"*One hand can't clap*": Combining Scientific and Local Knowledge for Improved Caribbean Fisheries Management

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ABSTRACT

Migratory marine resources pose a challenge to common property theory. A given fish stock (e.g. a tuna species) may be used by coastal and offshore fisheries, by small and large-scale harvesters, and more than one nation. The movement of the stock makes it difficult to develop shared values and mutually agreeable rules among the users who can monitor one another's behaviour and impose sanctions. Migratory resources pose cross-boundary issues. It may be necessary to have commercial fishery quotas enforced by government authorities, as community-based solutions would not be effective. In the case of resources fished by several nation states, international institutions are needed. Such resources pose cooperation and enforcement problems that cannot be solved at the local or national levels.

A case in point is the migratory pelagic fish caught by the fishers of Gouyave, Grenada, West Indies. The International Commission for Conservation of Atlantic Tuna (ICCAT) reported that Atlantic Blue Marlin (*Makaira nigricans*), Atlantic White Marlin (*Tetrapturus albidus)*, and Atlantic Swordfish (*Xiphias gladius*) fish stocks are overexploited. The ICCAT adopted management measures to rebuild these stocks, which requires countries throughout the region to reduce landing levels to those in 1996. Stock assessments and management strategies were based solely on scientific assessment.

The new regulations impact livelihoods in the fishing community of Gouyave. Fishers, stakeholders, and community members disagree with the proposed plan to reduce landings of these species. Based on their local knowledge and technological experimentation, they argue they have information to contribute to the assessment of the status of the pelagic fishery that would be important for management planning. They argue that the government should take a more holistic approach to managing large pelagic species, and that ICCAT's objective of rebuilding stocks cannot be achieved without causing much economic hardship on the community. Stakeholders note that to ensure sustainability of the fishery and the community, management strategies could include: (1) maintaining economic viability of the fishery; (2) monitoring the bait fishery; (3) maintaining proper quality control to ensure fish export; and (4) considering alternative livelihood options.

Much could be done to improve Caribbean fisheries planning and decision-making by creating opportunities for management that are participatory and cross-scale. In our case study, there are three levels of management: community (Gouvaye), the nation state (Grenada) and regional/international (ICCAT). While the national and regional levels are well coordinated, the community level of management, and the knowledge held by fishers, is rarely taken into account. Decision-making can be improved by creating a platform that facilitates adaptive learning, and sharing of scientific and local knowledge amongst the stakeholders. This grounded platform needs to be created first at the national level through participatory processes, and then used as a means to inform decisions at regional and international levels.

INTRODUCTION

Much progress has been made in the scientific study of fisheries, marine ecology and oceanography. Yet despite the accumulation of a great deal of scientific data, there is insufficient information to manage fish stocks, especially those of multi-species fisheries in tropical seas. We have long been taught to believe that fisheries management requires extensive research, sophisticated models, large amounts of data, and highly trained experts. We now know that these ingredients do not always work, and we are coming to realize that simpler approaches can be more practicable and cost-efficient, as we must "reinvent fisheries management" (Pitcher et al. 1998). Management, especially in small-scale fisheries, can work with lower inputs of data, including qualitative indicators, proximate variables and local and traditional knowledge, as means of evaluating the status of a fishery and determining future directions. Managers and scientists have specific knowledge of marine resources; however, fishers' knowledge can help widen the range of information available for decision-making.

Traditional ecological knowledge may be defined as "a cumulative body of knowledge, practice and belief, evolving by adaptive processes and handed down through generations by cultural transmission" (Berkes 1999: 8). This knowledge base is both cumulative and dynamic, building on experience and adapting to change. It is an attribute of societies with historical continuity in resource use on a particular land. Practical knowledge that does not have such historical and multigenerational character can simply be called local knowledge, as in some Caribbean fisheries (Gomes et al. 1998). Local and traditional knowledge can complement scientific knowledge by qualitative monitoring, and providing long-term local observation and institutional memory for understanding ecosystem change (Berkes and Folke, 2002). In fisheries management, local knowledge can combine empirical information on fish behaviour, marine physical environments and fish habitats, and the interaction among the components. It is an important guide to cultural resources; knowing when, and how to fish; and an important information base for local resource management (Ruddle, 1994). Johannes, et al., (2000) argued, "*when scientific observations and fishers' observations concur, this increases our confidence in* *both".* Hanna (1998) argued that in the Maine soft shell clam fishery, scientific and fishers' knowledge helped to "*bridge the gap between knowledge needed to use the resource in the short-term, and knowledge needed to sustain the resource over the long-term".*

In the Caribbean there is little known about fishers' local and traditional knowledge, except in Gomes et al., 1998. Such knowledge is potentially important because it provides information necessary for management. This study explored how Gouyave (Grenada) fishers' knowledge of large pelagic species, presently and in the future, can inform institutions at various levels of management by providing useful information to notify resource managers and provide useful information for fisheries planning and management. This paper outlines a description of Gouyave longline fishery, learning and developing technological and ecological knowledge of the longline fishery, and discusses how the use of fishers' knowledge can be used to inform national and international policy and management of large/ocean pelagic species, using the issue of the International Commission for the Conservation of Atlantic Tuna (ICCAT) management regulations for large pelagic species in Grenada. It is hoped that by documenting fisher's knowledge of Gouyave longline fishers, will provide fishery managers in the region with practical ways to include fishers' knowledge in fisheries management and policy.

