Diminishing sustainability of traditional fishing practices in Siquijor Island, central Philippines

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Introduction

Although the importance of local, traditional fishing knowledge cannot be underestimated (Johannes 1981, 1998), documenting it in a form that is understandable by both resource managers and scientists remains a challenge. This is because both ecological dynamics and local culture and traditions must be well understood.

Islands and communities in the Philippines are rich, both in terms of marine biodiversity and traditional fishing practices. However, compared with the accumulated effort initiated by the late R.E. Johannes and his collaborators in the Pacific Islands region (e.g. Johannes 1981, 1998), information from the Philippines remains scant and focused mostly on anthropological aspects of fishing (e.g. Russell and Alexander 1996; Abernethy et al. 2007). According to Johannes (1981:ix):

> …when anthropologists study man in nature, the general form of queries is usually 'how does this environment influence you?' rather than 'what can we learn about this environment from you?'

I grew up in Siquijor Island in the central Philippines, and was a fisherman and at the same time a biologist with a strong commitment to understanding local resource management. I blended my own experiences and observations along with those of other locals (mostly my relatives), which I found to be valuable in formulating sound management practices. Presenting local observations with information in the scientific literature is the goal of this article. Specifically, it provides a detailed account of local fishing practices on Siquijor Island, how they have changed over time, and the potential impacts of such practices on the sustainability of local resources. The focus is mainly on northwestern Siquijor (Fig. 1). To supplement my own observations, I conducted several informal interviews with local fishermen.

Method and study area

Observations were made primarily by myself, a fisherman native to western Siquijor (Fig. 1) and who lived there from the 1990s until late 2015. The study area covers the barangay (village) of Tambisan, in the municipality of San Juan to the north of Alibangbang. The latter is part of the municipality of Siquijor. The total land area of these barangays is 1,945 ha (19.5 km^2). The shallow marine ecosystem (less than 30 m deep) of the study area covers 1,035 ha, of which 175 ha is coral reef, 636 ha is seagrass beds, and about 120 ha consists of *Caulerpa* (*lato*) communities mixed with seagrasses. At least five patches of mangroves were reforested with *Rhizophora* species in the 1980s and 1990s, with a total area of 10.7 ha being connected with 20.5 ha of beach forests. The area includes 5.6 ha of sandy beach, most of which is located in front of privately owned beach resorts.

Results and discussion

The following fishing practices are organized according to their importance and urgency in terms of immediate management intervention.

Poison fishing (locally called panubli, panglagtang*)*

In the recent past, local fishers used plant roots to catch fish. The most common plant used was *Derris trifoliata* (*tubli*), and its use has been reported elsewhere in the literature (e.g. Leonard 1939; Kawamura and Bagarinao 1980). *Derris* roots were usually soaked in water for at least two weeks to soften them before use. A bundle of roots (~25 cm long x 5 cm thick) was more than enough for a single fishing operation that targeted coral bommies and holes occupied by either conger eel (*Conger cinereus*) or striped catfish (*Plotosus lineatus*). The poison is in the sap (the active ingredient is rotenone), which is produced by pounding the root bundle several times above-water, then waving the pounded root

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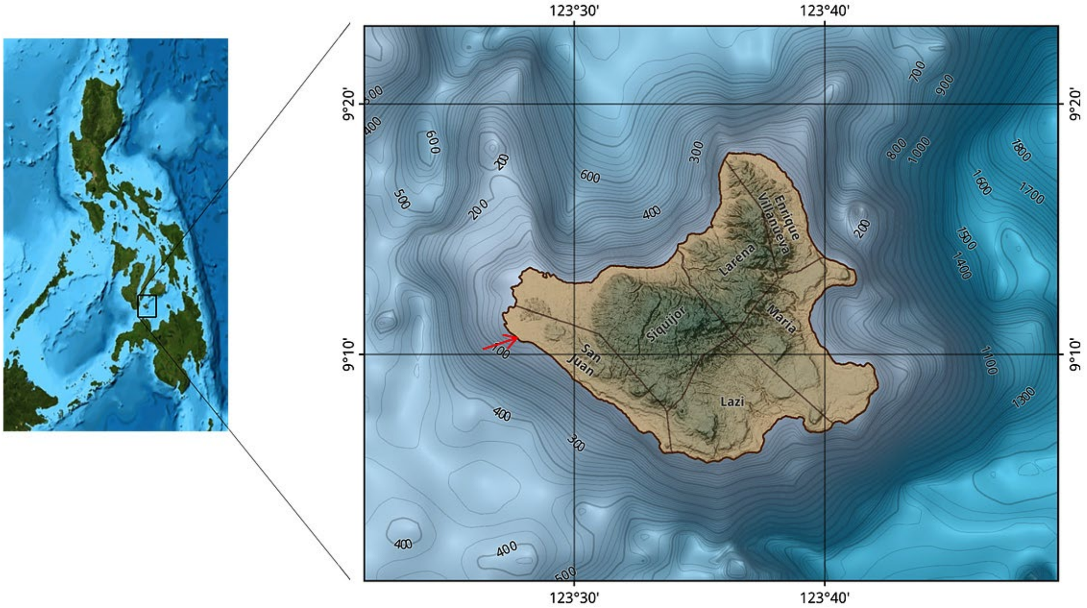

