

## Current Status of the Longline fishery in Barbados

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### ABSTRACT

The local fishing industry is nutritionally, economically and socially important to Barbados, but recent developments are poorly documented and managers lack up-to-date information. The longline fleet, for example, has grown rapidly since the introduction of the first local vessel in 1990, and has undergone a number of shifts in target species, gear design and fishing operations over this period. However, the current nature of the longline fleet and its fishing operations remain unreported. This study addresses this lack of information by describing the current fleet, its vessel specifications, fishing operations and annual catch, and economic productivity. Data were collected through structured and informal interviews with vessel captains and owners, personal observation and catch monitoring at the main landing site, and at sea observation and monitoring during fishing trips. Landings data were also extracted from the Barbados Fisheries Division database. There are currently over 30 active local longline vessels in the Barbados fleet, fishing year-round and landing around 200 – 400 mt annually. The main target species are yellowfin and bigeye tuna, but swordfish, blue and white marlin and Atlantic sailfish also contribute significantly to the catch. The vessels typically carry 3-5 crew, spend 1-2 weeks at sea, fish around 32-47 km of line and fish in Barbados' EEZ to the east of the island. The vessels of this high investment fishery are privately owned and financed. Despite approximately 40 % of the catch attracting foreign exchange, economic productivity is highly variable.

KEY WORDS: Longline, yellowfin tuna, billfish, economic valuation, Barbados

### Estado Actual de la Pesquería de Palangre en Barbados

La industria pesquera local es vista nutricional, económica y socialmente importante para Barbados, pero los últimos acontecimientos están poco documentados y los administradores de la falta de información al día. La flota palangrera, por ejemplo, ha crecido rápidamente desde la introducción del primer local buque en 1990, y ha sufrido una serie de cambios en las especies objetivo, artes de diseño y las operaciones de pesca durante ese período. Sin embargo, la naturaleza actual de la flota de palangre y sus operaciones siguen siendo la pesca no declarada. Este estudio se ocupa de esta falta de información mediante la descripción de la actual flota, su barco pliego de condiciones, las operaciones de pesca y capturas anuales y la productividad económica. Los datos fueron recolectados a través de estructurados y entrevistas informales con los capitanes de los buques y los propietarios, personal de observación y vigilancia de las capturas en el sitio de aterrizaje principal, y en el mar de observación y vigilancia durante los viajes de pesca. Los desembarques También se extrajeron datos de la Dirección de Pesca Barbados base de datos. En la actualidad hay más de 30 locales activos palangreros en la flota de Barbados, la pesca durante todo el año y el aterrizaje alrededor de 200 - 400 mt por año. Las principales especies objetivo son el rabil y el patudo, pero el pez espada, azul y aguja blanca y pez vela del Atlántico también contribuir de manera significativa a la captura. Los barcos suelen llevar tripulación 3-5, 1-2 semanas pasan en el mar, los peces en torno a 32-47 km de línea y los peces en Barbados "zona económica exclusiva al este de la isla. Los buques de esta pesca de alta inversión son de propiedad privada y la financiación. A pesar de aproximadamente el 40% de las capturas atraer divisas, la productividad económica es muy variable.

PALABRAS CLAVES: Palangre, el rabil, marlines, la valoración económica, Barbados

### Etat Actual de la Pêche a la « Longline » a la Barbade

L'industrie de pêche locale est importante économiquement et socialement ainsi que pour l'alimentation des Barbadiens, mais son évolution récente est peu connue et les gestionnaires manquent d'informations actualisées. La flotille de pêche à la « longline », par exemple, s'est rapidement développée depuis l'introduction du premier navire local en 1990, et a subi un certain nombre de changements pour ce qui concerne les espèces cibles, les modèles des engins de pêche et les opérations de pêche au cours de cette période. Cependant, il n'existe aucun rapport sur la nature actuelle de la flotille à la « longline » et de ses opérations. La présente étude pallie ce manque d'informations en décrivant la flotille courante, les spécifications du navire, les opérations de pêche, les captures annuelles et la productivité économique. Les données ont été récoltées grâce à : des interviews informels et structurés des capitaines et propriétaires des bateaux ; des observations personnelles et le suivi des captures sur le site principal de débarquement ; des observations et des suivis pendant les campagnes de pêche. Les données de débarquement ont aussi été extraites de la base de données de la division des pêches de la Barbade. Il y a actuellement 30 navires locaux actifs à la Barbade, qui pêchent toute l'année et débarquent autour de 200 – 400 tonnes annuellement. Les principales espèces ciblées par cette pêche est le thon albacore et le thon obèse. L'espadon, le marlin bleu, le marlin blanc et le voilier contribuent aussi significativement aux captures. Les navires transportent typiquement 3-5 hommes d'équipage, passent 1-2 semaines en mer, utilisent 32 à 47 km de lignes et pêchent dans la ZEE à l'est de l'île. Les navires de cette pêche à fort investissement appartiennent à des propriétaires privés qui les financent. Malgré le fait qu'environ 40 % des captures attirent des capitaux étrangers, la productivité économique est très variable.

