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ABSTRACT

Changes in fishing technology are important in assessing fish stocks. However, in many Fisheries Departments, it is rarely documented at the fishing community level. In the case of Gouyave, Grenada, surface longline fishers, they are constantly adapting and changing fishing technology to increase fish catch and income. The objective of this paper is to document the history of surface longline fishing technology (boat and gear), and determine how this technological knowledge, possessed by fishers could be included in fisheries management. Information was obtained from interviews with knowledgeable fishers.

Traditionally, Gouyave fishers were involved in beach seine and '3-line' (hand line) fishing, from non-mechanized wooden sloop canoes. By the 1980s, the Government of Grenada with assistance from the Cuban Government popularized surface longline fishing. Since then, fishers adapted and developed longline boat and gear technology to improve efficiency and effectiveness. Longline technology developed from twisted 2 x 113 kg strain monofilament mainline and droplines stored and deployed from a box, to single monofilament lines stored and deployed from reels. Boat technology developed from mechanized 5 m wooden canoes to 6 - 12 m fibreglass vessels.

KEY WORDS: Fishing technology, Gouyave, surface longline

## Historia de la Tecnología de Pesca con Línea Larga en Gouyave, Grenada

Cambios en la tecnología de pesca son importantes para evaluar la reserva pesquera. Sin embargo, en muchos departamentos pesqueros estos cambios son raramente documentados en la pesca a escala comunitaria. En el caso de Gouyave, Grenada, pescadores de línea larga superficial se están adaptando constantemente y cambiando la tecnología pesquera para incrementar la captura de peces e ingresos. El objetivo de este trabajo es documentar la historia de la tecnología de pesca con línea larga superficial (bote y engranaje), y determinar como este conocimiento tecnológico poseído por los pecadores podría ser incluido en el manejo pesquero. La información fue obtenida a través de entrevistas con pescadores de experiencia.

Tradicionalmente los pescadores de Gouyave estaban pescando con red playera y '3-líneas' (línea manual), desde canoas de balandro de madera no mecanizadas. Hacia los anos 80, el Gobierno de Grenada con la asistencia del Gobierno Cubano popularizó la pesca superficial en aguas costeras. Desde entonces, los pescadores de adaptaron y desarrollaron botes con línea larga y tecnología de engranaje para mejorar la eficiencia y efectividad. La tecnología de línea larga se desarrolló de línea principal de mono filamento torzonada de 2 x 113 Kg. de esfuerzo y líneas de fondo guardadas y desplegadas desde una caja, a líneas de mono filamento único guardadas y desplegadas desde carretes. La tecnología de botes se desarrollo pasando de canoas mecanizadas de madera de 5m a navíos de fibra de vidrio de 6-12m.

PALABRAS CLAVES: Tecnología pesquera, Gouyave, línea larga superficial

## INTRODUCTION

A new paradigm is emerging in small-scale fisheries management: large volume of scientific data is not necessary to evaluate the status of a fishery - management can work with low inputs of data by including qualitative indicators, proximate variables, and local and traditional knowledge (Pitcher et al. 1998, Charles 1998, Berkes et al. 2001). In recent years, many researchers and practitioners have come to value local and traditional knowledge as reliable, low-input data that could be included in fisheries management (Gadgil et al. 1993, Ruddle 1994, Hanna 1998, Berkes 1999, Johannes et al. 2000, Johannes 2001). The term 'fisher knowledge' and in some instances 'local knowledge' is used here to describe the body of ecological knowledge and management practices on aquatic resources and the environment, evolving by adaptive processes. Traditional knowledge is a cumulative body of knowledge, evolved by adaptive processes and handed down through generations (Berkes 1999).

In the Caribbean, little is known about local and traditional knowledge of natural resources except in the following cases: mangrove conservation in St. Lucia (Smith and Berkes 1993); sustainable extract forest timber in Dominica (Berkes 1999); management of sea urchin resources in St. Lucia and Barbados (Berkes 1999); and using fisher knowledge of sea colour and debris to indicate the presence of flyingfish (*Hirundichtys affinis*) and large pelagic species in the eastern Caribbean (Gomes et al. 1998). In the case of Gouyave surface longline fishery, fishers possess two types of local knowledge: ecological knowledge (species abundance, effects of current, and reproductive and spawning seasonality) (Grant and Berkes 2004); and technological knowledge (gear and boat technology). The objective of this paper is to document technological knowledge possessed by Gouyave fishers and to determine how this knowledge could be included in fisheries management.

## METHODS

Fisher technological knowledge of longline gear, boats, and fishing practices was documented during the period December 2002 to March 2004.

