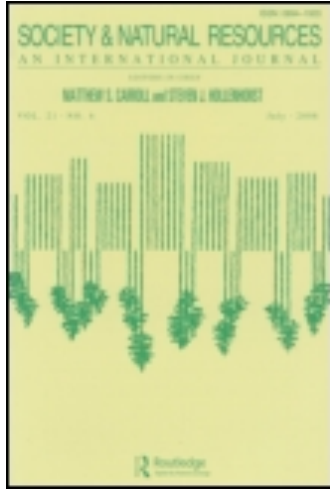


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### **Winners and Losers in Marine Conservation: Fishers' Displacement and Livelihood Benefits from Marine Reserves**

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## **Winners and Losers in Marine Conservation: Fishers' Displacement and Livelihood Benefits from Marine Reserves**

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*Marine reserves can create both benefits and costs to fishers. This article explores the perceptions of fishers in Kenya and Seychelles about displacement, spillover, and overall impacts of local marine reserves on their livelihoods. We test whether these perceptions are different among fishers from different geographic and socio-economic conditions. Sixty-six percent of fishers had been displaced from marine reserves or coastal development and 90% believed they had caught fishes that spilled*

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*over from marine reserves. Poorer fishers in Kenya were both displaced from, and also felt like they benefited from, marine reserves. This highlights how people's experiences with marine reserves, both positive and negative, are affected by a range of social considerations that may not be incorporated in typical evaluations of ecological and economic marine reserve success.*

**Keywords** coral reef, marine reserve, protected areas, small-scale fishery, social impacts, social-ecological system, socioeconomic

Unlike terrestrial reserves, which are largely justified for biodiversity conservation, marine reserves are often implemented with fisheries management objectives implicitly offering to fishers long-term benefits that may counter the negative effects of displacement from reserves (Sala et al. 2013). These benefits and costs have differential effects among various stakeholders (Mascia and Claus 2009). The costs of displacement result from increased travel to fishing grounds, with implications for fuel, time, and safety (Daw 2008; Mascia and Claus 2009); loss of particular grounds and fish stocks; increased search time due to loss of familiar fishing grounds; and increased densities of fishers in remaining fishing areas (Carter 2003). The cost borne by an individual fisher depends on the spatial fishing habits of individuals, in turn affected by the species they target and the gears and vessels used, as well as their fishing experience and skill, the availability of alternative sources of income, and a range of socioeconomic and cultural constraints (Smith et al. 2010; Coulthard 2011). For example, wealthier fishers are expected to benefit the most from marine reserves because they can often influence the marine reserve establishment process to better fit their needs, and are also better poised to take advantage of alternative opportunities such as from tourism (e.g., Christie 2004; Béné et al. 2009). Alternatively, fishers entrenched in poverty may not have the resources or capacity to fish further afield or diversify livelihoods (Cinner et al. 2009). Thus, reserves are expected to have unequal effects on different fishers depending on their existing resource space, skills, technology, institutions, and socioeconomic conditions.

In the longer term, as biomass accumulates in reserves, fishers may enjoy fisheries benefits from enhanced larval production (Harrison et al. 2012) and “spillover” of adult fish into fishing grounds (McClanahan 2010). Several ecological studies have found higher fish biomass, total catch, or catch per unit effort (CPUE) adjacent to reserves than further away (McClanahan and Mangi 2000; Stamoulis and Friedlander 2013; Russ et al. 2004). Fishers may also perceive benefits related to exclusion of outsiders, reduced competition, and better enforcement of regulations in the vicinity of a reserve (Mascia et al. 2010), particularly if reserves are implemented as part of a broader zoning strategy.

Whether benefits can compensate for displacement costs depends on a range of complex biological, geographical, economic, and technological factors (Smith et al. 2010). Fishers' support for marine reserves can be undermined by discounting of uncertain potential future benefits (Smith et al. 2010) and failure to deliver expected benefits (Pita et al. 2011). While most studies have focussed on the effects of reserves on fisheries yields (e.g., McClanahan 2010), fisherfolks' perception of reserves may also consider other ecosystem services as tourism, conservation of resources for the future, ecosystem resilience, and “ripple effects” on the well-being of local communities (Mascia and Claus 2009). Ultimately, how fishers perceive the trade-offs between long- and short-term, direct and indirect benefits and costs will be crucial

for the legitimacy and acceptance of marine reserves, compliance, and subsequently ecological success (Pollnac et al. 2010; Christie et al. 2003). Studying fishers' perceptions about the costs and benefits of marine reserves can help to highlight whether and how they support marine reserves, define what they view as burdensome, and inform whether policy measures could increase benefits.