MOTS CLÉS: Longline, Albacore, Marlin, Evaluation

## INTRODUCTION

Barbados has a long tradition of fishing and notably from as far back as the late 1800s the offshore pelagic fishery had become the primary fishery in the island (Willoughby and Cecil 2001). This holds today with pelagic landings accounting for around 90% of total recorded landings (CARIFIS database, Barbados Fisheries Division). The offshore pelagic fleet has continued to develop and diversify over the last 60 years from a sail-powered fleet to a mechanized one in the 1950s; from launches fishing day trips to the addition of ice-boats fishing further afield and staying at sea for a week or more in the late 1970s - 1980s; to the further addition of longline vessels in the 1990s (Willoughby and Cecil 2001).

Fishing makes a significant contribution to the nutritional, economic and social well being of Barbadians. An estimated 6,000 persons, either directly or indirectly, are provided with employment and incomes through businesses related to the fishing industry (Fisheries Division 2004) and approximately 2-3,000 mt of locally caught fish are landed annually for domestic consumption (CARIFIS database). As such, ensuring the sustainability of the major fisheries in Barbados is very important, but effective management needs up-to-date information on the status of the resource as well as on the nature and fishing operations of the various fishing fleets. This has been challenging in the face of such rapid fleet development and available information has not kept pace with the changes, particularly with regard to the longline fleet, which has not been examined since the early 1990s when the fleet was first established (Hunte *et al.* 1994).

Through the current study we attempt to address this lack of up-to-date information by describing the current fishing practices in detail and conducting a preliminary analysis of the economic status of the longline fleet, the most recent addition to Barbados offshore pelagic fishery.

## METHODS

Data on the current operations of the longline fleet were collected through structured face-to-face interviews (using a standard questionnaire) with 20 longline captains from August – September 2006. Each interview lasted around 20 – 30 minutes and sought information on the general characteristics of the fleet, the range of gears and techniques used, the on-board fish handling practices for the target species, the use of logbooks and the perceptions and views of the fishers. This information was augmented in 2008 with economic details of the longline fishing operation through further structured interviews with a majority of longline captains and owners.

Informal interviews and personal observation were also used to supplement data collected through structured interviews. This involved numerous conversations with longline captains, crew members, and other persons involved in the longline fishery; many observational visits to the Bridgetown Fishing Complex (BFC); and joining the

crew of a longline vessel for the duration of three fishing trips between September and October 2006. Typical prices for gear were obtained from local suppliers. Additional detail on the dimensions of the vessels, engine sizes and manufactures was obtained from the vessel registration FIS database held at the Fisheries Division, and landings data for each vessel from 2001-2005 were obtained from the CARIFIS database also held at the Fisheries Division.

## RESULTS

### Fleet Development

After the first registered longline vessel entered the pelagic fleet in 1990 others followed quickly, increasing from around four in late 1990 to 15 by 1995, then to 23 in 1997 (Willoughby and Cecil 2001) and to approximately 30 in 2004 (Fisheries Division 2004). Currently (2006-2008) there are 34 active vessels in the local longline fleet.

