




# Tracking progress towards the MacArthur Foundation's 10 Year Coastal and Marine Strategy

## Global Monitoring Report

In support of the John D. and Catherine T. MacArthur Foundation's grant,  
"Monitoring the Impact of Investments in Coastal and Marine Conservation"



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Cover photo: Coastal fisheries provide critical livelihoods, food security and cultural practices for coastal communities around the world, including for local fishers in Western Province, Solomon Islands. Photo: Emily Darling / WCS

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### **Acknowledgements**

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MacArthur  
Foundation



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## Executive Summary

The decline of coastal and marine ecosystems is a critical conservation issue. Over 95 percent of ocean predators have been overfished; a third of coral reefs are severely degraded; and the majority of the world's fisheries are over-exploited and expected to experience further depletion. In the coming decades, declining fisheries will threaten nutrition and human health for coastal communities, with developing countries disproportionately vulnerable. A key goal of the Wildlife Conservation Society's work with the MacArthur Foundation has been to coordinate and implement collaborative monitoring activities that can rigorously examine and evaluate the impact of the MacArthur Foundation's investments. This work is aligned with many emerging goals of conservation science: to advance knowledge, inform policy, build capacity, and catalyze a culture of evidence-based decision making. Throughout Melanesia, the Western Indian Ocean, Indonesia, and the Caribbean, WCS has brought together partners to monitor the effectiveness of marine conservation investments in order to, (1) work with diagnose, evaluate, and learn from investments in priority geographies around the world; (2) strengthen the use of open-source tools to ensure monitoring data are accessible and available to global monitoring partners; and (3) evaluate the evidence to identify best practices for sustainable fisheries and coastal management in areas of high biodiversity, and improve links between monitoring data and decision making. This current document represents the first global survey of a coordinated social-ecological monitoring framework based on the scholarship of Nobel Prize winner Elinor Ostrom, in order measure the social and ecological outcomes of local communities managing and governing their own resources. Our work embraces the reality that there is no one-size-fits-all, where management comprises state-led marine reserves, co-management between governments and communities, and customary governance by local communities. We present case studies that monitor shared core indicators across different management systems and local contexts to tell these stories, and we learn about successes and challenges around the world. The following case studies from the Indo-Pacific Ocean to the Caribbean Sea include Kenya, Madagascar, Indonesia, Solomon Islands, Fiji and Cuba. We document many shared themes, including calls to action for strengthening local leadership; managing conflict; investing on the recovery of fishery resources where coral reef habitats remain relatively healthy; and empowering diverse voices in fisheries governance. This work continues to build the quantitative and qualitative evidence towards identifying effective investments for coral reef fisheries management.

Locations of priority geographies included in this report. Locations are colour coded to their respective sections; and show photos of monitoring teams in each geography. The objective of the global monitoring framework is to investigate the social and ecological outcomes of grantmaking investments in coastal and marine conservation and governance. Photos: E. Darling / WCS.



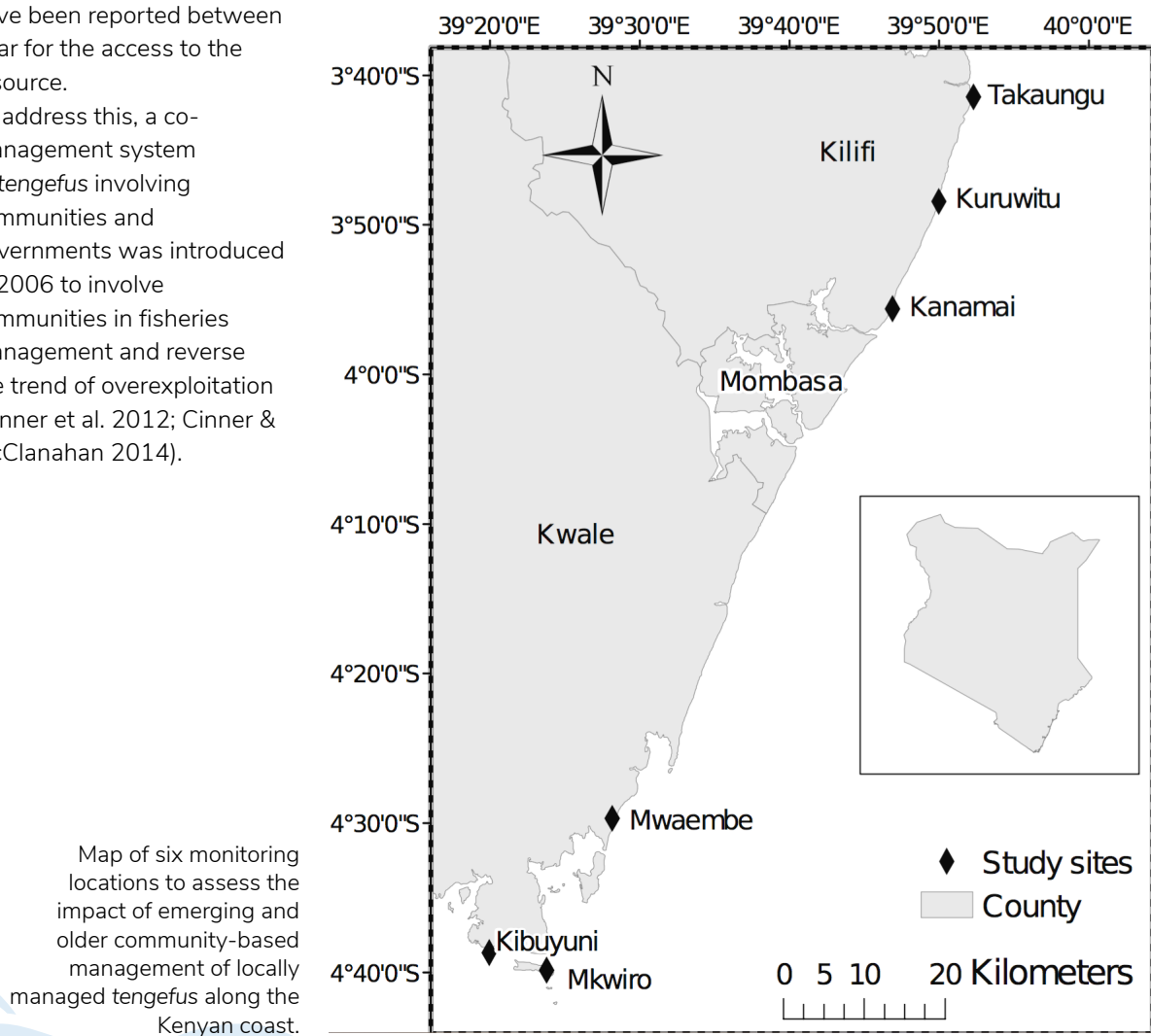


## Background

- Artisanal and subsistence fisheries account for > 90% of the catch of marine fisheries in Kenya, (LeManarch et al. unpublished) and provide important food security and livelihoods for coastal communities (Devisse 1989).
- Despite high dependency, unsustainable fishing practices have led to resource depletion. Over the last 20 years, WCS Kenya, in collaboration with other stakeholders, has initiated and engaged in active management with communities on management options, including co-management and the adoption of new technologies, e.g. gated traps. WCS Kenya has been educating fishers and recommending laws for improving the social and ecological sustainability of small-scale fisheries along the Kenya coast.
- The Kenyan coral reef fishery is a multi-species, multi-gear fishery including gill and drift nets, traps, hand lines, spear guns and beach seine nets, and numerous conflicts have been reported between gear for the access to the resource.
- To address this, a co-management system of tengefus involving communities and governments was introduced in 2006 to involve communities in fisheries management and reverse the trend of overexploitation (Cinner et al. 2012; Cinner & McClanahan 2014).

## The Activities

- To directly assess the impact of emerging and older community-based management of locally managed tengefus, social and ecological monitoring surveys were conducted in six communities in 2017. Three communities on the South Coast and three communities on the North Coast were selected, with a sampling design of new tengefus (Mkwiro and Takaungu), mid-process tengefus (Kibuyuni and Kanamai) and older tengefus (Mwaembe, Kuruwitu).
- For socio-economic monitoring, a total of 367 household interviews were conducted, with 44–74 households surveyed per community depending on the size of the village, and an additional 11 key informant interviews.
- Ecological surveys of coral and reef fish ecosystems were also conducted in the fishing grounds of each community to establish a baseline (2010-2014) and compared to repeated monitoring in 2016-2017.



## The Story

- Overall, there are few striking differences between new, emerging, and older tengefus in ecological or social outcomes. This suggests management may occur along independent trajectories, and many tengefus share issues around conflict, fairness and benefits. Emerging tengefus generally perform highly, and often better than older tengefus; and a priority should be continuing to engage and support governance in mid-process tengefus. A priority is supporting governance in all types of tengefus, not only those in the mid-process, as adoption of effective governance actions and outcomes takes time.
- Highest coral cover was observed in emerging tengefus (Kibuyuni and Kanamai, >30% hard coral cover). Highest fish biomass was observed in Kuruwitu, an older tengefu with 10+ year history of funding and partnerships. However, fish biomass at all sites was below the sustainable threshold of 500 kg/ha.



Concerns over the economic benefits of management and corruption must be addressed to reduce conflict and increase the sustainability of local management actions. Currently, fish biomass remains below sustainable thresholds (500 kg/ha) in all surveyed tengefus. © E. Darling/WCS.

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*There are few striking differences between new, emerging, and older tengefus in ecological or social outcomes. This suggests management may occur along independent trajectories, and many tengefus share issues around conflict, fairness and benefits.*

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- Many communities recognized the role of human agency as the causal agent of change on marine resources (up to 93.8% of households in Mkwiwo recognize human agency). In other communities (e.g., Takaungu), less than half of households recognize human agency). More communication around management is required to provide information on status of resources and benefits of management to better understand perceived fishery losses due to poor management. In Takaungu, for example, collaboration with a local NGO, Friends of Takaungu, could address these issues through educational and awareness activities.
- Fishing is a primary livelihood for most households (>50%) and respondents had access to few alternative livelihoods (2 livelihoods, on average).
- There was a high variability in the respondents perceptions of their ability to influence the management of marine resources (31% - 77% in 6 communities), despite the devolution of power to counties and establishment of BMUs.
- There was also high variability in perceived fairness of management, from a low perception ~20% in Takaungu to a relatively higher perception >60% in two emerging tengefus (Kibuyuni and Kanamai) and a new tengefu (Mkwiwo).

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*“Nets and freezers are being used by the leaders and they have distanced themselves from the members. Before we used to benefit from fish market and freezers”*

*survey respondent*

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- With the exception of a new tengefu in Mkwiro, less than one-third of respondents believed management made it easier to catch fish. Many respondents noted conflict over marine resource management (>45% in all communities, on average).
  - » In general, a common perceived cost of management was poor leadership marked by nepotism, corruption and dominance of market by the tengefu leaders
  - » From a respondent, “nets and freezers are being used by the leaders and they have distanced themselves from the members. Before we used to benefit from fish market and freezers”
- Overall, there was a mixed response to the perceived benefits of management on personal and community wellbeing.
  - » Few respondents perceived a benefit of management. For example, many respondents did not feel that management has made it easier to catch fish; as low as 9% in Takaungu, as high as 61% in Mkwiro.
  - » Some respondents noted benefits of tourism and the recovery of marine resources, while others noted the negative impacts such as corruption, the presence of too many rules, loss of fishing grounds, and the use of illegal fishing practices.
- Less than half, on average, of respondents within communities noted an increase in wellbeing over the last three years. When they did, these benefits were associated with improvements in the local economy, suggesting benefits from fisheries management must be incorporated into economic wellbeing (e.g., fish prices and access to fish markets, facilities to increase fisheries value, etc.)

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*“Some respondents noted benefits of tourism and the recovery of marine resources, while others noted the negative impacts such as corruption, the presence of too many rules, loss of fishing grounds, and the use of illegal fishing practices.”*

*survey respondent*

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Annual Fishers Forums facilitated by WCS provide a space for learning and feedback to address fisheries related issues. In 2017, more than 120 fishers attended the forum. A recommendation is a key forum for managers to ensure that research findings and community recommendations are shared with government managers and decision makers. More frequent forums that bring together stakeholders and managers can build momentum for increased compliance and awareness towards sustainable fisheries management. © E. Darling/WCS.



## Next Steps

- An ongoing in-depth study of common-pool governance (Ostrom design principles, funded by the MacArthur Foundation) is identifying the common weaknesses and strengths of tengefus, and identifying core ways to communicate principles by working with community leaders to translate these design elements into Swahili.
- Management preference surveys can help reveal which management options are preferred help craft rules that are more likely to be adapted, and to improve compliance. This will also need more communication to fishery managers (e.g., government officers). For example, continued discussions with county government officials during forums can increase compliance.
- Future efforts should consider appropriate mechanisms that could be used to strengthen local leadership (e.g., a community's BMU) both within and across communities (e.g., collective leadership across neighbouring BMUs to reduce conflict between neighbours). This would further the government mandated co-management approach. For example, WCS is facilitating with funding from MASMA a co-management planning process for Kuruwitu that brings together all the landing sites in the BMU.
- WCS's annual Fishers' Forums provide a space for learning and feedback to address fisheries related issues. A similar Manager's Forum to ensure research findings and community recommendations are shared with fisheries and other marine resource managers is also recommended. More frequent forums that bring together stakeholders and managers are needed to build momentum for increased compliance and awareness of management activities that can lead to sustainable management.

*A key goal is to support local management and continue rebuilding fish biomass – all tengefus remain below sustainable targets of 500 kg/ha.*

*Annual Fishers' Forums provide a space for learning and feedback to address fisheries related issues. A similar Manager's Forum to ensure research findings and community recommendations are shared with fisheries and other marine resource managers is also recommended.*

- A key goal is to support local management and continue rebuilding fish biomass – all tengefus remain below sustainable targets of 500 kg/ha. Increasing biomass can also increase value of catch as higher tropic species (snappers, groupers) can be caught for higher prices. Maintaining fish biomass above this level will also lead to healthy coral reefs that are more resilient to climate change.
- Next steps will also scale up the governance design principles study to additional sites to understand and improve decision-making for co-managed tengefus along the coast of Kenya.
- Important future activities are to build the capacity of tengefu leaders through monitoring of monitors to identify issues limiting BMU leadership and designing targeted education and training programs for community leaders to improve their leadership and management performance.



The future of Kenya's small-scale fisheries lies with local leaders and communities collaborating with local governments. Fisheries management can be improved through investments in leadership, monitoring and training programs to improve the social and ecological performance of managed areas. © E. Darling/WCS.



