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Editor

Kenneth Ruddle
Asahigaoka-cho 7-22-511
Ashiya-shi
Hyogo-ken
Japan 659-0012
Email: mb5k-rddl@asahi-net.or.jp

Production

Fisheries Information Section
SPC, BP D5, 98848 Noumea Cedex
New Caledonia
Fax: +687 263818
Email: cfpinfo@spc.int
www.spc.int/coastfish

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Editor's note

This unavoidably delayed issue contains three contributions.

In the first article, "Diminishing sustainability of traditional fishing practices in Siquijor Island, central Philippines", Abner A. Bucol, of Silliman University, describes changes in traditional fishing practices. The author, now a formally trained marine biologist, is also a local fisherman of Siquijor Island. As a result, this article is based on his own experiences and observations as a fisherman, supplemented by his recent interviews with local fishermen, combined with information that derives from formal marine science. The author suggests that full-time and authentic local fishermen, "who clearly possess rich indigenous ecological knowledge, should be involved and consulted (not just informed) in any conservation effort such as in setting up of a marine protected area."

The second article, entitled "Repackaging colonialism: Good governance, democracy, globalization and cognitive platitudes as assumed basic values in tropical small-scale fisheries development," is an essay written by the editor. This essay argues that a continuity of colonial era attributes and models characterizes the post-colonial period, although their presentation and vocabulary has been adapted by the use of inoffensive blandishments such as "good governance", "democracy" and an associated suite of terms and concepts that serve to undermine the sovereignty of tropical nations and which are dished-up within a neoliberal framework. The historical roots of the issue and the rationale provided by modernization theory are summarized, and exemplified by pre-existing fisheries credit institutions, and the myth of open access in small-scale fisheries. "Globalization" is examined as "global governmentality", or the purposeful manipulation of international institutions to maintain the global management role of Western nations.

Finally, there is a brief article, "Memories of sawfish fisheries in a southwestern Atlantic estuary" by Vinicius Giglio, Osmar Luiz, Marta Reis and Leopoldo Gerhardinger. The authors examine a former mangrove fishery, based on the local ecological knowledge of a small sample of elderly men, all of whom specialized in catching sawfish. This succinct article provides a useful contribution to the information on a once-widespread, but now severely-threatened species.

Kenneth Ruddle

Note from the editorial board:

In line with a worldwide trend to limit the impact of producing printed publications on the environment, SPC has decided to stop the production and distribution of printed copies of this and its other fisheries-related information bulletins. The bulletins will now be produced only in digital format and remain accessible from SPC's website at:

<http://www.spc.int/coastfish/en/publications/bulletins.html>

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

Abner A. Bucol¹

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 km²). 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 sea-grass 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

¹ Silliman University-Angelo King Center for Research and Environmental Management, Dumaguete City, Philippines.
Email: abnerbucol2013@gmail.com

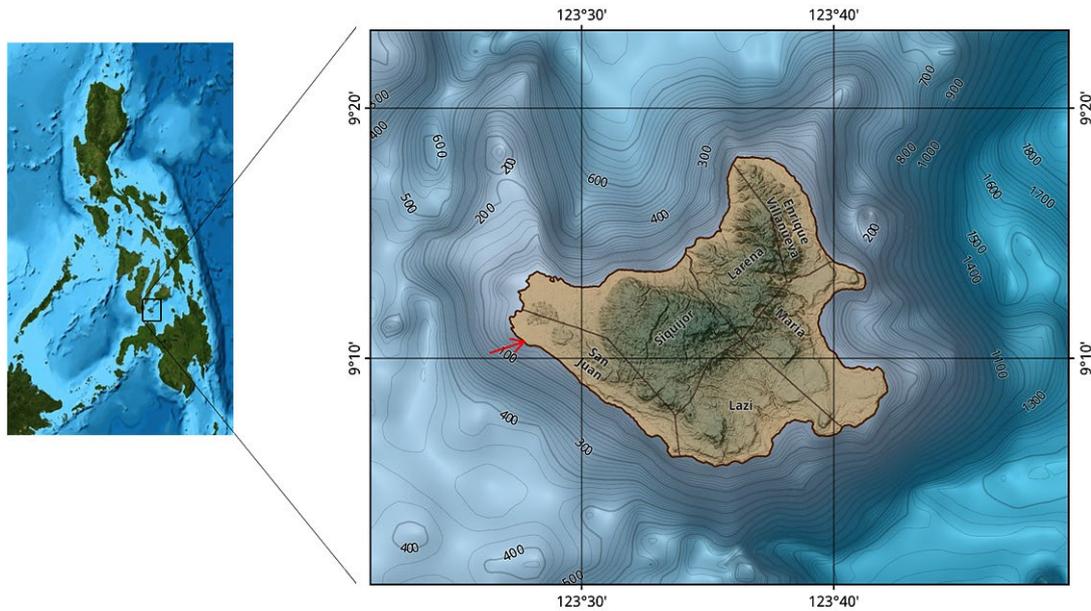


Figure 1. Location of the study area on the northwestern coast of Siquijor.

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 peso² 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 back-reef zone) to capture emperorfish (*Lethrinus* sp.). Modified versions of this type of poisoning use a more potent poison, such as the pesticides endrin and malathion, 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 (*Sphyræmia 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.

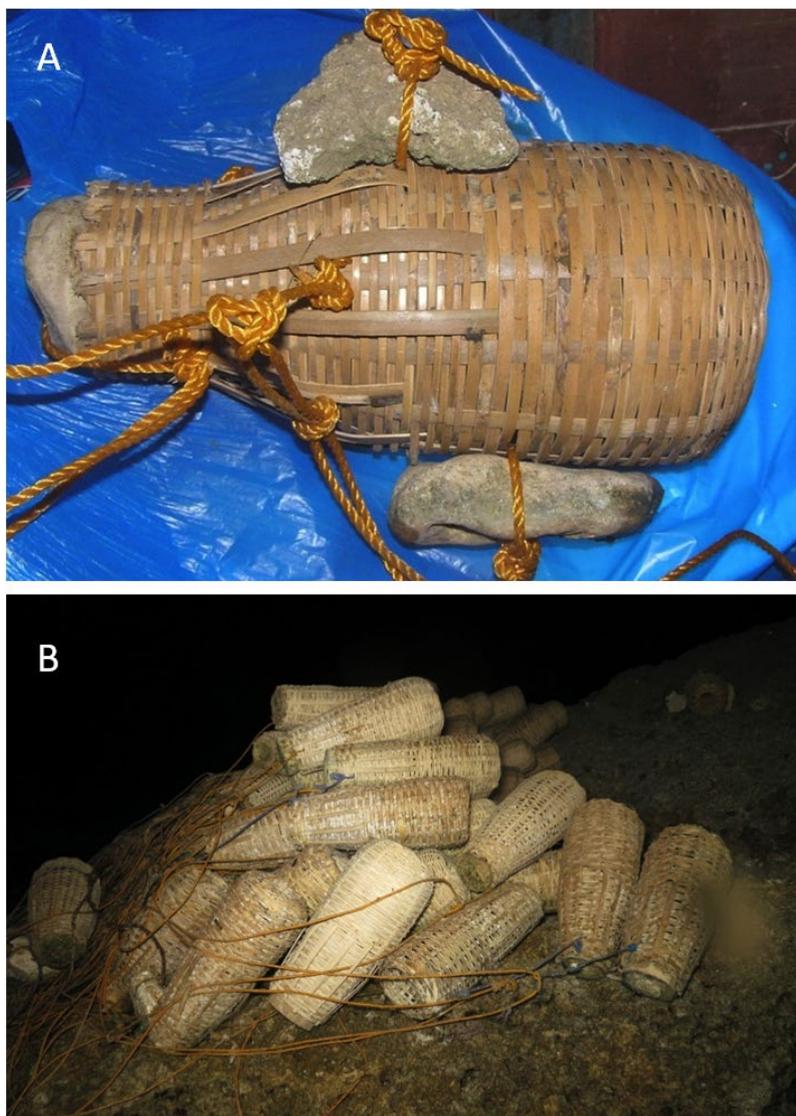


Figure 2. A) A close-up of the older version of the eel pot (*balantak*) used to capture moray eels in Siquijor. B) Linked pots type (note the main line attached to all traps)

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 vai-giensis*, *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 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 $\text{day}^{-1} \text{site}^{-1}$, CPUE of *H. asinina* ranged from 0.1 to $0.6 \text{ kg person}^{-1} \text{hr}^{-1}$ with a mean value of $0.25 (\pm 0.03 \text{ SE}) \text{ kg person}^{-1} \text{hr}^{-1}$. 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 $8,550 \text{ kg year}^{-1}$. Given the prevailing price of $400 \text{ pesos kg}^{-1}$, 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 as 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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Repackaging colonialism: Good governance, democracy, globalization and cognitive platitudes as assumed basic values in tropical small-scale fisheries development

Kenneth Ruddle¹

Abstract

A continuity of colonial era attributes and models characterizes the post-colonial period, although their presentation and vocabulary has been adapted by the use of inoffensive blandishments. “Good governance”, “democracy” and an associated suite of terms and concepts serve to undermine the sovereignty of tropical nations, within a neoliberal framework. The historical roots of the issue and the rationale provided by modernization theory are summarized and exemplified by pre-existing fisheries credit institutions, and the myth of open access in small-scale fisheries. “Globalization” is examined as “global governmentality”, or the purposeful manipulation of international institutions to maintain the global management role of Western nations.