BACKGROUND

1. Gouyave Longline Fishery

The country of Grenada is made up of 3 islands, Grenada, Carriacou and Petit Martinique; the total area is about 344 sq. km, and a population of over 100,000 (Fig. 1). The most southerly of the Windward Islands, situated between 11^{o}35' and 12^{o}15' north latitude, and 61^{o}35' and 61^{o}48' west longitude, which is 19 km at its greatest width, and has an area of 311 sq. km, most of which has rugged and mountainous features with some flat land found mainly along the east and south coasts (Brierley, 1974). The fishery in Grenada is mainly small-scale, and has been divided into 3 stock types, based on fishing effort methods and fish type: (1) oceanic/large pelagic stocks; (2) demersal stocks; and (3) inshore pelagic stocks. In 2001, the ocean pelagic stock was the most important fishery, contributing 81% of total fish landed, followed by demersal stocks at 12%, and inshore pelagic stocks at 7%. Of the small island states in the eastern Caribbean (St. Lucia, Barbados, St. Vincent and the Grenadines and Grenada) the annual landings reported to Food and Agricultural Organization (FAO) of oceanic species for 1990-1999 showed Grenada with the highest yellowfin tuna (*Thunnus* albacares) and sailfish (*Istiophorus platypterus*).

Description of the surface longline gear

In Gouyave, west coast of Grenada, life revolves around oceanic/large pelagic, using surface longline (referred to in this paper as longline) made from monofilament plastic. Longline is made up of three major components; the mainline, dropline, and buoyline. The mainline ranged from 3-10 km total length, is made of monofilament nylon with 136 kg breaking strain. Braided nylon loops 1.5 cm thick are inserted every 18 m along the mainline, onto which the droplines are clipped during the gear set. Droplines varied in length from 3-32 m, using 5-8 different lengths, depending on fishers' preference; also baited with live flyingfish (*Hirundichtys affinis*) or jacks (Carangidae). Buoylines, 3 m in length, are attached after every third hook. Flags are placed at either end of the mainline to signal other boats that a longline is in the area (Fig. 2). Mainline and droplines are deployed from separate manual reels.

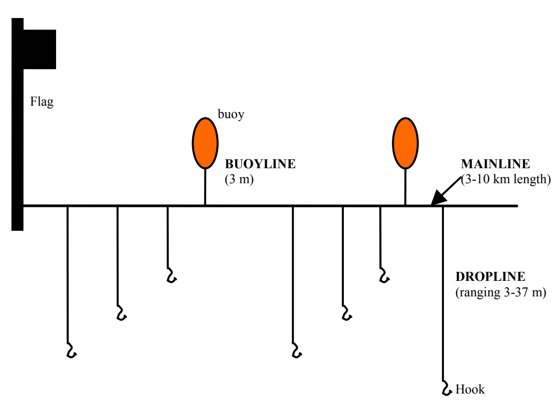


Figure 2. Schematic diagram illustrating typical traditional surface longline gear used by Gouyave longline fishers.

Boat Types

There is an estimated 179 active small-scale and medium-scale vessels in Gouyave, 52% are longline vessels. There are 3 categories on longline boats (Fig. 3): 65 small vessels (<5.5m open day trip wooden canoes with 1 outboard engine, fishing 11-13km from shore, longline carrying 150 hooks, with 2 crew); 20 medium fiberglass vessels (6-9m forward cabin day trip fiberglass canoes with 2 outboard engines, fishing up to 32 km from shore, longline carrying up to 180 hooks, with 2 crew); and 10 large launchers or semi-industrial vessels (9-12m wheel house 4-5 days trip fiberglass canoes with inboard engine, fishing up to 161km from shore, longline carrying over 300 hooks, with 3-5 crew). Non-longline fishing boats are <5m, mechanized or non-mechanized, operated by 2 crew.

Fish Types

The longline fishery in Gouyave targets ocean/large pelagic species such as, Yellowfin Tuna (*Thunnus albacares*), White Marlin (*Tetrapturus albidus*), Blue Marlin (*Makaira nigricans*), Common Dolphinfish (*Coryphaena hippurus*), Sailfish (*Istiophorus platypterus*), and Swordfish (*Xiphias gladius*).

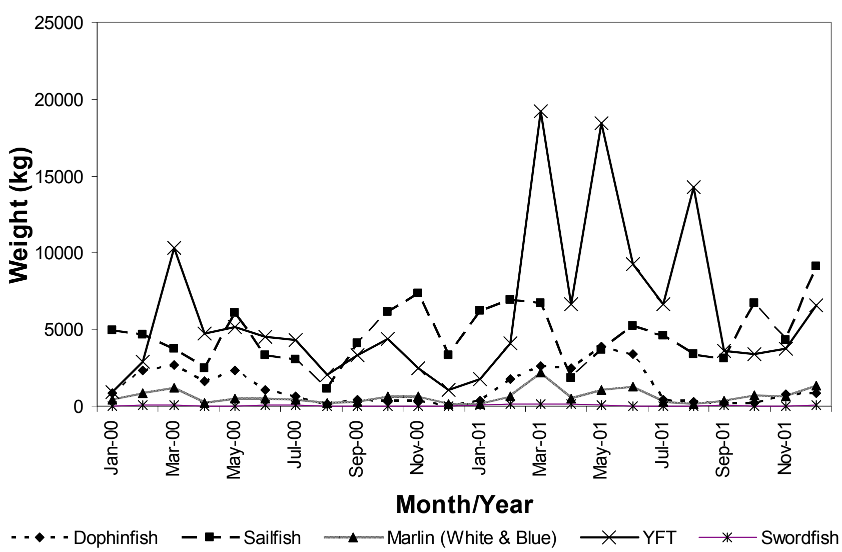


Figure 4. Monthly weight of species landed by all vessels for the period 2000 and 2001.