Figure 1. Location of the study area on the northwestern coast of Siquijor.
Source: Map of Siquijor – data taken from SRTM30_PLUS (bathymetry), SRTMGL1 (topography), GADM (administrative boundary); rendered by JLP Maypa.

bundle near the target hole(s) and under ledges. Before applying the poison, a fine-mesh seine net (*sahid*) was encircled around a coral bommy or a massive coral head (genus *Porites*) to capture escaping congers and catfishes. This technique is still in use, but the dwindling supply of roots of *Derris*, a relatively slow growing plant, has led local fishermen to use the more readily available chlorine granules, which are probably more destructive than *Derris*.

Chlorine is known to be toxic (Thornton 2001) but most reports are on the effects of chlorine residues on fishes. Chlorine is available at any local store as a household bleaching agent for as little as 1.00 peso[2] per small sachet. A 1.5 litre plastic soft drink container with ~10 sachets (worth 10 pesos) is enough for a half-day's fishing operation targeting *Plotosus lineatus*. But other fishes are also targeted, especially cardinalfishes (family Apogonidae, genera *Cheilodipterus* and *Apogon*) and species that congregate near or under coral bommies. This fishing practice is highly destructive because of the corrosive and toxic properties of chlorine on coral polyps and other marine organisms, including other invertebrates and fishes. The exact number of fishers on the island who use chlorine is unknown, but in the author's home village, at least one person uses chlorine on a daily (full-time) basis, and other fishers use it occasionally.

Another form of poisoning is the use of seeds from a vine that is locally called *lagtang* (*Anamirta cocculus*), which is also known to be a fish poison in the Philippines (Kawamura and Bagarinao 1980) and elsewhere (Jothivel and Paul 2008). As used in the past, *lagtang* is pounded and mixed with crushed crustaceans (hermit crab or *umang*, genus *Coenobita*) and raw octopus meat. The bait-poison mixture is usually placed in sandy habitats (immediate backreef zone) to capture emperorfish (*Lethrinus* sp.). Modified versions of this type of poisoning use a more potent poison, such as the pesticides endrin and malathione, which are still widely used in the Philippines (Lu and Cosca 2010).

Perhaps the least used type of fish poisoning in the study area is *soro-soro*, a local term for the plant *Euphorbia* sp. This method is probably as old as the use of *Derris*, and it is possible that other once-locally abundant plant species were used (e.g. *Barringtonia asiatica*). A group of at least 10 fishermen is needed for this communal effort, which includes gathering *Euphorbia* branches and chopping them into smaller pieces in tidal creeks and intertidal pools, thereby releasing the poisonous sap. As the author witnessed sometime in the 1990s, most fishes in the mangroves were killed, including apogonids (*Sphyraemia orbicularis*) and siganids (*Siganus guttatus*), and even moray eels (*Echidna nebulosa, Gymnothorax* spp.) were stunned or blinded and some died

2 1.00 peso = 0.02 USD (April 2016)

within a few hours. However, this type of fishing is rarely practiced nowadays, probably because so few fish remain in the mangrove embayment, and because the required *Euphorbia* plants, formerly available from households as ornamentals, are no longer available.

*Moray eel pots (*balantak*)*

Outside of the Philippines, such as in Indonesia, most moray eels are considered to be unpalatable (Máñez and Paragay 2013) and are sometimes targeted only by spearing. In Siquijor, however, most locals prefer the relatively small (ca. 20-30 cm length) moray eels for several, mostly economic, reasons. Fresh morays are often sold locally (within the municipality) for 40–50 pesos (USD 1.00) per kg. In some cases, they are dried, and then sold for at least 100 pesos per kg (USD 2.27). A rapid examination of moray eels captured by local fishers revealed that the most commonly caught species from the coral reefs were *Gymnothorax richardsonii* and *G. chilospilus*, whereas *G. richardsonii, Echidna nebulosa* and *E. delicatula* were commonly caught in the rocky-weedy reef and in the intertidal area. The drab and greenish species, such as *G. Buroensis, G. monochrous* and *G. richardsonii,* were usually encountered in seagrass beds.