Keywords: development, globalization, governance, neoliberalism, modernization theory

Introduction

The terms “liberal” and “liberalism” are now imbued with multiple and seemingly conflicted meanings and principles. The principal usages refer, first, to a governance relationship between a state and its subjects, and second, to the support of individual liberty and private property. To some, the distinguishing characteristics of a liberal form of governance is the free selection and pursuit of economic activities, inculcation of habits of self-regulation, and use of the market as a key indicator of appropriate levels of governance (Foucault 1997). Further, the market is regarded “...as a powerful instrument of civilization, inculcating such virtues as prudence, diligence, punctuality, self-control...” (Hindess 2001:26). By extension, this line of reasoning that securing market and property rules, while concomitantly reducing or eliminating non-market economic activities, means that the rule of the market can be used as a powerful instrument of development policy and management of natural resource extraction. This is amply demonstrated by the imperial history of Western nations. Perversely, it follows that measures taken both now by authoritarian regimes and historically by former colonial administrations, to establish and legally secure property rules and rights and to ensure that all transactions follow the rule of the market, are an integral part of liberal policy and reasoning.

Very little has changed in the transition from an era of colonial administration to one of now mature post-colonial states. Polite discourse no longer dares to mention the presumed incapacity of non-Westerners to govern themselves as a condition that could be removed only after generations of instruction by colonial administrators. It has been replaced by politically correct blandishments of neoliberalism regarding the elimination of structural factors and the transformation of cultures and values. Present-day imperial rule now operates through international financial institutions, the use of markets to regulate the behavior of only nominally sovereign governments, and aid conditionalities. Particularly forceful is the near universal promotion of “good governance”.

Good governance, together with the terms “empowerment”, “popular participation”, “responsibility” and “democracy” associated with it, is currently among the concepts most promoted by international development agencies. However, its objective is to constrain sovereign government freedom of action by subjecting it to the power of national and international markets that are highly manipulated by Western core economic interests (Gill 1995; Cooke 2003). As Hindress (2001:35) comments succinctly:

“[w]hile modern democracy allows citizens only a limited role in the government of the state to which they

¹ Research Center for Resources and Rural Development, Hanoi, Vietnam. Email: mb5k-rddl@asahi-net.or.jp

belong, it is often sought to secure a degree of legitimacy for the activities of the state which other regimes are unable to match. It is this, rather than the expansion of popular control itself, that particularly appeals to the development agencies and financial institutions which promote democracy as a fundamental component of good governance.”

Hindress (2001:37) appropriately concludes: “... international neo-liberalism is the most powerful, and consequently also the most dangerous, liberalism of our time.”

The historical roots of problems

It has been widely argued that the antecedents of modern Western economic power and dominating attitudes are embedded as nascent forms in imperial and colonial behavior (Wallerstein 1974–1989; Giddens 1990; Kendall 2001). Stemming from this, the underlying cause of problems in tropical small-scale fisheries is the projection of Western policies and programmes based on Western models and approaches into areas for which they are inherently unsuited (Ruddle and Hickey 2008). This stems from a continuing legacy of colonialism and cultural imperialism, as demonstrated in donor and development agency behavior of a continued reliance on unproved models and approaches designed largely by Western fisheries biologists, social scientists and policy-makers. Whereas non-Western models of proven viability were formerly disparaged openly, these days disparagement is more subtle; it often takes the form of labeling them as traditional or special cases, and dismisses them with no further examination.

More commonly, however, it is claimed that pre-existing management systems either did not exist or never existed, a common deceit based either on outright fabrication by those who cleave to the Western “developmentalist” line, or just plain ignorance and/or unwillingness to conduct the primary field research required to check the existence or not of pre-existing systems in a given locality (Baird 2010; Ruddle 2007a). More common is the unquestioned parroting that pre-existing systems have been eroded beyond all hope of recovery, and so are useless for modern purposes. In the Asia-Pacific region, the colonial era had a major and lasting impact on pre-existing systems for managing nearshore fisheries. Its main impacts include undermining or displacing traditional tenure systems in conjunction with an added legal complexity, with the Western-based state law at odds with local customary law.

Lamentably, there is nothing new about such deception, since there are many examples from the colonial era that had a major and lasting impact on pre-existing systems for managing fisheries resources (Ruddle 1994a, b, c). Impacts were especially severe where large-scale and permanent European settlement occurred, and where indigenous property concepts and rights were not recognized, or if recognized initially, as in New Zealand, were gradually overwritten and forgotten. In New Zealand, for example, despite a vital and well-documented fisheries tradition and a treaty intended to protect Maori property, the rights of indigenous fisheries were gradually usurped. In the beginning, European settlers made little use of marine resources, but as the Maori population declined, their land rights diminished, and laws effectively dispossessed them of their fishing rights, Euro-New Zealanders gradually came to dominate fishing. Fiji provides an excellent example of a blatant attempt by local colonial officials to destroy a pre-existing fisheries management system in favor of expatriate entrepreneurs, in defiance of the expressed wishes of the British Crown and the unambiguous orders of the metropolitan government. Although the Crown desired that Fijians not be deprived of their customary reef rights, neither royal command nor official British government policy was ever implemented. Rather, in 1887 the Acting Governor of Fiji opened all reefs to beche-de-mer fishing by non-Fijians, in the interests of the economy. Further, via the Rivers and Streams Ordinance of 1882 it was interpreted that private fishing rights of Fijians were abolished and that they belonged to the Crown (Ruddle 2007b).

In general, Western-trained lawyers believe that customary law is invalid for upholding legal claims and inferior to the Western legal tradition. This has been a major external factor that either deliberately or by default undermined customary law and community resource rights (Ruddle 1994a, b, c, 1995 and 2007a,b). In general, national independence has changed the situation but little, partly because the devolution of authority conflicts with the basic task of nation-building (Ruddle 1994a).

Modernization theory, the neocolonialist rationale

In the second half of the twentieth century, the USA based its relationship with newly independent nations on a theory of modernization that guided its foreign assistance and trade policies, as well as those toward nationalism and counterinsurgency. At its core was the notion that the economic and political levels of Western industrialized nations were the standard to which all other nations should be raised. Non-Western “backwardness” and solutions to it were explained by social science theories.

The USA perceived that it had a duty and responsibility to instruct and uplift other nations, a sense of trusteeship integral to its concept of liberal developmentalism.

The term “development” has been used by the United States (US) government from the beginning of the twentieth century, at first to distinguish its evangelical civilizing mission from European colonial policies. Under this approach, educational and medical institutions were an extension of Christian evangelical missions, and development was presented as a “spiritual” or “conversion experience”. This subterfuge is illustrated by the activities of the Rockefeller Institution for Medical Research in China during the 1920s and 1930s, which focused on implanting and nurturing transferred institutions and ways of thinking.

