight the incredible marine biodiversity of the BHS and underscore the urgent need for science-based conservation strategies.

Conservation Note

Many shark and ray species are highly vulnerable to fishing pressures because they grow slowly, reach reproductive maturity late, and have limited reproductive output. Key threats to these species include direct catch, bycatch, the shark fin trade, and disturbance of critical habitat. To sustain elasmobranch populations in the BHS, it is essential to strengthen species protection, improve fisheries management, and monitor aggregation sites.

Marine Mammal Group

The BHS marine mammal group includes dugongs and several dolphin species that inhabit coastal waters and the open sea. Their presence demonstrates that the BHS continues to provide important habitat, foraging grounds, and movement corridors for marine mammals, which play vital ecological roles.

Species Recorded

The marine mammals recorded in the BHS include dugongs and at least five dolphin species. Dugongs are closely associated with seagrass beds in Raja Ampat, Fakfak, and Kaimana, while dolphins use a range of environments, from coastal areas and straits to more open waters, including the Kaimana and Dampier Straits.



Dugong
Dugong dugon



Australian Humpback Dolphin
Sousa sahulensis



Spinner Dolphin
Stenella longirostris



Indo-Pacific Bottlenose Dolphin
Tursiops aduncus



Common Bottlenose Dolphin
Tursiops truncatus



Killer Whale
Orcinus orca

Ecological Significance

Dugongs and dolphins serve as important indicators of the health of marine ecosystem. Dugongs rely on healthy seagrass beds as their primary food source, which means the condition of seagrass directly reflects the quality of dugong habitat. The presence of dolphins indicates high aquatic productivity, abundant food, and a generally high-quality marine habitat.

Conservation Note

Marine mammals require healthy and minimally disturbed environments. Threats such as seagrass degradation, vessel traffic, underwater noise, bycatch, and human pressure in coastal areas can jeopardize their survival. It is essential to integrate continuous monitoring and protection of critical habitats into the BHS conservation strategy.

An aerial photograph of a coastal village. In the foreground, several houses with bright blue corrugated metal roofs are visible, some built on stilts over the water. A small boat is anchored nearby. The background shows a dense line of green tropical forest along the coast.

Home for Coastal Communities

The BHS is not only ecologically rich but also home to tens of thousands of coastal communities that have long interacted with their natural surroundings. Approximately 80,000 people live in more than 142 villages within the MPA in the BHS (Central Statistics Agency of Papua Province, 2023; Central Statistics Agency of West Papua Province, 2023). These communities adapt to their environment and have developed socio-cultural systems deeply rooted in coastal and marine areas, which serve as sources of livelihood and collective identity.

The number of households varies considerably across the BHS. For instance, Teluk Mayalibit MPA has approximately 849 households, while the Misool MPA has 2,143 households. The highest concentration of households is in Cenderawasih Bay National Park, with 2,134 households. The heads of households in the BHS range in age from 21 to 94, with an average age of 47, indicating a predominantly working-age population. Each household has an average of 6 members, well above the national average of 3.9. This reflects a strong collective social structure in which family members across generations often live together¹.

Community attachment to place is evident in the length of residency. On average, households have lived in the same location for over 33 years, with residents of Kofiau-Boo Islands averaging 41 years. This low level of mobility indicates strong social, cultural, and spiritual ties to the areas. These ties are an important consideration in conservation efforts that prioritize equity and sustainability.

The BHS is also marked by a rich ethnic and religious diversity. Most residents identify as Christian (73%), while 27% identify as Muslim, and the 2021–2023 survey recorded more than 93 ethnic groups, reflecting a mosaic of cultures living in close proximity. Major ethnic groups include the Biak (including Biak-Numfor and Biak-Raja Ampat), Maya (Sailolof, Salawati, Samate), Matbat, and Wandamen. This diversity forms a complex social and cultural landscape that must be considered in inclusive, community-based conservation.

Most community members primarily rely on small-scale agriculture, which accounts for 34% of their livelihoods. They cultivate small plots of corn, bananas, sweet potatoes, and cassava to meet food needs and provide supplementary income (Mambrisaw et al., 2006). Fishing is the second most common source of income, accounting for 33% of livelihoods, followed by informal sector work, including services, tourism, and small trade (25%).

Dependence on the sea as a primary source of income varies across regions, with the highest in Cenderawasih Bay National Park (42%). In contrast, North Misool has a lower dependence at 24%, and the Kofiau-Boo Islands have the lowest at 8.5%. This variation highlights differences in geography and access to resources, underscoring the need for management approaches that are tailored to the specific context of each community.

¹ All demographic, social, and livelihood data presented in this section are derived from the Bird's Head Seascape social monitoring database, Science for Conservation Program, Institute for Research and Community Service, University of Papua (2021–2025).

Aerial view of Dibalal Village, Kofiau-Boo, Raja Ampat.
© Faris Luthfi (S4C LPPM UNIPA)



The drying process of salted fish in Deer Village, Kofiau-Boo, Raja Ampat.
© Faris Luthfi (S4C LPPM UNIPA)



The drying process of copra in Tolobi Village, Kofiau-Boo, Raja Ampat.
© Arnoldus Ananta (S4C LPPM UNIPA)

STORY BOX • HOME FOR COASTAL COMMUNITIES

Kofiau-Boo Community, Raja Ampat

By: BHS Social Monitoring S4C LPPM UNIPA

Living in coastal areas does not always mean that fishing is the primary livelihood for the residents. In the Kofiau-Boo MPA, 70% of households rely on farming, specifically through copra production. The scattered coconut groves across the islands make this area a significant hub for copra production, attracting buyers from Seram and Halmahera. Copra is the economic backbone of the Kofiau-Boo community. However, fluctuating market prices present serious challenges for families involved in coconut farming. During a market downturn, the price of copra can drop to as low as Rp1,500 per kilogram, well below production costs. In these situations, communities often turn to marine resources as a fallback, which has direct implications for fisheries management. Therefore, improving market access and ensuring price stability are urgent priorities for government agencies and institutions working in this region.

CHAPTER 3

Socio-Ecological Status of the Bird's Head Seascape

"Assessing Key Ecosystem Conditions and Seascape Resilience"

The current condition of the Bird's Head Seascape socio-ecological system is assessed through monitoring of ecosystems, key species, and the well-being of coastal communities. Monitoring results indicate that several ecological indicators, particularly hard coral cover and functional fish biomass were assessed as high, with increasing trends at the seascape scale..

However, the status of species such as turtles, sharks, rays, dugongs, and marine mammals still requires ongoing monitoring and protection, given ongoing pressures from habitat degradation and human activities. This section also reveals that ecological gains have not fully translated into improved socio-economic conditions for coastal communities, particularly in terms of economic welfare and household food security, which remain vulnerable.



Coral reef ecosystems and functional fish assemblages are showing resilience and recovery in some areas, but mangroves, seagrasses, keystone species, and coastal communities continue to face significant pressures.

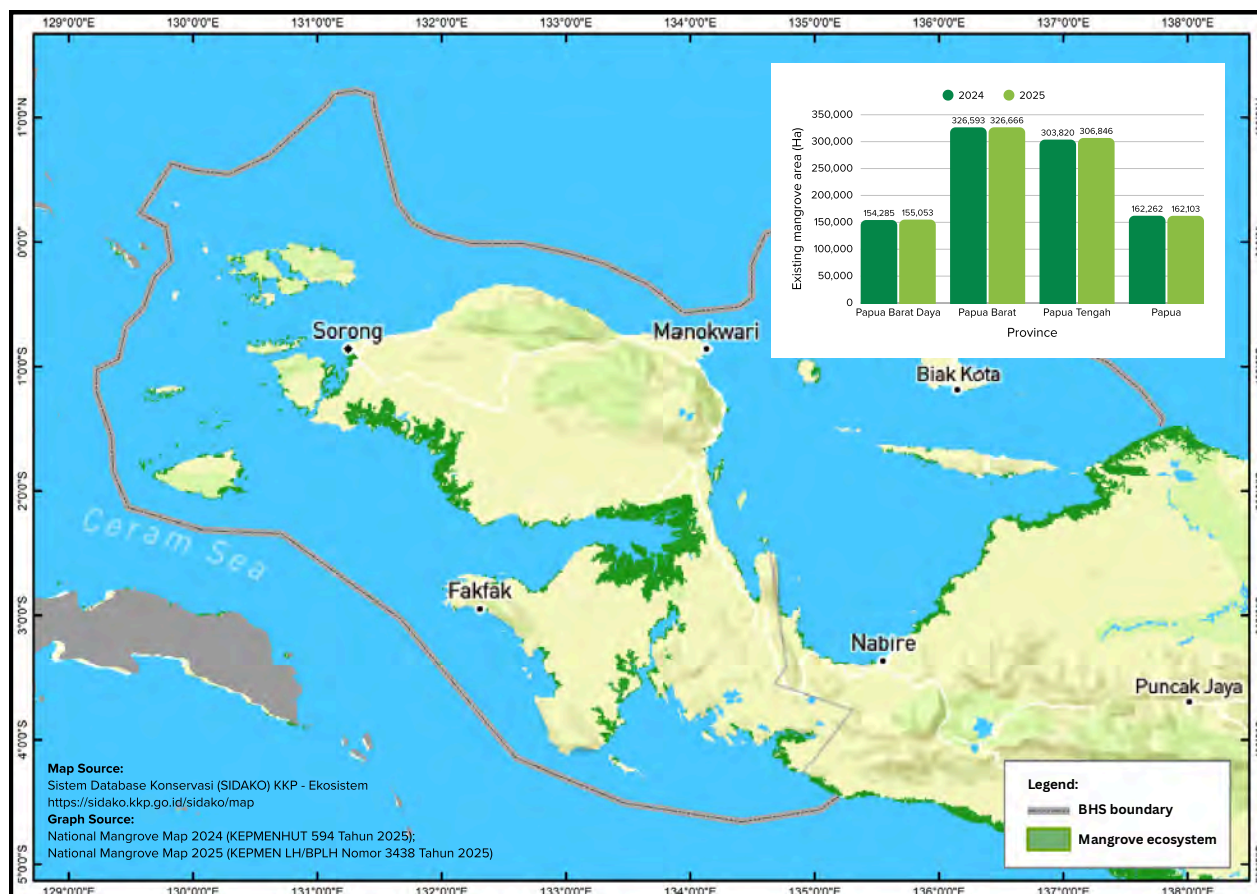
The presence of sea turtles, elasmobranchs, and marine mammals underscores the BHS's importance as a globally significant conservation habitat, yet species protection continues to rely on patrols, monitoring, habitat management, and community engagement.

Meanwhile, human well-being indicators show that coastal communities remain under economic and food security pressure — a reminder that conservation success must be measured not only by ecosystem health but also by tangible benefits delivered to local communities.

Monitoring team members collecting data on sea turtle nests and eggs at Jeen Womom Coastal Park.
© Thomas Hombahomba (S4C LPPM UNIPA)

Ecosystem Status: Mangrove

Mangroves in the BHS are a crucial component of the coastal socio-ecological system, connecting bays, estuaries, small islands, coastal villages, seagrass beds, and coral reefs. The BHS has been recognized as the center of global marine biodiversity, with vast and diverse mangrove and seagrass ecosystems that provide important ecosystem services for the culture, livelihoods, and food security of coastal communities (Mangubhai et al., 2012; Purwanto et al., 2021).



According to the 2025 National Mangrove Map, which is based on the Decree of the Minister of Environment/BPLH Number 3438 of 2025, mangrove coverage in West Papua Province was recorded at 326,666 hectares and in Southwest Papua at 155,053 hectares. Using these two provinces as proxies for the BHS study area, the total mangrove area in the BHS is estimated at approximately 481,719 hectares. These figures should be treated as preliminary estimates based on administrative areas and may require adjustments once official spatial boundaries for the BHS are available to enable more accurate overlay analysis.

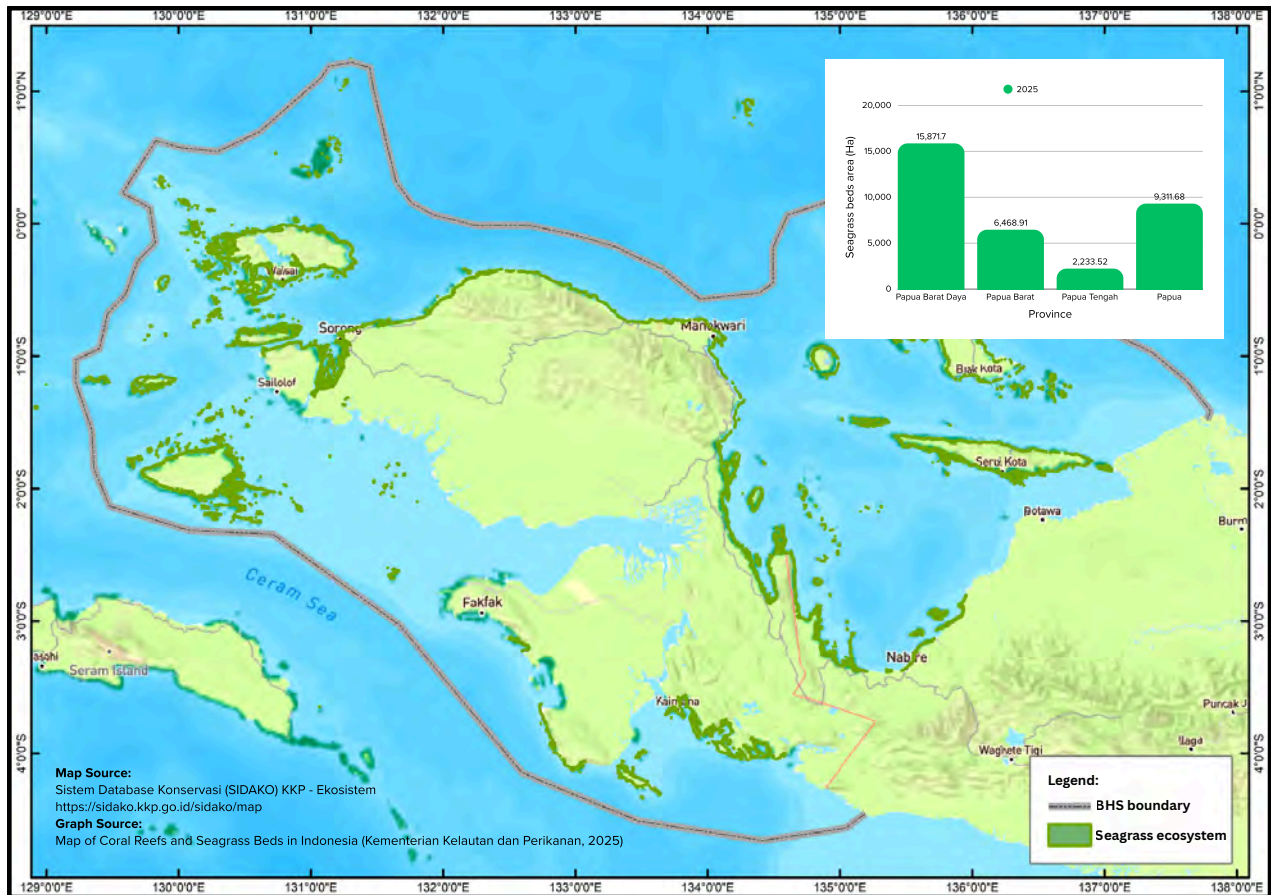
Ecologically, the mangroves in the BHS have strategic value because several key areas are part of an important mangrove landscape in Papua. Bintuni Bay, for example, is home to the largest contiguous mangrove block in Indonesia. Studies conducted in this region have documented a rich diversity of vegetation, including 57 species across 47 genera and 25 families (Kasihiw et al., 2023). These mangroves also provide coastal protection, habitat for fish and other biota, carbon storage, and livelihood for local communities (Kasihiw et al., 2023; Murdiyarso et al., 2021). While mangrove cover in the BHS is reported to be relatively stable at some sites, pressure on this ecosystem continues to grow.

Purwanto et al. (2021) identified Kaimana as a notable exception, recording a loss of approximately 315 hectares between 1996 and 2016. The threats to the mangroves include land clearing for agriculture and aquaculture, logging, mining, coastal population growth, and coastal development. Therefore, the status of the mangroves should be assessed not only by their area but also by their cover conditions, local pressures, and the effectiveness of the protective measures in place.



Ecosystem Status: Seagrass

Seagrass meadows in the BHS play a vital role as a connecting habitat between mangroves, shallow waters, and coral reefs. This ecosystem serves as a nursery ground for fish and marine life, stabilizes sediments, maintains water clarity, and supports blue carbon ecosystem services. In the context of Indonesian marine management, the 2025 National Coral and Seagrass Map identify seagrass as a crucial component of shallow marine benthic habitats requiring management based on current spatial data.



According to the 2025 National Coral and Seagrass Map (Ministry of Maritime Affairs and Fisheries, 2025a), the coverage of seagrass meadows in Southwest Papua Province is recorded at 15,871.70 hectares and West Papua at 6,468.91 hectares. Using these two provinces as administrative proxies for the BHS study area, the estimated total area of seagrass meadows in the BHS is approximately 22,340.61 hectares. As with the mangrove estimate, this figure should be treated as a preliminary and will need to be refined once the official BHS spatial boundaries are established.

Several local studies have confirmed that seagrass meadows in the BHS play a vital role in supporting fisheries and conserving marine species. McKenzie et al. (2007) identified 11 seagrass species across several areas in the BHS. In the South Misool MPA, Raja Ampat, Tebaily et al. (2021) recorded eight seagrass species at three observation sites: Yefgag, Yellu, and Harapan Jaya. Their study classified seagrass conditions at these sites as poor to moderate, based on seagrass cover of 30–59%. They found a strong relationship between seagrass cover and the richness of fish species. In Cenderawasih Bay, seagrass meadows have also been recognized as foraging habitat for green turtles, especially in the waters of Mangga Island and Kalilemon. This highlights the importance of seagrass in



providing habitat connectivity for migratory species (Tapilatu et al., 2022). The status of seagrass beds in the BHS needs to be assessed not only in terms of their extent but also in terms of their ecological functions. These functions include serving as nursery habitats for fish, providing foraging areas for turtles, stabilizing sediment, and connecting mangroves and coral reefs. However, compared to coral reefs, information on seagrass conditions in the BHS remains limited and has not yet been incorporated into a long-term monitoring system. To properly evaluate seagrass cover, species composition, local pressures, and habitat changes in priority areas, field verification and regular monitoring are essential.



Ecosystem Status: Coral Reefs

The Reef Health Monitoring (RHM) Program has been operating since 2010 (Pakiding et al., 2020). It is a collaborative effort involving several organizations: the Yayasan Konservasi Indonesia (an affiliate of Conservation International), the Yayasan Konservasi Alam Nusantara (an affiliate of The Nature Conservancy), WWF-ID, WWF-US, and the University of Papua.

From the outset, monitoring was conducted by CI, TNC, and WWF Indonesia across 12 Marine Protected Areas (MPAs): Kaimana MPA (Buruway and Triton Bay management areas); Raja Ampat Marine Tourism Park (TWP), encompassing Asia and Ayau Islands, Mayalibit Bay, Dampier Strait, Misool Islands, Kofiau-Boo Islands, Fam Islands; West Waigeo Nature Reserve (SAP KKN); Cenderawasih Bay National Park (TNTC); Nusakias Van Den Bosch Bay Coastal Park; and Berau Bay. Ecological monitoring was focused on two components of the coral reef ecosystem: the abundance and biomass of reef fish population, and the percentage of benthic cover.

These indicators include coral reef conditions and populations of functional fish species (herbivores) and target fish species. Other criteria include species from various trophic levels, functional groups, and home ranges. A comprehensive description of the monitoring protocol is provided in Appendix 4: Reef Health Monitoring Methods. The summary of indicator data is presented below:

Coral Reef Condition: The condition of a coral reef refers to the composition and structure of the benthic community — the layer of organisms living on the reef's surface. This composition influences ecological processes from the bottom-up and affects the overall dynamics and function of the reef ecosystem. Benthic communities, particularly hard corals, provide the primary habitat for various coral reef organisms. In addition to hard corals, the presence of soft corals, algae, dead coral, coral fragments, and crustose coralline algae (CCA) reflects the stability, productivity, and recovery potential of coral reefs. A complete list of coral genera recorded in the BHS is provided in Appendix 5: List of Coral Genera. The taxonomic richness of this area is further reflected in the ongoing discovery of new reef fish species across the BHS (Appendix 6: New Reef Fish Species in the BHS).

Indicator: benthic cover composition (Ahmadia et al., 2013).

Reef Fish Communities: The structure of reef fish communities influences the relationship between fishing pressure and the ecological function of coral reefs. Carnivorous fish targeted by fisheries serve as indicators of fishing pressure, while herbivorous fish play a crucial role in controlling algal growth and maintaining space for coral recruitment and growth.

Indicator: the biomass of key fisheries species and functional fish groups (such as those from the families Serranidae, Lutjanidae, Haemulidae) and functional herbivorous fish (including Acanthuridae, Scaridae, Siganidae) (Ahmadia et al., 2013)

Ecosystem Status: Coral Reefs

1. Hard Coral Cover

Average Percentage of Hard Coral Cover in the BHS

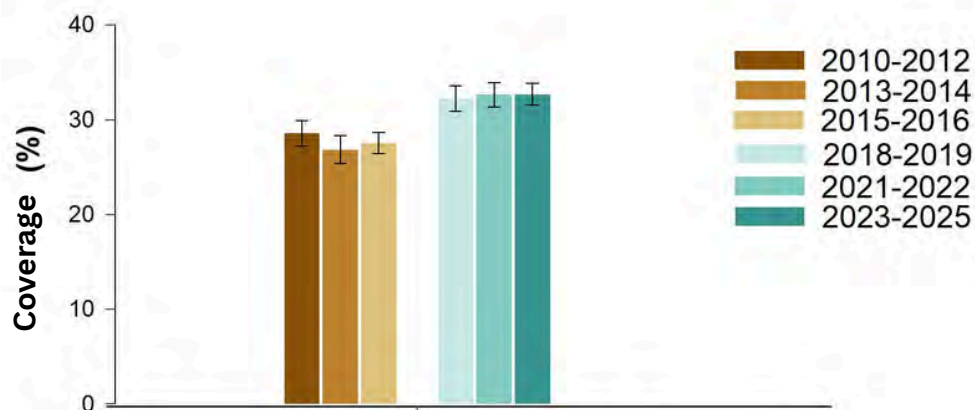


Figure 3.1 Hard Coral Cover in the Bird's Head Seascape: Regional Average (2010–2025)

Note: Monitoring years for the conservation areas contributing to each BHS average value include: Period 2010–2012: Cenderawasih Bay National Park, Misool, Kofiau, Dampier Strait, Mayalibit Bay, and Ayau; Period 2013–2014: Kaimana, Misool, Kofiau, Dampier Strait, Mayalibit Bay, Ayau, and West Waigeo; Period 2015–2016: Cenderawasih Bay National Park, Buruway, Kaimana, Fam, Misool, Kofiau, Dampier Strait, Mayalibit Bay, Ayau, and West Waigeo; Period 2018–2019: Cenderawasih Bay National Park, Buruway, Kaimana, Berau Bay, Fam, Misool, Kofiau, Dampier Strait, Mayalibit Bay, Ayau, and West Waigeo; Period 2021–2022: Fam, Misool, Kofiau, Dampier Strait, Mayalibit Bay, Ayau, and West Waigeo; Period 2023–2025: Cenderawasih Bay National Park, Buruway, Kaimana, Nusalasi Bay, Fam, Misool, Kofiau, Dampier Strait, Mayalibit Bay, Ayau, West Waigeo, North Misool, Maksegara, and Werur.

- Monitoring of live hard coral cover in the BHS has shown an increasing trend in coral reef ecosystem condition during 2010–2025. At the start of monitoring in 2010–2012, the average live hard coral cover was 28.59%. It declined slightly to 26.86% in 2013–2014 but then recovered to 27.56% in 2015–2016. A more significant increase was observed from 2018–2019 onward, reaching 32.25%, followed by relatively stable levels of 32.67% in 2021–2022 and 32.71% in 2023–2025. Overall, average live hard coral cover increased by 4.12 percentage points, from 28.59% in the initial monitoring period to 32.71% in 2023–2025. The stability of cover values over the last three periods also suggests the pattern is consistent with improving reef condition at the seascape scale, although changes may also reflect variation in monitored sites, local pressures, environmental conditions, and management context.

Substrate and coral growth forms were assessed using the Point Intercept Transect (PIT) method with observations recorded at 0.5 m intervals along three 50 m transects, resulting in 300 data points per site.

© Mulyadi (BBTNTC)

Comparison of Hard Coral Cover Between MPAs in the BHS

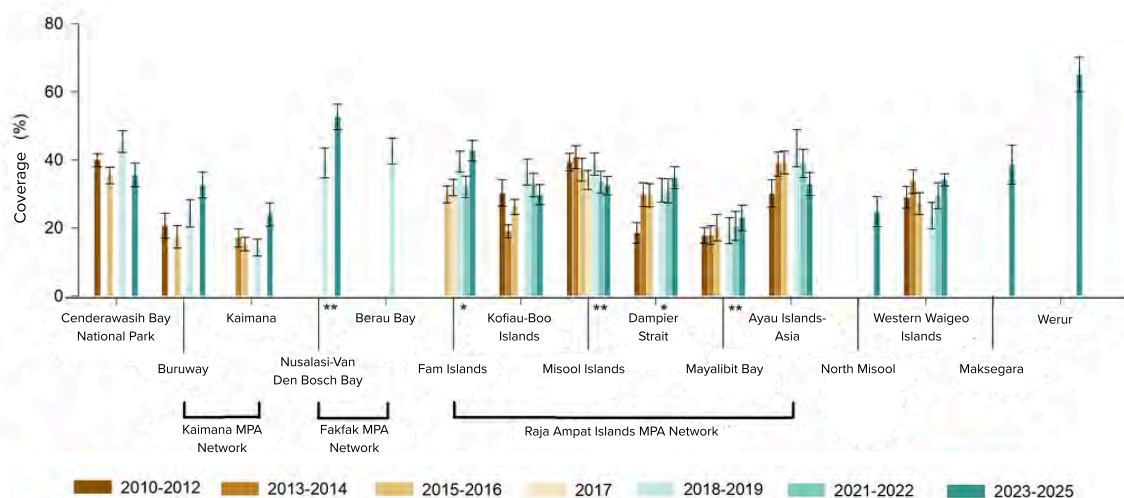


Figure 3.2 Comparison of Hard Coral Cover Between MPAs in the BHS (2010–2025)

Note:

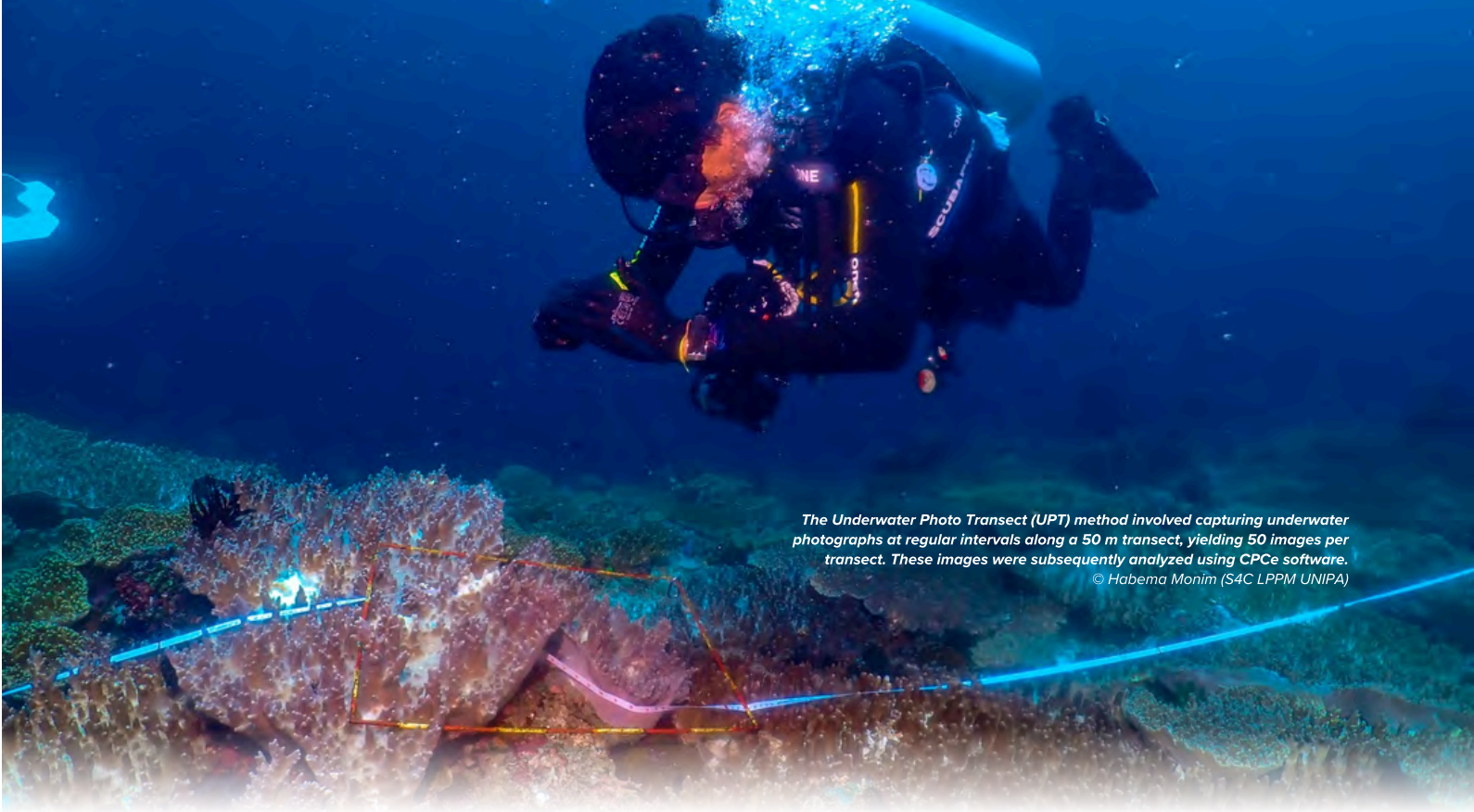
*** Significant at the 10% significance level; ** significant at the 5% significance level; * significant at the 1% significance level.

Monitoring years in each conservation area include: Cenderawasih Bay National Park: 2011, 2016, 2018, 2023; Buruway: 2012, 2015, 2019, 2025; Kaimana: 2013, 2016, 2019, 2025; Nusalasi Bay: 2018–2019, 2025; Berau Bay: 2018; Fam: 2015–2016, 2017–2018, 2019, 2022, 2025; Kofiau: 2010, 2014, 2016, 2018, 2021, 2025; Misool: 2011, 2013, 2015, 2017, 2019, 2022, 2025; Dampier Strait: 2010, 2014, 2016, 2018, 2021, 2025; Mayalibit Bay: 2012, 2014, 2016, 2018, 2021, 2025; Ayau: 2010, 2014, 2016, 2018, 2021, 2025; North Misool: 2024; West Waigeo: 2012, 2014, 2016, 2018, 2021, 2025; Maksegara: 2024; Werur: 2024.

- Monitoring results show that live hard coral cover varies significantly across Marine Protected Areas (MPAs) in the BHS, reflecting differing ecological conditions and pressure levels at each site. In the most recent monitoring period from 2023 to 2025, the highest coral cover was recorded at Werur (65.11%), followed by Nusalasi Bay (52.68%), Fam (42.72%), and Maksegara (38.59%), all of which indicate relatively good coral reef conditions. Several areas fall in the moderate category, including Cenderawasih Bay National Park (35.57%), Dampier (34.80%), West Waigeo (34.17%), Ayau (32.98%), Buruway (32.61%), Misool (32.46%), and Kofiau (29.84%). In contrast, several areas showed relatively low coverage, including North Misool (24.82%), Kaimana (23.95%), and Mayalibit Bay (23.05%). These variations confirm that coral reef conditions in the BHS are strongly influenced by habitat characteristics, ecosystem connectivity, and local pressures^{1,2}.
- Most of the conservation areas have shown a stable to increasing trend at varying rates. The most notable increases were recorded in Nusalasi Bay, which rose from 39.19% in 2018–2019 to 52.68% in 2023–2025, and in Fam, which rose from 29.90% in 2015–2016 to 42.72%. Other areas showing gradual improvement include Kaimana (17.11% to 23.95%), Dampier Strait (18.63% to 34.80%), Buruway (20.73% to 32.61%), and Mayalibit Bay (17.87% to 23.05%). In contrast, some areas experienced declines. For instance, Ayau decreased from 43.52% to 32.98%; Kofiau fell from 36.46% to 29.84%; and Misool dropped from 40.89% to 32.46%, although they remained in the moderate category. These varying trends indicate that ecosystem recovery and stress levels vary across BHS. Therefore, interpreting these changes requires careful consideration of the local context and the disturbance history at each site^{1,2}.
- Variation in the status and trends of live hard coral cover across the MPAs indicates that the effectiveness of conservation area management is strongly influenced by a combination of protection measures, habitat quality, resource-use pressure, and environmental disturbances. Areas with high cover and positive trends should be prioritized as core conservation zones and potential sources of larvae for surrounding areas, while sites with low cover or declining trends will require more intensive intervention. Key management strategies for vulnerable areas include strengthening patrols, regulating destructive activities, managing sources of land-based sedimentation, and enforcing zoning regulations. Regular monitoring using consistent methodologies is also necessary for the early detection of changes and the evaluation of management outcomes. A collaborative approach involving the government, indigenous communities, and conservation partners will be crucial for maintaining the resilience of the BHS coral reefs against local pressures and climate change. Hard coral cover data for each area and monitoring period are available in Appendix 7.

1. All data in this section is sourced from the Bird's Head Seascape reef health monitoring database, Science for Conservation Program, LPPM, University of Papua.

2. The 2023 coral reef health monitoring data in Cenderawasih Bay National Park is sourced from the 2023 Performance Report of the Cenderawasih Bay National Park Center.



Ecosystem Status: Coral Reefs

2. Biomass of Key Fishery Species

Average Biomass of Key Fisheries Species in the BHS

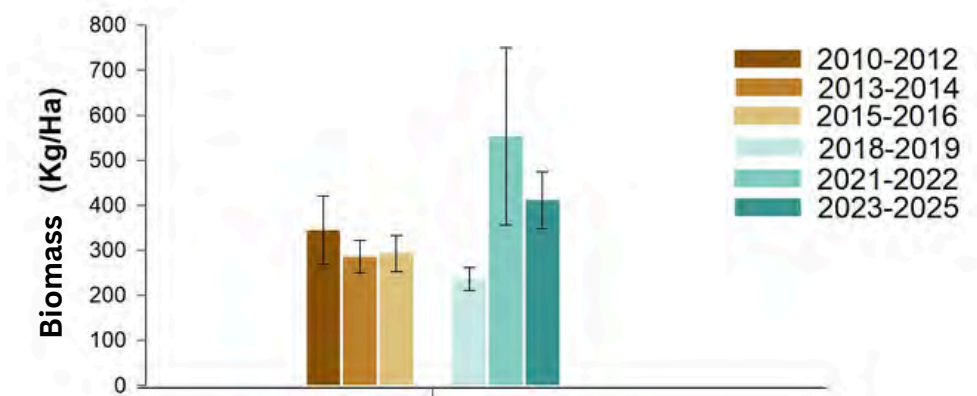


Figure 3.3 Biomass of Key Fishery Species in the Bird's Head Seascape: Area-Wide Average (2010–2025)

Note: Monitoring years for the conservation areas contributing to each BHS average value include: Period 2010–2012: Cenderawasih Bay National Park, Misool, Kofiau, Dampier Strait, Mayalibit Bay, and Ayau; Period 2013–2014: Kaimana, Misool, Kofiau, Dampier Strait, Mayalibit Bay, Ayau, and West Waigeo; Period 2015–2016: Cenderawasih Bay National Park, Buruway, Kaimana, Fam, Misool, Kofiau, Dampier Strait, Mayalibit Bay, Ayau, and West Waigeo; Period 2018–2019: Cenderawasih Bay National Park, Buruway, Kaimana, Berau Bay, Fam, Misool, Kofiau, Dampier Strait, Mayalibit Bay, Ayau, and West Waigeo; Period 2021–2022: Fam, Misool, Kofiau, Dampier Strait, Mayalibit Bay, Ayau, and West Waigeo; Period 2023–2025: Cenderawasih Bay National Park, Buruway, Kaimana, Nusalasi Bay, Fam, Misool, Kofiau, Dampier Strait, Mayalibit Bay, Ayau, West Waigeo, North Misool, Maksegara, and Werur.

- Biomass monitoring of key fishery species in the BHS showed fluctuations during the 2010–2025 period. At the beginning of monitoring in 2010–2012, biomass was recorded at 345.29 kg/ha, then decreased in 2013–2014 to 286.54 kg/ha and remained relatively stable in 2015–2016 at 293.02 kg/ha. The decline continued in 2018–2019, reaching a low of 236.76 kg/ha, before increasing sharply in 2021–2022 to 553.56 kg/ha. In the most recent period, 2023–2025, biomass decreased again to 412.06 kg/ha but remained higher than the entire initial monitoring period. Overall, this trend indicates that key fish stocks in the BHS have a strong capacity for recovery, though they remain influenced by fluctuations in fishing pressure, habitat conditions, and year-to-year ecological variation.

Comparison of Biomass of Key Fishery Species among MPAs in BHS

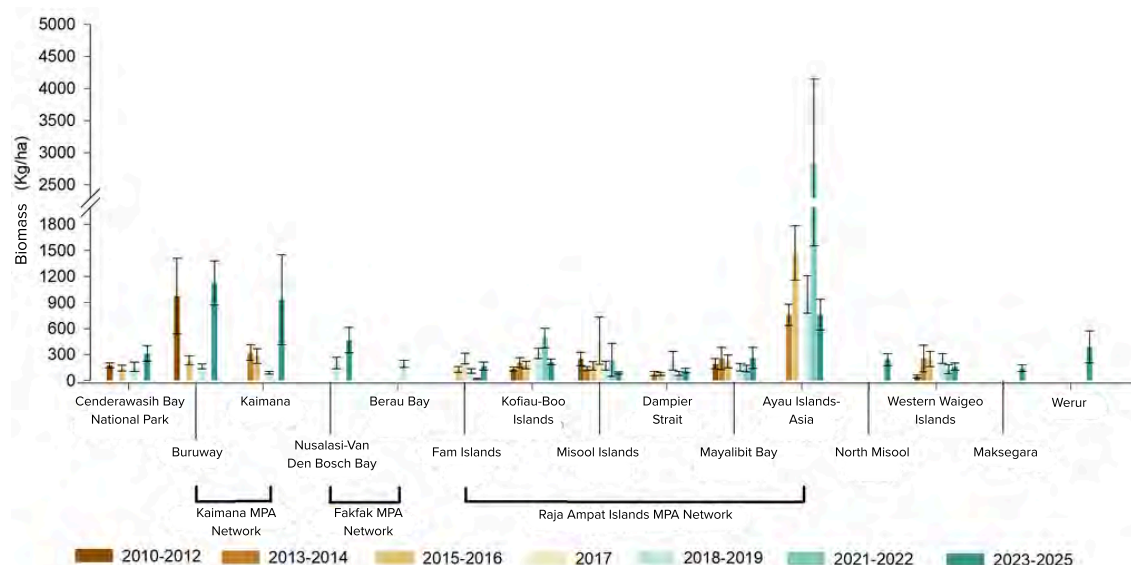


Figure 3.4 Comparison of biomass of key fisheries species between MPAs in BHS (2010–2025)

Note:

*** Significant at the 10% significance level; ** significant at the 5% significance level; * significant at the 1% significance level.

Monitoring years in each conservation area include: Cenderawasih Bay National Park: 2011, 2016, 2018, 2023; Buruway: 2012, 2015, 2019, 2025; Kaimana: 2013, 2016, 2019, 2025; Nusalasi Bay: 2018–2019, 2025; Berau Bay: 2018; Fam: 2015–2016, 2017–2018, 2019, 2022, 2025; Kofiau: 2010, 2014, 2016, 2018, 2021, 2025; Misool: 2011, 2013, 2015, 2017, 2019, 2022, 2025; Dampier Strait: 2010, 2014, 2016, 2018, 2021, 2025; Mayalibit Bay: 2012, 2014, 2016, 2018, 2021, 2025; Ayau: 2010, 2014, 2016, 2018, 2021, 2025; North Misool: 2024; West Waigeo: 2012, 2014, 2016, 2018, 2021, 2025; Maksegara: 2024; Werur: 2024.

- Monitoring the biomass of key fishery species has revealed striking differences between MPA in the BHS. In the most recent period (2023–2025), the highest biomass was recorded in Buruway at 1,127.50 kg/ha, followed by Kaimana at 933.89 kg/ha, Ayau at 761.93 kg/ha, Nusalasi Vanden Bosch Bay at 468.67 kg/ha, and Werur at 390.31 kg/ha. Other areas fall into the intermediate category, including Cenderawasih Bay National Park (313.94 kg/ha), Mayalibit Bay (262.99 kg/ha), North Misool (242.42 kg/ha), Kofiau (215.05 kg/ha), and West Waigeo (163.14 kg/ha). The lowest biomass in the most recent period was observed in the Misool Islands at 90.09 kg/ha and Dampier at 114.53 kg/ha. These variations indicate that fisheries productivity and the condition of key fish stocks differ across regions. Such differences are strongly influenced by habitat quality, fishing pressure, area size, and the effectiveness of local management practices^{1,2}.
- Some MPAs displayed significant increases in biomass, while others experienced sharp fluctuations or declines compared to the previous period. The most notable upward trends were observed in Kaimana, where biomass rose from 92.49 kg/ha in 2018–2019 to 933.89 kg/ha in 2023–2025, and in Buruway, which increased from 164.25 kg/ha to 1,127.50 kg/ha. Nusalasi Vanden Bosch Bay also more than doubled its biomass from 203.16 kg/ha to 468.67 kg/ha, and Cenderawasih Bay National Park recorded an increase to 313.94 kg/ha during the most recent period. Conversely, Ayau experienced a sharp decline, dropping from a peak of 2,850.16 kg/ha in 2021–2022 to 761.93 kg/ha, though it remains among the highest in the BHS. The Misool and Kofiau Islands also exhibited fluctuating patterns, with declines noted in the most recent period. This indicates that key fish stocks in some areas are unstable and sensitive to various pressures and changes in natural recruitment^{1,2}.
- The differences in the status and biomass trends of key fish species across the MPAs indicate that the benefits of conservation for fish stock recovery are unevenly distributed across the BHS. Areas with high biomass and increasing trends should be maintained as core locations for broodstock and spillover to surrounding areas, while areas with low or declining biomass require enhanced fisheries management. Priority measures include improving zoning compliance, monitoring fishing operations, protecting critical habitats such as coral reefs and spawning grounds, and regulating the use of more selective fishing gear. Given the high variability in fish biomass, regular monitoring with adequate sample sizes is essential to distinguish between genuine changes and natural population variations. Collaboration among local governments, indigenous communities, and conservation partners is vital to ensure that key fish stocks remain productive and support food security for coastal communities in the BHS.

1. All data in this section is sourced from the Bird's Head Seascape reef health monitoring database, Science for Conservation Program, LPPM, University of Papua.

2. The 2023 coral reef health monitoring data in Cenderawasih Bay National Park is sourced from the 2023 Performance Report of the Cenderawasih Bay National Park Center.

Reef fish data were collected using the Underwater Visual Census (UVC) method, which enabled direct documentation of species composition, abundance, and size to assess coral reef ecosystem condition.

© Mulyadi (BBTNTC)

Ecosystem Status: Coral Reefs

3. Functional Fish Biomass

Average Biomass of Functional Fish Species in the BHS

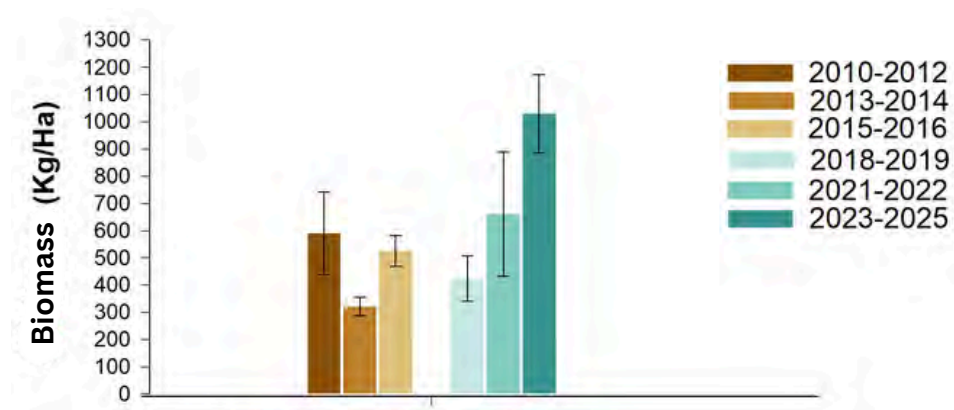


Figure 3.5 Functional Fish Biomass in the Bird's Head Seascape: Overall Area Average (2010–2025)

Note: Monitoring years for the conservation areas contributing to each BHS average value include: Period 2010–2012: Cenderawasih Bay National Park, Misool, Kofiau, Dampier Strait, Mayalibit Bay, and Ayau; Period 2013–2014: Kaimana, Misool, Kofiau, Dampier Strait, Mayalibit Bay, Ayau, and West Waigeo; Period 2015–2016: Cenderawasih Bay National Park, Buruway, Kaimana, Fam, Misool, Kofiau, Dampier Strait, Mayalibit Bay, Ayau, and West Waigeo; Period 2018–2019: Cenderawasih Bay National Park, Buruway, Kaimana, Berau Bay, Fam, Misool, Kofiau, Dampier Strait, Mayalibit Bay, Ayau, and West Waigeo; Period 2021–2022: Fam, Misool, Kofiau, Dampier Strait, Mayalibit Bay, Ayau, and West Waigeo; Period 2023–2025: Cenderawasih Bay National Park, Buruway, Kaimana, Nusalasi Bay, Fam, Misool, Kofiau, Dampier Strait, Mayalibit Bay, Ayau, West Waigeo, North Misool, Maksegara, and Werur.

- Monitoring of functional herbivorous fish biomass in the BHS shows an increasing trend from 2010 to 2025, though with fluctuations between monitoring periods. At the start of monitoring in 2010–2012, biomass was recorded at 590.22 kg/ha; it declined sharply in 2013–2014 to 321.48 kg/ha, then recovered to 525.53 kg/ha in 2015–2016. A moderate decline followed in 2018–2019 (424.11 kg/ha) before a significant increase in 2021–2022 to 660.79 kg/ha. The highest value was recorded in the most recent period (2023–2025), with biomass reaching 1,028.92 kg/ha, nearly double that of the initial monitoring period. This trend indicates an improvement in the ecological function of coral reefs across the BHS, as herbivorous fish play a critical role in controlling algal growth and supporting coral recovery.

Comparison of Functional Fish Biomass among MPAs in the BHS

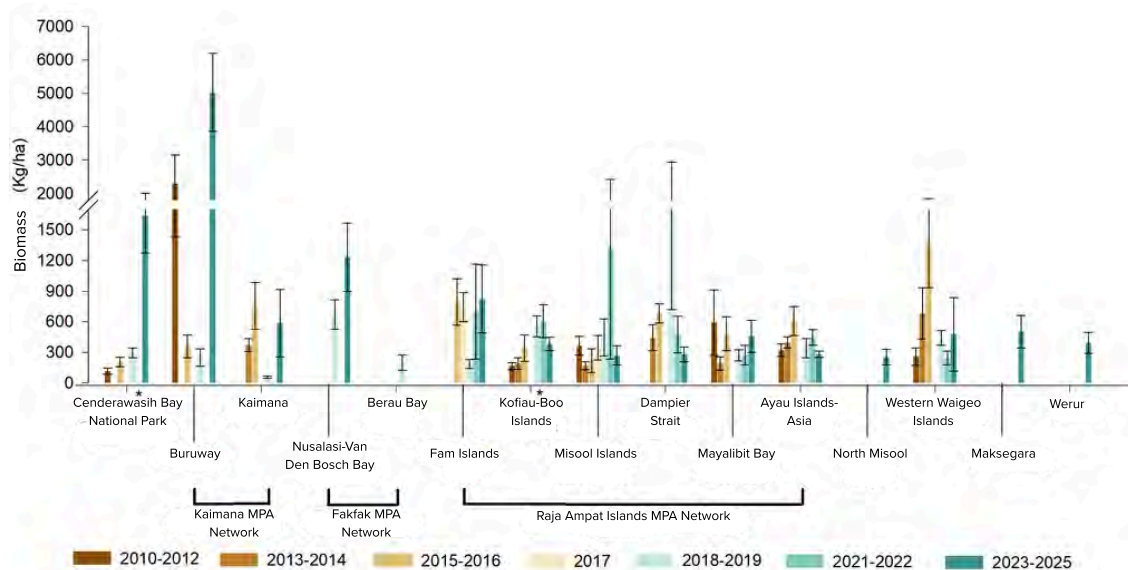


Figure 3.6 Comparison of Functional Fish Biomass among MPAs in the BHS (2010–2025)

Note:

*** Significant at the 10% significance level; ** significant at the 5% significance level; * significant at the 1% significance level.

Monitoring years in each conservation area include: Cenderawasih Bay National Park: 2011, 2016, 2018, 2023; Buruway: 2012, 2015, 2019, 2025; Kaimana: 2013, 2016, 2019, 2025; Nusalasi Bay: 2018–2019, 2025; Berau Bay: 2018; Fam: 2015–2016, 2017–2018, 2019, 2022, 2025; Kofiau: 2010, 2014, 2016, 2018, 2021, 2025; Misool: 2011, 2013, 2015, 2017, 2019, 2022, 2025; Dampier Strait: 2010, 2014, 2016, 2018, 2021, 2025; Mayalibit Bay: 2012, 2014, 2016, 2018, 2021, 2025; Ayau: 2010, 2014, 2016, 2018, 2021, 2025; North Misool: 2024; West Waigeo: 2012, 2014, 2016, 2018, 2021, 2025; Maksegara: 2024; Werur: 2024.

- Monitoring the biomass of functional herbivorous fish reveals significant differences among the MPAs in the BHS. In the most recent period (2023–2025), the highest biomass was recorded in Buruway (5,025.37 kg/ha), far exceeding other areas, followed by Cenderawasih Bay National Park (1,639.54 kg/ha), Nusalasi Vanden Bosch Bay (1,232.39 kg/ha), Fam (821.84 kg/ha), Kaimana (586.63 kg/ha), and Maksegara (502.76 kg/ha). Several areas fell within the intermediate range: Kofiau (382.42 kg/ha), Werur (392.04 kg/ha), West Waigeo (476.66 kg/ha), and Mayalibit Bay (455.12 kg/ha). In contrast, lower biomass levels were recorded in Ayau (283.46 kg/ha), Dampier (282.00 kg/ha), Misool Islands (270.25 kg/ha), and North Misool (252.58 kg/ha). These variations indicate that the herbivorous capacity of coral reef ecosystems differ considerably across the BHS and is strongly influenced by habitat conditions, fishing pressure, and the effectiveness of conservation management^{1,2}.
- Some areas showed significant increases in biomass, while others experienced notable fluctuations or declines compared to the previous period. The most prominent increases occurred in Buruway, rising from 248.79 kg/ha in 2018–2019 to 5,025.37 kg/ha in 2023–2025. Similarly, Cenderawasih Bay National Park saw an increase from 293.89 kg/ha to 1,639.54 kg/ha. Nusalasi Vanden Bosch Bay also experienced a considerable increase from 670.14 kg/ha to 1,232.39 kg/ha, while Fam rose from 184.98 kg/ha to 821.84 kg/ha. In contrast, several areas experienced declines from their peak values. The Misool Islands dropped from 1,329.39 kg/ha in 2021–2022 to 270.25 kg/ha; Kofiau decreased from 605.06 kg/ha to 382.42 kg/ha; and Ayau fell from 606.21 kg/ha in 2015–2016 to 283.46 kg/ha. These patterns indicate that herbivorous fish biomass is highly dynamic and sensitive to factors such as recruitment success, fishing pressure, and local ecosystem conditions^{1,2}.
- Variation in the biomass of herbivorous fish among MPAs indicates that algal control and coral recovery are not yet evenly distributed across the BHS. Areas with high biomass and improving trends must be protected, as they are critical foundations for the resilience of the coral reef ecosystem. In contrast, areas with low or declining biomass require increased attention through reduced fishing pressure and protection of feeding and nursery habitats. Key management measures should include strengthening the zoning of conservation areas, monitoring the targeting of herbivorous fish by fishing gear, and safeguarding nursery and feeding grounds. Because herbivorous fish are highly responsive to habitat change and human pressure, regular monitoring with consistent site coverage is essential for tracking ecological function across the seascape. Collaboration among government, indigenous communities, and conservation partners will be crucial to ensuring that the ecological function of herbivorous fish remains a cornerstone of coral reef health in the BHS. Data on key fisheries and functional fish biomass per conservation area are available in Appendix 8: Fish Species Biomass Data.