# 10 Core Marine Dashboard Indicators for Global Coral Reef Fisheries

Kenya

Construct	Indicator	New tengefu		Mid-process tengefu		Established tengefu	
		South coast	North coast	South coast	North coast	South coast	North coast
		Mkwiro	Takaungu	Kibuyuni	Kanamai	Mwaembe	Kuruwitu
Context							
Market access	Presence of middlemen (fish traders)	Yes	Yes	Not always	Yes	Yes	Yes
	Presence and access to ice for refrigeration	No	Yes	Yes	No	No	Yes
Resource System							
1 Essential habitat	Hard coral cover, % (baseline, 2010-2012)	25.3	0.76	41.3	34.3	8.75	21.6
	Hard coral cover, % (recent: 2016-2017)	23.4	no data	41.6	33.3	10.1	19.4
2 Reef fish assemblages	Reef fish biomass, kg/ha (baseline: 2010-2014)	288.69	91.1	224.4	70.6	112.59	364.08
	Reef fish biomass, kg/ha (recent: 2016-2017)	389.49	no data	305.76	135.53	314.27	376.54
Resource Units							
3 Fishable biomass	Biomass of target reef fish, kg/ha (baseline: 2010-2014)	267.02	63.7	138.09	39.04	70.03	329.28
	Biomass of target reef fish, kg/ha (recent: 2016-2017)	355.49	no data	233.06	98.59	234.72	328.5
Actors							
4 Knowledge of human agency	% of respondents that recognize humans as the causal agents of change on marine systems	93.8	43.2	65.2	52.9	59.0	55.4
5 Importance of resource	Percentage of respondents with fishing as a primary livelihood	64.6	45.5	68.1	72.9	47.5	44.6
	Average number of household livelihoods	2.0	1.5	2.0	2.0	2.0	2.0
Governance System							
6 Knowledge and fairness of governance	% of respondents that feel that they can influence the management of marine resources	77.1	31.8	33.3	32.9	50.8	58.1
	% of respondents who feel that decision-making is fair or very fair	68.8	22.7	62.3	60.0	36.1	47.3
7 Number & nestedness of management partners	Number and identity of management partners	4 - EAWLS, KCDP, KWS, WCS*	3 - Friends of Takaungu, KFS, Kilifi county offices*	5 - EAWLS, KCDP, KWS, WCS, KFS*	5 - KFS, Kilifi county office, WCS, CORDIO, village chief*	4 - KFS, COMRED, WCS, sea turtle group*	10 - KFS, KCWA, WCS, Beach residence, Oceans Alive, village chief, KMFRI, Tourism board, Rea Vipingo and Vipingo Ridge*
Interactions							
8 Harvesting	% of respondents who think management has made it easier to catch fish	66.7	9.1	31.9	38.6	23.0	27.0
9 Conflict	% respondents noting the presence of any conflict in marine resource management issues (as daily, weekly, monthly or annual)	45.8	63.6	56.5	45.7	67.2	50.0

\* EAWLS: East African Wildlife Society, KCDP: Kenya Community Development Program, KFS: Kenya Fisheries Service, KWS: Kenya Wildlife Service, CORDIO: Coastal Oceans Research and Development in the Indian Ocean, WCS: Wildlife Conservation Society, KCWA: Kuruwitu Conservation & Welfare Association, COMRED: Coastal Marine Resource Development

# 10 Core Marine Dashboard Indicators for Global Coral Reef Fisheries

Kenya

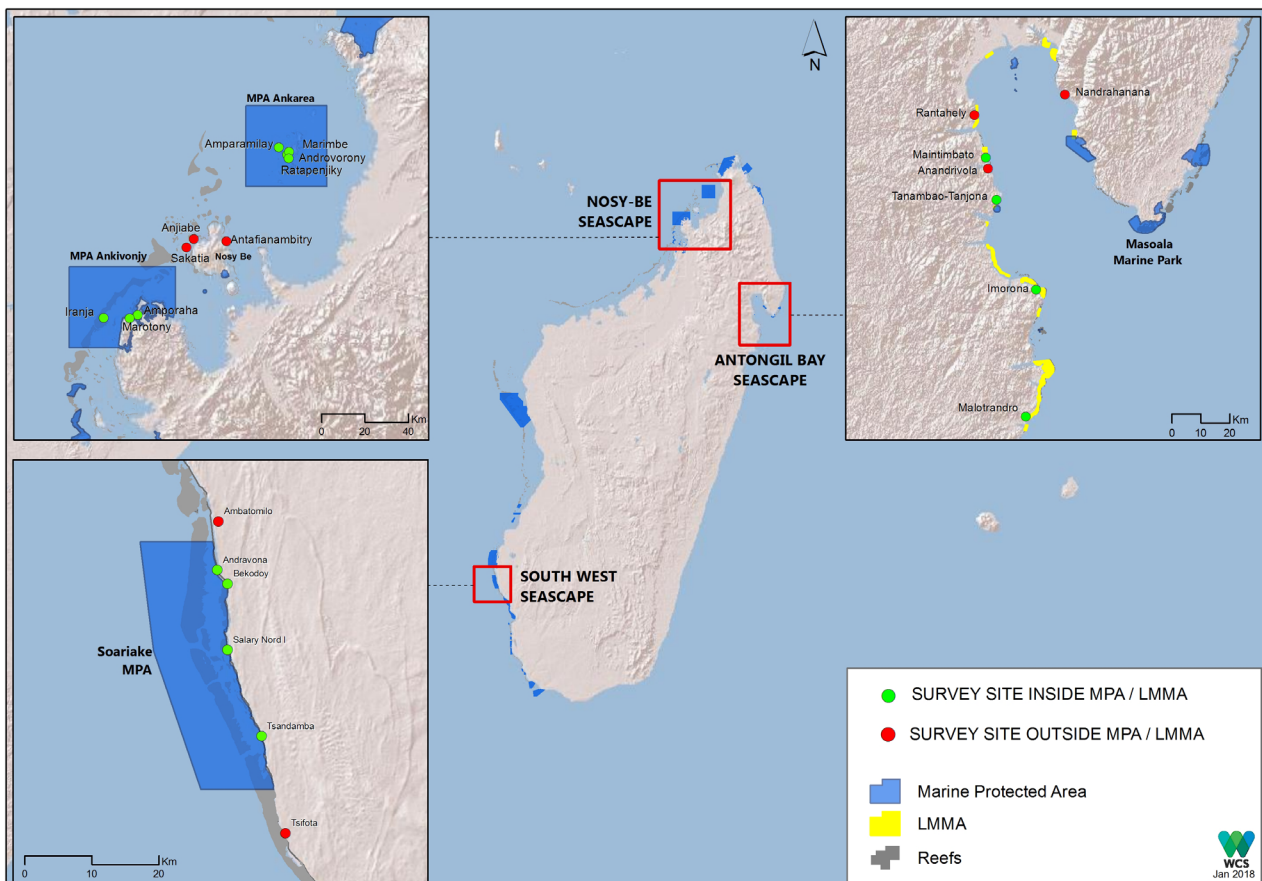
Construct Indicator		New tengefu		Mid-process tengefu		Established tengefu	
		South coast Mkwiro	North coast Takaungu	South coast Kibuyuni	North coast Kanamai	South coast Mwaembe	North coast Kuruwitu
Outcomes							
10 Social performance	Perceived impacts of resource management to COMMUNITY wellbeing: % of respondents who identified management as having good or very good impacts	39.6	0.0 <sup>1</sup>	33.3	21.4	19.7	24.3
	Perceived impacts of resource management to PERSONAL wellbeing: % of respondents who identified management as having good or very good impacts	29.2	0.0 <sup>1</sup>	31.9	20.0	16.4	17.6
	Examples of benefits of management	"The environment has started to be good again, there are breeding grounds for fish now and the community are getting good catch from the ocean"	"There are tourist to come watch our fish"	"They bring the community together by having meetings oftenly"	"We have the freedom of managing our issues and we get gear sponsorship"	"Getting rights to work on the ocean"	"The business is good and fish are available"
	Examples of costs of management	"People bribing to be allowed to use illegal gears"	"The fishing community has been forced to go far and wide to look for fish"	"The fishing community misses their income because too many rules"	"Corruption has risen in the management"	"Illegal fishers are fishing by giving bribes to fisheries officers"	"The nets and freezers are being used by the leaders only and they have distant themselves from us"
	Perceived fairness of impacts of resource management: % of respondents who identified management impacts as either fair or very fair	58.3	13.6	43.5	48.6	31.1	32.4
	Examples of comments on fairness of management	"Only leaders gains", "Male fishers are always given priorities and women are always looked down upon"	"The management team favor themselves"	"Others are benefiting while other don't"	"Those who manage are benefiting more than the fishers"	"The leaders find a way how they will manage to benefit themselves", "There is no transparency we are in the dark"	"The managers are the ones benefiting", "Only fishers benefit"
	Percentage of interviewees noting increases in subjective wellbeing over the last three years	41.7	34.1	49.3	51.4	32.8	20.3
	Example of reasons why life has improved or not improved	"Fishing has been able to make me take care of my life", "Income has increased"	"Moved from dirt house to block house due to income from fishing and small business", "Income enables us to cater for our families"	There is no fairness as the community is complaining about the unfairness of the management leaders	"Income has increased with the increase in fish catch", "Cultures have been forgotten"	"The economy has worsened", "There is no employment which can bring in money"	"The economy has worsened and income is not sufficient", "I have established myself in fishing"

<sup>1</sup> Out of 44 household respondents in Takaungu, respondents answered that management was 'very bad', 'bad', or 'neutral' or did not answer

# Madagascar

## Background

- Madagascar is the 4th largest island in the world, with a coastline of 4,828 km and an EEZ of 1,225,259 km<sup>2</sup> (Burke et al., 2011). Madagascar is located in the Western Indian Ocean (WIO) region - a global marine biodiversity hotspot second only to the coral triangle (McKenna & Allen 2003, Spalding et al 2007, Obura 2012) - and harbors high levels of diversity and richness in corals, mangroves and seagrass beds. It is also home to a wide diversity and large number of threatened species of marine mammals, sharks, and marine turtles Cooke 2003, Cerchio et al. 2009).
- Over 250,000 people live in Madagascar's coastal zone and rely on small-scale fisheries for livelihoods and food. Coastal populations are amongst the most impoverished, isolated, and marginalized communities in Madagascar. Many fishers operate seasonally and rates of migration from inland areas to coastal zones are increasing, leading to conflicts between different social and ethnic groups over access to marine resources.
- There are currently two forms of marine resources management in Madagascar: (i) formal marine protected areas (MPAs) typically IUCN Category 5 or 6, of which 20 MPAs are managed by national or international associations / NGOs covering 730 677 ha; and (ii) Locally Managed Marine Areas (LMMA) managed by local communities based on social conventions known as "Dina" and which covers 10% of continental shelf in Madagascar.
- The Government of Madagascar has formally recognized the contribution of marine resource management to the country's development goals. In 2014, Madagascar's President committed to tripling the area of Madagascar's MPAs and reaffirmed Madagascar's commitment to Aichi targets. Nevertheless effective translation of such high-level commitments to on-the-ground support for conservation is often lacking due to a lack of resources and capacity, as well as persistent corruption at all levels of Government.



MPAs and LMMAs where WCS Madagascar provides support for management of marine resources.

## The Activities

WCS carries out field based conservation in three priority seascapes throughout Madagascar.

The key tenets of WCS's approach to field conservation include

- supporting communities to be effective managers of marine natural resources,
- adopting locally appropriate governance and management models,
- supporting governments to ensure timely and proactive enforcement and control actions, and
- collecting adequate ecological and social data to allow adaptive management of protected areas in response to changing threats and opportunities.

The **Northwest Seascape** focuses on the Ankarea and Ankivonjy MPAs that cover 132,059 ha and 139,409 ha respectively, both created and managed by WCS in collaboration with local communities. Containing some of the most resilient reefs of the WIO, these MPAs protect islands, mangroves, and coral reef habitats as well as several endangered species, including dugongs, whale sharks, five species of marine turtles, blue whales, humpback whales and the Madagascar fish eagle. Approximately 1,600 traditional fishermen operate in this area and carry out spear and line fishing to catch fish, sea cucumbers and sharks (Andrianaivojaona 2014). The main threats to the MPAs include organized trafficking of sea cucumbers, marine turtles, and shark products; impacts from onshore and offshore extractive industry activities; extraction of timber from mangroves for construction and fuelwood; and impacts of tourism activities on the nearby Nosy Be Island.

The **Antongil Bay Seascape** located in northeast Madagascar is a semi enclosed bay of 3,746 km<sup>2</sup> containing coral reefs, mangroves, estuaries, seagrass beds, rocky shores, sandy substrates, small islands and the mouths of 9 major rivers. The endangered scalloped hammerhead (*Sphyrna lewini*), the endangered green turtle (*Chelonia mydas*) and the



Nearshore fishing with nets in the northwest of Madagascar, where nearly half of respondents report fishing is their primary livelihood. © Abdoul Santisy/WCS.

critically endangered hawksbill turtle (*Eretmochelys imbricate*) are threatened by targeted fishing and small-scale fishery by-catch (Metcalf et al., 2007; Humber et al., 2011). The Bay is also a nursery and feeding ground for humpback whales. Around 3271 fishers operate in Antongil Bay, and WCS has supported the created of 26 LMMAs covering 8448 ha to assist communities to sustainably manage the Bay's small-scale fisheries. Fishing is primarily traditional and nearshore although a small number of industrial prawn trawlers also operate in the bay, and unlicensed fishing for sharks occurs offshore causing conflict with local fishers. Agriculture for cash crops such as clove and vanilla is a substantial alternative livelihood for some fishers in the region, but volatile global markets lead to spikes in fishing activity. Main threats to this seascape include weak enforcement by community managers and Government; habitat destruction and overfishing due to the actions of both informal groups and organized networks of beach seiners; and conflicts between small-scale and industrial fishers.

The **Southwest Seascape** focusing on the Soariake MPA forms part of the important Toliara Reef system and contains important habitat for marine turtles and coastal dolphins. WCS has been working with local communities here since 2007 to sustainably manage small-scale fisheries. The Soariake MPA is an IUCN Category 6 MPA that covers an area of 92,705 ha and which provides resources for approximately 3000 licensed fishermen (Andrianaivojaona 2014). Fishing is a key source of protein and food in the southwest and particularly for the Vezo people, who inhabit this region and have traditionally, relied exclusively on fishing for their food needs. Fishing methods include spears, line fishing, and nets to target catches ranging from octopus and reef fish to sharks and turtles (Gough et al. 2009, Andrianaivojaona 2014). Main



threats to this seascape include overfishing resulting from high population growth, and hunting of marine turtles and dolphins.

To complement its field-based conservation activities, WCS provides support to the Government of Madagascar in national marine spatial planning; policy development activities related to shark and ray conservation and sustainable fisheries management; and technical assistance for control and surveillance activities based on the use of SMART conservation software. WCS's marine conservation activities are supported by John D. and Catherine T. MacArthur Foundation, with co-funding from donors including the Helmsley Charity Trust, the Darwin Initiative, the French Development Agency (AfD), The Tiffany & Co. Foundation, the Waterloo Foundation, and the Global Partnership for Sharks and Rays. In November and December 2016, 1056 households were surveyed in the three marine seascapes (northwest: 355 surveys; northeast: 406 surveys; southwest: 310 surveys). We also interviewed 78 key informants, including local leaders and management officials.