Mean species composition (% weight) landed by longline vessels for the period January 2000 to December 2001 were: yellowfin tuna (52%); sailfish (33%); dolphinfish (11%); marlin (5%), and swordfish (0%). For the same period yellowfin tuna increased significantly (Fig. 4).

METHOD

Fishers' knowledge of large pelagic species was documented during the period December 2002 to March 2004. Participant observation (Jorgensen, 1989) was used to observe fishers and fishing practices on land and at sea (trips to sea), and working with the Fisheries Division and social groups of fishers. Key informant interviews were conducted with retired and knowledgeable fishers, (recommended by fishers and community members), on the history of longline fishing in Gouyave, longline fishing techniques, and fishers' ecological knowledge. Participatory techniques (IIRR, 1998; Pido, et al., 1996) such as small group meetings with fishers and staff of the Fisheries Division (FD) were held to discuss fishers' knowledge and policy implications.

RESULTS

1. Learning and developing longline technological knowledge

Historically, Gouyave used different fishing techniques, such as: beachseine for inshore pelagics; bazor (dip net) and handline for flying fish, touch and "cali" gear (dip net) for ballyhoo; 3-line (handline technique) and "seche" fishing (specialized handline) for ocean pelagic species; fish pot for demersal; and trammel net for lobster and turtles (Personal communication, Osmond Small, 2003). Vessels were wooden canoes 4-5 m in length, and larger sloops or double ender wooden boats, 5-6 m in length, both powered by oars and sails. Mechanization, with outboard engines began in the early 1950's, and by the late 1960's diesel inboard engines were introduced.

The 1979 Grenada People's Revolutionary Government, with assistance from the Cuban government, helped to popularized surface longline fishing. Fishermen were sent to Cuba to be trained, and Cuban master fishermen with fishing equipment (boat and gear) were sent to train fishermen in Grenada. Grenadian fishers were trained in pole fishing ("fly fishing") for skipjack tuna using artificial bait, construction of fish and lobster traps, the art of surface longline for ocean pelagic specie, bottom longline for shark, and gillnet for flying fish (Personal communication, Johnson St. Louis, 2003). Of all the gears fishers were exposed to, longlining had the greatest impact on Gouyave fishers.

Popularization of longline started with the Cuban design between 1980 and 1983, using 2X250 lbs strain monofilament drilled and twisted mainline and dropline, stored and deployed from a box, using 8/0 tuna hooks. Secondly, an early Grenadian design in 1985, using twisted 2X250 lbs strain monofilament drilled and twisted mainline, single 400 lbs strain dropline, stored and deployed from a box, using 7/0 mustard hooks. Thirdly, an American design in 1987/88, using single 800 lbs strain monofilament mainline, 400 lbs strain dropline, stored and deployed from hydraulic reels. Finally, the present design from 1990s-present, using single strain monofilament main and drop lines, ranging from 150-500 lbs stored and deployed from manual or hydraulic reels, using 7/0 or 8/0 hooks (Table 1). Boat technology also improved with longline changes over the years. Vessels evolved from wooden canoes, to wooden forward cabin pirogues, to fiberglass forward cabin pirogues, to larger fiberglass boats. Presently, there is evidence of all four vessel types in the fishery.

Since the introduction of longline gear in 1979, Gouyave fishers developed technological knowledge to increase efficiency and effectiveness of the gear. Three main technological changes were made:

- Changes in the construction and weight of monofilament lines, constant experimentation with strain of monofilament lines, size of hooks, and gear designs (depth and position of dropline);

- Development and adaptation of unique boat design, but keeping boat sizes small enough to haul on beach in case of hurricane, improving the economic efficiency, and facilitated changes in bait use; and
- Learning to use live jacks bait when the preferred bait (flying fish) is not available, thus extending the fishing season by several months.

Overall, fishers in different fishing communities in Grenada adapted the longline technology to suite their own cultural preferences. Gouyave fishers adapted to daily fishing from small boats; while fishers in other communities adapted for larger boats.

2. Learning and developing ecological knowledge of the marine resource

With technological knowledge of longline gear and boat, fishers' knowledge of large pelagic species and the open ocean environment also developed over the years. They developed the knowledge of how and where to set their lines based on their knowledge of the presence of birds, current movement, seawater colour, fish movement, fish behavioral patterns, and bait preference (based on fish stomach content observation). This local based knowledge is recent and still developing. Main ecological knowledge is presented below.

Fishers' knowledge (seawater colour)

Blue water: Eight months of the year fishers say there is blue water, and 4 months green water. Some fishers say "Ocean gar" (Sailfish) and marlin swim together in blue water. They also catch more flying fish (bait) in blue water.

Green water: Fish prefer green water. Green water occurs due to the Orinoco water flows, mainly August to November. Fishers said they caught more tuna in green water.