1. All data in this section is sourced from the Bird's Head Seascape reef health monitoring database, Science for Conservation Program, LPPM, University of Papua.

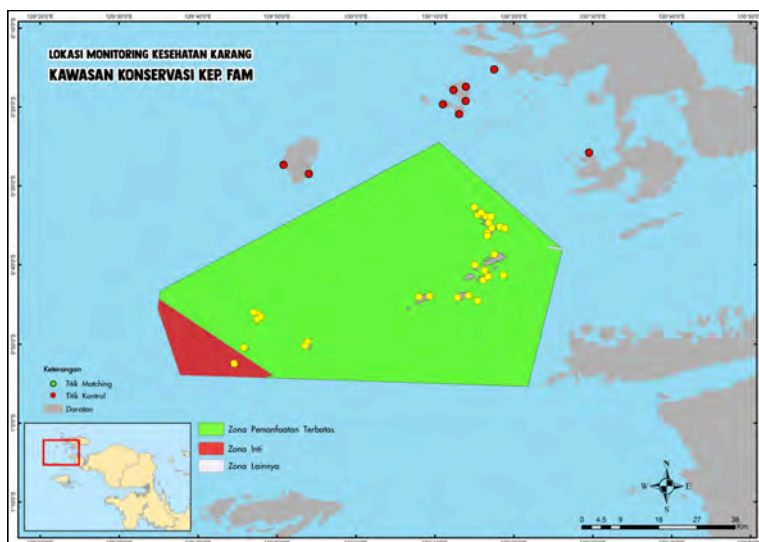
2. The 2023 coral reef health monitoring data in Cenderawasih Bay National Park is sourced from the 2023 Performance Report of the Cenderawasih Bay National Park Center.

Potrait of Coral Health Conditions

from the Fam Islands Marine Protected Area, Raja Ampat
monitoring year 2025

PIT • UVC

Point Intercept Transect
Underwater Visual Census



Regional Identity

This Marine Protected Area was established through **Decree of the Minister of Maritime Affairs and Fisheries of the Republic of Indonesia Number 13 of 2021**.

With an area of 359,385.65 hectares,
which is managed as:

Park in the Waters of the Raja Ampat Islands in West Papua Province - Area 6 of the Fam Islands Waters.

Limited Use Zone
338.264,32 hectares

Core Zone
20.949,29 hectares

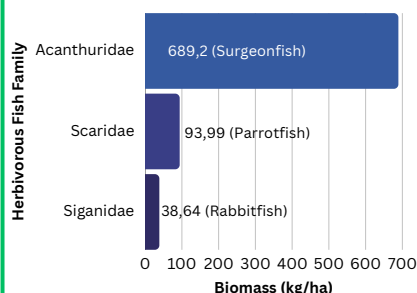
Other Zones
172,04 hectares

Functional Fish

average biomass

821,84 kg/ha

dominated by Acanthuridae

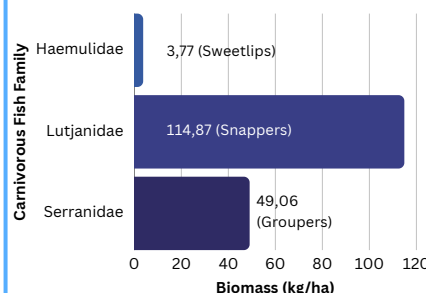


Key Fisheries

average biomass

167,71 kg/ha

dominated by Lutjanidae

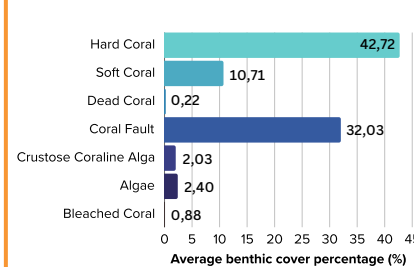


Benthic Community

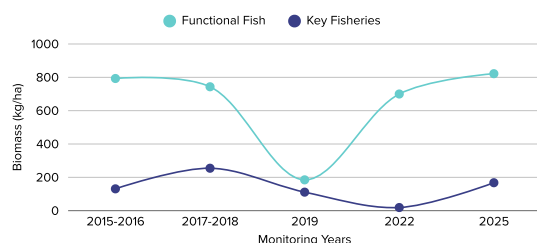
average cover

42,72%

indicating benthic recovery

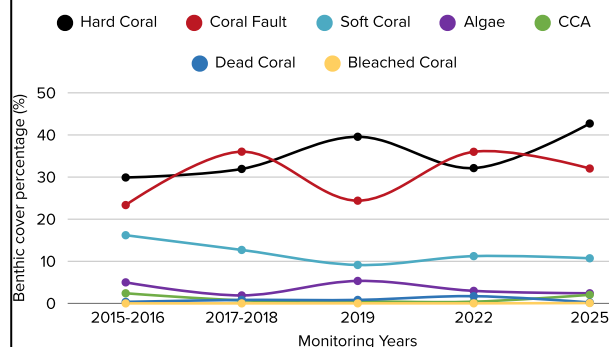


Annual Biomass Trends: Functional Fish and Key Fisheries



- In the period of 2025, the average biomass of functional fish increased to **821.84 kg/ha**. This biomass was dominated by the Acanthuridae, while Scaridae and Siganidae were less abundant but increased during the last monitoring period.
- Similarly, the average biomass of key fisheries rose to **167.71 kg/ha in 2025**, although it has not yet returned to the peak levels of 2017-2018. The increase was primarily supported by Lutjanidae and Serranidae.

Benthic Cover Trends



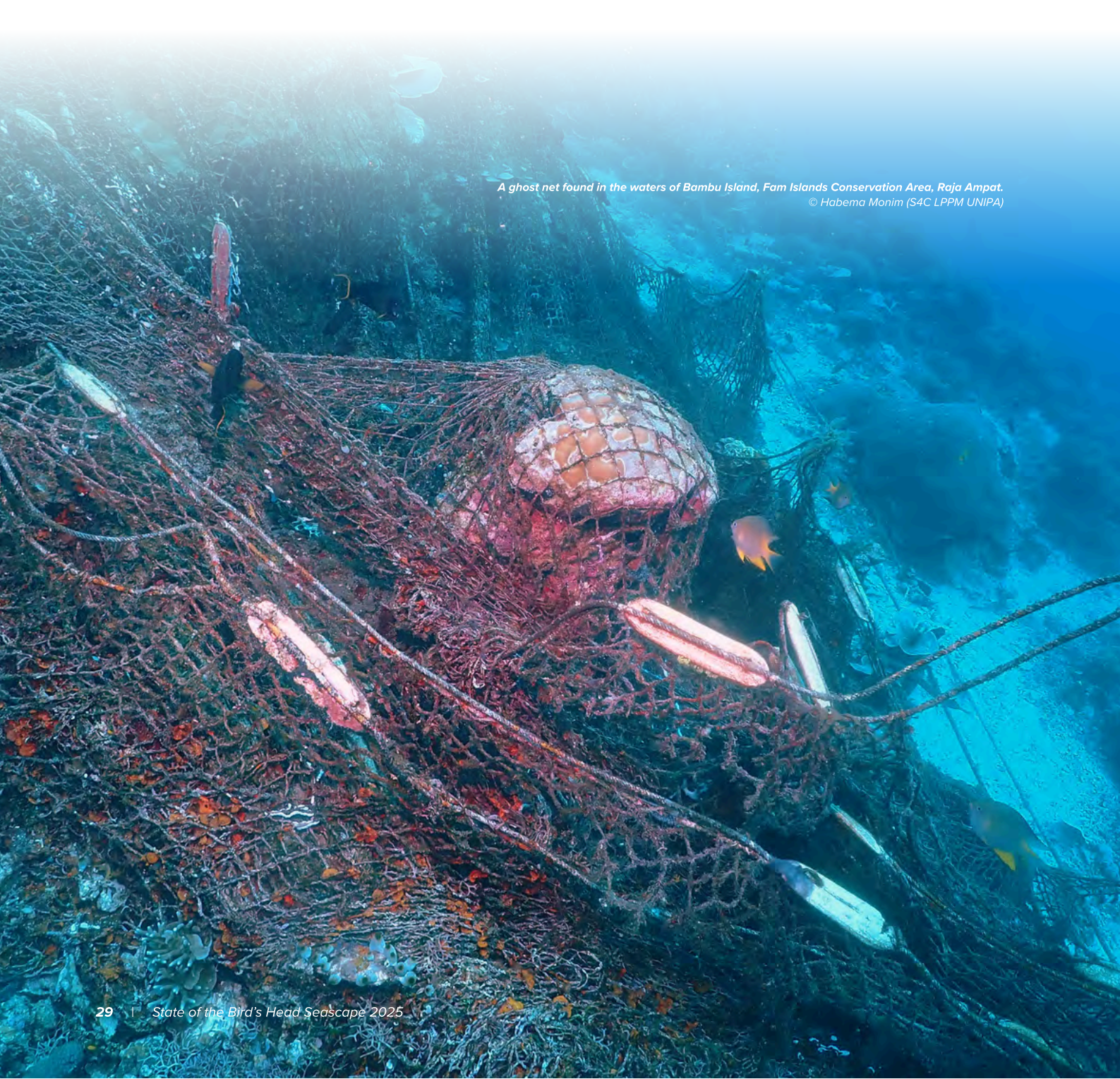
- Hard coral cover shows an increasing trend in 2025, indicating the recovery of coral reefs. In contrast, coral rubble is decreasing during this period.
- Alga terlihat menurun di tahun 2025 dan pemutihan karang sangat kecil.

Ecosystem Status: Coral Reefs

4. Threats and Recovery

The positive trends in coral cover and fish biomass across the BHS cannot be separated from ongoing pressures, most notably rising sea surface temperatures, which trigger coral reef bleaching events. Bleaching has increased in both frequency and intensity over the past decade. To assess the extent to which corals in the BHS can withstand this thermal stress, a coral thermal resistance test has been conducted as part of the monitoring program; the results are presented in Appendix 9: Coral Thermal Testing in Raja Ampat. Coral bleaching surveys conducted across several areas have also documented the distribution and severity of bleaching, as presented in Appendix 10: Coral Bleaching in the Dampier Strait.

Coral health monitoring in areas that recently joined the RHM network — Werur, Malaumkarta, and North Misool — has provided an important baseline for long-term monitoring (Appendix 11: Coral Reef Health Monitoring: Snapshots from the North Misool MPA, Maksegara CKKD, and Werur Raya MHA). Studies of coral reef conditions in South Misool have further enriched our understanding of variations in ecosystem conditions within the same conservation area (Appendix 12: South Misool Coral Reefs). In response to these pressures, active restoration efforts in the Kalig Island area represent a concrete intervention to support coral reef recovery in the BHS, with progress regularly monitored and presented in Appendix 13: Recovery of the Coral Reefs Restoration Area on Kalig Island..



*A ghost net found in the waters of Bambu Island, Fam Islands Conservation Area, Raja Ampat.
© Habema Monim (S4C LPPM UNIPA)*

Species Status: Sea Turtle

The BHS is home to four of the world's seven sea turtle species: leatherbacks, olive ridleys, green turtles, and hawksbill turtles.



Illustration: © Dawn Witherington

Leatherback Turtle (*Dermochelys coriacea*)

Body morphology: The largest turtle species, with a shell resembling leather without scales. There are seven longitudinal ridges on the back and a W-shaped beak.

Total Length Range: 165-190+ cm^{1,2,3}

Maximum Body Weight: 400-500 kg (females); up to 900 kg (males)^{1,2,3}

Habitat: Open sea in all subarctic to tropical waters in all oceans^{1,2,3}

Main Food: Jellyfish

National Protection Status: Fully Protected⁴

IUCN Red List Category and Criteria: Critically Endangered (Subpopulation status in the West Pacific Ocean)⁵



Illustration: © Dawn Witherington

Olive Ridley Turtle (*Lepidochelys olivacea*)

Body morphology: Has a gray to greenish-gray color with an almost round shell that slightly protrudes upward.

Total Length Range: 70-80 cm^{1,2,3}

Maximum Body Weight: 70-80 kg^{1,2,3}

Habitat: Bays and estuaries in all tropical waters of the Pacific, Indian, and Atlantic oceans^{1,2,3}

Main Food: Shellfish, shrimp, crab, fish

National Protection Status: Fully Protected⁴

IUCN Red List Category and Criteria: Vulnerable⁵

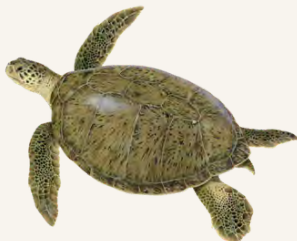


Illustration: © Dawn Witherington

Green Turtle (*Chelonia mydas*)

Body morphology: Light green to greenish brown with a large oval shell

Total Length Range: 90-120 cm^{1,2,3}

Maximum Body Weight: 120-230 kg^{1,2,3}

Habitat: Bays and sheltered waters in all subtropical and tropical waters^{1,2,3}

Main Food: Seagrass, algae

National Protection Status: Fully Protected⁴

IUCN Red List Category and Criteria: Low Risk (Least Concern)⁵



Illustration: © Dawn Witherington

Hawksbill Turtle (*Eretmochelys imbricata*)

Body morphology: Distinctive carapace patterned with overlapping yellow, black, and brown scales.

Total Length Range: 90-110+ cm^{1,2,3}

Maximum Body Weight: 60-80 kg^{1,2,3}

Habitat: Coral Reefs, Estuaries and Lagoons in all tropical and some subtropical waters^{1,2,3}

Main Food: Sponges, anemones, shrimp, squid

National Protection Status: Fully Protected⁴

IUCN Red List Category and Criteria: Critically Endangered⁵

Each year, various beaches in this region serve as important nesting sites for sea turtles, from the Raja Ampat Islands to the Bird's Head coast of Papua, including Tambrau, Sidey, Fakfak, and Kaimana. The presence of all four species underscores the BHS's significance as one of the world's most important sea turtle habitats.

1. seaturtle.org

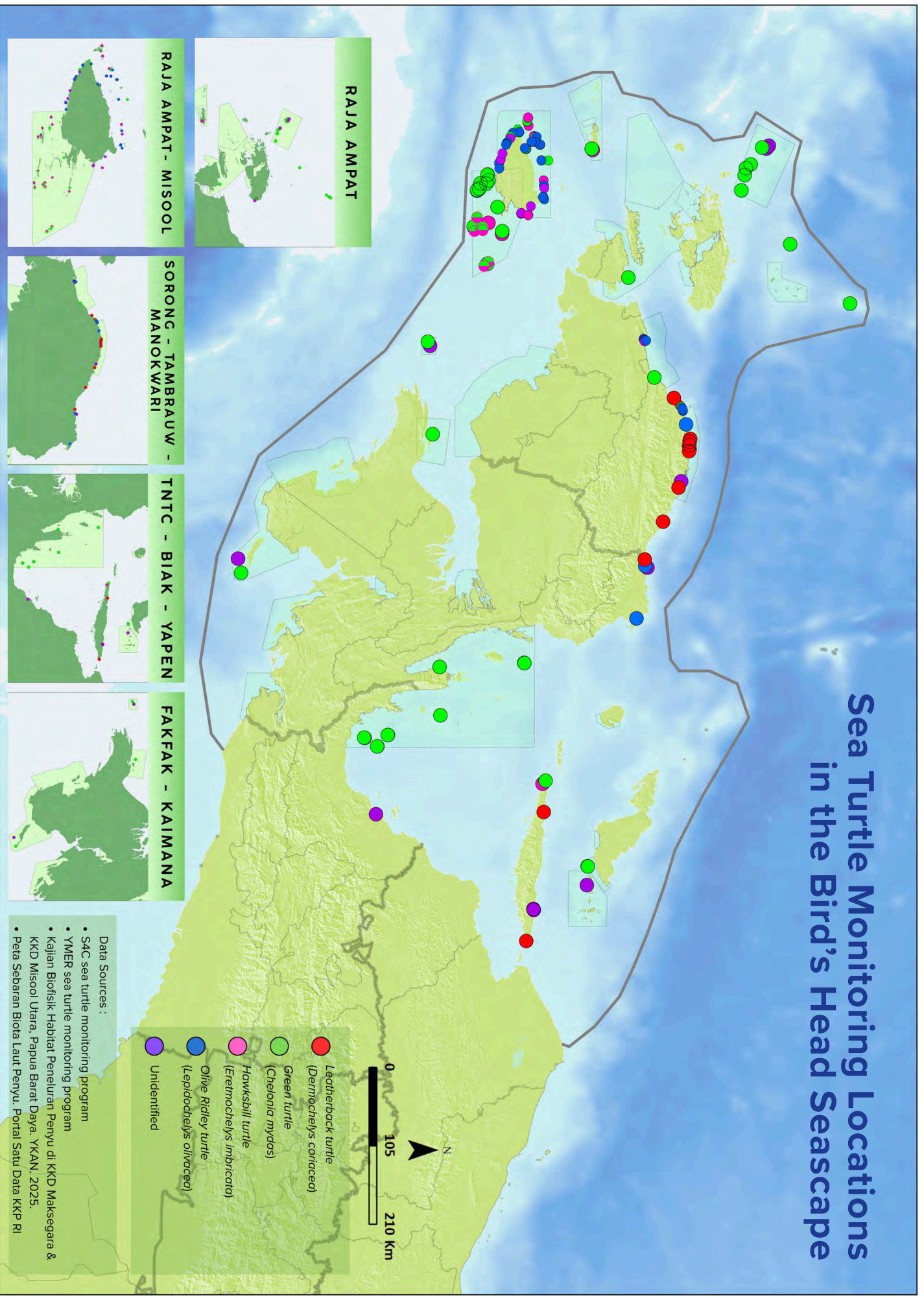
2. Pritchard, P. C. H. and Mortimer, J. A. (1999) *Taxonomy, External Morphology, and Species Identification*. pp. 21-38. In: Eckert, K.L., K.A.Bjorndal, F.A. Abreu-Grobois, and M. Donnelly (Editors). 1999. Research and Management Techniques for the Conservation of Sea Turtles. IUCN/SSC Marine Turtle Specialist Group Publication No. 4. (for further details see <http://www.iucn-mtsg.org/publications.htm>)

3. Wyneken, J. The Anatomy of Sea Turtles. (2001). U.S. Department of Commerce NOAA Technical Memorandum NMFS-SEFSC-470. 172 pp.

4. Kementerian Kelautan dan Perikanan. (2025). *Status Perlindungan, Pelestarian dan Pemanfaatan Jenis Ikan Yang dilindungi/Genetik Ikan*. <https://portaldata.kkp.go.id/portals/data-statistik/jns-ikan-dilindungi/tbl-dinamis>

5. <https://www.iucnredlist.org/>

Sea Turtle Monitoring Locations in the Bird's Head Seascape



Species Status: Sea Turtle

Turtle Monitoring in Tambrau

*The BHS is home to four of the world's seven sea turtle species that nest along its coastline: the leatherback turtle (*Dermochelys coriacea*), the olive ridley turtle (*Lepidochelys olivacea*), the green turtle (*Chelonia mydas*), and the hawksbill turtle (*Eretmochelys imbricata*) (Mangubhai et al., 2012). One of the main turtle nesting sites in the BHS is Jeen Womom Coastal Park — a marine conservation area — established specifically to protect turtle nesting habitats, particularly for leatherback turtles.*

Nesting activity for leatherback turtles in the western Pacific is primarily concentrated in Jeen Womom Coastal Park. Approximately 75% of all western leatherback turtle nesting occurs on Jeen Yessa and Jeen Syuab beaches, both located within the Jeen Womom Coastal Park (Dutton et al., 2007). Since the 1980s, the number of leatherback turtle nests has declined significantly, largely due to extensive egg harvesting that occurred from the 1970s through the 1990s (Bhaskar, 1987). Although large-scale egg harvesting has ceased, low hatchling production continues to hinder population recovery.

One strategy for supporting leatherback turtle population recovery is to ensure that the hatchlings produced is sufficient to sustain viable population levels. Research by the Institute of Research and Community Service (LPPM) UNIPA has identified high sand temperatures, predation, erosion, tidal inundation, and *Ipomoea* sp. root invasion as threats to turtle nests in Jeen Coastal Park Womom (Pakiding et al., 2023; Tapilatu & Tiwari, 2007). Therefore, conservation efforts at the park should focus on nest protection to increase hatching success rates and maximize hatchling production. Continuous population monitoring is essential for assessing the impact of conservation activities and for implementing adaptive management.



The sea turtle monitoring team at Warmamed Beach measuring the carapace width of a leatherback turtle.
© Spenyel Yenusy (S4C LPPM UNIPA)

Method

Turtle nesting activity is measured by the number of nests recorded and the number of nesting females observed. To record the number of nests in Jeen Coastal Park Womom, the S4C LPPM UNIPA team and local patrol personnel conduct daily morning patrols along the Jeen Yessa and Jeen Syuab beaches. Data recorded include turtle species, egg-laying or non-egg-laying tracks, nest location (below high tide, above high tide, in grass, under a tree), nest sector, and nest disturbance (Schroeder & Murphy, 1999).

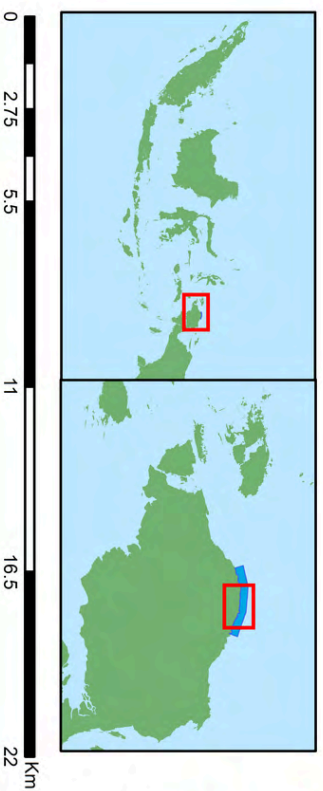
Nesting female counts are obtained through night patrols (Bolten, 1999) — conducted between 8:00 PM and 4:00 AM, the period during which turtles come ashore to lay eggs. At Jeen Womom Coastal Park, only nesting leatherback females are recorded and tagged. The S4C LPPM UNIPA team uses Passive Integrated Transponder (PIT) tags — a microchip marker with a unique nine-digit code — allowing individual females to be identified and tracked across nesting seasons (Dutton & McDonald, 1994).

To increase the leatherback hatchling production, the S4C LPPM UNIPA team and local patrol personnel protect nests at Jeen Womom Coastal Park using methods tailored to the primary threats identified at each site (Table 3.1) (Boulon, 1999)

The number of leatherback turtle hatchlings produced is estimated based on the number of surviving nests, the average hatching success rate, and the average number of eggs per nest (Miller, 1999). Surviving nests are those that were not lost to disturbance, such as predation by dogs or being washed away by floodwaters. The average hatching success rate is the percentage of eggs hatched per nest. Generally, the average hatching success rate for protected nests is higher than the average hatching success rate for unprotected nests. Therefore, hatchling production is calculated separately for protected and unprotected nests, then combined (a full description of the monitoring protocol is presented in Appendix 14: Turtle Monitoring and Nest Protection Methods).



Sea Turtle Monitoring Sites within Jeen Womom Coastal Park



Map Sources :

1. Provincial and Regency Administrative Boundary Shapefile (<https://ranahair.indonesia.go.id/portal-web/unduh/rb-wilayah>).
2. Conservation Area Shapefile based on MMAF Ministerial Decrees.
3. Science for Conservation LPPM UNIPA Monitoring Sites



Table 3.1. Threats to Sea Turtle Nests and Protection Methods at Jeen Yessa and Jeen Syuab Beaches

Threat	Threatened beach/location	Nest protection method
Elevated sand temperatures and predation risk	Wembrak	Nests on the western section of the beach are relocated to permanent, fenced enclosures. In the central and eastern sections, nests are shaded with ferns and protected with fencing. Additional nests are relocated beneath trees and safeguarded with protective fencing.
	Batu Rumah	Nests on the western section of the beach are shaded with ferns and protected with fencing.
Elevated sand temperatures, predation risk, and encroachment by creeping beach morning glory (<i>Ipomoea</i> sp.)	Jeen Syuab	All nests along the beach are relocated to permanent, fenced enclosures.
Predation by pigs, dogs, and monitor lizards	Batu Rumah	Fencing for nests located in the central and eastern sections of the beach.
	Warmamed	Nests in the central and eastern sections of the beach are protected with fencing.
Loss of nests due to river flow, coastal erosion, and tidal inundation	Jeen Syuab, during the nesting season from October	Nests are relocated to safer sites, either within the beach zone above the high-tide line or into designated relocation enclosures.

Results

Nest count trends over the past five years reveal different patterns across the four turtle species nesting at Jeen Womom Coastal Park. Leatherback turtle nest experienced a significant recovery in 2025 following a sharp decline in 2023 at both Jeen Yessa and Jeen Syuab beaches. In contrast, olive ridley turtle nest numbers, which had been increasing until 2023, experienced a sharp decline in 2024. Despite the fluctuations, nest count trends remain consistent across both sites (Figure 3.8).

Nesting activity was observed at both Jeen Yessa and Jeen Syuab, though with varying intensity between sites. A notable

difference is seen in green and hawksbill turtles, which nest in greater numbers at Jeen Yessa. Here, a maximum of 20 nests per year was recorded. At Jeen Yessa, green turtle nest numbers show an increasing trend, while hawksbill turtle nest numbers show a declining trend.

It is important to note that year-to-year fluctuations in nest numbers are common in sea turtle populations. Thus, the five years of monitoring data (2021-2025) are insufficient to draw conclusions about long-term population trends, which typically require monitoring periods of over a decade.

A member of the sea turtle monitoring team protects a leatherback turtle nest threatened by high sand temperatures using cocomesh shading.

© Elisa Putra (S4C LPPM UNIPA)



STORY BOX • TURTLE MONITORING IN TAMBRAUW

Cocomesh: An Alternative Material for Shading Turtle Nests Threatened by High Sand Temperatures.

The main threat to turtle nesting at Wembrak Beach is high sand temperatures, which can reduce nesting success and hatchling survival rates and skew the sex ratio toward female hatchlings. One effective method for lowering sand temperatures is shading with beach fern (*Cycas* sp.) leaves, which has been shown to increase hatching rates from less than 1% to over 30%. However, beach fern leaves are rarely found on Wembrak Beach. To address this, the S4C LPPM UNIPA team has developed an alternative nest-protection method using cocomesh — a woven coconut-fiber material designed to provide shade and reduce sand temperature, thereby enhancing the survival prospects of turtle nests.

The average temperature at Wembrak Beach is approximately 32°C, which exceeds the optimal incubation temperature range of 29.5°C to 30.5°C. Without shade, nests are at risk of hatching failure. Cocomesh shade can reduce temperatures by 0.73°C–0.86°C, while fern shade can reduce them by 0.76°C–1.11°C. Although the cocomesh shade is less effective than the fern at lowering sand temperature, average nest hatching success under both materials is comparable. Therefore, cocomesh is a practical alternative for shading turtle nests at Wembrak Beach, where fern leaves are scarce.



Hatched sea turtle eggs at Jeen Womom Coastal Park.
© Thomas Hombahomba (S4C LPPM UNIPA)

During the years of 2021 to 2025, the number of female leatherback turtle detected ranged from 295 to 385 per year (Figure 3.8). This increase in detection numbers of reflects the improved detection capabilities due to the addition of field personnel and PIT tag readers within the S4C LPPM UNIPA team.

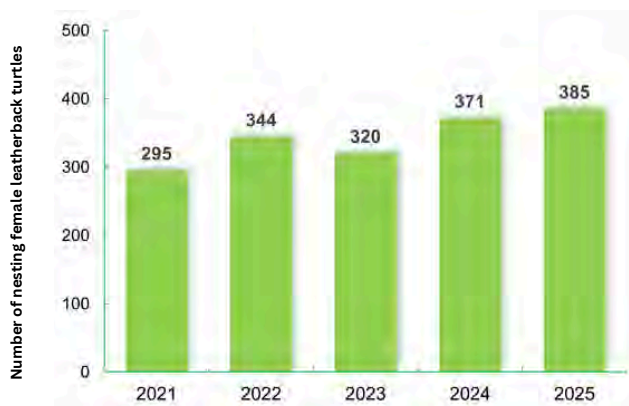


Figure 3.7 Number of nesting female leatherback turtles detected in Jeen Yessa and Jeen Syuab, 2021-2025

Between 2021 and 2025, the number of leatherback turtle nests successfully protected ranged from 1,029 to 1,694 each year. The absolute count of protected nests varied in line with the total number of nests observed. However, the proportion of nests successfully protected increased from 40–50% to over 60% over the last three years (2023–2025). This improvement was driven by an increase in field personnel and greater community participation (Figure 3.9).

The estimated production of leatherback turtle hatchlings at Jeen Womom Coastal Park from 2021 to 2025 showed significant annual variation (Figure 3.10). The highest number of hatchlings was recorded in 2022, while the lowest was in 2023. This decline in 2023 was attributed to a sharp reduction in the number of nests and a lower average nest hatching success rate. These conditions are believed to be linked to higher sand temperatures compared to previous years. In 2024 and 2025, hatchling numbers recovered, likely reflecting improved environmental conditions for nesting and increased nest-protection efforts by field teams.

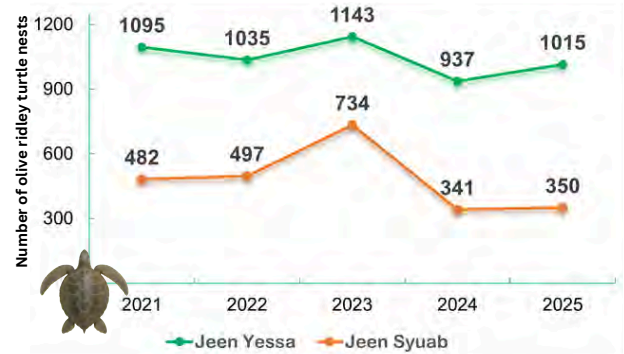


Figure 3.8 Number of nests for leatherback, olive ridley, green, and hawksbill turtles in Jeen Yessa and Jeen Syuab, 2021-2025



Figure 3.9 Number of protected leatherback turtle nests and percentage of total nests protected at Jeen Womom Coastal Park, 2021-2025

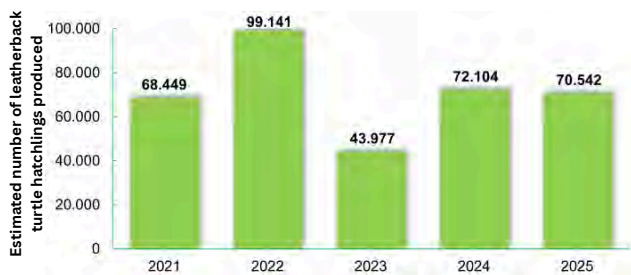


Figure 3.10 Estimated number of leatherback turtle hatchlings produced at Jeen Womom Coastal Park, in 2021-2025

6.904
THE NUMBER OF PROTECTED
LEATHERBACK TURTLE NESTS
FROM 2021 TO 2025

THE NUMBER OF
PROTECTED
LEATHERBACK TURTLE
increases
by 30%
FROM 2023 TO 2025

354.213
ESTIMATED NUMBER OF
LEATHERBACK TURTLE
HATCHLINGS PRODUCED
IN 2021-2025

Leatherback turtle hatchlings successfully emerging from the nest.
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Species Status: Sea Turtle

Turtle Monitoring in Raja Ampat

By: Yayasan Penyu Papua (YPP)

The Papua Turtle Foundation (YPP) is an active conservation partner in the BHS. The foundation conducts ongoing monitoring and patrolling programs at turtle nesting beaches on Piai Island and Sayang Island, located in the West Waigeo Islands in West Papua Province. These activities are specifically designed to protect the green turtle (*Chelonia mydas*) population from hunting of nesting females and egg theft, both of which remain significant threat on these two islands.

Area Patrols and Surveillance

From July 2023 to January 2024, YPP conducted 15 patrols around Sayang Island and Piai Island, during which they recorded 96 violations involving traditional fishing boats, manual and compressor-powered dive boats, bottom-fishing boats, and shark-fishing boats. In the subsequent period, from February to May 2024, nine patrols were conducted, recording 90 violations. In 2025, 44 patrols were conducted, documenting 139 violations involving fishing boats and vessels, including those using explosives and those hunting turtles on Sayang Island. These findings indicate a sustained high level of exploitation pressure around the nesting area, underscoring the need for ongoing management efforts.

Nesting Activity on Piai Island

Piai Island is an important nesting site, featuring a nesting beach that extends 3,000 m along its 4.65 km circumference. This monitored beach area covers approximately 6.51 ha. Data on green turtle nesting at this island show significant fluctuations during the monitoring periods:

- From June to December 2023: a total of 806 green turtle nests were recorded. Based on an average of 115 nests per month, the total nest count for 2023 was 1,381 nests—representing a 6% decrease compared to the 2008–2013 baseline of 1,477 nests — and it falls short of the program's target of a minimum 15% increase from the baseline. The decline has been attributed to the prolonged impact of poaching nesting female turtles and egg theft during October 2022–May 2023, when monitoring was suspended due to a program break.
- From January to May 2024: 923 green turtle nests were recorded. A comparison with the baseline is not possible because the data did not cover a full year at the time of reporting.
- From January to December 2025: 3,478 green turtle nests were recorded, representing a 136% increase from the 2008–2013 baseline of 1,477 nests.
- From June 2023 to May 2024 and January–December 2025 (full cycle): Total nests recorded reached 5,207 nests.



Sea turtle monitoring activities conducted by YPP patrol members on Piai Island.
©Yayasan Penyu Papua

The distribution of nests along coastal sectors also shows a notable shift. In previous years, the highest concentration of nests consistently occurred in 00–29 marker sectors, which offer the best beach conditions. However, during June–July 2023, the highest concentration shifted to sectors 36–53. This change is suspected of being related to severe abrasion in the earlier sectors. A similar event was recorded again in April–May 2024 and identified as a major factor in reduced nesting activity during the peak season.

Hatching Success and Hatchling Production

Monitoring natural nest hatching success yielded generally positive results. During June–December 2023, an analysis of 346 nests showed an average hatching success rate of 85.62%, with an average success rate of 78.92% of hatchlings reaching the sea, equivalent to the production of 58,527 hatchlings.

During January to May 2024, an analysis of 92 sample nests yielded an average hatching success rate of 87.10% and an average success rate of 81.97% of hatchlings reaching the sea, or a total production of 67,876 hatchlings.

Overall, total hatchling production during the June 2023 to May 2024 cycle reached 123,560 hatchlings, with an average hatching success rate of 85.93% and an average of 79.56%. Hatchlings reached the sea. In addition, an analysis of the success of natural nest hatching for the period from January to December 2025 was conducted on 581 nest samples, revealing an average hatching success of 89.12% and a rate of 81.97% hatchling reaching the sea, or a total production of 223,360 hatchlings.

As a supplementary measure, the YPP also implemented a nest relocation program from sectors 30–59, which are vulnerable to tidal inundation. During this cycle, 21 nests were relocated: seven nests in February 2024 successfully hatched with an average hatching success rate of 82.20% and an average hatchling emergence rate of 80.66%, resulting in a total of 604 hatchlings. From April to September 2025, 63 nests were successfully relocated, resulting in an average hatching success rate of 48.89% and an average hatchling emergence rate of 46.26%, representing a total production of 2,917 hatchlings.

Nest Predation

Threats to nests not only come from human activities but also from natural predators. On Piai Island, monitor lizards (*Varanus indicus*) have been identified as the main predators of turtle nests. From June to December 2023, these lizards preyed on 84 nests, accounting for 6.1% of the total, exceeding the program's tolerance threshold of 5.3%. The high rate of predation observed during this period was attributed to a lack of monitoring in the previous eight months, which allowed the lizards to develop strong predation habits. During the subsequent period from January to May 2024, predation by monitor lizards occurred on 51 nests (5.3%), with an additional nine nests lost to human activities and three submerged due to high tide. In total, from June 2023 to May 2024, monitor lizards preyed on 135 nests, or 7.8% of all nests recorded. In the following year, from January to December 2025, monitor lizards preyed on 257 turtle nests (7.4%), again exceeding the program's tolerance threshold of 5.3%. High wave activity during the long-wave season encroaches on a portion of the nesting beach, leading to egg spoilage, while coastal erosion reduces nest depth in affected areas.



Monitoring team members collecting data from hatched nests and eggs at the Piai Island post.
© Yayasan Penyu Papua



Temporary holding of live hatchlings at the Piai Island post.
© Yayasan Penyu Papua



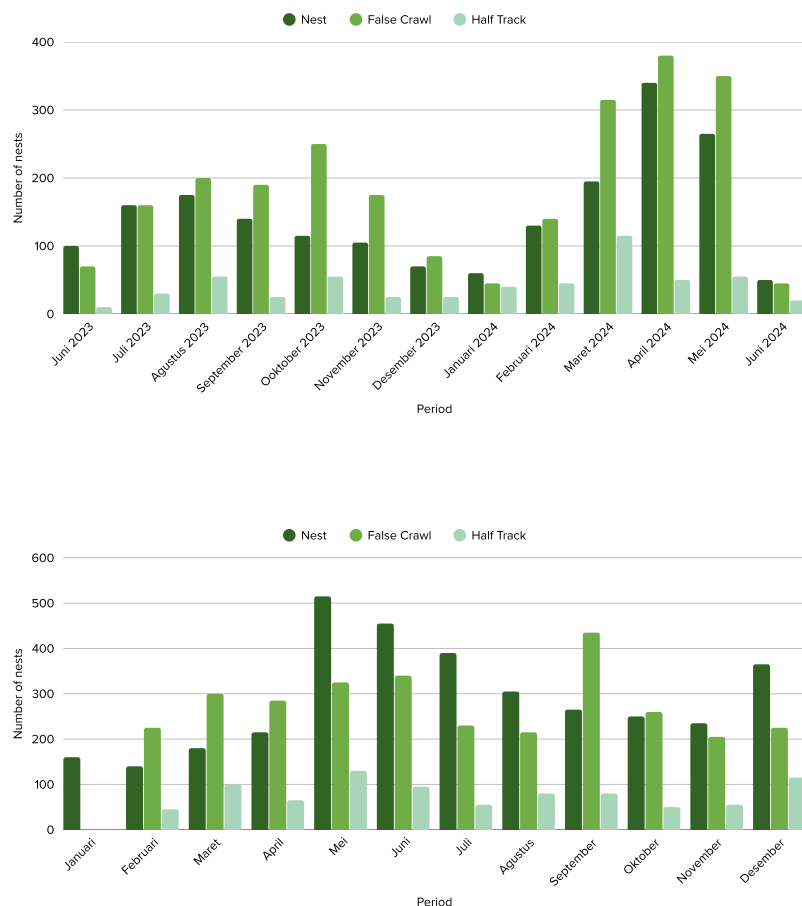


Figure 3.11 Number of green turtle (*C. mydas*) nests each month, June 2023-June 2024 Piai Island (top) and Number of green turtle (*C. mydas*) nest each month during January-December 2025 on Piai Island (bottom)

Nesting Activities on Sayang Island

On Sayang Island, three surveys were conducted in July, September, and October 2023, recording a total of 62 green turtle nests. Of these nests, nine were predated by monitor lizards, and one was taken by humans. The subsequent survey in May 2024 recorded 16 nests, of which two were predated by monitor lizards, and one was taken by humans. Additional nest surveys were conducted in several nesting beaches from February to November 2025, during which a total 597 green turtle nests were recorded.

Threats and Challenges

The most significant threats faced by the turtle populations on Piai Island and Sayang Island, aside from natural predators, are illegal turtle poaching. Between June and December 2023, the YPP team documented 86 turtle poaching marks on Piai Island and 23 on Sayang Island, indicating an estimated total of 86 nesting females poached during the BAF Cycle 4 program. This level of poaching of nesting females directly affects the number of nesting turtles in the following months, as evidenced by the nesting data for April and May 2024. In addition, escalating coastal erosion poses a long-term structural challenge that warrants serious consideration in the nesting beach management strategy at the BHS.

Yenbekaki Village, Raja Ampat

The monitored turtle nesting beaches in Yenbekaki Village consist of two sites: Warebar Beach (approximately 7,000 m) and Warwesun Beach (approximately 1,060 m). Both beaches have experienced a significant decline in turtle populations due to high predation rates and ongoing hunting pressure.

Monitoring at Warebar Beach from March to July 2021 recorded seven hawksbill turtle nests, as many as nine leatherback turtle nests, and 75 olive ridley turtle nests. During February to May 2022, monitoring recorded six hawksbill turtle nests, two leatherback turtle nests, and 20 olive ridley turtle nests. During May to July 2025, 37 olive ridley turtles and nine leatherback turtle nests were recorded.

Monitoring at Warwesun Beach from July to September 2021 recorded seven hawksbill turtle nests and six olive ridley turtle nests. From February to August 2022, three hawksbill turtle nests, one leatherback turtle nest, and 32 olive ridley turtle nests were recorded.



Venu Island in the Buruway MPA, Kaimana.
© Habema Monim (S4C LPPM UNIPA)

Species Status: Sea Turtle

Monitoring Turtles on Venu Island, Kaimana

(Historical Baseline), by: Conservation International (CI)

Venu Island, meaning "egg island" in the Koiway language — is one of the most strategically important sea turtle nesting sites in the BHS. Located just south of the Bird's Head in Kaimana Regency, this small, bracelet-shaped island is approximately 700 m long and 300 m wide. It has relatively flat terrain, with elevations ranging from 0 to 7 m above sea level. The island is surrounded by beautiful white sandy beaches, making it an ideal nesting habitat for three globally protected sea turtle species: the green turtle (*Chelonia mydas*), hawksbill turtle (*Eretmochelys imbricata*), and olive ridley turtle (*Lepidochelys olivacea*). In the local Koiway language, green turtles are referred to as jalepi, hawksbill turtles as eran, and olive ridley turtles as bambawar. These three names reflect the Koiway people's long history of coexistence with these species, which predates formal conservation efforts.

Historically, the BHS was home to a very large hawksbill turtle colony, with an estimated 5,000–6,500 nests occurring annually along the northern coast of the Bird's Head (Salm, 1984; Schulz, 1987 in Groombridge & Luxmoore, 1989). Venu Island is estimated to host approximately 40% of tall hawksbill nests in the BHS, with nesting activity occurring year-round and peaking between December and May (Mangubhai et al., 2012). However, intense exploitation pressure from the 1960s to the early 2010s

led to a drastic decline in their population. For decades, the capture of thousands of green and hawksbill turtles, particularly by fishers from outside the region seeking carapaces and eggs, went largely unchecked. As a result, the number of hawksbill turtle nests in West Papua fell to fewer than 200 nests per year (Mangubhai et al., 2012).

Initiation of the Monitoring Program (2011)

In response to this situation, Conservation International (CI), together with the West Papua Natural Resources Conservation Agency, through the Kaimana Region IV Natural Resources Conservation Agency, and local indigenous communities, initiated a systematic turtle-monitoring program on Venu Island in February 2011. This program involves regular data collection on nesting activities, covering time of nesting, species, female body size, nest location, nesting frequency, and number of eggs per nest. In addition, a community patrol team has been formed to protect the nesting beach from natural and human threats. Monitoring takes place every night from 7:00 PM to 11:00 PM local time, where nests are recorded, measured, and marked. As part of the protection protocol, eggs found in vulnerable locations are relocated to safer areas within 24 hours to reduce predation risk and improve hatching success.

Egg Laying Data Trends, 2011–2016

Monitoring data from the first six years of the program (2011–2016) reveals trends that highlight the complex relationship between conservation efforts and ongoing threat pressures. In the first three years (2011–2013), the number of recorded nests remained relatively stable, with a positive trend observed: there were 208 nests in 2011, 245 in 2012, and 219 in 2013. During this period, a total of 2,477 individual turtles were recorded nesting on Venu Island, marking an initial achievement that indicates a positive impact from monitoring and patrolling.

This trend significantly changed in the years of 2014–2015. The number of nests sharply dropped to 115 in 2014, reaching a low of just 79 nests in 2015, which represents a decline of over 67% from the peak in 2012. In 2016, there was a modest recovery, with 123 nests recorded. It is important to consider the variation in the number of monitoring days across these years, which ranged from 133 to 332 days, when interpreting these figures. Nevertheless, the consistent decline from 2012 to 2015 suggests underlying structural pressures that cannot be solely explained by changes in monitoring efforts.

Table 3.12 Number of sea turtle nests recorded between 2 March 2011 and 30 May 2016 on Venu Island, Kaimana Regency, West Papua Province, Indonesia.

Year	Number of Monitoring Days	<i>C. mydas</i>	<i>L. olivacea</i> + <i>E. imbricata</i> *	Total
2011	259	120	88	208
2012	332	150	95	245
2013	313	125	94	219
2014	257	74	41	115
2015	218	37	42	79
2016	133	68	55	123

*Nests of hawksbill turtles and olive ridley turtles were counted together.

Key Threats Identified

During this period, two main categories of threats were documented: illegal hunting and coastal erosion. The poaching of sea turtles and egg theft for their eggs continued, exacerbated by the temporary suspension of the customary ban (sasi) on sea cucumber harvesting. This suspension attracted outside fishermen to the waters around Venu Island and increased the use of turtles for food. The area’s law enforcement capacity is very limited, with community patrols able to conduct patrols only once a month, creating a significant gap in the region’s protection system.

Seasonal coastal erosion poses an increasingly serious threat to nesting habitats. From March to May, high waves consistently reduce the width of nesting beaches by up to 10 m, not only destroying existing nests but also limiting the area available for new nesting sites. This situation is worsened by illegal logging on the island, which diminishes protective vegetation and accelerates coastal erosion.

The CI monitoring program on Venu Island has laid a crucial foundation through systematic data collection, community-based patrol teams, and nest relocation protocols. Data collected from 2011 to 2016 highlight significant ongoing challenges: uncontrolled hunting pressure, insufficient monitoring capacity, and escalating environmental threats due to climate change and human activities near nesting areas.

Tabel 3.13 Number of sea turtle nests recorded between 7 March 2016 and 19 May 2017 on Venu Island, Kaimana Regency, West Papua Province, Indonesia

Year	Number of Monitoring Days	<i>C. mydas</i>	<i>L. olivacea</i>	<i>E. imbricata</i>	Total
2016	135	117	12	77	206
2017	332	98	9	82	189



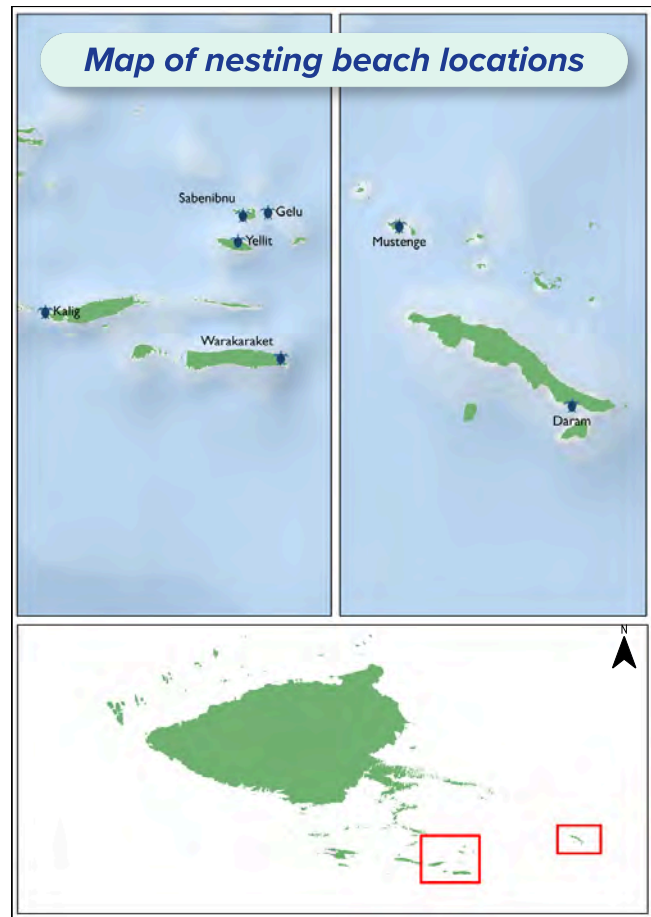
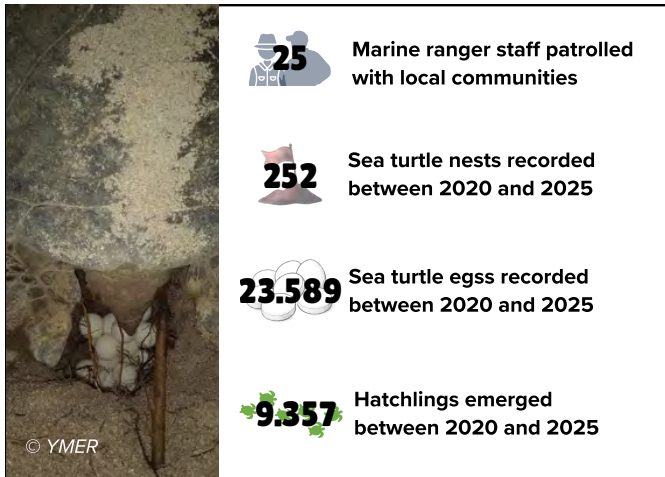
A sea turtle coming ashore to nest on Venu Island.
© Nita Johana (Conservation International)

Species Status: Sea Turtle

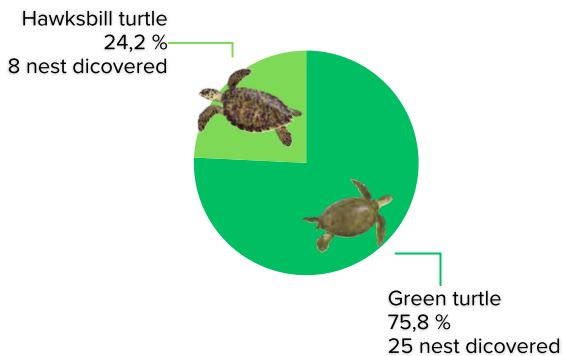
Turtle Monitoring in South Misool

By: Misool Ecosystem Regeneration Foundation (YMER)

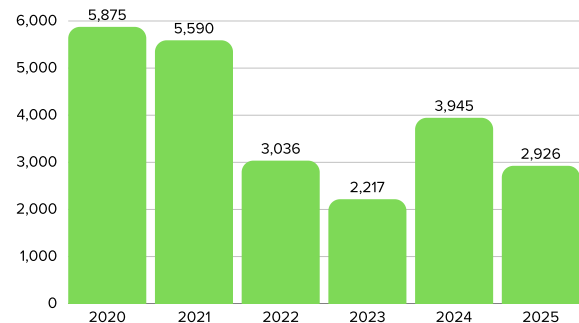
The Misool Ecosystem Regeneration Foundation (YMER), in collaboration with local communities in South Misool, Raja Ampat, regularly monitors sea turtles at seven key nesting sites. This data serves as critical foundation for understanding nesting trends, managing threats, and ensuring the future of sea turtles in the waters of Raja Ampat. To support these efforts, 25 marine rangers patrolled the sea and assisted with monitoring alongside local communities.