A review of available literature and reports was conducted to construct the history of longline development. The authors soon realized that not much information was documented for Gouyave, thus key informant interviews were conducted with over 12 retired and knowledgeable fishers (recommended by fishers, community members, and Fisheries Division staff), and two Fisheries Officers at the Fisheries Division (FD), on the history of longline fishing and longline fishing techniques in Gouyave. One useful technique was to ask fishers to build models of the different longline designs using the same material as in the past, (as much as possible). During interviews with other fishers, model longlines were presented to ensure the researcher and interviewee were discussing the same gear adaptation. It also helped fishers recall how the gear was used and construction techniques, since there were so many versions of the longline gear.

## RESULTS

This section documented Gouyave longline fishery and traced the history of longline and boat changes in Gouyave from the 1960s to present. Time periods were arbitrarily chosen based on significant technological changes. Three major periods were identified: pre-longline era (< 1960s - 1978), popularization of longline (1979 - 1999), and present longline (2000 - 2004).

### Gouyave Longline Fishery

The fishing community of Gouyave located on the west coast of Grenada (latitude 11°35’ and 12°15’ north, and longitude 61°35’ and 61°48’ west). The fishery in Gouyave is small-scale, with three stock types based on fishing methods, and fish type: demersal, inshore pelagic, and the most important - oceanic/large pelagic.

In Gouyave, surface longline (referred to in this paper as longline) construction consisted of: mainline, droplines, hooks, float lines, buoys, flags, and lighted poles. Braided nylon loops were inserted along the mainline onto which droplines of varied lengths were ties during gear set. Buoylines were attached every third dropline. Flags and lighted poles were placed at either end of the mainline to signal boats that a longline was in the area. While fishing, a boat was allowed to drift with the current, while the entire longline was placed in the water. To identify and locate the drifting longline, two flags were placed at each end. Every 60 - 90 minutes fishers patrolled the entire line to check for missing buoys, which signaled that a fish was on the dropline. To retrieve the line, the first end in the water became the starting point (Mitchell 1992).

The longline fishery targeted yellowfin tuna (*Thunnus albacares*) and bycatch such as sailfish (*Istiophorus platypterus*), common dolphinfish (*Coryphaena hippurus*), blue marlin (*Makaira nigricans*), white marlin (*Tetrapturus albidus*), swordfish (*Xiphias gladius*), albacore (*Thunnus alalunga*), wahoo (*Acanthocybium solandri*), shark (*Katsuwonus pelamis*), bigeye tuna (*Thunnus obesus*), and fringe tuna (*Auxis thazard*) listed in order of market preference.

**Pre-Longline Era (< 1960s – 1978)**

Before the 1970s, Gouyave fishers used different traditional fishing techniques. The main gear was beachseine for inshore pelagic species. Others included: 'bazor' and handline for flying fish; touch and 'cali' gear (similar to a dip net) for ballyhoo (*Hemiramphus brasiliensis)*; '3-line' (a 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).

The '3-line' handline fishing technique required three fishers with monofilament line and a single straight hook: a bow-line, the deepest baited with a live flyingfish; a middle-line, constructed with a swivel and lead weight to keep the line suspended in mid-water; and the stern-line, the shallowest, both baited with a piece of fish. Using different depths and placing lines at different sections of the boat prevented the lines from becoming tangled. Some fishers attached the line to a 15 cm bamboo/trap that would 'dance' or signal to fishers that a fish was on the hook. This technique was used to catch the occasional large pelagic species such as marlin and sailfish.

In the early 1970s, fishers observed Venezuelan industrial longline vessels fishing. At times, they lifted lines from the water, to copy the technology, "*we copied as much as was good for us, and we made up [invented] the rest*". Later, two boats started experimenting in secret with a very primitive form of longline, using cord, wire, and 26 straight hooks. Mainline and droplines were made from braided nylon, with twisted copper wires to attach the straight hook, to prevent fish cutting the line when they 'bite' (Figure 1). Fishers would affix the line to the stern of the boat with a 5 - 8 cm tyre trap, drifted with the current and set the line, fishing 11 - 13 hours/day, depending on the wind. The main problems with this technology were the raw-material for line construction was very expensive, and because the line was not allowed to drift it burst continuously because of the tension. With this newly constructed gear, they caught flyingfish, sailfish, marlin, dolphinfish, and kingfish. In terms of performance, this new construct fished 10% better than the '3-line'.