In the 1930s, locals caught small (>30 cm length) morays only during low tide with either a *bolo* to kill foraging morays (mainly *Gymnothorax richardsonii*) at night in the intertidal area (locally called *panolo*), or by using bait wrapped in coconut husk attached to a line made of *maguey* (genus *Agave*) fibre. As the small morays bit the bait (usually boiled mollusc or fresh fish), their sharp, conical teeth would cling to the fibre of the coconut husk.

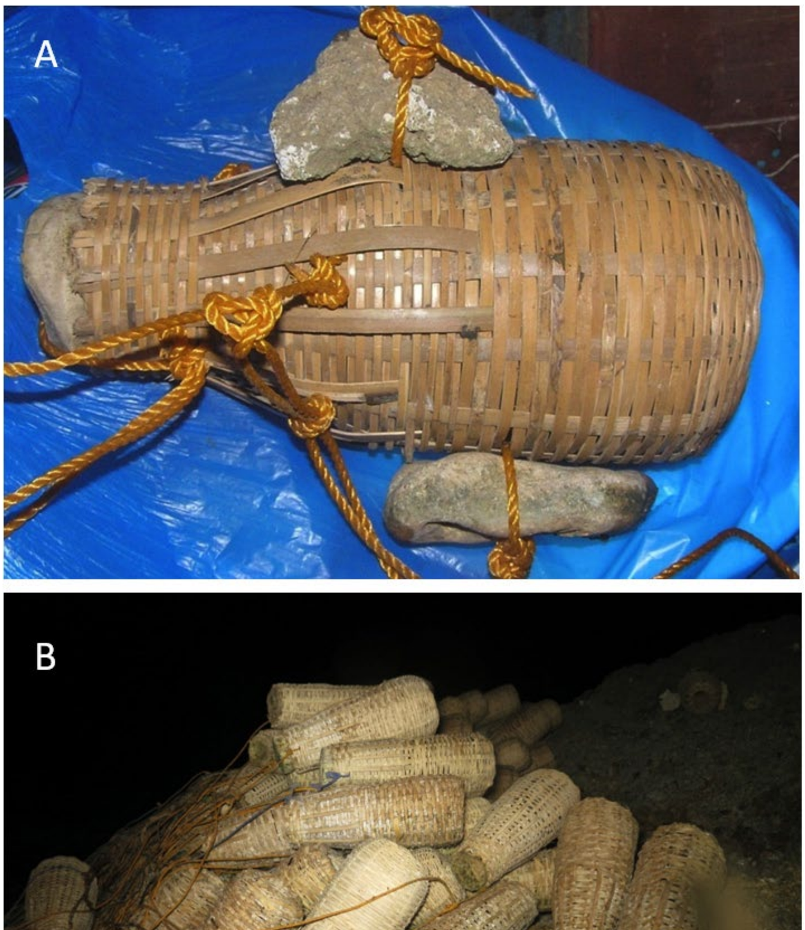

Figure 2. A) A close-up of the older version of the eel pot (*balantak*) used to capture moray eels in Siquijor. B) Linked pots type (note the main line attached to all traps)

According to older residents (70 years of age and older) of Tambisan, San Juan, the present eel-pot design (Fig. 5) was patterned from the eel pot called *balantak* used to catch freshwater eels (*Anguilla* spp.) in neighbouring Negros and Mindanao islands. This name has been retained to refer to the modified basket-like eel pot. The present design is made of carefully woven thin bamboo strips (*nawi*) so that it looks like a bottle with a wooden cap. At the opposite side is a narrow entrance with its sharp and pointed end directed inwards (*sodyang*) so that the eels become trapped once they are lured inside the pot. The pot is about 30 cm long, with a diameter of 10–15 cm. A pair of stones (about the size of a fist) serves as a weight for the pot.

Before about 2000, eel pots were usually set out at dusk (around 17:00) and retrieved in the early morning (about 06:00). This technique mainly targets larger eels. Fishermen must ensure that individual eel pots are well positioned, with their entrance perpendicular to the substrate. Fishermen found it time-consuming to set out all of the pots and because they were placed about 5 m apart, retrieval was difficult, especially during *habagat* (southwest monsoon season) because pots either became dislodged or covered by thick algae.

This problem was solved by attaching all of the eel pots to a main rope (line) at about 5 m intervals, making retrieval easier. On the other hand, this more convenient method has also allowed fishermen to exploit the resource more heavily, because each person can set and retrieve a series of pots at least twice a night within an interval of only one to two hours, depending on the availability of bait.