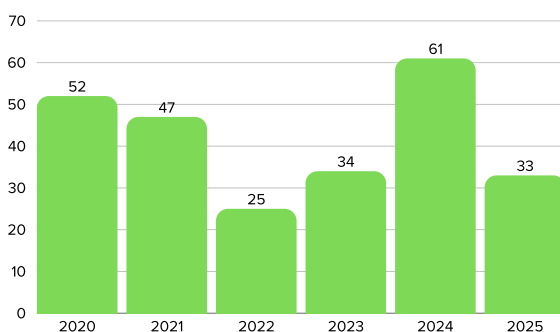
Species composition of monitoring year 2025*



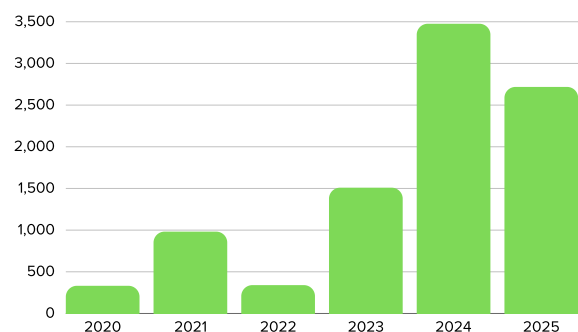
Number of turtle eggs recorded between 2020 and 2025*



Number of turtle nests recorded between 2020 and 2025*



Number of turtle hatchlings hatched between 2020 and 2025*



*Note: The graph is a processed aggregate data from seven monitoring locations.

Species Status: Elasmobranch

The elasmobranch group, which includes sharks and rays, is one of the most important marine megafauna groups in the Bird's Head Seascape (BHS). The presence of this group strengthens the BHS's status as an area with high marine conservation value, as several regions in West Papua and Papua have been identified as important habitats for sharks and rays through the Important Shark and Ray Areas (ISRA) approach (IUCN SSC Shark Specialist Group, 2024; ISRA, 2024).

Within the BHS, areas such as Raja Ampat, Misool, Kaimana, Fakfak, and Cenderawasih Bay encompass diverse coastal and marine habitats: coral reefs, mangroves, seagrass beds, straits, bays, and deep waters. These environments provide critical habitats for various shark and ray species, which use these areas for feeding, aggregation, reproduction, and movement.

Ecologically, elasmobranchs play a crucial role in maintaining the structure and the balance of marine ecosystems. Some sharks serve as apex predators, helping regulate their prey populations, while various ray species are closely associated with benthic habitats and the dynamics of benthic communities. However, this group is highly vulnerable biologically. Many shark and ray species grow slowly, reach sexual maturity later, and produce fewer offspring. These traits make their populations slower to recover when they are under pressure from overfishing, bycatch, habitat degradation, and environmental change. Globally, according to IUCN, more than one-third of all shark and ray species threatened with extinction, primarily due to fishing pressure and bycatch (IUCN, 2024).

Attention to elasmobranchs in the BHS has increased due to various protection activities, research, and monitoring of priority species. Several species, including manta rays, whale sharks, zebra sharks, reef sharks, wobbegongs, and endemic walking sharks, have become key focuses for conservation, research, and marine tourism. The designation of several areas in West Papua and Papua as ISRAs further underscores their significance for threatened elasmobranch species. These ISRAs include locations that support restricted-range species, reproductive sites, feeding areas, aggregation zones, and areas with high diversity of sharks and rays (ISRA, 2024). Southeast Misool, for example, is designated as an ISRA because it supports threatened species, species with restricted range, reproductive areas, feeding areas, aggregation zones, and high elasmobranch diversity.



A whale shark feeding near a lift-net fishing platform (bagan) in the waters of Kaimana, West Papua.
© Prehadi (Loka PSPL Sorong)



A reef manta ray at a cleaning station in Raja Ampat demonstrates the ecological interactions between manta rays and reef fish communities.
© Ronald Mambrasar (Konservasi Indonesia)

While various studies and efforts have aimed to protect elasmobranchs in the BHS, the information available for systematic compilation in this assessment remains limited. This does not mean that elasmobranch data in the BHS is unimportant or unavailable; rather, the data presented in this report are unevenly distributed across regions, monitoring years, methods, and species. Some information is location-specific, some data focus on priority species, and other data is found in technical reports, partner databases, or monitoring records that have not yet been fully integrated into a cohesive seascape assessment framework.

Given these constraints, this section provides a preliminary snapshot of elasmobranch status based on available information, rather than a comprehensive assessment of all shark and ray populations in the BHS. One primary data source is the Baited Remote Underwater Video (BRUV) system in South Misool, which provides insights into the composition and occurrence of sharks and rays at specific monitoring sites. This information is further complemented by studies of priority species, such as manta rays, whale sharks, and zebra sharks, which have been the focus of ongoing conservation efforts in the BHS. Strengthening integrated elasmobranch monitoring at the seascape level will be essential for understanding population trends, identifying key habitats, and supporting more adaptive management of conservation areas.

Species Status: Elasmobranch

BRUV Survey 2019-2023: Sharks and Rays in South Misool

— Comparing Shark Abundance Between the Protection Zone and the Sasi Zone (YMER, 2023)



Elasmobranchs are an important group of marine megafaunas found in coastal and coral reef ecosystems. Some shark species act as top predators, while rays serve important ecological roles in bottom habitats. This group is particularly vulnerable to overfishing pressure and bycatch due to its typically slow reproductive rates. Consequently, the presence and relative abundance of elasmobranchs serve as valuable indicators for assessing the health of marine ecosystems and the effectiveness of conservation area management.

In the BHS, particularly in Raja Ampat, the protection of sharks and rays has become an essential aspect of marine conservation area management. This initiative has been formalized through Raja Ampat Regency Regulation No. 9 of 2012, which prohibits the fishing of sharks, manta rays, and certain other species in Raja Ampat waters. Monitoring data collected with the BRUV in the Misool Islands MPA provide valuable insights into the status of elasmobranchs in one of the BHS's key conservation areas.

Composition of Sharks and Rays Recorded by BRUV

The 2023 BRUV survey conducted by YMER comprised 183 deployments, of which 168 were available for analysis. A total of 139 individuals from 13 species and seven families were recorded, which included sharks, rays, and other marine megafauna such as turtles. Among these, 109 individuals were sharks belonging to four species: blacktip reef shark (*Carcharhinus melanopterus*), grey reef shark (*Carcharhinus amblyrhynchos*), whitetip reef shark (*Triaenodon obesus*), and tawny nurse shark (*Nebrius ferrugineus*). The blacktip reef sharks were the most frequently recorded species, followed by the grey reef sharks. Overall, the relative abundance of sharks in the South Misool MPA was at 0.65 sharks per hour, based on the MaxN value — the maximum number of individuals visible in a single frame, which helps avoid double-counting.

The survey recorded several species of rays, including Mobula sp., spotted eagle ray (*Aetobatus ocellatus*), giant guitarfish (*Glaucostegus typus*), blue-spotted maskray (*Neotrygon australiae*), blue-spotted fantail ray (*Taeniura lymma*), round ribbontail ray (*Taeniurops meyeri*), and whiprays of the family Dasyatidae. Ray species diversity was higher than in previous surveys, while the species composition of sharks and turtles remains relatively constant. These findings indicate that the Misool Islands are significant not only for reef sharks but also for numerous high-conservation-value ray species.



Shark Abundance Higher in Protected Zones

A comparison between zones reveals clear differences between the Food Security and Tourism Sub-Zone and the Sasi Zone. In 2023, the abundance of sharks in the Food Security and Tourism Sub-Zone was found to be approximately 6.4 times higher than in the Sasi Zone, with a ratio of 6.837:1. Specifically, 95 sharks were recorded in the Food Security and Tourism Sub-Zone, compared to only 14 in the Sasi Zone.

Within the Sasi Zone, the relative abundance of sharks decreased from 0.267 to 0.173 sharks per hour, primarily due to a sharp decline in the occurrences of blacktip reef sharks. The Food Security and Tourism Sub-Zone, by contrast, maintained a relatively higher occurrence of reef sharks. Statistical analysis identified zoning as the primary variable influencing shark abundance in the Misool Islands MPA. Other variables, including depth, deployment duration, and their interaction, did not significantly affect the maximum number of sharks observed (MaxN values). These findings indicate that variation in marine spatial management significantly influences both the occurrence and relative abundance of sharks.



Management Implications and Interpretive Notes

These results suggest that areas with stronger protection levels can provide safer habitats for sharks and support the presence of key species. Beyond zoning, regular area surveillance is also critical. The report documents a strong correlation between the frequency of YMER and BLUD patrols and shark occurrences in the Food Security and Tourism Sub-Zone. This indicates that protection regulations should be accompanied by routine patrols, compliance from area users, and support from the government and traditional institutions.

These findings should nonetheless be interpreted with caution. The BRUV survey focuses on the Food Security and Tourism Sub-Zone and the Sasi Zone in the Misool Islands MPA. Therefore, the results are best understood as a South Misool case study rather than a comprehensive assessment of the BHS. Furthermore, the BRUV method provides relative abundance estimates based on individuals recorded in the video footage, rather than absolute population estimates. Not all deployments were available for analysis due to technical issues, including memory card errors, camera obstruction, and strong currents that overturned the equipment. To enhance assessment of elasmobranch status throughout the BHS, regular monitoring using consistent methods should be expanded to other conservation areas.

In addition to reef sharks monitored using the BRUV, the BHS is also an important habitat for three groups of elasmobranchs with high conservation and ecological value: manta rays (*Mobula alfredi* and *Mobula birostris*), zebra shark (*Stegostoma tigrinum*), and whale shark (*Rhincodon typus*). Long-term research and monitoring on all three species has been conducted by various conservation partners in the region, generating important data on abundance, movements, behavior, and population responses to protection efforts. In-depth findings for each species are available in the following appendices: Appendix 15: Manta Ray Research; Appendix 16: Zebra Shark Research; and Appendix 17: Whale Shark Research.



Species Status: Marine Mammals

Marine mammals represent an important group of species in the BHS, including dugongs and cetaceans such as dolphins and whales. Their presence underscores the importance of the BHS as a habitat that connects coastal ecosystems, seagrass beds, coral reefs, bays, straits, and deep-sea environments. Unlike species that rely solely on one type of habitat, many marine mammals have extensive spatial requirements and utilize a variety of habitats throughout their life cycles. Dugongs are closely associated with seagrass beds as feeding habitats, while dolphins and whales can inhabit productive coastal waters, estuaries, straits, and deep-water channels.

Kaimana is one of the important areas for marine mammals in the BHS and has been designated an Important Marine Mammal Area (IMMA) due to its support for several marine mammal species. This region features a variety of significant coastal and oceanic habitats, including estuarine mangroves in Arguni Bay, coral islands, narrow, deep channels in the Triton Bay area, and proximity to the Seram Sea trench (IUCN-MMPATF, 2022).

The IMMA Kaimana factsheet highlights key species found in the area, including the Australian humpback dolphin (*Sousa sahulensis*), dugong (*Dugong dugon*), Indo-Pacific bottlenose dolphin (*Tursiops aduncus*), and Bryde's whale (*Balaenoptera edeni*). Other notable species present in this region include the pantropical spotted dolphin (*Stenella attenuata*) and spinner dolphin (*Stenella longirostris*).

Ecologically, marine mammals serve as important indicators of habitat conditions and aquatic productivity. Dugongs, for example, are highly reliant on seagrass meadows, and their presence and feeding trails can offer valuable insights into the health of these habitats and pressures they face along coastlines. Seagrass meadows are essential not only for dugongs but also for other migratory species, as they support biodiversity, regulate climate, and sustain the livelihoods of coastal communities (UNEP-COBSEA, 2026). Meanwhile, the presence of cetaceans such as dolphins and whales can indicate aquatic productivity, prey availability, and habitat connectivity between coastal and open-sea environments.



Dolphins in the waters of Folley Village, Misool Islands, Raja Ampat.
© Habema Monim (S4C LPPM UNIPA)

Orcas observed in Bird's Head Seascape (BHS) waters are typically encountered either alone or in small groups.
© ocean-sounds.org



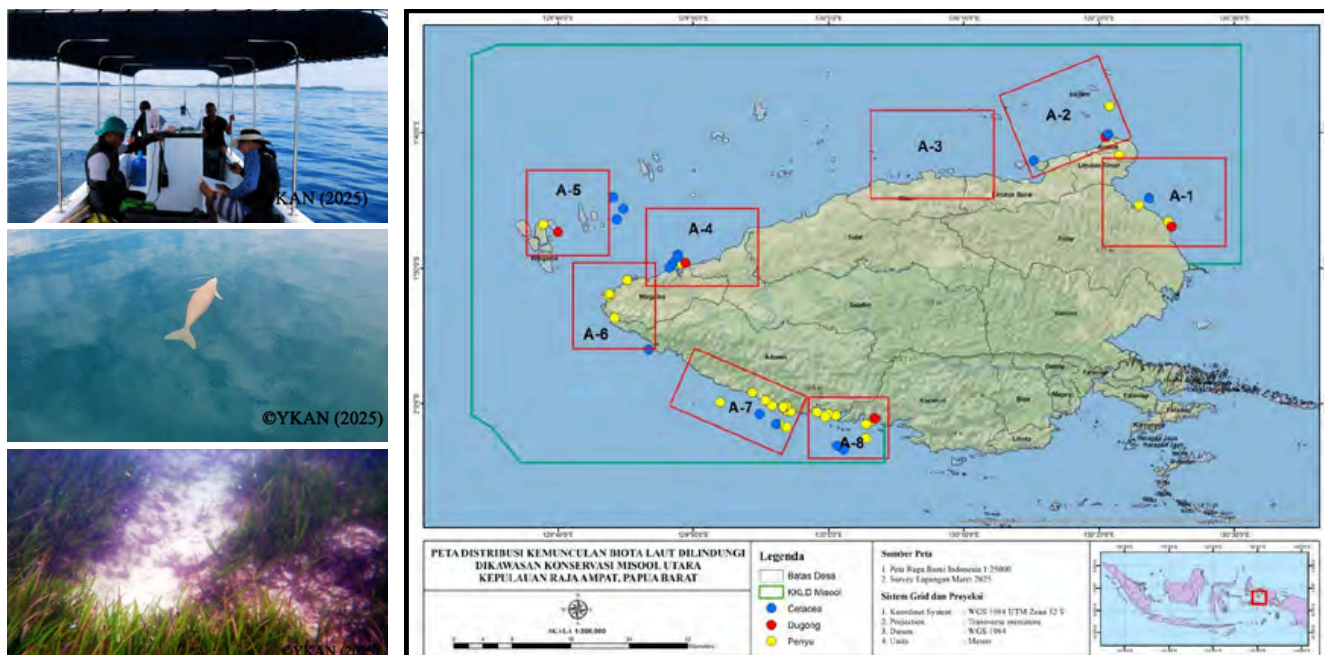
However, the information about marine mammals that can be systematically incorporated into the SOTS 2025 report is currently limited. Various studies and observations have been conducted at the BHS, particularly in Raja Ampat and Kaimana. However, the data compiled in this report are uneven in terms of coverage, monitoring periods, methods, and species. Cetacean information often comes from specific surveys, occurrence records, technical reports, or field observations that have not been fully integrated into long-term monitoring systems at the seascape level. This situation highlights the need to strengthen marine mammal databases, particularly to better understand their occurrence patterns, critical habitats, threats, and management needs.

Given these data constraints, this section focuses on dugong studies in the North Misool MPA, given the species' direct connection to seagrass ecosystems — one of the key coastal-marine ecosystems in the BHS. The available information can provide an initial overview of habitat conditions, evidence of dugong presence, and the species' protection needs. This section can also serve as a starting point to emphasize the importance of more consistent marine mammal monitoring through methods such as visual surveys, community-based sighting records, passive acoustic monitoring, and data integration across conservation partners in the BHS.

Species Status: Marine Mammal

Dugong Habitat and Population in the North Misool Marine Conservation Area, Raja Ampat Islands, Southwest Papua Province

— by Yayasan Konservasi Alam Nusantara (2025)



Dugongs as a Key Species in Seagrass Ecosystems

The dugong is an important marine mammal in Indonesia and is classified in the order Sirenia. It is recognized as a vulnerable species by the IUCN, listed in Appendix I of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES), and is protected in Indonesia under Government Regulation No. 7 of 1999 concerning the Preservation of Plant and Animal Species and Law No. 5 of 1990 concerning the Conservation of Biological Natural Resources and their Ecosystems. This protected status highlights the dugong's significance as a priority species, whose population is under pressure and at risk of continuing decline without adequate habitat management and protection.

In the BHS, dugongs are closely linked to seagrass ecosystems in coastal areas, as seagrass provides a primary food source and essential habitat for their daily activities. This dependence suggests that the presence of dugongs indicates interconnections among the status of various species, the condition of the coastal ecosystem, and the effectiveness of management practices in conservation areas. A 2025 study conducted by the Nusantara Nature Conservation Foundation (YKAN) in the North Misool MPA provided valuable insights into dugong distribution, habitat potential, aquatic environmental conditions, and the presence of other marine mammals, particularly cetaceans such as dolphins.

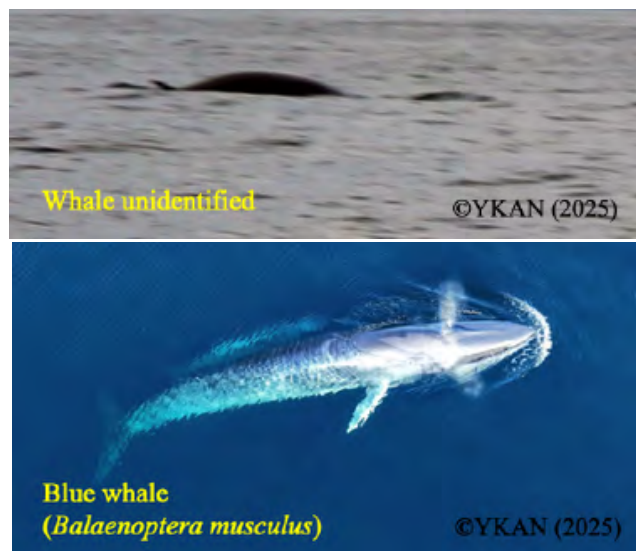
Indications of Dugong Presence and Utilization of Seagrass Habitat

The 2025 YKAN study found that dugongs were still present in several coastal areas of North Misool associated with seagrass ecosystems. Dugong populations were not evenly distributed but concentrated in shallow-water areas that support their feeding and daily movements. Environmental analysis also indicated that dugongs tend to associate with shallow, clear, calm, warm waters with favorable redox potential, consistent with the characteristics of a healthy and productive seagrass habitat.

There is significant evidence of dugong's use of seagrass habitats, as demonstrated by the discovery of 83 feeding trail locations identified through visual surveys conducted while swimming. These feeding trails are spread across the study area, with the highest concentrations found in Areas A1, A5, A6, and A7. The elongated and circular feeding trail patterns reflect the typical grazing behavior of dugongs in seagrass beds, while variations in shape and width of the trail suggest possible differences in feeding behavior and the size of individual dugongs.

The presence of dugongs was further supported by passive acoustic Monitoring. Of the 176 samples of marine sound recordings analyzed, 11 exhibited sound patterns indicative of dugong presence. The analysis revealed that dugongs were detected in five study areas, predominantly in shallow to medium waters near the coastline and in close association with seagrass beds, which serve as their feeding habitat. Area A2 was identified as one of the sites with the highest dugong concentrations, particularly around West Limasa and East Limasa.

Dolphins and Other Cetaceans as Indicators of North Misool's Ecological Importance



In addition to dugongs, studies in the North Misool MPA have recorded the presence of various cetacean species, including dolphins and whales. The species identified in the report include the spinner dolphin, bottlenose dolphin, and blue whale. The presence of these cetaceans indicates that North Misool is not only an important shallow coastal habitat for dugongs but also a significant part of a broader marine landscape for pelagic and semi-pelagic marine mammals.

Visual observations documented active behavior in cetaceans, such as spyhopping, hunting, and lobtailing. These behaviors indicate social activity, movement, and foraging activities within the study area. Sightings of bluefin tuna and whales were also recorded, reinforcing the idea that the waters around Misool may serve as an important corridor for the movement of large marine mammals. However, since this study was not designed as a survey of the cetacean population, the findings should be considered supplementary information on the area's ecological significance, rather than an assessment of dolphin or whale status.

Acoustic data also indicates the presence of dolphins in several study areas. Of the 176 ocean sound recordings analyzed, five showed sound patterns indicative of cetacean groups, including dolphins. Compared to dugongs, cetaceans tend to inhabit a broader and more dynamic range of habitats, extending from mid- to deep waters. In Area A4, the report documented the co-occurrence of dugongs and dolphins across various depth zones, while Area A8 recorded the presence of dolphins in deeper waters exceeding 50 m.

Priority Protection of Seagrass Habitat and Marine Mammal Range

The findings from the dugong study in North Misool indicate that a habitat-based approach is essential for managing of marine mammals. Dugongs are particularly drawn to clear, calm, shallow waters that are associated with seagrass meadows. Therefore, protecting these shallow seagrass habitats is critical for their survival. High concentrations of feeding trails and dugong sightings, especially in areas A1, A4, A5, A6, and A7, should be prioritized for dugong habitat conservation.

Coastal area management must consider the various threats facing the region, particularly since dugongs inhabit shallow to medium-depth waters that can be easily affected by human activities. These activities include fishing, maritime transportation, and development. It is essential to manage actions that could disrupt dugong habitats, such as high-speed boat traffic, increased water turbidity, and the use of destructive fishing gear, especially in areas that critical for dugong survival.

For cetaceans, including dolphins, conservation efforts should focus on the protection deeper-water ranges and corridors. Unlike dugongs, cetaceans typically inhabit deeper waters with stronger currents, and high dissolved oxygen levels. Therefore, marine mammal management strategies in North Misool must differentiate between two primary habitat needs: shallow seagrass meadows as dugong feeding habitat, and mid- to deep-water areas for cetacean ranges and movement corridors.

Interpretive Notes and Further Monitoring Needs

While this study provides important information on the presence of dugongs and other marine mammals in North Misool, careful interpretation of findings is essential. The available data come from a single study period in 2025 and use a combination of direct and indirect observation methods. These methods include visual observation, passive observation, and surveys, acoustic monitoring, feeding trail identification, aerial surveys, and underwater video. Therefore, findings are more suited for describing dugong presence, habitat utilization areas, and the relationship between dugongs and seagrass ecosystems, rather than for providing an absolute estimate of dugong population numbers.

Several indicators, such as feeding trails and sound recordings, provide valuable evidence of dugong habitat use and the presence of other marine mammals. However, these indicators cannot be directly converted into an exact count of individuals, as one dugong may create multiple feeding trails or be detected multiple times. Similarly, the data on dolphins and other cetaceans in this study should be considered supplementary information regarding the significance of North Misool waters for marine mammals, rather than as a basis for making quantitative conclusions about cetacean population status.

To enhance the assessment of the status of dugongs and other marine mammals in North Misool, it is essential to conduct regular follow-up monitoring using consistent methods. This includes repeated surveys in areas A1–A8, documentation of feeding trails, visual observations, aerial surveys, and passive acoustic monitoring. In addition, monitoring the quality of the aquatic environment will help identify changes in distribution, the intensity of habitat uses, and potential pressures on dugongs over time. Consequently, the results of the 2025 YKAN study will provide an important baseline for dugong habitat management and marine mammal protection in North Misool.



Status of Coastal Communities and Socio-Economic Well-being

The assessment of the coastal community's status and their socio-economic well-being of the BHS was conducted through a social monitoring program within the BHS conservation area. This program was initiated through a partnership between the University of Papua, Conservation International, and the World Wildlife Fund (WWF). Since 2010, routine monitoring of human well-being has been conducted in conservation areas in the BHS: Cenderawasih Bay National Park, Kaimana, Buruway, Etna Bay, Kofiau-Boo Islands, Misool Islands, Dampier Strait, Mayalibit Bay, and North Misool.

The University of Papua conducted household surveys of randomly selected, representative residents in each of the conservation areas. Data collected covered economic well-being, health, political empowerment, education, and culture. Monitoring intervals varied among conservation areas, generally ranging from two years in the earlier rounds to three or four years in later rounds. Baseline data were obtained from the 2010–2012 period. All statistical data in this section are sourced from the BHS social monitoring program, unless otherwise noted.

This report examines five human well-being attributes commonly used in public welfare policies, with one key indicator selected per attribute:

Economic well-being: The resources that people draw on to meet basic needs and the level of access to various sources of well-being (Sen, 1999).

Indicator: Household material assets

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

Indicator: Household food security

Political empowerment: The ability of people to participate in decision-making processes that affect their lives (United Nations Development Program et al., 2005)

Indicator: Household rights to marine resource management

Education: The structures, systems, and practices used for the transfer of knowledge and skills within a society (Stephanson & Mascia, 2014)

Indicator: School participation rate

Culture: Includes arts, ways of life, systems of values, traditions, and beliefs (UNESCO, 2001)

Indicator: Attachment to place

A detailed explanation of the Monitoring Indicators is provided in Appendix 18: Socio-Economic Monitoring Methods.

1. Economic Well-being: Household Material Assets

The household material asset indicator in the BHS shows dynamic economic well-being of coastal communities, with an increase during the initial monitoring period, then declining in subsequent years. The Dampier Strait consistently recorded the highest index value, indicating stronger household economic conditions than in other areas. However, the downward trend in the most recent period indicates that households' ability to maintain and renew assets remains constrained. This pattern emphasizes the importance of strengthening economic support and sustainable livelihoods to improve the resilience of coastal communities in conservation areas.

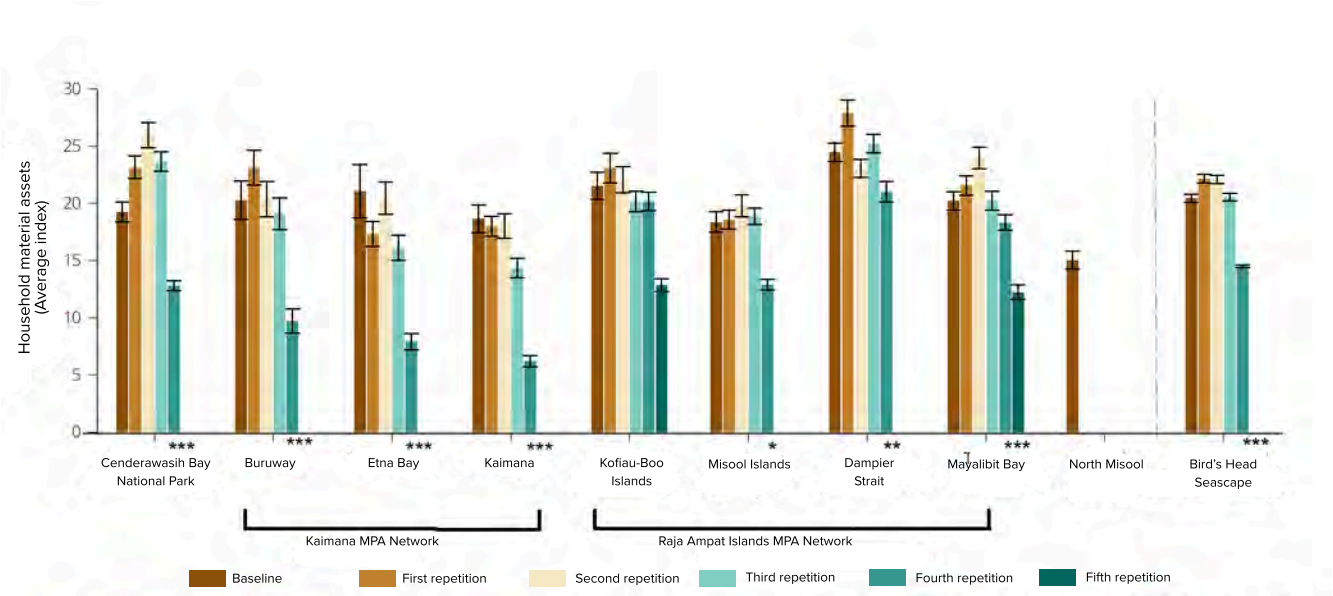


Figure 3.12 Household Material Asset Index Across BHS Conservation Area

Notes:
*** p<0.01 (Virtually certain); **p<0.05 (Extremely likely); *p<0.1 (Very likely) indicates a significant change in trend (up or down).

Initial and repeat monitoring years in each conservation area: Cenderawasih Bay National Park early 2010, Repeat monitoring 2012, 2014, 2017, 2023; Kaimana initial condition 2012, Repeat monitoring 2014, 2016, 2019, 2025; Kofiau-Boo Islands initial condition 2011, Repeat monitoring: 2013, 2015, 2018, 2021, 2025; Misool Islands initial condition 2011, Repeat monitoring 2013, 2015, 2018, 2023; Dampier Strait initial condition 2012, Repeat monitoring 2014, 2016, 2019, 2024; Teluk Mayalibit initial condition 2010, Repeat monitoring 2012, 2014, 2017, 2021, 2025; North Misool initial condition 2023.

The fifth-iteration data (2025) from the Kofiau-Boo Islands and Mayalibit Bay were not included in the BHS scale analysis.

In this study, household material assets are defined as physical household possessions that are in working condition, including electronic devices, communication devices, energy sources, transportation, and fishing assets (e.g., boats). A higher index indicates better asset ownership and quality, reflecting higher household economic well-being.

1. GENERAL TRENDS IN ECONOMIC WELL-BEING

- During the initial monitoring period of the BHS scale, the household material assets index increased from a baseline of 20.44 to 22.16 at the first repeat.
- There was a peak in the second repeat, but the index then declined in the third period and experienced a sharp drop in the fourth repeat, falling to 14.59.
- This pattern indicates that the economic well-being of coastal households improved at the start of the monitoring period but faced increasing challenges in the later periods.

2. DIFFERENCES IN STATUS BETWEEN AREAS AND IMPLICATIONS FOR MANAGEMENT

- In the most recent period (fourth and fifth repeats), the highest index values were recorded in the Dampier Strait, which had a value of 21.02, followed by North Misool at 15.04, Misool Islands at 12.89, and Kofiau-Boo Islands at 12.86. The most significant declines compared to the previous period were seen in Triton Bay at 6.21, Etna Bay at 7.90, and Buruway at 9.71.
- Field monitoring indicates that mobile phones and various types of boats — whether oar-powered, outboard-motorized, or fiberglass — are the most common household assets. Changes in asset ownership during the monitoring period are likely influenced by several factors, including income dynamics, the lifespan of production assets, purchasing power, environmental conditions, and economic access. This indicates that the MPA operates within a dynamic socio-economic context and changes in household well-being are affected not only by the management of conservation areas but also by a range of external factors.

1. Economic Well-being: Household Material Assets

Field Notes

The dynamics of the household material asset index in the BHS indicate that changes in asset ownership among coastal communities are influenced by multiple interrelated factors. One primary determinant is household income dynamics, particularly for those dependent on fisheries and other natural resources. When income declines, households prioritize meeting their basic needs, which limits their ability to purchase, build, or maintain productive assets.

Asset deterioration compounds this issue: boats, outboard motors, and other productive assets degrade over time and cannot be replaced due to economic constraints. This situation is further exacerbated by rising economic pressures, including higher prices and low household purchasing power, leading households to make purchases only for urgent needs. Furthermore, reductions or the discontinuation of assets in several areas have hampered asset accumulation previously supported by intervention programs.

Environmental conditions and limited market access also play significant roles. Adverse weather conditions, heavy rainfall, and limited market connectivity can disrupt fishing activities and agricultural production, reducing households' economic capacity to maintain assets. Overall, changes in the household material asset index in BHS reflect not only the community's economic conditions but also vulnerability to environmental pressures, market dynamics, and the level of institutional support.



Lopintol Village in Mayalibit Bay, Raja Ampat.
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2. Health: Household Food Security

Household food security in the BHS shows a dynamic pattern. It consistently increased during the initial monitoring period, peaked in the third iteration, and then declined again in the final period. This trend suggests that while households have improved their access to food and ability to meet nutritional needs, these gains are not yet fully stable and remain susceptible to economic and environmental challenges. These findings highlight that strengthening household food security is critical for supporting community well-being and the sustainability of conservation area management.

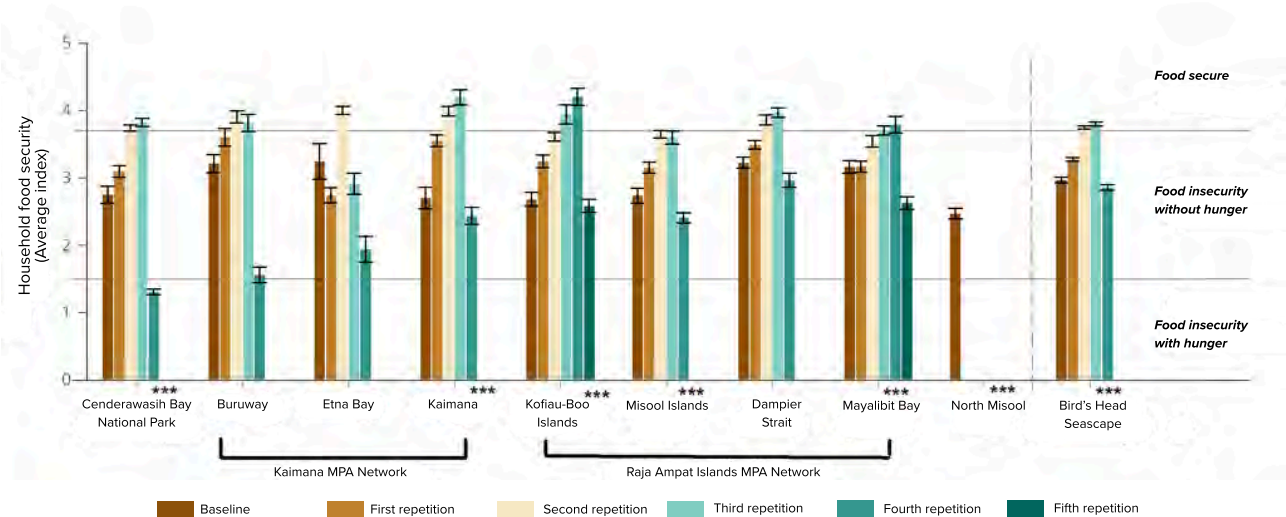


Figure 3.13 Household Food Security Index across BHS Conservation Areas

Notes:
*** p<0.01 (Virtually certain); **p<0.05 (Extremely likely); *p<0.1 (Very likely) indicates a statistically significant change in trend (upward or downward).
Initial and repeat monitoring years in each conservation area: Cenderawasih Bay National Park early 2010, Repeat monitoring 2012, 2014, 2017, 2023; Kaimana initial condition 2012, Repeat monitoring 2014, 2016, 2019, 2025; Kofiau-Boo Islands initial condition 2011, Repeat monitoring: 2013, 2015, 2018, 2021, 2025; Misool Islands initial condition 2011, Repeat monitoring 2013, 2015, 2018, 2023; Dampier Strait initial condition 2012, Repeat monitoring 2014, 2016, 2019, 2024; Teluk Mayalibit initial condition 2010, Repeat monitoring 2012, 2014, 2017, 2021, 2025; North Misool initial condition 2023.

The fifth-iteration data (2025) from the Kofiau-Boo Islands and Mayalibit Bay were not included in the BHS scale analysis.

Household food security status is classified on a scale with three categories:
(1) Food secure, which indicates that a household can reliably obtain nutritious, sufficient, and safe food through socially acceptable means;
(2) Food insecure without hunger, where households have concerns about the adequacy of their food supply, leading to changes in their consumption patterns. This often results in a decrease in food consumed, but without a significant reduction in the overall amount of food intake;
(3) Food insecure with hunger, which indicates that households have reduced food intake to the extent that members experience physical hunger.

1. GENERAL TRENDS IN FOOD SECURITY

- At the BHS scale, the household food security score increased from 2.97 in the base year to 3.28 in the first iteration, and then to 3.75 in the second repeat. The highest score of 3.80 was recorded in the third repeat, indicating that households were nearing the food-secure category.
- However, in the fourth repeat, the score declined to 2.87, indicating a deterioration in food security in the most recent monitoring period compared to previous years.
- Overall, BHS experienced improvements during the initial period but faced food security challenges in the final years of the monitoring period.

2. DIFFERENCES IN STATUS BETWEEN AREAS AND IMPLICATIONS FOR MANAGEMENT

- In the most recent period (fourth and fifth repeats), the highest food security value was recorded in the Dampier Strait (2.97), followed by Mayalibit Bay (2.63) and the Kofiau-Boo Islands (2.59).
- Conversely, the lowest food security values were recorded in Cenderawasih Bay National Park (1.31), Buruway (1.56), and Etna Bay (1.94). Other areas, such as North Misool (2.47), Triton Bay (2.44), and the Misool Islands (2.41) showed medium security levels but remained vulnerable.
- The differences in food security status among regions are likely influenced by factors such as access to food and markets, livelihood diversity, environmental and seasonal conditions, household economic capacity, and external support. To strengthen food security, which is essential for the well-being of coastal communities, it is crucial to focus on conservation area management, particularly by efforts to sustain coastal resources and enhance access to economic opportunities.

2. Health: Household Food Security

Field Notes

The dynamics of household food security status in the BHS indicate that households' ability to meet food needs is influenced by various interrelated factors. One of the key factors is access to food and markets. Many necessities, such as rice, sugar, cooking oil, and other food items, still rely on supplies from outside the region. Therefore, household food security is strongly affected by access to transportation, food distribution, fuel availability, and proximity to market centers. Households in areas with better market access tend to have more stable food security than those in relatively remote areas or those facing transportation challenges.

Furthermore, the diversity of livelihoods and food sources plays an important role in strengthening household food security. Livelihood diversity is also a key factor: households that combine fishing, gardening, trading, service work, and formal employment generally have a better capacity to adapt to economic pressures and seasonal disruptions than those relying on a single source of income. The availability of local food from the sea and gardens also serves as a buffer when market access is disrupted.

However, environmental and seasonal conditions pose significant challenges. High rainfall, windy seasons, rough seas, and adverse weather interrupt fishing activities, reduce garden yields, and disrupt inter-regional food distribution. In some locations, households cultivate gardens on separate or distant islands, making access to food crops difficult during periods of rough seas.

Moreover, household economic capacity and purchasing power greatly affect the household's ability to meet its food needs. Fluctuating food prices, low returns on seafood and agricultural products, and limited household income can reduce households' purchasing power, leading to dietary adjustments or reduced food quality. Household characteristics, such as the number of family members and high non-food expenditures, also influence the ability to provide adequate nutrition.

External support, including food aid and cash assistance at specific times, has helped strengthen household food security in several regions. Overall, changes in household food security status in the BHS are influenced not only by local food availability but also by market access, livelihood diversity, environmental conditions, household economic capacity, and the reliability of distribution systems and social assistance.



Auxiliary health center (Pustu) in Dusner Village, Wondama Bay.
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3. Political Empowerment: Household Rights to Marine Resources

Household perceptions of access rights and control over marine resources in the BHS show a recovery pattern following a decline in the middle monitoring period. While the latest index indicates improvement, the level of community management rights remains in the intermediate range and varies across areas, with the highest values recorded in Mayalibit Bay. These findings suggest that strengthening the recognition of access rights, clarifying utilization regulations, and inclusive governance remain critical to supporting effective management of conservation areas and the well-being of coastal communities.

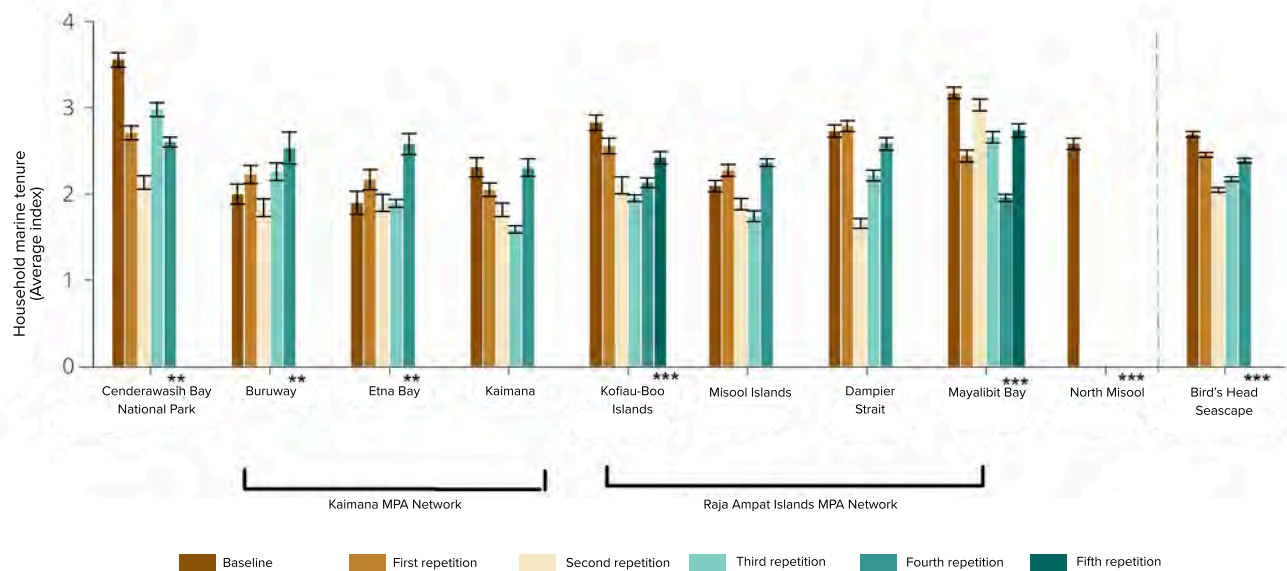


Figure 3.14 Index of Household Rights to Marine Resources Across BHS Conservation Areas

Notes:

*** p<0.01 (Virtually certain); **p<0.05 (Extremely likely); *p<0.1 (Very likely) indicates a statistically significant change in trend (upward or downward).

Initial and repeat monitoring years in each conservation area: Cenderawasih Bay National Park early 2010, Repeat monitoring 2012, 2014, 2017, 2023; Kaimana initial condition 2012, Repeat monitoring 2014, 2016, 2019, 2025; Kofiau-Boo Islands initial condition 2011, Repeat monitoring: 2013, 2015, 2018, 2021, 2025; Misool Islands initial condition 2011, Repeat monitoring 2013, 2015, 2018, 2023; Dampier Strait initial condition 2012, Repeat monitoring 2014, 2016, 2019, 2024; Teluk Mayalibit initial condition 2010, Repeat monitoring 2012, 2014, 2017, 2021, 2025; North Misool initial condition 2023.

The fifth-iteration data (2025) from the Kofiau-Boo Islands and Mayalibit Bay were not included in the BHS scale analysis.

The Marine Resource Rights Index measures the extent of household rights to marine resources, which includes access, utilization, management, and decision-making over the 12 months before data collection. This assessment is based on participation in marine resource governance. The index is scored on a scale of 0 to 5, with higher scores indicating greater household involvement in the management and decision-making processes related to marine resources.

1. GENERAL TRENDS IN HOUSEHOLD RIGHTS TOWARDS MARINE RESOURCES

- At the BHS scale, the household rights index for marine resources declined from 2.69 in the base year to 2.45 in the first iteration, reaching its lowest at 2.05 in the second repeat.
- The index then rebounded to 2.18 in the third repeat and further improved to 2.39 in the fourth repeat.
- This pattern indicates that community perceptions of access rights weakened in the middle monitoring period but have begun to recover in the latest monitoring. Overall, the BHS remains at a moderate level, showing a recovery trend that requires further strengthening.

2. DIFFERENCES BETWEEN AREAS AND MANAGEMENT IMPLICATIONS

- In the most recent period, the highest index values were observed at Mayalibit Bay (2.74), followed by Cenderawasih Bay National Park (2.60), Dampier Strait (2.59), North Misool (2.58), and Etna Bay (2.58). Intermediate values were recorded in Buruway (2.53) and Kofiau-Boo Islands (2.42). The lowest values were recorded at the Misool Islands (2.36) and Triton Bay (2.31).
- These differences observed indicate that access rights and tenure recognition for marine areas vary significantly across the BHS. This variation is believed to stem from several factors, including the degree of community reliance on marine resources, the strength of local customary institutions, the clarity of territorial boundaries, levels of participation in governance, and the management dynamics of conservation areas.

These findings underscore the importance of marine conservation area management in clarifying access rights and strengthening local institutions to support effective marine resource management.

3. Political Empowerment: Household Rights to Marine Resources

Field Notes

The dynamics of household rights to marine resources in the BHS reveal that the levels of recognition, access, and community involvement in the use and management of marine resources are shared by interrelated social, economic, and institutional factors. One significant factor is the profile of household livelihoods. Communities that are directly dependent on the marine sector — such as those engaged in fishing, marine product utilization, and coastal resource-based economic activities — tend to have greater involvement in accessing and making decisions about marine resources. In contrast, households that rely more heavily on wage-based employment or non-marine sectors often show lower levels of utilization and recognition of marine rights.

Furthermore, the strength of customary institutions and local rights systems, including customary rights, *petuanan*, customary territorial tenure over land and sea, clan-based rights, and ties to their villages of origin, also plays a crucial role in controlling marine space across different areas in the BHS. Many villages identify marine boundaries using natural landmarks, such as rivers, headlands, or islands, which reinforces the legitimacy of Indigenous Peoples' customary authority over these areas. However, the clarity and certainty of marine boundaries are essential in determining the implementation of household rights to marine resources. Changes in relationships between clans or villages, the lack of permanent boundaries, and the weak integration of customary rules with formal governance systems can lead to uncertainty in the recognition and management of marine areas.

On a positive note, community involvement in marine resource institutions and governance, including through management groups, village forums, and conservation institutions, has broadened the scope for community participation in decision-making and resource management. Changes in conservation area governance, resource access policies, and the implementation of community empowerment programs can also influence the level of recognition and implementation of community marine rights. Moreover, factors such as social history, intergroup relationships, and the degree of community interaction with the conservation area contribute to variations in the level of rights recognition across different villages.

Overall, these patterns indicate that the status of household rights to marine resources in the BHS is influenced not only by community dependence on these resources but also by the strength of customary institutions, the clarity of managed areas, involvement in governance, regional policy dynamics, and the integration of customary and formal governance systems. This integration is essential to ensure equitable and sustainable management of marine resources.

The drying process of ebi shrimp, an economically important fisheries commodity in Beo Village, Mayalibit Bay.

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4. Education: School Participation Rate

School participation in the BHS has been relatively high and stable, with consistent increases during the initial monitoring period, followed by a slight decline in recent years. This trend suggests that access to education at the household level remains generally strong but is vulnerable to socioeconomic pressures that could affect the sustainability of children's schooling. These findings underscore the importance of maintaining inclusive and sustainable access to education as part of strengthening the well-being of coastal communities in conservation areas.

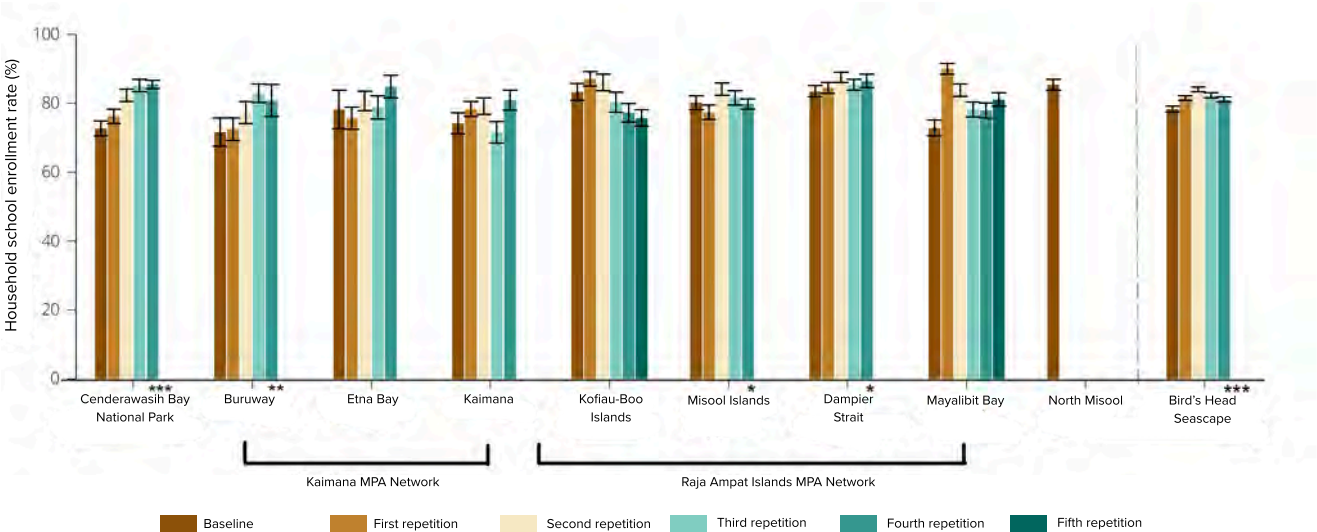


Figure 3.15 Average School Participation (%) Across BHS Conservation Areas

Notes:
*** p<0.01 (Virtually certain); **p<0.05 (Extremely likely); *p<0.1 (Very likely) indicates a statistically significant change in trend (upward or downward).

Initial and repeat monitoring years in each conservation area: Cenderawasih Bay National Park early 2010, Repeat monitoring 2012, 2014, 2017, 2023; Kaimana initial condition 2012, Repeat monitoring 2014, 2016, 2019, 2025; Kofiau-Boo Islands initial condition 2011, Repeat monitoring: 2013, 2015, 2018, 2021, 2025; Misool Islands initial condition 2011, Repeat monitoring 2013, 2015, 2018, 2023; Dampier Strait initial condition 2012, Repeat monitoring 2014, 2016, 2019, 2024; Teluk Mayalibit initial condition 2010, Repeat monitoring 2012, 2014, 2017, 2021, 2025; North Misool initial condition 2023.

The fifth-iteration data (2025) from the Kofiau-Boo Islands and Mayalibit Bay were not included in the BHS scale analysis.

This study measures the percentage of school-age children (ages 5–18) enrolled in formal education in each household.

1. GENERAL TRENDS IN SCHOOL PARTICIPATION

- At the BHS scale, school participation rates were 78.3% in the baseline year, rising to 81.5% in the first iteration and 84% in the second. However, it declined slightly to 82.3% in the third repeat and further to 81.8% in the fourth.
- Overall, the BHS maintained relatively high and stable school participation rates throughout most of the monitoring period, with a modest decline in the most recent years. This indicates that access to education is generally strong but remains vulnerable to socioeconomic pressures.

2. DIFFERENCES IN STATUS BETWEEN AREAS AND IMPLICATIONS FOR MANAGEMENT

- In the most recent period, the highest participation rates were recorded in the Dampier Strait (86.5%), followed by Cenderawasih Bay National Park (85.5%), North Misool (85.4%), and Etna Bay (84.8%). Intermediate values were observed in Mayalibit Bay (81.1%), Triton Bay (80.9%), Buruway (80.8%), and Misool Islands (79.8%). The lowest value was recorded in the Kofiau-Boo Islands (75.7%).
- Differences between conservation areas are likely influenced by several factors. These include the availability of educational facilities and services, access to qualified teaching staff, the overall quality of educational services, physical accessibility and transportation options, geographical conditions, household economic conditions, parental awareness, and social attitudes toward education. In addition, institutional support and educational programs play a crucial role in shaping these differences.

4. Education: School Participation Rate

Field Notes

The participation rates for children aged 5–18 in the BHS are influenced by a variety of interrelated structural, social, economic, and geographic factors that affect access to and the continuity of education.