There were two types of vessels: wooden canoes, 4 - 5 m in length, powered by oars (sometimes sail); and sloops or double ender wooden boats, 4 - 6 m in length, powered by oars and sails. By the early 1950s, canoe boats were modified by opening the shaft on the stern to secure the engine. The Wilson's brothers (from the USA), fitted an inboard engine on larger wooden boats, and by the late 1960s, diesel inboard engine was introduced. Boats did not have navigational or safety equipment.

**Popularization of Longline (1979 – 1999)**

In 1979 the Grenadian Revolutionary Government with assistance from the Cuban government helped to popularized longline. Fishermen were sent to Cuba to be trained, and Cuban master fishermen with fishing equipment (seven fully equipped longline ferro-cement boats) were sent to train fishermen in Grenada. Grenadian fishers were trained in pole fishing ("fly fishing") for skipjack tuna with artificial bait, construction of fish and lobster traps, the art of surface longline, bottom longline for shark, and gillnet for flying fish (personal communication, Johnson St. Louis 2003). Of all the gears, longline had the greatest impact on Gouyave fishers. 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.

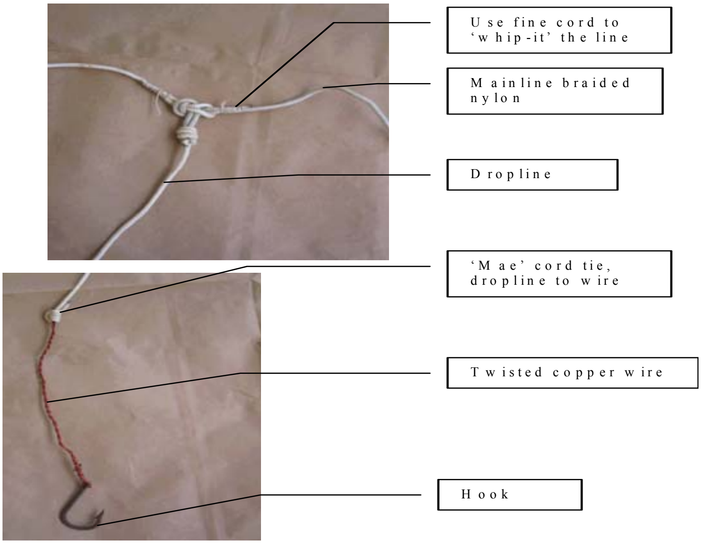


**Figure 1**. Primitive longline made with braided nylon cord, wire, and straight hook

*Cuban design (1980 - 1983)* — Popularization of longline started with the Cuban design between 1980 and 1983, using 2 X 113 kg test strain monofilament, drilled and twisted mainline and dropline, stored and deployed from a ply box, using curved 8/0 tuna hooks #9202 (Fig. 2). The distance between droplines on the main was fixed at 18 m apart. Dropline lengths were also fixed at 18, 14, 9, and 4.6 m. Droplines were attached to the mainline, using #18 braided nylon cord/rope, to make a common fisherman's knot. Fishers used 30-50 hooks per line; total length 0.5 km. Main species caught were yellowfin tuna, sailfish, and marlin (Table 1).

The Cuban technology fished 80% better than the primitive longlines, attracting more fishers and investors to fishing. During this time, fishers caught so much fish there wasn't enough freezer storage space; "*at that time the revolution was pretty young and we hadn't enough cold-storage facilities on the island to store tuna and bycatch*" (personal communication, Joseph Taviner 2003). In many instances, fishers had to bury fish because of spoilage.

Fishers were trained on seven Cuban ferro-cement boats, 12 m in length and 4.6 m wide, with two cabins (one in the bow and the other the stern) powered by sails and inboard engines. Four Cuban and four Grenadians were aboard each vessel, working together as a team (a captain, a cook, an engineer, and a fisher); Grenadians learning from Cubans; "… *each Grenadian was given a specific task [on the boat]. We watched what the Cubans were doing* *and learn*" (personal communication, Matthew Duncan 2003). Fishers used boats as the pre-longline era.