Various types of bait have been used, depending on their availability and catching efficiency. The preferred baits are boiled octopus (locally called *kugita* and *tabogok*) and cuttlefish (*boko'-boko'*). But because these baits are becoming scarce in the area, alternatives such as fresh fish and molluscs are being used (using low commercial value species such as *Sardinella* spp., anchovies, family Engraulidae, and wrasses, family Labridae) and molluscs (*Malleus malleus*, *Trochus* spp., *Cerithium* spp., and various conch snails ranging from small *Strombus* to large *Lambis* species). Because juvenile giant clams (Tridacnidae) were perceived as being either "unimportant" or having no commercial value, they were often used as bait.

According to a former fisherman, the most efficient way to ensure sustainability of the moray eel fishery is to maintain 5–10 bamboo traps (*palan-an*) to capture the seagrass-associated parrotfish (*Calotomus spinidens*) because, aside from additional income, the excess (unsold) individuals of this species could be used as bait for moray eels. These bamboo traps do not require bait, but rely only on filamentous algae growing on the surfaces of the split bamboo.

In the 1980s and 1990s, a group of five local fishermen agreed to set aside the leeward and sheltered seagrass beds found in deeper lagoons (5–6 m deep), coves and embayment as "temporary reserves" to be used only during the southwest monsoon, when most reefs and seagrass beds are battered by intense waves. This enabled fishermen to secure an income from the moray eel fishery — even during the monsoon period — in a sustainable manner. This periodic closure is similar to other practices such as customary management tenure (Ruddle et al. 1992). The younger generation of fishers, however, is completely unaware of this fishing practice.

Based on the initial monitoring of catch per unit of effort (CPUE) done between 29 October and 15 November 2013, there are at least 10 full-time moray eel fishermen (*mamalantakay*) in just two barangays (Tambisan, San Juan and Tambisan, Siquijor), with an average of 50 eel pots person^{-1} catching an average of 3.2 kg person^{-1} in about 2.5 hours of fishing. Based on these values, an average CPUE of 1.32 (±0.19 S.E.) kg person^{-1} hr^{-1} and a corresponding income per unit of effort of 59.75 (±9.9 SE) pesos person^{-1} hr^{-1} were calculated. It should be noted that in some cases, the fisherman must factor in an amount for the purchase of bait, which reduces his daily income.

When expressed in grams per eel pot per hour, the CPUE was calculated to be 41.42 g pot^{-1} hr^{-1}. This value can be used for further monitoring of CPUE because of the variability in the number of pots used by the fishermen. This CPUE is far below what it was in the 1980s, when CPUE for each pot could reach about 300–500 g pot^{-1} hr^{-1}.

*Fish pots and traps (*palan-an, panak*)*

Two types of fish traps are used, the larger type (roughly 2 m x 5 m) is locally called *bobo*. At least 15 fishermen on Siquijor Island use this type of gear, which is usually deployed in *takot* or deep pinnacle reefs at depths of 100–200 m. The other type of fish trap is a circular fish pot, called *palan-an* (Fig. 3-A), which is used by at least 37 fishers on the island. This trap is usually set in seagrass-algal beds to capture smaller species of parrotfish usually *Leptoscarus vaigiensis*, *Calotomus spinidens*, and juveniles of *Scarus* spp. (e.g. *S. psittacus* and *S. ghobban*). These species are lured into the trap by different techniques. One method is to allow the filamentous algae (e.g. *Spyridia* and *Ceramium*) to grow on the fish pots for at least two weeks. These algae serve as natural baits. Once the traps appear dark, due to algal growth, they are brought to the surface, sun-dried