Dark green: Also called "grumsy water", this water is rich in plankton, thus catch more variety of fish, mainly tuna.

Generally there isn't much agreement among fishers on preferred water for dolphinfish.

Fishers' knowledge (birds)

Birds are strong indicators that fish are present, *"no birds, no fish"*. Birds travel with fish, and sense when fish are coming. Fish brings food to the surface, so birds can feed. Birds don't follow marlin they mainly follow dolphinfish, yellowfin tuna, and sailfish. When fishers see a specific species of bird, they can tell what type of fish is in the water. "*When you see a Jablote bird you know tuna (yellowfin tuna) is around, they feed on the slime on the tuna's body*". Boobie, Vickie, and Mauve birds (*Larus atricilla*) all signal the presence of dolphinfish and yellowfin tuna. Twahoo and Moien birds signal the presence of Sailfish. Further investigation is underway.

Fishers' knowledge (current)

Most fishers agree that strong current carries fish away, i.e. the fish moves with the current. With less/slow current fish feed better. North and north-west current is better for fishing, it brings the fish. "*You catch yellowfin tuna better in north current*". When there is a south or south-west current, it is usually stronger and fish are carried away by the current; "*Hardly hold fish in south current*".

Additional categories of fishers' knowledge

Other categories of fishers' knowledge were investigated:

- **Fish feeding and stomach content**. For most large pelagic species caught, the natural prey was flying fish, but other fish species were found in the stomach, a few will be mentioned in this paper: **yellowfin tuna** – Flying gurnards (*Dactylopterus volitans*), squid (*Loliginidae*), small blackfin tuna (*Thunnus atlanticus*), even plastic bags and leaves; **large marlin** – blackfin tuna (*Thunnus atlanticus*), kingfish (*Scomberomorus cavalla*), squid (*Loliginidae*), skipjack tuna (*Katsuwonus pelamis*), yellowfin tuna (*Thunnus albacares*); **dolphinfish** – squid (*Loliginidae*), ballyhoo (*Hemiramphus brasiliensis*), jacks (*Selqr crumenonophthalmus*); and **Sailfish** – anchovies (*Anchoa hepsetus*), squid (*Loliginidae*).

- **Fish feeding behaviour**. Yellowfin tuna are fast, fierce, hungry feeding fish. They feed early morning (4-9 AM) and late evening (4-8 PM), travel in schools for many miles to get their food, and burn a lot of energy. Once they meet bait, they swim in a circle, making the circumference smaller and smaller to move the bait closer together. Once the circle is small enough, they bring the bait to the surface and feed. While each yellowfin tuna in the school feeds, birds come to feed, while the Jablote bird feeds on the slime on the body of the yellowfin tuna.

  Marlins use their upper jaw ("sword") to spear prey, surface out of the water, shake off the bait catch, and eat the prey. Dolphinfish are smarter feeders, they take time to feed. Sailfish curve their body, swimming in a circular pattern around the bait, with caudal fin and upper jaw almost touching to keep the bait from escaping. Then extend their dorsal fin ("umbrella") to prevent their bait from escaping, then feed.

- **Fish response to phase of the moon**. Of the fishers interviewed, 28% said the phase of the moon does not affect longline fishing, but it affects other types of fishing. On the other hand, 63% of fishers interviewed said the phases of the moon affect fishing. More fish is caught in the first quarter, and more yellowfin tuna 3-4 days after full moon.

- **Fish response to temperature, rain, and wind**. Dry season (March – June) is the best time for fishing longline (68% of respondents). "*When the sea is smooth and the heaven's clear, it is better for fishing, you see the fish jumping*". When it is rainy fishers cannot fish, it is dangerous for small canoes. "*With heavy wind the sea is usually rough, plenty squall, high seas, can't take chances at sea*".

- **Reproductive seasonality**. Fishers know the reproductive seasonality of yellowfin tuna, dolphin, and sailfish. Not much information is known on swordfish reproductive seasonality, as not a lot is caught by Gouyave fishers. For marlin (white and blue), fishers have never observed ripe eggs.

Fish Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Tuna			■	■	■	■	■					
Marlin												
Dolphinfish			■	■	■	■						■
Sailfish			■	■	■	■						■

- **Harvesting seasonality**. Fishers had a fair idea, month specific, when fish types were available.

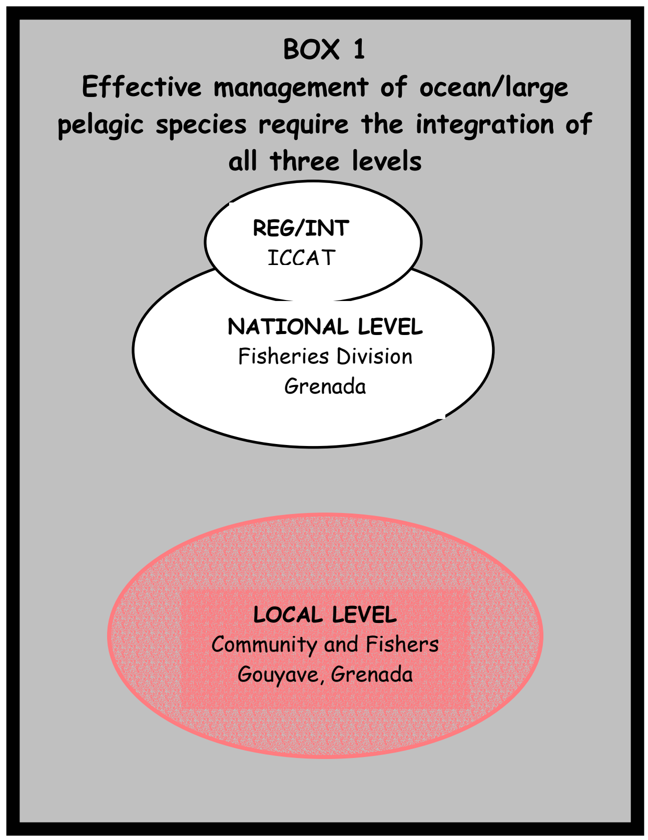
Fish Type	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Tuna			■	■	■				■	■		
Marlin	■	■			■	■				■		
Dolphinfish			■	■	■	■	■	■				
Sailfish	■									■	■	■