While a number of studies have examined the ecological and economic dimensions of spillover (reviewed by Halpern et al. 2010; Graham et al. 2011), fewer studies have explicitly quantified the trade-off between the costs of displacement and spillover (Rudd et al. 2003) and fewer still how individual fishers experience and perceive displacement and spillover from marine reserves. In this study, we ask fishers about their own perceptions of displacement, spillover, and overall impacts of marine reserves on their livelihoods. Specifically, we examine whether fishers in both Kenya and Seychelles (1) personally were displaced by a reserve or coastal development; (2) perceived that they had caught fish that had spilled over from a reserve; (3) perceived that their catch has changed as a result of the reserve; and (4) perceived that a reserve has been positive or negative for their livelihoods. We test whether these responses about perceived benefits and costs are related to fishers' geographic and socioeconomic characteristics. Our hypotheses are that (1) fishers who are poorer (i.e., lower fortnightly expenditures and material style of life), elderly, and less mobile (i.e., don't use a boat) are more likely to experience the effects of displacement, and are less likely to perceive spillover or livelihood benefits; (2) perceptions about marine reserves are related to the use of different fishing gears; and (3) perceptions about displacement from and benefits of marine protected areas (MPAs) are related to local context, history, and processes resulting in significant heterogeneity between sites.

## Methods

### Study Sites

We focused on smallscale artisanal trap and hand-line fishers in Kenya and Seychelles, which are within the same biogeographical region and both target coral reefs and associated habitats, but the two countries represent opposite ends of the regional spectrum of wealth and development. Seychellois fishers have powered fiberglass boats and greater access to technology, while only some Kenyan fishers had access to boats and none had engines. Both countries included large state-governed marine parks and smaller, privately owned or community-managed reserves (Table 1). Seychellois fishers have experienced additional displacement from land reclamation activities.

Seychelles marine parks were established and are managed by government bodies, except Cousin Island special nature reserve, which is managed and strictly enforced by a private nongovernmental organization (NGO). In Kenya, Mombasa Marine National Park was established in 1991 and is managed by the Kenya Wildlife Service. In 2005, a 29-ha community-based marine reserve was established at Kinuni with the support of environmental NGOs. This *tengefu* (a Swahili word meaning putting something aside) is associated with a successful community development organization, has full-time guards, and has a fee structure in place for visiting tourists. Other communities have attempted to replicate the Kinuni *tengefu* initiative

Table 1. Site description of marine reserves

Marine reserve	Management	Closure size (ha)	Year established	Compliance	Sample area	Sample size	Estimated number of fishers <sup>a</sup>
<i>Seychelles</i>							
Curieuse MNP	Government	1470	1997	Variable	NE Praslin	11	70
Cousin Special Nature Reserve	Private	120	1968	High	SW Praslin	9	68
St Anne MNP	Government	1453	1973	Variable	E Mahe	32	304
Baie Ternay MNP	Government	80	1979	Variable	W Mahe	10	114
Port Launay MNP	Government	158	1979	Variable			
<i>Kenya</i>							
Mombasa National Marine Park	Government	1000	1991	High	Bamburi	20	65
Kinuni <i>tengefu</i>	Community based	29	2005	High	Kinuni	12	26
					Kuruwitu	18	34
					Vipingo	13	27
Bureni <i>tengefu</i>	Community based	5.2	2010	Low	Bureni	14	30
Tiwi <i>tengefu</i>	Community based	12.5	2009	High	Tiwi	20	46
Tradewinds <i>tengefu</i>	Community based	11.8	2009	Low	Tradewinds	17	178

<sup>a</sup>Only including artisanal fishers.

with varying degrees of success, including at our study sites in Bureni, Tiwi and Tradewinds (Table 1).

### Sampling

We conducted structured interviews with fishers considered key spatial decision makers during fishing (mostly captains). In Kenya, sampling of fishers was in discrete landing sites, while, due to the lower numbers of fishers in Seychelles, fishers were sampled from around the coastline of the two main islands (Mahe and Praslin) and divided by region (Table 1). In Seychelles, small boat artisanal hand-line and trap fishers (those most likely to have interactions with marine reserves) were selected from the Seychelles Fishing Authority list of all registered boats and requested to take part in the interviews. Additional unregistered fishers were also sampled opportunistically based on encounters at landing sites. We grouped fishers geographically by whether they lived in East or West Mahe, and Southwest or Southeast Praslin. In Kenya, random sampling stratified by gear was based on a list of active fishers and their gear generated with key informants at each landing site (Table 1).