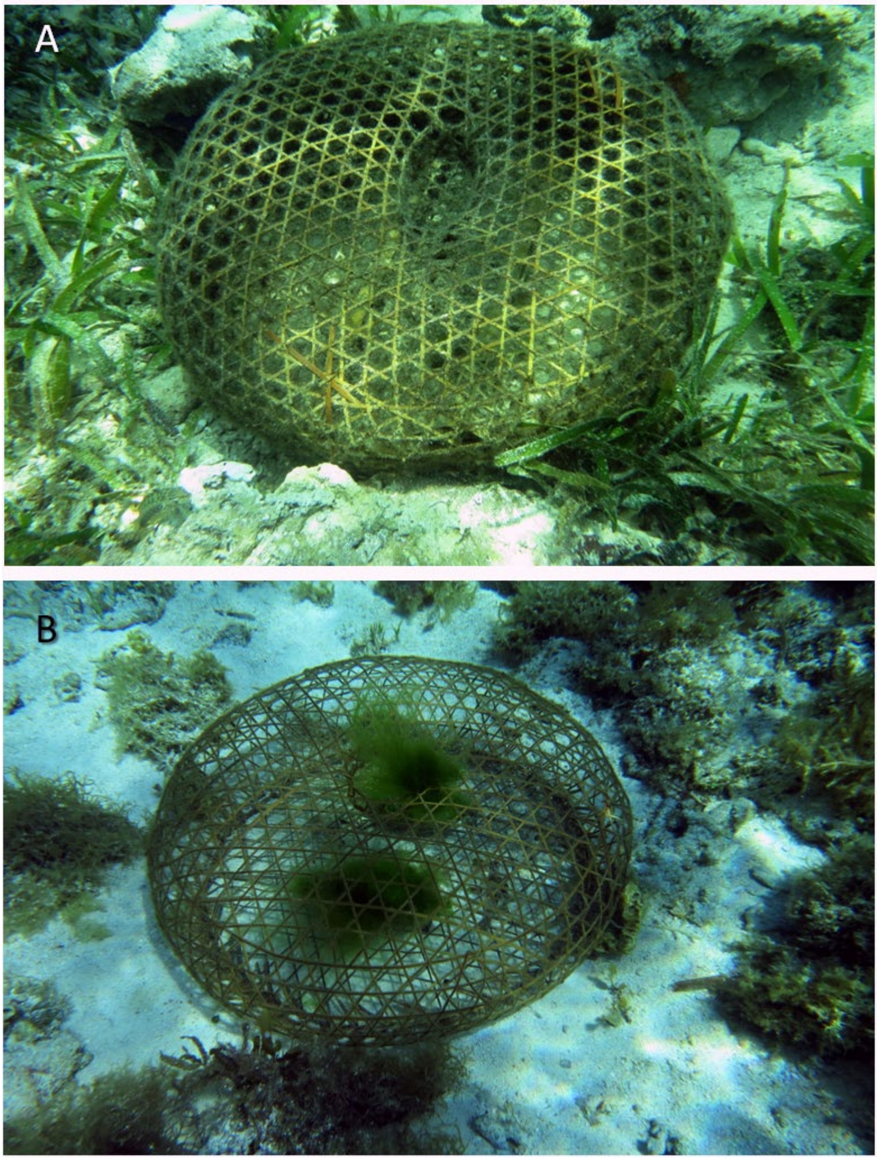

Figure 3. Small circular fish pots used to capture parrotfish species (A) and siganids (B). Note the green alga *Enteromorpha* as bait. The small bait, near the entrance in B, is locally called *solot.*

for two days, and then soaked for another week for further trapping.

While waiting for the filamentous algae to colonize the trap's surface, young seagrass leaves (*Syringodium isoetifolium* and *Thalassia hemprichii*) and tips of the brown alga *Sargassum polycystum* are attached to the bottom of the trap as bait.

Wrasses (family Labridae) such as *Halichoeres* and *Thalassoma* are caught using macerated crustaceans (genera *Grapsus*, *Thalamita* and *Coenobita*) and sea urchins (genera *Diadema* and *Echinothrix*).

A similar version of this trap (locally called *panak*) has a wider entrance and larger mesh size, and is used mainly to capture siganids (Fig. 3-B). The bait used is the green filamentous algae *Enteromorpha intestinalis* (*lanay*), which grows abundantly near freshwater springs in Poblacion, San Juan. It is of interest to note that local fishers use a pinch of *E. intestinalis* near the entrance of the pot as shown in Fig. 3-B (termed *solot*, thinner and longer filaments than the main bait attached at the base of the trap) to indicate whether siganids have been foraging at or near the trap. If a single pot is still empty (no siganid caught) at the time of retrieval (usually timed during the highest tide at around noon), but there are signs that siganids have bitten part of the *solot*, the same pot is left in the same spot because locals believe that siganids will feed again in the afternoon before the low tide.

*Gill nets (***pukot, tingkay, pataan***)*

At least 90 fishermen are involved with gillnetting (*pamukot*) in shallow marine habitats (seagrass-coral reef) within the study area. Although double and triple ply trammel nets are have been banned, some fishermen still continue to use them. Because the gill net is relatively new (introduced to the area in the 1970s), only those gill nets that can potentially affect both the short-term and long-term movements of finfishes will be examined.

A drive-in net used by a group of fishers (*sin-sin*) is similar to a typical drive-in net, using at least five people to scare or drive fish into a C-shaped gill net. This gear targets seagrass-associated emperorfish (*katambak*) of the family Lethrinidae and wrasses (Labridae). Because of the small mesh size of the gill net, juveniles are also caught.

Tingkay is a method that uses a gill net and stakes, and is set-up as a barrier net during the highest tide at midday (usually during March to April spring tides) so as to trap retreating fish that spend part of their time during high tide to feed or shelter in the mangrove embayment. This net and method is similar to the *kesokes* net in Palau (as described by Johannes 1981) but is done mainly in mangrove embayments.