DISCUSSION

In this case study, Gouyave fishers have both technical and ecological knowledge of the longline fishery. This information has potentially useful qualitative information that could complement scientific knowledge, and which could be used to inform policy and management at regional and international institutional levels. Using the issue of ICCAT's management regulations for large pelagic species, which is based mainly on scientific knowledge, the authors considered various ways of including/integrating fishers' knowledge in these management regulations.

Fishers' knowledge could be integrated in new international stock conservation measures (e.g. ICCAT) to be implemented by national (Grenada) and regional (the Caribbean community). ICCAT was established in 1969 to study populations of tuna and tuna-like fish and such other species of fishes exploited in tuna fishing in the Convention area as these species are not under investigation by another international fishery organization. Such study includes research on the abundance, biometry and ecology of the fish populations; the oceanography of their environment; and the effects of natural and human factors on their abundance (FAO/CFU 2002). ICCAT's focus has been on major tunas and tuna-like stocks of the Atlantic and its activities include: coordinating the collection of fisheries statistics among harvesting countries; maintaining a centralize database; coordinating biological, ecological, and environmental research; and proposing, adopting, and coordinating the implementation of agreed stock management measures (Singh-Renton et al., 2002). Recently, ICCAT assessments of several large tuna and billfish stocks showed signs of being fully or overexploited (Table 2). 'New entrants to the fisheries are faced with stringent catch limits imposed to arrest stock declines or fish stock rebuilding, allowing no room for additional access' (Singh-Renton et al., 2002).

Three levels of management, important in implementing international stock management, were identified: the community/local level (Gouyave fishers and community members); the nation state (Fisheries Division, Grenada); and regional/international (REG/INT) level (ICCAT). While the national and regional levels of management are well coordinated, mainly due to regional/international workshops and training programmes, at the community level knowledge held by fishers is rarely included in fishers planning (Box 1). We now present the impact of ICCAT's regulations for Grenada, in particular Gouyave, and identify a number of ways fishers' knowledge at the community level could better inform national and regional/international management measures.



BOX 1
Effective management of ocean/large pelagic species require the integration of all three levels

The Grenada Fisheries Division (FD) management policies for oceanic pelagic species based in ICCAT's recommendations are as follows:

1. Blue and white marlin rebuilding programme: landings maintained or reduced to 1996 or 1999 levels (whichever is greater), and stock assessment to be conducted in 2002 for white marlin and 2003 for blue marlin; and
2. Swordfish stock rebuilding programme (2000-2009): increase biomass by reducing Total Allowable Catch – reduce catches to 1996 levels, and protect small swordfish (minimum size 25 kg/ 125 cm lower jaw fork length).

BOX 2
ICCAT's Regulation:
What does it mean for Gouyave?

White and Blue Marlin

- Reduce catch from 66,674 lbs. (year 2001) to 51,408 lbs. (year 1996), i.e. reduce catch by 23%; and
- Participate in Marlin research

Swordfish

- Reduce catch from 11,962 lbs. (year 2001) to 788 lbs. (year 1996), i.e. reduce catch by 93%; and
- Do not catch small Swordfish less than 55 lbs. or 4 ft. long

For the community of Gouyave, this management policy translates into a reduction of 23% in marlin catches and 93% in swordfish catches (Box 2). Fishers' compliance depends on whether it is in the best interest/benefit to them and the importance of the species to their livelihood. In the case of swordfish, which is of less economic importance to fishers (less than 1% annual landings), and where the Grenada Fisheries Division stop issuing export licenses, fishers stopped targeting this species. In the case of marlin, which is 5% total annual landings, fishers are undecided about what they should do. On one hand they agree with conservation, but on the other 54% of fishers interviewed sight limitation of gear (cannot control what the gear catch), and economic importance as reasons they are unable to reduce marlin catches at this time. However, if restrictions were placed on Sailfish, which contributed 40% total annual landings, locally valued, and considered the fish that feeds the community, fishers would have a hard time complying with this regulation.

