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Endenese Fisheries: Exploratory Findings on Environmental Perceptions, Fish Effort, and Overfishing in Eastern Indonesia

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Abstract: *Fishing fleets in South East Asia have recently experienced unprecedented expansion. Consequently, catches and regional diversity have dramatically decreased throughout the Indian Ocean. Regional governments and conservation organizations blame the local fishermen and their use of damaging fishing practices for the present state of resources. However, many of these institutions endorse a narrow perspective on bioeconomic governance and human action (rational action choice) that compromises the understanding of resource use and exploitation among small-scale fisheries. Over the last few decades, there is a growing recognized tradition that points to the importance of ecological systems of knowledge, uncertainty representation, and traditional skills, in conceptualizing processes of environmental decision-making and the likelihood of introducing successful sustainability practices. In line with this perspective, this article presents preliminary findings regarding resource use decision-making processes among Endenese fishing villages in central Flores Island, Indonesia. Grounded on 22 months of ethnographic, experimental and ecological research (semistructured interviews, participant observation, visual surveys, probability and uncertainty assessments), and exploring local cognitive representations of marine processes, climate, ichthyology and the role of luck, this article discusses the current economic representations of small-scale fishers as avid maximizers. It concludes by emphasizing the need to further explore the role of mental models and beliefs regarding uncertainty in motivating fishing effort to design adequate conservation and governance programs.*

Key Words: small-scale fisheries, luck, uncertainty representation, decision-making, traditional ecological knowledge

Introduction

Fisheries in Southeast Asia have experienced an unprecedented expansion in the last half-century (Semedi 2001). As a consequence, the catch per unit of effort has dropped significantly in many regions of the Indian and Pacific Oceans (Boomgaard 2005; Butcher 2004, 2005; Henley and Osseweijer 2005). Reports from conservation and intergovernmental organizations attribute stock depletion to overfishing and damaging fishing practices (Ingles et al. 2008; UNEP 2008). In an attempt to regulate endangered resources, countries like Indonesia have engaged in decentralization, community-based and ecosystem management approaches (Satria and Matsuda 2004; Williams and Staples 2010).

Many of these efforts have encountered difficulties in dealing with the large-scale illegal trade of aquatic resources (Fox 2005; Heazle and Butcher 2007). They have also failed at recognizing the inequities in fishing capacity that are so common in Eastern Indonesia. In the province of Nusa Tenggara Timur, where the current research takes place, poverty extends to one third of the population (Monk et al. 1997; Resosudarno and Jotzo 2009). But, most significantly, limitations in management and development approaches have impaired the understanding of local fishermen's role in environmental degradation. A strict bioeconomic perspective has prevented the eradication of damaging fishing practices such as bombs and cyanide-potassium (Lowe 2006). The continuous use of non sustainable practices has, in return, resulted in very limited foreign investment, a condition that further exacerbates poverty and environmental pressure (Halim 2002).

Over the last decades, scholars have noted that fishery managers and government officers often work under the assumption that maximization and self-interest are the main motivations behind the allocation of fishing effort (Allison and Ellis 2001; Cordell 1974; Perry et al. 2003). This assumption is deeply rooted in the idea that fisheries, when not regulated, are open access systems where everybody's property

becomes nobody's (Feeny et al. 1990; Gordon 1954; McCay 1981). It also stems from the way human behavior is characterized by economic formalizations.

Bioeconomic models of Maximum Sustainable Yield and Optimal Foraging Theories or Marginal Value Theorem (Smith 1983; Winterhalder and Smith 2000) explain individual decisions and conservation practices through rational action choice (Gowdy 2008). These models have been relatively successful in generating simple, parsimonious, and generalized explanations consistent, in some cases, with field observations and ethnography (Winterhalder 1981, 1996).

At the same time, Optimal Foraging Theories (OFT) have been widely criticized for remaining inattentive to the social embeddedness of decision-making processes concerning subsistence practices. Critics have targeted OFT's assumptions about optimality and rational action, stressing its restrictions in dealing with dynamic choices (Foley 1985; Gigerenzer 2008; Gigerenzer and Brighton 2009; Houston et al. 1988; Mangel and Clark 1986; McCay 1981). Remaining for the most part inattentive to advances in the studies of decision making under uncertainty (but see Mangel 1990; Mithen 1989, 1990; Wilke 2006), the role of information as constraining efficiency has been left unexplored. OFT has marginally addressed psychological and social preferences (Aswani 1998).

