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Fisher perceptions of threats and fisheries decline in the heart of the Coral Triangle

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Abstract. *Larsen SN, Leisher C, Mangubhai S, Muljadi A, Tapilatu RF. 2018. Fisher perceptions of threats and fisheries decline in the heart of the Coral Triangle. Ocean Life 2: 41-46.* The Coral Triangle contains the most species-diverse coral reefs in the world, and at its center is the Raja Ampat archipelago in West Papua, Indonesia. The marine resources of Raja Ampat are an important source of food and livelihood for thousands of people, but overfishing and destructive fishing practices threaten its coral reefs and fisheries. To better understand the threats, we surveyed the 'most knowledgeable fishers' in all 88 of Raja Ampat's coastal villages (n = 495) in 2003-2005. We analyzed the links between declines in fish catch and threats to marine resources as perceived by fishers. Blast fishing, cyanide fishing, and 'outsiders' were perceived to be the causes of the fish declines and the greatest ongoing threats to fisheries resources. We also found evidence of inter-generational differences in perceptions on the health of local fisheries. For fishers who had over 15 years of fishing experience, 77% reported a decrease in fish catch. For fishers who had less than 5 years of experience, only 41% reported a decrease in catch. Education and outreach on illegal fishing practices and the benefits of healthy coral reef ecosystems are likely to be ongoing needs in communities in Raja Ampat.

Keywords: Coral reefs, destructive fishing, marine conservation, shifting baselines, Raja Ampat

INTRODUCTION

Coral reef ecosystems are threatened worldwide from a number of anthropogenic factors and are a high priority for conservation (Hughes et al. 2003; Bellwood et al. 2004; Brooks et al. 2006). The most species-diverse coral reefs are found in the Coral Triangle that spans Indonesia, Malaysia, Papua New Guinea, Philippines, Solomon Islands and Timor-Leste (Veron et al. 2009). In this region, more than 100 million coastal inhabitants rely directly and indirectly on coral reefs for their livelihoods (Hoegh-Guldberg et al. 2009).

In the center of the Coral Triangle is the Raja Ampat archipelago in West Papua, off the northwest tip of the Bird's Head Peninsula, Indonesia. The archipelago consists of the four main islands of Waigeo, Batanta, Salawati, and Misool along with hundreds of smaller islands encompassing roughly 43,000 km^2 (McKenna et al. 2002). Raja Ampat was declared a maritime regency in 2003, giving it greater autonomy in adopting policies to improve fisheries management for the benefit of local livelihoods and coral reefs. Raja Ampat contains the greatest known concentrations of hard corals and reef fish species on the planet (Allen 2008; Allen and Erdmann 2009; Veron et al. 2009) and is a hotspot for cetaceans (Ender et al. 2014). Subsistence fishing predominantly using handlines from small canoes was the only form of fishing in the region prior to the 1960s and is still extensively practiced in Papua. The introduction of commercial fisheries in the 1960s resulted in a rapid decline in fishery resources due to over-exploitation (Palomares et al. 2007). Overfishing, destructive fishing practices, poorly planned coastal development, and climate change threaten the unique biodiversity and livelihoods of people in this area (Bailey et al. 2008; Mangubhai et al. 2012).

Given its global significance and the threats faced, Raja Ampat is the focus of major ongoing marine conservation efforts by government, communities, and international organizations (Coral Triangle Initiative 2009; Mangubhai et al. 2012). To support the establishment of a network of marine protected areas (MPAs) in Raja Ampat, The Nature Conservancy conducted a coastal rural appraisal to gather data on marine resource use and threats. This data was collected and analyzed in order to inform an integrated approach to marine conservation in Raja Ampat that would ensure the protection of local livelihoods as well as conserve the unique biodiversity of the region. These data were an essential component of a marine conservation planning process to identify and later zone the MPAs in the network (Grantham et al. 2013; Halpern et al. 2013; Mangubhai et al. 2015), and provide a baseline for subsequent adaptive management and impact assessment (Lincoln Smith et al. 2000; Mascia 2003).

The coastal rural appraisal aimed to answer the research questions: (i) what are the demographic characteristics of fishers in Raja Ampat, (ii) how do they perceive fish catches have changed over time; and (iii) if a decline in catch is perceived, what is driving the decline?