One significant factor is the availability of educational facilities and services. Access to primary education is generally available in most villages; however, junior and senior secondary education remains concentrated in specific villages or administrative centers. As a result, some children must relocate to other villages or cities to continue their education and gain access to higher educational opportunities. In addition, the availability of qualified teaching staff and the continuity of educational services have a major impact on school participation rates, particularly in newly established villages or remote areas that lack adequate educational facilities.

Physical access and geographic conditions are significant constraints, especially in island regions that rely on sea transportation. Factors such as the distance to school, travel costs, weather conditions, and high wave seasons can limit student mobility and disrupt educational continuity. Household economic capacity also plays a role, especially when children must attend school outside their home village, which incurs additional transportation and accommodation costs. Social factors are equally important. Growing parental awareness of the value of education and family support for school continuity are key drivers of higher educational participation across regions. However, in some villages, social perceptions and household economic pressures still prevent education from being prioritized.

Institutional support, such as free schooling programs, educational assistance, village funds, and scholarship opportunities, helps to enhance access and continuity for school-age children.

Overall, changes in school participation rates for children aged 5 to 18 in the BHS are influenced not only by the availability of educational facilities, but also by geographic access, household economic conditions, social support, and the effectiveness of educational interventions in promoting equitable learning opportunities across villages.

YPK Bethel Deer Elementary School in Kofiau, Raja Ampat.
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5. Culture: Place Attachment

Community emotional attachment to marine areas in the BHS is generally high and relatively stable, though recent monitoring has indicated a downward trend in most areas. The highest levels of attachment recorded in the most recent period were found in Dampier Strait, Cenderawasih Bay National Park, and Etna Bay. These findings reflect the strong connection that communities have to marine spaces, which are integral to their identity, culture, and livelihoods. This underscores the importance of emotional attachment as a crucial form of social capital for the successful management of conservation areas, as it can enhance community ownership, awareness, and participation in protecting marine resources.

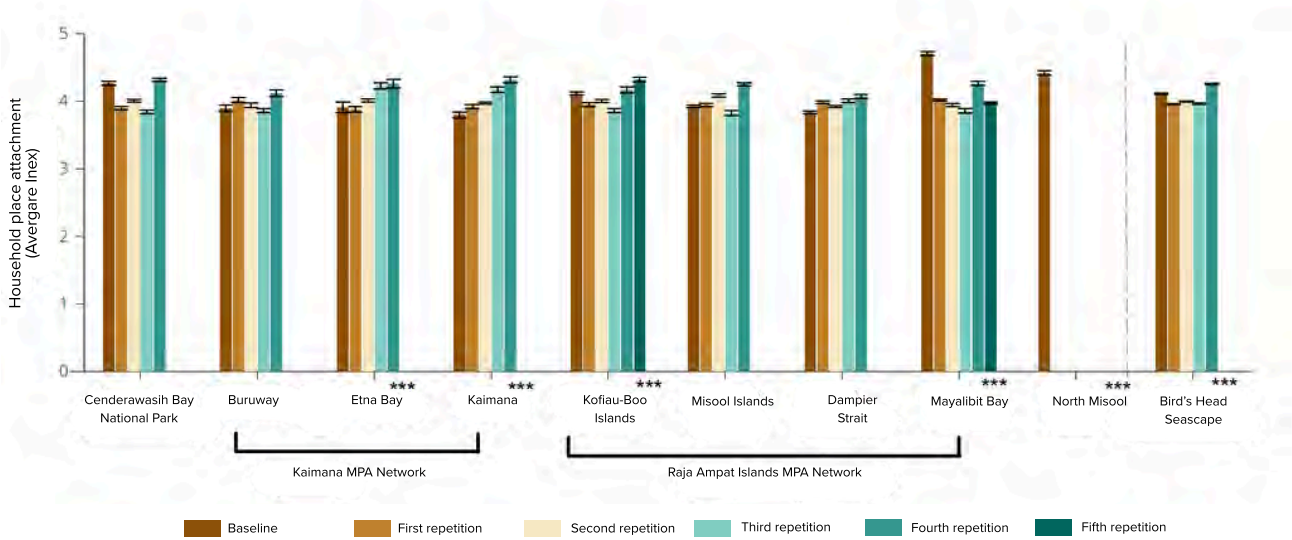


Figure 3.16 Average Household Emotional Attachment to Water Areas Across BHS Conservation Areas

Notes:
*** p<0.01 (Virtually certain); **p<0.05 (Extremely likely); *p<0.1 (Very likely) indicates a statistically significant change in trend (upward or downward).

Initial and repeat monitoring years in each conservation area: Cenderawasih Bay National Park early 2010, Repeat monitoring 2012, 2014, 2017, 2023; Kaimana initial condition 2012, Repeat monitoring 2014, 2016, 2019, 2025; Kofiau-Boo Islands initial condition 2011, Repeat monitoring: 2013, 2015, 2018, 2021, 2025; Misool Islands initial condition 2011, Repeat monitoring 2013, 2015, 2018, 2023; Dampier Strait initial condition 2012, Repeat monitoring 2014, 2016, 2019, 2024; Teluk Mayalibit initial condition 2010, Repeat monitoring 2012, 2014, 2017, 2021, 2025; North Misool initial condition 2023.

The fifth-iteration data (2025) from the Kofiau-Boo Islands and Mayalibit Bay were not included in the BHS scale analysis.

The Marine Resource Rights Index measures the extent of household rights to marine resources, which includes access, utilization, management, and decision-making over the 12 months before data collection. This assessment is based on participation in marine resource governance. The index is scored on a scale of 0 to 5, with higher scores indicating greater household involvement in the management and decision-making processes related to marine resources.

1. GENERAL TRENDS IN EMOTIONAL ATTACHMENT

- On the BHS scale, the emotional attachment score was at 4.11 in the base year. It then decreased to 3.96 in the first iteration, before rising slightly to 3.99 in the second repeat. In the third iteration, the score decreased again to 3.97. However, in the fourth iteration, the emotional attachment index experiences a significant increase, reaching 4.26, surpassing the base-year value.
- Overall, BHS showed high and stable levels of emotional attachment throughout most of the assessed period. This shows that people's access to the sea is strong but socio-economic pressures increasingly affect it.

2. DIFFERENCES BETWEEN AREAS AND MANAGEMENT IMPLICATIONS

- In the most recent period, the highest values were recorded in North Misool (4.42), Triton Bay (4.32) and Cenderawasih Bay National Park (4.32), Etna Bay (4.26), Misool Islands (4.25), Buruway (4.12), and Dampier Strait (4.07). The intermediate value is seen in Mayalibit Bay (3.97), and the lowest values were recorded in the Kofiau-Boo Islands (3.96).
- Differences between areas are believed to be influenced by various factors, such as length of residence in the area, historical connections to the region, and reliance on the sea for livelihoods. Moreover, the sea plays a significant role in shaping social and cultural identities. Other contributing factors include social change, mobility and access outside the village, the composition of the population and social dynamics within the community, as well as the importance of emotional ties in community-based conservation.

5. Culture: Attachment to Place

Field Notes

The dynamics of household emotional attachment to local waters in the BHS highlights that communities' relationships with the sea are shaped by interconnected social, cultural, economic, and experiential factors. One significant aspect is the length of residence and the historical connection to the area. Households that were born, raised, and have lived long-term in a village typically exhibit stronger emotional ties to the surrounding marine environment. In addition, being indigenous, having kinship ties, and maintaining intergenerational ties contribute to a deeper sense of belonging to local waters.

Livelihood dependence on the sea is also a significant factor affecting communities. Those whose daily activities are directly tied to the marine environment, such as fishing or using coastal resources, tend to have a stronger emotional attachment than households engaged in waged employment or non-marine sectors. In many areas, the sea is seen not only viewed as a source of livelihood but as a core element of social identity, cultural space, and community pride, and a living environment for coastal communities. This attachment gives the sea considerable social and emotional significance in people's lives.

However, social changes, increased connectivity beyond the village, advancements in communication technology, and shifts in attitudes of the younger generation have influenced how the community's emotional attachment to their marine areas has evolved over time. The presence of in-migrants with diverse occupational backgrounds and social networks also creates differences in attachment levels between villages, particularly in communities where daily life is not directly tied to the sea. Overall, the emotional attachment of the community to local waters in the BHS remains relatively strong and represents an important form of social capital for managing community-based conservation areas. Communities that feel emotionally connected to their marine areas tend to have a stronger sense of ownership, support local regulations, and play an active role in maintaining the sustainability of the surrounding marine resources.

The coastline of Tolobi Village in Kofiau, Raja Ampat.
© Marthinus Rumere (S4C LPPM UNIPA)



Arborek Island in the Dampier Strait MPA, Raja Ampat.
© Habema Monim (S4C LPPM UNIPA)

Portrait of Community Well-Being Monitoring in BHS: Dampier Strait MPA

Dampier Strait Conservation Area is a priority marine conservation area in Raja Ampat Regency, Southwest Papua Province. Located in the heart of the BHS, it is the second-largest marine conservation area in Raja Ampat, covering 353,531 hectares. This area features a rich and diverse marine ecosystem and is recognized as one of the world's centers of marine biodiversity. The area supports crucial habitats, including coral reefs, seagrass beds, and mangrove forests (Veron et al., 2009; Allen & Erdmann, 2009, 2012). These ecosystems serve as spawning, nursery, and refuge areas for various marine species, including those that are endemic and economically important to the livelihoods of coastal communities (Mangubhai et al., 2012).

The area was officially designated as a Marine Conservation Area through a decree issued by the Minister of Marine Affairs and Fisheries. This designation is part of Indonesia's commitment to protecting 10% of its total national waters (Directorate General of Natural Resources and Ecosystem Conservation, 2017). The primary management objectives include maintaining the sustainability of marine ecosystems, supporting the long-term viability of fisheries resources, and promoting economic growth in coastal communities. To achieve these goals, a zoning system has been established that includes a no-take zone, a utilization zone, and other zones to balance ecosystem protection with the sustainable use of marine resources.

The Dampier Strait Marine Reserve is managed collaboratively by the Regional Government through the Raja Ampat Regional Public Service Agency (BLUD UPTD KKPD), in partnership with Indigenous communities and conservation partners. However, there are ongoing challenges, including environmentally damaging fishing practices, pressure from tourism, and limited capabilities for patrol and surveillance. Since 2012, UNIPA has been implementing a periodic socioeconomic monitoring program that includes baseline surveys and ongoing assessments scheduled through 2024. This program aims to evaluate the impact of establishing conservation areas on community well-being and to document socio-economic changes over time (Glew et al., 2012).

In 2024, monitoring activities took place in 21 villages within the Dampier Strait Marine Conservation Area. The data collected covered demographics, food security, health, community participation in marine resource management, cultural values, household economics, asset ownership, marine resource use, and perceptions of climate and weather change. The methods employed combined household surveys with a participatory approach, ensuring the information obtained accurately reflected the community's socioeconomic conditions.

Portrait of Community Well-being Monitoring in the BHS: Dampier Strait MPA

HIGHLIGHT OF SOCIO-ECONOMIC TRENDS

 **Monitoring Period**
2012 • 2014 • 2016 • 2019 • 2024

1 KEY CHANGES (2012—2024)

HOUSEHOLD MATERIAL ASSETS

24,47 → 21,02
↓ Decreased by 14%
Household material assets declined throughout the 2012–2024 monitoring period

FOOD SECURITY

3,23 → 2,97
↓ Decreased by 8%
Food security declined to the *Mild Food Insecurity* category in 2024

HOUSEHOLD RIGHTS TO MARINE RESOURCES

2,73 → 2,59
↓ Decreased 5%
Access rights declined in 2016 but gradually recovered through 2024.

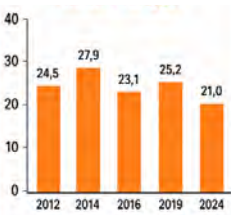
SCHOOL PARTICIPATION

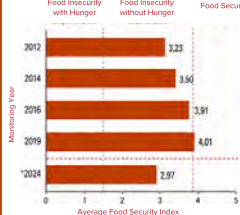
83,5% → 86,5%
↑ Increased by 3%
School participation remained consistently high, exceeding 84% throughout the monitoring period.

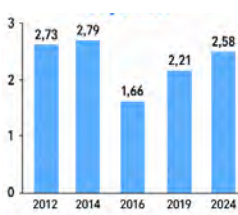
PLACE ATTACHMENT

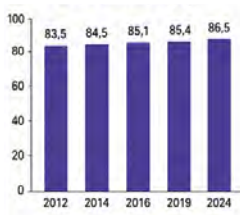
3,84 → 4,07
↑ Increased by 6%
The community's emotional attachment to the marine area continues to strengthen.

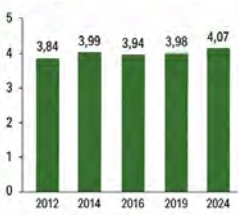
2 SOCIO-ECONOMIC INDICATOR TRENDS (AVERAGE INDEX)

HOUSEHOLD MATERIAL ASSETS

The index declined by 14%, from 24.47 to 21.02 in 2024.

FOOD SECURITY

The index declined by 8%, placing households in the *Mild Food Insecurity* category (2.97) in 2024.

HOUSEHOLD RIGHTS TO MARINE RESOURCES

The index declined sharply in 2016 but gradually recovered by 2024.

SCHOOL PARTICIPATION (%)

School participation increased by 3.0 percentage points, from 83.5% to 86.5% in 2024.

PLACE ATTACHMENT

The index increased by 6%, from 3.84 to 4.07 in 2024.

3 INTERPRETATION AND DISCUSSION

**Household Material Assets Declined**
The household material asset index decreased by 14%, from 24.47 (2012) to 21.02 (2024). This decline indicates increasing economic pressure on households, followed by fluctuations in income and living costs.

**Food Security Remains a Concern**
The food security index declined by 8%, reaching the *Mild Food Insecurity* category (2.97) in 2024. Food availability and accessibility require further attention.

**Household Rights to Marine Resources Improved**
Perceived household rights to marine resources declined in 2016 before improving during 2019–2024. These results highlight the importance of clear access arrangements and effective communication regarding resource management.

**School Participation Remains High**
School participation remained above 84% throughout the monitoring period and increased to 86.5% in 2024. Education continues to be a key strength within the community.

**Place Attachment Continues to Strengthen**
Community attachment to the marine environment continues to increase, reflecting strong social capital that supports collaborative management.



4

KEY LESSONS



Conservation continues alongside ongoing economic pressures experienced by households.



Food security requires more targeted support and interventions.



Perceptions of marine resource access rights influence community compliance and support for conservation.



High educational participation represents a long-term investment in community development.



Strong cultural and emotional ties to place remain a major asset for effective area management.

5

PRIORITY RECOMMENDATIONS



Increase the economic benefits of conservation for local communities through village-based tourism and sustainable fisheries.



Diversify household income sources beyond seasonal tourism.



Strengthen food security through home gardens, seafood processing, and improved market and transportation access.



Clarify and strengthen local communities' rights to access and use marine resource areas.



Build on community social capital as the foundation for collaborative monitoring and adaptive management.



RISK STATUS OF DAMPIER STRAIT MPA

ECONOMY



Needs attention

FOOD SECURITY



Watch

EDUCATION



Good

SOCIAL & CULTURAL



Very good

GOVERNANCE



Recovering

SCAN ME!



Scan the QR code to access the complete collection of social and ecological monitoring publications from the Bird's Head Seascape, Papua.



The Environmental Education (PLH) curriculum is delivered at the Wau-Weyaf Village learning house.
© Community Empowerment Program (S4C LPPM UNIPA)

Portrait of a Successful Conservation Area: Jeen Womom Coastal Park

Jeen Womom Coastal Park, Southwest Papua, under the LPPM UNIPA, has demonstrated an effective integrated approach through its Science for Conservation Program. This program links the protection of leatherback turtles (*Dermochelys coriacea*) with the economic and educational development of local communities. As a result, a thriving social ecosystem has been created alongside environmental conservation, grounded in tangible economic benefits and fostering a younger generation with strong environmental literacy.

There are five villages near Jeen Womom Coastal Park: Resye and Womom villages in Tobouw District, and Syukwo, Wau, and Weyaf villages in Abun District. Since 2010, LPPM UNIPA has collaborated with these communities on coconut development and educational activities for young people, which include socio-economic surveys and community mentoring. In 2025, the program expanded to Amberbaken district, reaching the villages of Waramui, Wefiani, Manggapnut, and Warpaperi.

Building Economic Capacity Through Local Resources

One of the key initiatives for economic development in this area is community-based coconut oil production. More than 100 community members are actively involved in processing coconuts into coconut oil. In 2021, these members received capacity-building support through the coconut processing and value-addition program. Over the span of 10 months, participants produced between 1,000 to 1,300 liters of coconut oil, earning between IDR 27,500 and IDR 30,000 per liter. These direct economic benefits have strengthened community acceptance and participation in leatherback turtle conservation.



Coconut oil production and sea turtle noken handicraft-making by local communities in Jeen Womom Coastal Park.
© Community Empowerment Program (S4C LPPM UNIPA)

Weaving Hope Through the Hands of the Women of Jeen Womom



Sea turtle noken handicrafts and turtle-shaped keychains.
© Community Empowerment Program (S4C LPPM UNIPA)

Community members at Jeen Womom Coastal Park are also supported in developing turtle-motif noken, traditional Papuan woven bags featuring turtle designs that celebrate the area's natural heritage. This initiative primarily involves women, who produce two to three bags each month, with a selling price ranging from IDR 80,000–100,000 per unit. In addition, turtle-shaped amigurumi keychains are being developed as another craft product. Both items are introduced through structured training and are supported throughout the entire production process.

Since 2020, the direct economic benefits to community members have steadily increased. Over a six-year period, the total direct economic benefits to the community in these villages reached IDR 5 billion. This amount was generated through various service provisions, including salaries for participation in turtle conservation activities, transportation, nest relocation, and other conservation programs.



Figure 3.17 Direct economic benefits to the community, Jeen Womom Coastal Park (excluding site Amberbaken)

Environmental Literacy From an Early Age

The Science for Conservation Program has also developed informal education through the Environmental Learning and Education House, which has benefitted over 250 children around Jeen Womom Coastal Park since its establishment 12 years ago. The program includes basic literacy, computer skills, and English, as well as an introduction to coastal ecosystems and sea turtles. By integrating academic and environmental education, the program aims to raise conservation awareness from an early age and prepare the next generation to be environmentally literate and supportive of community-based conservation efforts.

The Science for Conservation program operates in formal schools in villages near Jeen Womom Coastal Park, addressing the shortage of local teaching staff. The program team delivers curriculum-based materials tailored to the area's coastal and environmental conditions. This initiative also helps identify children who need extra support, and those students are then referred to the Learning Center for further assistance.



Teaching activities at the learning house.
© Community Empowerment Program (S4C LPPM UNIPA)

CHAPTER 4

Governance for the Future of Papua's Seas

"Achieving Effective Conservation Through an Inclusive and Measurable Area Management System"

Conservation area governance in the BHS is implemented through a formal management system, effectiveness of assessment, marine resource governance, and recognition of customary conservation practices such as sasi laut. Currently, the BHS comprises 17 conservation areas with management authority shared among the central government, provincial governments, and Indigenous community-based managers. The governance assessment indicates that community participation, resource utilization regulations, monitoring, enforcement, and conflict resolution are critical factors in determining management effectiveness.

This section also confirms that sasi laut has evolved from a local customary practice into a vital component of conservation governance, increasingly documented, organized, and relevant to the future of the management of Papua's marine conservation areas.

A group of people are sitting on a bamboo floor, looking at a map and discussing conservation areas. One person is holding a small electronic device. There are various items on the floor, including a yellow folder, a blue folder, a white sheet of paper, and some markers. The background shows a wooden wall and some bags.

The governance of conservation areas in the BHS is built on a strong institutional foundation through the conservation area network, the EVIKA (Evaluation of the Effectiveness of Conservation Area Management) mechanism, monitoring of marine resource governance, and recognition of customary practices such as sasi laut.

However, there is still a need to strengthen management effectiveness. Community participation remains inconsistent, monitoring and enforcement systems vary across regions, and coordination among various authorities remains a challenge. Moving forward, governance in the BHS needs to move beyond simply designating areas to adapting more inclusive, measurable, data-driven management practices that connect formal policies with the rights and practices of Indigenous communities.

Focus Group Discussion in the Dampier Strait MPA, Raja Ampat.
© Dahlia Menufandu (S4C LPPM UNIPA)



Sunset view of Namatota Village in Kaimana.
© Habema Monim (S4C LPPM UNIPA)

Management of Marine Protected Areas in the BHS

Marine conservation areas in the BHS have been established since 2003. Several Regional Marine Protected Areas (KKLD) have been declared, through customary law by local communities as well as through official recognition by regional and national governments. To date, there are 17 MPAs in the BHS, including designated and reserved areas, covering over 5.2 million hectares.

The management of conservation areas, in accordance with regulations, is a shared responsibility between national and regional governments, each operating within its respective management authority. This process is conducted in collaboration with relevant conservation partners.

For conservation areas governed by provincial authorities, management is implemented through various mechanisms. Some of these areas are designated Regional Public Service Agency (BLUD), while others function as Regional Technical Implementing Unit (UPTD). Currently, in line with directives from the Ministry of Marine Affairs and Fisheries (KKP) and the Ministry of Home Affairs, there is an expectation that conservation area management will adopt BLUD status to improve management effectiveness.

In addition to the previously mentioned conservation areas, several customary-based natural resource management initiatives in Papua have been established and strengthened. Although these initiatives are informal, they are managed by communities using traditional mechanisms and wisdom passed down through generations. This approach receives support and recognition from the government. One notable practice is *sasi laut*, a system for regulating access to and utilization of coastal and marine resources based on customary law. Several customary law community management areas (Masyarakat Hukum Adat - MHA) have also been established in the BHS area to enhance effective governance of marine resources.

Marine Protected Area Management Status in the BHS

The conservation areas in the BHS are currently divided into several categories and types with their respective management statuses, namely:

1. Ministry of Forestry

1. Cenderawasih Bay National Park (TNTC), managed by the Teluk Cenderawasih National Park Authority
2. Venu Island Wildlife Sanctuary, managed by the Ministry of Environment and Forestry-West Papua Natural Resources Conservation Center
3. Sabuda Tataruga Island Wildlife Sanctuary, managed by the Ministry of Environment and Forestry-West Papua Natural Resources Conservation Center
4. Kofiau Marine Nature Reserve, managed by the West Papua Natural Resources Conservation Center
5. Bintuni Bay Nature Reserve, managed by the West Papua Natural Resources Conservation Center

2. Ministry of Marine Affairs and Fisheries

1. Padaido Islands Marine Tourism Park and Surrounding Seas, managed by the Kupang Marine Management Center.
2. Parks in the Waters of the Western Waigeo Islands and Surrounding Seas, managed by the Kupang Marine Management Center.
3. Parks in the Waters of the Raja Ampat Islands and Surrounding Seas, managed by the Kupang Marine Management Center.

3. Provincial Government

1. Marine Parks in the Biak Numfor Region, managed by the Papua Regional Government through the Department of Marine Affairs and Fisheries of Papua.
2. Jeen Womom Coastal Parks, managed by the Southwest Papua Regional Government through the Jeen Womom Coastal Park Regional Technical Implementing Unit (UPTD).
3. Parks in the Waters of the North Misool Region of the Raja Ampat Islands managed by the Southwest Papua Regional Government, through the Regional Public Service Agency Regional Technical Implementing Unit (BLUD UPTD) Raja Ampat MPA Management.
4. Parks in the waters of the Raja Ampat Islands in West Papua Province, managed by the Southwest Papua Regional Government through the Regional Public Service Agency Regional Technical Implementing Unit (BLUD UPTD) Raja Ampat MPA Management.
5. Park of A Thousand and One Rivers of Teoenebikia in the South Sorong Waters, managed by the Regional Government of Southwest Papua, through the Department of Marine Affairs and Fisheries of Southwest Papua.
6. Berau Bay Coastal Park and Nusalasi-Van Den Bosch Bay Coastal Park in Fakfak, managed by the West Papua Regional Government through the Regional Public Service Agency Regional Technical Implementing Unit (BLUD UPTD) Kaimana-Fakfak.
7. Marine Tourism Park of Buruway, Arguni, Kaimana, and Teluk Etna in Kaimana, managed by the West Papua Regional Government through the Regional Public Service Agency Regional Technical Implementing Unit (BLUD UPTD) Kaimana-Fakfak.

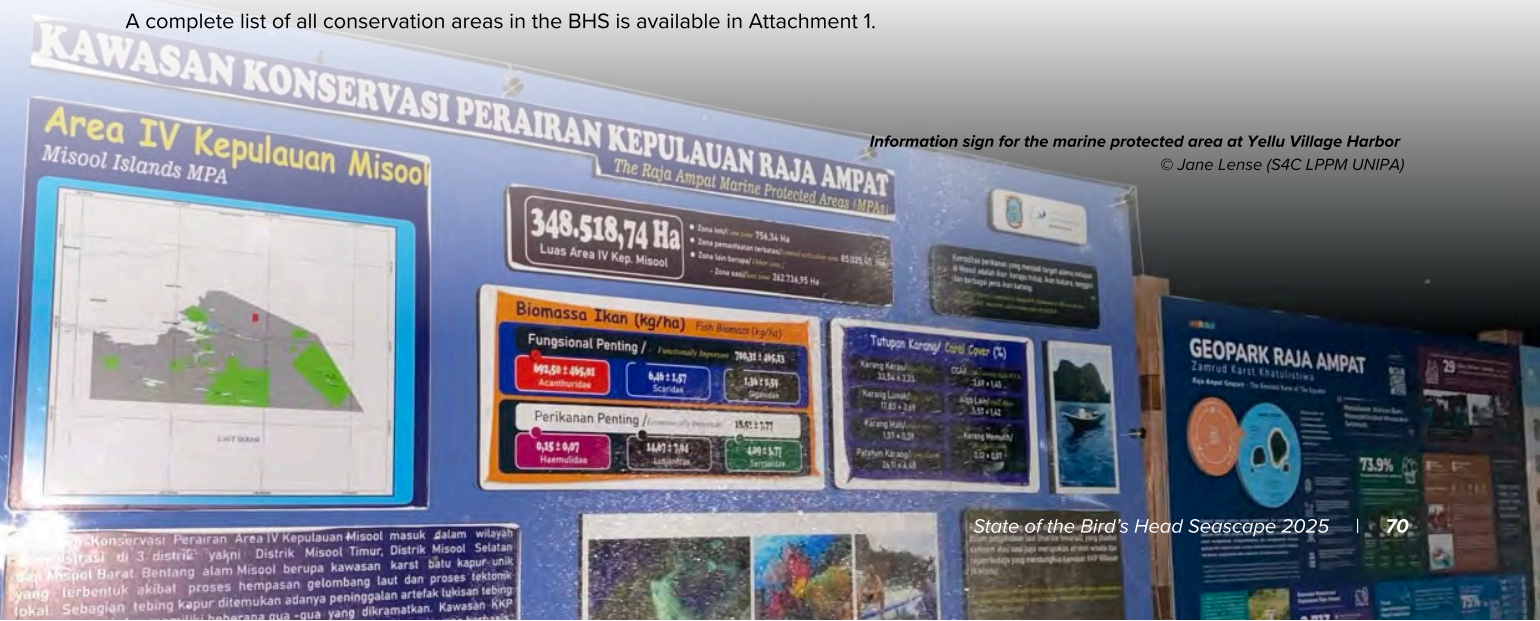
Apart from the 7 MPAs above, which are managed by the Regional Government, there are 2 Conservation Area initiatives which still have reserve status, namely:

1. TCBFM (Traditional Community-Based Fisheries Management Bintuni) in West Papua Province
2. Prospective Maksegara Regional Conservation Area, in Southwest Papua Province

4. Customary Law Community (MHA) Managed Area

1. Customary Law Community (MHA) Werur in Tambrauw Regency
2. Customary Law Community (MHA) Mpur Wot in Tambrauw Regency
3. Customary Law Community (MHA) Malaumkarta in Sorong Regency
4. Customary Law Community (MHA) Aara Napiti Tribe in Kaimana Regency

A complete list of all conservation areas in the BHS is available in Attachment 1.



Information sign for the marine protected area at Yellu Village Harbor
© Jane Lense (S4C LPPM UNIPA)



*The coastline of Urbinasopen Village in Raja Ampat.
© Jennifer Maleke (S4C LPPM UNIPA)*

Marine Resource Governance

Alongside welfare monitoring, the BHS social monitoring program tracks patterns and trends in marine resource governance across eight conservation areas: Dampier Strait, Kofiau-Boo, Southeast Misool, Mayalibit Bay, Buruway Bay, Kaimana, Etna Bay, and Cenderawasih Bay National Park.

Marine resource governance involves the management processes of marine resources, which include how decision-making authority is allocated, how management decisions are made, and how those decisions are enforced (Mascia et al., 2017). The way resources are governed can significantly affect the social and ecological outcomes of policy interventions such as the establishment of conservation areas (Persha et al., 2011; Fox et al., 2011). Successful governance regimes often share key characteristics (Ostrom, 1990). These include participatory decision-making mechanisms, context-appropriate regulations, active and accountable systems for monitoring and enforcing rules, and affordable conflict-resolution mechanisms, such as inexpensive, rapid, and on-the-spot dispute-resolution processes. Focus group discussions (FGDs) and key informant interviews (KIs) were conducted in each monitored settlement to understand marine resource governance in the conservation areas. These methods focused on how marine resource management decisions are made, the rules that govern the resources, how management is monitored and enforced, and how conflicts over marine resources are resolved.

About half of the monitored settlements participated in these discussions every two years. This process enables a comprehensive assessment of marine resource governance every four years. In the first edition of the BHS's Household Network Status Report, we document the status of resource governance based on 148 FGDs and KIs in eight MPAs across the seascape. This report presents the governance status and trends based on four key attributes of marine resource governance within the BHS. A full description of the governance data collection protocol is provided in Appendix 20: Marine Resource Governance Monitoring Methods.

PARTICIPATION IN DECISION MAKING

User groups that engage in decision-making have been associated with positive social and ecological outcomes in various contexts (Ostrom, 1990; Persha et al., 2011). We monitored the percentage of user groups—such as individuals who use marine resources in similar ways—that participated in creating marine resource management rules across the eight monitored conservation areas.

Indicator: participatory decision-making.

RESOURCE USE RULES

Rules that are locally based and specify when, where, how, or by whom resources can be used are more likely to produce positive social and ecological outcomes than those that are not tailored to local conditions (Ostrom, 1990). We monitored the proportion of important species and habitats, as identified through FGDs, that had specific use rules in the eight MPAs monitored. Species and habitats were considered 'important' based on their economic, cultural, and spiritual values.

Indicator: rules tailored to specific conditions

MONITORING AND ENFORCEMENT OF RULES

Governance systems that implement graduated sanctions, for example, penalties that become more severe depending on the type of violation, are more likely to achieve positive social and ecological outcomes than systems that do not impose any sanctions or that apply a single sanction for different violations.

Indicator: sanctions imposed

CONFLICT RESOLUTION

The ability of users and officials to resolve disputes over marine resources or their management quickly and affordably has been found to be associated with more positive social and ecological outcomes (Ostrom, 1990). We monitored the average time required to resolve conflicts between users and between users and officials in eight MPAs across the surveyed seascape.

Indicator: accessible and Affordable conflict resolution mechanisms

Marine Resource Governance

1. Participation

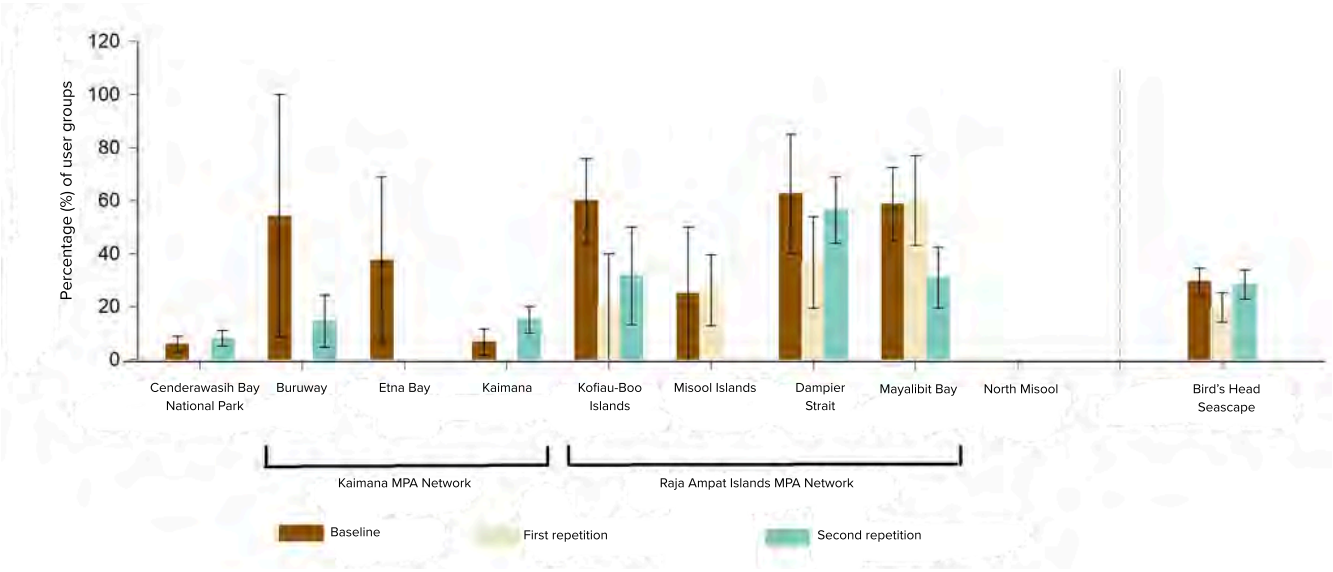


Figure 4.1 Comparison of participation among resource user groups in establishing resource use rules

Notes:

Initial and repeat monitoring years in each conservation area: Cenderawasih Bay National Park early 2010, Repeat monitoring 2012, 2014, 2017, 2023; Kaimana initial condition 2012, Repeat monitoring 2014, 2016, 2019, 2025; Kofiau-Boo Islands initial condition 2011, Repeat monitoring: 2013, 2015, 2018, 2021, 2025; Misool Islands initial condition 2011, Repeat monitoring 2013, 2015, 2018, 2023; Dampier Strait initial condition 2012, Repeat monitoring 2014, 2016, 2019, 2024; Teluk Mayalibit initial condition 2010, Repeat monitoring 2012, 2014, 2017, 2021, 2025; North Misool initial condition 2023.

- At the BHS scale, baseline data recorded an average user participation rate of 30.98% ± 5.06. This rate decreased to 19.59% ± 5.09 during the first iteration. In the second iteration, participation values increased to 26.95% ± 5.71. This pattern indicates that community involvement declined; it began to recover in the most recent monitoring period. However, the participation rate in the second iteration remained below the initial level. Overall, regional participation is moderate and requires ongoing efforts to strengthen further.
- In the second iteration, the highest participation rate was recorded in the Dampier Strait (56.35%), followed by the Kofiau-Boo Islands (31.54%), Mayalibit Bay (30.89%), and the Misool Islands (30%). Areas with medium participation rates included Kaimana (15%) and Buruway (14.44%). Meanwhile, several areas recorded low participation or had no available data, including the Misool Islands, North Misool, and Cenderawasih Bay National Park. North Misool does not yet have sufficient data to assess changes between monitoring periods. These disparities suggest that community involvement is not evenly distributed across the BHS. The variation may reflect differences in program intensity, accessibility, and local institutional capacity.
- When comparing different time periods, several areas showed increased participation in the second iteration. Notably, Dampier Strait, increased from 36.57% to 56.35%, Kofiau-Boo rose from 20% to 31.54%, Buruway went from 0% to 14.44%, and Kaimana grew from 0% to 15%. In contrast, Mayalibit Bay decreased from 60% to 30.89%, while Misool dropped from 26.19% to 0%. Cenderawasih Bay National Park experienced a slight increase from 0% to 7.98% in the most recent period. However, several other areas lack comprehensive data, making it difficult to draw definitive conclusions about long-term trends. In general, patterns of user participation show considerable regional variation and are strongly influenced by local conditions in each area.
- Monitoring results indicate that community participation in conservation area management is dynamic but inconsistent across different regions. Increasing participation may be associated with active communication, sustained field facilitation, and more open consultation processes. In contrast, regions experiencing a decline in participation require attention. Revitalizing village forums, involving key user groups, and ensuring greater transparency in decision-making are essential for improvement. Area managers must also ensure that community participation goes beyond mere attendance and has a meaningful influence on management policies. In future monitoring, this indicator should be supplemented with measures of participation quality, frequency of involvement, and representation of vulnerable groups.

Marine Resource Governance

2. Monitoring and Enforcement of Rules

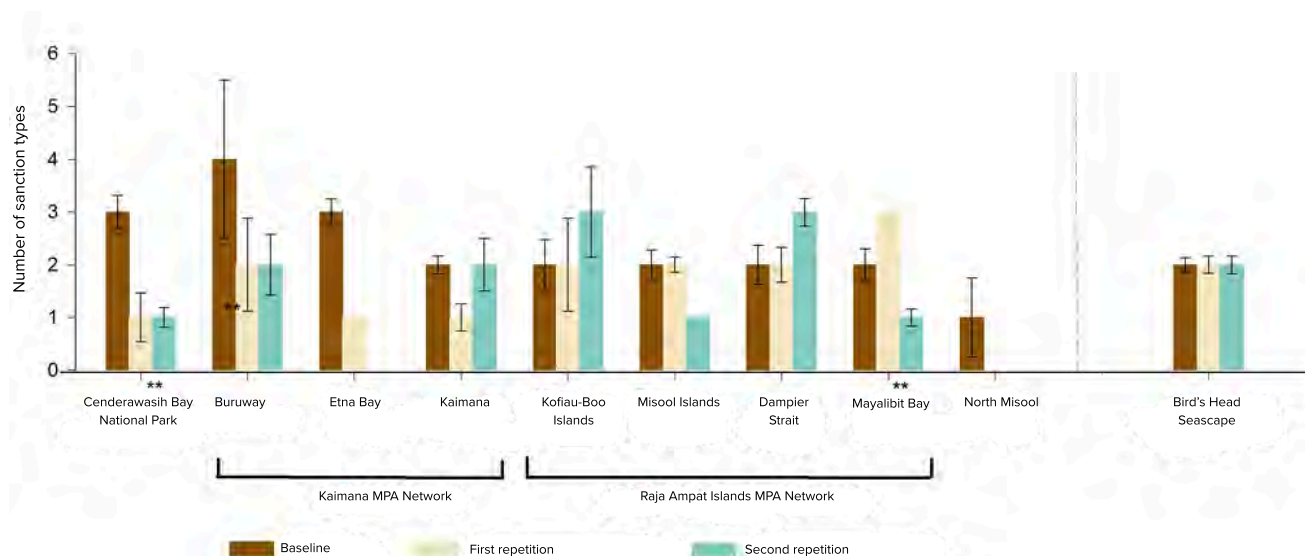


Figure 4.2 Number of Sanctions Issued to Encourage Compliance with Resource-Use Rules

Notes:

Initial and repeat monitoring years in each conservation area: Cenderawasih Bay National Park early 2010, Repeat monitoring 2012, 2014, 2017, 2023; Kaimana initial condition 2012, Repeat monitoring 2014, 2016, 2019, 2025; Kofiau-Boo Islands initial condition 2011, Repeat monitoring: 2013, 2015, 2018, 2021, 2025; Misool Islands initial condition 2011, Repeat monitoring 2013, 2015, 2018, 2023; Dampier Strait initial condition 2012, Repeat monitoring 2014, 2016, 2019, 2024; Teluk Mayalibit initial condition 2010, Repeat monitoring 2012, 2014, 2017, 2021, 2025; North Misool initial condition 2023.

- At the BHS scale, the average number of sanctions in the baseline data was 1.89 ± 0.12 . This number decreased to 1.50 ± 0.16 in the first iteration and slightly further to 1.43 ± 0.17 in the second iteration. This pattern suggests that the number of sanction mechanisms implemented or recognized by the communities tends to decline over time. Such a decline may indicate a weakening of the monitoring system, simplification of the sanctions regime, or a decrease in community understanding of relevant regulations. Overall, the BHS trend highlights a need to strengthen the site-level monitoring and enforcement systems.
- Based on the second-repeat survey data available for each area, the highest value was recorded in the Kofiau-Boo Islands (2.75), followed by Dampier Strait (2.14), Buruway (2.00), and Kaimana (1.50). North Misool recorded a baseline value of 0.75 in 2023, but no repeat data are yet available to assess temporal change. Several other areas recorded relatively low values or did not yet have data from the latest monitoring round, including Cenderawasih Bay National Park (1.00). The differences among MPAs indicate that the effectiveness of rule enforcement is uneven across the BHS. Higher scores represent a more active monitoring and violation-handling system.
- When compared across time periods, several areas showed increases in the second iteration. Notably, Kofiau-Boo rose from 1.67 to 2.75, Dampier Strait increased from 1.50 to 2.14, and Kaimana went from 1.00 to 1.50. Conversely, significant decreases occurred in Mayalibit Bay, which fell from 3.00 to 0.91; in Misool, which fell from 1.86 to 1.00; and in Buruway, which dropped from 4.00 at baseline to 2.00 in the latest period. Cenderawasih Bay National Park showed a slight increase, rising from 0.86 to 1.00. Overall, regional trends vary, influenced by local institutional capacity, patrol intensity, and management support at each location. This indicates that the sustainability of regulation enforcement remains highly dependent on the specific conditions of each region.
- Monitoring and enforcing regulations are crucial to ensuring compliance with conservation area rules. The decline in scores across several areas indicates the need for more routine patrols, re-education on the area regulations, and clearer sanction mechanisms at the village and regional levels. Areas that demonstrate improvement can serve as models of best practices, particularly in fostering collaboration among area managers, village governments, and indigenous communities.
- Beyond the number of sanctions issued, the effectiveness of enforcement should also be assessed through compliance levels, the resolution of violations, and community perceptions of the fairness of the regulations. In the upcoming monitoring period, it is recommended that these indicators be enhanced with data on the frequency of supervision and the procedure for following up on violations.

Marine Resource Governance

3. Conflict Resolution

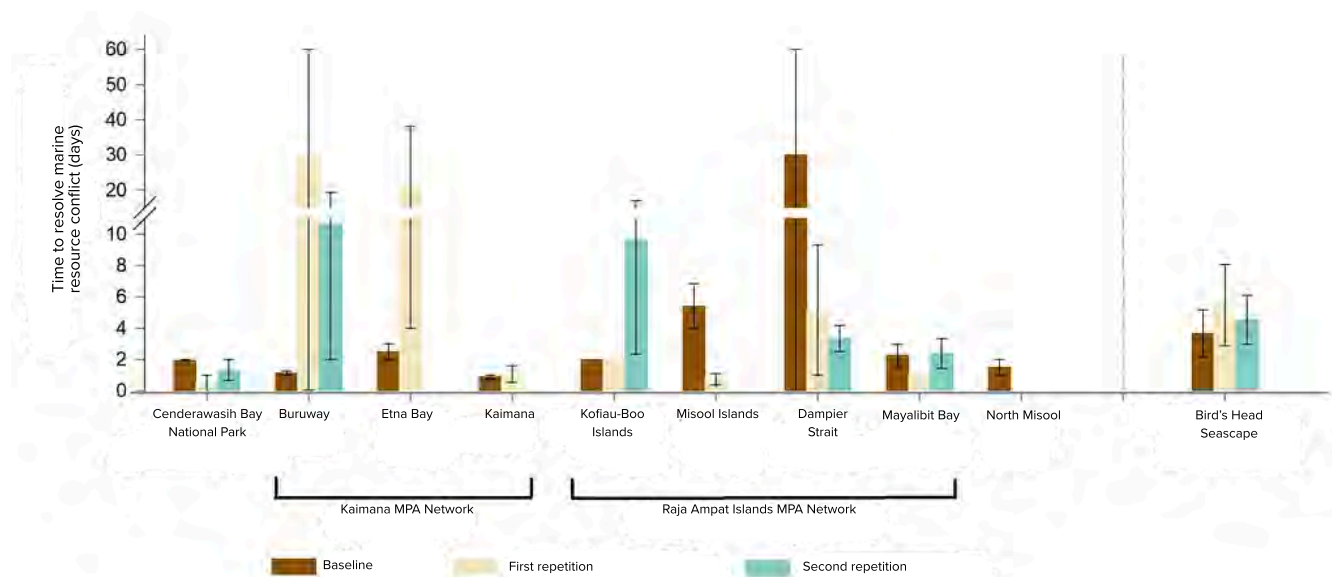


Figure 4.3. Average Time Required to Resolve Conflicts

Notes:

Initial and repeat monitoring years in each conservation area: Cenderawasih Bay National Park early 2010, Repeat monitoring 2012, 2014, 2017, 2023; Kaimana initial condition 2012, Repeat monitoring 2014, 2016, 2019, 2025; Kofiau-Boo Islands initial condition 2011, Repeat monitoring: 2013, 2015, 2018, 2021, 2025; Misool Islands initial condition 2011, Repeat monitoring 2013, 2015, 2018, 2023; Dampier Strait initial condition 2012, Repeat monitoring 2014, 2016, 2019, 2024; Teluk Mayalibit initial condition 2010, Repeat monitoring 2012, 2014, 2017, 2021, 2025; North Misool initial condition 2023.

- In the baseline data at the BHS scale, the average time taken to resolve conflicts was 6.60 ± 3.10 days. This time decreased to 5.47 ± 2.61 days in the first iteration and further declined to 4.31 ± 1.46 days in the second iteration. This gradual decrease indicates that conflicts are being resolved more quickly at the regional level than in the previous period. This improvement suggests a rise in mediation capacity, enhanced coordination among parties, or a more effective conflict management mechanism. Overall, the BHS trend reflects positive developments in the effectiveness of conflict resolution.
- In the second iteration, the longest conflict resolution times were recorded in Buruway (10.67 days) and the Kofiau-Boo Islands (9.63 days). Intermediate values were observed in the Dampier Strait (3.33 days), Mayalibit Bay (2.38 days), and North Misool (1.50 days). Areas with relatively short conflict-resolution times included Cenderawasih Bay National Park (1.33 days) and Kaimana (0 days), indicating either no cases or very rapid conflict resolution during that period. The differences between regions indicate that the complexity of conflict and local institutional capacity significantly influence the speed of resolution. Areas with longer resolution times require more attention to prevent prolonged conflict.
- When comparing different time periods, several regions showed significant improvements. In Dampier Strait, the duration decreased from 30 days in the baseline to 3.33 days in the second iteration. Similarly, North Misool showed a decrease from 27.60 days to 1.50 days. However, there is no recent data available for Etna Bay, making it impossible to draw conclusions about trends in that area. On the other hand, Kofiau-Boo experiences an increase from 2 days in the previous period to 9.63 days, suggesting a more complex conflict or a longer resolution process. Overall, trends across the conservation areas indicate that most regions have been more effective, though some locations still need to strengthen their conflict-resolution mechanisms.
- The ability to resolve conflicts quickly and fairly is a crucial component of effective conservation area governance. The decrease in average conflict-resolution time in the BHS demonstrates progress in the mediation system and in stakeholder coordination. However, areas with longer resolution times, such as Buruway and Kofiau-Boo, should be prioritized. This can be achieved by strengthening local mediation forums, involving traditional leaders, and clarifying dispute-resolution procedures. Successful practices from areas that have effectively reduced conflict-resolution times can serve as models for other locations. In future monitoring, this indicator should be enhanced with information on the type of conflict, the level of resolution, and stakeholder satisfaction with the mediation outcome.

Marine Resource Governance

4. Regulations on the Use of Marine Resources

The BHS shows a positive trend in the regulation of marine resource use, encompassing both species and critical habitats. At the regional level, the number of species that are specifically regulated has increased in the most recent assessment compared to the previous one, while the number of regulated habitats remained relatively stable. Regarding habitats, the average coverage increased from 3.28 habitats in the baseline data to 3.53 in the second iteration, although it was higher in the first iteration. This suggests there is a strong community and management focus on protecting marine resources. Overall, governance of marine resource utilization in the BHS is improving and becoming more adaptive to conservation needs. Detailed data on governance monitoring results for each conservation area and monitoring period are available in Appendix 21: Marine Resource Governance Data.

1. Comparison of Specially Regulated Species

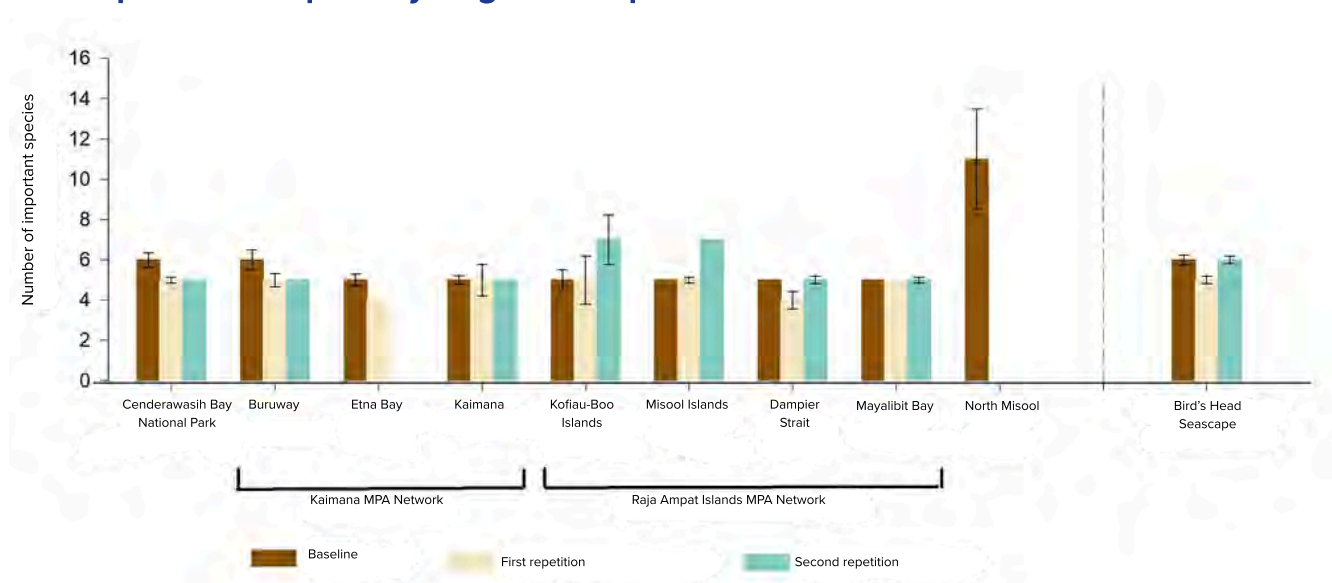


Figure 4.4. Comparison of Specially Regulated Species

Notes:

Initial and repeat monitoring years in each conservation area: Cenderawasih Bay National Park early 2010, Repeat monitoring 2012, 2014, 2017, 2023; Kaimana initial condition 2012, Repeat monitoring 2014, 2016, 2019, 2025; Kofiau-Boo Islands initial condition 2011, Repeat monitoring: 2013, 2015, 2018, 2021, 2025; Misool Islands initial condition 2011, Repeat monitoring 2013, 2015, 2018, 2023; Dampier Strait initial condition 2012, Repeat monitoring 2014, 2016, 2019, 2024; Teluk Mayalibit initial condition 2010, Repeat monitoring 2012, 2014, 2017, 2021, 2025; North Misool initial condition 2023.