Although it is indisputable that commercial fisheries in Southeast Asia are creating unnatural pressures on fish stocks (Butcher 2004; Ellis 2009; Helfman 2007), the responsibility of small-scale fisheries in the current decline of marine biodiversity cannot be established with certainty. Because decision making processes explaining fishing effort are multifaceted and extend beyond simple economics (Bene and Tewfik 2001; McGoodwin 1990), it is necessary to address local interests, systems of values, and adaptation strategies in order to fully comprehend the impact of fishermen in their environment (Allison and Ellis 2001; Ludwig et al. 1993; Mc Ilgorm et al. 2010).

To that end, building from a cognitive and ecological anthropology perspective, this article presents preliminary findings regarding information, local ecological knowledge and decision making processes explaining fishing effort of Endenese fishing communities in the island of Flores, Indonesia. Positioned on the northern margins of the Savu sea, Ende has been known for its prodigious catch and marine biodiversity (Fox 1977; Monk et al. 1997; Roos 1877; van Suchtelen 1921; Weber 1902). It has remained marginalized from investment and economic development (Butcher 2004).

But, with drops in production landings throughout the Indo-Pacific region, coral bleaching, and climate change, new plans have been drafted that include the creation of one of the largest marine protected areas in the Coral Triangle (TNC 2009). Unfortunately, information on the state of marine resources in the Savu is very fragmented. There is a dearth of knowledge on the way local communities use and represent the marine ecosystem (Munasik et al. 2011) and a wide propensity to blame local fishermen for the current state of environmental degradation.

In order to explore perceptions and decisions about the environment, resource use, and climate change, I conducted ethnographic research, using semistructured interviews and participant observation, in June-July 2009, November 2010-January 2011, and June 2011-December 2012 in Pulau Ende, Ipy and Arubara. Preliminary findings indicate that the quantity of fish has decreased in Ende Bay over the last 50 years and that significant changes have been observed by the local fishermen in sea surface temperature and wave activity (Badan Pusat Statistik Kabupaten Ende 1985-2011). In addition, findings suggest that decisions regarding fishing effort combine assessments of sailing conditions, knowledge of prey availability, and weather patterns. Interviews regarding traditional knowledge and ecological assessments have showed that decision making is not conducted under conditions of perfect knowledge. The major explanation given for variability in resource exploitation and motivations to go fishing is luck (*rezeki*). There is not a clear notion of risk or of probability quantification. This latter finding challenges the univocal characterization of fishermen as optimizers and rational actors. It also suggests that studying local perceptions of environmental uncertainty is crucial when assessing the patterns of ecological variability of an area to design sustainable management strategies.

Ende

Ende city is a mid-sized port surmounting to approximately 17,000 people (Badan Pusat Statistik Kabupaten Ende 2010), and the capital of the district. Across the bay from the city is Pulau Ende, a small island that includes seven villages with a total of 8,000 people and about 1500 fishermen.

Coastal Endenese have a complex origin. They reflect a mix between local hinterland groups (i.e., *Ata Lio* and *Ata Nage Keo*), Javanese and Chinese traders,

Bimanese warriors, Sumbanese slaves, and migrant Bugis, Butonese and Makassarese fishermen from Sulawesi (Dietrich 1983; Knaap and Sutherland 2004; Nakagawa 1984, 1996; Needham 1968, 1980; Sareng Orin Bao 1969; Tule 2004). Islam spread in the 16th century through trade and resulted in the consolidation of Buginese cultural traits to the expense of local characteristics (Edjid 1979). Buginese traits include a unique syllabic alphabet system named *Bahasa Lota* (Banda 2005; Roos 1877; van Suchtelen 1921), complex descent myths (Pelras 1996), food prescriptions, birth and wedding ceremonies, and an intricate symbolism and set of ritual practices that link social representations of the house and the boat (*perahu*, *sampan*) (Chou 2003; Sopher 1965; Southon 1995). Also among these traits is the practice of *mencari rezeki* or the search for fortune (*nggae ka*) as a way to explain one's decisions in all aspects of life (Acciaioli 2004; Pelras 1996).