In the 1930s and 1940s, the approach was supported by US academic social scientists with techniques for research and analysis that lent the sociology of modernization a statistical and pseudo-scientific aura. International comparative studies became the vogue, as exemplified by the work of sociologist Talcott Parsons, who employed national accounting to measure changes in the relative economic efficiency of nations. By the mid-1940s it was essentially agreed that modernization included five *universally* valid main precepts. These were:

1. tradition is everywhere basically uniform, so problems of development would also be uniform;
2. there is a universal linear path to modernity, with the same stages of development culminating in Western levels of urban industrialism and consumerism;
3. development can be accelerated, mainly by contact with developed societies and central planning;
4. development is a process of releasing restrained energies and resources, therefore pre-existing systems and thought must be destroyed to enable progress to take its natural course; and
5. all states wish to modernize, and the USA could lead this global movement.

Contrary to the widely held notion, the Marshall Plan did not provide the model for later modernization schemes. Rather, Point Four (1949), which was explicitly linked to the strategic and economic objectives of the US, provided the example. It licensed an unprecedented scale of intervention by the US in other countries' affairs, such that Western economists almost took over the management of sovereign governments, and comprehensive development role virtually became the solemn duty of

developing countries governments. Beginning with infrastructural projects as straightforward but ad hoc foreign aid, Point Four evolved via import substitution industrialization into structuralist theories to overcome the colonial trade patterns that were identified as a cause of underdevelopment.

In addition, Point Four drove some academic social sciences in the USA, which provided the theory to support the strategy (Pletsch 1981), and so enjoyed enormous prestige within the national security establishment (Cooper and Randall 1997). Major players rode the merry-go-round from federal appointments to foundation boards to university faculty positions. Supported by the Ford Foundation and other institutions (Simpson 1998), universities set up Area Studies Centers to conduct applied research useful to government. The Ford and Rockefeller foundations also funded the Center for International Studies at MIT, the interdisciplinary illuminati of which included W.W. Rostow, an economist whose development model of a universal five stages modernization process was grounded in the history and national interest of the USA (Rostow 1960). According to Rostow's thinking, to preserve its momentum the USA must expand world trade and increase its exports. He also asserted that humanitarianism and selfishness go together, since, regarding development, the US national interest and that of the rest of humanity were inseparable (Latham 2000).

However, by the late 1960s Rostow's theory had been refuted by academics, who were themselves ditched by international assistance institutions and replaced by either tame in-house experts or think tanks to create strategies and justifications for aid. Academics replaced Rostow's ideas with dependency theory, focusing on the processes of underdevelopment rather than the dynamics of development (Packenham 1992). But that too was attacked in the 1980s and early 1990s. The recent and mostly academic approaches of post-colonial and post-modernism relocated the study of power relations from economic development toward culture and knowledge creation. Because these were seen as having little applicability to development, doctrine continued to evolve within the US Agency for International Development, the World Bank, and United Nations (UN) agencies.

The rationale and methods of development were also seriously challenged by the environmental movement, and especially by the highly influential books of Carson (*Silent Spring*, 1962), Ehrlich (*The Population Bomb*, 1968), Meadows et al. (*The Limits to Growth*, 1972), and Schumacher (*Small is Beautiful*, 1973). That seemingly irreconcilable difference was mitigated in 1987, when the Brundtland Report popularized “sustainable development”, an essentially

vapid term that at once is both scientifically unsatisfactory yet totally inoffensive, and therefore is perfectly suited to the requirements of international conference reporting and UN agency documentation. Notably, it provided a way for environmentalists and development specialists to collaborate, and was an approved way of channeling dissent.

Nevertheless, US government policy adhered to the idealized vision of the North Atlantic nations as the norm to which all nations aspire. During the Reagan administration, it adopted structural adjustment, with a withdrawal of the state from the economy and privatization, the lifting of import and exchange controls, the dependence on legal codes and standards to regulate trade, and the subjection of all sectors of the economy and society to market discipline.

Although, on paper at least, modernization theory undoubtedly mobilized global humanitarianism and enabled the poor to a share in “progress”, it has much to answer for because it simultaneously hyped illusion and imbued it with an aura of pseudoscience. But far worse is that it virtually issued a *carte blanche* to avarice, self-interest and, sometimes, ghastly intervention. As a consequence, development aid has become a vast industry and an integral part of international relations.

Some deceptions of modernization theory

(1) *Informal credit in fisheries*

One uncomplicated illustration of the stereotypical ideas promoted by the modernization theory to either dismiss or destroy pre-existing systems is provided by informal credit, which, in the small-scale fisheries of developing countries, were invariably condemned as lacking transparency and accountability, with money-lenders characteristically demanding high interest rates under onerous conditions that might include catch-sale bondage, obligatory boat rental, or tied purchase of supplies (Ruddle 2011). Although several cases have described particularly onerous conditions within convoluted credit systems in South Asian small-scale fisheries (e.g. Aghazadeh 1994; Khan et al., 2005; Rahman et al. 2002), such situations are not the norm. Evidence to the contrary was demonstrated in the 1940s by Raymond Firth in his classic study, *Malay Fishermen* (Firth 1966). Further, contrary widespread evidence was provided by scholars examining client-patron relationships, and another group that includes Merlijn (1989), Platteau and Abraham (1987), Stirrat (1974), and Yap (1978), who focused on the role of middlemen in fishing communities, and who challenged the established view by emphasizing the range of social and economic functions they perform.

The latest body of evidence emerged in the 1990s, when Adams (1992), Adams and Fitchett (1992), Bouman (1990), and Bouman and Hospes (1994) showed the widespread importance of informal financial systems in poorer nations, and, contrary to stereotypical thinking, that well-functioning pre-existing credit schemes are neither uncommon nor necessarily exploitative. Subsequently, rural credit arrangements have been revealed as both heterogeneous and segmented, with the coexistence of “formal” and “informal” credit markets being widely reported for Asia (e.g. Bardhan and Udry 1999; Barslund and Tarp 2003; Duong and Izumida 2002; Yadav et al. 1992; Ruddle 2011), and other regions (Ruddle 2011).

However, that work has been largely overlooked by the predominantly economist development practitioners. Yamey (1964) attributed their failure to consider local studies to a concern with entire national economic sectors, like foreign trade or public finance, and a preference for distilled reports rather than primary studies. Although to be expected half a century ago, this explanation omits the underlying culprit, “modernization” based on Western models (Ruddle and Hickey 2008; Ruddle and Satria 2010a, b).

(2) *The myth of open access*

Another and much discussed deception is the Myth of Open Access. This was grounded in and popularized by Hardin’s (1968) generalized model of the tragedy of the commons, and the collective action responses to it. By definition, this is an abstract simplification of a wide range of realities, which accounts both for its appeal and the controversial nature of its postulation of the universal irreconcilability of the behavior of individual resource users with the sustainability of the resources they exploit. But much of the criticism of Hardin’s model is best leveled at the dogmatic interpretation of it by users. Despite its shortcomings, the straightforward assumptions of Hardin’s model have been of enormous importance in stimulating great awareness of and research on the nature of the relationship between property regimes and patterns of natural resource use. Regrettably, Hardin’s thesis has been used widely to influence opinion and to justify the change of effective and efficient pre-existing common property management systems to those either controlled by the state or privately, on the false promise of better limiting access to resources (e.g. Ostrom 1990; Andelson 1991; Steins et al. 2000).

Hardin’s (1968) tragedy-of-the-commons model is the principal Western theory held to account for problems in certain fisheries. But this model is grounded in the erroneous notion that the misuse of fishery resources stems from the institution of common property. Thus, fisheries must be managed to

mitigate the selfish and myopic behavior of fishermen consequent upon fisheries being a classic example of a common property resource. This has been widely viewed as the predominant pattern of individuals. The proposition asserts that inherent in the exploitation of common property resources is the tendency to physical wastage of the resource, an incentive to overexploitation by users, leading inexorably to the now familiar “tragedy of the commons”, and a tendency toward economic wastage via overcapitalization of the industry, and eventual impoverishment of fishing communities and immobility of labor. To counteract these inherent tendencies, so the conventional theory runs, management by authorities external to fishing communities is required. Generally, it is accepted that the replacement of common property regimes by systems of controlled access could either eliminate or ameliorate excess effort. Although there is no unanimity of opinion concerning the optimal design of such systems, they have been widely implemented, together with catch quotas, gear and/or seasonal limitations, licensing, or a combination of these and other elements. All share the common characteristic of assigning fish harvesting rights to selected individuals, who then receive all or part of the economic rent created by the reduction in effort.