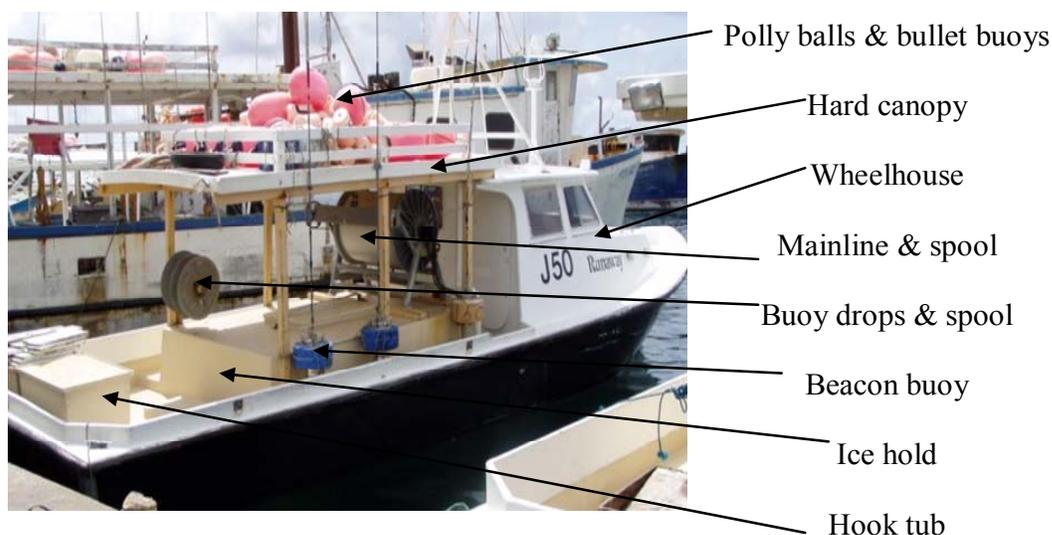
### Fishers

The crew (100% male) of longline vessels range from three to five fishers, with some vessels always carrying a set number, whilst others may vary crew size with fishing trip. All crew members carry out general tasks, such as baiting hooks when the gear is being set, hauling and stowing hooks when the gear is retrieved, and icing the fish after they have been butchered. Crew members also have specific tasks according to their position (*e.g.* captain, butcher or buoyman). Crew members usually remain with one vessel unless that vessel stops fishing for a long period of time, changes ownership, or the crew members do not get along.

The captains range in age from 28 – 58 years and are all experienced fishers. The majority (70% of those interviewed) have 20 or more years of fishing experience and 65% have actually been longlining for >10 years. Most longline captains (90%) started their fishing careers in other forms of fishing and obtained their knowledge of longline fishing techniques and fish handling practices through training from, and observation of, more experienced longline fishers in the local fleet as well as American longliners operating in the region in the 1980s.

### Vessels

According to vessel captains, more than half of the longline vessels currently active in the Barbados pelagic fleet were locally built (61% of vessels) (Figure 1). Others are from North America (22% USA built, 17% Canadian built). About half the fleet are purpose-built longliners, whilst the rest were converted from other types of fishing, predominantly ice-boats. There are no new boats in the fleet, with vessels having an average age of over 18 years, and nearly 70% of the fleet having replaced the original engine.



**Figure 1.** Typical Barbadian longline vessel (2006).

The majority (70 %) of the vessels have glass reinforced plastic (GRP) hulls, whilst 19 % are wooden, two have steel hulls and two are part wood part GRP. Vessels range in size from 12.6 - 25 m in length, with the vast majority (78%) being between 13 – 16 m. They are all powered by inboard diesel engines ranging from 135 – 660 hp. The majority of vessels (76 %) carry engines > 399 hp. Fish hold capacities range from 1.4 – 22.7 mt, with ice holds comprising three to six separate bins and a passage-way for access.

The longline vessels generally carry the same basic navigational and electronic equipment (Table 1). Some of the vessels also carry other electronic equipment such as televisions, radios (stereos), VCRs and DVD players. All of the vessels have a covered wheelhouse, accommodation bunks and small galley. Most of the deck area is also covered with a hard canopy, on top of which the various floats and buoys are stowed. The deck area is dominated by an inbuilt ice hold, on which the mainline spool (and on some vessels, the buoy drop spool) are mounted. The hook tubs are located on the aft deck, usually in the corners and the beacon buoys (beepers) are also stowed there. All of the vessels have an outside steering position, with controls located close to the mainline spool, allowing a single person to control the boat and gear as it is being hauled. This position is also used for manoeuvring when docking the vessel.

### Fishing Gear

The longline fishing gear comprises lines, hooks and a number of accessories (Table 2, Figure 2) and varies very little among vessels. The mainlines, branch lines and buoy drops of all the vessels are made of monofilament nylon, with most (70%) mainlines being between 32 – 47 km long and 700 lb (318 kg) test. Branch lines and drop lines are usually 400 lb (181 kg) test and between 28 – 30 m in

**Table 1.** Summary of the navigational and electronic equipment carried by Barbadian longline vessels, shown as percentage of vessels (n = 20)

Equipment	Function	% Vessels
VHF radio	Short range communication	100
GPS unit	Indicates position, mileage & bearing from the starting point. and assists in navigation	100
SSB radio	Long range communication (up to 300 miles)	95
ADDF receiver	Relocating the longline gear via the beacon buoys (beepers)	95
Automatic pilot	Automatically steers vessel	80
Temperature gauge	Indicates sea surface temperature	75
Depth sounder (fish finder)	Indicates depth of water, depth of the plankton and subsurface temperature of the water	65
Radar	Detects other vessels and gives a visual of the land during bad weather	25

length. Vessels fish between 200 - 700 hooks with the majority (55%) carrying between 400 – 499 hooks. Almost all vessels (95%) use 8/0 size hooks and fish at between 44 - 84 m below the surface.