Anthropologists have explored Coastal Endenese groups incidentally while studying kinship rules, magic, and agricultural practices of hinterland communities (Forth 1998; Nakagawa 1984, 1996; Needham 1968; Tule 2004). Historians have devoted some attention to the illegal trade of slaves and pirating activities carried out by the Endenese in the eighteenth and nineteenth centuries (Dietrich 1983; Knaap and Sutherland 2004; Needham 1968, 1980). During this time, the Endenese were a powerful force that engaged in commerce activities throughout the entire eastern Indo-Pacific region. After Dutch military intervention in the early twentieth century, Ende became famous as Sukarno's exile destination. At that time, Endenese had already endured the transition to a local agricultural economy under colonial pressure and became both politically and commercially isolated. Nowadays little seems to have changed.

In comparison to other parts of Indonesia like Kalimantan or Java, development programs have progressed at a slower rate in Flores (Resosudarmo and Jotzo 2009). In Ende, fishing is still carried out by traditional boats (*sampan*) or smaller motor boats with 4 ½ to 1 inch fishing nets. Activities are mostly for subsistence or small-scale trade as there is no industry operating in the district or external investment to support the improvement of the fishing gear.

Bigger fish are sold at the town markets of Mbongawani, Senggol, and Wolowona along with octopus (*Octopus* spp. Octopodidae), squids and scallops (*Amusium* spp. Pectinidae), manta rays (*Dasyatis* spp. Dasyatidae), *Mobula* spp. Mobulidae, *Myliobatidae* spp. Mobulidae, and sharks (*Alopia* spp. Alopiidae, *Charcharinus* spp. Charcharinidae, *Isurus* spp. Lamnidae), anchovies and sardines (*Sardinella gibbosa* Bleeker Clupeidea, *Sardinella lemuru* Bleeker Clupeidae, *Dussumeria acuta* Valenciennes Clupeidea). A common list of species includes flying fishes (*Cypselurus* spp. Exocoetidae), sail fishes and marlins (*Istiophorus* spp. Istiophoridae, *Makaira indica* Cuvier Istiophoridae, *Makaira mazarra* Lacepède Istiophoridae, *Xiphias gladius* Linnaeus Istiophoridae, *Istiophorus platypterus* Shaw Istiophoridae), tunas (*Thunnus maccoyii* Castelnau Scombridae, *Thunnus obesus* Lowe Scombridae, *Thunnus tonggol* Bleeker Scombridae), skipjacks (*Euthynnus affinis* Cantor Scombridae, *Katsuwonus pelamis* Linneaus Scombridae), needle fishes (*Tylosorus* spp. Belonidae), scads (*Caesio caerularea* Lacepède Caesionidae, *Caesio cuning* Bloch Caesionidae), snappers (*Lutjanus* spp. Lutjanidae), and grouppers (*Cromileptes altivelis* Innamura and Yabe Serranidae, *Eponephelus tauvina* Forsskål Serranidae).

Traditional Ecological Knowledge and Climate Change: Why Optimization is Not "Rational"

One of the key criteria among Optimal Foraging Models and Rational Action Choice is the idea that decisions are always made considering the whole set of alternatives at hand. Optimization is the result of a sound evaluation of outcomes in terms of all possible options and their assigned probability (Gigerenzer et al. 1999). From a cognitive approach, however, rational action choice entails a set of psychological skills and preferences that is far from being realistic (Gigerenzer 2008; Gladwin 1971, 1980; Quinn 1978). For example, it implies the ability to have perfect knowledge about the environment or to clearly conceptualize the probability values of different choices and alternatives in terms of risk perception (Mithen 1989, 1990). This misconstruction of skills and preferences is the result of a lack of studies on the cognition of fishing decision-making processes (Bene and Tewfik 2001; Colfer et al. 1999).

In marine environments, choice is always riddled with uncertainty (Acheson and Wilson 1996; Hilborn and Mangel 1997; Mangel and Clark 1983). The amount of fish present in a particular fishing spot cannot be readily or accurately ascertained, weather conditions are hard to predict, and probabilities are not always easily perceived (Gladwin 1971; Quinn 1978). Dynamic ecosystems, rapid choices, and changing conditions in the socioeconomic environment all

constrain the structure in which decisions need to be made and render the idea of an exhaustive consideration of alternatives implausible.

Far from perfect knowledge, research has shown that people rely on local mechanisms of prediction and ecological knowledge to secure livelihoods and adaptation (Godoy et al. 2009; Orlove et al. 2002; Tucker 2007b). Much of this knowledge has been formalized in systems of predictive cues that encompass fishermen's experiences and observations over centuries (Bjarnason and Thorlindsson 1993; Cordell 1974; Paolisso 2002). In other cases, knowledge has remained implicit or embedded in cultural practices (Dove 1993; Rappaport 1968).