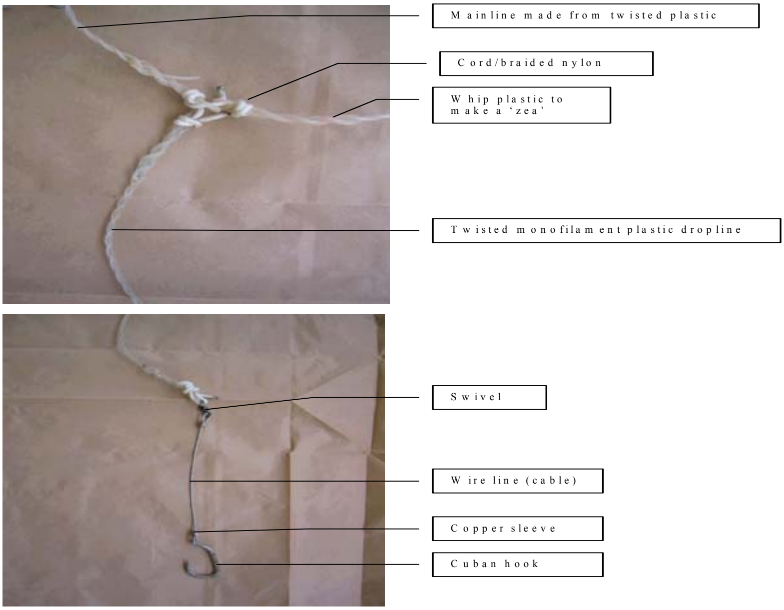


**Figure 2**. Adapted Cuban design made with twisted monofilament, wire, and curved hook

*Early Gouyave Design (1985-1987)* — After the revolution, fishers continued using the Cuban technology but with some adaptation. This new adapted version, we term the early Gouyave design. Fishers were still using twisted monofilament mainline, but with single monofilament dropline of 181 kg. Droplines were snapped to mainline, using a branch hanger, and no cable attached to hooks. Main and dropline were stored and deployed from a box. Dropline length varied by boat size: small boats used lengths between 4.6 - 23 m, with 7/0 hooks; while larger boats used 27 - 32 m with 8/0 mustard hooks #7698. Longlines were now using up to 100 hooks (6 - 10 km in length). Main pelagic species caught were yellowfin tuna and sailfish (Table 1).

Over the years, boats increased in length and power. Small canoes, 4 - 5 m in length, were mainly mechanized, with one 25 - 30 hp outboard engine; larger wooden boats, 6.7 - 7 m in length, with two outboard engines (built wider to accommodate two engines). Large wooden boats with inboard engines were still operating.

**Table 1**: Evolution of the longline gear in Gouyave (1980s to 2004)

| ***VARIABLES*** | **CUBAN DESIGN (1980-83) A** | **EARLY GOUYAVE DESIGN (1985) B** | **AMERICAN DESIGN (1987/88) c** | **PRESENT GOUYAVE DESIGN (1990s-2004) d** |
|---|---|---|---|---|
| ***Boat size (m)*** | 12-14 | 5-9 | 9-14 | 5-12 |
| ***Monofilament plastic*** | Splice the ends<br>Used twisted plastic<br>2X113 kg strain drilled and twisted into a line<br>manual system of deployment<br>tie dropline to mainline<br>Cable used between hook and line | Crimp end with sleeves<br>Manual twisted plastic mainline (2X113 kg) & single dropline 181 kg strain<br>Snap dropline to mainline<br>No cable between hook and line | Crimp end with aluminum sleeves<br>Single monofilament plastic<br>Hydraulic Mainline: 318-363 kg strain<br>Hydraulic and manual dropline 181 kg strain<br>Snap on dropline to mainline<br>No cable between hook and line | Crimp end with aluminum sleeves<br>Single monofilament plastic<br>Mainline 68-227 kg strain<br>Dropline 45-136 kg strain<br>Tie with snap on dropline to mainline<br>No cable between hook and line |
| ***Deploy line*** | Used box to store main & drop lines.<br>Hooks were detached; when setting attached hooks to line. | Used box to store mainline<br>Dropline on reel | Used hydraulic reels to store lines | Small boats, mainline and dropline on manual reel<br>Larger boats, some with hydraulic mainlines |
| ***Dropline*** | Vary dropline 14-18 m<br>Distance between dropline varies from 4.6-23 m<br>Mainline fixed 18 m spacing | Vary dropline from 4.6-23 m<br>Distance between dropline: small boats 4.6-23 m large boats 27-32 m | All dropline the same 14-18 m (some boats)<br>Distance between dropline arbitrary (hydraulic system) | Vary dropline from 2.7-27 m<br>Distance between dropline varies 16-32 m apart |
| ***Hooks*** | Curved hooks 8/0 tuna hook 9202<br>30 – 50 hooks per line | small boats 7/0 large boats 8/0 mustard hooks 7698<br>Up to 100 hooks per line | Flat hooks<br>9/O 7698B<br>300 hooks per line | Hooks 7/0 or 8/0<br>100- 500 hooks per line depending on boat size. |
| ***Buoyline*** | Set at 4.6 m depth<br>1 buoy every 3 hooks | Set at 4.6 m | Lines 14-18 m, others at 18 m<br>1 buoy every 6 hooks | Set at 1.8-4.6 m<br>1 buoy every 3 hook |
| ***Depth fished*** | 4.6-23 m | 4.6-23 m | 27-41 m (fishing deep) | 23-27 m |
| ***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*** | Yellowfin Tuna<br>Sailfish<br>Marlin | Yellowfin Tuna<br>Sailfish | Swordfish (using stick lights)<br>Yellowfin Tuna | Yellowfin tuna<br>Sailfish<br>Dolphin<br>Marlin |