The fully assembled gear is shown in Figure 2 and the standard set up procedure is described here. A beacon buoy, connected to one or two polly balls is attached to the start of the mainline with one or more snaps. A bullet buoy may also be attached to the start of the mainline. A number of branch lines, each with a baited hook, are then attached to the mainline followed by a bullet buoy. This process is repeated until a 'section' is completed, at which point a polly ball is attached to the mainline to separate the sections. This cycle is repeated for each section until the end of the mainline has been reached or the desired numbers of hooks or baits have been set. At this point the

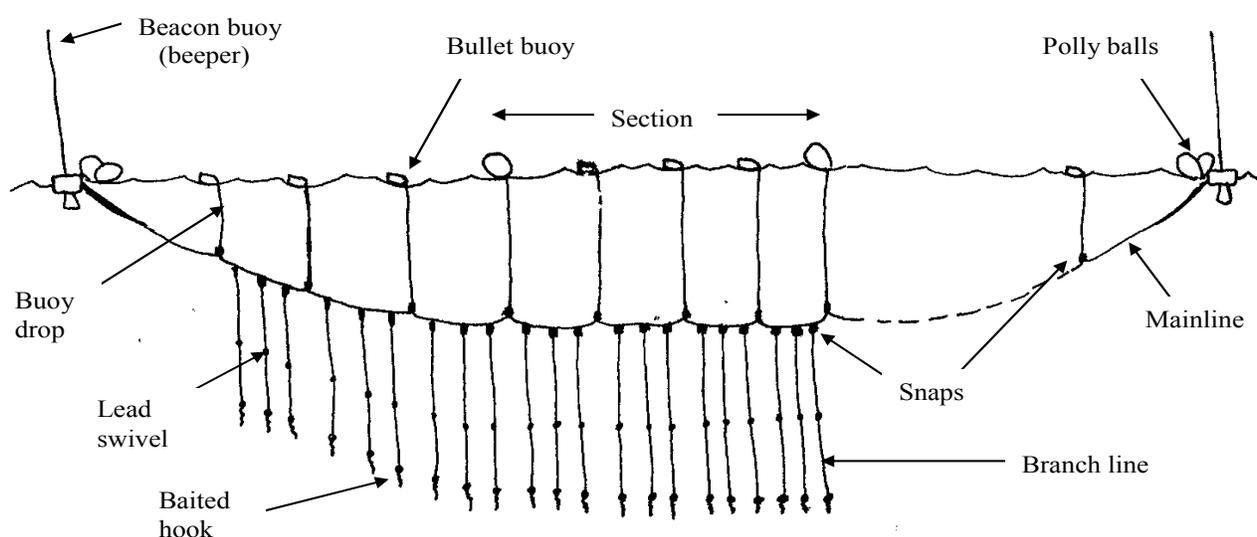
mainline is cut from the spool and the end attached to another beacon buoy with one or two polly balls. Additional beacon buoys may be placed in the gear by some fishers to allow recovery of all sections in cases where the mainline is accidentally cut.

All fishers use the same basic set up, however, the length of the sections used may vary among individuals. This variation mainly comes in the number of branch lines (hooks) placed between bullet buoys (range: 3 – 5) and the number of bullet buoys placed between polly balls demarcating each section (range: 6 – 12). As such a section may carry from 18 – 60 hooks.

The longline gear is stored onboard as separate components between fishing sets: the mainline on a large hydraulically operated spool; the buoy drops on a separate hand operated spool; the branch lines and hooks in large hook tubs; the beacon buoys latched to the canopy uprights; and the polly balls and bullet buoys on the deck adjacent to the beacon buoys. These components are re-assembled every time the line is set, and disassembled each time the line is hauled.