Over the last half century, with climate change and advanced environmental degradation due to intensification of extractive practices, ecological patterns have been altered. While uncertainty has affected the efficacy of local belief systems, in some regions this has not undermined their use. Predictive cues are consistently incorporated into scientific forecasts among African and Indian farmers to anticipate droughts and plan crops (see Acharia 2010; Pareek and Trivedi 2010; Roncoli et al. 2001, 2002).

This has not been the case in Ende. Despite the fact that there are no available forecasts even at the regional level, former predictive mechanisms have become unreliable and their use by younger generations less frequent. But, as it will be argued later, this does not indicate that fishermen do not rely on environmental cues or that they remain unaware of environmental patterns and uncertainty sampling costs (van Oostenbrugge et al. 2001).

Through interviews and surveys among Endenese fishermen, I was able to determine that an informal system of weather forecasting and maritime conditions was in place well before the introduction of engines and fishing intensification in the 1980s. In conversations and fishing trips, I was able to record a thorough body of environmental and climatic information in terms of cues or signs of the marine ecosystem. The association of environmental indicators to fish stocks would permit a fisherman to estimate presence or absence of fish, weather events, and currents. In spite of being frequently used, this knowledge remains fragmented and to some level implicit making elicitation an arduous process.

Difficulties might be rooted in the fact that even older fishermen have now begun to challenge the certainty of predictions. Thirty to forty years ago weather conditions could be determined with moderate exactitude before going to sea, and predictions on stocks and climate could extend to longer periods of time like seasons. Nowadays, such knowledge is rare and might only be applicable if the frame in which decisions are made is modified or new patterns of variability can be detected that encompass previous cues.

One good example of the changes in the efficacy of predictive knowledge can be found in the use of fishing calendars. According to most fishermen, it is widespread knowledge that fishing patches are selected on the basis of an annual calendar regulated by the monsoon seasons and moon phases that permits them to calculate the presence and abundance of certain species. In this system, winds and sea water temperature might be the most important factors determining catch, unit of effort, and sailing conditions. But as a consequence of increased climatic alterations, the onset of the dry and wet monsoon seasons has changed (see Badan Pusat Statistik Kabupaten Ende for climatic data; Aldrian and Susanto 2004; Hamada et al. 2002). This has brought many interviewees to mention the impossibility of relying on calendars anymore to establish with certainty the availability of fish species. They say, "*Ikan tidak kenal musim lagi*"[1] ("Fish do not know seasons anymore").

In fact, in the 1980s, precipitation events would commonly start in October and continue until late March (Badan Pusat Statistik Kabupaten Ende 1984-2010). These were preceded by a reduction of the strength in the eastern trade winds (*angin timur*) and an intensification of western and northern winds (*angin barat*, *angin utara*). With the wet monsoon, changes in currents and sea water temperatures would increase the availability of species like small tunas, squids, and anchovies. However, according to the fishermen, in the last 2 years the western winds, which inaugurate the wet season, lack strength. The onset of the rainy season has been delayed until December and shortened its duration. This seems to indicate a significant change in climatic patterns that affect marine species in terms of life histories and biomass. Most significantly, it is the opposite of what would be normally expected as a result of the current transitional period (2010-2011) between El Niño and La Niña conditions, maybe signaling the beginning of new precipitation and temperature patterns.

These environmental and climatic alterations not only affect coastal communities by increasing the fre-

quency of extreme events such as typhoons, destructive storms and beach abrasion. But they have also resulted in increased crop failures and reduced catches that have long term impacts on the population's morbidity and mortality rates. With changes in biomass affecting total catches and ultimately reducing incomes, families have lower possibilities of diversifying their diets and paradoxically consume less and less fish. Environmental uncertainty combined to economic instability has created new challenges that many fishermen do not feel prepared to deal with. Under these conditions, it would be reasonable to assume that the change in patterns of variability has affected the competency of traditional forecasting cues and contribute to their progressive disappearance as fishermen perceive their fallibility.

Yet, far from a simple interpretation, these interviews also suggest that previous weather-related knowledge and fishing experience have been reformulated and are still being consolidated in new associations and re-associations of cues. Some fishermen indicated that they pay attention to stars and clouds (shapes, positions, movements and colors) and atmospheric phenomena like lightning to determine wind conditions that might affect fishing. In some cases, fishermen pay attention to the presence of marine life (zooplankton) to predict currents and winds, and to fishing feeding behavior to anticipate possible fishing spots. These cues might not be new, though the temporal decision making frame in which they are applied has changed.