- In the second iteration, the highest number of regulated species was recorded in North Misool (11 species), which is significantly higher than in other areas. The Kofiau-Boo Islands (7 species) and the Misool Islands (7 species) both recorded the next highest numbers. Most other areas had around 5 species, including Buruway, Dampier Strait, Mayalibit Bay, Kaimana, and Cenderawasih Bay National Park. Some periods saw lower values in Dampier Strait, with only 4 species, but this increased again in the most recent period. This variation observed across different conservation areas suggests that species management priorities are strongly influenced by local context, utilization pressures, and the strength of local community regulations.
- When comparing different time periods, several areas showed an increase in the number of species that are specifically regulated. North Misool increased sharply from 5 species in the baseline data to 11 in the second iteration, indicating expanded regulations. The Kofiau-Boo Islands increased from 4.5 to 7 species, while the Misool Islands increased from 5 to 7 species. In contrast, some areas, such as Buruway, decreased slightly from 5.5 to 5 species, although these levels remained relatively high. Other locations, including Kaimana, Mayalibit Bay, and Cenderawasih Bay National Park, showed stability, suggesting that while the species regulation system is well established, it has not developed significantly yet.

Marine Resource Governance

4. Regulations on the Use of Marine Resources

2. Comparison of Specially Regulated Habitats

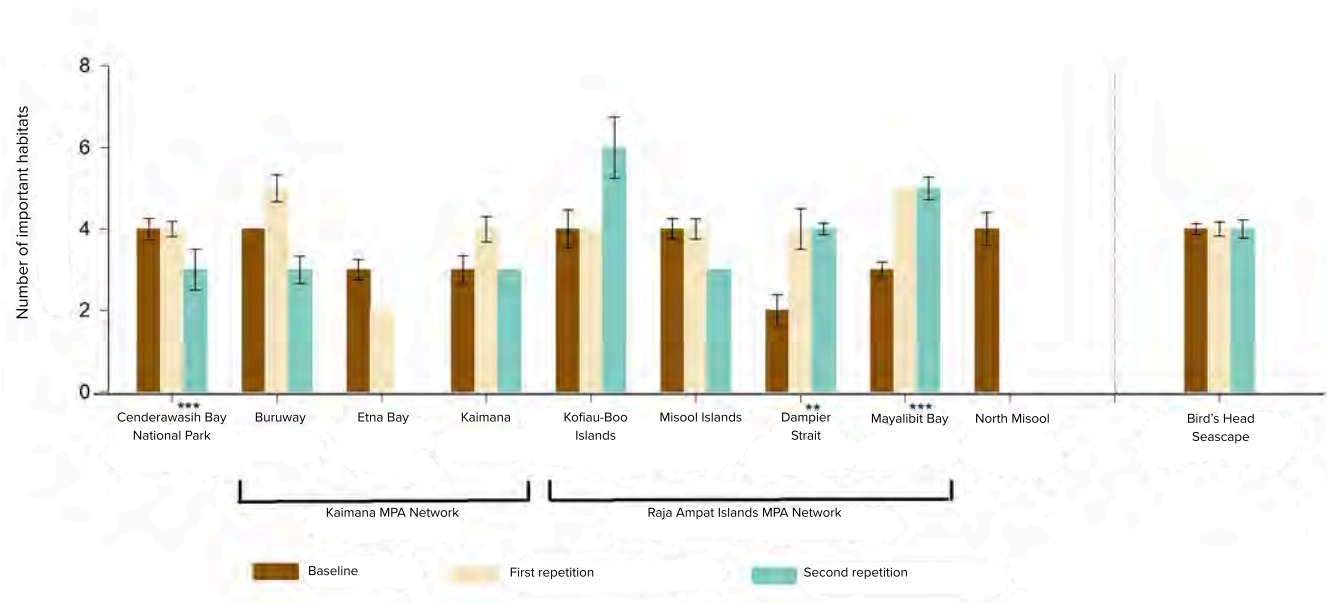


Figure 4.5. Comparison of Specially Regulated Important Habitats

Notes:

Initial and repeat monitoring years in each conservation area: Cenderawasih Bay National Park early 2010, Repeat monitoring 2012, 2014, 2017, 2023; Kaimana initial condition 2012, Repeat monitoring 2014, 2016, 2019, 2025; Kofiau-Boo Islands initial condition 2011, Repeat monitoring: 2013, 2015, 2018, 2021, 2025; Misool Islands initial condition 2011, Repeat monitoring 2013, 2015, 2018, 2023; Dampier Strait initial condition 2012, Repeat monitoring 2014, 2016, 2019, 2024; Teluk Mayalibit initial condition 2010, Repeat monitoring 2012, 2014, 2017, 2021, 2025; North Misool initial condition 2023.

- In the second iteration, the highest number of regulated habitats was recorded in the Kofiau-Boo Islands, with an average of 5.25 habitats per island. This was followed by Mayalibit Bay (4.27 habitats), Misool North Sumatra (4 habitats), and the Dampier Strait (3.14 habitats). Other areas such as Kaimana and Misool had 3 habitats, while Buruway had 2.33 habitats, placing them at an intermediate level. Cenderawasih Bay National Park reported 2.38 habitats, while several other areas did not yet have data from the latest monitoring round. The differences noted across conservation areas indicate that habitat protection priorities are not uniform throughout the region. Areas with high values typically have more critical habitats or more actively managed systems.
- When compared across time periods, several areas exhibited an increase in the number of regulated habitats. The Kofiau-Boo Islands rose from 3.25 habitats in the baseline to 5.25 in the second iteration, while North Misool increased from 3 to 4 habitats. The Dampier Strait also increased from 2 to 3.14 habitats. In contrast, Buruway experienced a significant decline from 4.67 habitats in the first iteration to 2.33 in the most recent period. Similarly, TNTC decreased from 3.71 to 2.38 habitats. Some areas, such as Kaimana and Misool, remained stable, indicating that while the habitat management systems are functioning, they have not yet developed significantly.
- The increasing number of species and habitats undergoing specific management reflects a growing awareness of the importance of sustainable marine resource management. High-performing areas, such as North Misool, Kofiau-Boo, and Mayalibit Bay, can serve as excellent examples of effective practices for protecting ecologically valuable species and critical habitats. In contrast, areas that are stagnant or in decline need reassessment of management priorities, regulatory effectiveness, and on-the-ground implementation.
- It is essential to continuously strengthen the integration of customary regulations, community agreements, and formal conservation area policies to ensure more effective management and greater community acceptance. In future monitoring efforts, this indicator should be supported by data on compliance and the biophysical condition of resources to evaluate the actual impact of the implemented regulations.

EVIKA: Evaluation of the Effectiveness of Marine Conservation Area Management in the BHS

The EVIKA assessment is based on four main criteria: input, process, output, and outcome, which are further divided into 24 specific indicators (Directorate General of Marine Spatial Management, 2022).

- 1. Input criteria.** This evaluates management and zoning plans, human resources, management budgets, and management infrastructure.
- 2. Process criteria.** This assesses management activities carried out by the Management Organizational Unit (SUOP). It includes the preparation and implementation of Standard Operating Procedures (SOPs), supervision of resource utilization and monitoring, community outreach and empowerment, partnership management, and licensing services.
- 3. Output criteria.** This evaluates products and services generated through management processes. Key aspects include controlled utilization, changes in threat sources, compliance levels, community knowledge, community empowerment products, and the availability of data and information for both managers and the community.
- 4. Outcome criteria.** This assesses management results concerning the condition of conservation targets within the conservation area. It examines the condition of the core zone compared with other zones, socio-economic conditions, benefits arising from the conservation area, and voluntary community involvement in various conservation management activities.

According to the Decree of the Director General of Marine Spatial Management No. 28/2020 on the Evaluation of the Effectiveness of Conservation Area Management (EVIKA), Conservation Areas designated by the Minister of Maritime Affairs and Fisheries are

classified into three management levels. These areas can be managed by either the Central Government through the Ministry of Marine Affairs and Fisheries or by the Provincial Government.



Gold

Sustainability management

Final Score >85%

The benefits of management are experienced by the community while ensuring that conservation values are protected and maintained sustainably.



Silver

Optimum management

Final Score >50-85%

Conservation area management operates adaptively, and several management objectives have been successfully achieved.



Bronze

Minimum management

Final Score <50%

The area design and planning have been completed. However, additional efforts are still needed to meet the management objectives.

A complete explanation of EVIKA components, indicators, and assessment procedures is presented in Appendix 22: EVIKA Assessment Method. Management recommendations from the 2025 EVIKA assessment process for all conservation areas in the BHS are fully detailed in Appendix 23: Table of EVIKA Assessment Recommendations in the BHS in 2025.



Focus Group Discussion during the 2025 EVIKA assessment in Denpasar, Bali.
© Darlahi Matulagale (S4C LPPM UNIPA)

Effectiveness of Management of the Cenderawasih Bay National Park Area

Cenderawasih Bay National Park (TNTC) is the largest marine national park in Indonesia, covering 1,453,500 hectares. It was established by Decree of the Minister of Forestry No. 8009/Kpts-II/2002. Administratively, the park is in Teluk Wondama Regency, West Papua Province, and Nabire Regency, Central Papua Province. Most of TNTC consists of marine waters (89.8%), while the remaining area comprises terrestrial, coastal, island, and coral reef ecosystems.

The management of TNTC is carried out by the Cenderawasih Bay National Park Authority (BBTNTC), which operates as a technical implementation unit under the Directorate General of Natural Resources and Ecosystem Conservation. According to the Regulation of the Minister of Environment and Forestry Number 17 of 2022, which details the Organization and Work Procedures of the Technical Implementation Unit of the Directorate General of Natural Resources Conservation Center, BBTNTC is responsible for various site-level conservation functions. These include area protection and security, ecosystem restoration, provision of data and information, conservation collaboration, partnerships, and community empowerment within and around the area.

The effectiveness of TNTC management is assessed using the Management Effectiveness Tracking Toll or METT, which is one of the instruments designed to assess management effectiveness in conservation area, as outlined in the Regulation of the Director General of KSDAE Number P.15/KSDAE-SET/2015. METT was developed by WWF and the World Bank based on the World Commission on Protected Areas (WCPA) framework, which consists of six main assessment elements: context, planning, input, process, output, and outcome. This framework enables METT to assess how effectively management has been implemented and to identify aspects that require further strengthening.

Between 2014 and 2021, there were signs of improvement in the effectiveness of TNTC management. However, the METT



assessment planned for 2021 was not conducted due to budget constraints, limited in-person meetings during the COVID-19 pandemic, and the introduction of new methods for assessing the effectiveness of conservation area management. During this period, BBTNTC took the opportunity to follow up on the 2019 METT recommendations by strengthening management planning, developing the 2022 TNTC Medium-Term Development Plan (RPJPN), and increasing area security patrols¹.

A reassessment of TNTC was conducted in 2022, yielding a score of 106 out of 133, indicating 80% effectiveness. By 2024, the METT score increased to 109, reflecting an achievement level of 82%. This improvement highlights enhanced management effectiveness, particularly in budgeting, staff training, equipment, planning, legal status, boundary confirmation, and area integration. However, there remains a need to improve stakeholders' awareness, concern, involvement, and participation. Consequently, it is essential for TNTC management to further strengthen these areas through collaboration-based programs, community empowerment initiatives via management units, and enhanced area supervision with management partners¹.

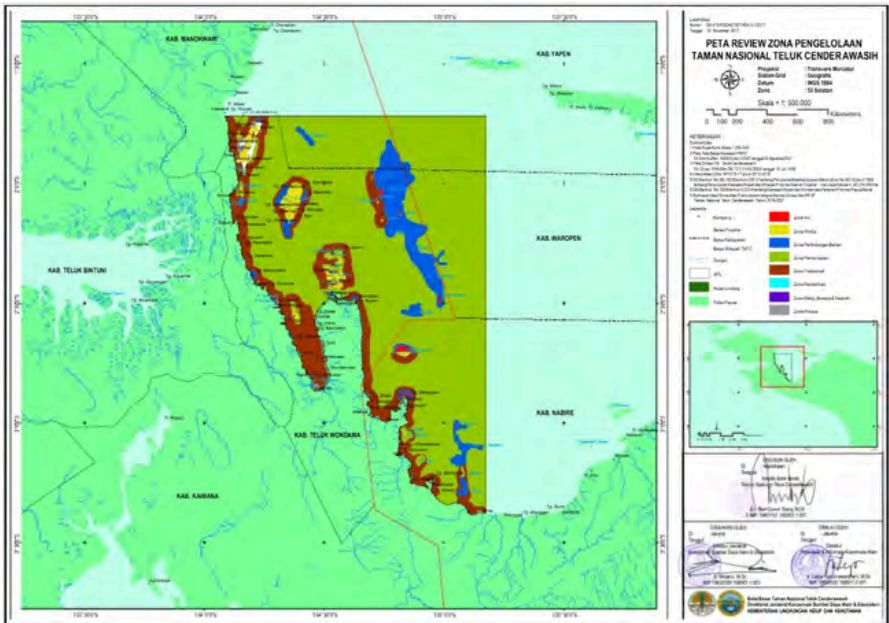


Figure 4.6 TNTC Management Zone Review Map. Source: Attachment to SK.418/KSDAE/SET/KSA.0/11/2017

Latest METT Achievement:

↑82% by 2024

Increased from 80% in 2022

2024 Score: 109 out of 133

Category: Relatively well-managed

1. All data in this section is sourced from the 2024 Performance Report of the Cenderawasih Bay National Park Center.



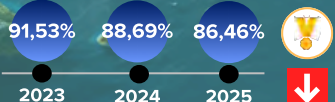
Parks in the Waters of the Raja Ampat Islands and Surrounding Seas



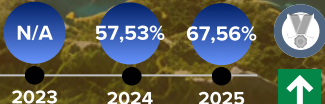
Parks in the Waters of the Western Waigeo Islands and Surrounding Seas



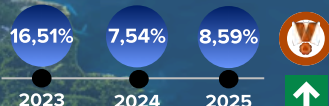
Parks in the waters of the Raja Ampat Islands in West Papua Province



Parks in the Waters of the North Misool Region of the Raja Ampat Islands



Teoenebikia River Park in the South Sorong Waters



Berau Bay and Nusalasi-Van Den Bosch Bay Coastal Park



EVIKA (Evaluation of the Effectiveness of Conservation Area Management) is an instrument for comprehensively and continuously assessing the effectiveness of conservation area management.

LEVEL OF MANAGEMENT (EVIKA 2025)

- Sustainable (> 85%)
- Optimum (50 - 85 %)
- Minimum (< 50%)

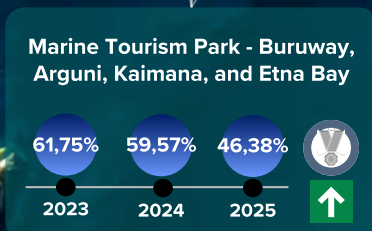
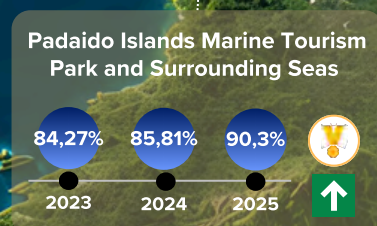
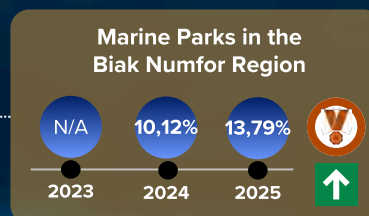
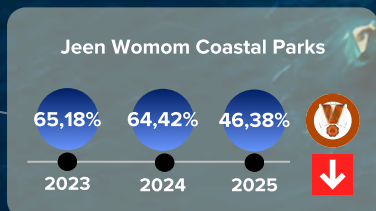
RECENT TREND

- Increasing
- Decreasing

EVIKA Status and Trend Distribution Map 2023-2025

Marine Protected Areas in the Bird's Head Seascape

EVIKA 2025 dan Change Trends 2023-2025



Management recommendations resulting from the 2025 EVIKA assessment process for all conservation areas in the BHS are presented in full in Appendix 23: Table of EVIKA Assessment Recommendations in the BHS in 2025.

Data Resource:

<https://sidako.kkp.go.id/sidako/status-pengelolaan>

(*)Note: The 3D visualization is illustrative; object sizes and distances are not represented at a fixed cartographic scale.



A monitoring team from the local community collects lobsters to be handed over at the opening ceremony of the *sasi* in Menarbu Village, Wondama Bay.
© Mulyadi (BBTNTC)

Sasi Laut: A Customary-Based Conservation System Recognized in the BHS

Sasi laut is a system for regulating access to and utilization of coastal and marine resources based on customary law. This practice has been long established among the communities in the BHS (Awaludinnoer, 2017; Macap et al., 2025; Purwanto et al., 2014). It governs the time, location, type, and size of marine life that may be harvested through mechanisms agreed upon by customary rights holders, traditional leaders, religious leaders, and the village governments (Purwanto et al., 2014). In the current BHS context, *sasi* is viewed not only as a tradition but also as an effective tool for community-based conservation governance that is increasingly documented, organized, and formally recognized (Saleh et al., 2025).

In principle, *sasi laut* imposes temporary closures on specific locations for high-value commodities, such as sea cucumbers, lobsters, lola, and certain fish species. These closures can last for six months to two years and involve clearly marked boundaries and discussions to establish harvest times, catch sizes, and distribution methods (Awaludinnoer, 2017; Macap et al., 2025; Purwanto et al., 2014). In many areas, regular monitoring is conducted to ensure that stocks have recovered before the harvest period begins (Awaludinnoer, 2017; Purwanto et al., 2014). These rules are not always formally documented, but compliance is generally high because they are supported by customary and religious legitimacy.

In Raja Ampat, the practice of *sasi laut* has been documented since the establishment of the Regional Marine Conservation Area (KKPD) (Awaludinnoer, 2017; Purwanto et al., 2014). As of 2014, there were 27 *sasi* locations recorded, totaling 20,162 hectares, which represents approximately 1.7% of the entire area of the Raja Ampat RMPA (Purwanto et al., 2014). Within the Misool KKPD, there are 5 *sasi* locations covering 9,180 hectares, while the Kofiau KKPD has 6 *sasi* locations covering 1,955 hectares (Purwanto et al., 2014). This data indicates that *sasi* has become an integral part of the formal marine space management mosaic in conservation areas. A comprehensive catalogue of all active *Sasi* locations recorded in the BHS, along with complete management information, is available in Appendix 24, Table of Marine *Sasi* Practice Data, of the BHS.

One well-documented example of this sustainable fishing practice is found in Folley Village in Misool (Awaludinnoer, 2017). Since 2012, the community has designated approximately 2,357 hectares of coastal area as a *sasi laut* for sea cucumbers. *Sasi* groups, consisting of village youth, traditional leaders, and community leaders, conduct routine patrols and enforce restrictions on harvest size. Annual data indicate a significant increase in the number of sea cucumbers, rising from 6 in 2013 to 13 in 2016. In addition, the average daily harvest grew from 191 individuals in 2013 to 681 in 2016. This positive trend can be attributed to the harvest-size restrictions and the regular monitoring.

The *sasi* opening ceremony in Salafen Village, North Misool.
© Adia Puja Pradana (YKAN)



However, in 2017, yields decreased due to pressure from outside fishers engaged in illegal fishing and limited patrol fuel for the sasi patrol groups (Awaludinnoer, 2017). This situation highlights an important lesson for the broader development of *sasi laut* initiatives.

In several villages in Misool, Raja Ampat, the practice of sasi, typically managed by men, has been entrusted to women's groups (Anonymous, 2022, 2023, 2024; Hartanto, 2022; Kosasih, 2025; Pradana, 2024; Geographic, 2025). For example, the Waifuna Group in Kapatcol Village, West Misool District, has been managing a 213-hectare sasi area with YKAN assistance since 2011. Their management includes monitoring the population, overseeing finances, and implementing science-based harvesting

regulations, such as minimum size limits for sea cucumbers and requirements for environmentally friendly fishing gear.

The success of Waifuna Group has inspired other villages: the Zakan Day Group in Salafen Village manages 497.85 hectares of *sasi laut* area, while the Joom Group, known as the Jak Sasi in Aduwei Village—meaning women who guard the sea, which in the Matbat language—currently has 60 members managing 265.55 hectares (Kosasih, 2025).

More than a mere conservation practice, the women-led sasi in Misool has become a powerful tool for empowerment, with the harvests supporting education, health, and various community needs. This demonstrates that women can play a crucial role in the governance of customary-based marine resources.



The sasi opening ceremony in Salafen Village, North Misool.
© Adia Pula Pradana (YKAN)



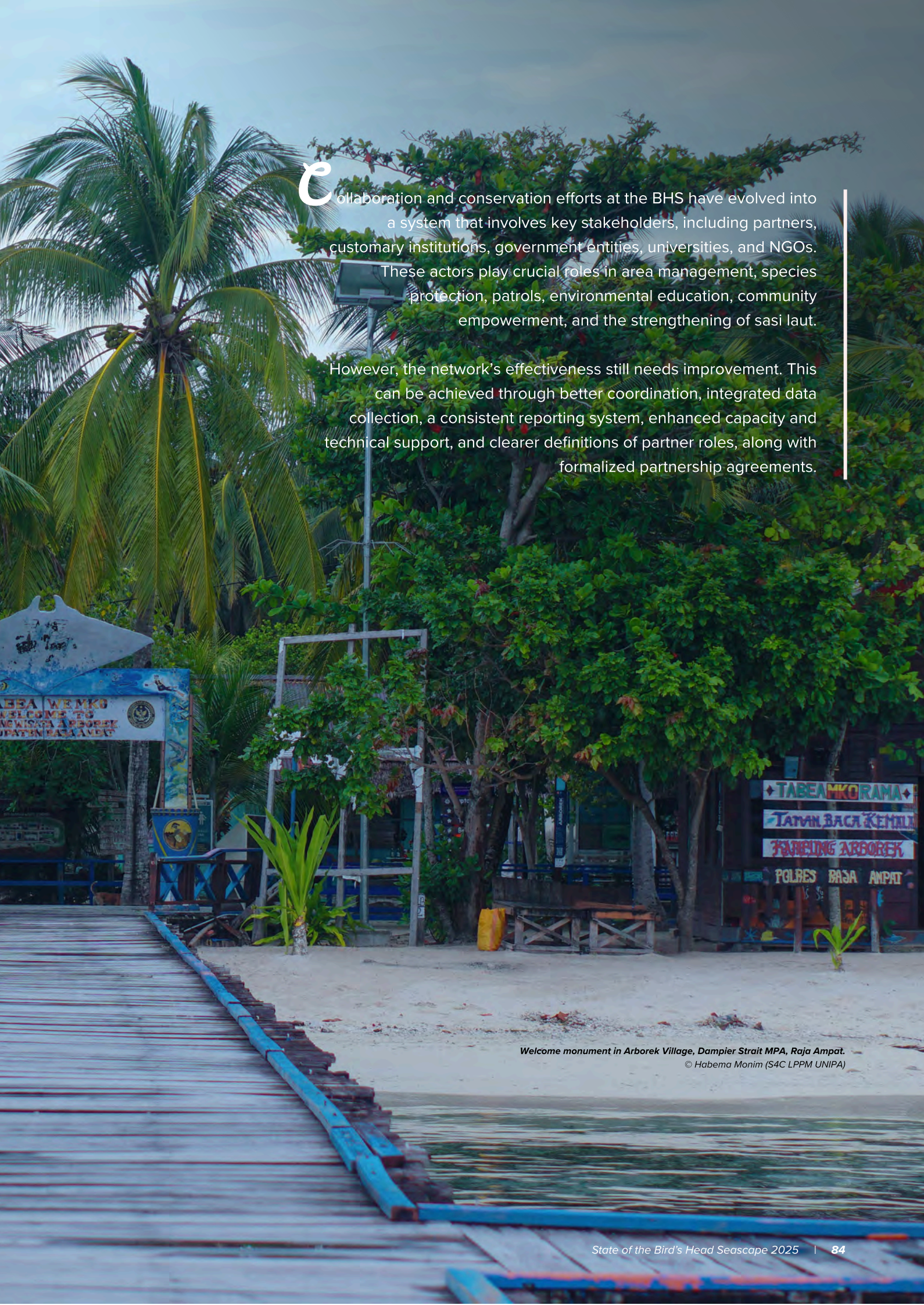
CHAPTER 5

Collaboration for Conservation

“Network Efforts, Partner Roles, and Joint Strategies in Protecting the Bird’s Head Seascape”

Conservation at the BHS is grounded in collaboration among institutions, regions, and communities. Since its establishment, partnerships have supported various initiatives, including area patrols, turtle monitoring, protection of key species, environmental education, community empowerment, and stronger marine conservation, turtle patrol, and surveillance networks.

The BHS Turtle Conservation Management Network, the Patrol and Surveillance Network, and the Sasi Laut Network demonstrate that effective conservation depends not only on the government but also on customary practices, local partners, universities and research institutions, NGOs, and community supervisory groups. Looking ahead, the effectiveness of collaboration needs to be enhanced through integrated data systems, joint reporting, capacity building, and clearer partnership policies.



Collaboration and conservation efforts at the BHS have evolved into a system that involves key stakeholders, including partners, customary institutions, government entities, universities, and NGOs. These actors play crucial roles in area management, species protection, patrols, environmental education, community empowerment, and the strengthening of sasi laut.

However, the network's effectiveness still needs improvement. This can be achieved through better coordination, integrated data collection, a consistent reporting system, enhanced capacity and technical support, and clearer definitions of partner roles, along with formalized partnership agreements.

Welcome monument in Arborek Village, Dampier Strait MPA, Raja Ampat.
© Habema Monim (S4C LPPM UNIPA)



Learning workshop for Blue Abadi Fund Cycle 5 grantees with BHS conservation partners.
© Burhan (Blue Abadi Fund)

BHS Conservation Partners

The management of conservation areas relies on partnership mechanisms that engage diverse stakeholders. Since the initiative started in 2009, BHS conservation has been established and managed through strong collaborations among several NGOs, local communities, the government, and academic institutions. The collective conservation efforts at the BHS progressively evolved to include local partners, the wider public, and local government.

The partnership at BHS began with a few NGOs and has since expanded to include several institutions. Notable collaborations include the Collaboration Forum for Addressing Illegal Fishing, the BHS Super Team for support in ecological monitoring, and the Sasi Manager Network. These partnerships have enhanced management effectiveness in BHS and provide a model that can be replicated in other areas.

One major partnership mechanism is the Blue Abadi Fund (BAF), an initiative launched in 2017 that provides grants to institutional partners for marine and coastal conservation efforts in the BHS. The programs supported by this fund are typically thematic and innovative, focusing on three main pillars: environmental conservation and rehabilitation; community empowerment and livelihoods; and environmental education and outreach.

In practice, partners engage in various activities, including conducting patrols, monitoring priority species such as sea turtles and birds of paradise, restoring coral, mangrove, and coastal habitats, and implementing community-based livelihood initiatives in key areas such as Raja Ampat, Misool, Kaimana, and Manokwari.

Community empowerment is central to the BAF approach. Partners collaborate with local groups, including customary organizations, fishers, women's groups, and youth, through various initiatives such as skill training, ecotourism development, value-added processing of fisheries products, and support for sustainable local energy projects. Informal education efforts include local storytelling classes, dive training, and programs aimed at enhancing women's role in conservation.

In terms of field education, partners design and deliver locally relevant environmental education programs for schools. In addition, public outreach is conducted through social media, signage, cultural performances, and beach and sea cleanups. Integrated waste management is also a significant focus, with partners establishing waste banks, household waste-sorting systems, and community recycling activities.

Overall, partnership conservation in the BHS has effectively protected coastal and marine ecosystems through an inclusive, adaptive, and community-based approach. The distribution map and scope of work of conservation partners can be seen on the following page, and a complete list of partners and conservation areas is available in Appendix 25: List of BHS Conservation Partners and Work Areas.

BHS Turtle Conservation Management Network

As a strategic step to enhance the protection of turtle species in the BHS, the Network for Conservation of Turtles in West Papua Province was established in 2021 under Joint Agreement Number 01/LPSPL.1/KK/KB/VI/2021, which was signed on June 10, 2021. This network provides a formal framework for cross-institutional collaboration in the management of nesting beaches and associated habitats, as well as in research, data collection and monitoring, population monitoring, and law enforcement. Furthermore, it encourages the active participation of local community groups in conservation efforts.

Institutions and agencies participating in the Network for West Papuan turtles are:

1. PSPL Sorong Workshop – Management of Coastal and Marine Resources - KKP
2. Science for Conservation Program, LPPM UNIPA
3. West Papua Natural Resources Conservation Agency
4. Supervisory Unit – Marine Resources and Fisheries Supervision - Ministry of Maritime Affairs and Fisheries
5. Water Police of the West Papua Regional Police
6. West Papua Province Maritime Affairs and Fisheries Service
7. Fisheries Service of Tambrauw Regency
8. Raja Ampat Maya Tribal Council
9. BLUD UPTD (Regional Public Service Agency Regional Technical Implementing Unit) Management of the Raja Ampat Islands, Marine and Fisheries Ministry
10. Indonesian Sea Turtle Foundation (YTSI)
11. WWF Indonesia Tambrauw site
12. Indonesian Nature Conservation Foundation (YKAN)
13. Yayasan Konservasi Indonesia/Conservation Foundation (YKI/CI Indonesia)
14. Fauna & Flora International (FFI) Indonesia Program
15. Misool Baseftin Foundation (YMB/now known as YMER)
16. Papua Turtle Foundation (YPP).

The network's scope covers three main areas

1. Turtle conservation management: planning, implementation, monitoring, reporting, handling stranded or dead turtles, research, law enforcement, and public awareness/socialization
2. Community coaching and capacity building: training, technical exchange visits, field mentoring, and local capability development
3. Evaluation and reporting: periodic evaluation and standardized reporting to support data-driven decision-making and long-term monitoring.

By 2022, four registered institutions were actively involved in turtle monitoring and reporting activities in the BHS: LPPM UNIPA, Papua Turtle Foundation (YPP), Misool Baseftin Foundation (YMB/YMER), and Nusantara Nature Conservation Foundation (YKAN). These institutions document nesting activity, monitor populations, and provide regular management support along with adaptive recommendations based on their field observations.

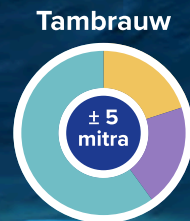
Despite ongoing efforts, data on nesting locations and habitat status across the BHS remain unevenly distributed and not consistently updated. Monitoring data is relatively better available in several priority locations, such as Jeen Womom (Tambrauw), Piail Island, and the Misool area. Conversely, data for several other potential locations in the BHS remain limited, not systematically documented, or not regularly updated. This situation highlights the need to strengthen reporting systems, integrate databases across institutions, and develop more consistent community-based documentation mechanisms.

Blue Abadi Fund team visit to Batu Rumah Beach in Jeen Yessa, Jeen Womom Tambrauw Coastal Park in 2025.
© S4C LPPM UNIPA



Meeting with the Marine and Fisheries Agency of West Papua Province, UNIPA, and conservation partners in BHS.
© S4C LPPM UNIPA





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Conservation Working Partners

9

Regions

Data update until

2025

Distribution and Scope of Conservation Partners' Work in the Bird's Head Seascape





BHS Patrol and Surveillance Network

Strengthening patrol and surveillance systems is a key element of Conservation Area Management for the Marine Protected Area (KKP) in the BHS. This network includes government institutions, implementing units, technical agencies, civil society organizations, and Community-Based Marine and Fisheries Surveillance Groups (Pokmaswas) to prevent violations, monitor resource use, and maintain ecosystem sustainability. There is a need for clearer policies to support these efforts.

At the national level, several government institutions have mandates to supervise implementation directly. The Cendrawasih Bay National Park Authority (BBTNTC) is responsible for patrols within this national park. In the West Waigeo MPA and the Raja Ampat Islands and Surrounding Seas MPA, patrol activities are carried out by the Ministry of Maritime Affairs and Fisheries (KKP). Meanwhile, supervision in the Bintuni Bay Nature Reserve is under the authority of the Ministry of Environment and Forestry (KLHK).

At the regional level, two BLUD UPTD (Regional Public Service Agency Regional Technical Implementing Unit) units play a significant role in patrol and monitoring.

1. **BLUD UPTD Raja Ampat** conducts activities in the Raja Ampat MPA, including Ayau-Asia Islands, Mayalibit Bay, Dampier Strait, Fam Islands, Kofiau-Boo Islands, and Misool Islands.
2. **BLUD UPTD Kaimana-Fakfak** oversees supervision activities in TWP Area I-IV, including Buruway, Arguni, Kaimana, and Etna Bay, as well as in conservation areas within the Fakfak region, including Berau Bay Coastal Park and Nusalasi-Van Den Bosch Coastal Park.

The involvement of partners, communities, and non-governmental organizations strengthens field-level supervision. In West Waigeo MPA, the Papua Turtle Foundation (YPP) supervises activities on Sayang Island and Piai Island and monitors beach-nesting turtles. In the North Misool area, the West Papua Nazareth Foundation (YNPB) actively conducts patrols and supports customary governance practices. Meanwhile, the Misool Basefin Foundation (YMB) conducts surveillance on Daram Island and in coastal villages in Southeast Misool. In addition, community surveillance groups, such as Pokmaswas Nusa Matan, play an important role in patrol activities in Teluk Nusalasi Van Den Bosch Coastal Park and Teluk Berau Coastal Park, and they contribute to the preparation of management plans based on community input.

Patrol and surveillance activities are spread across institutions and locations. This approach reflects a collaborative effort that spans multiple sectors and scales, functioning as both a tool for ecological protection and as a means of empowering communities and encouraging social participation.

Despite existing challenges related to logistics, data availability, monitoring consistency, and coordination among networks, these initiatives have significantly contributed to reducing pressure on conservation areas.

Looking ahead, developing integrated reporting systems, enhancing technical capacity, and strengthening collaborative mechanisms will be crucial for creating a more effective, adaptive, and well-supervised system across the BHS.

Sasi Laut Network at the BHS

The development of *sasi laut* governance at BHS has been significant. In 2023, the government, together with customary institutions and local organizations, worked together to map active *sasi laut* areas, covering 74,926 hectares and managed by 66 *sasi laut* actors across various districts (Saleh et al., 2025). The results of this effort laid the groundwork for establishing the BHS Sasi Network in December 2023, which serves as a platform for interregional coordination. This network was later formalized as the Indigenous Peoples Movement for *Sasi* Conservation (G-MAPESA), operating from the village to the provincial level (Saleh et al., 2025).

The *Sasi Laut* Network functions as a platform for sharing knowledge, aimed at harmonizing practices and integrating data management (Saleh et al., 2025). During the 2025 annual training meeting in Sorong, representatives from villages in Raja Ampat, Fakfak, Kaimana, Sorong, Tambrauw, Wondama, and Yapen convened to discuss strengthening the organizational structure, updating the *sasi laut* area map, and developing a system for recording *sasi laut* production results. The network also promotes the creation of Articles of Association and Bylaws as a step toward more formal institutionalization.

The discussion during the meeting identified three main governance issues that need to be addressed (Saleh et al., 2025). First, planning, data recording, and the timing and documentation of *sasi laut* openings and closures remain weak in several places. Second, communication channels such as messaging groups, and social media are not yet managed optimally. Third, there is a need for closer coordination regarding policy and governance changes at both the provincial and national levels to ensure that formal regulations explicitly recognize and protect *sasi laut* practices.

In response to current challenges, *Sasi Laut* Network advocates for enhancement of the legal framework through recognition mechanisms such as district and provincial regulations, as well as the Other Effective Area-Based Conservation Measures (OECM) approach (Saleh et al., 2025). It is also important to establish policy dialogue forums at the national, district, and provincial levels to promote synergy among customary institutions, government, and civil society organizations. In addition, strengthening data collection and monitoring capacity is crucial for making informed decisions regarding the opening, closing, and management of *sasi laut*, supported by more accurate information.

In the future, the sustainability of *sasi laut* in BHS will depend on three key factors:

- Data consolidation and monitoring to support evidence-based decision-making;
- Clear regulations that protect customary rights and authorities according to national law; and
- Stronger interregional coordination through the *Sasi Laut* Network to ensure that best practices can be replicated and challenges addressed collectively.

With an active area of nearly 75,000 hectares and the participation of numerous *sasi laut* practitioners across various districts, *sasi laut* in the BHS has evolved from a local customary practice into a conservation-based, networked, adaptive, and increasingly integrated system within the region's formal marine governance framework. A map of the distribution of *sasi laut* management areas in BHS is shown on the next page.

Grand gathering of sasi practitioners and launch of the book Papua dan Sasi: Tradisi Leluhur untuk Kehidupan by Konservasi Indonesia in Sorong, Southwest Papua Province, in 2025.
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Map Source:
Yayasan Konservasi Indonesia, 2025



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Distribution of Sasi Laut Management Areas in the Bird's Head Seascape of Papua



CHAPTER 6

Towards a Sustainable Future

“Challenges, Policy Recommendations, Opportunities, and New Initiatives for Effective MPA Management”

“The future of the BHS will depend not only on the establishment of conservation areas, but also on effective, equitable, and action-oriented management. Key challenges include pressure on the ecosystem, the vulnerability of key species, low community well-being and food security, and weak monitoring and enforcement.

Management recommendations focus on reducing local pressures, protecting species, strengthening coastal communities, securing sustainable funding, coordinating institutions, and using data to inform decision-making. This section also highlights new opportunities, such as blue carbon initiatives, Other Effective Area-Based Conservation Measures (OECMs), the ReShark program, innovative funding, and citizen science, to transform the BHS into a learning laboratory for tropical marine conservation.”

*A fisherman and his son returning from the sea in a village within Teluk Cenderawasih National Park.
© Michael Tuhuteru (UNIPA)*

From Status to Course of Action

The BHS has made significant progress, establishing itself as one of the most important seascapes in Indonesia and globally. Over the past two decades, this area has transformed from a collection of site-based conservation initiatives into an extensive network of protected areas. This development involves collaboration among central and regional governments, indigenous communities, universities, conservation organizations, and development partners. Such an achievement is essential for the protection of coastal and marine ecosystems, high-conservation-value species, and the living spaces of Papua's indigenous peoples.

This report highlights that, while conservation areas have been established successfully, this progress has not consistently led to a decrease in on-the-ground pressures. The BHS 2025 dashboard presents mixed signals: certain ecosystem indicators, such as live coral cover and functional fish groups, are performing well, but human well-being indicators, particularly economic well-being and household food security, remain low and continue to decline. Furthermore, there is a clear need to strengthen governance, monitoring, and enforcement efforts.

This situation underscores that the future of the BHS cannot be ensured solely by simply expanding conservation areas or enforcing regulations. The next challenge is to ensure that these conservation areas effectively protect critical habitats, sustain key species populations, support food security and community livelihoods, and promote equitable, effective, and sustainable governance. This section aims to connect the report's findings to the future action agenda.

A. Challenges



1. Ecosystem: Overlapping Pressures

The coastal and marine ecosystems of the BHS play a crucial role in supporting biodiversity, fisheries, tourism, and the livelihoods of indigenous Papuan communities. Coral reefs, mangroves, and seagrasses form an interconnected socio-ecological system that sustains the life cycles of diverse marine life, including reef fish, turtles, dugongs, manta rays, whale sharks, and other keystone species. However, these ecosystems are increasingly facing complex pressures from climate change and local human activities.

Climate change poses a significant threat to coral reef ecosystems through rising sea surface temperatures, marine heatwaves, coral bleaching, and ocean acidification (Hughes et al., 2018; Obura & Grimsditch, 2009; Siebeck et al., 2006). The coral bleaching event reported in Raja Ampat in late 2024 and 2025 demonstrates that even areas with high ecological resilience are not completely immune to the effects of ocean warming. In such conditions, local pressures such as sedimentation, pollution, physical damage from anchors or vessels, uncontrolled tourism, and destructive fishing practices can weaken the resilience of coral reefs.

The grounding of the MV Caledonian Sky in 2017 near Kri Island in the Dampier Strait, Raja Ampat, serves as a reminder that coral reef damage can occur suddenly and have significant consequences. This incident underscores the need for effective regulation of shipping lanes and navigation systems, monitoring of vessel activity, and the establishment of rapid response mechanisms in and around conservation areas, particularly in regions with high tourism and ship traffic.

In addition to climate change and physical damage, several other factors must be monitored as part of an early warning system. These include the outbreaks of crown-of-thorns starfish (COTS), coral disease, and the degradation of mangroves and seagrass beds. Important pressures in these ecosystems stem from land conversion, residential and infrastructure development, declining water quality, and inadequate coastal spatial planning. If these issues are left unaddressed, they can degrade habitat functions, diminish ecosystem services, and weaken the resilience of coastal communities.

Thus, the ecosystem challenges in the BHS are not just a list of biological threats; they involve a combination of global climate pressures and local issues that can be addressed through improved governance and management practices. Because climate change cannot be halted solely at the conservation area level, the most effective strategy at the BHS is to reduce local pressures, enhance monitoring, maintain habitat connectivity, and ensure that coastal spatial planning does not undermine long-term ecological functions.

2. Species: Protection Amidst Exploitation Pressures

The BHS is a critical habitat for many high-conservation-value species, including sea turtles, manta rays, whale sharks, zebra sharks, endemic walking sharks, dugongs, dolphins, and whales. The presence of these species strengthens the BHS's significance in global conservation efforts and serves as an important indicator of ecosystem health. However, many of these species possess biological traits that make them vulnerable, such as slow growth, low reproductive rates, extensive migration routes, and dependence on specific habitats.

For sea turtles, the main challenges include poaching, harvesting eggs, disturbance of nesting beaches, marine debris, bycatch, and changes in coastal habitat conditions. Jeen Momom is a crucial habitat for Pacific leatherback turtles, but ensuring the sustainability of turtle populations requires more than just protecting their nests. Migration routes, feeding areas, interactions with fisheries, and the security of marine habitats all play vital roles in determining the chances of survival for these turtles as they reach adulthood.

Elasmobranchs face several threats, including direct fishing, bycatch, trade in their body parts, and habitat degradation. Raja Ampat is recognized as a critical area for the conservation of sharks and rays; however, formal protection requires various measures such as field monitoring, recording encounters, tracking aggregation sites, and managing fishing and tourism activities in sensitive areas. Initiatives such as ReShark and the StAR Project in Raja Ampat show promise for species recovery, particularly for the zebra shark. The success of these initiatives, however, depends significantly on maintaining secure habitat, reducing fishing pressure, securing community support, and implementing long-term monitoring.

Marine mammals face several challenges, including ship traffic, underwater noise, the risk of ship collisions, bycatch, and changes in habitat quality. Dugongs, for example, rely heavily on healthy seagrass meadows, making their protection so closely tied to the conservation of seagrass. In addition, cetaceans such as dolphins and whales need marine areas free from excessive disturbance, especially along migration routes, feeding grounds, and sites of encounter that could also become popular tourist attractions.

The challenges related to species in the BHS highlight that wildlife protection cannot be achieved solely through prohibitions. Effective protection must be supported by population and encounter data, mapping of critical habitats, regulation of human activities in sensitive locations, and patrols and law enforcement. In addition, collaboration with fishers, tourism operators, indigenous communities, and local governments is essential.

3. Society: Social Resilience that Needs Strengthening

Coastal communities and indigenous peoples are at the core of the BHS. They are not only beneficiaries of the sea, but also knowledge holders, guardians of customary territories, fisheries stakeholders, managers of sasi, and key partners in conservation efforts. Therefore, the success of conservation in this region largely depends on whether communities have the necessary capacity, rights, and opportunities to participate in management.

The BHS 2025 dashboard indicates that economic well-being and household food security remain significant concerns. This is critical because even ecologically successful conservation efforts will fall short if communities surrounding conservation areas continue to experience economic vulnerability, limited market access, few livelihood options, and uncertain benefits from area management.

In many coastal villages, reliance on marine resources is high. When market access is restricted, transportation costs rise, distribution chains are weak, and product value remains low, these communities find it challenging to boost their incomes even in areas rich in marine resources. This situation can worsen the pressure on resources, especially when alternative livelihood options are limited or the benefits of marine tourism and conservation are not shared fairly.

Limited access to education, clean water, sanitation, and basic services also affects communities' ability to participate in resource management. Furthermore, the weakening of customary institutions and government structures needs to be addressed. Practices such as sasi laut illustrate that traditional systems remain crucial for regulating resource use; however, these institutions need support to adapt to economic changes, market pressures, government policies, and the influx of new actors in coastal areas.

4. Governance: from zoning to effectiveness

Governance plays a crucial role in determining whether management recommendations can be effectively implemented. The BHS has an extensive network of conservation areas and involves diverse stakeholders and authorities at multiple levels of government. While this diversity is a strength that fosters collaboration, it also poses challenges. Effective governance requires strong coordination, clear role allocation, sufficient funding, and reliable accountability mechanisms.

If management resources do not match the area's size and complexity, essential activities such as patrols, ecological and social monitoring, public education, handling violations, and evaluating management effectiveness will be challenging to carry out consistently.

Regulation enforcement needs to be strengthened. The BHS 2025 dashboard indicates that monitoring and enforcement of regulations are currently inadequate. This underscores the necessity for collaborative patrols, law enforcement involvement, a mechanism for reporting violations, and clear follow-up on cases involving the capture of protected species, the use of destructive fishing gear, zoning violations, coral mining, and the illegal trade in marine wildlife.

Furthermore, overlapping authorities and changes in government administration can affect the consistency of management. The BHS spans several provinces and districts and includes conservation areas overseen by both national and regional authorities. Without an active coordination forum, data, policies, funding, patrols, and community assistance programs can end up operating in isolation, failing to address shared priorities. Therefore, evaluation findings such as EVIKA need to be translated into operational follow-up plans at the site level.

B. Area Management Recommendations



1. Strengthening Ecosystem Resilience by Reducing Local Pressures

Climate change poses a long-term challenge that cannot be addressed solely at the level of conservation areas. Nevertheless, conservation area managers and their partners can take significant steps to enhance ecosystem resilience by addressing and mitigating local pressures. For coral reefs, the most crucial step is to reduce stressors such as sedimentation, pollution, physical damage from boating and tourism activities, and destructive fishing practices.

In regions with high tourism intensity, such as Raja Ampat, it is essential to enhance marine tourism management by establishing clear and consistent standard operating procedures (SOPs). These SOPs should govern the behavior of tourists, tour operators, and guides; boats and mooring points; visitation limits; designated snorkeling and diving spots; and damage reporting mechanisms. Minimum standards in sensitive locations should include implementing mooring buoy systems, banning anchoring over coral reefs, mandating briefings for tourists, and overseeing tour operators.

Shipping and navigation arrangements within conservation areas must be prioritized. It is essential to clarify ship lanes, anchorage zones, and prohibited areas for large vessels, as well as to establish navigation information systems and rapid response mechanisms for incidents. This is particularly important in areas with high traffic, such as the Dampier Strait, which attracts significant tourism.

To protect mangroves and seagrass, key recommendations include enhancing coastal spatial planning and integrating habitat protection into regional development plans.

Marine debris management also needs to be improved as a cross-sectoral initiative. It cannot be effectively addressed solely through beach cleanups; instead, it should be integrated into local waste management systems, community and tourist education, business accountability, and monitoring of ship-borne waste. Furthermore, ongoing ecosystem monitoring is essential for early warning of coral bleaching, coral disease, COTS outbreaks, increased sedimentation, and seagrass decline.

2. Protecting key species through patrols, space management, and behavior change

To effectively protect key species in the BHS, a comprehensive approach is essential. Turtles, manta rays, whale sharks, zebra sharks, walking sharks, dugongs, dolphins, and whales require not only legal protection but also secure habitats, protected migration routes, and reduced risks from human activities. Therefore, species management requires a combination of patrols, law enforcement, population monitoring, habitat management, and collaboration with communities and businesses.

For sea turtles, safeguarding nesting beaches like the Jeen Womom is a top priority. However, this focus must be expanded to include marine management through bycatch mitigation, education for fishers, documentation of turtle incidents that become entangled in fishing gear, and protection of their feeding grounds. For elasmobranchs, monitoring of live capture, shark finning, illegal trade, and bycatch needs to be strengthened through collaborative patrols and an active reporting system.

For dugongs and other marine mammals, management efforts should focus on protecting seagrass habitats, regulating vessel traffic, reducing underwater noise, and documenting encounters and incidents. Vessel speed regulations, safe observation distances, and codes of conduct for marine mammal tourism should be considered in locations with frequent encounters. In addition, it is important to compile data on encounters, bycatch, nesting sites, aggregation sites, migration routes, and violations into a shared database. This will enable a shift from a reactive approach to a proactive, evidence-based management strategy.

3. Putting People at the Center of Sustainability

Sustainable conservation in the BHS can only be achieved if coastal communities receive tangible benefits and have a strong voice in management. Therefore, socio-economic recommendations should focus on enhancing community livelihoods, expanding economic opportunities, and ensuring that the management of the conservation area does not increase the vulnerability of coastal households.

Low indicators of economic well-being and food security highlight the need for interventions beyond conventional conservation approaches. Area management needs to be linked to strengthening community product value chains and improving the quality of fishery products, as well as to ensuring better market access, transportation, and post-harvest processing, and to supporting local resource-based businesses.

In addition, alternative livelihoods should be developed based on village conditions, community capacity, and environmental carrying capacity. This includes options such as marine tourism, processed fishery products, culture-based ecotourism, women-owned businesses, small-scale aquaculture, and environmental services.

Environmental education and awareness-raising must continue, but with a more contextual approach. Education materials should be linked to food security, village health, indigenous peoples' rights, fisheries sustainability, and local economic opportunities. Furthermore, access to clean water, sanitation, and basic education should be recognized as part of the social foundation of conservation, as these factors influence a community's capacity to engage in management efforts.

Strengthening indigenous community institutions is also a vital recommendation. The practice of *sasi laut* shows that indigenous communities have resource management systems relevant to modern conservation efforts. However, these customary institutions need to be enhanced to establish clear rules, document decisions, monitor resource conditions, resolve conflicts, and negotiate with external parties. Strong conservation is one that empowers coastal communities by reinforcing their rights, building their capacity, and increasing their resilience.

4. Strengthening Institutional Governance, Funding, and Coordination

The BHS has a vast network of conservation areas, but it must be supported by adequate management capacity. Key recommendations for improving governance include strengthening management institutions, increasing personnel capacity, clarifying authority, improving cross-agency coordination, and ensuring stable long-term funding.

Budget constraints should be addressed through a combination of government funding, sustainable revenue sources, regional independent revenue, partner support, and innovative financing mechanisms. The BHS's experience with the Blue Abadi Fund (BAF) illustrates that long-term funding is a crucial foundation for sustainable management. However, sustainable funding should not replace government responsibilities; rather, it should complement public funding to ensure consistent patrols, monitoring, community empowerment, and management evaluation.

Law enforcement should be strengthened through collaborative patrols that involve area managers, the National Agency for Marine and Fisheries Development (PSDKP), law enforcement officers, local governments, indigenous communities, and community watchdog groups. The purpose of these patrols is not only to detect violations but also to promote compliance. This can be achieved by disseminating information about zoning regulations, establishing reporting mechanisms, documenting cases, ensuring transparent follow-up, and maintaining regular communication with the community.

The results of EVIKA must be translated into regional action plans. Assessments of management effectiveness should not just serve as evaluation documents; they should also guide priorities for work, budget needs, allocation of responsibilities, and indicators of success. Moreover, it is essential to strengthen coordination within the BHS network to avoid fragmentation across data, policies, funding, patrols, and community assistance programs.

5. Using Data to Inform Decision-Making

All the recommendations outlined require a solid foundation: robust, accessible, and relevant data for decision-making. The BHS has a long history of monitoring socio-ecological factors, including coral health, key species, community well-being, and the effectiveness of area management. The challenge ahead is to ensure that this data is not merely stored as reports but actively used to design policies, set priorities, evaluate success, and refine management strategies.

Ecological data must be continuously integrated with social and governance information. For instance, changes in coral reef conditions should be analyzed in conjunction with tourism pressure, fishing activities, compliance with zoning regulations, and the economic conditions of local communities. Similarly, declines in food security or economic well-being should be assessed alongside changes in resource access, management regulations, market access, and livelihood dynamics. By developing a more integrated data system, management recommendations can be made more quickly, accurately, and transparently.