There is a disconnection between government policies, i.e. conflicting government policies. For example, on one hand government, in this case the Fisheries Division, wants to increase capitalization, while on the other hand they agree to international limits. The overall policies of the FD are to increase fish production, to increase earning from the fishery, and provide employment for its people. From a technology standpoint, the FD had been working to increase capitalization by encouraging fishers to get into bigger, safer boats to travel further out at sea, and eventually increase fish landings. From a biological standpoint the FD supports ICCAT conservation measures by implementing policies to reduce catch of specific species. One fisher summarized the disconnection by saying, "*If the Government knew limits were coming, why did they make us increase our boat size?*" Internally resolving these disconnections require an understanding that these conflicts exists, and then working as a team to resolve them. Presently, the FD is divided into 6 units (biology, technology, extension, administration, quality control, and statistics), each unit worked in isolation, each solving different problems on their own. This type of segregated problem solving resulted in disconnection when units are not properly coordinated. Officers from the different units need to work together to ensure consistent policies.

The FD needs to value and use fisher's knowledge in policy and management. Fishers' possess both technological and ecological knowledge, which is presently not being used/valued by the Fisheries Division. Information possessed by fishers can be used to monitor stocks and ocean environment, provide biological and technical data, and provide contextual information for management purposes. Gouyave fishers have a fair idea of the best ocean environment for catching large pelagic species. Fishers know favourable conditions to go fishing, e.g. colour of seawater, presence of bird and type, current movement, and phases of the moon. Fishers have the knowledge that stocks have reduced; half of the fishers interviewed stated that they are catching less fish now than ten years ago, quarter stated they were actually catching more, and the remainder said they were not sure. They have an idea of biological parameters, such as, feeding patterns & behaviour, reproductive & harvesting seasonality. They have improved on conventional surface longline gear design and made the gear more efficient and effective at catching large pelagic species. More importantly, fishers are aware of contextual information useful in interpreting landings, biological and catch per unit effort data; information useful in understanding and assessing fishery data (Grant and Rennie, in press). Thus in the absent of scientific data, fishers have a wealth of knowledge that could be used in assessing fish stocks.

There are differences between community-level fishers and national-level FD with respect to the objectives they wish to achieve through the management of large pelagic species. Community-level objectives are based on fishers' experiential knowledge; while and national-level objectives are based on the Fisheries Division biological and technical knowledge. These two types of knowledge are potentially complementary. Based on fishers' local technical and ecological knowledge, they argued that ICCAT's management approach was too limiting. While species conservation was important, direct reductions are not the solution, as this would create economic hardship, not only for fishers, but the community as well.

Fishers argued for a holistic approach, one that includes, maintaining the economic viability of the fishery, monitoring the bait fishery, maintaining quality control, and improving alternative income generating activities (Fig. 5). From a national and technical knowledge perspective, the FD focuses on implementing ICCAT's management regulation, and supporting regional management and decision-making that ignores fishers' local situation. The FD views large pelagic species as shared stocks with international demands for conservation, and that stock rebuilding is not just important to Grenada, but other countries regional and international (Fig. 5). Fishers and the FD are not working together for the exchange and transmission of knowledge between the groups. Fishers with little/no input from FD, developed local knowledge and practices to suite their needs and the community. FD working in isolation from fishers increased international technical, technological, and biological knowledge, through regional and international training courses and workshops, have not passed on this knowledge to fishers in a systematic manner, thus the divide.

Fishers and community – Local knowledge and practice	**Fisheries Division –** National and international-level biological and technical knowledge
• **Local technological knowledge** • **Local ecological knowledge**	• **National and international-level biological and technical knowledge** • **International technological knowledge**
Based on these broad knowledge base, fishers and community see the need to: • Maintain economic viability of the fishery to meet individual and community expectations (control fishing effort, eliminate illegal fishing, increase local sales, export more by-catch); • Monitor the bait fishery (monitor jack landings, improve storage of live jacks, rebuild flying fish stocks); • Maintain and where necessary improve quality control of fish and fish markets; and • Provide alternative income generating activities to fishing (improve agriculture, educations and training for fishermen)	Based on these broad knowledge base, Fisheries Division see the need to: • Acknowledge and make use of avenues existing for modest expansion in this fishery in order to increase fish production while at the same time reducing fishing pressure on the highly impacted demersal stocks; • Ensure equitable sharing of resources and sea space among local fishers and for protection of the waters from foreign illegal fishers; • Support the principle of regional approach at management of stocks, which are shared and under straddling jurisdictions; • Promote regional/sub regional mechanism for decision-making and action; and • Commit to follow-up guidelines provided through regional stock assessment generated by agencies such as ICCAT, UN, FAO, and CFU

Local technological knowledge === International technological knowledge
Local ecological knowledge === National and international biological & technical knowledge

Based on these broader combined knowledge,

- **How can we bridge the two???**

Combining fishers & community with Fisheries Division Knowledge

Figure 5. Diagram showing the link between fishers & community and Fisheries Division

Style of management and communication are critical for successful integration of fishers' knowledge in national policy and management. The challenge for effective Caribbean fisheries planning and decision-making is to create opportunities for management that are cross-scaled and participatory, that links knowledge possessed by fishers and FD. A top-down style of management has only served to alienate fishers and the FD. A bottom-up approach, getting fishers involved in management is a more favoured approach. For this style of management to work, one needs effective two-way communication between fishery managers and fishers. For Gouyave fishers, there was almost no communication between fishery managers and fishers. Extension officers, the main link between the FD and fishers, were not communicating with fishers, thus creating distance between the two parties.