As is well known, a fundamental criticism of the model is that it fails to examine a commons in terms of its specific social and cultural contexts, and so does not account for local customs and behavior that often greatly modify patterns of natural resource use. In short, it is wrong under many circumstances. Depletion of common property resources is, thus, by no means inevitable, and, as is well documented, commons-owners may collectively agree to implement sound resource management practices. The nature of human impact on such resources will vary, mainly according to such factors as the strength and appropriateness of local rules governing usage, and the opportunity costs of exploiting the commons while foregoing the use of other resources. The nature of such community behavior, especially regarding decision-making, reduces “free rider” behavior, such that it cannot be assumed that users of common property resources are always selfish, operate on the basis of perfect information about resources and the competition, and, unhampered by social sanctions, seek to maximize private short-term benefits while transferring maximum costs to the public sector. It has been conclusively demonstrated that many fishers do not behave in this fashion.

This flaw arose in many applications of the model because it was incorrectly assumed that a common property resource is always synonymous with open access resource, as has long since been demonstrated. It is not; common property is not accessible to all people (Ciriacy-Wantrup and Bishop 1975). Rather, since a common property resource is defined by

terms of inclusion and exclusion, use rights are confined to restricted groups, such as cooperatives, villagers, clans, and the like. That makes it imperative to understand in each local situation both the concepts of resources, property rights and regimes and institutional arrangements, together with the interrelationships among them. Resource use is managed by locally recognized and sanctioned rights and rules that clarify resource ownership and structure, and regulate the individual and group behavior of resource users toward each other and their property. Such local institutional arrangements may differ widely (Nguyen and Ruddle 2010; Ruddle 1994b, 1996a, b, c, 2007a; Ruddle and Johannes 1990; Ruddle and Satria 2010a, b). No resource is everywhere managed by any single property regime: rather, in some places or in certain periods a given resource may be managed as common property, whereas elsewhere or at another time it is managed under a private regime (Khumsri 2008, 2010; Khumsri et al. 2008). Prevailing management regimes are essentially a product of socio-political conditions, and, thus, the categories are often blurred. The complex variety of possible situations demands specific, local investigation in every instance.

Further, those idealized property regimes of state, private, common or communal, and none (or open access) regimes might coexist in a single area, for different types of resources, thus resources can be exploited under several types of property regime, whose nature will depend on their geographical and temporal location (Khumsri et al. 2008). Alternatively, depending on the composition of the rights, a single resource or resource area might be embraced by more than one category of right. In Japan, for example, exclusive plots for aquaculture use are leased within common fisheries rights areas (Ruddle 1987). And *de facto* and *de jure* rights coincide within a single fishery. Further, property rights and regimes and associated rules change as physical, biological, technological, economic, political, social, and other conditions in a locality or country change (Khumsri 2008, 2010; Khumsri et al. 2008). Fisheries in particular are often mixed systems with characteristics that change through time. Thus, it is critical to distinguish between a resource and a property regime under which it is held (Bromley 1989; Ostrom 1986).

Fishermen’s territoriality is widespread, in both Western and non-Western societies. Often it can be regarded as a transformation of an open access resource to a commons, by the *de facto* local creation internal boundaries within the larger space, thereby creating a nested set boundaries used under state and customary laws, respectively. Such a situation also arises under state law when fishermen’s behavior is modified and local boundaries are created by gear, size or other restrictions. Territoriality is a fundamentally important concept, in that it facilitates restrictive

rules and regulations governing access to, the use of, and distribution of the fruits of resources. Territoriality is regarded as a critical component of institutions required to ensure resource conservation.

Also stemming from the failure to examine cases in context is the ascription of resource depletion and economic impoverishment to the nature of property rights. Although there can be no doubt that open access regimes are particularly deleterious, the real problem lies in the response: generally either to the imposition of alternative management regimes by external authorities or to some form of privatization, on the erroneous assumption that private property is both resource conservative and economically beneficial, in contrast to common property. Other actual or potential alternative management regimes are ignored.

The dogmatic interpretation of Hardin's model can be faulted for contributing to the polarization between local resource users and central or local governments. This has been exacerbated by overly enthusiastic researchers exaggerating the social wisdom and ecological perceptiveness of the former while belittling the latter. This again is a result of the failure to place resource systems within their larger social and cultural contexts, particularly by resource economists, some of who seem unable to distinguish cultural from social factors! In many cases, resource depletion is better seen as a result of the policies of past colonial or of the present governments of the independent nations that replaced them.

Manipulation toward global governmentality

The term globalization is not used here "...to account for the processes, agents, policies and particular events which give rise to a world in which global flows, mobilities and networks disrupt a pre-ordained world of nation states" (Larner and Walters 2001:16). Rather, the perspective taken is that of global governmentality, which focuses on the fundamental manipulative forces that have brought the world to its present situation, and form the broad context in which fisheries – and all renewable natural resources – are ordained to be managed.

Here it is necessary to digress briefly to clarify usage in this essay of the terms "government", "governance" and "governmentality". For the term government, standard social science usage is followed to mean both a defined administrative bureaucracy that controls a nation-state, and the structure of the governing organization that enables the employment and deployment of state power, the enforcement of existing laws and legislation new ones, arbitration of conflicts, and the monopoly of legitimized violence (Barclay 1990; Bealey 1999; Flint and Taylor 2007). "Governance" is used to signify

the activity of governing performed by a government. The term "global governance" pertains to the international system of relationships between independent states, and particularly trends within the international system since the end of World War II that include an increased regulation of trans-border or global issues likesuch as the environment, and a greater role for non-state entities and global civil society (Rosenau 1999).

It is important to understand that governance is scale-neutral because its range of operation extends from a single person to all humans, and it is functionally neutral. If it is accepted that a moral or natural purpose of governance is to assure, via a hierarchy of administrative elements and political processes, a generally beneficial reconciliation of various opinions and divergent interests, the term "governance" may be applied to any purposeful activity engaged in by any number of people, and include, nation-states, international organizations, corporations, non-governmental organizations, and fishing villages.

The term "governmentality" is more complex and implies purposeful manipulation of the governed by the government. The concept was developed during the late 1970s and early 1980s by Michel Foucault, and elaborated in the 1990s in the social sciences (e.g. Burchell et al. 1991 and Rose 1996, 1999). For present purposes, the focal aspects of governmentality are, first, the way governments attempt to produce a citizenry to fulfill a government's policies, and, second, the organized practices (mentalities, rationalities and techniques) used to govern subjects. In other words, governmentality is the carefully calculated means of directing and manipulating how people behave (Jeffreys and Sigley 2009).

Thus, for neoliberalism to function as designed, individuals must be induced or educated to accept full responsibility for the conduct of their own lives (Rose 1999) because it links reduced state welfare and security to a condition where citizens are free, enterprising, and autonomous individuals. In that way, intrusive state bureaucracies and religion-based moral standards dwindle as subjects increasingly govern themselves. Through the transformation of subjects with duties and obligations, into individuals, with rights and freedoms, modern individuals are not merely free to choose but obliged to be free "to understand and enact their lives in terms of choice" (Rose 1999:87).

Eco-governmentality is a sub-field of so-called political ecology that emerged in the mid-1990s with the work of Luke (1999), Darier (1999) and Rutherford (1999). It examines specific social and environmental relationships and links them with location-free

national and international systems of governance. The approach is useful for studies of trans-border environmental and other change, and in particular for tracking the cross-scales impacts and implications of policy, from the individual, through the fishing village and domestic region, to the state, and then to global organizations and corporations. The approach focuses on how government and producers of expert or specialized knowledge construct the environment to design and implement management that facilitates a government's goal of controlling subjects' lives by inducing individuals and small groups first to internalize and then to disseminate the knowledge and power to eventually create a self-regulating network with goals that coincide with those of the state. The process appears to be subtle and non-coercive because it structures and rationalizes behavior and local participation in defining problems, implementation, management, and monitoring interventions.