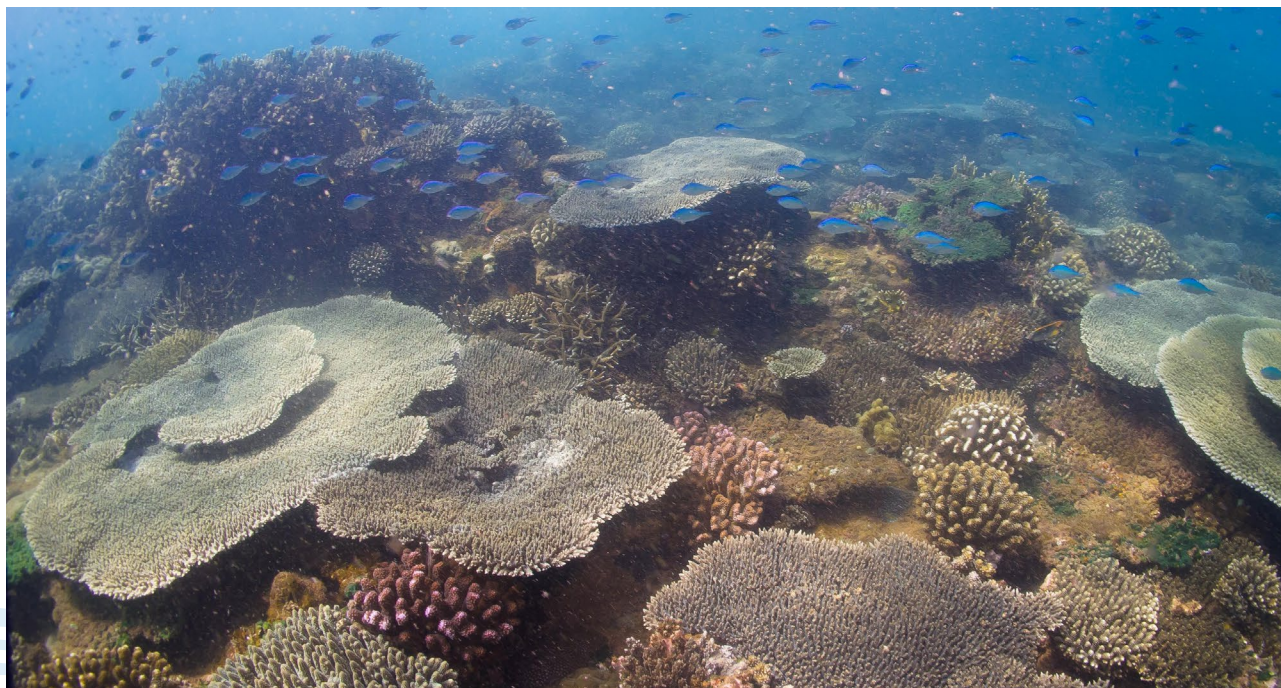
## The Story

In the **Northwest Seascape**, coral cover and fish biomass are relatively high when compared to other sites in Madagascar, and these variables are generally higher in no-take zones of the two MPAs. Fish biomass is above the suggested sustainable fishing threshold of 1100 kg/ha for the Western Indian Ocean

## Many believe living conditions have improved as a result of increased fish biomass

(McClanahan et al 2011, D'agata 2017, Graham et al. 2017), marine resources are perceived to be in a good state and catches have increased despite increased fishing efforts. People have also noted decreased resources in areas open to fishing, although there was a high degree of variability in response to questions in relation to whether management had increased fishing. There is a moderate level of dependence on marine resources. 26% to 67% of respondents citing fishing as their primary livelihood – with lower dependence in the Ankivonjy MPA – and on average, communities had two alternative sources of income including tourism and agriculture. Many believe living conditions have improved as a result of increased fish biomass, and in some areas because of tourism (e.g. Nosy Iranja), or agriculture due to rising prices of cash crops such as vanilla (e.g. Nosy Komba). In Ankivonjy, 27% to 66% of the respondents agreed that human activity is a causal agent for changes in marine ecosystems, but less than 46% acknowledge this in Ankarea. Between 39% and 60% of respondents feel that decision making in relation to marine resources is fair, although less than half of respondents felt that they can influence management of resources. Many respondents expressed concerns about the increase of fishers coming from outside the MPAs or due to

*Relatively high coral cover and fish biomass in the northwest MPAs of Ankarea and Ankivonjy indicate marine resources are in a good state, despite impacts from the 2016 coral bleaching event. With moderate dependence on marine resources, reducing conflict and strengthening MPA governance is a key priority. © E. Darling/WCS.*



increases in local population. Respondents also noted frequent conflicts over marine resource management in key locations such as Antafiambotry (Nosy Faly). Reduction of the surface of available fishing grounds and limitations on fishing activities were seen as other sources of conflict and as 'costs' of management for local communities.

The **Antongil Bay Seascape** has relatively high fish biomass and coral cover (average of 40%) and data indicate that the creation of no-take areas within LMMA's are benefitting coral cover and fish biomass (D'agata 2017). The reliance of communities on fisheries as their primary source of income was low, ranging from 4% to 22% and most communities had 2 or 3 alternative sources of income. Communities' perceptions of the benefits of management in the seascape vary greatly across the villages. In areas with active management 26% to 57% of people agree that management has increased fish catch, whilst in areas without management less than 11% of respondents agree. However, less than half the respondents in managed areas believe that management has led to benefits at the household or community level. The sense that marine management decisions are fair is also highly variable, ranging from 22% in Anandrivola to 75% in Malotrandro. Less than half of the community of respondents feels they can influence management decisions for marine resources and a frequent comment was that only fishers benefit from management of marine resources. Even though awareness that human activities can impact the marine environment is high (55-83%), there remain challenges to conservation given few respondents believe management of marine resources can improve wellbeing of communities. Respondents occasionally reported conflicts in relation to areas with managed fishing and no take areas, with conflict most frequently reported in Tanambao. This may relate to perceived impacts of migrant and illegal fishers, a handful of industrial trawlers and beach seining networks that operate in parts of Antongil Bay. Up to 65% believe wellbeing has improved in recent years. However, most believe this relates to increased revenue from agriculture (e.g. cloves) and not fisheries.

In the **Southwest Seascape** there is a very high reliance on marine resources with between 71% and 92% households in the seascape identifying fishing as their primary livelihood. Fish biomass is generally less than half the suggested sustainable fishing threshold of 1100 kg/ha for the Western Indian Ocean (D'agata 2017, Graham et al. 2017) and appears to be decreasing, with communities perceiving a decrease in available marine resources in this seascape. Coral cover is also lower than other regions of Madagascar averaging 22% inside no take zones and less outside



More than half of respondents (65%) reported increases in wellbeing in recent years in the Antongil Bay Seascape. Mostly these benefits are related to increased revenue from agriculture (e.g. cloves, above) and not fisheries, although there is evidence that coral cover and fish biomass are recovering with locally managed marine areas. © C. Birrell/WCS.

these, in part due to destructive fishing practices (e.g. gleaning on reef flats). Local communities generally understand the negative effects of their activities on the natural resource base. 84-89% of the population acknowledge human activities impact marine ecosystems, yet to date few alternative livelihood activities have been available; agriculture is rare due to climatic and cultural constraints, and tourism is limited by access to the region.

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*Recently, WCS-supported pilot initiatives to link community aquaculture farmers to private sector partners have proven extremely successful and offer hope for future alternative activities that will relieve pressure on reef fisheries.*

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Households have experienced significant (albeit seasonal) benefits from temporary closures and zoning of octopus fisheries with communities recognizing that such closures have facilitated access to marine resources. Importantly these initiatives have generated knowledge about, and support for, management initiatives within communities that provide a sound base for future actions. The benefits of management of marine resources are recognized and accepted by the community, with 75% to 92% of respondents believing management decisions are fair and most of the community, i.e. 59% to 81%



of respondents, believe management of marine resources improves their wellbeing. A significant proportion of the community is engaged in managing the marine environment through the Soariake Community Association, however those not involved express concern that the benefits of protected areas and management primarily favor members of the association. This may partly explain why less people, 30% to 56% of respondents, believe they can influence the management of marine resources. Threats include use of destructive fishing gear, habitat destruction, migratory and unregulated fishing, all of which lead to localized conflicts linked to infringement of management rules. For example in Andravona respondents commented, "There are many fishermen who do not respect the rules and they dominate".

## Next Steps for WCS Madagascar

- In the Northwest Seascape, WCS will work to improve governance within the MPAs to improve representativeness and inclusiveness of local communities in decision-making, and to reinforce awareness raising and education in relation to the need for, and benefits of, marine resource management. For local communities that are dependent on alternative incomes the promotion of community aquaculture will help reduce the pressure on fishing grounds that remain in relatively good condition, and thus contribute to maintaining the level of fishable biomass. Such activities will also work to incentivize local participation and support for marine conservation. WCS will continue to work to develop advocacy and lobbying skills for community co-managers so that they can have a "voice" in regional and national debates that affect their environment - including extractive industry developments (oil and gas, mining) and confronting organized exploitation and trafficking of marine resources (sea turtles, sharks, sea cucumber etc.). WCS will also support Government to reinforce its efforts in terms of control and surveillance to counter illegal exploitation and trafficking.
- In the Antongil Bay Seascape, increased involvement of all local communities in marine resource management is key to ensuring the improved conditions of the area's marine resource. WCS will work to increase the number of LMMAs in the Bay thus increasing overall coverage and reducing leakage of impacts between sites as well as reinforcing the governance of existing ones. WCS will conduct broad communication campaigns on the objectives and benefits of marine resource management. This will contribute to increasing inclusiveness through more representative membership of LMMA management associations – including more households that are only

Sea cucumber farming provides an alternative marine livelihood to women in the Southwest Seascape in Soariake. Marine resources provide a key source of protein and food in the southwest and particularly for the Vezo people. WCS-supported pilot initiatives to link community aquaculture farmers to private sector partners have successfully provided skills and market for an alternative livelihood that promises to reduce reliance on reef fisheries.  
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partially or slightly reliant on fisheries - resulting in a greater sharing of benefits of management and ensuring their longer-term sustainability. WCS is working to secure sustainable use of Antongil Bay through implementing a Marine Protected Area to manage the entire bay, integrating a network of LMMAs and including local communities in co-management.

### Key next steps for Antongil Bay include:

- communication strategies to engage migrant fishers in management actions,
  - tackling a series of growing threats including organized beach seine activities, and
  - reducing conflict with industrial fishers by supporting local fishers in dialogue and negotiation.
- 
- Reef fishing will remain the key livelihood for Vezo people in Soariake MPA, however if current trends continue the ecosystem risks collapsing in the short to medium term and it is critical to intervene. WCS will build on relatively high levels of support for management in this zone, will work with communities to raise awareness about the need for immediate and tangible action, and will roll-out improved techniques for management reef fisheries (species specific fishing methods, reviewing the minimum sizes of fish, and reviewing allowed fishing zones). WCS will work to improve governance within the MPAs so as to improve representativeness and inclusiveness of local communities in decision-making, and to reinforce awareness raising and education in relation to the need for, and benefits of, marine resource management. WCS will build on existing successful pilot activities and expand aquaculture activities within the MPA to cover more households and villages, to identify other income generating activities such as ecotourism, to diversify local communities livelihoods and to reduce reliance on fishing. This work will include a focus on youth who are the reef fishers of tomorrow. Improving access to healthcare and family planning for women in Soariake is among WCS's objectives as it has been proven in other parts of southwest Madagascar to increase women's participation in conservation and income generating activities.

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## 10 Core Marine Dashboard Indicators for Global Coral Reef Fisheries

Construct	Indicator	Marine Protected Areas							Some management			
		Ambandja			Ambilobe				Ambandja	Nosy Be		
		Ankivonjy MPA		Nosy Iranja	Amparamilay	Ankarea MPA		Ratapenjke	Nosy Faly	Nosy Komba	Nosy Sakatia	
Amporaha	Marotogny	Andravorogna	Marimbe			Antafiambotry	Anjiabe		Sakatia			
Context												
Market access	Presence of middlemen (fish traders)	yes	no	no	no	no	yes	yes	yes	yes	yes	
	Presence and access to ice for refrigeration	no	no	no	no	no	no	no	no	no	no	
Resource System												
1	Essential habitat	Hard coral cover, %	22% (NT); 6% (R)			40.5% (NT); 37% (R)			35%	60%	45%	
2	Reef fish assemblages	Reef fish biomass, kg/ha	1242 (NT); 551 (R)			2057 (NT); 770 (R)			124	167	128	
Resource Units												
3	Fishable biomass	Biomass of target reef fish, kg/ha	1191 (NT); 525 (R)			1838 (NT); 704 (R)			111	128	105	
Actors												
4	Knowledge of human agency	% of respondents that recognize humans as the causal agents on change on marine systems	45.5	65.9	48.7	26.7	11.1	28.0	45.7	64.0	40.0	46.9
5	Importance of resource	Percentage of respondents with fishing as a primary livelihood	42.4	51.2	25.6	66.7	61.1	40.0	54.3	62.0	34.0	24.5
		Average number of household livelihoods	2	2	2	2	2	2	2	2	2	2
Governance System												
6	Knowledge and fairness of governance	% of respondents that feel that they can influence the management of marine resources	21.2	43.9	38.5	33.3	11.1	44.0	31.4	40.0	40.0	40.8
		% of respondents who feel that decision-making is fair or very fair	63.6	68.3	66.7	60.0	38.9	44.0	57.1	60.0	46.0	65.3
7	Number & nestedness of management partners	Current management partners	WCS	WCS	WCS	WCS	WCS	WCS	WCS	Crades, Blue Ventures	None	None
Interactions												
8	Harvesting	% of respondents who think management has made it easier to catch fish	33.3	39.0	25.6	0.0	22.2	20.0	14.3	28.0	16.0	24.5
9	Conflict	% respondents noting the presence of conflict in marine resource management issues (as an annual or monthly occurrence)	9.1	7.3	0.0	0.0	11.1	16.0	8.6	52.0	14.0	4.1

# 10 Core Marine Dashboard Indicators for Global Coral Reef Fisheries

Construct Indicator		Marine Protected Areas							Some management			
		Ambandja Ankivonjy MPA			Ambilobe Ankarea MPA				Ambandja Nosy Faly	Nosy Be Nosy Komba Nosy Sakatia		
		Amporaha	Marotogny	Nosy Iranja	Amparamilay	Andravorogna	Marimbe	Ratapenjke	Antafiambotry	Anjiabe	Sakatia	
Outcomes												
10	Social performance	Perceived impacts of resource management to COMMUNITY wellbeing: % of respondents who identified management as having good or very good impacts	15.2	29.3	10.3	13.3	22.2	16.0	17.1	22.0	6.0	6.1
		Perceived impacts of resource management to PERSONAL wellbeing: % of respondents who identified management as having good or very good impacts	24.2	31.7	15.4	26.7	16.7	16.0	25.7	26.0	18.0	16.3
		Examples of benefits of management	“The arrival of WCS allowed us to protect our resources”	“The number of fish obtained increases and there is an evolution of marine knowledge”	“It brings me money, the tourist buys what i sell”	“The species in the sea are managed sustainably”	“Fishing becomes easier because the resources are abundant”	“We earn more money”	“The increase in seafood improves the financial income of each household”	“Since the existence of the management of resources, the products of the sea continues to increase”	“During the opening period there are many products and all households take the opportunity to earn money”	“Strengthening my knowledge about the sea”
		Examples of costs of management	“You need a permit to fish, while it’s very difficult to have a permit”	“Conflicts between local communities”	“The disappearance of malagasy customs”	“Decrease of catch products and also the fishing places”	“Reduction of fishing locations”	“There is an introduction of the laws from time to time those that makes life difficult for a fisherman”	“Fishermen are restricted and limited in their activities”	“The closing period is too long, so we have no other work to do”	“Requires exchange of activities”	“Some people change their jobs because of dwindling marine resources”
		Perceived fairness of impacts of resource management: % of respondents who identified management impacts as either fair or very fair	30.3	43.9	23.1	26.7	16.7	20.0	17.1	26.0	28.0	34.7
		Examples of comments on fairness of management	“Everyone sees the benefits of management”	“The management is equitable”	“Because everyone benefits from it”	“Management helps vulnerable people”	“In fact the standard of living of people are almost the same”	“Those who have more benefit, and others less”	“WCS regulations are good but it is the manager who modifies it during the application”	“The collectors earn much more than the fishermen”	“Villagers agree with the rules”	“Because it is for all the members of the association, we are on the same feet of equality”
		Percentage of interviewees noting increases in subjective wellbeing over the last three years	33.3	61.0	51.3	40.0	50.0	52.0	42.9	50.0	60.0	40.8
		Example of reasons why life has improved or not improved	“The fish starts to be abundant”	“There is more tourism”	“There is more tourism”	“The social environment is good”	“Income has risen sharply”	“There is not enough rain (the rice fades and perishes)”	“The material goods in our homes are almost complete”	“There is no money because the catch of fish does is not good”	“Due to the increase of the vanilla price “	“There is an increase of tourism”