MATERIALS AND METHODS

From November 2003 to March 2005, a socio-economic survey was conducted across the Raja Ampat Regency that targeted individuals who were engaged in fishing activities (Figure 1). The survey was designed by The Nature Conservancy and was pre-tested with trained enumerators at Kofiau and Misool islands prior to implementation. The aim of the survey was to compile fishing data that could inform marine conservation planning processes and future conservation activities, and hence it used a purposive sampling technique (Shadish et al. 2002) rather than a random sample of the population. The survey was a structured interview with the 'most knowledgeable' fishers to better understand the factors that were perceived to affect marine resources.

When the survey team entered a village, the enumerators consulted with the village head or another community leader who identified the most knowledgeable fishers to be interviewed. Occasionally other individuals in a community would approach the survey team and ask to be interviewed. If the individuals purported to be knowledgeable about fisheries, they were added.

The survey gathered information on respondents' demographic characteristics, use of marine resources, and perceived threats to marine resources. A total of 88 out of the 89 villages in Raja Ampat were surveyed (Figure 1). The omitted village was located inland, and the community did not directly depend on fishing. All interviews were in the Indonesian language with enumerators from the region who had been trained in socioeconomic survey techniques. We obtained free, prior and informed consent from participants before conducting interviews. During the verbal consent process, participants were informed about the survey, its purpose, how the data would be utilized, that participation was voluntary, and that their individual responses would be kept confidential.

Interview data were entered into a pre-structured Excel database using data validation functions to minimize entry errors. The data were analyzed in Excel and Sigmaplot 11.2.

RESULTS AND DISCUSSION

Results

A total of 495 people were surveyed. The majority of respondents were male, and the average respondent was 36 years old and had completed primary school. Interestingly, 9% of respondents were women, suggesting that fishing is not a male-only activity in Raja Ampat. A bit less than half of the respondents (48%) identified their livelihoods as exclusively fishing. Slightly fewer (41%) indicated that they both fished and farmed, while the remainder identified themselves as farmers (6%) or had other primary occupations (4%). The majority of respondents (79%) had spent over 15 years fishing and almost all respondents owned a boat, though only 16% said they had a boat with an engine (Table 1).

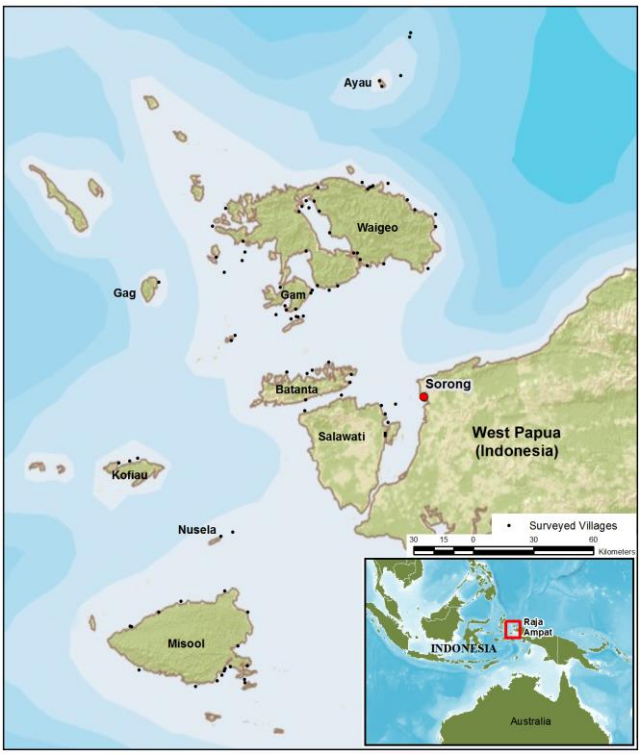

Figure 1. Villages surveyed in the Raja Ampat coastal rural appraisal 2003-2005.

Table 1. Demographic characteristics of survey respondents

Demographics	***N***	**%**
Gender		
Male	450	90.9
Female	45	9.1
Age (mean and stdev)	36.4	10.8
Education		
None	11	2.2
Primary	326	65.9
Junior	95	19.2
Senior or higher	63	12.7
Occupation		
Fisher	239	48.3
Both fisher and farmer	203	41.0
Farmer	31	6.3
Other	22	4.4
Years fishing		
<5	19	3.8
5-15	87	17.6
>15	389	78.6
Boat type		
Boat without engine	406	82.0
Boat with engine	78	15.8
No boat	11	2.2

When asked how fish catch 'now' compared with 'before' (when the person first started fishing), 74% of respondents said that catch was less, 23.6% said it was the same, and 2% said it was more. Respondents who said that catch was less (n = 367) were asked to name the causes in an open-ended question. More than one cause could be given. The top three causes for catching less fish were blast fishing (62%), cyanide fishing (41%), and 'outsiders' (17%) (Figure 2).