### Fishing Practices

Longline fishing is conducted year-round, although there appear to be several peaks in activity during the year

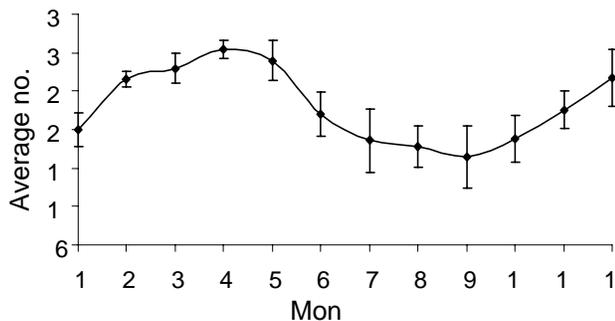


**Figure 2.** Typical fishing gear set up of a Barbadian longline vessel, showing details of the end and adjacent section only. The full gear is made up of around 15 sections.

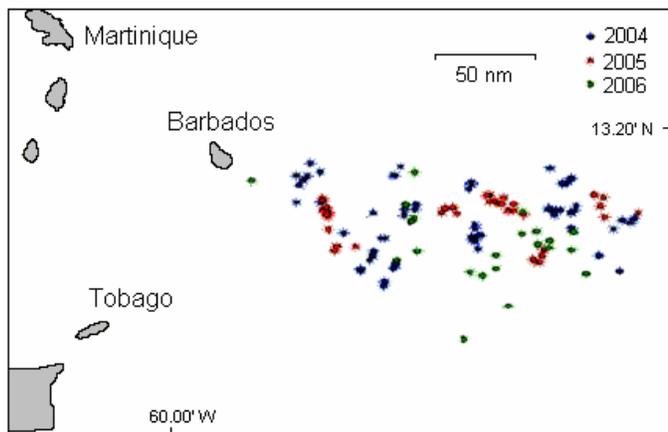
**Table 2.** Composition of the longline gear carried by Barbadian longliners. Averages are calculated for the 14 vessels giving this information.

Category	Name	Description	Average amount
Lines	Mainline	Horizontally set line from which the branch lines are suspended	490 km
	Buoy drops	Vertical lines used to suspend the mainline at particular depths below the surface	124
	Branch lines	Vertical lines to which the hooks are attached	498
Hooks	Hooks (baited)	One attached to each branch line	498
Accessories	Polly balls & bullet buoys	Attached to one end of the buoy drops suspending mainline in the water column	15 polly balls 113 bullet buoys
	Beacon buoys (beepers)	Radio beacon buoys used to locate the gear via an ADDF	3
	Snaps	Used for rapid and easy attachment of Polly balls, bullet buoys and branch lines to the mainline	626
	Lead swivels	Adds weight to the branch lines causing them to sink and allows them to rotate freely	498
	Light sticks & glow beads	Attached to the branch lines directly above the baited hooks and used to attract fish (particularly swordfish)	n/a

(Figure 3). The interviewed captains indicated that fishing is better at certain times of the year, highlighting water temperature as an important parameter effecting catch rates. The longline fleet operates mainly off the east, south or southeast coasts of Barbados, with the favoured fishing area being directly southeast of the island. Vessels generally fish between 60 – 300 nautical miles (111 – 556 km) from the BFC (Figure 4).



**Figure 3.** Seasonality of longline fishing in Barbados shown as monthly mean number of longline fishing trips by the longline fleet (2001 – 2005). Error bars show standard error.



**Figure 4.** GPS coordinates of fishing sets made by five Barbadian longline vessels between 2004 and 2006.

Regular fishing trips for the longline vessels can range from 6-21 days. Occasionally, vessels will also make short trips (24 – 48 hr) when testing new or repaired gear, when conducting experimental fishing, or when targeting dolphinfish and flyingfish for cash to fund a longline trip. On these trips, fishing is conducted between 15 – 30 nautical miles (28 – 56 km) from land. The major factors determining the length of longline trips are catch rate, weather, and the rate at which the bait and ice are depleted.

Interviewed captains indicated that several types of data are routinely collected on fishing trips. This may be done by keeping a mental note, by using the vessel's electronic equipment (e.g. GPS to store waypoints) and/or in formal or informal logbooks. Typical data collected include: date, GPS coordinates of set, moon phase, distance and bearing from home port, species, and numbers of fish caught. Additional data are noted by some fishers including: time of sets, sea colour and sea surface temperature. None of these data are handed over to the Fisheries Division.