### Dependent Variables

Fishers were asked (1) whether they personally used to fish in areas where fishing effort had been displaced (largely by marine reserves but also by coastal development in Seychelles); (2) whether they perceived that they personally caught fish that had come from a marine reserve; (3) the effect of the reserve on their catch (answer: positive, neutral, negative); and (4) the effect of the reserve on their livelihoods overall (answer: positive, neutral, negative). For fishers who had been displaced we asked an open-ended question on how they responded.

### Independent Variables

We examined six key geographic and socioeconomic characteristics of fishers: (1) whether they used a boat; (2) landing site (i.e., geographic location); (3) gear types used, including hand line, spear, trap, gillnet, trap, mixed (i.e., a combination of these), and other (i.e., octopus hook, seine net); (4) age (in years); (5) fortnightly household expenditure (in U.S. dollars); and (6) a multivariate measure of material style of life based on the presence of their household possessions and structures (Pollnac and Crawford 2000), which was factor analyzed to develop an index of wealth. The material style of life principal components in Kenya and Seychelles explained 35% and 22% of the variance, respectively.

### Analysis

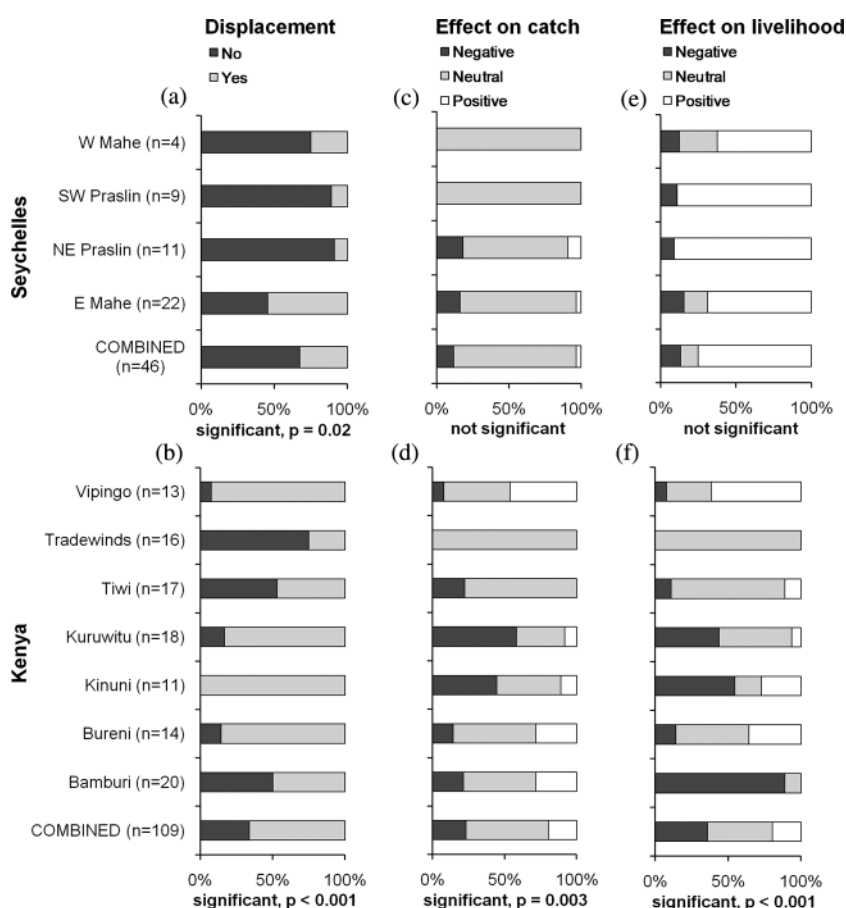
We tested whether fishers' experience of displacement and perception of benefits from marine reserves (i.e., dependent variables from those already described) were significantly different among their geographic and socioeconomic characteristics (i.e., independent variables from those already described) using chi-squared test for categorical variables (i.e., boat ownership, landing site, and gear type), and the Mann–Whitney *U* and Kruskal–Wallis tests for continuous variables (material style of life, fortnightly expenditures, and age). All analyses were conducted in SPSS.