All respondents were also presented with a list of possible threats to marine resources and asked whether the threat was ongoing or not. One third of respondents said there were no ongoing threats in the list. In the districts of Samate, Misool, West Waigeo, and Kofiau, however, nearly 90% of respondents reported ongoing threats, while in the district of Teluk Mayalibit, only 6% of respondents listed an ongoing threat. Teluk Mayalibit, however, is located along a nearly enclosed bay with coral reefs restricted to the mouth, and this unique geographic characteristic may explain the low level of perceived ongoing threats. The ongoing threats chosen (n = 330) were largely the same as the perceived causes of a decline in fish catches: blast fishing, cyanide fishing, and outsiders. Only 4% chose overfishing as an ongoing threat (Figure 3).

To examine the degree to which 'outside fishers' are perceived to drive the threats, respondents were asked if they have seen or heard outside fishers in their area. Seventy-eight percent of respondents said yes (n = 388). While 'outside fishers' may be an ambiguous term that could mean people from the next village or people from outside Raja Ampat, it usually means people who are from the latter (A. Muljadi and S. Mangubhai, personal observations). Its utility comes in distinguishing locally based threats from external threats. When respondents who said they had seen or heard outside fishers were asked the open-ended question, "what sort of the activities do outside fishers do in your area," 65% said blast fishing (Figure 4). This suggests that people from outside Raja Ampat who were engaged in blast fishing have a disproportionate impact on the perceived ongoing threats.

When the experience levels of fishers were compared with the perceptions in fish catch, respondents who had fished longer were more likely to perceive that catch has decreased, with the opposite being true for respondents who had spent less time fishing (Figure 5). This suggests that the baseline for fishers with less than 5 years' experience is lower than more experienced fishers, or that 5 years is too short a period to notice a decline in fisheries, or that the decline perceived by longer practicing fishers occurred more than five years prior to the survey. We found a strong correlation (chi-square 13.66, p=0.001) between years fishing and a perceived decline in fish catch and a weaker correlation between the age of a fisher and a perceived decline in fish catch (chi-square 4.467, p=0.011), confirming Papworth et al. (2009) supposition that a shifting baseline for fish catches should be present at different levels of experience instead of simply different ages of fishers.

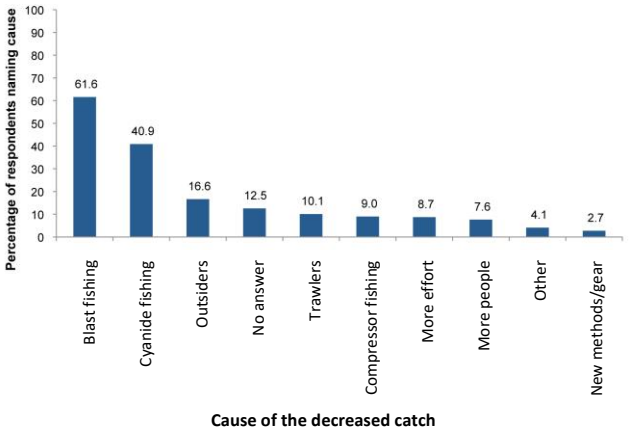

Figure 2. For respondents who said that catch had decreased, responses to the question: "What are the causes for the decrease in catch?" This was an open question where respondents could name multiple causes (*n*=367)

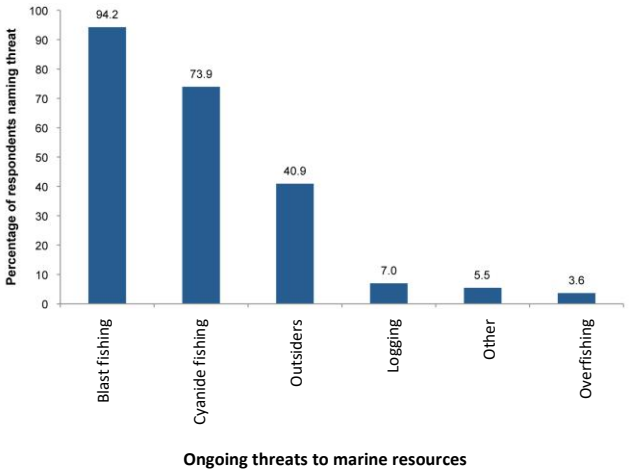

Figure 3. Ongoing threats to marine resources. Respondents could choose more than one threat (*n*=330)