Bottom-up style of management and effective two-way communication might create a platform for knowledge sharing and learning, between fishers and FD. In this case, the following strategies were identified:

- **Preparing FD and fishers for open communication**. In many instances it is assumed that both groups are open to two-way communication. Fishery managers assume that fishers don't want to speak to them, or they complain a lot, and fishers think fishery managers are to 'uptight'. Secondly, fishery managers assume that fishers understand when they speak and visa versa. Removing barriers to open two-way communication is important in a consultation process.
- **Building relationships and respect**. To begin the process, fishery managers had to meet fishers in their own "space", i.e. meeting fishers on the fishing beach, at the homes, in bars where they congregate, listening to their problems and issues. A way of showing approval and appreciation for fishers' knowledge and contribution to the national economy. Fishery managers also need to understand social rules of the community, and giving fishers and community due respect.
- **Group discussions on specific subject area**, e.g. ICCAT policies, illegal fishing to name a few. Fishers mentioned a number of issues they would like the FD to address. To effectively tackle these problems, the FD identified priority areas,

and held subject specific meetings on how to deal with the problems, a forum for discussion and working towards possible solutions.

- **Knowledge gathering and documentation**. From the above group discussion, further information gathering will be required. The information is later shared between the two groups, facilitating exchange and feedback. At this stage fishers would feel a part of the solution and would willingly give information to solve these problems. Proper documentation of fishers' information is critical for learning to occur.
- **Trial and error learning and problem solving**. It is important that fishers understand that the FD doesn't have all the answers, but that the process is by trial and error and that problem solving will take some time. During this phase, it is important to give fishers feedback. In many cases, fishers are left feeling exploited as initially they were consulted, but do not understand how final decisions for implementation were made.

CONCLUSION

"One hand can't clap". On one hand, knowledge that resides with the FD (national and international biological, technical, and technological knowledge) used to develop national and international policies and management of large pelagics, ignores community needs, constraints, and ability to comply with regulations. On the other hand, fishers' knowledge (local ecological and technical) focuses on solving fishers and community's immediate needs, and not necessarily international concerns. Effective fisheries management requires creating a platform that facilitate learning and sharing of knowledge via communication among stakeholders, and a bottom-up style of management. That is, ensuring the knowledge possessed by both groups with be used, thus broadening the knowledge base and information necessary for policy and management of large pelagic species.

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Fig. 1: Map of Grenada

Fig. 3: Canoes (small), Fibreglass (medium), and Large longline vessels in Gouyave

Table 1: Evolution of Longline Fishery in Gouyave (Impact of the Cuban and American Design on present Grenadian design)

VARIABLES	CUBAN DESIGN (1980-83)	EARLY GRENADIAN DESIGN (1985)	AMERICAN DESIGN (1987/88)	PRESENT GRENADIAN DESIGN (1990S-PRESENT)
Boat size (m)	• 12-14	• 5-9	• 9-14	• 5-12
Monofilament plastic	• Splice the ends • Used twisted plastic • 2X250 lbs. strain drilled and twisted into a line • manual system of deployment • tie dropline to mainline • Cable used between hook and line	• Crimp end with sleeves • Manual twisted plastic mainline (250 lbs.X2) & single dropline 400 lbs. strain • Snap dropline to mainline • No cable between hook and line	• Crimp end with aluminum sleeves • Single monofilament plastic • Hydraulic Mainline: 700-800 lbs. strain • Hydraulic and manual dropline 400 lbs. strain • Snap on dropline to mainline • No cable between hook and line	• Crimp end with aluminum sleeves • Single monofilament plastic • Mainline 150-500 lbs. strain • Dropline 100-300 lbs. strain • Tie with snap on dropline to mainline • No cable between hook and line
Deploy line	• Used box to store main & drop lines. • Hooks were detached; when setting attached hooks to line.	• Used box to store mainline • Dropline on reel	• Used hydraulic reels to store lines	• Small boats, mainline and dropline on manual reel • Larger boats, some with hydraulic mainlines
Dropline	• Vary dropline 15 - 20 fathoms • Distance between dropline varies from 5-25 fathoms • Mainline fixed 20 fath. spacing	• Vary dropline from 5-25 fathoms • Distance between dropline: small boats 5-25 fathoms large boats 30-35 fathoms	• All dropline the same 15 – 20 fathoms (some boats) • Distance between dropline arbitrary (hydraulic system)	• Vary dropline from 3-30 fathoms • Distance between dropline varies 18-35 fathoms apart
Hooks	• Curved hooks 8/O tuna hook 9202 • 30 – 50 hooks per line	• small boats 7/O large boats 8/O mustard hooks 7698 • Up to 100 hooks per line	• Flat hooks • 9/O 7698B • 300 hooks per line	• Hooks 7/0 or 8/0 • 100- 500 hooks per line depending on boat size.
Buoyline	• Set at 5 fathoms depth • 1 buoy every 3 hook	• Set at 5 fathoms	• Lines 15 - 20 fathoms, others at 20 fathoms • 1 buoy every 6 hooks	• Set at 2-5 fathoms • 1 buoy every 3 hook
Depth fished	• 5-25 fathoms	• 5-25 fathoms	• 30-45 fathoms (fishing deep)	• 25-30 fathoms
Distance	• 44 hooks set out about 0.5 km	• 75 hooks set out about 6 km	• 400 – 500 hooks set out 32 plus km •	• 100-500 hooks set out 3-12 km
Species targeted	• Yellow fin Tuna • Sailfish • Marlin	• Yellow fin Tuna • Sailfish	• Swordfish (using stick lights) • Yellow fin Tuna	• Yellow fin tuna • Sailfish • Dolphin • Marlin