## 10 Core Marine Dashboard Indicators for Global Coral Reef Fisheries

Construct		Indicator	Locally Marine Managed Areas (LMMAs)				Open Access	Some management	
			Mananara Nord		Maroantsetra				
			Imorona Centre	Malotrandro	Tanambao	Maintimbato	Rantohely Secteur	Nandrahanana	Anandrivola
Context									
Market access		Presence of middlemen (fish traders)	Yes	Yes	No	No	Yes	Yes	No
		Presence and access to ice for refrigeration	No	No	No	No	No	No	No
Resource System									
1	Essential habitat	Hard coral cover, %	44% (NT); 42% (R)	52% (NT); 23.5% (R)	44% (NT); 42.5% (R)	84% (NT); 14% (R)	1%	no data	no data
2	Reef fish assemblages	Reef fish biomass, kg/ha	998 (NT); 559 (R)	321 (NT); 267 (R)	1395 (NT); 510 (R)	663 (NT); 207 (R)	2563	no data	no data
Resource Units									
3	Fishable biomass	Biomass of target reef fish, kg/ha	978 (NT); 531 (R)	315 (NT); 256 (R)	1351 (NT); 510 (R)	637 (NT); 195 (R)	2490 (OA) (impossible to do it in the reserve)	no data	no data
Actors									
4	Knowledge of human agency	% of respondents that recognize humans as the causal agents on change on marine systems	71.7	60.0	82.4	59.3	54.8	70.4	57.1
5	Importance of resource	Percentage of respondents with fishing as a primary livelihood	11.3	9.1	13.7	22.2	4.1	13.0	19.0
		Average number of household livelihoods	3	3	3	2	2	2	2
Governance System									
6	Knowledge and fairness of governance	% of respondents that feel that they can influence the management of marine resources	30.2	21.8	49.0	29.6	32.9	46.3	20.6
		% of respondents who feel that decision-making is fair or very fair	41.5	74.5	29.4	59.3	68.5	70.4	22.2
7	Number & nestedness of management partners	Current management partners	WCS	WCS	WCS, Hanidcap International	WCS, MEDAIR, CARE	WCS, MEDAIR	DELC, MEDAIR, SARAH, association MAKIRA, MNP, CARE	MEDAIR
Interactions									
8	Harvesting	% of respondents who think management has made it easier to catch fish	26.4	47.3	56.9	48.1	41.1	11.1	6.3
9	Conflict	% respondents noting the presence of conflict in marine resource management issues (as an annual or monthly occurrence)	18.9	18.2	66.7	11.1	17.8	7.4	1.6

## 10 Core Marine Dashboard Indicators for Global Coral Reef Fisheries

Construct	Indicator	Locally Marine Managed Areas (LMMAs)				Open Access		Some management
		Mananara Nord				Maroantsetra		
		Imorona Centre	Malotrandro	Tanambao	Maintimbato	Rantohely Secteur	Nandrahanana	Anandrivola
Outcomes								
10 Social performance	Perceived impacts of resource management to COMMUNITY wellbeing: % of respondents who identified management as having good or very good impacts	13.2	7.3	9.8	31.5	12.3	5.6	3.2
	Perceived impacts of resource management to PERSONAL wellbeing: % of respondents who identified management as having good or very good impacts	13.2	21.8	5.9	35.2	24.7	1.9	7.9
	Examples of benefits of management	"We earn money and have food at the same time"	"Every time we fish we bring back fish"	"On gagne de l'argent et de nourriture en meme temps"	"Since the existence of the reserve we have more fish problem not like before"	"Since the existence of the reserve we still have fish even if it is sometimes very little"	"There is no reserve in the area"	"Yes the fishermen earn money and bring evolutions within our village"
	Examples of costs of management	"After the implementation of the reserve, fish price increased"	"Reduction of the fishing area"	"This has created some conflicts among the population"	"The price does not match our purchasing power"	"Fishermen can no longer do what they want from the sea"	"There is no management"	-
	Perceived fairness of impacts of resource management: % of respondents who identified management impacts as either fair or very fair	13.2	49.1	2.0	18.5	23.3	5.6	0.0
	Examples of comments on fairness of management	"There are those who have more advantages than others"	"Only a small section of the population who obtain benefits"	"Non-members have more benefits than members, so it's a waste of time"	"In fact many people have lost their benefits"	"It is the fishermen who receive benefits"	"There is no management"	"There are certain fishermen who have more advantage than the others"
	Percentage of interviewees noting increases in subjective wellbeing over the last three years	43.4	54.5	37.3	63.0	57.5	64.8	39.7
	Example of reasons why life has improved or not improved	"Thanks to the rising prices of agricultural products, our life is improving"	"It's easy to earn money because of the good quality of the fish"	"Being able to eat regularly"	"Rise in prices of annuity (rent) products"	"Our children go to school"	"Rise in prices of annuity (rent) products"	"Buy land to build a house"



## 10 Core Marine Dashboard Indicators for Global Coral Reef Fisheries

Established Marine Protected Area				Some management				
Tulear 2								
Soariake MPA								
Construct	Indicator	Andravona	Bekodoy	Salary Nord 1	Tsandamba	Tsifota	Ambatomilo	
Context								
Market access	Presence of middlemen (fish traders)	yes	yes	yes	yes	yes	yes	
	Presence and access to ice for refrigeration	no	no	yes	no	no	no	
Resource System								
1	Essential habitat	Hard coral cover, %		21.5% (NT); 17% (R)		no data	no data	
2	Reef fish assemblages	Reef fish biomass, kg/ha		345 (NT); 744 (R)		no data	no data	
Resource Units								
3	Fishable biomass	Biomass of target reef fish, kg/ha		269 (NT); 621 (R)		no data	no data	
Actors								
4	Knowledge of human agency	% of respondents that recognize humans as the causal agents on change on marine systems	86	89.2	84.6	84.3	88	92.2
5	Importance of resource	Percentage of respondents with fishing as a primary livelihood	88	86.5	71.2	88.6	92	70.6
		Average number of household livelihoods	1.5	2	2	1	2	2
Governance System								
6	Knowledge and fairness of governance	% of respondents that feel that they can influence the management of marine resources	52	51.4	55.8	30	30	25.5
		% of respondents who feel that decision-making is fair or very fair	80	91.9	75	84.3	70	80.4
7	Number & nestedness of management partners	Current management partners	WCS	WCS	WCS	WCS	Blue Ventures	Blue Ventures, WCS
Interactions								
8	Harvesting	% of respondents who think management has made it easier to catch fish	40	51.4	42.3	48.6	42	60.8
9	Conflict	% respondents noting the presence of conflict in marine resource management issues (as an annual or monthly occurrence)	26	5.4	13.5	5.7	14	3.9

# 10 Core Marine Dashboard Indicators for Global Coral Reef Fisheries

		Established Marine Protected Area				Some management	
		Tulear 2					
		Soariake MPA					
Construct	Indicator	Andravona	Bekodoy	Salary Nord 1	Tsandamba	Tsifota	Ambatomilo
Context							
10 Social performance	Perceived impacts of resource management to COMMUNITY wellbeing: % of respondents who identified management as having good or very good impacts	68	81.1	55.8	58.6	68	62.7
	Perceived impacts of resource management to PERSONAL wellbeing: % of respondents who identified management as having good or very good impacts	64	83.8	55.8	62.9	76	64.7
	Examples of benefits of management	"Plenty of products after the opening of the reserve, we can save money"	"Increase of products taken by days during opening of the reserve"	"Life is good when you open the reserve"	"Our catch is not stable, sometimes it is good , after it is average and small,it is like that"	"We receive large quantities of octopus at the opening the reserve"	"I was able to build a house thanks to the abundance of marine resources"
	Examples of costs of management	"Fishing area is limited and life is difficult"	"Lack of livelihood and limitation of access to fishing grounds"	"Decrease areas accessible to fishing"	"Decrease in marine ressources"	"Product prices are very low and there is no increase"	"Insufficient products during the closing period"
	Perceived fairness of impacts of resource management: % of respondents who identified management impacts as either fair or very fair	28	29.7	34.6	27.1	32	37.3
	Examples of comments on fairness of management	"There are many fishermen who do not respect the rules and they dominate"	"The whole population gets benefits on management"	"Leaders are more beneficial"	"Negative and positive impacts almost the same, but some people are more advantageous"	"Collectors are more beneficial"	"The leaders benefit a lot from the helpers"
	Percentage of interviewees noting increases in subjective wellbeing over the last three years	30	24.3	42.3	28.6	40	41.2
	Example of reasons why life has improved or not improved	"There are no alternative activities"	"We are satisfied with the opening of the reserve, because we can buy furniture"	"Marine products are no longer sufficient"	"Decrease in marine ressources"	"Decrease in seafood taken daily"	"The quantity of fish decreases"

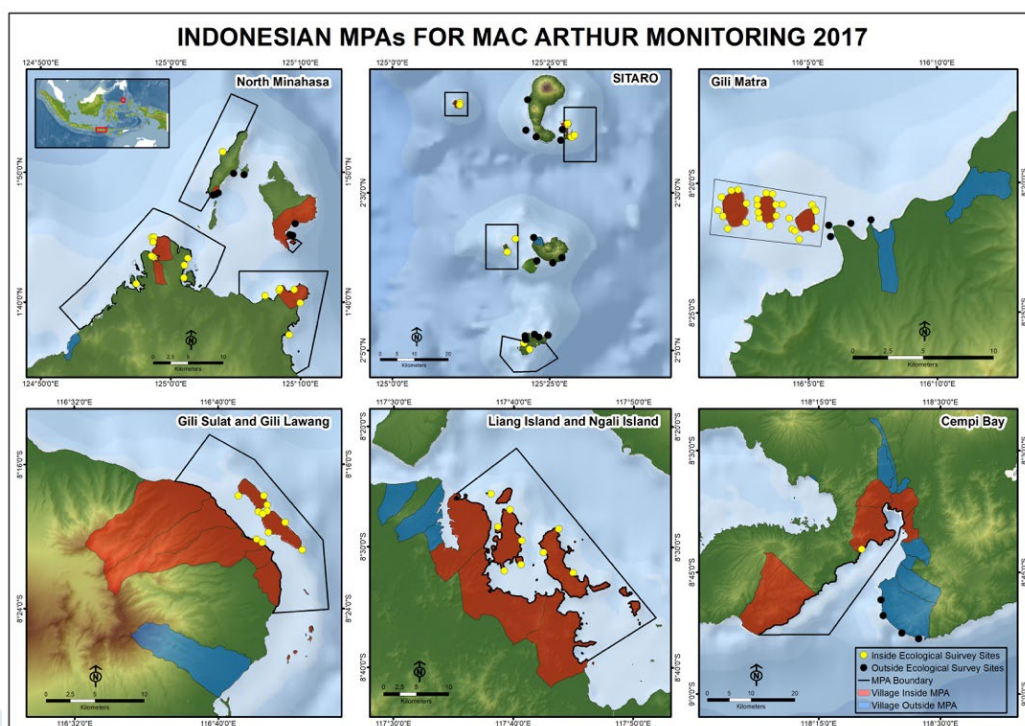
## Background

- Indonesia currently has ~18 million hectares of marine protected areas, across 165 locations across the archipelago. A key question is whether these MPAs provide benefits for marine resources and human wellbeing.
- The Sunda Banda Seascape in Indonesia is prioritized for conservation and coastal management, home to rich marine biodiversity and fisheries resources and exposed to high threats from unsustainable use of marine resources. WCS Indonesia currently monitors and engages with local management with MPAs in WNT (Lombok and Sumbawa) and North Sulawesi, and will continue to expand monitoring to more MPAs throughout the Sunda Banda Seascape.
- The main objectives of WCS conservation efforts are to develop well-designed MPA in each location that support habitat protection for coastal ecosystem - in particular coral reef ecosystem, and sustainable fisheries management.

## The Activities

- Most survey sites were chosen before the the current management design took place, thus most of the sites included within the MPA boundary (except Cempi Bay), leaving a few or no sites as control in the current MPA baseline information. This also indicates that these MPAs are newly developed (Sitaro, Liang-Ngali, and Cempi Bay) or with re-zoning in the last 2 years (North Minahasa and Gili Sulat-Gili Lawang).
- Ecological assessments were conducted at 75 sites from 6 MPAs; 51 sites in inside MPA and 24 sites in outside MPA, using data on hard coral cover and fish biomass (total biomass and fishable biomass). The site details in each MPA are shown in Figure 1.
- Socio-economic monitoring aims to assess human well-being and their socio-economic condition, to understand what social outcomes have resulted from MPA establishment and to learn what works or not. For socio-economic monitoring, a total 1,040 households were interviewed in 39 villages. Number of households surveyed per village is ranging from between 5 – 142 households depending on the

size of population. We also conducted interviews for 125 key informants. The socio-economic monitoring created baselines for new MPA, with the exception of Gili Matra MPA, where the baseline was established in 2012 and the first repeated monitoring was conducted in 2017.



Map of 6 MPAs in North Sulawesi Province and West Nusa Tenggara Province

## The Story

- Market access is high, with all MPAs reporting access to ice facilities and middlemen, suggesting fisheries are easily connected to markets.
- From all six MPAs, coral cover ranged from 14-88%, and ranges from 'bad' to 'very good' categories (English et. al., 1997). The lowest highest coral cover was found in the outside North Minahasa MPA, and the highest coral cover was found inside Cempi Bay MPA.
- Based on the assessment from 25 MPAs within the Sunda Banda Seascape ecoregion led by WWF in the end of 2017, the mean healthy hard coral cover in Liang Ngali MPA are significantly higher than that at the seascape level overall, altogether with the reefs of Gili Balu and Wakatobi (Setyawan et.al., in prep).
- Fish biomass ranged from 301.91-474.84 kg/ha which are lower than the sustainable threshold 500 kg/ha.
- Based on the condition of the reefs and fish biomass from the 6 MPAs, the outside MPAs ecosystem in general better than the inside MPA. There are good increases in fish biomass at the control sites of North Minahasa MPA and Gili Matra MPA, and slightly increase in coral cover in outside Gili Matra MPA and inside Gili Sulat-Gili Lawang MPA but both are still in the category of moderate (English et. al., 1997). Coupled with the socio-economic results that showing the lack of human agency and knowledge on MPA regulations in each sites, there is an indication of the need in increasing awareness and knowledge of the importance of coastal and fisheries management in order to improve the ecological status and community wellbeing.



Fisher is preparing bubu (fish trap) in Cempi Bay MPA.  
© WCS Indonesia.

*In general, coastal communities are highly dependent on marine resources for their livelihoods. With the exception of North Minahasa (50% of households dependent on fishing as a primary livelihood), all other communities reported over 80% of households with fishing as their primary livelihoods.*

- In Gili Matra, the development of tourism may contribute to less dependence on fisheries, as tourism offer better livelihood opportunities compare to fishing. Although there is easy market access and good fish prices available to fishers in Gili Matra, the number of household with fishing as their main livelihoods declined from 40% in 2012 to 9% in 2017. Many fishers may now engage with tourism for their livelihoods. Decreasing fish biomass in inside Gili Matra MPA also suggests threats to fisheries resources in the MPA from fish habitat degradation, shown by rapidly decreasing hard coral cover. Losses in essential habitat could be associated with destructive gear practices or climate change and coral bleaching.
- Households report access to 1 – 4 livelihoods per household (on average, 1.6 livelihoods per households) suggesting access to some alternative livelihoods.
- Across all respondents, more than half recognize humans as the causal agents of change on marine systems. This recognition is fairly consistent inside (63%, across all respondents) and outside (69%) the MPAs, with the notable exception of North Minahasa MPA, where agency is over 50% inside the MPA and only 8% outside the MPA.
- The community knowledge about management rules is varied. For rules about gear restriction and species protection, more than half of the respondents both inside and outside MPA know about this rule. However, for rules regarding time closure and area closure, less than half of the respondents in six MPAs know about these regulations.