**Results**

Assessing Fishers' Displacement from Marine Reserves

In the Seychelles, one-third (33%) of respondents had been displaced by a reserve or coastal development (Figure 1a), and there were significant differences between regions. More fishers on Mahe had been displaced than on Praslin (Figure 1a;  $\chi^2(3, n = 46) = 9.6, p = .022$ ).

In Kenya, nearly two-thirds (60%) of the fishers we interviewed had been displaced (Figure 1b) with significant differences between landing sites (Figure 1b;  $\chi^2(6, n = 109) = 31.5, p < .0001$ ). Additionally, there was a marginally significant relationship ( $p < .10$ ) suggesting that fishers who used a boat were less displaced than fishers who didn't use a boat ( $\chi^2(1, n = 107) = 2.7, p = .08$ ). Displacement differed by gear weakly in Seychelles ( $\chi^2(3, n = 46) = 7.8, p = .051$ ) but not in Kenya:  $\chi^2(6, n = 109) = 8.4, p = .210$ ). In Kenya, fishers who were displaced had significantly lower fortnightly expenditures and a lower material style of life than fishers who were not displaced (Table 2a). In Seychelles, other socioeconomic characteristics



**Figure 1.** How fishers in Seychelles and Kenya perceived that they were displaced from their fishing grounds (a, b); had their catch affected by the closure (c, d); and had their livelihood affected by the closure (e, f). Significance indicated for the chi-squared test and *p* value.



**Table 2.** Results of the questions: (a) displacement: did fishers personally use to fish in areas that have been displaced by either MPAs or coastal development?; (b) effect on catch: do fishers catch have increased or decreased as a result of the reserve?; and (c) effect on livelihood: has the marine reserve been positive or negative for fishers' livelihoods?

Displacement (a)	Fishers displaced	Fishers not displaced	<i>n</i>	<i>p</i>	
Kenya					
Material style of life index	□0.173 □ 0.098	0.115 □ 0.139	107	.038□	
Fortnightly expenditure (USD)	99.9 □ 6.1	131.9 □ 11.6	103	.007□	
Age (years)	39.2 □ 1.5	40.5 □ 2.3	109	.725	
Seychelles					
Material style of life index	0.244 □ 0.265	□0.179 □ 0.135	42	.191	
Fortnightly expenditure (USD)	528.7 □ 66.0	453.3 □ 58.4	36	.194	
Age (years)	49.1 □ 3.4	46.1 □ 2.4	45	.447	
Effect on catch (b)	Negative	Neutral	Positive	<i>n</i>	<i>p</i>
Kenya					
Material style of life index	□0.240 □ 0.180	□0.038 □ 0.115	0.088 □ 0.272	81	.326
Fortnightly expenditure (USD)	109.8 □ 17.4	117.8 □ 8.9	75.3 □ 6.7	80	.007□
Age (years)	37.2 □ 1.8	38.7 □ 1.9	42.1 □ 3.0	82	.522
Seychelles					
Material style of life index	□0.097 □ 0.282	0.004 □ 0.114 <sup>#</sup>		55	.925
Fortnightly expenditure (USD)	404.0 □ 107.6	453.6 □ 40.6 <sup>#</sup>		46	.523
Age (years)	53.6 □ 5.5	47.0 □ 1.4 <sup>#</sup>		48	.201
Effect on livelihood (c)	Negative	Neutral	Positive	<i>n</i>	<i>p</i>
Kenya					
Material style of life index	0.009 □ 0.173	□0.240 □ 0.104	□0.059 □ 0.212	91	.96
Fortnightly expenditure (USD)	110.6 □ 11.7	120.0 □ 9.8	84.7 □ 7.6	90	.122
Age (years)	41.0 □ 2.3	37.5 □ 2.3	38.6 □ 1.8	92	.272
Seychelles					
Material style of life index	□0.268 □ 0.221	0.457 □ 0.361	□0.005 □ 0.120	56	.335
Fortnightly expenditure (USD)	328.0 □ 99.1	370.0 □ 71.9	475.7 □ 42.8	47	.418
Age (years)	46.9 □ 6.4	50.6 □ 6.6	47.4 □ 1.7	59	.586

*Note.* Mean levels □ standard errors of material style of life, fortnightly expenditures, and age; significance indicated by □  $p < .05$ , Mann–Whitney *U*-test for (a) and Kruskal–Wallis test for (b) and (c). #, Due to low sample numbers, for Seychelles the categories neutral and positive have been combined into one category, nonnegative.

were not significantly different between fishers who were displaced or not (Table 2a). In response to displacement, respondents from Seychelles fished further out, found new grounds, or went deep-sea fishing, whereas in Kenya the majority of displaced fishers (67%) said they found new grounds.