*American design (1987-1989)* — In 1988 Government approved foreign fishing licenses for seven US longliners to fish in Grenadian water, with one local fisher onboard as observer (Samlalsingh et al. 1999, Weider 2001). Their technology, which we termed the 'American design', was single 318 - 363 kg strain monofilament mainline, 181 kg strain dropline, stored and deployed from hydraulic reels. All dropline lengths were similar 14 - 18 m. The distances between droplines were arbitrary, as the system was totally dependent on a hydraulic system. Branch hangers were used to attach dropline to mainline. Each longline had about 300 flat 9/0 #7698B hooks. Buoylines lengths were 14 - 18 m, one buoy every six hooks. Lines fished 27 - 41 m deep, with total line length of 32 km. Specie targeted was swordfish, using light stick (Table 1).

*The Gouyave design I (1987- early 1990s)* — From observing fishing operations on the Cuban and American vessels, reading, along with technical training provided by the FD, fishers started experimenting with different designs to develop a localized system. Fishers Desmond Gill (2003) summarized the changes:

> *"During the period [1988-1990] I had a small wooden canoe boat, about 4.6 m in length, powered by a 15 hp Yamaha engine. It was only two of us [fishers] at the time. We tried using a 36 kg monofilament strain with cable to catch kingfish, blackfin tuna, and barracuda. But big fish burst the line. So we increased the strain to 59 kg, still fish burst the line. So we increased the strain again to 91 kg, and we started catching sailfish and yellowfin tuna. Once we caught six sailfish, we had to tie them to the side of the boat because there wasn't enough space inside the boat. Then we made bigger canoe boats, 5.5-6 m, powered by 40 hp, and increased line strain to 113 kg. Later we increased the strain to 136 kg."*

Mainline and droplines were now made from single monofilament plastic. Reels were introduced to keep the line firm and straight. Fishers also started using sleeves on the line, and increased the number of hooks to about 100 (Samlalsingh et al. 1999).

Small canoes, 5 m long, powered by one 15 hp outboard engine, were still operational. There were also larger wooden boats without forward cabins, powered by one outboard engine; and large wooden boats with forward cabins, powered by inboard diesel engines. In 1986/87 a boat-building company in Mount Moritz fashioned pirogue boats from a Trinidadian mould (Samlalsingh, et al. 1999). They were also fiberglass boats, 9 m long, powered by two 40 - 48 hp outboard engines, with a crew of three fishers.

*The present Gouyave design II (late 1990s-1999)* — Between 1990-93/94 there was a boom in fiberglass pirogue vessels with forward cabin, powered by 60 - 85 hp engines. By the late 1990s, fishers began noticing a decline in fish stocks and decided they needed boats that could go further offshore and fish longer. Also, the operational cost of the fibreglass pirogue was very high, due to high fuel consumption and cost. According to one fisher, "O*ur expense was more than our wages.*" Thus in 1997, fishers and investors came together to design a larger semi-industrial vessel (built in the USA) that was affordable, with relatively low operational cost, and could travel further offshore. With the introduction of these larger vessels, the weight of lines increased, the number of hooks increased, and droplines were set deeper to target swordfish at nights (Table 2).

The 1997 boat census reported Gouyave had 72 vessels: 44 pirogues and 12 canoes involved in longline (Straker, 1997). Later large longline vessels were 10 - 13 m in length, powered by inboard diesel engines, forward cabin (cooking and sleeping accommodations), hydraulic mainline, dropline, and bouyline reels (some boats), and staying three to four days at sea, with safety and navigational equipment (Table 2).

**Present Gouyave Longline Technology (2000—2004)**

In the last four years, three major technological adaptations were made, adding to the diversity of longline: changes in line construction; changes in the weight of monofilament plastics; and changes in boat construction (Table 2).

*Changes in Line Construction* — The length of mainlines ranged from 3 - 10 km, with 136 kg breaking strain. Braided nylon loops 1.5 cm thick were inserted every 18 m along the mainline, onto which droplines are attached by branch hangers during the gear set. Droplines varied in length from 3 - 32 m, using five to eight different lengths, marked by coloured beads (Figure 3). Buoylines, 3 m in length, were attached after every third hook. Mainline and droplines are deployed from separate manual reels with over 300 hooks.