The actual fishing procedure is broadly similar among vessels although details differ. The captain decides, with or without input from his crew, on where the gear is to be set. The crew is responsible for setting up the fishing gear as the fishing location is approached. The bait (imported frozen squid and/or fresh flyingfish when in season) is brought out of the ice hold, the mainline is attached to the beacon buoy, and the polly balls and bullet buoys are put ready on the deck. When the exact location is reached, the captain slows the vessel, the beacon buoy is turned on and the captain verifies that the signal is being picked up by the ADDF receiver. The beacon buoy is then placed overboard and the captain resumes normal steaming of the vessel, allowing the mainline to run off the spool. As the vessel steams, the crew baits the hooks and snaps the branch lines with the baited hooks, the bullet buoys and the polly balls onto the main line in accordance with the set up practice for that vessel. As the final section of the mainline is baited, the captain is notified and once again reduces the speed of the vessel. A beacon buoy is then readied, attached to the mainline, turned on and checked for signal reception, and finally placed overboard to complete the longline gear set. At this point, the captain steams away (upwind or upcurrent) from the gear, usually within a five mile radius and allows the vessel and gear to drift independently. Setting the gear normally takes between 2-5 hours.

After the gear has soaked for the required period (between 6 - 13 hr), it is relocated using the ADDF, the beacon buoy is brought onboard and turned off, and the mainline is re-attached to the spool. The captain then steers the vessel along the mainline and controls the hydraulics of the spool from the wheel positioned on the deck area. The captain also removes the branch lines and buoy drops from the mainline, testing each for the presence of a fish before passing it to the other crew members who proceed to haul the hooks and buoys. When the captain removes a branch line with a fish, the crew is notified and the branch line is attached to a backup line before passing to a crew member for hauling. The fish is brought onboard the vessel using a 'grig' (gaff pole) and a 'pick' (meat hook). The butcher is responsible for onboard processing of the fish before it is placed in the ice hold.

The time taken for gear retrieval varies widely (3 - 15 hr) depending on the length of line, number of fish caught,

sea conditions, and whether or not the line has been damaged. The whole procedure beginning with the setting up of the gear until the gear is completely retrieved from the water is known as a 'set' and vessels usually make between 5 - 13 sets per fishing trip. The gear may be set to fish at anytime of the day or night, although night-time sets are more common if swordfish are being targeted.

### Fishing effort

The number of active longline vessels in the Barbados fleet continues to increase. For the period 2001-2005 the active fleet size rose from 25 to 30 vessels and currently stands at 34. Fishing activity varies among vessels with a mean range of 9 - 12 fishing trips per vessel per year over the five year period 2001-2005 and an overall mean of 10.5 trips per year.

### Catch

The main target species of longline fishing are large tunas (yellowfin and bigeye), billfishes (swordfish, blue and white marlin), and to a lesser extent Atlantic sailfish. Other species are also caught incidentally on the longline fishing gear, some of which are landed and kept (barracuda, bonito, albacore, dolphinfish, kingfish, and sharks), and others of which are discarded dead or released alive (pilot whale, oilfish, turtles, rays, and sharks). Other forms of fishing are also practiced opportunistically on longline fishing trips, especially during the pelagic fishing season (November – June). These include the use of handlines to target dolphinfish and wahoo (attracted to the floating buoys of the longline gear) and surface gillnets for flyingfish. The typical annual longline catch comprises mainly (73%) targeted large pelagic species, although 25%

is made up of dolphinfish and flyingfish (Figure 5). The total annual recorded landings of the Barbados longline fleet averages 307 mt, while the mean catch per trip is approximately 1 mt (2001 – 2005).

### Costs of Operation

Data collected from interviews with owners and captains provide insight into the costs associated with longline vessel operation. These values will be coupled with price and revenue data at a later date to allow for an analysis of fishery profitability. It is important to recognize that in the absence of public information on vessel-level operations, the reliability of this analysis is contingent upon the accuracy of the information provided by owners and captains.