In the coral reef off Solangon, a stationary gill net is deployed and checked regularly for fish. Locals call this method *pataan*. The same basic principle used with *tingkay* is used with *pataan*: fish that come from deeper parts of the reef to forage in the shallows (seagrass beds and limestone terraces) before returning to the reef (during daytime) as well as nocturnal feeding fish (that retreat at dawn) are targeted. Prior to 2012, *pataan* was done by moving from one location to another. Because of the proliferation of gill nets, locals opted to have stationary nets to ensure their daily catch.

Harvesting edible macroinvertebrates

Harvesting edible macroinvertebrates also contributes to the income of local fishermen. At least 70 people are involved in this type of fishing, 30 of whom rely heavily on sea urchin gathering on almost a daily basis. Most of these fishermen belong to a village in Barangay Solangon, San Juan, but a few reside in Cang-alwang, Siquijor municipality.

These fishermen usually gather the sea urchin *Tripneustes gratilla* (locally called *salawaki*), which is favored by local consumers for its pleasant taste. Each person can harvest around 300 individuals of this species, which yields 6 bottles (375 ml each) of roe. Fresh bottled urchin roe is sold in the nearby towns of Siquijor and San Juan at 40–50 pesos per bottle, or even 70 pesos per bottle for some species of sea urchins, locally called *tuyom* (*Diadema setosum* and *Echinothrix* sp.) because of the additional work required to remove their spines.

Conch snails of the genus *Lambis* (mainly *L. lambis* and *L. chiragra*) are usually sold fresh inside their shells for 40 pesos per kilogram. Locals seasonally relocate their gleaning grounds for *Lambis*. During *amihan* (northeast monsoon) and interim months when the weather is generally calm and macroalgae are dense, fishers glean seagrass beds for *Lambis* and other small strombids. During *habagat* (southwest monsoon), fishers shift their gleaning to the shallow offshore algal beds. This shifting of fishing ground due to the seasonal monsoons may contribute to the sustainability of this type of fishery by allowing stocks to recover when they are put to rest.

*Abalone fishing (***pangapinan***)*

Three techniques are used to capture the donkey's ear abalone (*Haliotis asinina*) (Fig. 4). One is by overturning rocks and massive coral colonies (*pangukab*) either by hand or using an iron hook (*ganso*). This is the most destructive method. Sometimes, massive coral colonies (e.g. *Porites* called *manonggol* or *binagong*) with diameter of about 2 m are broken into two to three parts. When the abalone is spotted right after overturning the rocks, a smaller *ganso* made from wire is used to detach the animal from the rock surface.

Another technique is by searching (*pangoot*) with just bare hands in holes and crevices in rocks and on ledges. This is potentially dangerous to the gatherer. In several instances, the author who in 1995–1999 was a gatherer himself, saw gatherers with fingers bitten by large moray eels (*Gymnothorax* spp.) and conger eels (*Conger cinereus*). Injuries may also come from venomous fishes, such as scorpionfish and lionfish (Scorpaenidae) and catfish (*Plotosus lineatus*). In most cases, the first two techniques were used together.

The third technique, which appears more convenient, is by searching at night in holes and ledges using an underwater flashlight (12 V with halogen bulbs). However, this method allows the gatherers to overexploit the abalone. In fact, prior to the collapse of the local abalone fishery in 2012, this harvesting technique was rampant throughout the island of Siquijor. Each gatherer spent, on average, two hours on each trip, but some of gatherers operated twice a day (after dusk 18:30–23:00 and early dawn 04:00–06:00).

Experienced gatherers have developed particular techniques for locating crevices or holes possibly occupied by abalones. One is to identify features

Figure 4. The donkey's ear abalone, *Haliotis asinina*.

of the abalone's foraging range, such as foraged turf algae with some excreta in the vicinity (about 10 cm wide from the opening). Gatherers observed that the striped catfish (*Plotosus lineatus*) preyed on juvenile *Haliotis asinina*. This observation has certain implications. For example, Nañola et al. (2011) suggested that the catfish *P. lineatus* could serve as an indicator of a heavily fished coral reef. If this fish preys on juvenile abalones, then abalones might be subjected to both direct impacts from overharvesting and indirect effects such as increased predation. In addition, the practice of overturning rocks and boulders might further expose juvenile abalones to other predators such as wrasses (e.g. *Thalassoma* and *Halichoeres* species). Moreover, large massive corals (e.g. *Porites*) are sometimes turned upside down (causing death of the entire colony) or divided into two to three pieces while searching for abalone.

One abalone gatherer called the author's attention to the presence of *H. asinina* in wave-formed ledges of seagrass rhizomes (mainly *Thalassia hemprichii*). At least five individuals were collected in just three patches of seagrass beds. These abalones appeared whitish, but other features indicated that they belonged to the same species. They probably took shelter underneath seagrass rhizomes during the southwest monsoon because the shallow reef flats are exposed to heavy wave action brought about by the monsoon and storms.