By 2003, there was no standard longline construction. In the past, fishers constructed lines using single monofilament plastic, with dropline lengths ranging from the longest length (23 m) to the shortest length (4.6 m), with 4.6 m increments, e.g., 23, 18, 14, 9, 4.6 m. Fishers changed line construction by mixing dropline length, e.g., 23, 4.6, 11, 2 m, with some fishers having up to ten different dropline lengths.

*Changes in Weight of Monofilament Plastic* — In the earlier days, fishers used twisted 2 X 113 kg strain monofilament line, however, constant experimentation with lighter breaking strain lines, hooks, and gear design, six longline types have evolved:

i) *Large line* made with 227 kg single strain monofilament line with large buoys; hooks baited with live flying fish; line operated from a hydraulic reel on semi-industrial vessels; and seasonal fishing October to June targeting yellowfin tuna, sailfish, and marlin.

ii) *Regular longline* made with 136 kg strain monofilament line; 7/0 and 8/0 hooks baited with medium and large live jacks (*Selqr crumenonophthalmus*) or flying fish; line operated from manual reel on all vessel types; and fishing year round targeting yellowfin tuna, sailfish, and marlin.

iii) *Light line* made from 91-113 kg strain monofilament line; 7/0 and 8/0 hooks baited with medium and large jacks; line operated from manual

**Table 2**. Description of three categories of longline vessels in Gouyave (2003).

| Variables | Canoe (Small) | Pirogues (Medium) | Semi-industrial (Large) |
|---|---|---|---|
| |  |  |  |
| | **BOAT** | | |
| ***# active boats*** | 67 | 21 | 10 |
| ***Crew*** | 2 | 2-3 | 3-5 |
| ***Boat Size (m)*** | <5.5 m (open) | 6-9 m (forwards cabin) | 9-12 m (wheel house) |
| ***Boat material*** | Wood | Wood or fibre | Fibre |
| ***Ice*** | No | No | Yes |
| ***Storage*** | Small | Medium – small cabin | Large – sleeping quarters and fish storage |
| ***Water (litre)*** | 19 | 38 | 378 |
| ***Navigational System*** | Basic | Basic | Advanced navigational system |
| ***Numbers of engines*** | 1 | 2 | 1 |
| ***Fuel*** | Gas; 57 litre/day; 2 tanks | Gas; 113 litre/day; 4 tanks | Diesel; 227 litre/trip; carries up to 757 litre |
| ***Power*** | Outboard 15-75 hp | Outboard 40-90 hp | Inboard 70-350 hp |
| | **GEAR** | | |
| ***Gear used*** | 1 manual mainline reel<br>1 manual dropline reel | 1 manual mainline reel<br>1 manual dropline reel<br>1 manual bouyline reel | 1 hydraulic mainline reel<br>1 manual dropline reel<br>1 manual bouyline reel |
| ***Longline (Monofilament line)*** | 113-136 kg strain | 136-181 kg strain | 227 kg strain mainline<br>204 kg strain dropline<br>136-204 kg strain buoyline |
| ***Length of longline*** | 3-10 km | 5-10 km | 11 km |
| ***Number of hooks*** | 150 hooks; 16 m apart | 160-180 hooks; 16-18 m apart | 300 plus hooks; 27-32 m apart |
| | **FISHING OPERATIONS** | | |
| ***Trips*** | 1 day trip (8 hours) | 1 day trip (up to 24 hrs.) | 4-5 days trip |
| ***Fishing area: distance from shore*** | 11-13 km West | Up to 32 km West | Up to 161 km West |
| ***Species targeted*** | Yellowfin Tuna<br>Blue & White Marlin<br>Dolphinfish<br>Sailfish | Yellowfin Tuna<br>Blue & White Marlin<br>Dolphinfish<br>Sailfish | Yellowfin Tuna<br>Blue & White Marlin<br>Dolphinfish<br>Sailfish<br>Swordfish |
| ***Bait*** | Carry live jacks<br>Catch flyingfish at sea | Carry live jacks<br>Catch flyingfish at sea | Carry live jacks<br>Catch flyingfish at sea<br>dead bait |

reel or box on all vessel types (in 2004 semi-industrial vessels started using this line); seasonal fishing targeting yellowfin tuna, sailfish, and marlin.

iv) *Light light line* made from 68-91 kg strain monofilament with small buoys; hooks (7/0) are baited with small live jacks; line operated from a box on canoes and pirogue vessels; seasonal fishing December to February targeting sailfish.