C. New Opportunities and Initiatives at the BHS

Despite the challenges faced, the BHS has significant opportunities to enhance its role as a critical laboratory for tropical marine conservation in Indonesia and globally. These opportunities arise from the development of new conservation strategies, innovative funding sources, species recovery efforts, and increased public participation. However, it is essential to manage these opportunities carefully to ensure they do not become isolated initiatives but rather integrate into a broader strategy to strengthen the effectiveness of the protected area network.

1. Blue Carbon: Climate Protection, Coastal Ecosystems, and Livelihoods

The mangrove and seagrass ecosystems in the BHS present a significant opportunity to develop a blue carbon strategy. In this context, blue carbon is important not only for mitigating climate change but also for enhancing coastal habitat protection, supporting community adaptation, food security, and improving the livelihoods of coastal communities.

Bintuni Bay stands out as a prime example of blue carbon potential in the BHS. It contains the largest concentration of mangroves in the analysis area and is one of the most crucial contiguous mangrove blocks in Indonesia. With its extensive mangrove cover, Bintuni Bay is vital for carbon storage, coastal protection, fish and marine life nursery habitat, and local livelihoods.

In addition to Bintuni Bay, Kaimana and Fakfak are important for their mangroves, which are directly connected to the established network of conservation areas and coastal management efforts. Thus, Bintuni Bay can be viewed as a key site with the greatest potential for blue carbon, while Kaimana and Fakfak exemplify how mangrove protection can be integrated into the management of conservation areas and regional development.

Seagrass meadows should also be included in the BHS's blue carbon agenda. While further detailed mapping and verification are needed to understand the extent and carbon stocks of seagrasses, these ecosystems play a vital role in carbon storage, sediment stabilization, water quality maintenance, and providing habitats for species such as dugongs and turtles. To ensure that blue carbon opportunities do not introduce new risks, their development must be based on solid data, participatory mapping, clear spatial status, protection of the rights of indigenous and local communities, and fair benefit-sharing mechanisms.

2. OECM: Recognition of Indigenous Peoples' Management Space

Other Effective Area-Based Conservation Measures (OECMs) provide an important opportunity to acknowledge areas that contribute to conservation, even if they are not officially designated as protected areas. OECMs are a key component of Target 3 of the Kunming-Montreal Global Biodiversity Framework, which aims to protect and effectively manage at least 30% of the world's land and ocean by 2030.

For the BHS, OECMs are important because marine conservation occurs not only in state-designated conservation areas but also within customary territories and local management areas that have traditionally been overseen by communities. One notable practice is *sasi laut*, which serves as a system for regulating resource use through open-close mechanisms, customary rules, social oversight, and collective agreements at the village level.

According to the OECMs criteria, specific *sasi laut* practices in the BHS show substantive suitability because they are located outside formal conservation areas, have boundaries recognized by the community, are managed by customary authorities or village institutions, and include mutually agreed-upon utilization regulations. However, to be officially recognized as an OECM, it is essential to strengthen boundary documentation, clarify management authority, maintain regulatory records, and establish a monitoring system that can demonstrate ongoing contributions to conservation.

The development of OECMs must be approached with care to prevent turning customary practices from becoming new administrative burdens. Recognizing OECMs should not replace customary authority; instead, it should reinforce its legitimacy, facilitate access to technical support and funding, and help ensure that community contributions to conservation are acknowledged within the broader policy framework. With the presence of *sasi laut*, established customary institutions, a network of conservation areas, and partner support, the BHS has the potential to serve as a model for community-based OECM implementation in Indonesia.

3. ReShark dan StAR Project: Species Recovery as Learning

The ReShark and StAR Project initiatives in Raja Ampat show that conservation in the BHS can focus not only on protecting existing species but also on restoring populations of those that have declined. The recovery of the zebra shark, also known as the Indo-Pacific leopard shark, exemplifies how science, technology, protected area management, and global collaboration can work together to support species recovery in their natural habitats.

The primary aim of this initiative goes beyond releasing individual sharks into the wild; it seeks to provide broader insights into managing key species in the BHS. Successful species recovery requires secure habitats, management of fishing risks, community support, long-term monitoring, and a data system capable of demonstrating the successes and challenges of population recovery. Therefore, species recovery must be integrated into the overall management strategy of the area, rather than treated as a separate program from habitat protection, regulation enforcement, and public education.

4. Sustainable and Innovative Funding for Conservation

Effective management of conservation areas requires long-term funding to support a range of activities. These include patrols, monitoring, community empowerment, data management, environmental education, habitat restoration, handling violations, and inter-agency coordination. Therefore, funding should not rely solely on short-term projects or donor support, as these are often not sustainable.

The BAF has become an essential source of funding for conservation efforts in the BHS. This funding mechanism highlights the need for long-term financial support to address the management funding gap in conservation areas. In the future, the lessons learned from the BAF can be enhanced by ensuring that funding is directed towards priority needs, implementing robust accountability measures, and continuing to complement government funding responsibilities.

Another opportunity arises through the Tropical Forest and Coral Reef Conservation Act (TFCCA), which could support coral reef conservation, empower coastal communities, protect habitats, and promote sustainable management in priority seascapes, including the BHS. Furthermore, results-based funding initiatives such as the Manta Impact Bond (or Manta Bond) could create new avenues to link the protection of iconic species to conservation financing and socio-economic benefits. However, all innovative funding schemes need clear success indicators, robust verification mechanisms, transparent benefit-sharing processes, and direct connections to the needs of local communities and area managers.

5. Citizen Science: Expanding Public Monitoring and Engagement

Citizen science offers an opportunity to expand the scope of monitoring efforts in the BHS. The BHS area is vast, yet the resources of managers and researchers are limited. In this context, local communities, including fishers, tour guides, dive operators, students, visitors, and community monitoring groups, can serve as valuable contributors to field-based observation and reporting. They can help document ecosystem conditions and species encounters.

Citizen science can be used to report encounters with endangered species, including manta rays, whale sharks, dugongs, turtles, dolphins, and whales. It can also be used to record incidents of coral bleaching, report marine debris, document zoning violations, and monitor changes in habitat conditions. In Raja Ampat, an approach to identifying individual manta rays by their unique body patterns has shown that field-collected visual data can be a valuable source of information for understanding these species' populations and movements.

For citizen science data to be effectively used in decision-making, the system must be straightforward yet credible. This requires clear reporting protocols, basic training, a standardized data format, and verification by experts or managers, along with providing feedback to reporters. Thus, citizen science can serve as an educational tool, foster a sense of ownership, and integrate into a shared data network within the BHS.

6. BHS as a Tropical Marine Conservation Learning Laboratory

If managed in an integrated manner, the BHS could become a vital learning laboratory for tropical marine conservation. Within a single seascape, the BHS brings together an extensive network of marine protected areas, customary marine management systems, mangrove, seagrass, and coral reef ecosystems, iconic species, sustainable financing mechanisms, species recovery initiatives, and a long-term ecological monitoring database.

This opportunity should be strengthened through systematic documentation of learning experiences. Successes, failures, and management challenges should be documented as valuable lessons for other regions. The role of universities, particularly UNIPA, is crucial in ensuring the continuity of this learning through applied research, training, data systems, and knowledge dissemination.

Ultimately, initiatives such as blue carbon, the OECMs, ReShark, the TFCCA, the Manta Impact Bond, and citizen science are not definitive solutions. Instead, they are tools for maintaining healthy ecosystems, protecting species, strengthening communities, and enhancing effective regional governance. By integrating these opportunities into a common strategy, the BHS can continue to demonstrate that strong marine conservation is based on science, respects indigenous traditions, is supported by long-term funding, and delivers tangible benefits to the Papuan people.

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Glossary

Adaptive Management: A management approach that adjusts strategies based on the results of monitoring, evaluation, learning, and changing field conditions.

Area Patrol: Field surveillance activities to prevent, detect, and take action against violations within conservation areas.

Bagan: A small pelagic fishing gear that uses a sail, a lift net, and light to attract fish.

Benthic Composition: The composition of the basic components of the water or reef surface, such as hard coral, soft coral, algae, coral fragments, dead coral, and sand.

Benthic Cover: The percentage of the bottom surface of the water or reef covered by benthic components such as hard coral, soft coral, algae, sand, coral rubble, and dead coral.

Biodiversity: The variety of living organisms, including genetic diversity, species, habitats, ecosystems, and the ecological interactions within them.

Biomass of Key Fishery Species: The total weight of target fish species or fish of important fishery value is an indicator of fish stock condition and fishing pressure.

Blue Carbon: Carbon absorbed and stored by coastal and marine ecosystems, especially mangroves, seagrasses, coastal swamps, and coastal sediments.

Bycatch: Marine biota caught accidentally in fishing activities that target other species.

Citizen Science: Activities involving the collection or monitoring of scientific data involving the public, local communities, or non-researchers.

Climate Change: Long-term changes in temperature, precipitation, seasonal patterns, sea levels, and extreme weather events that can affect ecosystems and communities.

Coastal Communities: Communities that live in coastal areas and have social, economic, cultural, or livelihood relationships with the sea and coastal resources.

Coastal Park: A conservation area in coastal areas is designated to protect ecosystems, habitats, species, and to support sustainable use by communities.

Cocomesh: Woven coconut fiber rope used as an alternative material to shelter turtle nests threatened by high sand temperatures.

Community Participation: Community involvement in the planning, decision-making, management, monitoring, and evaluation of resources.

Community-Based Conservation: A conservation approach that involves local communities as the main actors in the protection, utilization, and management of resources.

Conservation Area Network: A collection of conservation areas that are ecologically, socially, and institutionally interconnected to support broader seascape protection.

Conservation Area Zoning: Division of space within a conservation area based on management function, such as core zone, limited use zone, rehabilitation zone, or other zones.

Conservation Area: An area of land, coast, or sea designated to protect ecosystems, species, habitats, and environmental services.

Coral Bleaching: A condition where coral loses its symbiotic algae due to environmental stress, especially high sea temperatures, so that the coral appears white.

Coral Recruitment: The process of entry and growth of new coral individuals on the substrate, which is important for coral reef recovery.

Coral Reef Restoration: Active efforts to assist the recovery of damaged coral reefs through habitat rehabilitation, coral transplantation, or other interventions.

Coral Reef: A tropical marine ecosystem built by coral colonies and providing habitat for various species of fish and other marine biota.

Coral Triangle: A tropical marine region in the Asia-Pacific known as the center of the highest marine biodiversity in the world.

Core Zone: A zone within a conservation area that has a high level of protection and generally limits or prohibits direct use.

Critical Habitat: Habitat that has a very important function for the survival of the species, such as nesting sites, feeding areas, nursery areas, or migration routes.

Crustose Coralline Algae: Calcareous algae that grow attached to hard substrates and play a role in the stabilization and restoration of coral reefs.

Customary Rights of the Sea: Customary rights of communities over certain sea areas which are used, protected, and regulated based on local social, cultural, and institutional systems.

Customary Waters Area: Marine space that is socially, culturally, and historically recognized as part of the management area of indigenous communities.

Glossary

Degradation: The decline in the quality, structure, or function of an ecosystem due to human pressure, natural disturbance, or environmental change.

Destructive Fishing: Fishing practices that destroy habitats or harm ecosystems, such as the use of bombs, poisons, or destructive fishing gear.

Dugong: A seagrass-eating marine mammal that lives in shallow coastal waters and is an important indicator of the health of seagrass ecosystems.

Ecosystem Recovery: The process of returning the structure, function, or condition of an ecosystem after experiencing disturbance or damage.

Ecosystem-Based Management: A management approach that considers the relationships between habitats, species, people, environmental pressures, and governance.

Ecosystem: A unity between living things and their physical environment that interacts with each other in a certain space.

Ecotourism: Nature-based tourism activities that support conservation, benefit local communities, and minimize impact on the environment.

Elasmobranch: A group of cartilaginous fish that includes sharks, rays, and skates. **Endemic:** A species that is naturally found only in a particular geographic area.

Endangered Species: Species that face a high risk of population decline or extinction.

Endemic Species: Species that only live naturally in a certain area and are not found naturally anywhere else.

Erosion: The process of wearing away of soil, sand, rocks, or shorelines by wind, water, waves, currents, or other natural factors.

EVIKA: An evaluation instrument to assess the effectiveness of marine conservation area management.

Feeding Ground: The area that animals use to search for food regularly. **Feeding Trail:** Feeding trails left by dugongs in seagrass beds while grazing.

Fish Biomass: The total weight of fish in each area, generally expressed in kilograms per hectare.

Fish Functional Groups: Groups of fish classified based on their ecological roles, such as herbivores, carnivores, or plankton eaters.

Fish Home Range: The area used by fish to feed, shelter, breed, or move in their life cycle.

Food Security: A condition where households have sufficient access to safe, nutritious, and adequate food for a healthy life.

Functional Fish Biomass: The total weight of a group of fish that have an important ecological function, such as herbivorous fish that help control algae growth on coral reefs.

Governance: The system of rules, institutions, processes, roles, and decision-making mechanisms in the management of resources or areas.

Green Turtle: A species of sea turtle that uses seagrass beds as a safe feeding area and is one of the species that lays eggs in the BHS.

Habitat: The natural place or environment where plants, animals, or organisms live, reproduce, and feed.

Hard Coral Cover: The percentage of the reef covered by living hard coral.

Hard Coral: A group of reef-building corals that produce a calcium carbonate skeleton and form the primary structure of coral reef habitats.

Hatchlings: Baby turtles that have just hatched from their eggs and are moving toward the sea.

Hawksbill Turtle: A species of sea turtle associated with coral reefs and known for its distinctively patterned carapace.

Herbivores: Animals that eat plants or algae. In coral reef ecosystems, herbivorous fish help control algae growth.

Household Food Security Index: A measure that describes a household's ability to obtain sufficient, safe, nutritious, and socially acceptable food.

Household Material Assets Index: A composite measure that describes the level of household asset ownership as an indicator of economic well-being.

Household Material Assets: Ownership of physical household goods used as an indicator of economic well-being, such as telephones, televisions, boats, outboard motors, vehicles, and other productive assets.

Indicator: A measure or parameter used to assess the condition, change, or performance of an ecological, social, economic, or governance aspect.

Glossary

Indigenous Peoples: Groups of people who have historical, social, cultural, and spiritual ties to a particular territory and have traditional value and governance systems.

Key Ecosystems: Ecosystems that play an important role in supporting biodiversity, ecological functions, and community livelihoods, such as mangroves, seagrasses, and coral reefs.

Key Fishery Species: Fish species that are important for fisheries, community livelihoods, and assessment of the condition of fish resources.

Keystone Species: Species that have an important role in maintaining the structure, function, or balance of an ecosystem.

Larva: The initial stage of development of a marine organism after the egg hatches, before growing into a young or adult individual.

Leatherback Turtle: The world's largest turtle species with a leathery shell that makes Tambrauw's beaches an important nesting location.

Limited Use Zone: A zone within a conservation area that allows certain uses in a limited, controlled, and regulated manner.

Long-Term Monitoring: Monitoring that is carried out repeatedly over a long period to detect changes in trends and support decision-making.

Mangrove: An estuarine forest ecosystem that grows in tidal areas and acts as a coastal protector, carbon store, habitat for biota, and supports community livelihoods.

Manta Rays: A group of larger rays from the genus *Mobula* that have high ecological, conservation, and marine tourism value.

Marine Conservation Area: A marine area that is protected and managed to protect fish resources, ecosystems, and marine biodiversity.

Marine Nature Reserve: A marine conservation area established to protect biodiversity, habitats, and important ecological processes.

Marine Reserve: A marine conservation area established to protect biodiversity, habitats, and important ecological processes in the waters.

Marine Tenure: A system of rights, access, control, and rules governing the use of marine areas and marine resources by individuals, groups, clans, villages, or indigenous communities.

Marine Tourism Park: A marine conservation area managed to protect the ecosystem and to utilize nature tourism sustainably.

Megafauna: Groups of large marine animals, such as turtles, sharks, manta rays, dugongs, whales, and dolphins.

Monitoring: Activists to monitor community conditions, livelihoods, welfare, education, health, culture, and community relations with natural resources.

Monitoring: The activity of periodically monitoring the condition of ecosystems and species to assess environmental status, trends, and changes.

National Park: A nature conservation area that contains native ecosystems and is managed for the purposes of protection, science, education, tourism, and recreation.

Nature Reserve: A nature reserve area that has unique flora, fauna, and ecosystems that need to be protected so that their development can take place naturally.

Nest Relocation: Moving turtle eggs or nests from at-risk locations to safer locations to increase the chances of hatching.

No-Take Zone: A no-take zone in a conservation area that prohibits resource extraction activities to protect the habitat and population of species.

OECM: Areas outside formal conservation areas that make a significant contribution to biodiversity protection.

Olive Ridley Turtle: A relatively small species of sea turtle that lays eggs on several beaches in the BHS region.

Passive Acoustic Monitoring: A method of monitoring aquatic animals or environments by passively recording underwater sounds.

Phytoplankton: Microscopic organisms that live floating in water and carry out photosynthesis as the basis of the marine food chain.

Place Attachment: The emotional, social, and cultural attachment of a community to its place of residence, sea area, or living space.

Political Empowerment: The ability of communities to participate in decisions that affect access, rights, and management of resources.

Pop-Up Satellite Archival Tag: Satellite tracking devices attached to marine animals to record movement, depth, temperature, and cruising patterns.

Predator: A predatory animal that eats other animals. In the context of turtles, nest predators can include monitor lizards, dogs, pigs, or crabs.

Reef Health Monitoring: A coral reef health monitoring program that includes measuring benthic cover, fish biomass, and other ecological indicators.

Glossary

Reef Sharks: A group of sharks associated with coral reef ecosystems and acting as predators in maintaining the balance of fish communities.

ReShark: A shark population recovery initiative, including the release of zebra sharks hatched from eggs sourced from aquariums.

Resilience: The ability of an ecosystem to survive, recover, and continue functioning after experiencing stress or disturbance.

Sasi Laut: Customary practices that regulate the opening and closing of marine resource utilization at certain times, locations, and types of resources.

School Participation Rate: The percentage of school-age children in a specific age group who are currently pursuing formal education.

Seagrass: Flowering plants that live in shallow seas and form seagrass meadows, which are important habitats for fish, dugongs, turtles, and other marine life.

Seascape: A large marine area encompassing interconnected ecosystems, species, communities, resource uses, and governance systems.

Sedimentation: The process of soil, sand, or mud particles entering and settling into waters that can affect seagrass and coral reefs.

Social-Ecological Systems: Systems that describe the interrelationships between humans, ecosystems, species, resources, and governance.

Socio-Economic Welfare: The living conditions of a community that include economic aspects, health, education, culture, access to resources, and the ability to participate in decision-making.

Soft Corals: A group of corals that do not form hard skeletons like stony corals, but are still an important part of the benthic community.

Spawning: The process of reproduction in fish or aquatic life when eggs and sperm are released to produce offspring.

Sustainable Funding: Long-term financing mechanisms that support the sustainability of conservation area management and community programs.

Sustainable Livelihoods: Sources of income and ways of life of people that can meet current needs without destroying resources for the future.

Underwater Visual Census: A visual underwater observation method to record fish, coral, or marine biota on a specific observation route.

Whale Shark: The world's largest fish species, a filter feeder, is often found in productive waters such as Cenderawasih Bay and Kaimana.

Wildlife Sanctuary: A natural reserve designated to protect wildlife and their habitats.

Zebra Shark: A benthic shark that lives in coral reef habitats and is a focus of population recovery through the ReShark initiative .

Interpretation of the BHS MPA Network Status Report

The BHS MPA network status report documents the status and trends of ecological and social conditions over time. Observed ecological and social changes over time can result from a variety of processes. For example, changes in percent cover (an important indicator of coral reef health) can be related to changes in fisheries pressure, the natural diversity of fish populations, the impacts of disturbances (e.g., coral bleaching), the establishment of MPAs, or a combination of these factors. Similarly, changes in household food security can be caused by economic growth, extreme weather events affecting the availability of important food sources, fluctuations in fuel prices, the establishment of MPAs, or a combination of these factors. Without additional data, these alternative explanations are likely equally plausible.

In this report, we interpret ecological and social trends by describing possible explanations for the observed data patterns. Because we only monitor conditions within MPAs, we cannot definitively state that MPA establishment is the cause of the trends. Instead, we provide subjective judgments for interpreting the findings, based on expert assessments of the rationale for alternative explanations for each trend. Ultimately, positive trends in ecological and social conditions should not be interpreted as evidence of MPAs' positive impacts. Similarly, negative trends should not be interpreted as negative impacts of MPAs.

To determine whether the presence of MPAs is causing changes in social and ecological conditions, the B monitoring program also assesses conditions outside the MPA area that share characteristics with the MPA (using the same protocols as within the MPA). By monitoring changes over time in both the MPA villages and the control villages, and in coral reef habitat locations both within and outside the MPA area, we will be able to determine the social and ecological changes caused by MPA management and those caused by other factors (such as market shifts and natural disturbances). We expect to have short-term impact data on social and ecological conditions (i.e., changes in social conditions resulting from the establishment or implementation of MPA management) available in early 2020. Future BHS Status Reports are expected to also include information on MPA impacts.

Understanding and Interpreting Uncertainty

Grouping of uncertainties

Scientific monitoring always involves uncertainty. This can occur at every step of the monitoring process, from method development to data collection, analysis, and interpretation. Some uncertainties (e.g., measurement error) can be easily documented and quantified, while others remain unknown (e.g., whether an indicator accurately reflects the true situation). The magnitude of uncertainty can be quantified through statistical analysis or other techniques.

Treatment of uncertainty in the BHS MPA Network Report

In this report, we adopt the IPCC's standard classifications for describing uncertainty calculations (IPCC, 2013). Based on statistical analyses of monitoring data, we estimate confidence levels (i.e., the probability that a trend or outcome will occur) to describe conditions and trends in the Bird's Head Seascape MPA (see Table L.1).

For each finding in this report, we indicate the confidence level in double quotation marks (e.g., "almost certainly possible") with the exact value of the confidence level in parentheses. For example, if there is less than a 1% chance that the documented trend in a particular indicator could have occurred by chance, we write it as "almost certainly possible" ($p=0.01$). Here, the P-value describes the probability of obtaining a result at least as extreme as the observed data.

Table L.1. Possible Conditions

Terminology	Possible Outcomes	Confidence Level (P Value)
Almost certainly possible	99-100%	$P < 0.01$
Very possible	95-100%	$P < 0.05$
High probability	90-100%	$P < 0.1$
Possible	66-100%	$P < 0.33$
Between possible and impossible	33-66%	$P > 0.33$ and $P < 0.66$
Small possibility	0-33%	$P > 0.66$
Very impossible	0-10%	$P > 0.90$
Almost certainly impossible	0-1%	$P > 0.99$

Note: The categories under “Possible Outcomes” are not mutually exclusive and reflect standards of scientific agreement when reporting probabilities.

Understanding and Interpreting Graphs

The Bird's Head Seascape MPA Network Status Report translates monitoring data into status and trend analyses for key ecological, social, and management conditions within the seascape's MPAs. We present the data in a single-page dashboard, one for the entire seascape. For each ecological, social, marine resource governance, or management indicator, the dashboard provides an assessment of the status and trends.

MPA Status

We documented the status of each indicator in the most recent monitoring year and compared it to the average condition of the Bird's Head Seascape MPA during the baseline monitoring period (i.e., the time the MPA was first monitored). We grouped the current status into three general categories (see Figure L.1):

- **High:** conditions observed in the most recent monitoring year are higher than the average conditions observed at the baseline for the MPA. We include this definition if current conditions exceed the average baseline conditions for the seascape by more than one standard error.
- **Moderate:** conditions observed in the most recent monitoring year are within the same range as the average conditions observed at baseline for the MPA. We include this definition if current conditions fall within the average range of the baseline seascape conditions, plus or minus 1 standard error.
- **Low:** conditions observed in the most recent monitoring year are lower than the average baseline conditions for the MPA. We include this definition if current conditions are lower than the average baseline conditions of the seascape minus one standard error.

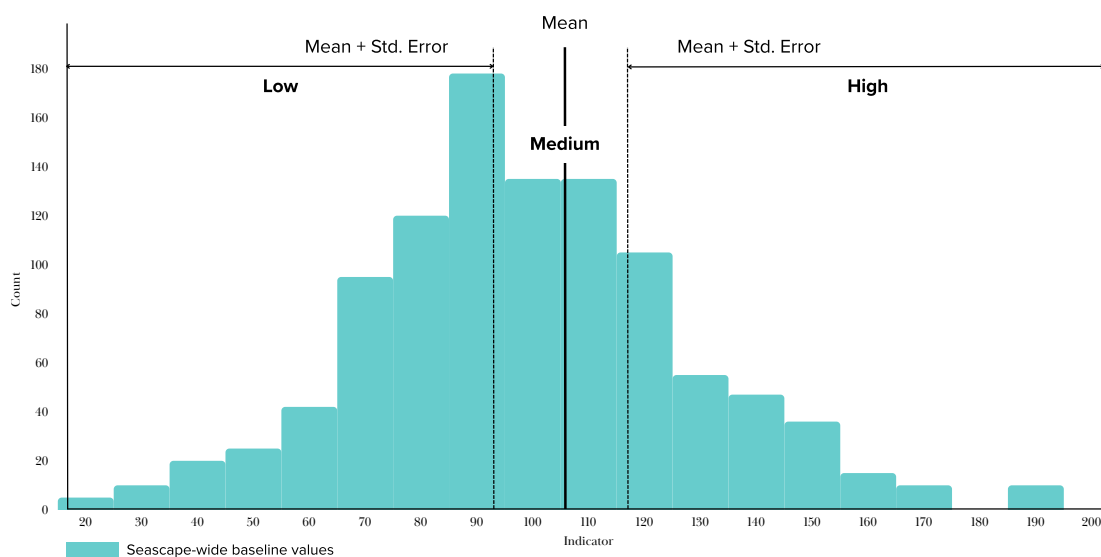


Figure L.1. Status Grouping

MPA Trend

We conducted statistical analyses of trends in key social, ecological, governance, and management conditions over time. We classified the trends into four general categories:

- **Increased:** the average condition observed in a particular MPA or MPA Network increased during the monitoring year.
- **Stable:** the average conditions observed in a particular MPA or MPA Network do not vary significantly over the monitoring year.
- **Declining:** the average condition observed in a particular MPA or MPA Network declined during the monitoring year.
- **Data not available:** insufficient time-series data to detect a trend in the condition.

We describe the confidence levels of all indicators (Table L.1), except for management assessment, as follows:

Table L.2 Indicators of the level of confidence of all indicators except management assessment

Trust Level	Information
Almost certainly possible	There is a chance of less than 1% ($P < 0.01$) that we will see a pattern of change (increase/decrease), if there is no change in the observed indicator.
Very possible	There is a chance of less than 5% ($P < 0.05$) that we will see a pattern of change (increase/decrease), if there is no change in the observed indicator.
High probability	There is a chance of less than 10% ($P < 0.05$) that we will see a pattern of change (increase/decrease), if there is no change in the observed indicator.

We describe the confidence levels for the management assessment indicators in Table L.3.

Table L.3 Indicators of the level of confidence of management assessment

Trust Level	Information
Almost certainly possible	There has been an increase of more than 15% in the management assessment score over time.
Very possible	There has been an increase of more than 10% in the management assessment score over time.
High probability	There has been an increase of more than 5% in the management assessment score over time.

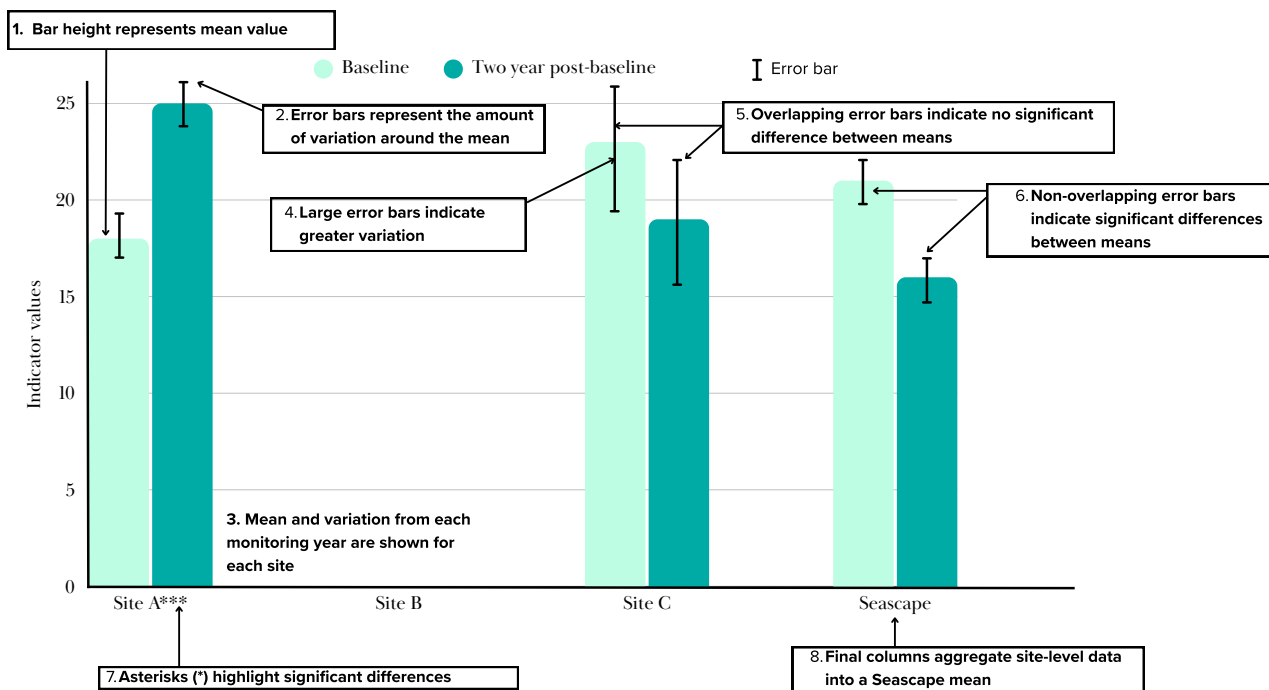


Figure L.2. Explanatory and Interpretation Graph

Appendices

Appendix 1. List of Marine Protected Areas in BHS

Based on the Regulation of the Minister of Maritime Affairs and Fisheries Number 31 of 2020 and Law Number 5 of 1990, several articles define the categories of conservation areas in the Republic of Indonesia. In this appendix, several MPAs in the BHS are falling into the categories outlined in both regulations, such as: Marine Tourism Parks (TWP), Parks, Nature Reserve Areas (KSA), and Nature Conservation Areas (KPA), Coastal Parks (TP), Nature Reserves (CA), Wildlife Reserves (SM), Traditional Community-Based Fisheries Management (TCBFM), Prospective Regional Conservation Areas (CKKD), and Marine Nature Reserves (CAL).

No	Area Name	Type	Management Authority
1	Padaido Islands Marine Tourism Park (TWP) and Surrounding Seas in Papua Province	National	Kupang Marine Management Center
2	Marine Parks in the Biak Numfor Region, Papua Province	Local/Provincial	Department of Marine Affairs and Fisheries of Papua
3	Parks, Nature Reserve Areas (KSA), and Nature Conservation Areas (KPA) of Cenderawasih Bay National Park	National	Cenderawasih Bay National Park Authority
4	Jeen Womom Coastal Parks (TP)	Local/Provincial	Department of Marine Affairs and Fisheries of Southwest Papua
5	Parks in the Waters of the Western Waigeo Islands and Surrounding Seas	National	Kupang Marine Management Center
6	Parks in the Waters of the Raja Ampat Islands and Surrounding Seas	National	Kupang Marine Management Center
7	Parks in the waters of the Raja Ampat Islands in West Papua Province - Area I, Ayau-Asia Islands	Local/Provincial	Department of Marine Affairs and Fisheries of Southwest Papua
	Parks in the waters of the Raja Ampat Islands in West Papua Province - Area II, Mayalibit Bay	Local/Provincial	Department of Marine Affairs and Fisheries of Southwest Papua
	Parks in the waters of the Raja Ampat Islands in West Papua Province - Area III, Dampier Strait	Local/Provincial	Department of Marine Affairs and Fisheries of Southwest Papua
	Parks in the waters of the Raja Ampat Islands in West Papua Province - Area IV, Misool Islands	Local/Provincial	Department of Marine Affairs and Fisheries of Southwest Papua
	Parks in the waters of the Raja Ampat Islands in West Papua Province - Area V, Kofiau-Boo Islands	Local/Provincial	Department of Marine Affairs and Fisheries of Southwest Papua
	Parks in the waters of the Raja Ampat Islands in West Papua Province - Area VI, Fam Islands	Local/Provincial	Department of Marine Affairs and Fisheries of Southwest Papua
8	Parks in the Waters of the North Misool Region of the Raja Ampat Islands, Southwest Papua Province	Local/Provincial	Department of Marine Affairs and Fisheries of Southwest Papua
9	Bintuni Bay Nature Reserve (CA)	National	Ministry of Environment and Forestry- West Papua Natural Resources Conservation Center
10	Sabuda Tataruga Island Wildlife Sanctuary (SM)	National	Ministry of Environment and Forestry- West Papua Natural Resources Conservation Center
11	Berau Bay Coastal Park (TP)	Local/Provincial	Department of Marine Affairs and Fisheries of West Papua
	Nusalasi-Van Den Bosch Bay Coastal Park (TP)	Local/Provincial	Department of Marine Affairs and Fisheries of West Papua
12	Area 1 Marine Tourism Park (TWP) - Buruway	Local/Provincial	Department of Marine Affairs and Fisheries of West Papua
	Area 2 Marine Tourism Park (TWP) - Arguni	Local/Provincial	Department of Marine Affairs and Fisheries of West Papua
	Area 3 Marine Tourism Park (TWP) - Kaimana	Local/Provincial	Department of Marine Affairs and Fisheries of West Papua
	Area 4 Marine Tourism Park (TWP) - Etna Bay	Local/Provincial	Department of Marine Affairs and Fisheries of West Papua
13	Venu Island Wildlife Sanctuary (SM) (included within KKP Buruway)	National	Ministry of Environment and Forestry- West Papua Natural Resources Conservation Center
14	Traditional Community-Based Fisheries Management (TCBFM) Bintuni	Local/Provincial	Department of Marine Affairs and Fisheries of West Papua
15	Park of A Thousand and One Rivers of Teoenebikia in the South Sorong Waters	Local/Provincial	Department of Marine Affairs and Fisheries of Southwest Papua
16	Prospective Maksegara Regional Conservation Area (CKKD) (in Makbon-Selemkai-Mega-Morait)	Local/Provincial	Department of Marine Affairs and Fisheries of Southwest Papua
17	Kofiau Marine Nature Reserve (CAL)	National	Ministry of Environment and Forestry- West Papua Natural Resources Conservation Center

Regency	Province	Area (ha)	Status	Legal Base for Determination/Reservation/ Management and Zoning Plans
Biak	West Papua	177.411,35	Ministerial Determination	Kepmen-KP No. 36 Tahun 2022
Biak Numfor	West Papua	49.062,44	Ministerial Determination	Kepmen-KP No. 184 Tahun 2023
Manokwari Selatan, Nabire, Teluk Wondama	Papua - West Papua - Central Papua	1.435.500,00	Ministerial Determination	SK Menhut 8009/Kpts-II/2002
Tambrau	Southwest Papua	32.250,86	Ministerial Determination	Kepmen-KP No. 53 Tahun 2017
Raja Ampat	Southwest Papua	267.209,16	Ministerial Determination	Kepmen-KP No. 32 Tahun 2022
Raja Ampat	Southwest Papua	57.875,75	Ministerial Determination	Kepmen-KP No. 32 Tahun 2022
Raja Ampat	Southwest Papua	100.008,99	Ministerial Determination	KepMen-KP No. 13 Tahun 2021
Raja Ampat	Southwest Papua	49.786,82	Ministerial Determination	KepMen-KP No. 13 Tahun 2021
Raja Ampat	Southwest Papua	353.440,54	Ministerial Determination	KepMen-KP No. 13 Tahun 2021
Raja Ampat	Southwest Papua	348.518,74	Ministerial Determination	KepMen-KP No. 13 Tahun 2021
Raja Ampat	Southwest Papua	137.318,73	Ministerial Determination	KepMen-KP No. 13 Tahun 2021
Raja Ampat	Southwest Papua	359.385,65	Ministerial Determination	KepMen-KP No. 13 Tahun 2021
Raja Ampat	Southwest Papua	308.777,35	Ministerial Determination	Kepmen-KP No. 191 Tahun 2023
Teluk Bintuni	West Papua	135.101,59	Ministerial Determination	SK. 3121/Menhut-VII/KUH/2014
Fakfak	West Papua	16.828,00	Ministerial Determination	SK Menhut No.783/Menhut-II/2014
Fakfak	West Papua	98.943,80	Ministerial Determination	Kepmen-KP No. 79 Tahun 2020
Fakfak	West Papua	247.864,07	Ministerial Determination	Kepmen-KP No. 79 Tahun 2020
Kaimana	West Papua	232.062,54	Ministerial Determination	Kepmen-KP No. 25 Tahun 2019
Kaimana	West Papua	35.475,86	Ministerial Determination	Kepmen-KP No. 25 Tahun 2019
Kaimana	West Papua	121.742,41	Ministerial Determination	Kepmen-KP No. 25 Tahun 2019
Kaimana	West Papua	110.523,32	Ministerial Determination	Kepmen-KP No. 25 Tahun 2019
Kaimana	West Papua	13,70	Ministerial Determination	SK Menhut No.783/Menhut-II/2014
Teluk Bintuni	West Papua	66.935,60	Substitute	Dokumen RZWP3K Provinsi Papua Barat dan Deklarasi Masyarakat Adat
Sorong Selatan	Southwest Papua	349.133,13	Ministerial Determination	Kepmen-KP No.67 tahun 2021
Sorong	Southwest Papua	135.300,00	Substitute	SK Gubernur-PB No. 523/87/4/2020
Raja Ampat	Southwest Papua	10.964,00	Ministerial Determination	SK Menhut No.783/Menhut-II/2014
Total Area		5.237.434,40 ha		

Appendix 2. List of Mangrove Types found in the BHS

No	Family	Genus	Species	Component
1	Myrsinaceae	Aegiceras	<i>Aegiceras corniculatum</i> , <i>Aegiceras floridum</i>	True/Exclusive
2	Avicenniaceae	Avicennia	<i>Avicennia marina</i> , <i>Avicennia alba</i> , <i>Avicennia lanata</i>	True/Exclusive
3	Rhizophoraceae	Bruguiera	<i>B. cylindrica</i> , <i>B. gymnorhiza</i> , <i>B. parviflora</i> , <i>B. sexangula</i>	True/Exclusive
		Ceriops	<i>Ceriops decandra</i> , <i>Ceriops tagal</i>	True/Exclusive
		Rhizophora	<i>R. apiculata</i> , <i>R. mucronata</i> , <i>R. stylosa</i> , <i>R. lamarckii</i>	True/Exclusive
4	Combretaceae	Lumnitzera	<i>Lumnitzera littorea</i> , <i>Lumnitzera racemosa</i>	True/Exclusive
		Terminalia	<i>Terminalia catappa</i>	Association
5	Bombacaceae	Camptostemon	<i>Camptostemon schultzei</i>	True/Exclusive
6	Sonneratiaceae	Sonneratia	<i>Sonneratia alba</i> , <i>Sonneratia caseolaris</i> , <i>Sonneratia lanceolata</i>	True/Exclusive
7	Meliaceae	Xylocarpus	<i>X. granatum</i> , <i>X. moluccensis</i> , <i>X. rumphii</i>	True/Exclusive
8	Acanthaceae	Acanthus	<i>Acanthus ebracteatus</i> , <i>Acanthus ilicifolius</i>	Association
9	Pteridaceae	Acrostichum	<i>Acrostichum aureum</i> , <i>Acrostichum speciosum</i>	Association
10	Lecythydaceae	Barringtonia	<i>Barringtonia asiatica</i>	Association
11	Clusiaceae	Calophyllum	<i>Calophyllum inophyllum</i>	Association
12	Apocynaceae	Cerbera	<i>Cerbera manghas</i>	Association
13	Fabaceae	Cynometra	<i>Cynometra sp.</i>	Association
		Derris	<i>Derris trifoliata</i>	Association
		Inocarpus	<i>Inocarpus fagiferus</i>	Association
		Pongamia	<i>Pongamia pinnata</i>	Association
14	Bignoniaceae	Dolichandrone	<i>Dolichandrone spathacea</i>	Association
15	Areaceae	Nypa	<i>Nypa fruticans</i>	Association
16	Euphorbiaceae	Excoecaria	<i>Excoecaria agallocha</i>	Association

References: Dharmawan & Widyastuti (2017); Lense (n.d.); Suharjo (2013); and Yayasan EcoNusa (2019).

Appendix 3. List of Seagrass Species recorded in the BHS

No	Scientific Name	Indonesian/local Name
1	<i>Cymodocea rotundata</i>	Lamun berujung bulat
2	<i>Cymodocea serrulata</i>	Lamun bergigi
3	<i>Halodule pinifolia</i>	Lamun serabut variasi daun sempit
4	<i>Halodule uninervis</i>	Lamun serabut variasi daun lebar
5	<i>Halophila ovalis</i>	Lamun senduk
6	<i>Halophila spinulosa</i>	Lamun senduk dasar keriting
7	<i>Halophila minor</i>	Lamun senduk kecil
8	<i>Thalassia hemprichii</i>	Lamun dugong
9	<i>Thalassodendron ciliatum</i>	Lamun kayu
10	<i>Syringodium isoetifolium</i>	Lamun alat suntik
11	<i>Enhalus acoroides</i>	Lamun tropika

Reference: McKenzie et al. (2007)

Appendix 4. Coral Reef Health Monitoring Methods

The Bird's Head Seascape MPA ecological monitoring program is a partnership program between Conservation International, The Nature Conservancy, World Wide Fund for Nature (Indonesia), World Wildlife Fund (United States), and the University of Papua. Since 2010, the partnership (originally CI, TNC, WWF-ID) has implemented ecological monitoring. This monitoring focuses on two components of the coral reef ecosystem: fish populations (abundance and biomass) and benthic cover (percentage cover). The coral reefs are monitored every 2-3 years using the Wilson and Green (2009) protocol, with an updated version by Ahmadi, et al. (2013).

In this report, we examine data from three selected ecological indicators to reflect evaluations of management targets, disseminate information to policymakers, and serve as indicators of ecosystem and fish population health. These indicators align with those used in MPA management assessments, which include coral reef condition and populations of key fisheries species and non-target species. Other criteria include characteristics of the ecological indicators (e.g., functional and trophic group differences, life history, and home range). Considering all of this information, we selected the following indicators:

1. **REEF FISHERIES:** artisanal, or small-scale fisheries, are traditional fisheries operated by individuals (as opposed to commercial enterprises), with low capital and energy requirements, typically small (not necessarily existing) fishing fleets, relatively short fishing trips, close to the coastline, and largely for local consumption. Artisanal fisheries can also feed into commercial trade chains, through fish traders, producing products for local consumption or export (FAO, 2016).
 - **Indicator: Key fish species.**
 - Three representative fish families were selected to reflect the fisheries status: Lutjanidae (snappers), Haemulidae (sweetlip), and Serranidae (groupers). These fish are often large and have a high market value. Total biomass was calculated from all species in these three families; biomass is a function of the combined number and size of fish.
2. **CORAL REEF RESILIENCE AND ECOSYSTEM FUNCTION:** Ecological resilience can be defined as the ability of an ecosystem to absorb disturbances or shocks and adapt to changes while maintaining the same ecosystem function and structure (Holling 1973, McClanahan et al. 2012).
 - **Indicator: Functional groups of fish.**
 - Representative herbivorous fish were selected to reflect the resilience status of coral reefs and ecosystem function, namely Acanthuridae (surgeonfish), Scaridae (parrotfish), and Siganidae (rabbitfish). The number of these species can serve as a measure of reef stability and of reef resilience to disturbances. Total biomass was calculated for all species in these three families; it is a function of the combined number and size of fish.
3. **CORAL REEF CONDITION:** the status of the composition or condition of the benthic (reef surface) community in a coral reef area that influences “bottom-up ecological processes” and has cascading effects on the dynamics and function of the entire reef ecosystem. Stony corals that build reefs form the three-dimensional structure of coral reefs that provide important habitat for many reef organisms.
 - **Indicator: Hard coral cover.**
 - Hard coral cover is the most commonly used indicator of coral reef condition. Coral cover is a measure of the proportion of the reef surface covered by living hard coral compared to coral rubble, rocks, algae, sponges, or other substrates.

Appendix 5. List of Coral Genera Recorded in the BHS

No	Family	Genus
1	Acroporidae	<i>Acropora</i> , <i>Anacropora</i> , <i>Astreopora</i> , <i>Isopora</i> , <i>Montipora</i>
2	Agariciidae	<i>Coeloseris</i> , <i>Gardineroseris</i> , <i>Helioseris</i> , <i>Leptoseris</i> , <i>Pachyseris</i> , <i>Pavona</i>
3	Euphyllidae	<i>Catalaphyllia</i> , <i>Euphyllia</i> , <i>Fimbriaphyllia</i> , <i>Galaxea</i> , <i>Physogyra</i> , <i>Plerogyra</i>
4	Fungidae	<i>Ctenactis</i> , <i>Cycloseris</i> , <i>Danafungia</i> , <i>Fungia</i> , <i>Halomitra</i> , <i>Herpolitha</i> , <i>Lithophyllon</i> , <i>Lobactis</i> , <i>Pleuractis</i> , <i>Podabacia</i> , <i>Polyphyllia</i> , <i>Sandalolitha</i> , <i>Zoopilus</i>
5	Lobophyllidae	<i>Acanthastrea</i> , <i>Australophyllia</i> , <i>Cynarina</i> , <i>Echinophyllia</i> , <i>Homophyllia</i> , <i>Lobophyllia</i> , <i>Oxypora</i>
6	Merulinidae	<i>Astrea</i> , <i>Caulastrea</i> , <i>Cyphastrea</i> , <i>Dipsastraea</i> , <i>Echinopora</i> , <i>Favites</i> , <i>Goniastrea</i> , <i>Hydnophora</i> , <i>Leptoria</i> , <i>Merulina</i> , <i>Mycedium</i> , <i>Oulophyllia</i> , <i>Pectinia</i> , <i>Platygyra</i> , <i>Scapophyllia</i> , <i>Trachyphyllia</i>
7	Pocilloporidae	<i>Madracis</i> , <i>Pocillopora</i> , <i>Seriatopora</i> , <i>Stylophora</i>
8	Poritidae	<i>Alveopora</i> , <i>Bernardopora</i> , <i>Goniopora</i> , <i>Porites</i>
9	Others	<i>Coscinaraea</i> , <i>Craterastrea</i> , <i>Psammocora</i> , <i>Stylaraea</i> , <i>Turbinaria</i>

Reference: Veron J.E.N., Stafford-Smith M.G., Turak E. and DeVantier L.M. (2016). *Corals of the World*. Accessed 16 Mar 2026. https://www.coralsoftheworld.org/ecoregion_factsheets/

Appendix 6. New Species in the BHS

As part of its biodiversity documentation efforts, research conducted by Konservasi Indonesia in 2018 successfully identified 9 (nine) new fish species in the Berau Bay and Nusalasi Bay – Van Den Bosch (Chandra, 2018). The species discovered included various families, such as Syngnathidae, Pomacentridae, Gobiidae, and Blennidae, with examples including *Choeroichthys hadiatyae*, *Chrysiptera uswanasi*, *Eviota gunawanae*, and *Ecsenius springeri*.

Furthermore, literature from Allen & Erdmann (2024) and a number of scientific journals also complements our understanding of the species richness in this region. Various species from the families Pomacentridae, Gobiidae, Labridae, and Apogonidae have been reported from Fakfak, Raja Ampat, Misool, and Cenderawasih Bay. For example, species such as *Pomacentrus mandacani*, *Eviota tetha*, *Meiacanthus fakfakensis*, *Cirrhilabrus xanthozonus*, *Cirrhilabrus marinda*, and *Siphamia papuensis* were found to have specific distributions in this region. These findings enrich the list of species in the BHS, confirming its role as a global center of biodiversity and active speciation, while also reinforcing its status as a vital natural laboratory for the development of global marine science (Allen & Erdmann, 2009; Hocdé et al., 2017).

A recent study by Allen & Erdmann (2024) noted that the BHS region, which includes Raja Ampat, Fakfak-Kaimana, and TNTC, is home to at least 1,884 fish species, a figure that exceeds that of any other region in the Coral Triangle and Southeast Asia.

As part of the Coral Triangle, the region with the highest marine biodiversity in the world, the BHS plays a vital role in global conservation and science (Veron et al., 2011). The coral reefs in the BLK are not only home to thousands of species but also a bright spot for new taxonomic discoveries that enrich our understanding of tropical marine biodiversity (Allen & Erdmann, 2009; Hocdé et al., 2017).

This scientific significance makes the MPAs at the BHS a vital “living laboratory,” where monitoring, sampling, and the description of new species are ongoing (Allen & Erdmann, 2024; Hocdé et al., 2017). These findings not only emphasize the importance of protecting the area but also position the BHS as an irreplaceable source of global scientific data (Browne et al., 2022).