Prior to the collapse of the fishery in 2012, abalone gatherers spent an average of 4.18 ±0.15 hours day^{-1} site^{-1}, CPUE of *H. asinina* ranged from 0.1 to 0.6 kg person^{-1} hr^{-1} with a mean value of 0.25 (±0.03 SE) kg person^{-1} hr^{-1}. An overall estimate of annual catch may be best based on observations made by the author's field assistant (Noe Bucol, an abalone gatherer) in the only landing site of the entire island (Solangon, San Juan). The usual weight of abalone bought by a local buyer on a daily basis was about two ice boxes (each containing about 45 kg) during the first two weeks of the southwest monsoon when extensive algal beds of *Sargassum* and *Padina* are removed, thereby increasing the detectability of abalones at night. This was then followed by a gradual decline to at least one box per day throughout the rest of the year. Using the above figures, it is probably safe to extrapolate that the annual catch would be around 8,550 kg year^{-1}. Given the prevailing price of 400 pesos kg^{-1}, an annual total gross income of 3.42 million pesos is estimated. From 2010–2012, about 47 regular abalone gatherers from around the island were distributed in the following harvesting sites: Tambisan (7 people), Cang-alwang (10), Cang-asagan (10), Maria (10), and Lazi (10).

Bendijo et al. (2004) reported catches of roughly 1.0 kg per person per fishing trip and an estimated annual catch of 1 tonne per 100 gatherers. Their figure is probably underestimated. In the early 1990s until 2000, gatherers delivered live abalones directly to the local buyer. Damaged abalones were either priced 50% lower or considered rejects. Processing abalones was done by the buyer only, to ensure quality. However, beginning in 2001 until 2012, gatherers were allowed to process abalones themselves. The gatherers developed certain modifications to the usual process of boiling abalones. For example, before boiling, fragments of tobacco (from cigarettes) were used to gradually kill the abalone, thereby avoiding contraction of the abalone's foot.

In 2012, certain gatherers cheated by injecting seawater in boiled abalones to increase their weight. It is possible that the dwindling wild population of *Haliotis asinina* had led these gatherers to adopt desperate measures to achieve catch targets. On the other hand, it may also be viewed as a simple cheating problem. Whatever the reason, the lack of a management system led to the collapse of the abalone fishery.

Spider conch gleaning

The conch *Lambis* has been used by the inhabitants of Siquijor as a direct source of food and income, usually sold fresh (Fig. 5), especially during the lean months for coral reef and open water fishing. It is probably among the most heavily overharvested groups of marine organisms. Recently, facing an increasing demand in conch, gleaners and local traders reported a significant decline in their catches and income. As far can be ascertained, there has been no assessment of the abundance of the spider conch *Lambis* in Siquijor Island. According to 70–80 year-old local fishers and gleaners, prior to and immediately after World War II, a 20–30 kg basket could be filled in one hour by one gleaner with all three species of *Lambis* combined. If this estimate is accurate, it would mean a significant decline because at present, on average, each person can only accumulate about 1 kg per hour of intensive gleaning.

Figure 5. A local vendor selling mixed species of spider conch (*Lambis* spp.) in Tambisan, San Juan, Siquijor.

Other observations

*Mass fish mortality (***tubli sa bulan***)*

A localized mass fish mortality event occurs each year (N. Bucol pers. comm.), usually during May (the intermonsoonal period), when the ocean current is relatively calm. Locals call this recurring fish kill event *tubli sa bulan*, which means "poisoned by the moon", referring to their belief that fish were poisoned mystically by looking at the moon (during full moon). Such a belief can probably be traced back to the animistic belief of the locals (Siquijodnon people are rich in beliefs, even nowadays), which makes the island famous to foreign tourists as well. Ecologically, however, the fish kill event can be explained as a result of reduced dissolved oxygen because of a combination of local conditions, such as poor water circulation and warm seawater from embayments as the high tide reaches the landward zone of the embayment during midday, thereby exposing it to the heat of the sun. This event usually happens during the time of the year when the southwest monsoon starts, with the first onset of heavy rains. During the intermonsoonal period, most of the fleshy algae (*Padina* and *Sargassum*) from the reef flat and seagrass beds that were removed by currents and waves and washed off to the embayments and lagoon begin to decompose. When the above conditions (i.e. combination of low water level, reduced salinity, moderate wave surges that limit outflow of water from the lagoon, and decomposing macroalgae) are present, hypoxia is likely to occur, resulting in mass fish mortality. This event, however, needs to be investigated and documented in detail. A similar event in Palau was mentioned by R. Johannes (1981).