- Each MPA has many partners involved in management, with 7 – 12 partners across local, provincial government, local and international NGOs involved in each MPA.
- On average, the proportion of respondents who feel that decision-making is fair or very fair is moderately low (38%). In the case of Gili Matra MPA, after repeat monitoring five years after the MPA was implemented, a substantial number (71%) of respondents now feel that decision-making is fair or very fair, suggesting long-term engagement with management can increase perceptions of fairness.
- Few respondents (20% of total respondents) reported the presence of any conflict in marine resources. Reported conflict was highest outside the MPAs of Gili Matra and Cempi Bay, suggesting conflict between neighbours may be an issue to consider in the future.
- On average, nearly half (47%) of the respondents perceived resource management is having good or very good impacts to community wellbeing, although this varied from only 3% inside Sitaro MPA to >75% inside Gili Matra MPA. Similarly, the impact of resource management for personal wellbeing was also varied. On average, fewer respondents (37%) identified that it has good or very good impacts on them. This varied from <2% of respondents

reporting positive impacts inside Sitaro MPA, to ~80% of respondents perceiving a positive impact from management inside the Cempi Bay MPA. For Gili Matra, there is an increase (from 39% in 2012 to 48% in 2017) in the number of respondents who mentioned the management having good or very good impact on their personal wellbeing, suggesting perceptions of benefits can increase over time.

- As examples of benefits, respondents described an increase in the number of fish and breeding grounds, the benefits of protection for future generations, the availability of boats and other programs (e.g., free waste containers in Gili Matra) and the regulation of destructive fishing practices.
- Respondents also reported costs to management, where there was no management or transparency in decision making, access to traditional activities (eating turtle eggs) was restricted, and that there is less freedom for fishers, less fish to catch, and that management is taking too long to implement.
- On fairness, respondents from all MPAs replied that the MPA process was good because it involved local stakeholders and fishers, and that the government provided some incentives in Gili Matra.

*Below: High coral cover in Cempi Bay MPA.*

© WCS Indonesia.

*Right: A women preparing fish satay using bamboo stick to be sold locally in Liang Ngali MPA. © WCS Indonesia.*



- In Sitaro, Liang-Ngali, and Cempi Bay, the MPA is still in process of development. There is no implementation of MPA management, thus the indicators in the dashboard are baseline information. The main challenges to these MPAs are the availability of qualified management unit due to the newly developed MPA and also limited access to the areas which is quite a distance from the government center. There is local NGO that works in Sitaro, but none in Liang-Ngali and Cempi Bay. At this point, they are highly depended to WCS to support the process.

## Next Steps

- The social-ecological baseline was considered as valuable input to develop MPA's management plan. When the management plan is implemented, it is important to understand what works and not both for human and marine resources. Monitoring and evaluating the outcomes of MPA implement can assess the impact of intervention and use this process to learn collaboratively with all stakeholders.
- The result of the monitoring is also used as recommendation to improve the local fisheries management system, and to develop fisheries co-management in each MPA. For MPA that already has co-management scheme, it is important to strengthen the established fisheries co-management in each MPA by providing assistance and ensuring the involvement of local community, local government, and private sectors.
- Illegal, Unreported, and Unregulated (IUU) Fishing is still a major challenge for marine

*When the management plan is implemented, it is important to understand what works and not both for human and marine resources.*

resource conservation in most MPA. In all sites, fish biomass was below a sustainable thresholds of 500 kg/ha. It is important understand the destructive fishing behavior and make efforts to reduce these impacts. We plan to conduct a survey using specialized questioning techniques specifically for investigating sensitive topics, in this case the practice of blast fishing and cyanide fishing in Liang Ngali MPA and Saleh Bay, Sumbawa, NTB. We will also continue the ongoing education and awareness on this subject and the importance of MPA for marine resources and people across multi stakeholders.

- In order to achieve effective MPA management and sustainable conservation program, each MPA needs combination of good governance at different levels, collaborating with local communities, assisted by qualified NGOs, and customized interventions that support the sustainable use of natural resources. WCS will continue its support to the provincial government to identify strengths and weaknesses of management, and provide assistance in developing management design, share expertise in monitoring and evaluation the program, and build capacity of local government to create independent and sustainable conservation program in each MPA.

Coral reef survey conducted in Sitaro 2014. © WCS Indonesia.





# 10 Core Marine Dashboard Indicators for Global Coral Reef Fisheries

Indonesia

Construct	Indicator	Sulawesi				Lombok				Sumbawa			
		North Minahasa MPA		Sitara MPA		Gili Matra MPA		Gili Sulat dan Gili Lawang MPA		Liang Ngali MPA		Cempi Bay MPA	
		Inside MPA	Outside MPA	Inside MPA	Outside MPA	Inside MPA	Outside MPA	Inside MPA	Outside MPA	Inside MPA	Outside MPA	Inside MPA	Outside MPA
Survey years		2016	2016	2016	2016	2012, 2017	2017	2014	2014	2016	2016	2016	2016
Number of households		n = 131	n = 24	n = 68	n = 31	n = 142 (2012), n = 111 (2017)	n = 22	n = 95	n = 25	n = 68	n = 62	n = 65	n = 196
<b>Context</b>													
Market access	Presence of middlemen (fish traders)	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
	Presence and access to ice for refrigeration	Yes	Yes	No	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
<b>Resource System</b>													
1 Essential habitat	Hard coral cover, % (baseline, 1010-2014)	35.95	26.67	39.85	43.21	26.00	16.79	31.01	No data	50.00	No data	88.00	33.42
	Hard coral cover, % (recent: 2016-2017)	19.96	14.33	No data	No data	17.08	23.50	38.98	No data	No data	No data	No data	No data
2 Reef fish assemblages	Reef fish biomass, kg/ha (baseline, 2010-2014)	280.97	184.41	370.71	365.59	585.89	247.16	527.96	No data	344.57	No data	106.96	472.51
	Reef fish biomass, kg/ha (recent, 2016-2017)	423.25	335.25	No data	No data	474.84	328.61	301.91	No data	No data	No data	No data	No data
<b>Actors</b>													
3 Knowledge of human agency	% of respondents that recognize humans as the causal agents of change on marine systems	51.15	8.33	54.41	80.65	22.54 (2012) 52.25 (2017)	63.64	94.74	100.00	70.59	46.77	52.31	51.53
4 Importance of resource	% of respondents with fishing as a primary livelihood	49.62	79.17	89.71	87.10	40.85 (2012) 9.01 (2017)	90.91	93.68	100.00	94.12	100.00	96.92	100.00
	Average number of household livelihoods	2.07	1.88	1.19	1.26	1.44 (2012) 1.49 (2017)	1.82	1.29	2.04	1.82	1.71	2.00	1.71
<b>Governance System</b>													
5 Operational rules	% of respondents that know about area closure	37.40	8.33	5.88	0.00	78.17 (2012) 90.09 (2017)	45.45	29.47	100.00	16.18	41.94	15.38	19.39
	% of respondents that know about time closure	0.00	0.00	4.41	45.16	11.27 (2012) 9.01 (2017)	77.27	14.74	0.00	27.94	27.42	36.92	39.29
	% of respondents that know about gear restriction	74.81	0.00	44.12	51.61	90.85 (2012) 97.30 (2017)	100.00	82.11	100.00	89.71	82.26	84.62	90.82
	% of respondents that know about species protection	60.31	33.33	66.18	32.26	72.54 (2012) 99.10 (2017)	95.45	47.37	0.00	54.41	59.68	81.54	79.08

# 10 Core Marine Dashboard Indicators for Global Coral Reef Fisheries

Indonesia

Construct		Indicator	Sulawesi				Lombok				Sumbawa			
			North Minahasa MPA		Sitara MPA		Gili Matra MPA		Gili Sulat dan Gili Lawang MPA		Liang Ngali MPA		Cempi Bay MPA	
			Inside MPA	Outside MPA	Inside MPA	Outside MPA	Inside MPA	Outside MPA	Inside MPA	Outside MPA	Inside MPA	Outside MPA	Inside MPA	Outside MPA
6	Number & nestedness of management partners	Number and identity of management partners	9 - LPM, BPD, Fisher groups, Manengkel Solidaritas, Education and Culture Agency of North Sulawesi, BAPEDA, BKSDA, Indonesian National Police, WCS*	No partners	10 - LPM, BPD, Fisher groups, Pokmaswas, Rumah Ganesa, Education and Culture Agency of North Sulawesi, BAPEDA, BKSDA, Indonesian National Police, WCS*	No partners	13 - BKKPN Kupang, Gili Eco Trust, Fisher groups, Community cooperatives, PNPM, Youth group, Community security group, Pokmaswas, Community waste management group, Gili Matra entrepreneur groups, Rare Indonesia, Fisheries Department of Nusa Tenggara Barat (NTB) Province, WCS*	No partners	7 - Fisher groups, Community cooperatives, Pokmaswas, Komite Pengelola Perikanan Laut, Fisheries Department of Nusa Tenggara Barat (NTB) Province, Fisheries Department of East Lombok District NTB Province, WCS*	No partners	9 - LPM, BPD, Fisher groups, Pokmaswas, Cooperative groups, Youth group, Fisheries Department of Nusa Tenggara Barat (NTB) Province, Fisheries Department of Sumbawa District NTB Province, WCS*	No partners	9 - LPM, BPD, Fisher groups, Pokmaswas, Cooperative groups, Youth group, Fisheries Department of Nusa Tenggara Barat (NTB) Province, Fisheries Department of Dompu District NTB Province, WCS*	No partners
7	Knowledge and fairness of governance	% of respondents who feel that decision-making is fair or very fair	13.74	4.17	16.18	3.23	72.08 (2017)	86.36	No data	No data	35.29	32.26	52.31	49.49
Interactions														
8	Harvesting	CPUE (kilograms per trip)	46.12	30.59	161.00	20.36	185.75 (2012) 48.07 (2017)	49.67	11.58	110.93	114.35	19.54	13.10	114.15
9	Conflict	% respondents noting the presence of any conflict in marine resource management issues	26.72	0.00	No data	No data	4.50 (2017)	50.00	No data	No data	30.88	19.35	16.92	33.16

\* LPM: Community Development Organization, BPD: Village Consultative Organization, Manengkel Solidaritas: Local NGO, BAPEDA: Planning and Regional Development Agency of North Sulawesi, BKSDA: Nature Conservation Agency of North Sulawesi, Pokmaswas: Community Patrol Group, Rumah Ganesa: Local NGO, BKKPN Kupang: Government conservation agency, Gili Eco Trust: Local NGO, PNP: National Program for Community Empowerment, Rare Indonesia: International NGO, Komite Pengelola Perikanan Laut: Local NGO.



# 10 Core Marine Dashboard Indicators for Global Coral Reef Fisheries

Indonesia

Construct Indicator		Sulawesi				Lombok				Sumbawa			
		North Minahasa MPA		Sitara MPA		Gili Matra MPA		Gili Sulat dan Gili Lawang MPA		Liang Ngali MPA		Cempi Bay MPA	
		Inside MPA	Outside MPA	Inside MPA	Outside MPA	Inside MPA	Outside MPA	Inside MPA	Outside MPA	Inside MPA	Outside MPA	Inside MPA	Outside MPA
10 Social performance	Perceived impacts of resource management to COMMUNITY wellbeing: % of respondents who identified management as having good or very good impacts	38.16	33.34	2.94	19.35	75.67 (2017)	13.64	No data	No data	45.59	56.45	70.77	70.92
	Perceived impacts of resource management to PERSONAL wellbeing: % of respondents who identified management as having good or very good impacts	38.93	25.00	1.47	16.13	39.44 (2012) 47.75 (2017)	22.73	14.74	28.00	51.47	56.45	78.46	72.45
	Examples of benefits of management	"It is good for fish breeding ground for fish," "Protect the sea and preserve other marine resources," "Create potential for tourism that will benefit the village," "More fish and catch result is increasing"	"It is good for future generation," "The management benefiting all stakeholders," "Government give incentives," "It is good to protect marine resources"	"Preserve coral reefs and fish" "Protect the sustainability of fisher livelihood" "More fish"	"To protect the coral reefs and fish," "More fish and more catch," "Secure fisher livelihood," "Increase fisher's income"	2012:" "Distribution of free waste containers," "Fisher was decreasing," "Distribution of fishing gears as muroami replacement," "Availability of one Fish Aggregating Device (FAD)" Management benefits 2017:" "More tourist come," "Fish catch is stabil and coral reefs is protected," "Income is increasing," "Zoning system is more organized"	"I'm able to catch fish with simple (small) fishing gear," "No conflict with tourism sector," "Protect fish and its sustainability," "No direct benefit for fisher, more benefit for tourism"	"Distribution of boats (fiber)," "Establishment of floating net cages for mariculture," "Fish catch is increasing," "Mangrove replanting," "Protecting fish house (coral reefs)"	No data	"Catching fish is becoming easy because the availability of Fish Aggregating Device (FAD)," "Fish is available and MPA is protecting fish sustainability," "Income is increasing," "Protecting coral reefs, sea, and ecosystem," "Limiting some fishing gear and no more blast fishing"	"Protect coral reefs and fish," "More fish," "Keep the fishing ground safe (from blast fishing)," "Government provide FAD to catch fish," "Cooperation between government and fishers"	"More fish," "Baby fish is protected from blast fishing," "Fisher income is similar or increasing," "Destructive fishing gears like blast fishing, trawl, small diameter nets (similar to mosquito nets) were forbidden," "Regulating fishing zone based on fishing gears," "Coral reefs is protected"	"Protecting small (baby) fish and fish able to breed," "Limiting desctuctive fishing gears," "I wish the fish catch increase," "Better income for local community"

Construct Indicator		Sulawesi				Lombok				Sumbawa			
		North Minahasa MPA		Sitaro MPA		Gili Matra MPA		Gili Sulat dan Gili Lawang MPA		Liang Ngali MPA		Cempi Bay MPA	
		Inside MPA	Outside MPA	Inside MPA	Outside MPA	Inside MPA	Outside MPA	Inside MPA	Outside MPA	Inside MPA	Outside MPA	Inside MPA	Outside MPA
10	Social performance	Examples of costs of management	“No monitoring (and tool/ equipments to do monitoring),” “No transparency in MPA management and financial,” “The management is bad and now is inactive,” “No benefit”	No data	No data	“Restricted area to fish,” “Fisher is not allowed to eat turtle eggs”	“Less fish catch,” “Restricted area to fish,” “Difficult to catch fish”	No data	No data	“Limit fisher freedom and fishing ground,” “Less catch and its difficult to catch fish,” “Income is decreasing,” “No monitoring,” “The cyanide fishing is causing seaweed harvest decreasing”	“Fish catch is decreasing,” “No fish landing facility,” “Less income”	“No management implemented,” “Fish catch is decreasing and uncertain,” “Zoning system will make fishing ground become narrow,” “Boat operated lift nets, small diameter nets, and blast fishing were causing fish catch decreasing,” “No shark is allowed to catch anymore,”	“Management is not implemented yet,” “Boat lift nets is still allowed to operate,” “Less catch and income,” “No actions taken for those who violated regulation”
		Examples of comments on fairness of management	“Local people were invited and included in the management decision process,” “MPA was good, but now is inactive and no transparency in its financial accountability,” “Local people and government work together”	“It is fair because the goal is to protect the environment”	“Local people agree with the MPA management,” “Local people understand and aware about the regulation on blast and cyanide fishing,” “No MPA management happened”	“MPA regulation was consulted with local people,” “Local people was involved in decision making process,” “MPA management benefited all stakeholders,” “Local people involved in management implementation”	“MPA regulation was consulted with local people,” “Local people was involved in decision making process,” “The government give incentives”	NA	NA	“Involving local people,” “Fisher aspirations were taking into account,” “Limiting marine resources exploitation,” “No conflict among fisher,” “MPA Management is to protect marine resources and everybody will benefit from it”	“Involving local community,” “The decision made is considering fisher’s aspirations,” “The management’s goal is to improve people welfare”	“Its forbid blast fishing, cyanide, and trawl operated. These gears make fishers suffered losses,” “Its aim is to protect marine resources, fish sustainability, and fisher livelihood,” “The decision will benefit fisher, especially small-scaled fisher”	“To protect marine resources,” “It is benefiting fishers,” “I comply with government regulation and follow the village leaders,” “It is limiting destructive fishing gears which make fisher suffered losses”
		Human wellbeing	Wealth (assets). Median number of items owned by households from a common list of 15 household goods and services (refrigerator, boat, engine, car, etc.)	7.0 ( range 1-13)	7.0 (range 3-10)	5.0 (range 2-10)	5.0 (range 1-8)	4.0 ( range 0-12)	7.5 (range 4-11)	4.0 (range 0-8)	5.0 (range 3-7)	7.0 (range 2-12)	6.0 (range 3-12)

# Solomon Islands

## Background

- Western Province of Solomon Islands is a biodiversity hotspot and forms part of the Coral Triangle region. Coral reefs and coastal ecosystems provide livelihoods and food security for a significant portion of the population, estimated at over 75,000 people. Modernization and increasing market access, along with steady population growth (estimated at 2% per year) have led to concerns that natural resources are at risk of overexploitation.
- Threats to sustainable resource use include large-scale timber extraction, exploitation of fisheries to supply local and national markets, and exposure to climate shocks and natural disasters. Increasingly, many communities rely on alternative income sources (e.g., development of markets for non-timber forest products) and alternative protein sources (e.g., pelagic fish species caught on nearshore fish aggregating devices) to secure livelihoods, food security, health and education.
- The management of natural resources has traditionally been based on close linkages between people and their land and sea. Customary resource management practices, governance arrangements, and local environmental knowledge guide resource management throughout Western Province.