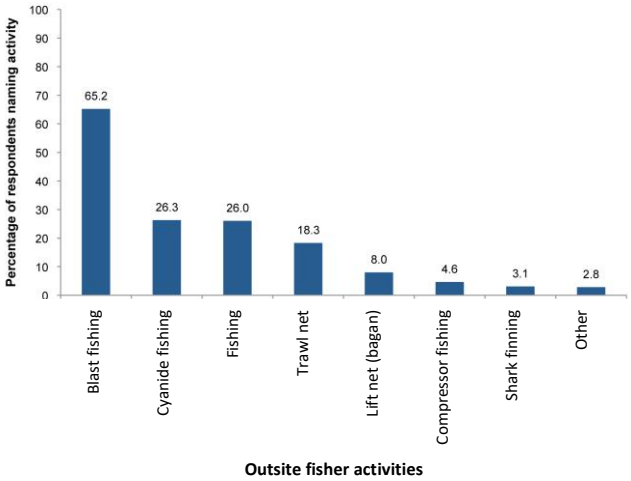

Figure 4. Activities of outside fishers according to respondents. Respondents could name more than one activity (*n*=388)

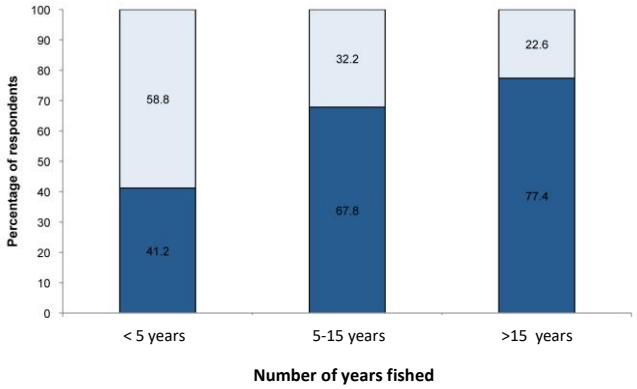

Figure 5. Relationship between the number of years a respondent had fished and their perception of how fish catch has changed (*n*=495). The dark color represents the percentage of respondents in each age group who reported a decline in fish catch while the light color represents the percentage of respondents in each age group who reported that fish catch was the same or more

Discussion

We found evidence of a 'shifting baseline syndrome' in the survey data, where successive generations of fishers accept a lower standard of marine resources as normal (Pauly 1995; Knowlton and Jackson 2008). It is important to note the period "before" in the survey was anchored temporally by the respondents themselves to the time when they began fishing. Our results confirm the findings of other studies reporting evidence of shifting baselines among younger fishers in Raja Ampat and that illegal, unreported and unregulated fisheries are critical issues for marine resource management in Raja Ampat (Ainsworth et al. 2008; Varkey et al. 2010; Mangubhai et al. 2012). While it is acknowledged that perception surveys may not reflect what is actually happening in the water, fisher perceptions echoed a study of historical trends in marine resource abundance in Raja Ampat which shows a 50% decline in fish and invertebrates since the late 1800s (Palomares et al. 2007). Similar trends have been reported from other locations. Evidence from the Gulf of California has shown that there can be a rapid shift in perception among fishers on the size and abundance of marine resources due to resource depletion (Saenz-Arroyo et al. 2005). A rapidly shifting baseline in Raja Ampat disadvantages local people and marine life. If, for example, minimal apex predator populations such as shark and grouper were to become accepted as 'normal,' the fisheries productivity of the Raja Ampat reefs is likely to be lower than if apex predators were present. Evidence from Palmyra, Christmas and Fanning Islands suggests that reefs, where apex predators are protected, have from 300 to 400% greater biomass than comparable reefs where apex predators have been largely extirpated by fishing (Stevenson et al. 2007).

A 2011 survey of resource use in Raja Ampat's Kofiau and Boo Islands MPA found that 15% of the fishers in the area were not community residents, and these outsiders were responsible for 70% of the catch volume (Muhajir et al. 2012a). Thus, outsiders may not only be responsible for a disproportionate share of the blast fishing but also a disproportionate share of the fish catch. This suggests that enforcing the laws on destructive fishing practices and empowering local communities to exclude outsiders from area fishing grounds may provide benefits to Raja Ampat's people and reefs. Long-term monitoring suggests "hard coral cover, the populations of key fisheries species and fish functional groups are being maintained or improving within the Bird's Head MPA network" (Glew et al. 2015). One study comparing co-managed marine reserves, national parks, and traditional fisheries management approaches found that effective conservation approaches almost always include the ability to exclude outsiders (McClanahan et al. 2006). Since 2012, monitoring efforts have been modified in Raja Ampat to take a more impact evaluation approach, which may provide insights into temporal and spatial patterns of MPA impacts once analyzed (Ahmadia et al. 2015; Fox et al. 2017).