Table 2: ICCAT's world stock status and management objectives for large pelagics fished by fishers in Grenada. Information from ICCAT Report, 2002-03

Atlantic Yellowfin Tuna (*Thunnus albacares*) – stocks fully exploited	
Stock Status	A full assessment was last conducted in 2000, using various age-structured and production models; emphasis was placed on the development of the production models, which covered a plausible range of F_{MSY} and MSY estimates. Both equilibrium and non-equilibrium production models were examined in 2000. The equilibrium model estimated MSY range at 144,600 to 147,300 MT, and the estimates of F_{MSY} ranged from 70,000 to 52,700 standard fishing days. MSY estimates based on non-equilibrium model were 152,200 MT. The agreed MSY range was 144,600 – 152,200 MT. In summary, the production model implies that catches could be slightly lower that MSY levels, but effort may be above or below the MSY level, depending on assumptions made to fishing power. Yield-per-recruit analyses also indicated that 1999 fishing mortality rates could either be above or about levels, which could produce MSY.
Current (2001) Yield	157, 000 MT
Management measures in effect	The scientific committee recommended to the Commission: • maintaining the 3.2 kg minimum size regulations • effective fishing effort not exceeding 1992 level • closed area/season for fishing on Fish Aggregating Devices • maintain present catch levels
Atlantic Blue Marlin (*Makaira nigricans*) – stocks over-exploited	
Stock Status	An assessment was carried out in 2000 various assessment techniques, which suggests that total Atlantic stocks is about 40% of B_{MSY} and that overfishing has taken place in the last 10-15 years. The assessment also suggest a less productive stock from 4,500 MT (1996 assessment) to about 2,000 MT, and a fishing mortality 4 times higher than F_{MSY}. The agreed MSY range was 2,000 MT (2,000-3,000). Uncertainty was reported in the assessment related to historical data that was not well quantified. To reduce the assessment in future assessments, historical catch and effective fishing effort data must be validated.
Recent (2000) Yield	3,394 MT
Management Measures in effect	The Committee recommends that the Commission takes step to reduced pelagic longline and purse seine landings to 50% of 1996 or 1999 levels, whichever is greater, by: • releasing live fish from fishing gear; • reducing fleet-wide effort; • better estimation on dead discards; • establishing time area closure; and • scientific observer sampling for verification should be considered
Atlantic White Marlin (*Tetrapturus albidus*) – stocks severely over-exploited	
Stock Status	Assessment information is not informative enough to provide high certainty estimates of stock status. Assessment results of 1996 are similar to 2000, which suggests that the Atlantic stocks are still over-fished and continues to suffer over-fishing. Again there is uncertainty to data and model inputs, the committee noted that to properly quantify and reduce this uncertainty improvements should be made in estimates of historical and recent catch, abundance indices and on the biology of white marlin. This will require research investment in estimating effective fishing effort, historical data validation, and biological investigations of age, growth,

	reproduction, and habitat requirements.
Management measures in effect	The Committee suggests that the Commission: • In 2001 and 2002, purse seine and longline fisheries limit landings to 33% of maximum (1996, 1999) level; • Continue improving observer programmes to obtain better estimates of catch and dead discards; and • Gather new quantitative information on the biology of white marlin.
Atlantic Sailfish *(Istiophorus albicans)* – suspect stocks fully exploited	
Stock Status	All previous assessments were done on aggregate data on sailfish and spearfish obtained from the offshore longline fleets. The west Atlantic sailfish/spearfish, the primary artisanal fisheries are from many countries in the Caribbean Sea, were fully exploited and fishing mortality fully stabilize since the 1980s. Assessment conducted in 2001 based on sailfish/spearfish composite catches and sailfish only catches, considerable uncertainty relating to both catches and catch rates that can only be addressed with more research investment in historical data validation and in investigating habitat requirement. At present the most reliable information is abundance indices and indication of changes in biomass for the stocks of sailfish only or sailfish/spearfish. Recent catch levels of sailfish/spearfish combined seem sustainable, because CPUE and catch have remained relatively constant.
Management measures in effect	The Commission recommends that West Atlantic Sailfish only catches should not exceed current levels; and greater emphasis on reports by species and data on dead discards.
North Atlantic Swordfish (*Xiphias gladius*) – stocks over-exploited, but have improved in recent years	
Stock Status	In 2002, the status of North Atlantic Swordfish was assessed using non-equilibrium stock production models and sequential population analyses based on catch and CPUE data. The assessment indicates that biomass has improved and there has been a reduction in catches. An updated estimate of MSY from production model analyses is 14,340 MT (range 11,580 – 15, 530). High recruitment in combination with actions taken to reduce catch has resulted in increased stock size.
Management Measures in effect	The Committee recommends • Catch limits - Country specific quotas • Minimum size limits - 125/119 cm Lower Jaw Fork Length minimum size regulations
Dolphinfish (*Coryphaena hippurus*) no data – Unknown; does not fall within ICCAT mandate, but work done in the Caribbean	
Stock Status	Others have conducted assessment of Dolphinfish, these include Oxenford and Hunte (1983) on defining number of stocks; Mahon and Oxenford (1999) yield per recruit analysis; Prager (2000) preliminary biomass estimates; and Parker et al., (2000) length-based catch curve and length-based VPA.