With fishing seasons presenting a higher uncertainty on the occurrence of winds and certain fish species, fishermen have begun to target multiple species by diversifying fishing tools. They have also incorporated some small innovations like the use of colorful baits, a practice that is common in other areas in Sulawesi. And most significantly, they have altered their pattern of activities in the wet season. Before, fishermen would remain at home for a period of forty days (in December, January, and February) while strong western and northern winds would prevent navigation. Nowadays, fishermen go fishing throughout the year, staying occasionally for periods of one or two weeks when storms hit the region. The frequency of their trips has, thus, changed. In addition, with the changes in marine activities from trade to a more fishing based subsistence, their trips and duration have shortened considerably.

However, the reason why optimization might not account for behavior in Ende is not only in terms of cognitive skills and the demands that perfect knowledge imposes in dynamic contexts (high cognitive costs when decisions need to be quick in a fast changing environment). Indeed, one might argue that changes in predictive systems might reflect an ongoing process of adaptation to develop more accurate representational beliefs and towards achieving optimization. One could also even argue that optimization towards catch maximization might occur under constraints, or that fishing effort could be best explained by satisficing or ameliorating principles (Mithen 1989, 1990; Simon 1957). But, as it has been the case for OFT, such line of reasoning cannot be readily tested or empirically assessed (Foley 1985; Gigerenzer et al. 1999; Gigerenzer and Gaissmaier 2011).

Optimization might not be a rational choice according to Endenese standards, as the main factor explaining the motivation to go fishing might lie not in a profit-driven mentality or in a risk-reduction perspective, but in a more comprehensive approach to uncertainty and life that defies a clear cut probability conceptualization.

As a matter of fact, the most important decision an Endenese fisherman has to face is to determine whether to stay fishing or to return given climatic conditions. This process, which combines the analysis of a number of cues like clouds, current strengths, and the behavior of other fishermen, is not single handedly explained by expertise or by the expectation of the fish to be caught that day (*harapan*). Similarly, tools or fishing gear do not seem to be the main cause behind catch numbers. Many interviewees when inquired about the role of previous experience and type of fishing equipment indicated that even those that have many years at sea or that employ motor boats with many nets can from time to time return empty handed.

Previous research has established that risk reduction and the avoidance of losses can be an important motivation behind the time spent fishing (Ammarell 2002; van Osteenbrugge et al. 2001). But in Ende, some fishermen are willing to stay at sea under adverse conditions if the catch might be certain, whereas others might favor an early return even when conditions are safe and the fish are eating. Therefore, evidence collected so far suggests that risk preference, experience, expertise, and gear do not completely account for the motivations inspiring fishing effort and decision-making.

The major explanation that is willingly given for variability of fishing effort and success is luck (*rezeki*). This concept is rooted in Islamic, Endenese, and Buginese traditional beliefs and rituals (Acciaioli 2004; Ammarell 2002; Pelras 1996). Its causality is complex. According to most interviewees, only god can determine the conditions in which luck occurs ("*peraturan dikirim oleh Allah")* and only he knows ("*hanya Allah yang tahu"*). Because marine environments, as well as any other ecosystem, are the result of god's creation, they remain unpredictable or random in terms of human perception ("*laut sembarang*"). The ocean is but a big puzzle ("*taka teki*").

In spite of the highly variable conditions surrounding fishing, fishermen can still try to grasp a limited understanding of the ocean that permits them to catch what has been granted for their subsistence. To that end, luck, catch and climate are all related in a system of signs that is given by god to interpret. These climatic signs, described previously as a system of traditional knowledge, are not straightforward and their predictive validity is not fixed. They are effective only with a certain probability. Thus, natural events are not completely predictable as such in this narrative of luck.

The decision to go fishing is indeed inspired in the idea that luck cannot be procured by other means but being a hard worker (*harus berusaha*) and diligent (*rajin*). But, overall, one cannot do anything to increase luck with certainty, but go to sea and search for fortune ("*Rezeki tidak bias tambah, hanya mencari cari ikan"*).