The process is exemplified by the way in which territory is brought under State control, and how human interaction of with it regulated (e.g. Braun 2000, 2003; Scott 1998), through measurement of natural resources for the purposes of extraction that "... allowed the state to impose that logic on the very reality that was observed" (Scott 1998:14), thereby simplifying complex ecosystems and depicting them as straightforward sites for resource extraction. Management changes the ecosystem composition by selective planting, harvesting and extraction, so eventually the once natural ecosystem resembles the way it is depicted in the simplified bureaucratic systems used to measure them. Indeed Scott (1998:23) shows how in early modern Europe scientific forestry models made by state foresters formed part of a more comprehensive body of statistical knowledge assembled to manage a population and facilitate "taxation, political control, and conscription". Similarly Braun (2000:27) demonstrates how the Geological Survey of Canada measurement and representation of the mineral composition of a territory enabled the government "... to manage individuals, goods and wealth so as to improve the condition of the state's population."

Since the types of knowledge produced to make nature intelligible to the state strongly influence the evolution of state rationality, Luke (1999) argues that the ecological domain is now the key area for the production of knowledge and power, which began in the early 1970s with increased awareness of ecological limits to human development. Production, knowledge and power became "environmentalized" and known as eco-governmentality.

In contrast, the term "globalization" is a recent concoction that describes a very old process in international human relationships. As currently used,

it describes an increase the worldwide scale of the interconnectedness of cultural, environmental and social phenomena. The term has been applied to commercial, ecological, economic, financial, organizational, religious, spiritual and trade activities, among a great many of the processes and structures (Ruddle 2007b). Although identified with various trends that developed largely during the last half-century, it can be argued that the substance of globalization does not connote anything particularly new, since the integration of the modern global economy started seriously with the beginning of European global rampages, 500 years ago.

However, the process really accelerated and became integrated some three decades ago with the simultaneous rapid advances in computer technology, removal of barriers to free movement of goods and capital, and huge increases in global reach in the political and economic power of multinational corporations. The speed and intensity of modern communications is unique in history. It is this awesome speed of contemporary communication combined with the portability, increasingly low cost, standardization and integration of the required hardware and software that now enables the process of globalization to penetrate into the remotest corners of the world, and to tie hitherto isolated fishing communities, for example, into the mainstream of the world fish trade (Quibria et al. 2002; Abraham 2007; Jensen 2007; Donner and Escobari 2010). Such a thing could never have occurred at the apogee of the British Empire, for example. Then, at the colonial policy level in London, it is possible to accept the concept of colonial era globalization, based on a standard policy.

"But at the local level implementation diverged widely, and substantial differences arose in each location. At that level globalization disintegrated. Regardless of local differences in political and economic conditions, which were substantial, this must in large part be attributed to the inability of central colonial officials in London to confirm and repeatedly check that policies were being implemented as intended. Without a rapid means of communication, that could never be attained." (Ruddle 2007b:217)

The illusion of globalization

Nevertheless, despite its vintage and pedigree, the actual meaning and full implications of the term globalization, generally remain poorly understood. However, the concept solidifies when it is made clear that globalization is thoroughly rooted in colonialism. Global trade was the supreme *raison*

d'être of the colonial era, which was based on the straightforward concept that metropolitan power plundered colonial raw materials and dumped European manufactured goods on the colonies in return. Wealth enriched the metropolitan countries, and what was returned to the colonies was in the form of investment in physical and administrative infrastructures to facilitate the continuous plunder of their natural resources.

The concept underlying such a disarmingly simple model was, and remains, that everybody everywhere eventually benefits from the increase in trade. As a result, export led trade is the dominant factor in the global economy, and expansion of exports is now seemingly regarded as the sole way of growth. That is a cruel illusion, because most of the resultant wealth accrues to the already rich, industrialized nations that already account for the bulk of world trade.

However, comparisons between globalization in the colonial era and the present are simplistic, because they mask its vast impact on societies and ecosystems. Contemporary globalization is underlain by the negative values that drive the world economy. Principal among them are the extreme faith placed in the particularly Anglo-American philosophy of the "magic of the marketplace", money as the principal if not sole criterion of value, the "cult of success", and the doctrine of *laissez-faire* capitalism that the common good is best served by uninhibited self-interest. The modern marketplace is dominated by enormous transnational corporations, with neither local nor national allegiances, and that are managed by professionals.

Around 1980, fundamentalist free-market governments in the United Kingdom and the US implemented policies based on deregulation, balanced budgets, low inflation, privatization, government directed by the market, and corporate global freedom. Deregulation of international financial markets was the cornerstone to such policy, so as to enable financial institutions to expand international operations, particularly providing their financial services in poor countries. Since modern communications allow lightning-fast investment of surplus cash anywhere a swift profit could be made, the relaxed rules regarding financial capital soon became a major destabilizing influence on the global economy, particularly because of the speculative nature of most such investment, particularly in developing countries. International speculative investment was totally unconcerned with its impact on local societies and national economies because its concern was to make money from money, and not the production of real goods and services. A vivid example of this occurred in July 1997, with the collapse of the east Asian currencies caused by nervous short-term

speculative investors suddenly pulling their money out of the region. The human and social costs of this collapse devastated millions of families and small businesses. The International Monetary Fund (IMF) was widely blamed as the source of this economic disaster because of its orthodox economic policies that undermine the market and the long-term stability of economies and societies. From this devastating crisis doubts about the benefits corporate-led globalization began to spread.

A key in understanding contemporary globalization is the structural changes that have occurred in the world economy since the early 1970s, when the fixed currency-exchange rules by which world trade had been managed since 1944 became dysfunctional. This has been manipulated by Western governments, a process largely controlled by the USA. In July 1944, the Allied powers met at a UN monetary and financial conference held in Bretton Woods, in order to create a new framework for managing the post-war global economy. Because the conference was dominated by the USA, it adopted a system based on the free movement of goods, with the US dollar (USD) becoming the main instrument of international exchange and linked to gold at a fixed price of USD 35 an ounce. In this way, the Allied nations who originally met at Bretton Woods in 1944 have maintained their clout in the world economic system, to the detriment of poorer and less powerful nations. They created and have carefully maintained a playing field that is level only for them.

At the same conference the IMF, the International Bank for Reconstruction and Development (IBRD, better known as the World Bank), and the General Agreement on Tariffs and Trade (GATT)/World Trade Organization (WTO) were established to govern and coordinate the global economy, based on global competition and corporate enterprise. The main function is to provide short-term, emergency loans to countries. Such loans are determined by a quota system, and voting power in the IMF is based on member countries' level of financial contributions to the institution. As a result, the rich nations dominated decision-making. The IBRD was established to meet the reconstruction of nations devastated by WWII, initially by providing loans for physical infrastructure, agricultural development, and the development of education. It later switched its focus from reconstruction to development in the newly independent countries. Owing to a lack of agreement at Bretton Woods, GATT/WTO began in 1947 by establishing rules for the global trade in industrial goods alone. This was done with the objective of reducing national trade barriers to stop the vicious competition manifested in the trade policies that so damaged the global economy before World War II. In 1994 GATT was replaced by the WTO, which functions as a forum for negotiations

and enforcement of resultant agreements. In addition to trade agreements, WTO also included a new General Agreement on Trade in Services, which had the objective of reducing variance to investment in over 160 areas that would include, in addition to trade goods, basic needs in areas such as water, health care, education, and in addition telecommunications, banking and investment, transport and the environment. In other words, the General Agreement on Trade in Services provided enormous business opportunities for the global expansion of multilateral corporations.

From the very start these organizations were perceived of as continuing Western domination (Stiglitz 2003). They are also extremely opaque organizations (Stiglitz 2003). There has been growing unease about the institutions' agenda of globalization, and in particular of the Dispute Resolution Board (DRB), which enables the WTO to approve tough trade sanctions against members who might disagree with its interpretation of global trade rules. Previously, all member states of GATT had to agree about disciplining a member. However, now the DRB appoints a panel of experts who try a case *in camera*. It decides on sanctions, which can be overcome only if every member state of the WTO opposes them; an impossibility, because the plaintiff state would not do so! Primacy is given to trade because national environmental laws, labor policies, cultural protection, food self-sufficiency, or any other policy held or formulated in the national interest is open to attack for being an unfair impediment to free trade. The national treatment clause essentially prevents a country from discriminating against products of foreign origin, regardless of the basis for such discrimination. In other words, the WTO system is biased in favor of rich Western nations, and essentially removes the power of sovereign governments to formulate policy, even if it best serves its own people. For example, according to WTO rules a nation wishing to prohibit an import that it deems harmful to public health must first prove its case scientifically, before it can ban such an import.