Appendix 7. Hard Coral Cover Data Table

MPA Name	Period	n Sites	Hard Coral Cover	
			Mean	SE
Parks in the waters of the Raja Ampat Islands in West Papua Province - Area I, Ayau-Asia Islands	1	9	30.222	3.967
	2	9	38.815	3.583
	3	9	39.259	3.371
	5	9	43.519	5.485
	6	9	39.000	4.150
	7	9	32.979	3.331
Area 1 Marine Tourism Park (TWP) - Buruway	1	20	20.733	3.700
	3	20	17.383	3.278
	5	20	24.333	3.999
	7	20	32.605	3.797
Parks in the waters of the Raja Ampat Islands in West Papua Province - Area III, Dampier Strait	1	28	18.631	3.050
	2	28	29.845	3.456
	3	28	29.631	3.433
	5	28	31.131	3.515
	6	28	30.935	3.513
	7	28	34.798	3.197
Parks in the waters of the Raja Ampat Islands in West Papua Province - Area VI, Fam Islands	3	24	29.903	2.458
	4	24	31.931	2.458
	5	24	39.569	3.041
	6	24	32.125	3.173
	7	24	42.722	2.989
Parks in the Waters of the Western Waigeo Islands and Surrounding Seas	1	8	29.000	3.242
	2	8	33.625	3.517
	3	8	27.208	3.185
	5	8	23.667	3.853
	6	8	29.500	3.839
	7	8	34.167	1.774
Parks in the waters of the Raja Ampat Islands in West Papua Province - Area V, Kofiau-Boo Islands	1	19	30.333	3.901
	2	19	19.070	1.884
	3	19	26.228	2.246
	5	19	36.456	3.767
	6	19	32.632	3.353
	7	19	29.842	2.933
Prospective Maksegara Regional Conservation Area (CKKD)	7	9	38.593	5.725
Parks in the waters of the Raja Ampat Islands in West Papua Province - Area II, Mayalibit Bay	1	13	17.872	2.264
	2	13	17.949	2.740
	3	13	20.128	3.840
	5	13	19.308	3.823
	6	13	20.615	4.278
	7	13	23.051	3.728
Parks in the waters of the Raja Ampat Islands in West Papua Province - Area IV, Misool Islands	1	18	39.444	2.573
	2	18	40.889	3.401
	3	18	37.185	3.326
	4	18	34.185	2.787
	5	18	38.796	3.316
	6	18	33.537	3.232
	7	18	32.463	2.688
Parks in the Waters of the North Misool Region of the Raja Ampat Islands, Southwest Papua Province	7	17	24.824	4.351
Berau Bay Coastal Park (TP)	5	14	42.584	3.816
Cenderawasih Bay National Park	1	29	39.943	1.954
	3	29	35.454	2.449
	5	29	45.529	3.203
	7	29	35.575	3.486

Appendix 7. Hard Coral Cover Data Table (Continued)

MPA Name	Period	n Sites	Hard Coral Cover	
			Mean	SE
Nusalasi-Van Den Bosch Bay Coastal Park (TP)	5	17	39.191	4.389
	7	17	52.681	3.683
Area 3 Marine Tourism Park (TWP) - Kaimana	2	24	17.111	2.675
	3	24	15.292	1.969
	5	24	14.243	2.506
	7	24	23.954	3.387
Werur Raya MHA	7	6	65.111	5.094
BHS	1	144	28.593	1.332
	2	119	26.860	1.472
	3	192	27.559	1.090
	5	192	32.251	1.345
	6	148	32.669	1.280
	7	192	32.706	1.152

Appendix 8. Fish Group Biomass Data Table

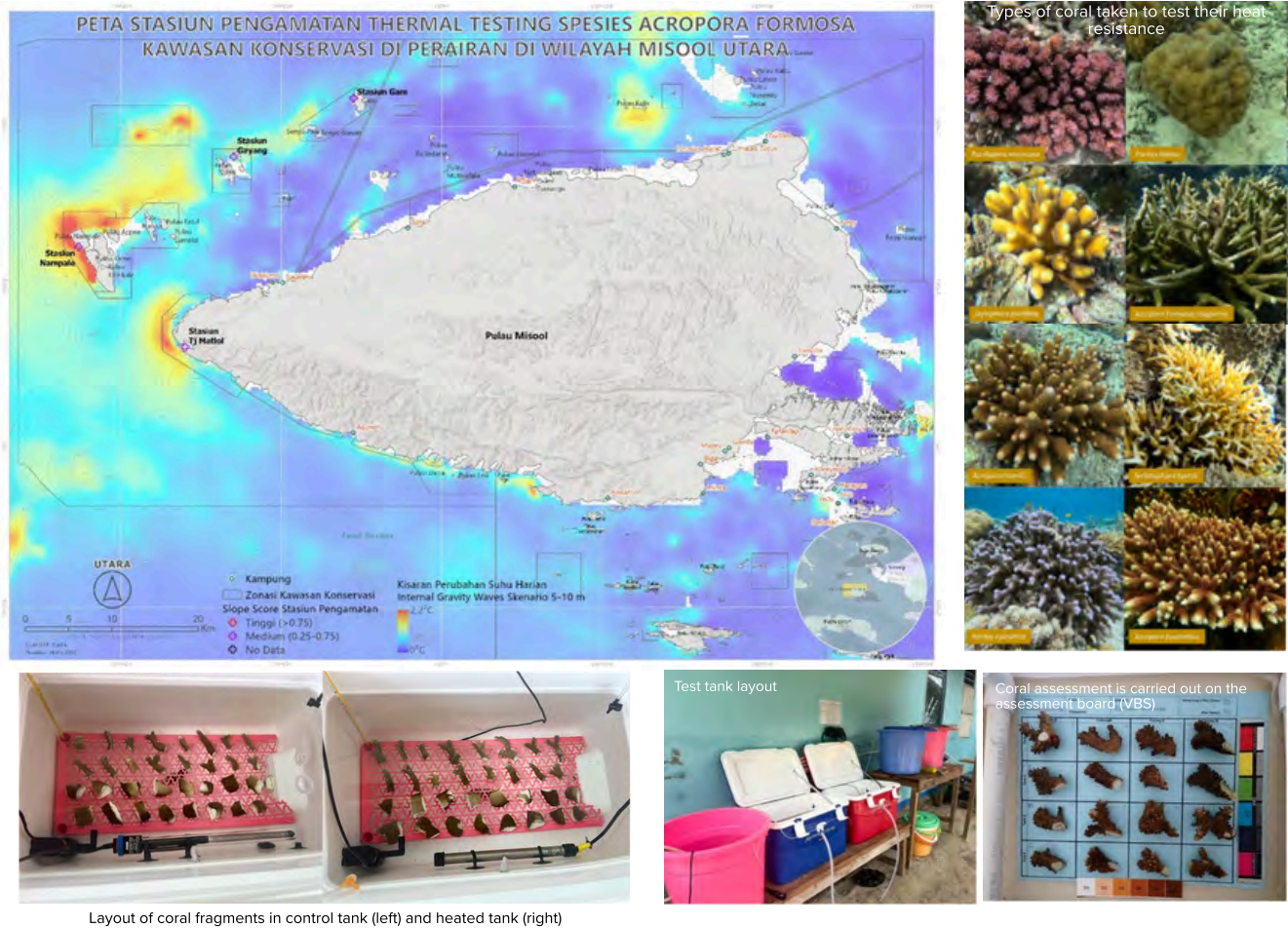
MPA Name	Period	n Sites	Key Fisheries		Fish Functional Groups	
			Mean	SE	Mean	SE
Parks in the waters of the Raja Ampat Islands in West Papua Province - Area I, Ayau-Asia Islands	1	16	525.886	148.915	321.530	61.598
	2	16	757.582	122.396	396.730	53.627
	3	16	1470.250	312.689	606.206	142.126
	5	16	995.284	216.794	342.032	95.023
	6	16	2850.161	1294.939	447.731	77.046
	7	16	761.935	178.655	283.463	30.096
Area 1 Marine Tourism Park (TWP) - Buruway	1	20	973.502	434.489	2295.948	859.125
	3	20	236.543	50.738	359.349	110.005
	5	20	164.253	26.820	248.794	83.894
	7	20	1127.500	254.394	5025.375	1169.340
Parks in the waters of the Raja Ampat Islands in West Papua Province - Area III, Dampier Strait	2	15	82.507	26.553	444.946	126.785
	3	15	80.187	17.935	679.734	94.430
	5	15	228.128	109.265	1828.498	1108.824
	6	15	82.591	20.993	474.561	178.537
	7	15	114.532	25.605	282.004	71.482
Parks in the waters of the Raja Ampat Islands in West Papua Province - Area VI, Fam Islands	3	24	131.031	32.573	793.010	227.961
	4	24	254.479	60.380	743.438	140.238
	5	24	111.112	26.052	184.978	43.253
	6	24	18.912	7.769	699.959	465.254
	7	24	167.707	45.096	821.838	332.238
Parks in the Waters of the Western Waigeo Islands and Surrounding Seas	1	9	47.370	17.495	258.385	85.253
	2	9	254.413	152.641	681.131	251.320
	3	9	249.601	86.318	1386.442	452.775
	5	9	253.961	56.279	440.794	72.573
	6	9	131.672	51.621	243.910	67.920
	7	9	163.143	42.938	476.660	359.620
Parks in the waters of the Raja Ampat Islands in West Papua Province - Area V, Kofiau-Boo Islands	1	19	134.699	20.853	166.271	34.993
	2	19	209.511	54.017	189.046	56.490
	3	19	182.904	43.018	342.078	127.861
	5	19	314.832	59.091	556.069	103.066
	6	19	490.900	112.783	605.062	159.247
	7	19	215.047	33.229	382.420	65.035
Prospective Maksegara Regional Conservation Area (CKKD)	7	9	144.686	41.423	502.765	158.474
Parks in the waters of the Raja Ampat Islands in West Papua Province - Area II, Mayalibit Bay	1	12	195.272	59.857	591.323	320.884
	2	12	254.779	126.687	189.798	64.776
	3	12	221.924	73.427	482.421	165.793
	5	12	155.904	43.077	269.501	54.021

Appendix 8. Fish Group Biomass Data Table (Continued)

MPA Name	Period	n Sites	Key Fisheries		Fish Functional Groups	
			Mean	SE	Mean	SE
Parks in the waters of the Raja Ampat Islands in West Papua Province - Area II, Mayalibit Bay	6	12	140.061	39.528	274.463	96.430
	7	12	262.994	122.616	455.122	156.563
Parks in the waters of the Raja Ampat Islands in West Papua Province - Area IV, Misool Islands	1	22	250.898	77.065	362.800	91.401
	2	22	138.484	22.194	168.858	39.858
	3	22	168.662	48.882	219.892	115.969
	4	22	459.944	273.623	344.424	119.247
	5	22	174.113	51.526	445.309	180.093
	6	22	239.921	191.714	1329.390	1093.195
	7	22	90.091	12.395	270.251	92.534
Parks in the Waters of the North Misool Region of the Raja Ampat Islands, Southwest Papua Province	7	17	242.420	67.282	252.577	75.958
Berau Bay Coastal Park (TP)	5	14	193.569	41.037	197.661	73.738
Cenderawasih Bay National Park	1	29	176.499	27.551	114.929	30.730
	3	29	143.490	32.309	207.102	45.715
	5	29	160.006	54.467	293.894	48.504
	7	29	313.943	91.441	1639.540	367.754
Nusalasi-Van Den Bosch Bay Coastal Park (TP)	5	16	203.159	69.109	670.135	143.384
	7	18	468.673	144.872	1232.391	334.124
Area 3 Marine Tourism Park (TWP) - Kaimana	2	24	324.663	88.140	369.879	63.311
	3	24	283.986	83.705	755.291	228.222
	5	24	92.490	15.885	58.842	10.749
	7	24	933.894	518.328	586.635	329.446
Werur Raya MHA	7	6	390.306	184.955	392.040	102.186
BHS	1	127	345.286	75.993	590.224	152.467
	2	117	286.540	36.295	321.483	34.118
	3	190	293.024	40.065	525.535	57.073
	5	220	236.761	25.779	424.105	82.640
	6	117	553.560	196.636	660.792	227.833
	7	240	412.063	62.878	1028.916	144.868

Appendix 9. Coral Thermal Test in Raja Ampat

Authors: Grace Easteria, Fadli Jaka, Dzikra Fauzia, Awaludinnoer Ahmad



Extreme changes in ocean temperatures can kill corals directly, even before bleaching mortality occurs (Hughes et al., 2018). Naturally, corals from environments with high thermal fluctuations have better resistance to bleaching (Oliver & Palumbi 2011; Palumbi et al. 2014), thus potentially increasing the success of restoration in the face of climate change (DeFilippo et al. 2022; Cornwell et al. 2021). YKAN (affiliated with TNC) has been conducting research since 2024 to identify climate-resilient coral reefs to support the marine conservation area zoning system in Raja Ampat.

Research using the Coral method Bleaching Automated Stress System (CBASS) in three areas: South Misool, North Misool, and the Dampier Strait. A total of 978 colonies of eight species (*Acropora formosa*, *A. hyacinthus*, *A. humilis*, *Porites lobata*, *P. cylindrica*, *Pocillopora verrucosa*, *Seriatopora hystrix*, and *Stylophora pistillata*) were collected from 12 locations through 32 experiments. Coral conditions after thermal exposure were assessed using the Visual Bleaching Score (VBS) scale, 1 (healthy) to 5 (completely white).

Porites lobata showed the best heat resistance with an average VBS of 1.83 up to a temperature of 36°C across the study area, while *Acropora formosa* was the most susceptible species with a VBS of 3.17–3.36 at 35°C. The bleaching risk of *P. lobata* was 81% lower than that of *A. formosa* in South Misool, and 93% lower in Dampier Strait. The genus *Porites* is known to have high thermal tolerance (McClanahan et al., 2004), while *A. Formosa* is vulnerable due to its thin tissue and symbiotic zooxanthellae, which are sensitive to oxidative stress (Clark et al. 2022; Munbondhe et al. 2023).

Other species that show strong resistance include *P. cylindrica*, *Pocillopora verrucosa*, and *Acropora hyacinthus*. Two-way ANOVA analysis confirmed that species ($F=46.23$; $p<0.001$) and environmental origin ($F=24.53$; $p<0.001$) were significant predictors of bleaching rates in the Misool region. In the Dampier Strait, only species ($F=18.938$; $p<0.001$) had a significant effect, while environmental origin did not.

Several allocations have been identified as potential refugia: Kalig Station (South Misool) for *P. lobata* and *P. cylindrica*; Gam (North Misool) with the highest heat-tolerant colonies (*P. lobata*, $n=16$; *P. cylindrica*, $n=10$); and Mioskon (Dampier Strait) with low slope values for *P. lobata* (0.25 ± 0.14) and *P. cylindrica* (0.25 ± 0.12), indicating relatively high heat tolerance. The Sauwandarek site (Dampier Strait), which frequently experiences bleaching, also supports many heat-tolerant species, reflecting strong local adaptation.

Appendix 10. Coral Bleaching Survey in Dampier Strait, Raja Ampat

Authors: Grace Easteria, Awaludinnoer Ahmad, Rizya Ardiwijaya, Fadli Jaka, Dzikra Fauzia

INTRODUCTION

Dampier Strait in Raja Ampat is an area with extremely high marine biodiversity, but it is increasingly vulnerable to coral bleaching due to rising sea temperatures. Bleaching occurs when corals lose their zooxanthellae, symbiotic algae that contribute to coral nutrition and color, potentially leading to coral death if prolonged. A similar event was recorded in Sauwandarek Village in 2024.



Alert Level 1 - 9 Dec 2025
Significant heat stress was recorded in West Papua Province (NOAA Coral Reef Watch)



Level watch - 10 Dec 2025
The heat stress downgraded by one level, but the area remained under close monitoring

METHODOLOGY



The survey was conducted on **December 11, 2025**, using the snorkeling method on the reef crest along the coastline of Sauwandarek Village, following **Coral protocol Watch Coral Health Chart** (Siebeck et al., 2006). Each coral colony was visually identified, and its tissue color was compared against the four-point CoralWatch color scale (B–E, values 1–6). Colonies were classified as healthy (score >3), mildly stressed (=3), or bleached (<3) (Anderson-King et al. 2023). **A total of 20 colonies of *Acropora* sp.** were marked for further post-bleaching monitoring.

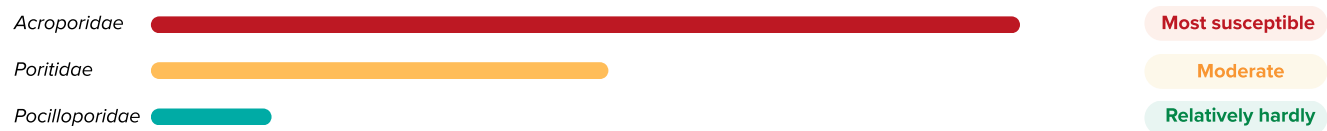
HEALTHY
> 3
Score: 4,5-5,5

MIDLY STRESSED
= 3
Critical threshold

BLEACHED
< 3
Score: 1,5-2,5

RESULTS AND DISCUSSION

The most severe bleaching was observed in the family Acroporidae, particularly the branching and table-shaped Acropora, which are known to be more sensitive to elevated temperatures (Obura & Grimsditch, 2009):



The family Poritidae (*Porites lobata* and *P. cylindrica*) experienced some blanching in some colonies, but most remained healthy. Pocilloporidae (*Pocillopora* and *Stylophora*) appeared the most stable, with most colonies remaining healthy, reflecting differences in heat tolerance between families.

NEXT STEPS



Acropora corals are the group most affected by rising sea surface temperatures in the Dampier Strait in December 2025. A total of **20 *Acropora* colonies**, ranging from healthy (score 4.5–5.5) to bleached (score 1.5–2.5), have been tagged for re-observation after bleaching to assess **coral recovery** and **mortality levels**. This data will be an important reference in understanding the response of the BHS coral reef ecosystem to increasing thermal stress, as well as being the basis for formulating an adaptive area management strategy to climate change.

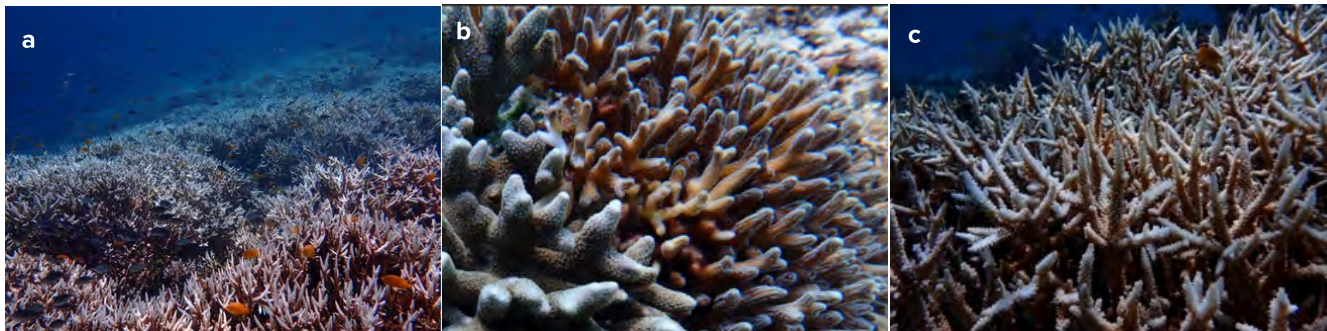


Figure 4.1. (a) The coral bleaching conditions that occurred in Sauwandarek were dominated by branching *Acropora* sp.; (b). *Stylophora* corals appeared the healthiest, compared to branching *Acropora* species that appeared to be bleached extensively (c). Documentation source: Yayasan Konservasi Alam Nusantara (YKAN), 2025.

Appendix 11. Coral Reef Health Monitoring: Snapshots from the North Misool MPA, Maksegara MPA, and Werur Raya MHA

Authors: Yayasan Konservasi Alam Nusantara (2024a; 2024b; 2024c)

The seascape-based overview of coral reef ecosystem conditions provides an important aggregate snapshot, but a deeper understanding requires a regional-scale review. Each conservation area in the BHS has its own ecological characteristics, pressures, and recovery dynamics that are not always reflected in the overall average. The following section presents a more detailed snapshot of coral reef conditions in three areas that were the focus of intensive monitoring during this period: the North Misool KK, the Werur Raya Customary Community Area in Tambrau, and the Maksegara Conservation Area Candidate in Malaumkarta, as a reflection of the diversity of conditions and management challenges that exist within the BHS MPA network.

Coral reef health monitoring in the waters of Tambrau Regency carried out by the DKP of Southwest Papua Province, UNIPA, YKAN, and other conservation partners.
© Awaludinnoer (YKAN)



Coral reef in the waters of Tambrau Regency
© Awaludinnoer (YKAN)



Snapshot of Reef Health Status

from three marine protected areas

Authors: Yayasan Konservasi Alam Nusantara

PIT UVC BBT

Point Intercept Transect • Underwater Visual Census • Bentos Belt Transect

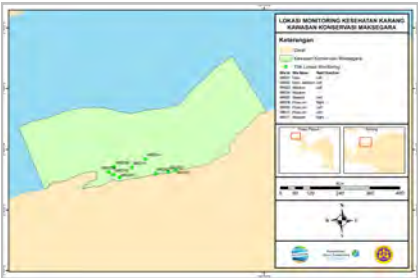


A. MPA

North Misool

Raja Ampat

• 17 Stations • Sep-Oct 2024

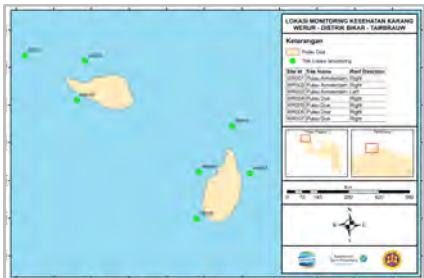


B. MPA

Maksegara

Malaumkarta

• 11 Stations • 2024



C. MHA

Werur Raya

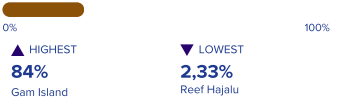
Tambrau

• 7 Stations • Oct 2024

HARD CORAL COVER

24,82%

Moderate

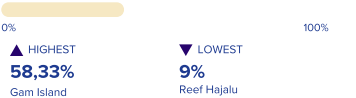


Coral rubble dominates 38.51% of the substrate. Dead coral increases in the no-take zone.

HARD CORAL COVER

38,59%

High

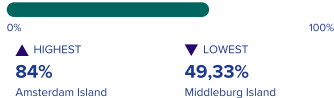


Coral rubbles were low (5.33%). Algae were found at all stations, averaging 16.85%.

HARD CORAL COVER

65,11%

High



Coral rubbles account for 14.56% of the total, and algae comprise an average of only 1.56%.

REEF FISH BIOMASS

506,74 kg/ha

Low



16 of the 17 stations were below the 970 kg/ha threshold. Key fisheries biomass increased in the restricted use zone.

REEF FISH BIOMASS

659,28 kg/ha

Low



All stations were below the 970 kg/h threshold. Key fisheries biomass decreased; functional fish biomass increased compared to 2022.

REEF FISH BIOMASS

813,43 kg/ha

Low



Below the 970 kg/ha threshold, key fisheries biomass increased compared to 2022. Functional fish showed no significant changes.

MEGABENTHOS

Blue Starfish	170	Drupela Snails	40
Sea Cucumber	13	Lola	38
Sea Urchins	77	Giant Clams (Kima)	10
COTS	7	Lobsters	7

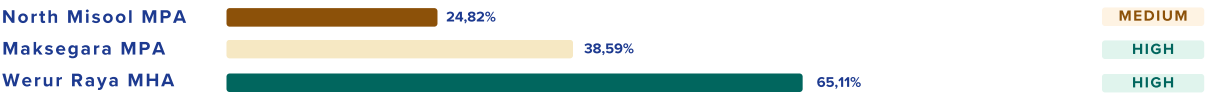
MEGABENTHOS

Blue Starfish	5	Drupela Snails	5
Sea Cucumber	-	Lola	3
Sea Urchins	-	Giant Clams (Kima)	11
COTS	-	Lobsters	1

MEGABENTHOS

Blue Starfish	27	Drupela Snails	41
Sea Cucumber	6	Lola	26
Sea Urchins	10	Giant Clams (Kima)	1
COTS	5	Lobsters	5

COMPARISON OF HARD CORAL COVER BETWEEN REGIONS



Appendix 12. Coral Reef Health Monitoring: A Snapshot of South Misool



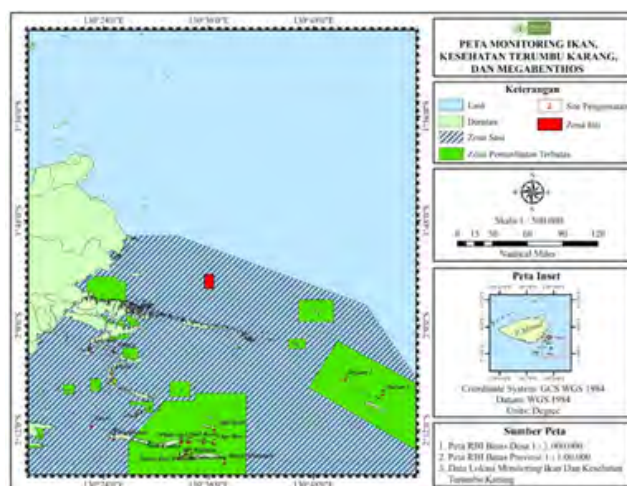
Monitoring of coral reef health and target fish biomass by YMER in the Food Security and Tourism Subzone of the South Misool Marine Protected Area (KKLD) provides important insights into the condition of the coral reef ecosystem. This data indicates that coral reef biotic cover remains in good condition. However, changes in substrate composition, fluctuations in target fish biomass, and the emergence of stress indicators such as bleaching and coral disease still require regular monitoring.

MONITORING COVERAGE:

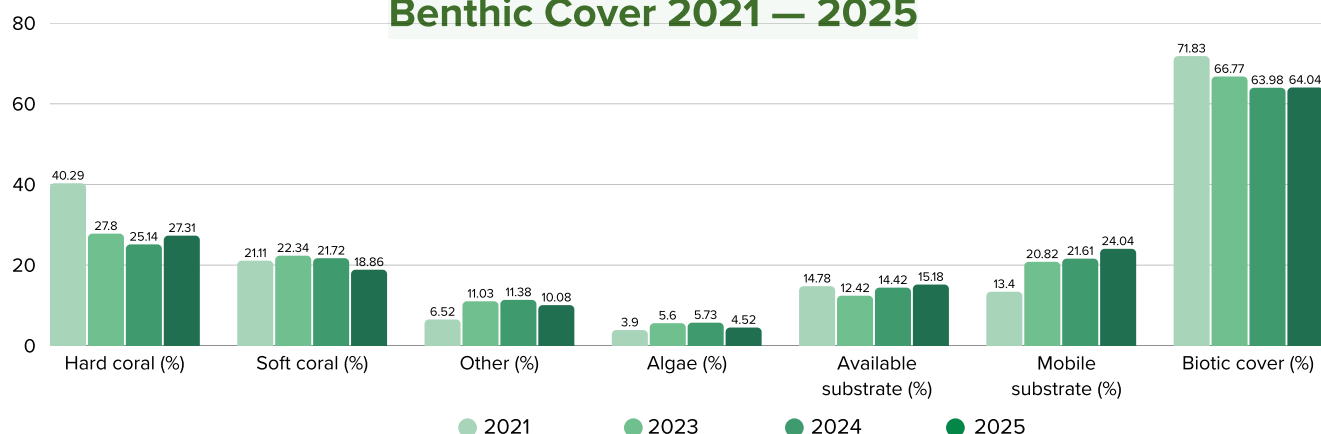
- **Data series available:** 2021, 2023, 2024, 2025
- **Number of sites:** 11 sites in 2021-2024; 14 sites in 2025
- **Depth:** 5 m & 12 m
- **Methods:** UVC for target fish, PIT for benthic, BBT for megabenthos
- **Components:** benthic cover, target fish biomass, megabenthos, bleached coral, and coral disease.

VITAL RECORDS:

The year 2025 is not completely comparable to previous years due to the addition of three new sites.



Benthic Cover 2021 – 2025

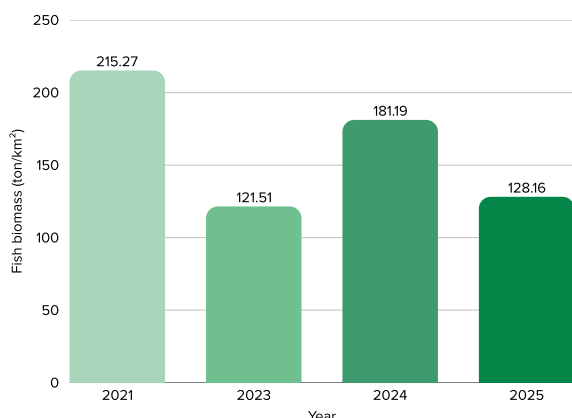


The biotic cover of coral reefs at the monitoring locations was relatively stable and was categorized as good. In 2021, the average biotic cover was recorded at 71.83%. This value then decreased to 66.77% in 2023, 63.98% in 2024, and slightly increased to 64.04% in 2025. Hard coral cover showed a more pronounced change, decreasing from 40.29% in 2021 to 27.80% in 2023, and then to 25.14% in 2024. In 2025, hard coral cover increased again to 27.31%, but this increase should be interpreted with caution, as the number of sites increased from 11 to 14.

Besides hard coral, the substrate should also be considered. The proportion of mobile Substrate increased from 13.40% in 2021 to 20.82% in 2023, 21.61% in 2024, and 24.04% in 2025. The increase in unstable substrate can hinder the recruitment and growth of new corals, making it an important indicator for further monitoring.



Fish Biomass Target 2021-2025



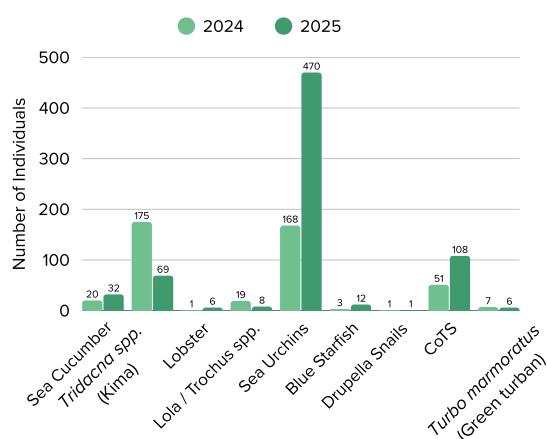
Target fish biomass fluctuates between years. In 2021, the average biomass was recorded at 215.27 tons/km². This value decreased to 121.51 tons/km² in 2023, then increased to 181.19 tons/km² in 2024, before dropping again to 128.16 tons/km² in 2025.

Biomass fluctuations are not only influenced by the number of species, but also by the size of the fish, the number of individuals, and the presence of schools of fish. In 2024, the increase in biomass was largely driven by the emergence of schools of fish from the Caesionidae family, as well as several other families, such as Carangidae and Acanthuridae. Conversely, in 2025, several locations did not record large numbers of fish schools, resulting in a decrease in average biomass.

Thus, target fish biomass should be read in conjunction with other indicators, such as the number of species, family composition, locations with extreme values, and utilization pressure in the surrounding area.

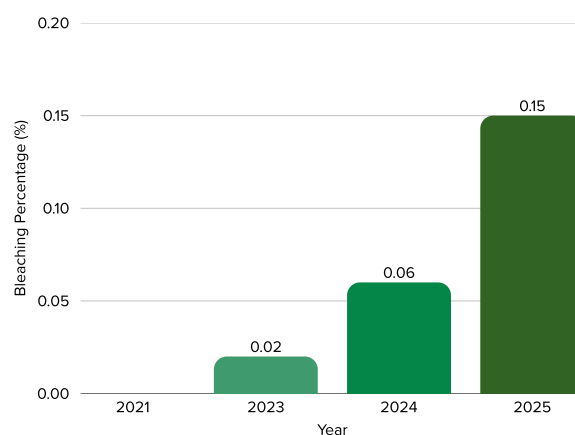
Megabenthos and Pressure Indicators

1. Megabenthos

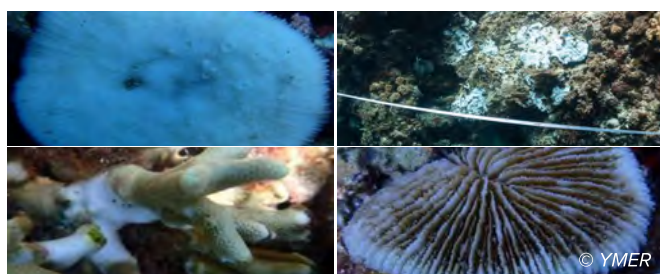


Megabenthos provides supporting information regarding the condition of coral reef ecosystems. By 2025, sea urchins were the most dominant group, with 470 individuals, primarily found in Little Yellit at a depth of 12 meters. Additionally, starfish, clams, and sea cucumbers were recorded as part of the megabenthos community.

2. Coral Bleaching



Pressure indicators also start to appear through bleaching records. Coral and coral disease. Coral bleaching increased from 0.02% in 2023 to 0.06% in 2024 and 0.15% in 2025. This is still a small number, but it is still important to note because bleaching is a signal of environmental stress that can develop if water conditions change.



In 2024, monitoring also recorded eight types of coral diseases or disorders, including White Band Disease, Yellow Band Disease, White's Syndrome Plague, Pigmentation Response, Tube Formers, Spot Biting, and Bleaching. This information is important as an initial baseline for assessing coral health stress in subsequent periods.

Key Message

Coral reefs at the YMER monitoring location, South Misool Marine Protected Area, still show good biotic cover.

The 2021–2025 data show an important dynamic: hardwood cover coral declined sharply after 2021, was relatively stable, mobile substrate tended to increase, and target fish biomass fluctuated.

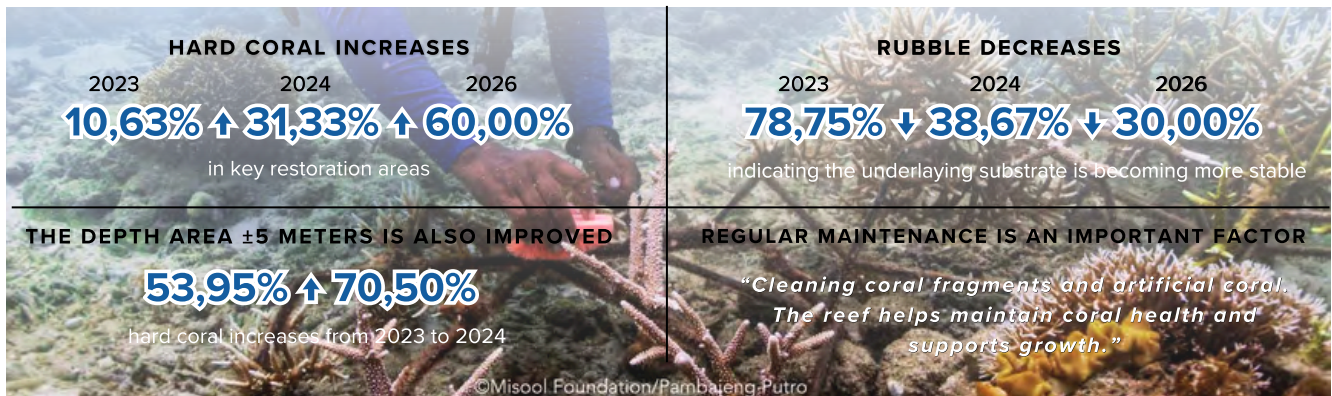
The area still has a strong ecological foundation, but it requires regular monitoring, management of local pressures, and careful interpretation of data, especially given changes in site coverage in 2025.

Appendix 13. Monitoring of Coral Reef Restoration Area on Kalig Island

Authors: Yayasan Misool Ekosistem Regenerasi

Benthic Cover Monitoring Results

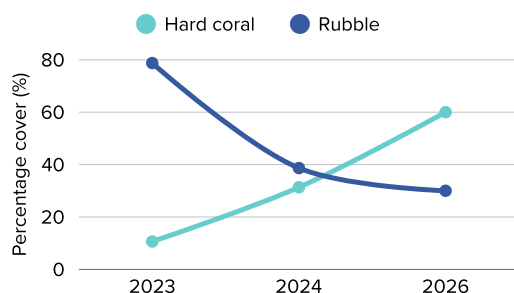
YMER's coral reef restoration activities on Kalig Island have shown positive signs of benthic ecosystem recovery. In the main restoration area, hard coral cover has been restored. Coral increased gradually after the placement of the artificial reef, while mobile cover, substrate/rubble decreased. Monitoring results in other areas at depths of approximately 5 meters also show a similar trend: increased live coral cover and decreased unstable substrate.



Main restoration areas: Recovery Trends in Major Restoration Areas

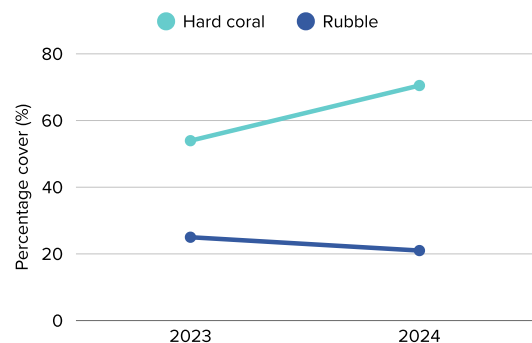
The initial survey in 2023 showed that the condition of the restoration area was still dominated by rubble at 78.75%, while hard cover accounted for only 10.63%. This condition indicates that the area had previously been damaged, leaving the bottom of the water.

substrate unstable enough to support new coral growth. After the installation of the artificial reef, hard cover Coral cover increased to 31.33% in 2024 and continued to increase to 60.00% in 2026. At the same time, rubble coverage decreased to 38.67% in 2024 and 30.00% in 2026. This trend indicates that the restoration process is progressing effectively, and the bottom of the waters is becoming more stable and increasingly covered by live coral colonies.



Area with a depth of ±5 meters: Benthic Cover Improvement in the Restoration Area.

Monitoring of benthic cover in the coral reef restoration area of Kalig Island at a depth of approximately 5 meters also shows an improving trend. Coral coverage increased from 53.95% in 2023 to 70.50% in 2024. During the same period, rubble coverage decreased from 25.00% to 21.00%. Furthermore, the other category decreased from 9.21% to 0.50%, while available substrate content decreased from 3.95% to 1.00%. This pattern indicates that empty spaces and unstable substrates are beginning to be covered by the growth of benthic biota, particularly hard corals.



Supporting factors for success: Factors that Support the Success of Restoration

- An artificial placement Reef as a restoration medium provides a substrate that better supports coral growth.
- Regular maintenance of coral fragments and restoration structures keeps the colony healthy.
- Cleaning of pest organisms, such as algae, parasites, and other marine plants, helps increase survival rate and accelerate coral growth.

In general, monitoring results indicate that coral reef restoration on Kalig Island shows positive signs of ecosystem recovery, marked by increased live coral cover and decreased unstable substrate in the restoration area.

© YMER

Appendix 14. Turtle Monitoring and Nest Protection Methods

MORNING PATROL is carried out in the morning to record turtle egg-laying activity.

Indicators: Turtle type, egg-laying status, sector number, nest location, and nest disturbance.

The procedures for carrying out morning patrols include:

- preparing patrol equipment;
- recording patrol information;
- carrying out patrols along the beach every day; and
- if new tracks are found left by turtles that landed last night, carrying out a data collection process;
- marking tracks that have been recorded so that there is no repetition of data collection. Mempersiapkan peralatan patroli.

NIGHT PATROLS are carried out at night to obtain data from mother leatherback turtles.

Indicators: Time of encounter with turtle, egg-laying stage when found, curved carapace length, curved carapace width, tagging number, sector number or nest coordinates, and notes on interesting things observed on the mother turtle or during patrols.

The procedures for carrying out night patrols include:

- preparing patrol equipment;
- recording night patrol information;
- carrying out the patrol process on the beach near the waterline;
- recording the time and stages of turtle egg-laying when the turtle is found;
- maintaining distance from the turtle;
- preparing equipment for measuring the turtle and tagging. Or reading the tagging on the turtle when the turtle has finished laying eggs;
- marking the location of the turtle egg nest using the triangulation method (if the nest will be protected or its hatching will be evaluated);
- measuring the length and width of the turtle's carapace and recording the tagging number, old or new, on turtles.

NEST TRANSFER is carried out with the aim of producing more baby turtles (hatchlings) from the original nest location.

Indicators: Number of eggs, type of turtle, information on date of laying, shape of nest, depth of nest, and width of nest.

The procedures for moving turtle egg nests include:

- preparing equipment (gloves, sewing meter, notebook, writing tools, container/bucket and nest marking tape and permanent marker);
- moving eggs from the natural nest to the container,
- making an artificial nest (safe location, nest hole according to the depth and width of the original nest space, and the shape of the nest to suit the type of turtle:
 - bottle (hard-shelled turtle) or
 - boots (leatherback turtle);
- moving eggs from the container to the artificial nest.

EVALUATION OF NEST HATCHING SUCCESS is carried out to find out how many (percentage) eggs hatch in one nest.

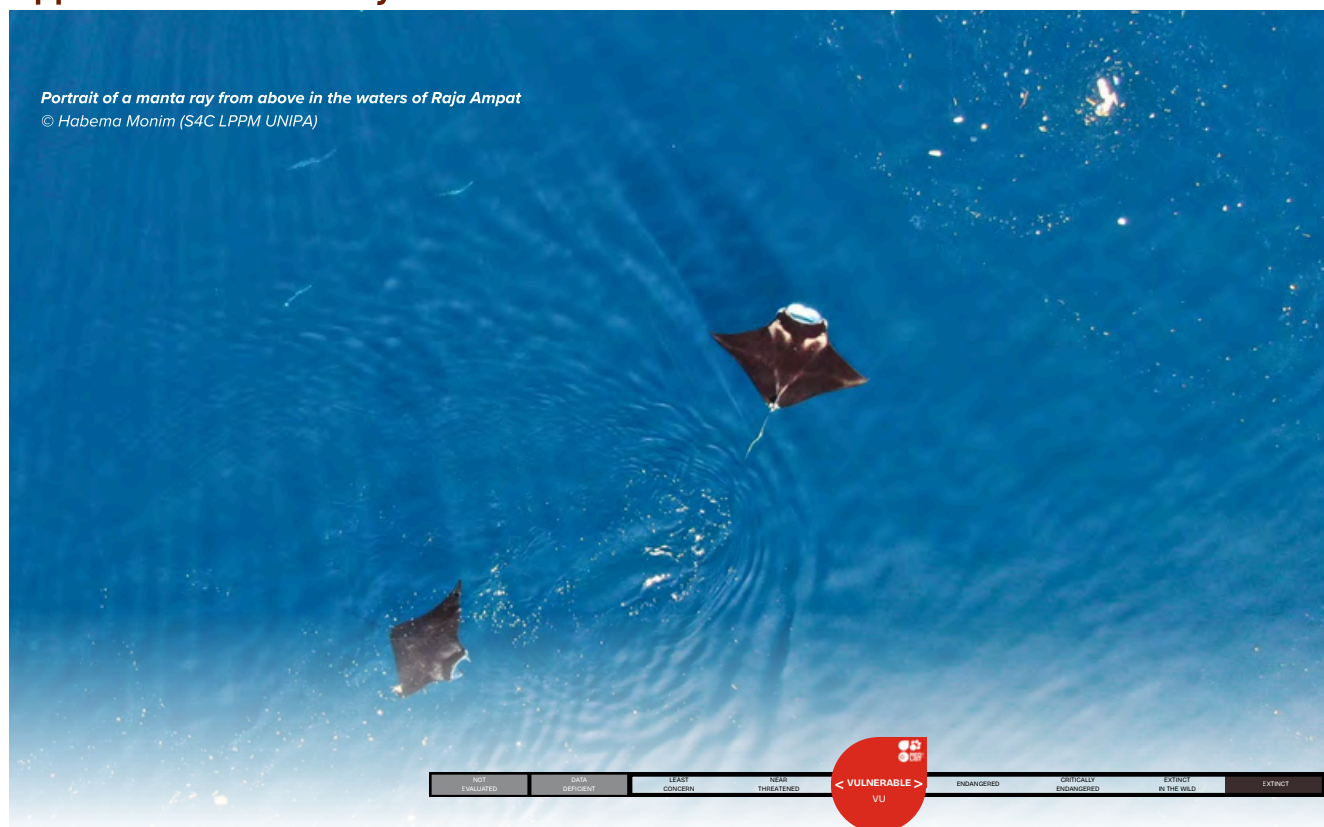
Indicators: large egg shells (>50%), small egg shell tears, live hatchlings, dead hatchlings, unhatched eggs, abnormal eggs.

Evaluation of hatching success is carried out 3-4 days after the nest hatches. If the nest does not hatch, the evaluation will be conducted after 70 days of incubation.

The procedure for evaluating nesting success includes:

- preparing the equipment that will be needed (gloves, masks, meters, data forms, and writing tools);
- digging the nest until the surface of the egg is visible, but if a hatchling is found that will rise to the surface, close the nest again so that the hatchling can rise to the surface by itself. This digging process is also carried out carefully so as not to tear the egg shell or injure the live hatchling in the nest;
- measuring the distance from the surface of the sand to the surface of the egg;
- grouping the contents of the nest;
- counting and recording the number of each group except the group of contents of the nest with small shell tears and then continuing with calculating the success of the nest hatching;
- reburying the contents of the nest except for the live hatchling;
- releasing the live hatchling when it is light or hot, the hatchling can be collected and buried in moist sand in a container to be released again at night.

Appendix 15. Manta Ray Research

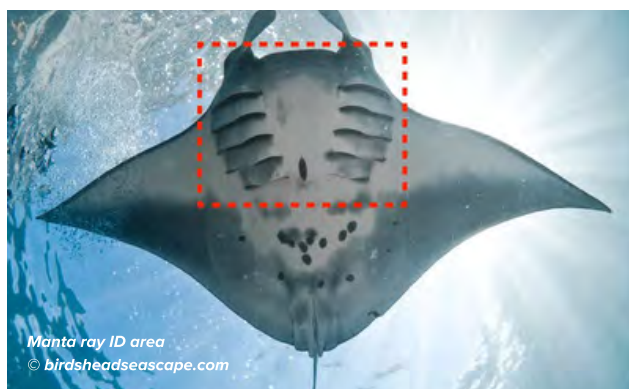
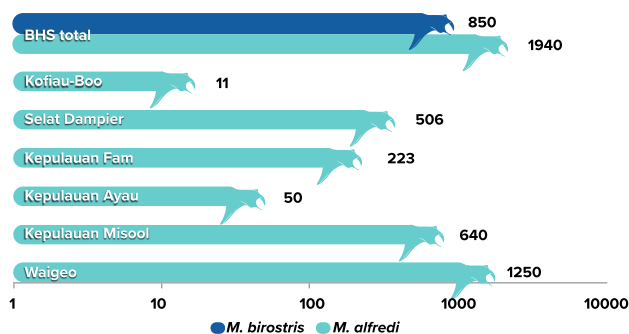


The Bird's Head Seascape (BHS) is known as a center of marine biodiversity and an important habitat for reef manta rays (*Mobula alfredi*) and giant manta rays (*Mobula birostris*). The Raja Ampat Islands in the northwest of the BHS are one of the world's top manta ray tourism destinations, and the importance of this species to the local economy led to the designation of Raja Ampat as a shark and ray sanctuary in 2012, followed by full protection of manta rays throughout Indonesian waters in 2014.

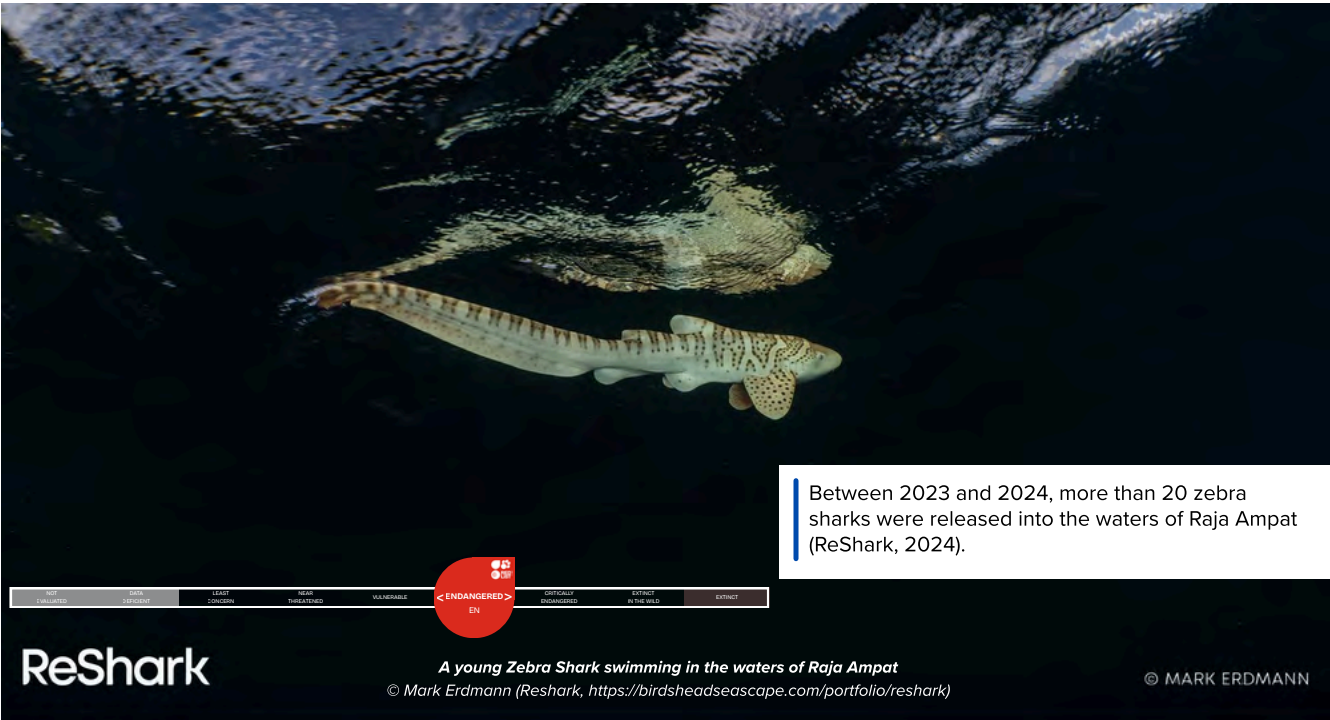
Monitoring of manta rays focuses on gathering locations, spawning, and cleaning stations, carried out through diving (SCUBA and freediving) with photo-ID techniques and underwater camera traps (Setyawan et al., 2020). Each manta ray has a unique pattern of spots and blotches on its ventral surface, like a human fingerprint, that remains constant throughout its life. Photo-ID techniques allow researchers to identify individuals, build population catalogs, and determine sex, thereby calculating the proportions of males and females in a population.

As of 2022, 1,682 manta rays were recorded in Raja Ampat, with the latest identification in 2024 reaching approximately 640 individuals in Misool, 1,250 in Waigeo, and fewer than 50 in Ayau Atoll (Setyawan, 2024; Gunadharna, 2022). Over 15 years of monitoring have shown that 90% of the BHS are aggregating areas for manta rays, especially in 13 conservation areas, most of which are in Raja Ampat. Extensive coral reef health provides food sources and cleaning stations, making these waters an ideal habitat for manta rays.

This conservation success was supported by a combination of national and regional policies, including the establishment of large-scale conservation areas, the designation of Raja Ampat as Southeast Asia's first shark and ray sanctuary, and strict management of manta ray tourism. As a result, the manta ray population has shown positive growth, demonstrating the success of collaborative conservation management at the BHS.



Appendix 16. Zebra Shark Research (*Stegostoma tigrinum*)



The leatherback shark or zebra shark (*Stegostoma tigrinum*) is the only species in the family Stegostomatida with a distribution in western Indo-Pacific waters (Allen & Erdmann, 2024). This non-aggressive species experienced a drastic population decline due to overfishing in the 1990s–2000s. In more than 15,000 hours of diving over two decades, researchers documented only three individuals in Raja Ampat, leading to the species being considered locally extinct (ReShark, 2025). Citizen reports indicate a sporadic presence of Science records in Misool, Dampier Strait, Ayau Besar, and Wayag.

In response to this threat, the StAR Project (*Stegostoma*) was launched (*Tigrinum Augmentation and Recovery*) as part of the ReShark global conservation network, a coalition of over 100 conservation organizations, aquariums, and government agencies.

This project aims to rebuild a healthy, self-sufficient, and sustainable population of leatherback sharks in their natural habitat (Arifin, 2024). Through egg translocations from accredited aquariums in Australia, the United States, and France, the shark eggs are hatched in hatcheries. Kri and Misool Islands . Once the sharks were old enough, they were released into the wild. In 2023, the first young leatherback sharks were released into Wayag Lagoon, followed by six individuals in Misool and the Dampier Strait in early 2024, and an additional 15 individuals over the next two months (Erdmann & Ichida, 2024).

The zebra shark is now listed as endangered by the IUCN (Dudgeon et al., 2019), with global populations under constant pressure from illegal trade in fins, meat, skin, and other body parts. Therefore, recovery projects such as StAR are strategically important not only to save this species but also to maintain the balance of the marine ecosystem, given sharks' role as apex predators.

With a target of releasing 500 sharks over 5-10 years (Erdmann et al., 2025), the StAR Project demonstrates that conservation efforts involving science, communities, and cross-institutional partnerships can restore the role of sharks and the marine ecosystem in Raja Ampat.



Appendix 17. Whale Shark Research (*Rhincodon typus*)

Whale shark (*Rhincodon typus*) is one of the key species in Cenderawasih Bay National Park (TNTC), the Bird's Head Seascape (BH) area of Papua covering an area of ±1.45 million hectares (Maruanaya et al., 2022). The waters off Kwatisore in Cenderawasih Bay are known as a year-round whale shark habitat, unlike most other locations in Indonesia, which are seasonal, making this area nationally important for the conservation of this species (Manuhutu et al., 2021).