*Capital Costs* — Operation of a longline vessel requires substantial fixed and recurring capital costs. The primary capital cost is the fixed cost associated with the vessel itself, though recurring annual costs can also be significant. The average price paid for vessels in the fleet was approximately US\$98,000, ranging from a minimum of US\$20,000 to a maximum of US\$277,000. However, nearly 40% of the fleet comprises vessels that were formerly used as ice-boats or for other forms of fishing and have been converted for longlining at an average cost of approximately US\$44,600. Including these upgrade costs, the average price of a vessel outfitted for longlining is just over US\$117,000. Further, nearly 70% of the fleet has undergone an engine replacement at an average cost of US\$23,500. This is likely due to the relatively advanced age of most vessels in the fleet

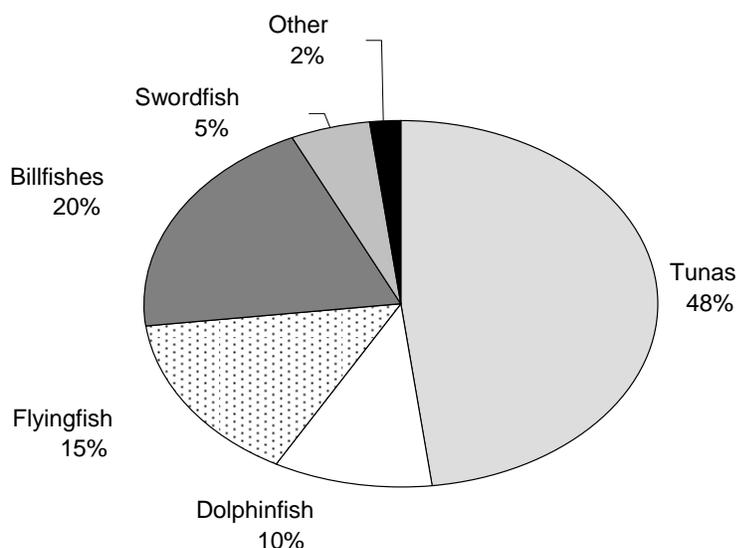


Figure 5. Mean annual longline catch composition shown by percent weight of recorded landings (2001 – 2005).

In addition to vessels, 27% of owners and captains interviewed indicated that they had an associated vehicle such as a truck or van that was primarily used for fishing-related purposes. These vehicles ranged in age from 1 to 12 years (average age = 7.5 yr) and were fully paid for in all cases.

Recurring capital costs are highly variable across the fleet depending primarily on the size of the vessel, the number of trips taken per year and whether or not the vessel is paid for or insured. It is notable that most (82%) of the vessels in the fleet are fully paid for. Those with payments remaining pay approximately US\$2,000 per month. However, despite the significant value and potential cost of vessel replacement, only 64% of the vessels in the fleet are reported to be insured. Insurance expenditures are significant, averaging nearly US\$6,500 per year and ranging from US\$3,500 to US\$30,000, based on information from the 13 vessels reporting.

Annual haul-up costs range widely from a minimum of zero (for those that did not haul-up) to a maximum of US\$20,000. Most vessels report one haul-up per year at a cost of less than US\$1,000. However, boats typically remain out of the water for approximately one month, presenting a significant opportunity cost in terms of lost fishing time.

Vessels are also outfitted with costly equipment and gear that must be periodically replaced. Reported gear life and frequency of gear replacement also vary considerably. Using reported values for length of mainline and number of hooks, polly balls, bullet buoys on board each vessel, the value of this gear at current prices ranges from approximately US\$5,000 to \$8,500 with an average of approximately US\$6,400. Hence, it is clear that significant additional and recurring capital expenditures are necessary to remain active in the fishery once a vessel has been purchased and outfitted. Table 3 presents summary statistics for vessel and associated fixed and recurring capital costs.

Naturally, most capital expenses are positively related to vessel size and inversely related to vessel age. It is

notable though that there was only a weak relationship between engine replacement expenses and vessel age, suggesting perhaps that variation in repair and maintenance is a causal factor in this important component of capital expense. This hypothesis is supported by a negative, albeit weak, relationship (correlation coefficient = -0.24) between stated frequency of repairs and whether or not the engine had been replaced. It is also notable that more experienced captains tended to perform maintenance activities less frequently and were associated with vessels that were hauled-up fewer times per year.

Captains also reported estimates of vessel worth or current market value, which averaged US\$148,500. If accurate, these values suggest that a majority of the capital expenditures could be recovered by owners given sufficient demand in the used vessel market. However, there is the potential for significant economic hardship in the event of vessel loss for the 36% of the fleet that remains uninsured. That many boats are unable or unwilling to pay for vessel insurance indicates a tenuous economic condition for a good portion of the fleet.