## The Activities

- The American Museum of Natural History (AMNH), with support from the Wildlife Conservation Society (WCS) and the Solomon Islands Community Conservation Partnership (SICCP), has been working in Western Province of Solomon Islands since 2015. This work has been largely funded by the National Science Foundation, and complements ongoing funding by the MacArthur Foundation and The Tiffany & Co. Foundation. WCS, supported by the MacArthur Monitoring program, has led monitoring and evaluation of the coastal and marine components.
- The work has sought to support four communities in Western Province to understand local definitions of success in resource management, develop indicators of this success, and assist communities in working towards their vision of a healthy and sustainable future.
- Project sites are in areas where the MacArthur Foundation has supported community-based resource management initiatives for over a decade, through grants to AMNH and the University of Queensland (UQ).
- The four communities are West Parara, Biche, Zaira, and Vavanga. The communities have between 80 and 120 resident adults. Data are drawn from 40-48 socio-economic surveys per community, and semi-structured interviews with 10-20 key informants per community. Ecological surveys of coral and reef fish ecosystems were also conducted in the regular fishing grounds of each community.
- Data collection for the wider project included a range of participatory and visual methodologies, with a focus on building in-depth relationships at the community level. Throughout the work, the research team has sought to design research and action that are explicitly based on community needs and aspirations.

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*Local worldviews of successful resource management can support a healthy and sustainable future*

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Typical Western Province land and seascapes from the study sites;  
Top: Zaira community © M. Esbach,  
Bottom: West Parara community © P. Pikacha



## The Story

The four communities vary in their degree of isolation - West Parara and Vavanga have a relatively short boat ride to a market town (Gizo), while Biche and Zaira both face a long and relatively expensive boat trip to access a major market. However, residents from Biche and Zaira do have some opportunities for selling goods at closer venues: Biche fishers, for example, benefit from the presence of a tourist lodge, to which they can sell items like crayfish.

None of the four sites have ice or middlemen fish traders within the community. However, West Parara and Biche have regular access to middlemen in neighbouring communities, and occasionally have someone in the village with an 'esky' (cool box) who will buy fish from local fishers. On the whole though, these opportunities are too far away or irregular for community members to consistently be able to take advantage of market opportunities for fisheries.

Respondents in the four communities were very aware of human impacts: 63 – 83% of respondents indicated knowledge of human impacts on the environment generally, and >85% affirmed that humans impact the marine environment in their community. This is possibly due to the occurrence of large scale and obvious events, such as logging or massive fishery overharvesting events, as well as ongoing awareness provided by supporting

*Knowledge of human impacts is high, >85% of respondents affirmed that humans impact the marine environment*

organizations like SICCP, AMNH and UQ.

Hard coral cover is variable (28-57% live coral cover), largely attributable to environment factors such as habitat and depth. In general, live coral cover is comparable with elsewhere in Melanesia, and some sites (particularly those close to Biche community) have high levels of live hard coral.

Total fish biomass and target fish biomass (defined as fish >10cm) ranges between 262.5 and 577.8 kg per hectare. While these data show fish biomass to be lower than mean values elsewhere in Melanesia, surveys of this kind typically find significant variability based on methodology, survey site, environment type and other variables. As such, these values do not necessarily reflect exploitation, and may also reflect low-relief reef structure, wave exposure, and higher macroalgae cover.<sup>1</sup>

<sup>1</sup> Further surveys could also consider the role of fish biomass at potential 'depth refuges', which are deeper than the range of spearfishers.



## *Future management targets could seek to build fish biomass towards global estimates of sustainable biomass on coral reefs (500 kg per hectare) <sup>2</sup>*

Catch per unit effort (CPUE) data is similar to other records from the Solomon Islands and Fiji. While accurate CPUE data are difficult to collect, these data support additional survey information (not included here), and likely indicate that in general marine resources are adequate for the current fishing needs in the four communities.

None of the communities had an especially high reliance on fishing as a source of income. West Parara had the highest dependence on fishing, although only one-third of respondents there identified fishing as within their three most important sources of income. Income was typically associated with sales of goods from the garden and occasional one-off wage labour. Monitoring future changes in livelihood use and fishing dependence could provide early-warning signs of changing resource use and potential conflict.

Three of the four communities currently have active marine resource management. Of those three, Biche and Zaira were relatively unified around the need and communication of rules in the marine zone. Both communities have had conservation activities running for a number of years and involving a range of partners. At West Parara, management of the marine environment is a relatively new initiative, and was driven by actions that were not communicated well to the rest of the community. Respondents at West Parara noted that they supported action around

management of the marine area, but raised concerns that the process to establish management rules had insufficient consultation to date.

Most communities had between two and three current management partners. Biche community have had many conservation and resource management visitors over the past ten years, which has led to some fatigue related to participation in externally driven projects.

## *Conflict within communities over marine resources is low*

In general, conflict within communities over marine resources was limited. Key informants at Biche community did report minor conflict within the community, which had recently been exacerbated by decisions to participate in logging activities outside the community boundary. No respondents at any of the sites reported physical violence.

In contrast, logging activities were perceived as having more negative impacts than use of marine resources. Most respondents in West Parara and Vavanga, where logging has taken place, reported negative impacts from this activity on their family, while respondents everywhere thought that logging had negative impacts on the ability of the community to cooperate and work together.

Vavanga, Biche, and Zaira all reported high levels of self-reported happiness, and important marker of subjective well-being, and in comments pointed to the availability of marine and terrestrial resource as a key driver of this. Values at West Parara were slightly lower (median 3 out of a possible 5), though 37% of these respondents were optimistic about the future.

<sup>2</sup> MacNeil et al. Nature 2015



## Next Steps

- WCS is currently helping residents there to strengthen village governance for natural resource management under a project funded by the U.S. National Fish and Wildlife Foundation. The community has already developed a draft management plan and is presently consulting with neighbouring communities to raise awareness about local rules. In West Parara, and the other communities, long-term social-ecological monitoring (MACMON) can assess future changes in governance and perceived fairness of decision-making processes and consultation.
- AMNH, in partnership with WCS, is preparing materials based on these and other data for the four communities. The products of this work include large-format books, maps and posters, as well as in-depth resources of interest to the communities (e.g., recipe books, local valuable plants), which capture information around natural and social systems, as well as the wide-ranging discussions held in communities over the last two years. Materials produced from this work will be closely linked to the specific management objectives of each community.
- Separately, WCS is working with SICCP, UQ and other partners on the early stages of designing innovative financing mechanisms to provide for long-term sustainability of community-based resource management with tangible benefits for resource owners. Monitoring the social perceptions of new financing mechanisms (e.g., perceived fairness, support, conflict, governance, etc.) will be critical to support the adaptation of projects over time.

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*WCS is currently helping residents to strengthen village governance for natural resource management*

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# 10 Core Marine Dashboard Indicators for Global Coral Reef Fisheries

Solomon Islands

Construct	Indicator	West Parara	Vavanga	Biche	Zaira	
Context						
Market access	Presence of middlemen (fish traders)	No	No	No	N	
	Presence and access to ice for refrigeration	No, occasional ice coolers ("eskies")	No	No, but some access to a tourist market, regular eskies at neighbouring village Peava	No, but nearby access to eskies affecting neighbouring reef	
	Distance to market (hours) *Markets defined as a permanent market house where people regularly supply the market with fish	1 hour	0.5 hour	3 hours	1 hour	
	Distance to market (km)	22.1 km	14.0 km	66.5 km	27.0 km	
Resource System						
1	Essential habitat	Hard coral cover, %	28.0	41.0	57.5	28.5
2	Reef fish assemblages	Reef fish biomass, kg/ha	351.9	345.7	581.6	264.6
Resource Units						
3	Fishable biomass	Biomass of target reef fish, kg/ha	339.8	337.5	577.8	262.5
Actors						
4	Knowledge of human agency	Percentage of respondents indicating knowledge of human impacts on reef [do respondents list human activities?]	83.0	68.8	78.9	63.4
		Percentage of respondents affirming that humans impact on the marine environment [do respondents answer 'yes' that humans impact marine environment?]	85.0	95.8	97.4	97.5
5	Importance of resource	Dependence on fisheries for primary livelihood				
		Percentage of interviewees with fishing in top three sources of income	33.0	4.2	17.5	17.5
Governance System						
6	Knowledge and fairness of management rules	% of interviewees with knowledge of rules	76.0	NA	96.0	100.0
		% of interviewees affirming that rules are fair	56.0	NA	73.0	90.0
		% interviewees affirming that rules work	67.0	NA	83.0	100.0
7	Management partners	Number of current management partners	3 (SICCP, AMNH, WCS)	2 (KIBCA, AMNH) <sup>1</sup>	2 (SICCP, AMNH)	3 (SICCP, AMNH, UQ)

<sup>1</sup> plus occasional partners (Auckland University of Technology and the Natural Resources Development Foundation.)

# 10 Core Marine Dashboard Indicators for Global Coral Reef Fisheries

Solomon Islands

Construct	Indicator	West Parara	Vavanga	Biche	Zaira	
Interactions						
8	Harvesting	Catch Per Unit Effort, CPUE (kg per person per hour)	1.28	1.00	2.31	1.25
9	Conflict	% interviewees noting the presence of conflict in marine resource management issues	15.4	0.0	40.0	0.0
		% interviewees noting logging impact on family	89.0	87.5	60.0	46.3
		% interviewees noting logging impact on community cooperation	97.5	100.0	75.0	97.6
Outcomes						
10	Social performance	Perceived impacts of resource management to personal and community wellbeing	Mostly positive, but concerns about leadership and communication.	NA - no coastal management	Most people positive while noting challenges to be overcome	Most people are positive about the role of resource management and conservation in village life
		Perceived fairness of impacts of resource management	Mostly positive, though some actors feel that consultation has been limited	NA - no coastal management	Mostly positive	Mostly positive
		% interviewees noting increases in subjective wellbeing from 5 years ago to current time	40.5	4.2	5.0	27.0
		Median current day subjective wellbeing (1-low wellbeing to 5-high wellbeing)	3	5	5	5



## Background

- Coastal fisheries are critical to the food security and livelihoods of Fijian people, with 33 percent of all animal protein consumed coming from fish.<sup>1</sup> Decades of poor or neglected management means that many coastal fisheries are largely fully exploited, especially close to urban centers, and increased access to economic markets has resulted in overharvesting and illegal harvesting of coastal resources.
- At the same time, Fijian culture and way of life is interwoven with their natural environment, and customary systems can be highly effective at maintaining sustainable fisheries and producing livelihoods outcomes with sustained support and under the right enabling conditions. Historically, Pacific island communities employed a variety of tools to control marine and coastal resource use. The most common tool used by communities in Fiji are *tabu* areas, which are no-take fisheries closures that are occasionally opened to fishing to enable fish and invertebrates stocks to recover, that are within larger locally managed marine areas (LMMAs).<sup>2</sup>
- On 20 February 2016, Fiji was hit by Category 5 Tropical Cyclone Winston. It was one of the largest cyclones Fiji had experienced with winds up to 233 km/hr and gusts of 306 km/hr. Over a 24-hour period the cyclone left a trail of destruction along its path. In addition to damage to homes, schools and other infrastructure, the cyclone destroyed food and agricultural crops on a large scale and impacted the livelihoods of 62 percent of the population<sup>3</sup>, including fisheries-dependent communities.<sup>4</sup>

## The Activities

- WCS has been working in Fiji since 2001, and has been collecting coral reef health data at villages across the Vatu-i-Ra Seascape since 2005, with the greatest effort around Kubulau District, and specifically the Namena Marine Reserve. The data have been used to inform ecosystem-based management planning in multiple districts in Bua Province, and to provide advice to communities on the establishment, opening and closing of *tabu* areas.
- With complementary funding from the David and Lucile Packard Foundation, WCS and research collaborators have assessed the effectiveness of *tabu* areas within LMMAs to provide fisheries and conservation benefits to local Fijian communities. This work revealed several key variables that we predict influenced *tabus* and LMMA outcomes, including (i) the presence/absence of clear physical and social

*In 2016, category 5 Tropical Cyclone Winston -- the strongest tropical cyclone in the southern hemisphere -- tore a path of destruction through Fiji's homes, crops and livelihoods*



Top: Women fishers from Nasavu in Bua District.

© Stacy Jupiter

Bottom: Tropical Cyclone Winston caused extensive damage, such as flipping this large coral in the Namena Marine Reserve. © Jack & Sue Drafa

<sup>1</sup> Gillett R (2009) Fisheries in the economies of the Pacific island countries and territories. Asian Development Bank, Mandaluyong City.

<sup>2</sup> Jupiter SD, Cohen PJ, Weeks R, Tawake A, Govan H (2014) Locally managed marine areas: multiple objectives and diverse strategies. *Pacific Conservation Biology* 20(2): 165-179

<sup>3</sup> Government of Fiji (2016) Fiji Post-Disaster Needs Assessment. Tropical Cyclone Winston, February 20, 2016. Government of Fiji, Suva, Fiji. 148 pp.