Implications for marine conservation

The persistence of fishing activities described in this article is noteworthy because most these are probably traditional fishing practices. However, recent modifications, such as the use of a more powerful fish poison (chlorine), the proliferation of trammel gill nets, bamboo fish traps, intensive gleaning of abalones and conch shells, are alarming. The once-practiced, but highly localized, agreement among fishers to retain some portions of their fishing grounds as "temporary reserves" allotted for the southwest monsoon period has long been forgotten by the younger generations of fishers.

The lack of support to establish a no-take marine reserve or fish sanctuary in the coral reefs near and within the lagoon in Tambisan might be due to locals' observations of recurring fish kills. This natural fish mortality has never been investigated in detail.

There are at least 17 small, community-based marine reserves around Siquijor (CCEF 2015). Based on an evaluation of their functionality, about 47% of the 15 marine reserves were considered functional in 2008 (Alcala et al. 2008). However, only a few of these marine reserves protect non-reef habitats (seagrass beds and mangroves) that may be subjected to the above-mentioned traditional, but potentially destructive, fishing practices (e.g. drive-in net for seagrass, *tinkay* or barrier net for mangroves and embayments). These habitats are considered nursery habitats for some commercially important reef fish such as snappers and emperors (Nagelkerken et al. 2000; Unsworth et al. 2007).

Chassels and Bucol (2011) stressed that in most cases in Siquijor, and perhaps elsewhere in the Philippines, full-time local fishers (who are usually not reflected in the list of members of local fishermen's associations) are often not involved in marine conservation consultations, such as when a marine reserve is to be established. Part of the reason is that most of their time in each day is spent fishing. Here, the author makes the plea that full-time fishers should be given utmost priority, in terms of consultations, simply because they know very well the local settings, and they live below the poverty level. Removing them from their traditional fishing grounds, without truly explaining to them in a manner that is understandable, in favor of the decision of the majority of the village (who are most often not fishers), is immoral.

The inconsistent patrolling (probably due to high operating costs) by the Bantay Dagat (personnel deputized by the Bureau of Fisheries and Aquatic Resources) against illegal fishing gear and methods (e.g. use of poison, trammel net) often encouraged a few locals to gamble in using destructive fishing gear. Some of the fishers have modified certain gear such as the trammel net so that when they are raided by enforcers, the periphery of the net (near both ends) is a legal mesh size (>5 cm mesh and single ply) but towards the centre, the net is three-layered (<5 cm mesh inner layer).

In some cases, long handlines are dropped outside, but very close to, the boundary of the reserve and because the current carries the hook-and-line, some fishers are able to encroach inside the no-take zone without being apprehended.

The main point that the author wishes to make is that both marine reserve protection and apprehending users of destructive gear and methods is of great usefulness, but only if it is done seriously.

Concluding remarks

Local fishers' knowledge of fish behavior and marine habitats is indeed rich and diverse. Their fishing techniques have been developed over time by taking into account local environmental dynamics (e.g. daily rhythm of tides and fish behavior). However, these techniques are slowly being modified or replaced by more destructive gear or methods.

Also, what we perceive to be "sustainable" traditional fishing may not be so because any tendency to extract more fish and invertebrates by intensively increasing fishing effort or the number of gear types may lead to the collapse of a fishery (as in the case of the localized abalone fishery that collapsed in 2012). For example, eel pots have been modified to increase yield. The use of this modified trap, using longlines, has enabled some fishers to place their eel pots near or across the boundary of marine reserves.

The use of temporary fishing closures – as was done by a group of eel pot fishers in the 1970s and 1980s – to prevent conch and abalone fishers from using algal beds during calm periods (inter-monsoonal and northeast monsoon) could provide a glimpse of sustainability in the near future.

Most importantly, apprehending users of destructive gear and methods such as chlorine and triple-ply trammel nets should be totally enforced. This is highly feasible because there is already an established fishwarden (Bantay Dagat) system in place as mandated by law (Republic Act 8550 or Fishery Code of the Philippines). Local government units (LGUs) are also mandated to manage and formulate specific local laws (ordinances) according to the needs of their respective municipal waters through the Local Government Code (Republic Act 7160).

Revival of the abalone fishery, once stocks are fully assessed, and supplemented with appropriate mariculture projects (e.g. grow-out method) under the technical supervision of government agencies (e.g. Bureau of Fisheries and Aquatic Resources and concerned LGUs) and academic institutions would be beneficial to increasing local fishers' income. Because the main cause of the collapse of the abalone fishery was the improper handling of products during post-harvest processing, intervention by government agencies would be necessary.

The above-mentioned suggested interventions, from enforcement of fishery laws and assistance with capture fishery management and post-harvest management, are all in line with the Department of Agriculture's strategies for the "Comprehensive National Fisheries Industry Development for 2016 to 2020."

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