Formal practices that might result in better luck refer to respecting the daily five prayers (*sholat*) as established in the Qur'an, and having a pure heart (*hati murni*). Luck can also be favored from prayers on Monday, Thursday, and Friday (*Jum'at*) nights that involve the burning of wood in front of the house (*kemenyan*). Furthermore, fishermen follow the *adat* (rules) set by the ancestors when building boats or venturing on new enterprises to sea, these are all connected to luck. Dreams also hold an important place among some fishermen as they are considered an indication of future success sent by god.

Other ways in which luck is sent by god include the finding of precious objects (*kulavu, barang gaib*), though in some cases these might be connected to demons (*djins*). This practice is associated by more religious fishermen to pagan beliefs (*kafir*) from the time when the ancestors were around (*nenek moyan*) and is considered very close to sin (*termasuk sirik, dosa*). In fact, some informants indicated that they would rather have nothing to do with precious objects as they might provide short term luck at the expense of a huge loss (sometimes human life). According to them, the devil (*iblis*) walked the earth way before humanity, and has clever ways of deceiving people. If one transgresses god's rules by engaging with magic objects risks eternal damnation for there is no forgiveness for such sin. The belief in magic objects as such is common among Endenese that have connections with Lionese groups or that reflect an Endenese -Lionese descent.

Finally, luck is also associated with following old *adat* rules when fishing for some species of coral fish (*'ikanasa', Serranidae* and *Lutjanida* spp.). According to such prescriptions, fishermen cannot talk, smoke, cook, or eat when fishing on one of these patches or they would risk making the fish angry.

Overall, it is interesting to observe, that next to the use of weather cues, this traditional body of knowledge and rules related to luck has become sparse among the newer fishermen who do not believe (*"Orang tidak percayaa lagi"*) or follow the established rules (*"Tidak ikut peraturan dari dulu"*). As one of the elder fishermen states, the lack of fish or failure in the catch can be the result of not respecting the former ways: *"Harus percayaa atau tidak dapat ikan. Dulu biasa per bulan perahu penuh, sekarang tidak yakin. Dua atau tiga hari lagi, habis"* ("One must believe in order to catch fish. Before, boats used to be full throughout the month when returning from fishing. Now, after 2 or 3 days there is no more fish").

In conclusion, one could say that the evidence presented here is not entirely incompatible to explanations of fishing effort by maximization practices. At the individual level, risk preferences and non-verbal processes of probability perception (unconscious) might still result in optimization over the long term. However, it is crucial to emphasize that luck as the main motivation behind fishing effort places rewards in a future afterlife and not in the achievement of material success. In addition, this narrative of luck implies a certain attitude towards nature that shapes the perception of ecological patterns. But luck also defines suitable rules on how to interact with an environment and which expectations are valid. This, in turn, constrains decision-making processes and resource use practices.

Therefore, local perceptions of environmental un-

certainty and nature are key to understanding what lies behind resource exploitation, along with religious beliefs and cultural values. Therefore, they should be addressed by government agencies and conservation institutions to design culturally sound management practices. I will further discuss the implications of these findings for rational theory and environmental policies in future articles.

Conclusions

In summary, preliminary findings suggest the importance of ecological knowledge in fishing effort, decision-making, and the existence of different attitudes towards the use of marine resources in Ende. Exploratory interviews indicate so far that neither conservation organizations nor the local government actively incorporate local ecological knowledge when drafting management plans for Ende, and they assume that fishermen are mostly driven by their own maximization of interests.

Nonetheless, in a world where climate change threatens to reshape the global ecology and economy of marine-human ecosystems (Badjeck et al. 2009; Cheung et al. 2009), conservation and management initiatives need to look at the local to understand why certain choices are made before assuming, as they usually do, that cost-benefit rationales apply uniformly. Because complex problems require insightful solutions, conservation and governmental institutions should forge a multidisciplinary methodological and theoretical perspective to engage local needs and vulnerabilities.

Cognitive and behavioral studies of decision-making in small societies can inform such endeavors by telling about the local impacts of overarching policies and the strategies devised to represent environmental uncertainty (Colfer et al. 1999; Tucker 2007a). Future research will explore these issues and ponder the importance of how different conceptions of the marine environment across generations and stakeholders (baselines) ultimately constrain local responses and livelihoods.

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Biosketch

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Notes

[1] I use italics underscored to distinguish words in Bahasa Indonesia and Endenese.

Appendix1.Map.
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http://en.wikipedia.org/wiki/File:Lokasi_Nusa_Tenggara_Timur_Kabupaten_Ende.svg

Appendix2.Map.

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