In the 1960s and early 1970s, non-Western nations tried strenuously to escape from the legacy of colonialism and obtain economic justice. One successful direct effort was the creation of the Organization of Petroleum Exporting Countries (OPEC), a cartel to control the supply of petroleum to force price increases and achieve greater national incomes for the benefit of their populations. Also, there was increasingly vocal opposition to transnational corporations, who were conceived of as reconstructing the world for their own exclusive benefit. However, when the less powerful nations attempted to raise the prices for their primary products, they were thwarted by the corporations.

In 1973, the New International Economic Order was endorsed by the summit of nonaligned nations, and shortly thereafter adopted by a Sixth Special Session of the UN. In 1974 the UN General Assembly approved the "Charter of Economic Rights and Duties of Nations", which endorsed the sovereignty of nations over their natural resources, the right of countries depending on a small number of primary resources to form cartels, and a statement of principles for a new international economic order as a suppression (solidarity of the oppressed) was issued. The newly independent nations set out collectively to challenge the power of Western nations. However, their efforts were an expression of politicians and intellectuals who realized that global inequalities could never be reduced in the marketplace, and that terms of trade would be the mechanism for creating an international economic system based on just relationships among nations.

Although the nonaligned movement started as a way to escape the polarization of the East-West struggle, it soon became a mechanism for enabling developing nations to come together. In the meantime in the UN, these same countries form the Group of 77, which promotes the development of the UN Conference on Trade and Development, within which Third World countries then push for fairer terms of trade. The principle underlying idea was to intervene in the marketplace to regulate the supply of primary commodities and ensure steady prices that would benefit both producer and consumer. However, the new international economic order was not supported by Western nations, whose superior position it would undermine, and Third World nations were unable to achieve a focus, owing to their lack of political power.

A boom in the primary commodity values, particularly of petroleum in 1972–1977, gave OPEC nations huge budgetary surpluses, some of which were used for infrastructural development. However, huge amounts were placed by Western investment institutions, or deposited in banks that lent them to developing country governments to fund development and pay for expensive imported petroleum products. Universally, petroleum-based fuel prices skyrocketed, contributing to rampant inflation when economic growth was low. At that time US President Nixon unilaterally both uncoupled the US dollar from gold and devalued the US dollar. This had meant developing nations had suddenly to service or repay their loans in devalued US dollars, and at higher interest rates, thereby enormously increasing the debts of non-oil-producing nations. To facilitate that, Western banks lent large amounts at very low rates of interest. Although some of the money was used as intended, much was put to frivolous uses, and much was simply stolen outright.

As it encountered financial difficulties, the IMF entered the picture to enforce harsh conditionalities when countries applied for assistance to overcome temporary balance of payments problems. Nations were forced to follow the advice of IMF economists, who argued that problems arose from excessive demand in domestic economies because of excessive imports and too few exports. The IMF insisted that structural adjustments would solve the problem. This would slow the domestic demand for imports and boost exports. Nations were forced to adopt these austerity measures, or risk being shunned by the international economic community. In 1985 the conditionalities were formalized by the Baker Plan, which called on the World Bank and IMF to impose wider adjustments on national economic policies. As is well known, the conditionalities imposed by the World Bank and IMF included privatizing state-owned enterprises, reducing the size and cost of governments through large-scale layoffs in the public sector, cutting basic social services and subsidies on essential foodstuffs, and reducing barriers to trade. These further depleted economies and had a major impact on health and welfare of the poor, and export commodities were given priority over the production of basic foodstuffs and other domestic necessities.

As a consequence, the 1980s was essentially a lost decade for most developing countries, during which growth stagnated and debt doubled. Worse, much of the credit obtained after structural adjustment conditionalities were implemented went to servicing the interest payments on pre-existing loans made from financial institutions and rich Western countries. Little remained for productive investment, such that the conditionalities of structural adjustment programmes took funds away from education and health. In effect, poor nations sent capital to rich Western institutions. Further, as a consequence of those actions, the IMF and World Bank undoubtedly achieved a level of control over sovereign states that was unheard of even during the colonial era.

The debt of developing nations has very little to do with economics, but everything to do with Western determination to continue dominating the world politically and economically (Stiglitz 2003; George 2004). No Western power would voluntarily abandon such a lucrative set-up. Structural adjustment is an integral part the Western capitalistic-hegemonic machine that makes sense only when understood as part of immoral philosophy that puts “market fundamentalism” far ahead of the needs of people. Such market fundamentalism, the keystone of Western neoliberalism, is based on an unswerving belief in the freedom of private corporations to trade, invest and move capital wherever they wish, with minimum interference. Massive

private transnational corporations now drive economic globalization, and many of them wield more power than do smaller nations. The values of efficiency and competition that drive business now also dominate debates on social policy, the public interest, and the role of government. Corporations are driven and structured by monopoly and profit, and have scant regard for social, environmental, or local level and family economic consequences of their business. Less commonly appreciated is the role of transnational corporations in destroying cultural diversity, via the homogeneous commercial culture and products sales strategies they have introduced worldwide.

This is nothing but a Western template for its perception of a “good life” spread worldwide. As an inevitable and integral part of its inexorable spread, local cultures are devalued, and the social relationships that formerly characterized families and communities are weakened. Local systems of governance and local institutions, like credit systems in rural communities, are swept aside as a global monoculture now characterizes societies worldwide, even in the remotest areas (Norberg-Hodge 1999). This has gone hand-in-hand with an almost manic mantra of privatization, downsizing of government, acquisitions and mergers that eliminate competition, and the introduction of business practices to education, welfare, and health systems, all of which have been accompanied by massive job losses. In addition to selling off public assets, governments constantly seek to attract private foreign investment, itself is no guarantee of economic progress since relatively little goes into productive activities and foreign exchange is siphoned off as corporations remit their profits overseas. Commonly too, multilateral corporations produce for the local market, thereby eliminating domestic competition through their superior efficiency and business methods. Governments of poor sovereign nations cannot intervene, as they are bound by international agreements on free trade and investment. Thus, their very sovereignty is undermined further.

Deregulation of global finance combined with lightning-fast communication has led to an enormous surge in international capital flows that enormously destabilize the global economy. Speculation now far exceeds productive investment, and has caused the recent financial crises. A minority of people has experienced increases, the gap between the rich and poor has widened greatly, and impacts on the environment and overuse of natural resources have increased vastly. As a consequence of lower barriers to foreign investment, the largest change that has occurred in almost four decades has been in global finance. Foreign exchange transactions now are virtually unrelated to productive investment in real goods or services. Rather, their objective is to profit

just from money movements. Such unregulated flows of international capital have taken power from the people's representatives (i.e. elected politicians), and handed it to rich investors, whose only loyalty is to themselves. As a consequence, the world economy has now changed into a worldwide casino. And in this casino sovereign governments are now hostage to unregulated speculative flows of capital. The enormous growth in the finance and investment industry has been intimately linked to the technological revolution in computing and telecommunications. Now the billions of dollars can be invested around the world within seconds using a personal computer. Making money in this way depends on volatility, not stability, and certainly not on long-term investment. It is characterized by astoundingly fast turning of quick profits and fast, herd-like exit from an investment in the mere glimmer of financial difficulties, as in the Southeast Asian financial crisis of mid-1997.

Concluding comments

Regardless of one's ideological standpoint, there is no escaping the fact that all economy depends on the natural environment and the maintenance of a healthy and productive functioning of ecological systems. The Western industrial model of production and constant growth has consumed vast quantities non-renewable natural resources since the Industrial Revolution. Ecosystems and natural resources are being eradicated at an alarming rate, and the production of waste exceeds the world's ecosystems' capacity to absorb it and regenerate themselves. Although most concern focuses on the supply of food, hydrocarbons, and industrial raw materials, more alarming is the destruction of such fundamental life-support systems as fresh water, atmospheric quality, and ecosystem functions. Human economic activity has overstressed global ecosystems such that the well being of future generations is threatened (MEA 2005). The wealthy economic and financial systems have had a major role in causing this situation. IMF conditionalities have contributed to this because their demands for helping government expenditure often have resulted in spending cuts on environmental protection, and the like (FOE 1999). Poverty is also no friend of environmental protection because people have no option but to exploit resources to sustain their own lives.