<sup>4</sup> Chaston Radway K, Manley M, Mangubhai S, Sokowaqanilotu E, Lalavanua W, Bogiva A, Caginitoba A, Delai T, Draniatu M, Dulunaqio S, Fox M, Koroivaqa I, Naisilisili W, Rabukawaqa A, Ravonoloa K, Veibi T (2016) Impact of Tropical Cyclone Winston on Fisheries- Dependent Communities in Fiji. Report No. 03/16. Wildlife Conservation Society, Suva, Fiji. 105 pp.

boundaries; (ii) the presence or absence of community monitors; (iii) congruence between decision making affecting tabus and their broader LMMAs; and (iv) whether rules (e.g., harvest frequency) were linked to the state of the resource base.<sup>5</sup>

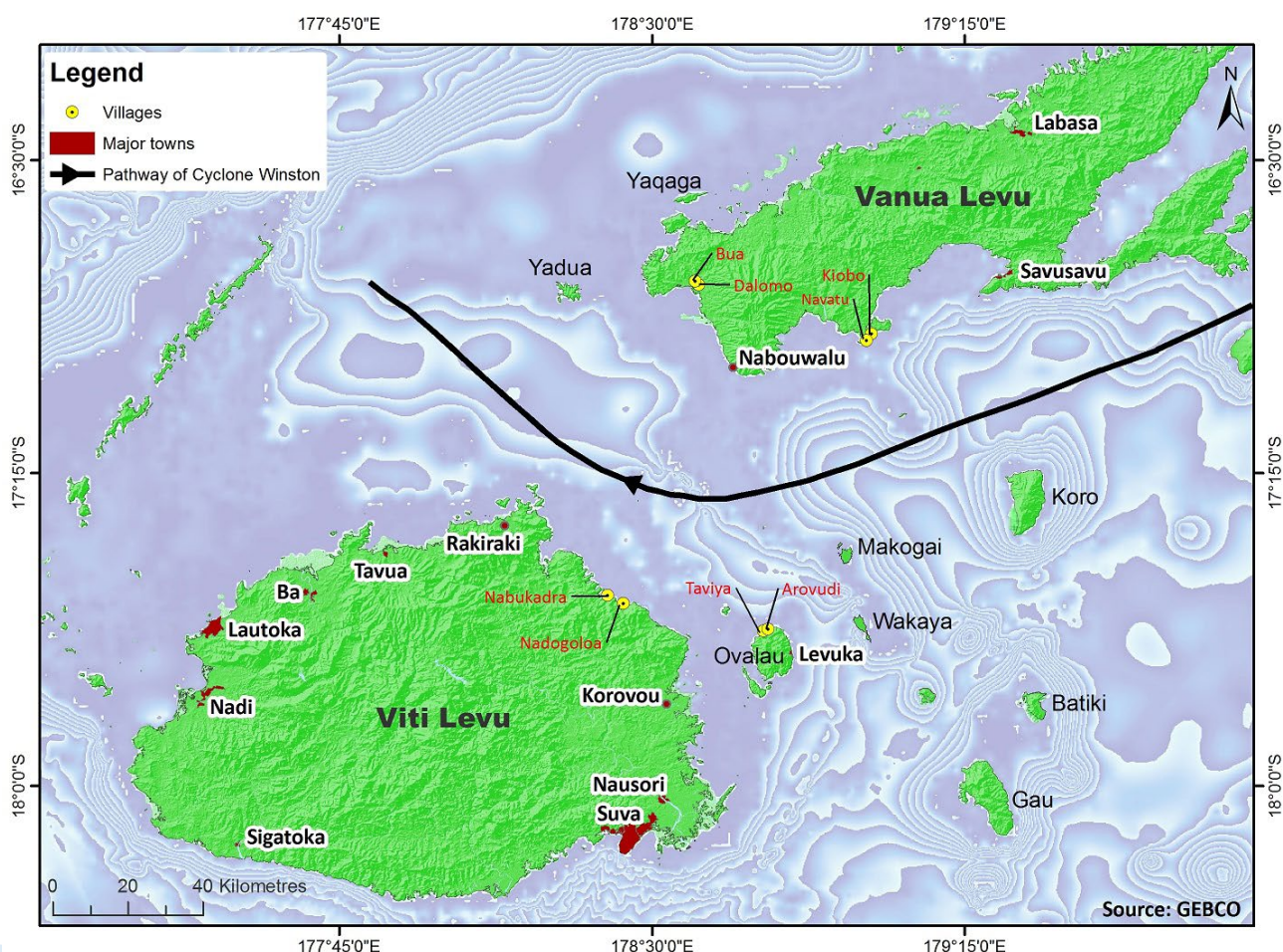
- To directly assess the impact of management and the effects of cyclone Winston, MACMON social and ecological surveys were conducted in eight communities were interviewed in the provinces of Bua, Lomaiviti and Ra in the Vatu-i-Ra Seascape in 2016. Data were collected from 10–26 household surveys per community depending on the size of the village, and semi-structured interviews with key informant in each community (October–November 2016). Ecological surveys of coral and reef fish ecosystems were also conducted in the fishing grounds of each community (May– July 2016).

*Substantial declines in reef fish biomass and coral cover were documented in Fiji following the path of Cyclone Winston; ecological recovery may take 10 years. Fisheries management can help communities rebuild livelihoods and food security.*

- In addition, the MACMON framework was adapted to assess a sustainable financing project, and used to collect baseline data in November 2016 to assess the effectiveness of the newly established Vatu-i-Ra Conservation Park in Ra Province, and a proposed **payment for ecosystem services** scheme.<sup>6</sup> Seed funding from the MacArthur Foundation helped to set up the Vatu-i-Ra Conservation Park.

<sup>5</sup> Jupiter S, Epstein G, Ban NC, Mangubhai S, Fox M, Cox M (2017) A social-ecological approach to assessing conservation and fisheries outcomes from Fijian locally managed marine areas. *Society and Natural Resources*. DOI: 10.1080/08941920.2017.1315654

<sup>6</sup> Nand Y, Loganimoce EM, Mangubhai S, Fox M, Uluiburotu L, Naisilisili W, Dulunaqio S, Lalavanua W, Gurney G, Teneva L (2017) Baseline ecological and socioeconomic surveys of the Vatu-i-Ra Conservation Park. Wildlife Conservation Society. Report No. 02/16. Suva, Fiji. 52 pp.



Map showing the eight villages (yellow circles with red text) where the MACMON surveys were conducted for a 2013–4 baseline and a repeat survey in 2016.



## The Story

Cyclone Winston had a large impact on coral reefs in the Vatu-i-Ra Seascape, with declines in coral cover recorded both inside and outside of tabu areas. Declines in coral cover between 2014 and 2016 ranged from 25.0% at open fishing sites at Nabukadra and Nadogoloa (Nakorotubu District, Ra Province) to 50.2% in the tabu area at Arovudi and Tavia (Levuka District, Lomaiviti Province). The loss of coral cover likely reflects the original pre-cyclone coral community composition (e.g. delicate branching corals) and whether coral reefs were in the direct pathway of the cyclone (Fig. 1). In 2016, surveys were not conducted on coastal reefs in Kubulau District because of high sediment loads in the water three months after the cyclone. Damage and losses estimated by WCS suggest that coral recovery may take at least 10 years and will be dependent on measures put in place that support coral recovery, such as a reduction in fishing pressure.<sup>7</sup> In mid-2016, the results from the surveys were used by communities in Nakorotubu District to make decisions to close their tabu areas for another 5–10 years to support the recovery of their coral reefs.

With the exception of the tabu areas at Bua and Dalomo (Bua District, Bua Province) and Arovudi and Tavia, fish biomass declined across all sites by 18.3–52%. Fish biomass declines are expected after highly destructive cyclones, particularly species that are dependent on corals and the reef matrix for habitat. Significant decreases in density, biomass and diversity of reef fish assemblages were recorded in New Caledonia up to 3 years after Cyclone Erica,<sup>8</sup> and are expected on Fiji's reefs. Post-cyclone, almost all sites surveyed in Fiji support less than 500 kg/ha of fish biomass, which is needed to maintain ecosystem function.<sup>9</sup> The results from this survey were used to reduce the number of fishing licences issued for Nakorotubu District in Ra Province in 2017.

*“There's a steady population of fish in the tabu. Bigger fish are now caught, and fish that were normally caught at night are now caught in the day”*

*survey respondent*

*“We protect our food sources and now I am sure that my children will have fish for the future.”*

*survey respondent*

The reliance of communities on fisheries as the primary source of income varied considerably between sites. Villages on the island of Levuka (Lomaiviti Province) had the lowest reliance on fishing for livelihoods, as many have employment in the town, including through the Pacific Fishing Company (PAFCO), a tuna cannery that has been operating there since 1963. In contrast, Navatu village (Kubulau District) holds only a small amount of land for agriculture, and had the highest reliance on fishery livelihoods. Catch-per-unit-effort (CPUE) data collected in 2014 showed fishers from Navatu village highly dependent on sea cucumbers for income. In general, most households rely on at least 2–3 different income sources. Across all villages, on average, 79% of respondents stated that management has made it easier to catch fish.

Households in Kiobo village were the most positive about governance and the positive impact that natural resource management had on their lives. Kiobo village has strong leadership through the district paramount chief Tui Kubulau, has received support from WCS for over 10 years, and has a dive tag system in partnership with the tourism industry that has provided school children grants to pursue higher education.

In contrast, less than half the households in Nabukadra and Nadogoloa felt they had an influence on the management of marine resources, or that decision-making was fair, and this came out strongly after Cyclone Winston where there was a diversity of views about whether to open tabu areas or not. This is because many of the decisions around tabu areas in Ra Province as well as the issuance of commercial licences for the district fishing ground is done at the district level, without comprehensive input or consultation with individual villages. These villages,

*“Life in the village is completely fine but this recent cyclone completely destroyed our farm so our economic status is affected severely”*

*survey respondent*

<sup>7</sup> Mangubhai S (2016) Impact of Tropical Cyclone Winston on Coral Reefs in the Vatu-i-Ra Seascape. Wildlife Conservation Society, Suva, Fiji. Report No. 01/16. Suva, Fiji, 26 pp.

<sup>8</sup> Guillemot N, Chabanet P, Le Pape O (2010) Cyclone effects on coral reef habitats in New Caledonia (South Pacific). *Coral Reefs* 29: 445–453

<sup>9</sup> MacNeil AM, Graham NAJ, Cinner JE, Wilson SK, Williams ID, Maina J, Newman S, Friedlander AM, Jupiter S, Polunin NVC, McClanahan TR; Recovery potential of the world's coral reef fishes. *Nature* 520:341–344, 2015.

who also are largely agriculturists, generally felt that marine resource management did not positively impact individual or community wellbeing, and was not fair to them. To date, efforts in Ra Province to develop an Integrated Coastal Management Plan led by the University of the South Pacific has been largely top-down, without adequate consultation at the community level, and may be contributing to negative perceptions around governance and outcomes.

The surveys also picked up some of the ongoing conflict between the adjacent villages of Dalomo and Bua Lomanikoro in Bua District. Dalomo village is small and only 10 households were surveyed, and although 83.3% of Dalomo households stated that management had a good or very good impact on them as individuals, many respondents did not feel decision-making was fair, there were high perceived conflicts, and they felt the impact of natural resource management was unfair or very unfair. This likely reflects a shared history of conflicts between the two villages relating to the length of closure of *tabu* areas, with fishers from Dalomo caught poaching within their shared *tabu* area.

Socioeconomic surveys were completed seven months after Cyclone Winston devastated Fiji. The impact of the cyclone on people's lives was clear throughout the surveys, with more than 50% of households in most villages feeling their overall wellbeing had decreased.

## Next Steps

- Funding for long-term monitoring of coastal fisheries is challenging in Fiji for all agencies, including government, non-government and academic institutions. With support from the MacArthur Foundation, WCS has one of the more extensive monitoring datasets that has contributed to (i) conservation planning and decision-making, (ii) the design, establishment and maintenance of community LMMAs, and (iii) assessing the conservation impact of management interventions. On-going support from the Foundation over the next three years will enable us to monitor the recovery of coral reefs post-cyclone Winston, and better understand community resilience to natural disasters like cyclones, which are expected to increase in frequency and magnitude with the impacts of climate change<sup>10</sup>.

- The results of this work are focusing management actions at different sites to ensure monitoring results contribute to adaptive planning and management that benefits the local communities we work with. For example:
  - » The management plan for Bua District was developed by the University of the South Pacific many years ago, and WCS is hoping to be able to review and update this plan (making it consistent with the other districts in the province and increasing local voice and consultation) over the next three years with support from the MacArthur Foundation.
  - » At the same time, with complementary funding from the Packard Foundation, WCS will work with communities in Bua District to look at the opportunity to develop a more comprehensive management plan for fisheries resources that will sit under an updated ecosystem-based management plan for Bua District.
  - » Lessons learned from Kubulau District, will be more widely shared with communities in Nakorotubu District as they establish a similar large marine reserve and establish a diver fee system similar to the Namena Marine Reserve. If established correctly, and communities see tangible benefits such as education grants for local children, this may help to address concerns about the fairness and benefits of management.
- Lastly, WCS Fiji is interested in the role that women play in fisheries management. Within the next three years, WCS Fiji would like to look at the current data collected under MACMON and assess the ability of the SES framework to look at gender differences, and its implications for natural resource management approaches being used in Fiji.



Women on Koro island mending fishing nets before a community harvest in 2014. © Emily Darling

<sup>10</sup> Cheal AJ, MacNeil MA, Emslie MJ, Sweatman H (2017). The threat to coral reefs from more intense cyclones under climate change. *Global Change Biology* 23: 1511-1524.



# 10 Core Marine Dashboard Indicators for Global Coral Reef Fisheries

Construct		Indicator	Bua		Kubulau		Levuka		Nakorotubu	
			Bua Lomanikoro	Dalomo	Kiobo	Navatu	Arovudi	Taviya	Nabukadra	Nadogoloa
Context										
Market access		Presence of middlemen (fish traders)	No middlemen, fish sold to local community only		Yes		No middlemen, fish sold to local community only		Yes	Yes
		Presence and access to ice for refrigeration	Access to ice and coolers		Access to ice and coolers		Electric freezers in village, also access to ice and coolers	Access to ice and coolers	Access to ice and coolers	Access to ice and coolers
Resource System										
1	Essential habitat	Hard coral cover, %	30.0% (tabu), 21.9% (open) ↓		28.4% (tabu), 44.82% (open) <sup>1</sup> NA		11.4% (tabu), 17.8% (open) ↓		21.1% (tabu), 22.2% (open) ↓	
2	Reef fish assemblages	Reef fish biomass, kg/ha	1373.5 (tabu), 643.1 (open) ↕		1002.3 (tabu), 499.8 (open) <sup>1</sup> NA		297.5 (tabu), 428.6 (open) ↓		399.7 (tabu), 202.4 (open) ↓	
Resource Units										
3	Fishable biomass	Biomass of target reef fish, kg/ha	1368.9 (tabu), 641.3 (open) ↕		797.5 (tabu), 419.2 (open) NA		294.7 (tabu), 424.5 (open) ↓		396.1 (tabu), 199.7 (open) ↓	
Actors										
4	Knowledge of human agency	% of respondents that recognize humans as the causal agents on change on marine systems	95.0	100.0	100.0	87.5	100.0	100.0	92.9	93.8
5	Importance of resource	Percentage of respondents with fishing as a primary livelihood	25.0	16.7	30.0	50.0	12.5	9.5	28.6	25.0
		Average number of household livelihoods	3.0	2.5	3.0	3.0	3.0	3.0	2.0	3.0
Governance System										
6	Knowledge and fairness of governance	% of respondents that feel that they can influence the management of marine resources	65.0	66.7	70.0	75.0	68.8	61.9	42.9	56.3
		% of respondents who feel that decision-making is fair or very fair	70.0	50.0	80.0	62.5	81.3	76.2	35.7	56.3
7	Number & nestedness of management partners	Current management partners	WCS, University of the South Pacific	WCS, University of the South Pacific	WCS	WCS	WCS	WCS	University of the South Pacific	University of the South Pacific
Interactions										
8	Harvesting	% of respondents who think management has made it easier to catch fish	85.0	83.3	100.0	75.0	93.8	66.7	50.0	56.3
9	Conflict	% respondents noting the presence of conflict in marine resource management issues (as an annual or monthly occurrence)	30.0	66.7	40.0	18.8	25.0	23.8	35.7	25.0