*Per Trip Costs.* — Summary statistics for primary operational (variable) costs are reported in Table 4. These costs include fuel, bait and ice, and are relatively consistent among vessels, averaging US\$2,561, US\$1,933 and US\$575 respectively. Groceries and offloading charges average US\$381 and US\$80 per trip. Naturally, the amount spent on these inputs is directly related to vessel size and length of trip, and will vary greatly with the price of fuel. The cost of repairs and gear replacements is not generally recorded and could not be estimated by the interviewed captains. Gear is generally reported to have a long life, averaging over seven years, however, 64% of those interviewed indicated that at least some gear was repaired or replaced every trip and that several days per week were spent repairing gear or performing vessel maintenance. Despite the lack of quantitative data for the costs of repairs and gear replacement, we can still conclude that these activities are a source of significant operating expenses.

**Table 3.** Capital and associated costs and characteristics for Barbadian longliners

Variable	n	Mean	Std Dev	Min	Max
Length of vessel ownership (years)	22	10.3	7.5	2.5	28
Age of vessel (years)	21	18.2	7.9	4.0	40
Vessel price (US dollars)	21	97,764	52,042	20,000	277,000
Vessel upgrade price (US dollars)	9	44,611	16,680	25,000	75,000
Estimate of vessel worth (US dollars)	21	139,524	45,543	50,000	250,000
Engine price (US dollars)	14	23,607	11,377	5,000	45,000
Engine size (horsepower)	9	337	77	265	510
Age of associated vehicle (years)	6	7.5	3.9	1.0	12.0
Vessel insurance cost per year (US dollars)	13	6,457	7,171	3,500	30,000
Number of haul-outs per year	12	0.9	0.4	0.3	2.0
Length of haul-out (months)	12	0.9	0.6	0.2	2.0
Annual haul-out cost (US dollars)	7	3,561	7,255	500	20,000

**Table 4.** Per Trip (variable) costs for Barbadian longliners (all values in US dollars)

Variable	n	Mean	Std Dev	Min	Max
Fuel cost per trip	13	2,562	2,819	151	9,500
Ice cost per trip	12	5,766	346	250	1,500
Bait cost per trip	9	1,933	809	1,000	3,500
Grocery cost per trip	14	381	158	300	750
Offloading & cleaning cost per trip	12	79	30	0	125
Other costs per trip	13	94	165	0	500

Based on reported trip costs and averages for each category of trip expenses, we can surmise that on average longline vessels spend in excess of US\$6,500 per trip (ranging from US\$3,000 to over US\$14,000) for non-labour expenses in addition to the costs of gear replacement or repair. Given that vessels take approximately one trip per month and can fish throughout the year, the fleet is likely giving up considerably more in terms of the opportunity cost of time associated with regular maintenance activities.

Interestingly, the per trip costs associated with fuel, bait, ice and groceries are strongly and positively related to the age of the vessel. Correlation coefficients between these variables and vessel age ranged from 0.73 to 0.98. While part of the explanation for this stems from the fact that older vessels in the fleet tend to have larger engines, the strength of these relationships suggests that as the fleet ages, operating costs will most certainly rise. Also of note is the absence of any relationship between the experience of the captain (number of years fishing) and operating costs. This suggests that if experience contributes to enhancing vessel profitability, it does so through catch and revenue improvements rather than cost minimization or operational efficiency.

### DISCUSSION

Longlining is currently an important contributor to the Barbados fishing industry. Although the longline fleet size is small compared with the other fleets (moses, day launches and ice boats), representing just 4.6% of all vessels registered in Barbados, it supplies, on average, around 15% of the island's total annual fish landings and is responsible for the majority of fish exports. Furthermore the longline fleet is the only one landing offshore pelagic species in the 'off-season' (July to October) and is therefore particularly important in maintaining a year-round supply of fresh fish, and in supporting full-time direct and indirect employment in the fishing industry.

The longline fleet is considered to be the most advanced of the local fleets, requiring high capital investment, using relatively sophisticated fishing gear and utilising pelagic fish resources across a significant proportion of the island's extended economic zone (EEZ).

Given the level of development that the longline

fishery has achieved, the current pool of human resources, and the important contribution to the Barbados fishing industry, the immediate future of longlining seems assured. The long-term future of the industry will however depend on a variety of factors including the status of the target and ancillary species and continued demand in local and foreign markets. Our preliminary view of the costs of operation suggests a tenuous economic condition for at least some of the fleet. It is worth noting that without the continued support of the Barbados government through subsidies on gear, equipment and maintenance expenses, the fishery as a whole may not be economically viable. That 25% of landings appear to come from alternate fishing lends support to this notion and suggests the need for a more thorough examination of the profitability of the fishery and the importance of ex-vessel market conditions. Although longline fishers have differing views about some aspects of the current fishery, the general consensus is that there is a need for improvement in the longline fishery.

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