*v)* *Common Tur line* made from 36-45 kg strain monofilament; hooks baited with small live jacks on canoes only; night fishing operations depending on the phase of the moon, targeting blackfin tuna and sailfish.

*vi)* *Barracuda line* ("wire line") made from 36-45 kg strain line; dropline has cable near the hook; hooks baited with small dead or live jack bait on canoes and pirogue vessels; line operated from a box; seasonal fishing targeting barracuda, sharks, blackfin tuna.

Many boats had at least two longline weight types, e.g., small canoes had a regular and light line. Use of line was based on availability of fish species and gear performance.

*Changes in Boat Construction* — With high fuel bills in the 1990s and Hurricane Lenny in 1999 which destroyed 25% of pirogue boats, by 2000, fishers started evaluating the benefits of canoes versus pirogues. Canoes had similar catch rates, low operational cost, and higher incomes, thus more fishers were attracted to this type of operation. This resulted in a decline in pirogue boat operations and an increase in canoes. In 2001 there were 68 longline boats, 40 canoes, 20 pirogues (a decline from 44 in 1997), and eight semi-industrial vessels. By 2003, the number of canoes increased to 67, a 458% increase in canoe longline boats since 1997.

By late 2003, there were three longline boat designs in Gouyave: wooden canoe/multi-purpose boats, operating near-shore; pirogue longline operating mid-shore; and semi-industrial/launcher vessels operating offshore (Table 2). Wooden canoes, totaled 67 were 5.5 m in length, open, eight hour day trips, with one outboard engine, fishing 11 - 13 km from shore, longline carrying 150 hooks, with two crew. Some fishers have further adapted these boats as multi-purpose vessels for longline (removable reels), trolling (bamboo pole fitting), and other fishing gears. Fiberglass pirogue canoes, totaled 21 were 6 - 9 m in length, with forward cabin, up to 24 hour day trips, with two outboard engines, fishing up to 32 km from shore, longline carrying up to 180 hooks, and two crews (reduced crew from three to two). Semi-industrial vessels, totaled 10 were 9 - 12 m in length, with wheel house, fishing trips four to five days, with inboard engine, fishing up to 161 km from shore, longline carrying over 300 hooks, with three to five crew.

Fishers also made changes to boat construction to accommodate the use of live jacks for use as bait. Seasonal availability of bait flyingfish in previous years, restricted longline fishing activities between January to June (Grant and Rennie 2003), but fishers found that with live jacks from the beach seine fishery, they could fish year round. To accommodate live jacks, fishers remodeled boats with bait-wells, which allowed sea water to move in an out through holes in the bottom. This would keep bait alive for the entire fishing trip. 'Bait-wells' were constructed below the engine in wooden canoes, and the center of pirogue boats. In early 2004, two of ten semi-industrial vessels converted an ice-box to a 'bait-well' so they could fish with jacks.

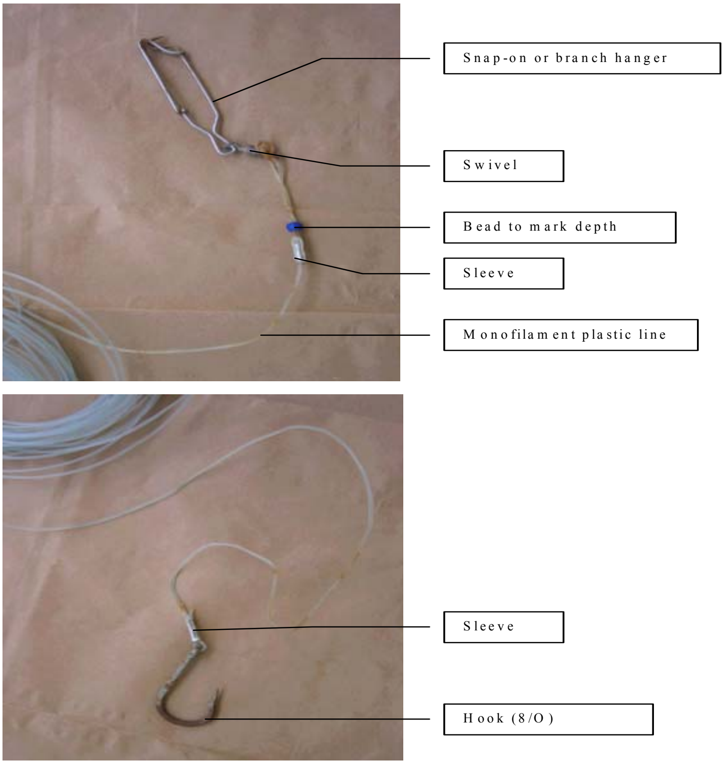


**Figure 3**. Present dropline design made with single monofilament, straight hooks, sleeves and branch hangers.

## DISCUSSION

Over the years, fishers improved longline and boat technology, based on observation, demonstration, and experimentation by trial and error. Is this knowledge important to fishery managers? And, how can fishery managers incorporate such knowledge in fisheries assessment, planning and management?