<sup>1</sup> 2016 ecological surveys for Kiobo and Navatu (Kubulau) not possible after cyclone Winstone; values are from 2014 survey

# 10 Core Marine Dashboard Indicators for Global Coral Reef Fisheries

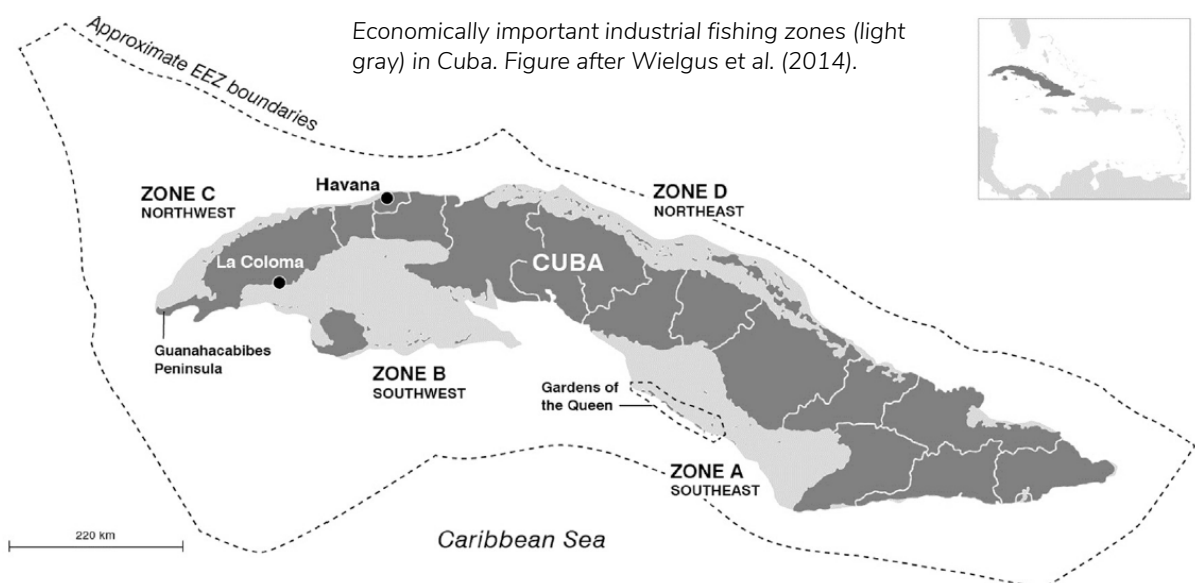
Construct	Indicator	Bua		Kubulau		Levuka		Nakorotubu	
		Bua Lomanikoro	Dalomo	Kiobo	Navatu	Arovudi	Taviya	Nabukadra	Nadogoloa
Outcomes									
10 Social performance	% who identified management having good impacts on COMMUNITY wellbeing	70.0	66.7	100.0	87.5	87.5	81.0	35.7	50.0
	% who identified management having good impacts on PERSONAL wellbeing	65.0	83.3	100.0	93.8	93.8	71.4	35.7	50.0
	Examples of benefits of management	“Recovery of marine life.” “People follow the rules and this increases their unity”	“Abundance of food fish for livelihood and also during village special occasion.” “We are able to eat fish everyday”	“There’s a steady population of fish in the tabu; Bigger fish are now caught; Fish that were normally caught at night are now caught in the day”	“Namena Marine Reserve - \$3,000/yr is given to the villge of Navatu for ‘compensation’ and also there’s a scholarship fund”	“The things that we don’t see before now we can see it. It’s in the tabu”	“Recovery of the community’s food fish, and during special occasions”	“More fish on nearby reefs”	“It brings prosperity to the ecosystem and also we get to have a lot of food during special occasions within our village”
	Examples of costs of management	“Poachers might be benefiting more then the community”	“Displacement of fishing area”	“Distance to to new fishing spot for women; non-tabu boundary is becoming smaller”	“Non-tabu boundary is getting smaller thus extensive level of exploitation in these areas”	“Older fishers have to travel further to fish”	“People from this village poach in the tabu area. Distance to new fishing ground, particularly for women”	“..financial constraints from the tabu because most of the famillies depend on the sea for their livelihood and also source of money”	“We have to travel far to catch fish for our family”
	% who stated management was FAIR	65.0	50.0	70.0	68.8	68.8	66.7	21.4	50.0
	Examples of comments on fairness of management	“I believe these impacts are equally shared”	“I believe that protecting the reef will benefit me and the next generation”	“We protect our food sources and now I am sure that my children will have fish for the future”	“Every household is experiencing the .. negative and positive impacts”	“Everyone gets fair share and inclusive to everyone”	“Every household shares these benefits”	Unfair: “It is very good for people who break the tabu. People like me respect the tabu but we don’t get anything”	Unfair: “We decide to protect our Tabu whilst other people from Nagavutoka came and fish in it”
	% of respondents with increased wellbeing over last 3 years	55.0	50.0	30.0	31.3	43.8	33.3	21.4	25.0
	Example of reasons why life has improved or not improved	“Westernized lifestyle and erosion of culture in our youths”	“Education - a lot of our youths are educated and this helps enhance our community vision and initiative for projects”	“Life in the village is completely fine but this recent cyclone completely destroyed our farm so our economic status is affected severely”	“Cyclone - negative impact on financial status yet enhanced family relations”	“Cyclone - Since the cyclone completely destroyed our farm, our source of income is severely affected.”  “All my weaving equipment has been taken and it stresses me a lot because that is the thing I love to do”	“Cyclone - migration to Suva, severe damage to coastline and it is hard to catch fish”	“Cyclone - family relations enhanced as villages tried to rebuild yet, its psychological impacts is still felt across the village”	“At the moment our source of income is slow to recover (farm and fishing) because of tropical cyclone winston”

## Background

- The Cuban archipelago has the largest and most diverse coastal habitats in the insular Caribbean comprised of barrier and patch reefs, extensive seagrass beds, mangrove forests and islands (Creary et al. 2008).
- Coral reefs cover 98% of the entire border of the Cuban shelf and occupy an area of ~ 4,920 km<sup>2</sup> (Burke et al. 2011). Most of the reefs are separated from mainland by cays and broad shallow lagoons with seagrass beds and patch reefs, providing some protection from human pressure, except for fishing and tourism (Creary et al. 2008).
- Currently, there are three types of legally recognized fisheries in Cuba: state-owned industrial fishing enterprises; small-scale private commercial licensed fishers contracted by the government; and private licensed recreational or sport fishers (Claro et al. 2009; Wielgus et al. 2014). These fisheries can be categorized as “industrial” (shrimp and bycatch), artisanal (finfish and shellfish), subsistence (mostly finfish) and recreational (Au et al. 2014).
- A considerably part of the commercial fisheries target reef-associated species including snappers, groupers, grunts, queen conch, oysters, sea cucumber and spiny lobster (Buesa 1997; Claro et al. 2001, 2004, 2009; Muñoz-Núñez 2009), all considered part of the artisanal fisheries (Au et al. 2014).
- Overfishing and until recently destructive fishing gear use may have threatened more than two-thirds of Cuba’s coral reefs (Burke & Maidens 2004).
- Subsistence reef fisheries (including recreational fisheries) are increasingly contributing to the livelihoods and food security of local coastal communities at relatively small scale in Cuba (Claro et al. 2004; Doyon 2007). This fishery is non-selective, multi-gear and multispecies and targets coral reef fishes and macro-invertebrates (Claro et al. 2004).
- Although no fishing cooperatives have been created in Cuba so far, a possibility that could start its development encompass a new fishing policy and law currently in final discussion and stages of approval (Valdivia et al. 2017).



Small wooden and metal boats used for subsistence fishing at Playa Larga, Bay of Pigs. © A. Valdivia



## The Activities

- Throughout 2017, WCS worked at both national and project-site levels to 1) bring together protected area managers, fisheries authorities and fishing communities in a series of participatory inception workshops and training activities, and 2) introduce and adapt WCS global social-ecological systems approach (MACMON) for the monitoring of fisheries and the impact of conservation management interventions.
- WCS's key workshop – Marine Monitoring Toolkit Workshop – was jointly organized with the Center for Fisheries Research (CIP) and gathered approximately 40 professionals from 10 organizations from the fisheries and conservation sectors of Cuba. This workshop presented social-ecological monitoring frameworks for the very first time in the country.

- Fruitful group discussions in all workshops outlined the need to 1) incorporate communities into management and decision-making schemes, 2) increase information flow and exchanges between the fisheries sector and protected area managers; 3) strengthen local capacities for the surveying and integration of social-ecological data, specifically training in methodologies such as MACMON; 4) adapt social ecological system (SES) –based methodologies such as MACMON to the Cuban context.

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*WCS's key workshop – Marine Monitoring Toolkit Workshop – was jointly organized with the Center for Fisheries Research (CIP) and gathered approximately 40 professionals from 10 organizations from the fisheries and conservation sectors of Cuba.*

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*Subsistence fishing in Cuba. Top left: Fisher with hook and line on truck tire. Top right: Fishers with small boat and net used to catch bait fish. Bottom left: Family catching bait for crab fishing. Bottom right: Small boat with homemade sail. © A. Valdivia*





## The Story

- We compiled the available information to assess the current baseline on social, ecological, and fisheries indicators of four areas along the south coast of the Cuban archipelago.
- Whereas extensive basic ecological monitoring data on benthic and reef fishes exist for coral reefs of several marine areas of Cuba, reef fishery data (e.g., fishing pressure) are mostly scarce or non-existent (Valdivia et al 2017).
- In addition, quantitative semi-structured surveys with a social-ecological systems approach to investigate fishers or fishing communities have not been performed in Cuba and thus, available social-economic and current ecological data need to be collected and eventually completed.
- Ecological indicators revealed highest hard coral cover at Gardens of the Queen National Park, followed by Guanahacabibes National Park, Bay of Pigs and Punta Frances. Reef fish biomass followed a similar trend, with Gardens of the Queen exceeding 3000 kg/ha (Valdivia et al 2017).

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The information compiled provides the available baseline for each indicator in the global monitoring framework developed with the kind support of the MacArthur Foundation, and allowed us to identify data gaps that should be collected in the future.

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*“Industrial” and artisanal shrimp and lobster fishing boats at the port of Júcaro Village, Ciego de Avila. © A. Valdivia*



## Next Steps

- In collaboration with local partners, WCS will support the creation of an inter-institutional working group to adapt the social-ecological monitoring frameworks to the Cuban context. More specifically, the group will develop survey instruments for MACMON in Cuba, which will guide its implementation on the ground.
- In addition, the group will develop a manual of best practices for social-ecological monitoring with a thorough assessment of current methodologies for social-ecological (MACMON), socio-economic (SocMon; Bunce et al 2003), and general project monitoring performance (Open Standards for the Practice of Conservation; CMP, 2007).
- Once surveys are developed, we will work with Fundación Antonio Núñez Jiménez to pilot MACMON in two sites: 1) Santa Cruz del Sur and 2) the Alejandro de Humboldt National Park (NP). WCS's two-pronged approach involves working in an area where commercial and artisanal fisheries are predominant (Santa Cruz del Sur), and in an area where subsistence fisheries provide for essential livelihoods to coastal communities (Alejandro de Humboldt NP).

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# 10 Core Marine Dashboard Indicators for Global Coral Reef Fisheries

Cuba

Construct	Indicator	Gardens of the Queen MPA (Communities of Jucaro/Santa Cruz del Sur)	Punta Frances MPA (Cocodrilo)	Guanahacabibes MPA (La Bajada)	Bay of Pigs (fished (Playa Larga))
Context					
Market access	Presence of middlemen (fish traders)	no data	no data	no data	no data
	Presence and access to ice for refrigeration	no data	no data	no data	no data
Resource System					
1 Essential habitat	Hard coral cover, %	17.1 <sup>1</sup>	10.4 <sup>4</sup>	15.2 <sup>7</sup>	14.4 <sup>10</sup>
	Algae cover, %	63.7 <sup>1</sup>	83.5 <sup>4</sup>	69.0 <sup>7</sup>	45.8 <sup>10</sup>
	Total coral species	42.0 <sup>1</sup>	35.0 <sup>4</sup>	32.0 <sup>7</sup>	36.0 <sup>11</sup>
	Coral bleaching, freq.	1.6 <sup>1</sup>	28 <sup>4</sup>	0.7 <sup>8</sup>	15 <sup>11</sup>
2 Reef fish assemblages	Reef fish biomass, kg/ha	3364 <sup>2</sup>	>91.0 <sup>5</sup>	2306 <sup>9</sup>	1133 <sup>2</sup>
	Total reef species	251 <sup>3</sup>	79 <sup>6</sup>	201 <sup>9</sup>	80 <sup>12</sup>
Resource Units					
3 Fishable biomass	Biomass of target reef fish, kg/ha	no data	no data	no data	no data
	Biomass of target reef fish, kg/ha	no data	no data	no data	no data
Actors					
4 Knowledge of human agency	% of respondents that recognize humans as the causal agents of change on marine systems	no data	no data	no data	no data
5 Importance of resource	Percentage of respondents with fishing as a primary livelihood	no data	no data	no data	no data
	Average number of household livelihoods	no data	no data	no data	no data
Governance System					
6 Knowledge and fairness of governance	% of respondents that feel that they can influence the management of marine resources	no data	no data	no data	no data
	% of respondents who feel that decision-making is fair or very fair	no data	no data	no data	no data
7 Number & nestedness of management partners	Number and identity of management partners	no data	no data	no data	no data
Interactions					
8 Harvesting	% of respondents who think management has made it easier to catch fish	no data	no data	no data	no data
9 Conflict	% respondents noting the presence of any conflict in marine resource management issues (as daily, weekly, monthly or annual	no data	no data	no data	no data

# 10 Core Marine Dashboard Indicators for Global Coral Reef Fisheries

Cuba

Construct	Indicator	Gardens of the Queen MPA (Communities of Jucaro/Santa Cruz del Sur)	Punta Frances MPA (Cocodrilo)	Guanahacabibes MPA (La Bajada)	Bay of Pigs (fished) (Playa Larga)
Outcomes					
10 Social performance	Perceived impacts of resource management to COMMUNITY wellbeing: % of respondents who identified management as having good or very good impacts	no data	no data	no data	no data
	Perceived impacts of resource management to PERSONAL wellbeing: % of respondents who identified management as having good or very good impacts	no data	no data	no data	no data
	Examples of benefits of management	no data	no data	no data	no data
	Examples of costs of management	no data	no data	no data	no data
	Perceived fairness of impacts of resource management: % of respondents who identified management impacts as either fair or very fair	no data	no data	no data	no data
	Examples of comments on fairness of management	no data	no data	no data	no data
	Percentage of interviewees noting increases in subjective wellbeing over the last three years	no data	no data	no data	no data
	Example of reasons why life has improved or not improved	no data	no data	no data	no data

1 Pina-Amargos et al. (2008) Rev. Inv. Mar.

2 Valdivia et al. (2017) Scientific Reports.

3 Pina et al. (2011) Rev. Inv. Mar

4 Gonzalez-Diaz et al. (2017) Rev. Inv. Mar.

5 Williams & Polunin (2001) Coral Reefs (only herbivorous fishes)

6 Navarro-Martinez & Angulo-Valdez (2015) Rev. Inv. Mar.

7 Perera-Valderrama et al (2016). Ocean and Coastal Management

8 De la Guardia et al (2004). Rev. Inv. Mar.

9 Rojas et al. (2011). Rev. Inv. Mar.

10 Valdivia et al. in prep.

11 Caballero et al. (2004)a Rev. Inv. Mar.

12 Caballero et al. 2004b Rev. Inv. Mar.