#### Assessing Perceptions of Fish Spillover from Marine Reserves

In both the Seychelles and Kenya, 90% of fishers felt that they had personally caught fish that had spilled over from marine reserves. Due to the low heterogeneity in responses, we did not test for differences across personal characteristics.

#### Assessing Perceptions of Catch Impacts from Marine Reserves

In Seychelles, most fishers (85%) perceived no effect of marine reserves on their catch and there were no significant differences between regions (Figure 1c;  $\chi^2(6, n=59)=5.2, p=.52$ ). In Kenya, a smaller majority of fishers (57%) also perceived no effect, while 23% felt that their catches declined, and 20% felt that their catches increased (Figure 1d). In Kenya, there were significant differences between regions, with Kuruwitu and Kinuni (both landing sites adjacent to the Kuruwitu conservation area) reporting the most negative impacts, but Vipingo (also nearby the same closure) reporting the most positive effects (Figure 1d,  $\chi^2(12, n=82)=29.5, p=.003$ ). Differences between gear types were not significant in either country. Likewise, using a boat made no difference to the perceived impact of a closure on fishers' catch in Kenya. Contrary to our hypothesis that the poorer fishers would be less likely to perceive benefits from marine reserves, in Kenya, fishers who felt that their catch benefited from the closure had a lower fortnightly expenditure than fishers who perceived a neutral or a negative impact (Table 2b). In Seychelles, socioeconomic characteristics were not significantly different between fishers with different perceptions about the impacts of marine reserves on their catch (Table 2b).

#### Assessing Perceptions of Livelihood Impact from Marine Reserves

In Seychelles, 75% of fishers felt that marine reserves were positive for their livelihood, and this did not vary significantly by location, gear type, or socioeconomic characteristic (Figure 1e); location:  $\chi^2(6, n=60)=5.2, p=.515$ ; gear type:  $\chi^2(6, n=60)=8.6, p=.195$ ; Table 2c). In Kenya, 35% felt a negative impact and 19% felt a positive impact on their livelihood (Figure 1f). There were significant differences between regions in Kenya, with Bamburi having extremely negative overall views about the parks impact on their livelihood, while Vipingo had the highest (Figure 1f,  $\chi^2(12, n=92)=63.8, p<.0001$ ). There were no significant differences between gear types ( $\chi^2(12, n=92)=15.0, p=.235$ ), and only marginal differences where non-boat users felt more positive impacts on their livelihood than boat users in Kenya ( $\chi^2(2, n=90)=5.6, p=.062$ ). Other socioeconomic characteristics were not significantly different between fishers with different perceptions about the impacts of MPAs on their livelihoods (Table 2c).

## Discussion

Of the limited empirical research on fishers' perceptions and experiences of MPAs, most studies have been in developed countries, and few have explicitly studied

perceptions of spillover (Pita et al. 2011). This article examines the perceptions and experience of displacement and spillover due to marine reserves of nearly 200 small-scale tropical fishers from two contrasting developing countries. A key finding is that although adult spillover has been difficult to conclusively prove in the ecological and conservation literature (Graham et al. 2011), the vast majority of fishers in both Kenya and Seychelles claim to have caught spilled over fish. However, while fishers agreed that some of their catch may have come from reserves, most did not perceive that this increased their catch to compensate for displacement, in agreement with previous studies (Pita et al. 2011). The implications are that raising expectations of spillover benefits during reserve inception risks later disillusionment if (as appears the case in this study) the benefits are not perceived to outweigh the costs of displacement. Similar results have been observed in European MPAs where fishers' belief in positive fishery benefits declined over time (e.g., Bloomfield et al. 2012; Mangi and Austen 2008).