Despite decades of effort, the practical problems that affect millions of small-scale fish harvesters and their dependents are not well understood, except by the fishermen and their families, of course. Although only relatively recently acknowledged by various types of advocates, activists and fisheries professionals, nevertheless a variety of problems that are presumed to afflict small-scale fisheries, and often ill-considered solutions to them, are scattered with

conviction far and wide. Such solutions commonly result in unanticipated consequences and less than successful results, revealing an unwitting naiveté of design based on the inapplicability of principles too commonly taken as universal. Underlying that are vague and unsubstantiated, and probably mostly untenable, assumptions in the various approaches to fisheries management, especially the more recent ones. More profoundly disturbing is the lack of appreciation of the deep and inherent contradictions between those approaches and the now predominant and worldwide force of neoliberalism.

A fundamental set of related issues seems mostly to have been shied away from, and therefore not hitherto examined comprehensively. As discussed in this essay, in particular the underlying and largely hidden issues of general development philosophy and global economic directions and philosophy are not examined in the context of small-scale fisheries. These are the major global issues forming the context in which small-scale fisheries are perceived by outsiders, and that shape local operational problems and solutions to them.

The underlying cause of small-scale fisheries problems in tropical countries is the hegemonistic behavior of the Western core. Hegemonism is manifestly at work when approaches to the administration and management of fisheries applied in Western countries that have either failed to achieve anticipated successes in the West, or are based on unvalidated assumptions, are advocated for use in the vastly different conditions of the tropical world, where, in contrast, there exist many examples of pre-existing systems that have long worked well. Nevertheless, either directly through development assistance or indirectly through international organizations or increasingly through commercial means, Western nations continue to promote failed Western systems while denying the usefulness of proven non-Western systems.

In short, tropical small-scale fisheries are handicapped by bias and the underlying reason for their mismanagement is the implementation of policies and programmes based on Western models and approaches, coupled with an inability and/or unwillingness to consider non-Western alternatives of empirically proven value. This is based on a continuing legacy of colonialism and associated attitudes that remain embedded in donor and development agency behavior. It is strongly manifested in a relative lack of understanding of tropical milieu and a persistence of various prejudices, and is exacerbated by the Western structure of knowledge and the division of academic disciplines, together with the temperate bias in conventional approaches to fisheries education and management. Further, although known from

colonial times, pre-existing systems of fisheries management in tropical nations have not usually been used as an alternative to introduced Western scientific approaches. During the colonial era, non-Western models were disparaged openly, whereas nowadays commonly they are dismissively labeled traditional or special cases. Often predicated on misguided theories, during the 1950s and 1960s a massive and experimental packaged transfer of social, economic, financial, educational, and legal systems, together with their underlying cultural values and aspirations regarded pre-existing economies, management systems, and often social and cultural systems as obstacles to modernization. Modernization provided the justification for foreign designers of fisheries management schemes to claim that either pre-existing system were primitive, unsustainable or often non-existent. This was reinforced by a general ignorance of the tropics and prejudice on the part of scientists and educators, whose careers were enhanced by work in temperate regions.

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Memories of sawfish fisheries in a southwestern Atlantic estuary

Vinicius J. Giglio¹, Osmar J. Luiz², Marta S. Reis³, Leopoldo C. Gerhardinger⁴

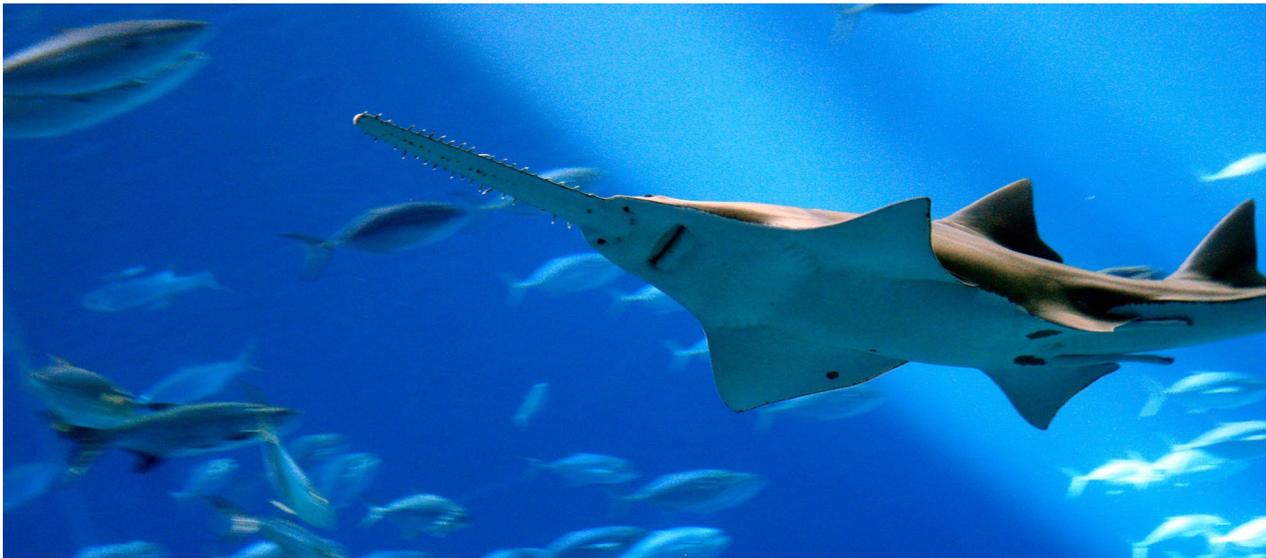
Abstract

An extinct sawfish fishery in mangroves of the Abrolhos Bank of eastern Brazil was investigated by interviewing four elderly and expert fishermen with local ecological knowledge of the area. Sawfish were usually caught with gill nets and longlines, as a secondary target of snooks (*Centropomidae*), Atlantic goliath grouper (*Epinephelus itajara*) and acoupa weakfish (*Cynoscion acoupa*) fisheries. Insights on the locally collapsed sawfish fisheries, traditional uses of the fish, and natural mortality events are given.

Introduction

Sawfishes (family Pristidae) are coastal elasmobranchs that share a unique anatomic feature: a large and elongated toothed rostrum. They represent one of the largest predators in shallow coastal waters and estuaries, yet only limited scientific data about them is available. Sawfishes are large, long-lived species and they were once widely distributed along the coastal waters of the Atlantic (Bigelow and Schroeder 1953). The species uses estuaries and rivers throughout its developmental stages. Now among the world's most threatened marine fishes (Wueringer et al. 2009; Dulvy et al. 2014), sawfishes suffer from anthropogenic impacts worldwide, mainly overfishing and coastal development

(Seitz and Poulakis 2006; Fernandez-Carvalho et al. 2014). The sawfishes of the western Atlantic – the largetooth sawfish, *Pristis pristis*, and the smalltooth sawfish, *P. pectinata* – have been classified as “critically endangered” by the International Union for Conservation Nature for more than 10 years (Carlson et al. 2013; Kyne et al. 2013). Fishing for those species has been prohibited in Brazil since 2004. Today, sawfish populations have collapsed or become extinct over most of its historical range in the western Atlantic, including southern and southeastern Brazil (Fernandez-Carvalho et al. 2014). The smalltooth sawfish has not been observed or fished in Brazil for more than 10 years (Faria and Charvet-Almeida 2008). The only known viable population that still remains occurs in the northwestern



Sawfish have a large and elongated toothed rostrum (image: Guy Incogneato - FlickrR)

¹ Programa de Pós-Graduação em Ecologia, Universidade Federal do Rio de Janeiro, PO Box 68020, Zip code: 21941-902, Rio de Janeiro, RJ, Brazil. E-mail: vj.giglio@gmail.com

² Department of Biological Sciences, Macquarie University, Sydney, NSW, 2109, Australia.

³ Departamento de Biologia Animal, Faculdade de Ciências da Universidade de Lisboa, Lisboa, Portugal.