*Is this knowledge important*? In comparing data on Gouyave fish landings (Figure 4) and technological information from fishers, there was evidence that knowledge is important. Between 1993 and 2002, the total large pelagic species landings by Gouyave longline fishers, showed an increase from 1993-1995, then a decrease (to 1997), and since 1999, landings increased (Figure 4 continuous line); compared to a gradual increase in national landings (Figure 4 broken line). Between 1993 and 1995, there was an increase in fish landings from 423 MT to 474 MT, which corresponded to the boom in pirogue boats. By 1996 and 1997, there was a sharp decline in landings, which corresponds to fishers noting the decline in near-shore fish stocks and wanting to obtain bigger boats to go further offshore to increase catch. By 1997, they secured larger longliners and by 1998, catch improved. In 1999, there was a decline in fish landing, the lowest it had ever been over the ten-year period (150 MT). This was the year of a fish kill, (origins unknown), and for four months consumers were afraid to eat fish. Then by the end of the year, Hurricane Lenny stopped fishing activities for some time. Since then, fish landings increased, peaking in 2001 (536 MT) and slowing in 2002, which was the period of intense changes and adaptation in fishing technology.

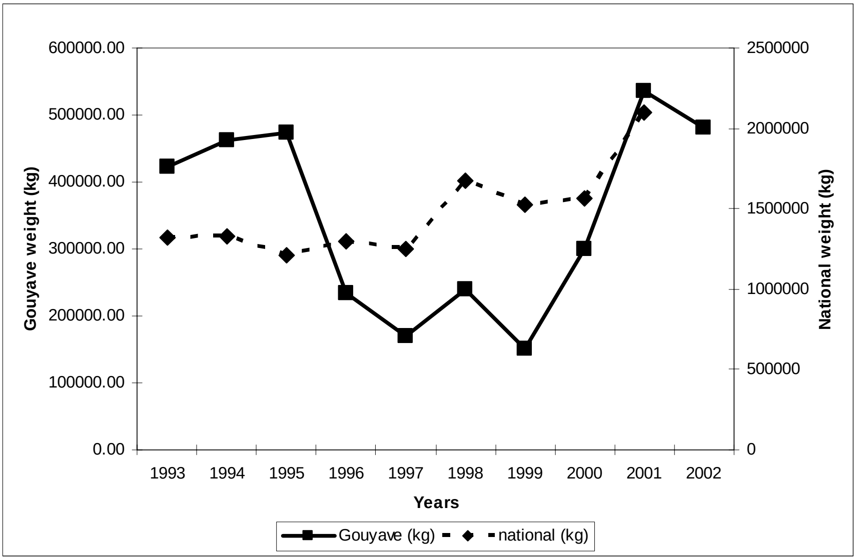


**Figure 4**. Total large pelagic species caught by Gouyave longline fishers compared to national total (1993 - 2002)

*How can this knowledge be incorporated in fisheries assessment, planning and management*? Firstly, data collection systems should document fisher technological knowledge, along with catch, effort, and biological data (Berkes et al. 2001). Information on changes in gear construction, fishing operations, and boat adaptation should be documented in detail, to be used later in assessment. Monitoring of data collection activities is essential, as this provides feedback so that changes can be made to the system (e.g., adjusting how gear information is recorded). At the Gouyave Fish Market, staff recorded '*common tur longline*' as handline, and '*regular longline*' and '*light line*' as longline, not making the distinctions between gears.

Secondly, fisheries assessments should somehow take into account technological changes, not just by description but also calculation. Gouyave fishers' decline in landings in 1996 - 1999 was not due to a decline in fish abundance, as other fishing communities were experiencing an increase in fish catch. Thirdly, fishery managers should have confidence in fisher knowledge by including such information in fisheries planning and management. In the future, fishers plan to further improve boat technology and to develop the technology to store bait. Fishery managers' confidence comes by creating policies that support fishers' initiatives.

A fishery system is not static; it is constantly evolving and changing. Gouyave longline fishery is a good example of this changing system. One thing is certain: fishers will continue to experiment, learn from each other, and increase gear effectiveness. Fisheries scientists and managers need to find ways to use technological knowledge to improve fishing techniques, fisheries assessment and management.

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