Many studies of marine protected areas have been focused on aggregate outcomes such as total catch or profit (Russ et al. 2004; McClanahan 2010), while social scientists have drawn attention to the importance of analyzing the governance arrangements around MPAs (Jentoft et al. 2007), including the political dynamics of their conception (Chuenpagdee et al. 2013), as well as evaluating the winners and losers from their establishment (Mascia et al. 2010). MPAs can further entrench existing power inequalities through "elite capture," where more powerful voices protect their interests and promote their visions at the expense of the marginalized (Christie 2004; Béné et al. 2009). Indeed, in Kenya, where new community-based reserves have been negotiated and established, we found that poorer fishers and those without boats were more likely to be displaced, consistent with our first hypothesis. However, poorer fishers (as indicated by lower fortnightly expenditures) were also more likely to perceive a positive effect on their catch, which was inconsistent with our hypothesized expectation that the poor would be less likely to perceive benefits from spillover. This might suggest that poorer fishers with more limited resource spaces are more likely to perceive both the negative and positive impacts of a closure. Our results suggest that the traditional approach of focusing on aggregate outcomes (e.g., total profit or catch) has the potential to alienate the most marginalized stakeholders, particularly in the short term, as stocks inside marine reserves rebuild (Sala et al. 2013). We suggest that marine reserve implementation in developing countries such as Kenya needs to consider ways to minimize or offset displacement of the poorest fishers through programs such as targeted involvement in planning and decision making; capacity building; and poverty reduction programs.

In Seychelles, despite considerable displacement (33%) and a distinct lack of perceived catch benefits, the vast majority (75%) of fishers perceived closures as having a positive overall impact on their livelihoods. This positive view may reflect the widely perceived benefits of reserves for the locally important tourism industry, the opportunity for accessing alternative fishing grounds, and the long time since reserve establishment, which can lead to more favorable views of MPAs (Pita et al. 2011).

In contrast, Kenyan fishers at particular sites perceived negative impacts on both catch and livelihoods. Ironically, Bamburi is one of the few places globally where spillover has had a demonstrable benefit for catch and profitability (the Bamburi landing site is adjacent to the Mombasa Marine Park; McClanahan 2010), yet overall perceptions there were most negative. The adjacent Mombasa

Marine Park is the only government reserve we studied in Kenya. Importantly, the establishment was much less participatory than the other Kenyan sites, and all revenues from the tourist entry fee go to the central government. In contrast, locally managed reserves have been established through community members' initiative in collaboration with NGOs, and they offer the possibility to distribute financial benefits from tourism or international donor support to community members. The negative perceptions about the Mombasa Marine Park by fishers are thus consistent with lower overall benefits (beyond fisheries) and lack of participation or ownership during establishment. These findings broadly support the contention that attitudes toward reserves may exhibit a "path dependency," influenced as much on the processes of inception and the political meaning of a reserve among stakeholders, as on material fisheries benefits actually derived (Chuenpagdee et al. 2013).

At smaller scales, the perception of benefits from Kenyan community-based marine reserves was uneven. Livelihood impacts of Kinuni *tengefu* were perceived more negatively at Kuruwitu and Kinuni, but positively in Vipingo, which has a greater involvement from members of the associated community organization. Fishers from the other two communities cited higher fisher densities in their grounds as a result of displacement from the marine reserve. Thus, local context and processes seem to have played a substantial role in shaping local perceptions about the benefits and costs of marine reserves.

Our initial hypotheses were partially supported by our results. Specifically, our first hypothesis (that fishers who are poorer, elderly, and less mobile are more likely to experience the effects of displacement, and are less likely to perceive spillover or livelihood benefits) had conflicting evidence: Poorer fishers were more likely to be displaced (supporting our hypothesis), but were also more likely to perceive benefits from marine reserves (contradicting). Age had no effect (contrasting with our hypothesis), but mobility had marginal effects (supporting). Our second hypothesis (that perceptions about marine reserves are related to the use of different fishing gears) was marginally supported in Seychelles, but not in Kenya. Our third hypothesis (that perceptions about displacement from and benefits of MPAs are related to local context, history, and processes resulting in significant heterogeneity between sites) was supported in Kenya but not Seychelles. Consistent with other multicountry investigations (e.g., Pollnac et al. 2010), the differing patterns between our contrasting case studies in Kenya and Seychelles highlight the complexity of these issues and critical role of context.

Our results on how people differentially experience the costs and benefits from marine reserves highlight how there are some people who win and some who lose out in the process of marine reserve development and management (Mascia and Claus 2009). Importantly, people's experiences with marine reserves, both positive and negative, are affected by a range of social considerations that may not be considered in typical evaluations of ecological (e.g., improved biomass inside marine reserve boundaries) and economic (e.g., improved CPUE, income from tourism) marine reserve success. More broadly, our study illustrates how the disaggregated costs and benefits from environmental interventions can create winners and losers, which may have potential implications for conflict, governance, and environmental justice (Daw et al. 2011). Indeed, our results reinforce the growing recognition for the important contributions that social science research can make in marine reserve planning and management (Fox et al. 2012).

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