⁴ University of the Region of Joinville, 89240-000, São Francisco do Sul, Santa Catarina, Brazil

Atlantic, off Florida in the United States (Carlson and Simpfendorfer 2014). The highest abundance of largemouth sawfish in the Atlantic was confirmed in the Amazon estuary in northern Brazil. (Fernandez-Carvalho et al. 2014). Recently, Giglio et al. (2015) verified that largemouth sawfishes were last caught 10 years ago on the Abrolhos Bank off of eastern Brazil. In a nearby estuary the species was considered extinct according to traditional fishermen (Reis-Filho et al. 2016).

Sawfishes are generally caught by commercial gill net fisheries (Simpfendorfer 2000) and on a smaller scale by line and longline fishers (Seitz and Poulakis 2006). In Brazil, there is little information about sawfish fisheries, especially where it has either collapsed or become extinct. Under such conditions, an alternative approach to overcoming constraints imposed by limited historical data is to tap into the memories of fishers (Venkatachalam et al. 2010; Leeney and Poncelet 2013). Fishers' local ecological knowledge (LEK) was suggested as a priority research for gathering information about sawfishes, especially in areas where they are rare or possibly extinct (Dulvy et al. 2014). In recent years, studies using fishers' LEK have been conducted to investigate the historical ecology of sawfishes (e.g. Leeney and Poncelet 2013; Giglio et al. 2015; Leeney 2015; Leeney and Downing 2015)

Here, we report on the LEK of elderly fishers about the characteristics of sawfish fisheries and two reported causes of natural mortality on the estuaries of the Abrolhos Bank off of eastern Brazil. Sawfishes were caught until approximately 20 years ago.

Methodology

This study was conducted in the Caravelas-Nova Viçosa estuarine complex (CNEC) located on the Abrolhos Bank, the most biodiverse reef complex of the South Atlantic (Leão et al. 2003). Fishing in the CNEC is mainly small-scale or subsistence, multi-specific and represents an important economic activity for local communities (Santos and Brannstrom 2015). In 2009, a marine protected area (MPA) was designated under a self-governing (community-based) regime, namely the Cassurubá Extractive Reserve. The community reserve covers a representative portion of CNEC and adjacent coastal areas.

Between 2009 and 2010, after 102 interviews with local artisanal fishers and fruitful discussions about sawfish natural history, we met four elderly fishers who were identified by their peers as having caught the largest number of sawfish, hence also likely the most knowledgeable about our taxa of interest. All four are estuarine fishers who spend their lives in



Location of the Abrolhos Islands, Brazil
(source: Wikimedia Commons)

the mangroves of the CNEC. In the past, fishing in the region was primarily a subsistence activity carried out by riverine communities using gill nets, hook-and-line, and longline from small dug-out canoes. However, since the 1980s, the advent of motorboats has led to increasing fishing activity throughout the CNEC, allowing artisanal fishing to expand both spatially and temporally.

Interviews with open questions were performed individually in fishers' households. Our aim was to gather information about fishing gear used to catch sawfish, fishing sites, quantity and number of individuals caught, uses for the sawfishes, and causes of natural mortality.

Results

The age of our informants ranged between 55 and 81 years and their experience ranged between 40 and 60 years. Fishing gear commonly used to catch sawfish were gill nets, longlines and hook-and-lines. Fishers caught up to 60 individuals during their lifetime, including juveniles weighing less than 10 kg. The largest sawfish weighed 300 kg (Table 1). The sawfish rostrum was traded as a souvenir and for medicinal or religious purposes. Sawfish were caught as a secondary target species

Table 1. Summary data of interviews with expert sawfish fishermen on Caravelas-Nova Viçosa estuarine complex, eastern Brazil.

Age	No. years of experience	Fishing gear used	No. of individuals caught	Largest individual caught (kg)	Use of saw
55	40	gill net, hook-and-line	15	180	souvenir
66	51	gill net	10	100	souvenir
69	40	gill net, longline	40	220	souvenir
81	60	longline	60	300	medicinal (asthma cure) charm to prevent bad luck

of fisheries aimed at acoupa weakfish (*Cynoscion acoupa*), cubera snapper (*Lutjanus cyanopterus*), snooks (*Centropomus* spp.) and Atlantic goliath grouper (*Epinephelus itajara*). No specific sawfish fishery ground was reported, but our informants acknowledged that sawfish were caught throughout the CNEC, and juveniles were caught in very shallow waters (< 1 meter depth).

In the CNEC, fishing was done from small rowing canoes. Catches of large sawfishes were challenging because they are powerful enough to drag a small canoe. To avoid being dragged, fishers cooperated using up to four canoes to tow large individual sawfish. The meat was divided among participants. Informant No. 4 mentioned an episode involving a large individual:

“When I verified that a large sawfish, of more than 300 kg was caught on the longline, I felt a tug that dragged the canoe for dozens of meters. I had to request help from other fishers with canoes to tire the fish and take it to the landing port.”

All informants agreed that the toothed rostrum is the main cause of sawfish entanglement in gill nets and longlines. According informant No. 3:

“They get entangled several times in gill nets by their saw, and cannot get out. Their saw is their ‘Achilles’ heel’, which causes species disappearance due to entanglement and the impossibility to escape. I witnessed a fish that got entangled in a fishing line and even without biting the hook, it was captured because it was overly entangled in the line.”

The elderly fisher (No. 4) witnessed individuals’ death from natural causes in mangroves:

“I found a sawfish that was about three meters in length, dead in red mangrove trees [*Rizophora mangle*] because the saw was trapped in the roots of trees. Other fish and two juveniles were trapped in the mud when the tide receded.”

Discussion

In many coastal communities, memories of elderly fishers are an important, if not the only available, source of information about extinct fisheries. This knowledge is vanishing fast as subsequent generations of fishers progressively shift their environmental baselines to the already degraded conditions that they experienced in their youth (Pauly 1995; Sáenz-Arroyo et al. 2005). Sawfishes were a relatively common fishery resource in the CNEC until the 1980s when it disappeared for over 10 years. Fishers mentioned overfishing by gill nets as the main cause of sawfish fishery collapse in the region (Giglio et al. 2015). In addition, it was verified that a longline is a commonly used gear for catching sawfishes in the CNEC and may have exerted a fishing pressure that contributed to the species’ collapse.

Our informants acknowledged that sawfishes entangle easily in gill nets, because of their elongate blade-like, toothed rostrum. Fishers using hook-and-line and longline methods also observed entanglement. In the CNEC, fishers mentioned that sawfishes, when caught using longlines, can become entangled several times, and thus, lines are a worrisome source of mortality to sawfishes (Seitz and Poulakis 2006), and their unique morphology makes them exceptionally vulnerable to fishing.

Our most elderly informants described two cases of what they believe were natural mortality events among sawfishes. Both sawfishes died at low tide. A large individual had its rostrum trapped in mangrove roots, and was badly damaged. Adults are sought in various coastal habitats from shallow estuarine areas to >100 m depths (Poulakis and Seitz 2004; Carlson et al. 2013), a strategy that possibly increases feeding success (Poulakis et al. 2011). However, this large individual entangled its rostrum between mangrove roots, possibly during a feeding incursion. On the other hand, it is not possible to confirm that entanglement was the cause of the sawfish's death because the individual was found already dead. It may have died before becoming entangled in the mangrove roots.

Death of small juveniles was also observed occasionally. Frequently, juvenile sawfishes were observed in shallow waters (<1 m depth), probably avoiding predators (Witthy et al. 2009; Poulakis et al. 2011). Several fish species were observed by fishers in mud puddles in a long plain called "Rio do largo", including juvenile sawfishes. Fishes become trapped in these pools for about five hours, which under conditions of intense heat and extremely low oxygen levels can cause death. Seitz and Poulakis (2004) reported a substantial decrease in water temperature owing to the passage of multiple cold fronts as another possible cause of natural deaths in Florida.

The occurrence of sawfishes in the CNEC was frequent until 1980; however, its abundance decreased rapidly due to the increase in fishing activity. Currently, the sawfish fishery in the region is considered to be collapsed (Giglio et al. 2015). Urgent efforts are required to avoid the extinction of the last sawfish populations in northern Brazil. The creation of MPAs to reduce fishing effort and protect key habitats is a critical management action needed to avoid the extinction of this iconic fish.

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Pacific Community, Fisheries Information Section
BP D5, 98848 Noumea Cedex, New Caledonia

Telephone: +687 262000; Fax: +687 263818; cfpinfo@spc.int; http://www.spc.int/coastfish