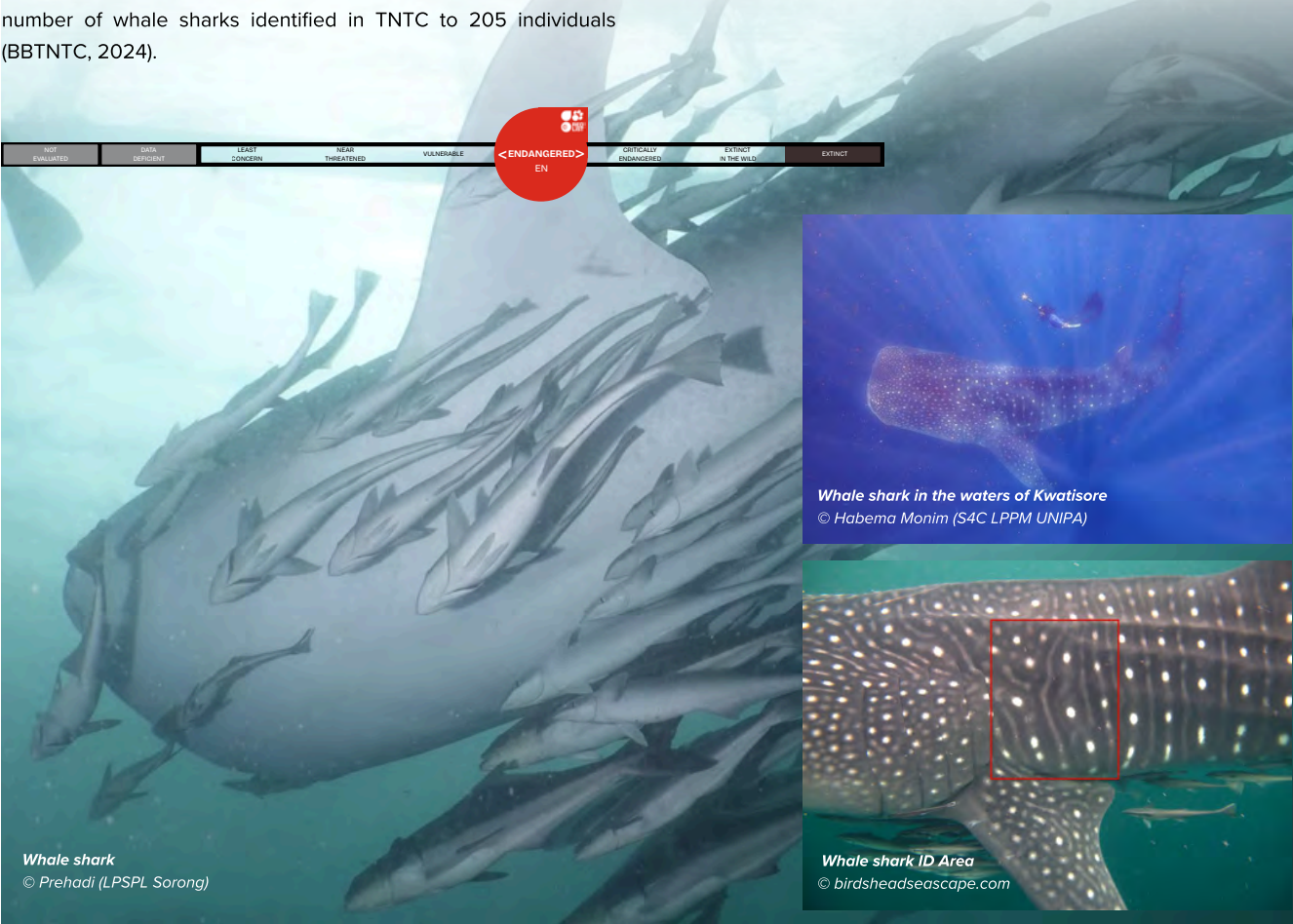
Whale shark monitoring is conducted through two approaches: direct and indirect. The direct approach relies on visual observation by fishermen, managers, and tourists. Indirect monitoring, on the other hand, uses technologies such as radio frequency (RF) monitoring. Identification (RFID) and Pop-up Satellite Archival Tag (PSAT) to track the movement and behavior of this species (Toha et al., 2019). Individual identification uses photographic identification (Photo-ID) based on unique spot patterns around the gills, as has long been done in the Kwatisore Waters in TNTC. WWF-Indonesia noted that since 2011, joint monitoring by partners such as BBTNTC, local governments, local communities, universities, and Kali Lemon Resort in Kwatisore has collected at least 10,556 photos, 606 occurrence data, and identified 135 different whale shark individuals, predominantly young males with an average length of around 4.4 meters (Ihsan, 2017).

The official TNTC publication also noted that monitoring in September 2024 documented 10 individuals through direct observation and 8 individuals based on information from fishermen, including two new individuals, bringing the total number of whale sharks identified in TNTC to 205 individuals (BBTNTC, 2024).

Follow-up monitoring by SPTN Region I Kwatisore in July 2025 again recorded six individual whale sharks in several fishing nets, accompanied by biophysical measurements of the waters as part of the area monitoring efforts (BBTNTC, 2025).

Recent research conducted by Edy Setyawan from Elasmobranch Institute Indonesia over 13 years (2010-2023), together with teams from Indonesia (BLUD UPTD Kaimana) and abroad (CI, University of Western Australia, Adelaide, and Shark Research Foundation), also recorded 268 unique individuals from 1,118 encounters throughout the BHS (Setyawan et al., 2025). Cenderawasih Bay was the primary location, with 159 individuals, followed by Kaimana with 95, while Raja Ampat and Fakfak had lower encounter frequencies. In contrast to Cenderawasih Bay, which tends to be year-round, whale sharks in Kaimana are seasonal, with an average stay of 37.8 days per visit. The presence of whale sharks in this area is influenced by the abundance of food, especially anchovies (*Stolephorus* sp.), as well as their interaction with fishing nets, which simultaneously opens opportunities for developing community-based ecotourism.

However, pressure on the population remains high. In Kaimana, 83.7% of individuals were recorded as having scars, higher than in TNTC (73.7%), most of which were associated with interactions with lift-net fishing gear. Given its status as an endangered species according to the IUCN, strengthened long-term monitoring, more specific site management—especially in Kaimana—and multi-stakeholder collaboration are needed to ensure sustainable whale shark conservation while supporting the well-being of coastal communities.



Appendix 18. Social Monitoring Methods

The Bird's Head Seascape KK social monitoring program is a partnership between the University of Papua, Conservation International, and the World Wildlife Fund (America). Since 2010, the partnership has monitored human well-being in eight (8) MPAs (Cenderawasih Bay National Park, Kaimana Network: Buruway, Etna Bay, Triton Bay, Raja Ampat Network: Kofiau-Boo Islands, Misool Islands, Dampier Strait, and Mayalibit Bay) from four districts in three provinces in Papua, West Papua, and Southwest Papua. The University of Papua conducted household surveys of randomly representative residents within the MPA areas. Data collected included economic well-being, health, political empowerment, education, and culture. MPAs were monitored every two years until the second iteration, and then every three years. Baseline data were collected from 2010 to 2012.

In this book, we examine data on five common human well-being attributes in public well-being policies. One key indicator from each attribute dimension is then selected as follows:

ECONOMIC WELL-BEING: There are resources people use to meet basic needs, as well as access to sources of well-being (Sen, 1999).

Indicator: Household material assets

Household material assets are more reliable and have been widely used as indicators of economic well-being. We adopted a "basket of goods" method that assesses whether a household owns specific assets (e.g., a boat, a telephone, and a television). The eleven items in the "basket" range from low-priced items (e.g., a mobile phone) to high-priced items (e.g., a car, a boat with an inboard motor). Each asset type is weighted.

HEALTH: A 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 of anyone, at any time, to obtain sufficient and safe nutrition for an active and healthy life in a socially acceptable manner (Bickel et al. 2000). The Bird's Head Seascape monitoring program adopted an international standard scale that divides households into three food security categories (Bickel et al. 2000), namely:

1. **Food secure:** Households show little evidence of food insecurity, meaning they can obtain sufficient, safe, and nutritious food in a socially acceptable manner.
2. **Food insecurity without hunger:** Evidence of food insecurity is seen in household members who are concerned about food sufficiency and make adjustments to food management, including attempts to reduce food quality and to adopt unusual coping strategies. Little or no reduction in food intake is reported.
3. **Food insecurity with hunger:** Food intake among household members has decreased to the point that they frequently experience physical hunger.

POLITICAL EMPOWERMENT: The ability of people to participate in decision-making processes that impact their lives (United Nations Development Program et al., 2005)

Indicator: Marine tenure

Rights to marine resources can be divided into five types of functional rights (Mascia & Claus, 2009), which include the right to enter an MPA; the right to take fish or other resources within the MPA; the right to manage the MPA (e.g., making decisions on how to utilize the resources); the right to prohibit others from entering the MPA (e.g., making decisions about who may and may not enter the MPA); and the right to transfer rights to marine resources to others (e.g., sale or lease rights).

The BHS social monitoring program uses a resource rights index to measure the rights received by each household during the 12 months preceding the survey. The index (ranging from 0 to 5) measures the number of rights a household has exercised during the 12 months preceding the survey.

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

Indicator: School participation rate

We measured the percentage of school-age children (ages 5-18, inclusive) enrolled in formal education in each household.

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

Indicator: Place Attachment

Place attachment is "a positive relationship or emotional bond between a person and a place" (Williams & Vaske, 2003). Research shows that place attachment is a strong predictor of environmentally responsible behavior and can influence environmental stewardship (Vaske & Kobrin, 2001; Gosling & Williams, 2010).

We measured each household resident's emotional attachment using a standard scale (modified from Gosling & Williams, 2010). The scale ranges from zero to five, with higher scores indicating a stronger emotional attachment to a household.

Appendix 19. Social Monitoring Data Table

MPA Name	Period	Household material assests		Food security		Marine tenure		School participation rate		Place attachment	
		Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Mayalibit Bay	1	20.212	0.799	3.162	0.095	3.173	0.064	0.729	0.023	4.708	0.029
	2	21.574	0.847	3.169	0.081	2.444	0.069	0.900	0.016	4.019	0.017
	3	23.975	0.944	3.544	0.088	3.033	0.069	0.838	0.018	3.941	0.023
	4	20.234	0.831	3.708	0.069	2.659	0.064	0.782	0.022	3.860	0.033
	5	18.320	0.674	3.792	0.124	1.955	0.042	0.779	0.022	4.263	0.030
	6	12.239	0.617	2.626	0.092	2.739	0.078	0.811	0.020	3.974	0.013
North Misool	1	17.415	1.117	3.080	0.122	2.059	0.089	0.852	0.025	4.081	0.031
	2	22.132	1.454	3.358	0.090	2.396	0.084	0.890	0.022	4.023	0.032
	3	21.368	1.385	3.569	0.067	1.847	0.110	0.912	0.017	4.106	0.024
	4	18.868	0.999	3.979	0.115	1.479	0.056	0.931	0.016	3.978	0.051
	5	15.036	0.797	2.467	0.078	2.583	0.068	0.854	0.016	4.420	0.034
Cendrawasih Bay National park	1	19.256	0.877	2.751	0.127	3.556	0.084	0.727	0.022	4.268	0.030
	2	23.159	0.982	3.098	0.085	2.709	0.080	0.762	0.021	3.899	0.022
	3	25.968	1.111	3.742	0.048	2.133	0.078	0.823	0.018	4.010	0.019
	4	23.660	0.850	3.823	0.059	2.980	0.079	0.851	0.018	3.843	0.027
	5	12.808	0.444	1.308	0.042	2.604	0.056	0.855	0.012	4.317	0.022
Kofiau-Boo Island	1	21.554	1.181	2.682	0.102	2.827	0.091	0.833	0.024	4.114	0.024
	2	23.100	1.297	3.247	0.095	2.557	0.090	0.871	0.021	3.953	0.030
	3	22.065	1.132	3.611	0.063	2.101	0.097	0.861	0.024	4.003	0.021
	4	20.180	0.894	3.946	0.140	1.950	0.040	0.803	0.029	4.167	0.046
	5	20.175	0.798	4.207	0.128	2.132	0.057	0.773	0.027	4.323	0.033
	6	12.858	0.558	2.585	0.095	2.422	0.070	0.757	0.024	3.963	0.023
Dampier Strait	1	24.468	0.793	3.228	0.081	2.731	0.071	0.835	0.017	3.837	0.020
	2	27.894	1.152	3.495	0.065	2.787	0.063	0.845	0.016	3.986	0.021
	3	23.067	0.796	3.864	0.074	1.658	0.057	0.875	0.015	3.921	0.017
	4	25.225	0.793	3.969	0.069	2.216	0.065	0.854	0.016	4.007	0.025
	5	21.021	0.882	2.966	0.104	2.585	0.072	0.865	0.019	4.074	0.032
Misool Islands	1	18.379	0.878	2.734	0.109	2.094	0.066	0.801	0.020	3.923	0.018
	2	18.581	0.812	3.150	0.083	2.274	0.069	0.774	0.021	3.943	0.025
	3	19.790	0.943	3.647	0.056	1.885	0.065	0.841	0.018	4.085	0.024
	4	18.852	0.711	3.601	0.095	1.744	0.064	0.816	0.021	3.826	0.039
	5	12.889	0.463	2.409	0.075	2.364	0.043	0.798	0.015	4.251	0.024
Buruway	1	20.293	1.688	3.214	0.137	2.000	0.120	0.717	0.041	3.900	0.046
	2	23.122	1.519	3.605	0.129	2.228	0.106	0.725	0.033	4.018	0.036
	3	20.393	1.540	3.908	0.092	1.841	0.104	0.773	0.032	3.939	0.033
	4	19.116	1.385	3.817	0.129	2.259	0.102	0.829	0.027	3.861	0.028
	5	9.705	1.058	1.559	0.119	2.533	0.186	0.808	0.046	4.117	0.049
Etna Bay	1	21.075	2.317	3.247	0.265	1.900	0.133	0.782	0.056	3.913	0.078
	2	17.328	1.100	2.742	0.116	2.168	0.117	0.757	0.032	3.879	0.039
	3	20.462	1.390	4.003	0.058	1.899	0.097	0.807	0.028	4.014	0.021
	4	16.125	1.092	2.913	0.155	1.894	0.045	0.788	0.034	4.227	0.046
	5	7.901	0.704	1.939	0.187	2.580	0.122	0.848	0.033	4.261	0.061
Kaimana	1	18.651	1.206	2.703	0.160	2.311	0.110	0.742	0.030	3.797	0.046
	2	18.006	0.883	3.554	0.087	2.050	0.078	0.784	0.022	3.919	0.029
	3	18.006	1.082	3.990	0.072	1.816	0.076	0.792	0.024	3.972	0.016
	4	14.346	0.865	4.198	0.113	1.590	0.042	0.716	0.031	4.173	0.040
	5	6.209	0.502	2.436	0.126	2.306	0.100	0.809	0.029	4.315	0.043

Appendix 20. Marine Resource Governance Monitoring Methods (FGD, KII)

In addition to welfare monitoring, the Bird's Head Seascape MPA social monitoring program also includes monitoring patterns and trends in marine resource governance in eight (8) MPAs (Cenderawasih Bay National Park, Kaimana Network: Buruway, Etna Bay, Triton Bay, Raja Ampat Network: Kofiau-Boo Islands, Misool Islands, Dampier Strait, and Mayalibit Bay).

Marine resource governance defines the process of managing marine resources, including how decision-making authority is allocated, how management decisions are made, and how they are enforced (Mascia et al., 2017). Resource governance can influence the social and ecological outcomes of political interventions (Persha et al., 2011; Fox et al., 2011), such as KK, and successful governance regimes have been found to share similar characteristics (Ostrom, 1990). These characteristics include: participatory decision-making mechanisms, context-appropriate regulations, active and accountable systems for monitoring and enforcing rules, and affordable conflict-resolution mechanisms (e.g., inexpensive, rapid, and on-the-spot dispute-resolution processes). Focus group discussions and key informant interviews were conducted in each monitored settlement to understand marine resource governance in each MPS. The focus group discussions and key informant interviews focused on how marine resource management decisions are made, the rules governing marine resource management, how marine resource management is monitored and enforced, and how conflicts over marine resources are resolved.

Focus group discussions and key informant interviews are conducted in approximately half of the monitored settlements within each MPA every two years. This process provides a comprehensive assessment of marine resource governance every four years. Consequently, in the first edition of the Bird's Head Seascape MPA Network Status Report, we documented the status of resource governance, drawing on 148 focus group discussions and key informant interviews conducted across eight MPAs in the seascape. In subsequent reports, we will report on governance status and trends. We examined the data using four key attributes of marine resource governance within the seascape:

PARTICIPATION IN DECISION MAKING

User groups in decision-making have been linked to positive social and ecological outcomes in a variety of contexts (Ostrom, 1990; Persha et al., 2011). We monitored the proportion of beneficiary groups (i.e., groups of individuals who use marine resources in the same way) who participated in designing marine resource management rules in the eight monitored MPAs.

Indicator: Participatory decision making.

RESOURCE USE RULES

Rules (which specify when, where, how, and by whom resources can be used) tailored to local conditions are more likely to produce positive social and ecological outcomes than rules that are not tailored to local conditions (Ostrom, 1990). Women monitored the proportion of important species and habitats (as determined by focus group discussions) that have specific use rules in the eight monitored MPAs. Species and habitats can be identified as 'important' based on their economic, cultural, and spiritual values.

Indicators: Rules that are adapted to certain conditions

MONITORING AND ENFORCEMENT OF RULES

Governance systems that implement graduated sanctions (e.g., penalties that increase with the type of violation) more often produce positive social and ecological outcomes than systems that do not implement sanctions or that apply a single sanction to a variety of violations.

Indicator: Sanctions given

CONFLICT RESOLUTION

The ability of users and officials to resolve disputes over marine resources or their management quickly and cheaply has been found to be associated with more positive social and ecological outcomes (Ostrom, 1990). Women monitored the average time required to resolve conflicts between users or between users and officials in eight MPAs across the monitored seascape.

Indicator: Affordable conflict resolution mechanisms

Appendix 21. Marine Resource Governance Monitoring Data Table

MPA Name	Period	Number of sanction		User participation		Number of habitats		Number of species		Conflict resolution time	
		Mean	SE	Mean	SE	Mean	SE	Mean	SE	Mean	SE
Buruway	1	3.500	1.500	54.170	45.830	4.000	0.000	5.500	0.500	1.130	0.130
	2	1.330	0.880	0.000	0.000	4.670	0.330	4.330	0.330	30.020	29.980
	3	2.000	0.580	14.440	9.880	2.330	0.330	5.000	0.000	10.670	8.690
Dampier Strait	1	1.570	0.370	62.500	22.500	2.000	0.380	5.000	0.000	30.000	30.000
	2	1.500	0.330	36.570	17.250	3.500	0.500	3.880	0.440	5.140	4.170
	3	2.140	0.260	56.350	12.520	3.140	0.140	4.710	0.180	3.330	0.840
Etna Bay	1	2.250	0.250	37.500	31.460	2.750	0.250	4.500	0.290	2.500	0.500
	2	1.000	0.000	0.000	0.000	2.000	0.000	4.000	0.000	21.000	17.000
Kaimana	1	1.170	0.170	6.670	4.940	2.500	0.340	4.670	0.210	0.880	0.130
	2	1.000	0.260	0.000	0.000	3.170	0.310	5.000	0.770	1.060	0.540
	3	1.500	0.500	15.000	5.000	3.000	0.000	5.000	0.000	0.000	0.000
Kofiau-Boo Islands	1	1.250	0.480	60.000	15.810	3.250	0.480	4.500	0.500	2.000	0.000
	2	1.670	0.880	20.000	20.000	4.000	0.000	4.330	1.200	2.000	0.000
	3	2.750	0.850	31.540	18.460	5.250	0.750	7.000	1.220	9.630	7.300
Maksegara	1	1.500	0.500	25.000	8.330	3.500	0.500	5.000	0.000	1.000	0.000
Malaumkarta	1	2.000	0.580	34.540	15.010	5.000	0.000	5.000	0.000	1.000	0.000
Mayalibit Bay	1	2.000	0.300	58.540	13.950	3.000	0.190	5.000	0.000	2.250	0.730
	2	3.000	0.000	60.000	16.960	5.000	0.000	5.000	0.000	1.000	0.000
	3	0.910	0.160	30.890	11.350	4.270	0.270	5.000	0.130	2.380	0.940
Misool Islands	1	1.780	0.280	25.000	25.000	3.250	0.250	5.000	0.000	5.400	1.440
	2	1.860	0.140	26.190	13.420	3.400	0.240	4.860	0.140	0.710	0.360
	3	1.000	0.000	0.000	0.000	3.000	0.000	7.000	0.000	0.000	0.000
North Misool	1	0.750	0.750	0.000	0.000	4.000	0.410	11.000	2.480	1.500	0.500
Cendrawasih Bay National Park	1	2.070	0.320	5.760	2.950	4.000	0.260	5.200	0.350	1.940	0.060
	2	0.860	0.460	0.000	0.000	3.710	0.180	4.860	0.140	0.500	0.500
	3	1.000	0.190	7.980	2.950	2.380	0.500	5.000	0.000	1.330	0.670
Werur	1	1.000	0.000	0.000	0.000	5.000	0.000	5.000	0.000	0.000	0.000
BHS	1	1.890	0.120	30.980	5.060	3.280	0.140	4.970	0.100	6.600	3.100
	2	1.500	0.160	19.590	5.090	3.610	0.170	4.550	0.180	5.470	2.610
	3	1.430	0.170	26.950	5.710	3.530	0.210	5.800	0.390	4.310	1.460

Appendix 22. EVIKA Assessment Method (Evaluation of the Effectiveness of Marine Conservation Area Management)

Previously, the Ministry of Maritime Affairs and Fisheries (KKP) developed the E-KKP3K assessment measuring tool in 2011, which was subsequently implemented in 2012. Along with the development of conservation area management, new challenges emerged. Therefore, in 2020, through the Decree of the Directorate General of Marine Spatial Management Number 28/KEP-DJPRL/2020, the KKP issued the EVIKA technical guidelines, which became a measuring tool for assessing the effectiveness of new conservation area management in the Republic of Indonesia. EVIKA is used as an instrument to assess the effectiveness of conservation area management and to improve management quality, performance, and planning.

EVIKA's assessment aspects include governance, area resources, conservation targets, social, economic, and cultural aspects. All these aspects are translated into indicators to measure management effectiveness across input, process, output, and outcome criteria. The criteria and indicators measured in this evaluation are:

- 1. **Input Criteria:** Area Status, Zoning Plan, Management Plan, Human Resources, Budget, Facilities, and Infrastructure.
- 2. **Process Criteria:** Standard Operating Procedures (SOP) for Management, Supervision, Outreach, Partnerships, Monitoring of Area Resources, Management of Facilities and Infrastructure, Licensing, and Community Empowerment (indigenous legal communities, local communities, and traditional communities).
- 3. **Output Criteria:** Controlled Utilization, Threats, Compliance Level, Community Knowledge (customary law communities, local communities, and traditional communities), Community Empowerment (customary law communities, local communities, and traditional communities), and Data and Information.
- 4. **Outcome Criteria:** Conservation Target Conditions, No-take Zone Conditions, Socio-Economic Conditions, and Community Participation (indigenous law communities, local communities, and traditional communities).

The EVIKA assessment consists of 42 questions designed to provide an overview of management effectiveness. Each assessment indicator has a weight of 30, depending on its importance. The final EVIKA score indicates the effectiveness of conservation area management in achieving its objectives, which are divided into three categories:

Appendix Table 22. EVIKA assessment categories

Final Evaluation Score	Color	Status	Information
<50%	Bronze	Minimum Managed	The design and planning of the area have been carried out, and the management process has been implemented, but efforts are still needed to achieve the management objectives.
>50-85%	Silver	Optimum Managed	Management functions have been running adaptively, and several management objectives have been achieved.
>85%	Gold	Sustainably Managed	The benefits of management are felt by the community with protected and sustainable conservation values.

Appendix 23. Recommendations for Management of the BHS MPA Based on EVIKA 2025 Assessment Results

Parks in the Waters of the Raja Ampat Islands and Surrounding Seas	
Provincial government	Management Organizational Unit (SUOP)
1. Ensure that spatial planning policies and spatial utilization permits are aligned with conservation area management targets. 2. Allocating conservation area management budget as a funding priority 3. Facilitating sustainable funding schemes for Regional Conservation Areas	1. Maintaining and improving HR competency in all management functions (biophysical, socio-economic, supervision, service, and administration) 2. Reviewing the Management Plan in accordance with Minister of Marine Affairs and Fisheries Regulation No. 31/2020 3. Improving management facilities and infrastructure in accordance with Minister of Maritime Affairs and Fisheries Regulation No. 6/2024 4. Carry out periodic monitoring with comprehensive coverage throughout the area 5. Enhance community outreach and awareness programs in a planned and effective manner 6. Regular monitoring of conservation targets, ecosystem conditions, and community socio economic conditions 7. Identifying types of threats and violations; updating publicly accessible management data 8. Establish partnerships with universities and NGOs for socio-economic monitoring and strengthening community capacity.
Parks in the Waters of the North Misool Region of the Raja Ampat Islands, Southwest Papua Province	
Provincial government	Management Organizational Unit (SUOP)
1. Ensure that spatial planning policies and spatial utilization permits are aligned with conservation area management targets. 2. Allocating conservation area management budget as a funding priority 3. Facilitating sustainable funding schemes for Regional Conservation Areas	1. Reviewing the Management Plan in accordance with Minister of Marine Affairs and Fisheries Regulation No. 31/2020 2. Improving HR competency in every management function 3. Improve facilities and infrastructure; carry out documented maintenance 4. Carry out periodic monitoring covering the entire area 5. Develop effective communication strategies and community outreach programs 6. Monitoring and evaluation of community group partnerships with a gender and social inclusivity perspective 7. Regular monitoring of conservation targets, ecosystems and social and economic aspects of society 8. Assistance and strengthening of the community's socio-economic capacity; collaboration in data collection on area utilization
Berau Bay Coastal Park (1P) and Nusalasi-Van Den Bosch Bay Coastal Park (1P) in West Papua Province	
Provincial government	Management Organizational Unit (SUOP)
1. Reviewing the zoning plan and management plan in accordance with Minister of Marine Affairs and Fisheries Regulation No. 31/2020 2. Fulfilling needs and improving HR competencies in every management function 3. Develop plans and increase budget allocation for conservation area management 4. Complete management facilities and infrastructure in accordance with Minister of Maritime Affairs and Fisheries Regulation No. 6/2024 5. Together with SUOP, prepare documents on tourism and fisheries carrying capacity and capacity. 6. Ensuring spatial planning and licensing policies are aligned with conservation targets 7. Facilitating sustainable funding schemes for KKPD	1. Developing SOPs for managing conservation areas 2. Carry out periodic monitoring covering the entire area; complete the report with a spatial map of the coverage. 3. Implement community outreach programs in a planned and effective manner 4. Regular monitoring of conservation targets and socio-economic conditions 5. Data collection on area utilization, compliance monitoring, and identification of types of threats 6. Public perception survey; data collection and mentoring of community groups 7. Updating governance, biophysical, and socio-cultural data periodically and making it accessible to the public
Marine Tourism Park (1WP) in Buruway, Arguni, Kaimana, Teluk Etina, and Surrounding Waters in West Papua Province	
Provincial government	Management Organizational Unit (SUOP)
1. Reviewing the zoning plan and management plan in accordance with Minister of Marine Affairs and Fisheries Regulation No. 31/2020 2. Fulfilling needs and improving HR competencies in every management function 3. Develop plans and increase budget allocation for conservation area management 4. Complete management facilities and infrastructure in accordance with Minister of Maritime Affairs and Fisheries Regulation No. 6/2024 5. Together with SUOP, prepare documents on tourism and fisheries carrying capacity and capacity. 6. Ensuring spatial planning and licensing policies are aligned with conservation targets 7. Facilitating sustainable funding schemes for KKPD	1. Develop and implement SOPs for conservation area management 2. Carry out periodic monitoring at least once a month, covering the entire area, equipped with a spatial coverage map 3. Identifying types of violations and documenting permits in conservation areas 4. Implement community outreach programs in a planned and effective manner 5. Monitoring of area utilization, threat identification, and community perception surveys 6. Data collection and mentoring of community groups; strengthening the social and economic well-being of the community 7. Regular monitoring of ecosystem conditions, conservation targets, and social and economic conditions of the community 8. Updating governance, biophysical, and socio-cultural data; data publication is publicly accessible.

Appendix 23. Recommendations for Management of the BHS MPA Based on EVIKA 2025 Assessment Results (continued)

Jeen Womom Coastal Parks (TP) in Tambrau Regency, West Papua Province	
Provincial government	Management Organizational Unit (SUOP)
1. Reviewing the Conservation Area Management Plan in accordance with Ministerial Regulation No. 31/2020 2. Issuing a Decree Appointing Conservation Area Managers 3. Fulfilling needs and improving HR competencies in every management function 4. Develop plans and increase budget allocation for conservation area management 5. Complete management facilities and infrastructure in accordance with Minister of Maritime Affairs and Fisheries Regulation No. 6/2024 6. Ensuring spatial planning and licensing policies are aligned with conservation targets 7. Facilitating sustainable funding schemes for KKPD	1. Develop and implement SOPs for conservation area management 2. Carry out periodic monitoring covering the entire area 3. Implement community outreach programs in a planned and effective manner 4. Establish partnerships with relevant stakeholders for area management 5. Regular monitoring of conservation targets and socio-economic conditions 6. Licensing data collection; identification and assistance of community groups 7. Monitoring utilization, threat identification, and public perception surveys 8. Updating governance, biophysical, and socio-cultural data periodically and making it accessible to the public
Park of A Thousand and One Rivers of Teoenebikia in the South Sorong Waters, West Papua Province	
Provincial government	Management Organizational Unit (SUOP)
1. Reviewing the Conservation Area Management Plan in accordance with Ministerial Regulation No. 31/2020 2. Issuing a Decree Appointing Conservation Area Managers 3. Fulfilling needs and improving HR competencies in every management function 4. Develop plans and increase budget allocation for conservation area management 5. Complete management facilities and infrastructure in accordance with Minister of Maritime Affairs and Fisheries Regulation No. 6/2024 6. Ensuring spatial planning and licensing policies are aligned with conservation targets 7. Facilitating sustainable funding schemes for KKPD	1. Develop and implement SOPs for conservation area management 2. Carry out periodic monitoring covering the entire area 3. Implement community outreach programs in a planned and effective manner 4. Establish partnerships with relevant stakeholders for area management 5. Regular monitoring of conservation targets and socio-economic conditions 6. Licensing data collection; identification and assistance of community groups 7. Monitoring utilization, threat identification, and public perception surveys 8. Updating governance, biophysical, and socio-cultural data periodically and making it accessible to the public
Marine Parks in the Biak Numfor Region, Papua Province	
Provincial government	Management Organizational Unit (SUOP)
1. Prepare and establish a Management Plan in accordance with Ministerial Regulation No. 31/2020 and No. 184/2023 2. Establishing the Management Organizational Unit (SUOP) for the Biak Numfor Conservation Area 3. Adding and improving HR competencies for all management functions 4. Increase budget allocation for conservation area management 5. Provide adequate and standard management facilities and infrastructure	1. Develop and implement SOPs for conservation area management 2. Increase regular monitoring, patrol and awareness activities 3. Establish partnerships for monitoring conservation targets (baitfish and cetacean spawning habitats) 4. Regular monitoring of resources (ecosystem, biophysical and socio-economic conditions of the community) 5. Increase community empowerment, mentoring and outreach activities 6. Ensure the availability of habitat threat data and target biota as a baseline for subsequent assessments. 7. Conducting studies on the carrying capacity and carrying capacity of conservation areas

Appendix 24. Sasi Laut practices at the BHS

No	Types of Sasi	Location	Petuanan/Ownership	Biota in Sasi	Sasi Duration
1	Sasi/Kerakera Adat	Kampung Ugar, Distrik Kokas, Fakfak	Orang Tua Ugar (Petuanan Pikipik Sekar) Pengelola Kerakera Ugar	Sea Cucumber and Lobster	6 months
2	Sasi/Kerakera Adat	Kampung Kiaba, Distrik Karas, Fakfak	Petuanan Marga Kanabaraf & Batirari	Sea Cucumber, Bia Lola and Bia Mata Bulan	1 year
3	Sasi/Kerakera Adat	Kampung Kiaba, Distrik Karas, Fakfak	Petuanan Kanabaraf	Sea Cucumber, Bia Lola and Bia Mata Bulan	1 year
4	Sasi/Kerakera Adat	Kampung Kiaba, Distrik Karas, Fakfak	Petuanan Marga Batirari	Sea Cucumber, Bia Lola and Bia Mata Bulan	1 year
5	Sasi/Kerakera Adat	Kampung Tarak & Tuberwasa, Distrik Karas, Fakfak	Petuanan Marga Baruan, Bau, Gia, Patur & Batirari	Sea Cucumber and Lobster	Depends on the owner
6	Sasi/Kerakera Adat	Kampung Tarak, Distrik Karas, Fakfak	Petuanan Marga Patur	Sea Cucumber, and Bia Lola	Depends on the owner
7	Sasi/Kerakera Adat & Agama	Kampung Patimburak, Kiminakra, Kinam, Mandoni, and Batufiafas	Ketua Pengelola Erinanam	Mangrove Crab and Blue Crab	7 Months
8	Sasi/Nggama adat & Agama	Pulau Namatota, Kaimana	Raja Namatota	Sea Cucumber, Bia Lola and Bia Mata Bulan	2-3 Years
9	Sasi/Nggama adat & Agama	Kampung Marsi, Kolam Sisir, Kaimana	Masyarakat Kampung Marsi	Sea Cucumber, Lobster, Bia Lola and Bia Mata Bulan	Depends on the Agreement
10	Sasi/Nggama adat & Agama	Kampung Kambala, Kaimana	Petuanan Marga Yagana	Sea Cucumber, Lobster, Bia Lola and Bia Mata Bulan	1 year
11	Sasi/Nggama adat & Agama	Kampung Kambala, Kaimana	Petuanan Marga Uriepa	Sea Cucumber, Lobster, Bia Lola and Bia Mata Bulan	1 year
12	Sasi/Nggama adat & Agama	Kampung Kambala, Kaimana	Petuanan Marga Sardiki	Sea Cucumber, Lobster, Bia Lola and Bia Mata Bulan	1 year
13	Sasi/Nggama adat & Agama	Kampung Kambala, Kaimana	Petuanan Marga Etana	Sea Cucumber, Lobster, Bia Lola and Bia Mata Bulan	1 year
14	Sasi/Nggama adat & Agama	Kampung Adijaya, Kaimana	Petuanan Marga Laturauw	Sea Cucumber, Lobster, Bia Lola and Bia Mata Bulan	2-4 Years
15	Sasi/Nggama adat & Agama	Kampung Adijaya, Kaimana	Petuanan Marga Sininggirauw	Sea Cucumber, Lobster, Bia Lola and Bia Mata Bulan	2-4 Years
16	Sasi/Nggama adat & Agama	Kampung Adijaya, Kaimana	Petuanan Marga Samay	Sea Cucumber, Lobster, Bia Lola and Bia Mata Bulan	2-4 Years
17	Sasi/Nggama adat & Agama	Pulau Adijaya, Kaimana	Petuanan Marga Sawoka	Sea Cucumber, Lobster, Bia Lola and Bia Mata Bulan	2-4 Years
18	Sasi/Nggama adat & Agama	Pulau Adijaya, Kaimana	Petuanan Marga Aituarauw	Sea Cucumber, Lobster, Bia Lola and Bia Mata Bulan	2-4 Years
19	Sasi/Nggama adat & Agama	Kayu Merah, Kaimana	Petuanan Marga Amerbay	Sea Cucumber, Lobster, Bia Lola and Bia Mata Bulan	2-5 Years
20	Sasi/Nggama adat & Agama	Kayu Merah, Kaimana	Petuanan Marga Metua, Karafey dan Wamoy	Sea Cucumber, Lobster, Bia Lola and Bia Mata Bulan	2-5 Years
21	Sasi/Nggama adat & Agama	Kayu Merah, Kaimana	Petuanan Marga Waria	Sea Cucumber, Lobster, Bia Lola and Bia Mata Bulan	2-5 Years
22	Sasi/Nggama adat & Agama	Kayu Merah, Kaimana	Petuanan Marga Nausrau	Sea Cucumber, Lobster, Bia Lola and Bia Mata Bulan	2-5 Years
23	Sasi/Nggama adat & Agama	Kayu Merah, Kaimana	Petuanan Marga Boymasa	Sea Cucumber, Lobster, Bia Lola and Bia Mata Bulan	2-5 Years
24	Sasi/Kadup Adat & Agama	Kampung Menarbu, Wondama	Masyarkat Kampung Menarbu	Sea Cucumber, Lobster and Bia Lola	3 years
25	Sasi/Kadup Adat & Agama	Kampung Aisandami, Wondama	Kelompok Ekowisata Wadowun Beberin	Sea Cucumber, Lobster and Bia Lola	3-4 Years
26	Sasi/Tasamu Adat & Agama	Kampung Asai, Kepulauan Yapen	Masyarakat Kampung Asai	Sea Cucumber, Lobster and Bia Lola	1 year
27	Sasi/Tasamu Adat & Agama	Malaumkarta, Sorong	Kampung Malaumkarta, Suatolo, Mibi, Suatut dan Malagufuk	Sea Cucumber, Lobster and Bia Lola	1-2 Years
28	Sasi Adat & Agama	Kampung Folley, Misool Timur	Marga Moom	Sea cucumber	6 months
29	Sasi Adat & Agama	Kampung Folley, Misool Timur	Marga Fadimpo	Sea cucumber	6 months
30	Sasi Adat, Agama & Pemerintah	Kampung Salafen, Misool Utara	Kelompok Perempuan Zakan Day	Sea cucumber	1 year

Appendix 24. Sasi Laut practices at the BHS (continued)

No	Types of Sasi	Location	Petuanan/Ownership	Biota in Sasi	Sasi Duration
31	Sasi Adat & Agama	Kampung Warsambin, Kalitoko and surrounding waters, Teluk Mayalibit	Kampung Warsambin	Sea cucumber	1 year
32	Sasi Adat & Agama	Dusun Wegalas, Teluk Mayalibit	Dusun Wegalas	Sea cucumber	1 year
33	Sasi Adat & Agama	Kampung Warimak, Teluk Mayalibit	Kampung Warimak	Sea cucumber	1 year
34	Sasi Adat & Agama	Kampung Waifoi, Teluk Mayalibit	Kampung Waifoi	Sea cucumber	1 year
35	Sasi Adat & Agama	Kampung Lopintol, Teluk Mayalibit	Kampung Lopintol	Sea Cucumber and Lema Fish	1 year
36	Sasi Adat & Agama	Kampung Solol, Salawati	Kampung Solol	Sea cucumbers, lobsters, bia lola, and all destructive fishing gear	5 years
37	Sasi Adat & Agama	Kampung Waibon, Salawati	Kampung Waibon	All Destructive Fishing Gear	3 years
38	Sasi Adat & Agama	Kampung Wamega, Salawati	Kampung Wamega	Sea Cucumber and Lobster	3 years
39	Sasi Adat & Agama	Kampung Samate & Kapatlap, Salawati	Kampung Samate	Sea Cucumber and Lobster	3 years
40	Sasi Adat & Agama	Tanjung Makai, Batanta	Masyarakat Kampung Arefi	Sea Cucumber, Lobster and Bia Lola	5 years
41	Sasi Adat	Kampung Kapatcol, Misool	Kelompok Perempuan Waifuna	Sea Cucumber, Lobster and Bia Lola	1-2 Years
42	Sasi Adat	Kampung Limalas, Misool	Marga Falon	Sea Cucumber, Lobster and Bia Lola	1-2 Years
43	Sasi Adat	Kampung Audam, Misool Timur	Marga Fadimpo	Sea Cucumber, Lobster and Bia Lola	1-2 Years
44	Sasi Adat	Kampung Folley, Misool Timur	Marga Mjam	Sea Cucumber, Lobster and Bia Lola	1-2 Years
45	Sasi Adat	Kampung Limalas, Misool Timur	Marga Mluy	Sea Cucumber, Lobster and Bia Lola	1-2 Years
46	Sasi Adat	Kampung Tomolol, Misool Timur	Marga Moom dan Falon	Sea Cucumber, Lobster and Bia Lola	1-2 Years
47	Sasi Adat	Kampung Tomolol, Misool Timur	Marga Faam	Sea Cucumber, Lobster and Bia Lola	1-2 Years
48	Sasi Adat	Pulau Wayag hingga Pulau Urani	Suku Kawe	Sea Cucumber, Lobster and Bia Lola	Mutual agreement
49	Sasi Adat, Agama & Pemerintah	Kampung Yensner and surrounding waters, Teluk Mayalibit	Kampung Yensner	Sea Cucumber, Lobster and Bia Lola	Mutual agreement
50	Sasi Adat, Agama & Pemerintah	Kampung Mumes and surrounding water, Teluk Mayalibit	Kampung Mumes	Sea Cucumber, Lobster and Bia Lola	Mutual agreement
51	Sasi Adat, Agama & Pemerintah	Kampung Kalitoko and surrounding water, Teluk Mayalibit	Kampung Kalitoko	Sea cucumber	Mutual agreement
52	Sasi Adat, Agama & Pemerintah	Kampung Arawai and surrounding water, Teluk Mayalibit	Kampung Arawai	Sea cucumber	Mutual agreement
53	Sasi Adat, Agama & Pemerintah	Pulau Senapan and surrounding water, Selat Dampier	Kampung Kapatlap	Sea Cucumber, Lobster and Bia Lola	Mutual agreement
54	Sasi Adat, Agama & Pemerintah	Pulau Yaf, Selat Dampier	Kampung Yenanas	All Destructive Fishing Gear	Permanent
55	Sasi Adat	Kampung Waifoi, Teluk Mayalibit	Gereja Waifoi	Sea cucumber	Depends on the needs of the Church
56	Sasi Adat	Kampung Runi, Kepulauan Ayau and Asia	Marga Mambrisau	Sea Cucumber and Lobster	1-2 Years
57	Sasi Adat, Agama & Pemerintah	Kampung Yefman, Selat Dampier	Kampung Yefman	Sea Cucumber and Lobster	3 years
58	Sasi Adat, Agama & Pemerintah	Kampung Yefman, Selat Dampier	Petuanan Samate	Sea Cucumber and Lobster	3 years
59	Sasi Adat	Kampung Tomolol, Misool Timur	Marga Fadimpo	Sea Cucumber, Lobster and Bia Lola	1-2 Years

Appendix 25. List of Conservation Working Partners at the BHS

No	Partner Name	Working Area
1	The Nature Conservancy (TNC)	BHS (through affiliate with TNC/YKAN)
2	Conservation International (CI)	BHS (through affiliate with CI/KI)
3	Re:wild	BHS, with the initial focus in Raja Ampat
4	The Manta Trust	Raja Ampat
5	Fauna & Flora International (FFI)	Kota Sorong, Raja Ampat, TAMBRAUW
6	Konservasi Indonesia (KI)	BHS
7	Yayasan Konservasi Alam Nusantara (YKAN)	BHS
8	WWF-Indonesia	BHS
9	Elasmobranch Institute Indonesia	Shark and manta research in the BHS
10	Thrive for Conservation	Raja Ampat
11	Yayasan Kehati	BHS, as an administrator of Blue Abadi Fund
12	Indonesia Climate Change Trust Fund (ICCTF)	Raja Ampat, through Coremap - CTI program
13	Yayasan TERANGI	Raja Ampat, through Coremap - CTI program
14	Reef Check Indonesia	Raja Ampat, through Coremap - CTI program
15	Starling Resources	BHS (consultant, e.g. Blue Abadi Fund)
16	73.Ltd	Raja Ampat
17	YP3SP	Raja Ampat
18	Yayasan EcoNusa	Papua, including the BHS
19	World Resources Institute (WRI) Indonesia	Papua, including the BHS
20	Greenpeace Indonesia	Papua, including the BHS
21	Yayasan Terra Abadi Papua (Terra Papua)	Papua, with the main focus in the BHS and Raja Ampat
22	Universitas Papua (UNIPA)	Manokwari, West Papua Province (main institution; see work units below)
23	Lembaga Penelitian dan Pengabdian kepada Masyarakat (LPPM) UNIPA	Raja Ampat MPA, Taman Pesisir Jeen Womom, TWP Maksegara, Taman Nasional Teluk Cenderawasih, Kaimana MPA, and Teluk Berau and Nusalasi MPA
24	Fakultas Perikanan dan Ilmu Kelautan (FPIK) UNIPA	Manokwari
25	HMJ Ilmu Kelautan UNIPA	Manokwari: Teluk Doreri
26	Mahasiswa Pecinta Alam Universitas Papua (MAPALA UNIPA)	Manokwari: Sidey dan Kaironi vilage
27	Universitas Kristen Indonesia Papua (UKIP)	Sorong, Southwest Papua Province
28	Universitas Victory Sorong	Sorong, Southwest Papua Province
29	Politeknik Kelautan dan Perikanan (KP) Sorong	Sorong, Southwest Papua Province
30	Politeknik Negeri Fakfak	Fakfak, West Papua Province
31	Universitas Muhammadiyah Sorong	Sorong, Southwest Papua Province
32	Badan Layanan Umum Daerah (BLUD) UPTD Pengelolaan KK Kepulauan Raja Ampat	Raja Ampat MPA: Ayau-Asia, Teluk Mayalibit, Selat Dampier, Misool, Kofiau, Kepulauan Fam, Pos Bantuan Wayag, dan Kawasan Perikanan Adat Teluk Mayalibit, Salawati and Batanta
33	Yayasan Penyu Papua (YPP)	Raja Ampat MPA: Pulau Pi'ai, Pulau Sayang, Selpelle, Salio, Yenbekaki, Kabare, Rauki, and Dorekar. Sorong: Kampung Malaumkarta
34	Yayasan Nazaret Papua Barat (YNPB)	Misool Utara in Raja Ampat: Folley, Audam, Linmalas Barat, Limalas Timur, Atkari, Solal, Salafen, Waigama, Aduwey
35	Kelompok Usaha Wisata Wadowun Beberin	Teluk Wondama in Cenderawasih Bay National Park: Kampung Aisandami, Kampung Yopanggar, and Kampung Sobey.
36	Professional Association of Divers Raja Ampat (PADRA)	Raja Ampat MPA: Kampung Saonek, Kawasan Pantai Yenmankwan, and Kampung Saporkren
37	Kelompok Nelayan Maido Fa Kofiau	Raja Ampat MPA: Kampung Deer, Mikiran, Dibalal, Awat, Tolobi
38	Yayasan Meos Papua Lestari (YMPL)	Kaimana MPA: Kampung Marsi
39	Yayasan Orang Laut Papua (YOLP)	Raja Ampat MPA: Kampung Yenbuba, Sawanderek, Yenbekwan, Arborek
40	Perkumpulan Bentang Nusantara (BENTARA) Papua	Salawati District in Raja Ampat: Kampung Solol
41	PAM GKI Ebenhaezer Arborek	Raja Ampat MPA: Kampung Arborek dan Yensawai
42	Penyelam Perempuan Molobin Raja Ampat (MORA)	Raja Ampat MPA: Kampung Saporkren, Yenbeser, Friwen, Yenbekwan, Sauwanderek, and Kurkapa
43	Kelompok Ekowisata Guraja Indah	Cenderawasih Bay National Park in Nabire: Kampung Sima
44	Komunitas Sinergitas Rakyat untuk Alam (SINARA) Kaimana	Kaimana MPA: Kampung Seram
45	Kelompok Pemuda Kobeberei Uriemi	Cenderawasih Bay National Park in Teluk Wondama: Kampung Uriemi

Appendix 25. List of Conservation Working Partners at the BHS (continued)

No	Partner Name	Working Area
46	Yayasan Kelestarian & Edukasi Kaimana (KEK)	Kaimana MPA: Kampung Seram
47	Kelompok Masyarakat Pengawas (POKMASWAS) Nusa Matan	Teluk Nusalasi Van Den Bosch and Teluk Berau MPA in Fakfak
48	Konsorsium Mitra Bahari (KMB) Papua Barat	Manokwari and Kaimana
49	Komunitas Peduli Sungai Remu (KPSR)	Sorong: Remu Utara
50	Kelompok Masyarakat Konservasi Penyu Belimbing (POKMAS KUMEP)	Raja Ampat MPA: Kampung Yenbekaki
51	Yayasan Eco Raja Ampat Lestari (CORERI)	Raja Ampat MPA: Kampung Waisai, Saporkren, Warsambin
52	Himpunan Pramuwisata Indonesia (HPI), Dewan Pimpinan Cabang Raja Ampat	Raja Ampat MPA: Waisai, Kepulauan Fam, Arborek, Fafanlap, Kampung Harapan Jaya, and Kampung Deer (Kofiau)
53	Yayasan Mange-Mange Papua (YM2P)	Kaimana MPA: Kampung Tugarni, Afu-Afu, Bayeda, Moyana, Gusimawa, dan Kokoroba; Teluk Arguni and Teluk Etna
54	Perkumpulan Akawuon	Tambrau: Kampung Sausapor
55	Yayasan Kalabia Indonesia (YaKIn)	Raja Ampat MPA
56	KUB Manduni Putra	Manokwari: Kampung Mubraidiba
57	Perkumpulan Mnuwar Papua	Teluk Wondama: Kampung Reisei, Torey, and Isei
58	Kelompok Anak Air Manokwari (KAAM)	Manokwari: Kelurahan Sanggeng, Manokwari Barat, Padarni, Pasir Putih, Kampung Mansinam, and Teluk Sawaibu
59	Yayasan Raja Ampat Sea Centre	Raja Ampat MPA: Kampung Arborek, Yenbuba, Sawanderek, and Meos Mansar
60	Yayasan Pengelolaan Lokal Kawasan Laut Indonesia (Indonesia Locally Managed Marine Area – ILMMA)	Biak: Kepulauan Padaido and Supiori
61	Bank Sampah Sorong Raya (KABASRA)	Southwest Papua: Kota Sorong, Kabupaten Sorong, and Misool
62	Lembaga Masyarakat Adat (LMA) Malamoi	Sorong regency: Seget. Raja Ampat: Salawati
63	BLUD UPTD Pengelolaan KKP Kaimana	Kaimana MPA, Taman Pesisir Teluk Berau and Teluk Nusa Lasi – Van den Bosch MPA
64	Yayasan Misool Ekosistem Regenerasi (YMER)	Misool Tenggara, Distrik Misool Selatan in Raja Ampat: Kampung Yellu, Kampung Fafanlap, Kampung Dabatan, and Kampung Usaha Jaya. Kepulauan Raja Ampat MPA
65	Dewan Adat Suku Maya Raja Ampat (DASMAYA)	Raja Ampat MPA: Kampung Arefi, Yensawai, Pam, Saukabu, and Saupapir
66	Kelompok Ekowisata Toweuw	Tambrau: Kampung Nanggouw
67	Kelompok Pengelola Sasi Kampung Menarbu	Teluk Wondama: Kampung Menarbu
68	Orang Muda Katolik (OMK) Santa Monika	Kota Kaimana
69	Yayasan Bentang Alam Papua (YBAP)	Kota Sorong
70	Yayasan Bumi Papua Lestari (YBPL)	Raja Ampat MPA: Kampung Yensawai Barat dan Yensawai Timur
71	Yayasan Sealam Karya Lestari (SELARAS)	BHS
72	Persatuan Jasa Pariwisata Raja Ampat (PERJAMPAT)	Raja Ampat
73	Child Aid Papua / Cahaya Anak Papua	Raja Ampat
74	Barefoot Conservation / Yayasan Jejak Kaki	Raja Ampat
75	DIANTARA	Raja Ampat
76	USBA Institut	Raja Ampat
77	Raja Ampat Research and Conservation Centre (RARCC)	Raja Ampat
78	Fakfak Mengajar	Fakfak regency
79	Perkumpulan Pioner Tanah Papua	Tambrau regency
80	Yayasan Bingkai Cerita Rakyat	BHS (Tambrau and Pulau Numfor)
81	Masyarakat Hukum Adat (MHA) Wooti Kook Malaumkarta Raya	Sorong regency: Kampung Malaumkarta and surroundings
82	Yayasan Penelitian Ekowisata Papua	Raja Ampat