While the survey respondents perceived destructive fishing practices and outsiders as the primary causes for a decline in catch in Raja Ampat, some respondents named additional factors including greater fishing effort, increases in the number of fishers, and the introduction of modern gear. All of these factors may be contributing towards declining fish catches, but understanding the magnitude of each factor was beyond the data in this study, and for local fisheries management and coral reef conservation efforts addressing the primary perceived causes may provide greater near-term benefits.

A 2010 survey of fishers in northern and western Raja Ampat found that blast fishing was perceived to have decreased compared with five years prior, though there were still reports of illegal blast fishing perpetrated by outsiders (Sala et al. 2011). In southern Raja Ampat, resource use surveys from 2006-2011 confirmed a decline in the use of destructive fishing gear and destructive methods such as blast fishing within MPAs (Muhajir et al. 2012a, 2012b). While these surveys suggest that destructive fishing practices are declining, the fact that blast fishing still occurs occasionally within MPAs shows the need for continuing enforcement and outreach initiatives in order to protect marine resources in Raja Ampat.

Along with ecological data from Raja Ampat, the results of the coastal rural appraisal were used in the designation of a Raja Ampat MPA network that covers 1,185,940 ha (Mangubhai et al. 2012) and its subsequent zonation (Grantham et al. 2013). The results also helped to guide the development of socioeconomic criteria for the zoning of the Raja Ampat MPA network (Table 1 in Mangubhai et al. 2015). Once the MPAs were declared in 2007, the data from the appraisal was used to guide initial conservation efforts in Raja Ampat and to build support for conservation by engaging with local communities (Leisher et al. 2012). A tourism entrance fee system in Raja Ampat has generated revenues for local government priorities, community conservation initiatives, and community well-being programs as well as helped build support for conservation action by incentivizing compliance with fishing regulations (Mangubhai et al. 2011).

Given the large area of the Raja Ampat Regency, and the finite budget for enforcing fishing regulations, local communities may benefit from having MPAs that are large enough to support apex predators and maintain ecosystem processes (Salm et al. 2000; McLeod et al. 2008; Jaiteh et al. 2016) but not so large that enforcement costs become prohibitive. A study from Indonesia and Papua New Guinea found that MPAs within the community's line of sight had greater success with excluding outsiders and curtailing illegal fishing activities than those that were not fully visible to local communities (McClanahan et al. 2006). While proximity of MPAs to communities is advantageous for self-policing, communities still need adequate resources in order to conduct patrols and communicate infractions in real time to authorities (Sala et al. 2011).

Education and outreach on legal and illegal fishing practices as well as the benefits that a restored coral reef ecosystem can provide are likely to be ongoing needs in Raja Ampat. From 2005 to 2010, the knowledge and attitudes in MPAs in southern Raja Ampat shifted towards more sustainable use of marine resources (Leisher et al. 2012), but continued efforts are needed especially among younger fishers who may have baselines that do not fully reflect an understanding of the benefits that an intact coral reef ecosystem can provide. In addition, a much broader outreach strategy is required that extends to communities residing outside of MPAs to ensure other reefs in the regency are not being degraded, and continue to provide food and livelihoods for local communities.

To conclude, we found that the majority of fishers interviewed perceived that the marine resources on which they depend for their livelihoods were declining, and the primary cause of this decline was illegal, destructive fishing methods that many associated with the presence of outsiders. Subsequent studies have shown that while there has been progressed at addressing these threats, they still exist and pose an ongoing threat to people and nature in Raja Ampat. Our results have since guided engagement with local communities and informed the development and implementation of an MPA network in order to address these threats. This survey is unique in that it provides a valuable baseline of how fishers from all of the coastal villages in Raja Ampat perceived the status of and major threats to local marine resources at the time when major national and international conservation initiatives were beginning in the region. Thus additional research examining how fisher perceptions of marine resource abundance and threats in Raja Ampat have changed since the 2003 survey would allow a valuable assessment of the effectiveness of ongoing conservation, education, and enforcement initiatives in the region.

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