FI:GCP/RLA/140/JPN

TECHNICAL DOCUMENT No. 1

FAO/GOVERNMENT COOPERATIVE PROGRAMME

SCIENTIFIC BASIS FOR ECOSYSTEM-BASED MANAGEMENT IN THE LESSER ANTILLES INCLUDING INTERACTIONS WITH MARINE MAMMALS AND OTHER TOP PREDATORS

ESTIMATED CATCH, PRICE AND VALUE FOR NATIONAL FLEET SECTORS FROM PELAGIC FISHERIES IN THE LESSER ANTILLES

FOOD AND AGRICULTURE ORGANIZATION OF THE UNITED NATIONS

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ESTIMATED CATCH, PRICE AND VALUE FOR NATIONAL FLEET SECTORS FROM PELAGIC FISHERIES IN THE LESSER ANTILLES

Report prepared for the

Lesser Antilles Pelagic Ecosystem Project

(GCP/RLA/140/JPN)

by

Elizabeth Mohammed, Paul Fanning, Christopher Parker, Derek Theophille, Louanna Martin, Sophia Punnett, Ralph Wilkins, Jeanine Rambally, Paul Phillip, Crafton Isaac, James Philmore and Audra Barrett

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ABSTRACT

Scientific Basis for Ecosystem-Based Management in the Lesser Antilles Including Interactions with Marine Mammals and Other Top Predators: Estimated catch, price and value for national fleet sectors from pelagic fisheries in the Lesser Antilles , by Elizabeth Mohammed[1], Paul Fanning[2], Christopher Parker[3], Derek Theophille[4], Louanna Martin[5], Sophia Punnett[6], Ralph Wilkins[7], Jeanine Rambally[8], Paul Phillip[9], Crafton Isaac[9], James Philmore[10] and Audra Barrett[11], FAO, Barbados, 2008. vii + 52 pp. 3 figures and 18 tables FI:GCP/RLA/140/JPN. Technical Document No. 1

Catch data are required for estimation of fishing mortality and for representation of fleet dynamics in the Lesser Antilles Pelagic Ecosystem (LAPE) model. The relative extractions by country and fleet type are used to investigate a range of policy scenarios (effort control) for management of shared stocks of pelagic species.

A review by the LAPE project concluded that the use of the regional fisheries statistical system (CariFIS) database is still limited and that there remained data management issues which were major impediments to full implementation of CariFIS in national fisheries statistics systems. The additional time and technical assistance required to solve these problems are beyond the scope of the LAPE Project.

It was necessary therefore to acquire the data by either extraction from international databases at Food and Agriculture Organization (FAO) and the International Commission for the Conservation of Atlantic Tunas (ICCAT) or a re-examination of country data holdings in the variety of software used (CariFIS, MS EXCEL, MS ACCESS). By preference, data were obtained from national sources; however, data were used from the international databases when individual country data proved inaccessible.

This report documents the modifications to available data and assumptions made in arriving at estimates of total catch and value of pelagic fisheries in the LAPE region. It is not intended to give a detailed analysis of catches in the region, but rather to provide information in the format necessary for input to the ecosystem model based on management issues to be examined.

Fisheries Divisions of: [1]Trinidad and Tobago, [3]Barbados, [4]Dominica, [5]Trinidad and Tobago, [6]St Vincent and the Grenadines, [9]Grenada,[10]Antigua and Barbuda and [11]Nevis Island Administration
Departments of Fisheries of: [7]St Kitts and Nevis and [8]St Lucia;
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GLOSSARY

CariFIS - Caricom Fisheries Information System - software package including databases for fisheries catch and effort data and fishing vessel licensing and registration data. It was developed by the Caricom Regional Fisheries Mechanism (CRFM) as the planned replacement for the earlier systems TIP and LRS.

Ecopath with Ecosim (or EwE) - a modelling system implementing a mass-balance model of tropho-dynamics frequently applied to aquatic systems and fisheries systems in particular (see www.ecopath.org for further description, the software and documentation)

Functional group: - a life-stage, species or group of species which plays an ecologically distinct role and is ecologically homogeneous i.e. similar prey field and predator field.

ICCAT - International Commission for the Conservation of Atlantic Tunas

LRS - Licensing and Registration System - database developed in the early 1990s by the Caricom Fisheries Resource Assessment and Management Programme (CFRAMP) to manage fishing vessel data.

TIP - Trip Interview Program - database developed in the early 1990s by the United States National Marine Fisheries Service and adopted by CFRAMP to input and manage fisheries catch and effort data.

BACKGROUND

The implementation of the Ecosystem Approach to Fisheries (EAF) entails important changes in the way fisheries management is conceived and practiced. The FAO technical guidelines for the ecosystem approach to fisheries (2003) define EAF as follows: "*An ecosystem approach to fisheries strives to balance diverse societal objectives, by taking into account the knowledge and uncertainties about biotic, abiotic and human components of ecosystems and their interactions and applying an integrated approach to fisheries within ecologically meaningful boundaries*". Although the main principles that characterize EAF are not new, but already embedded in a number of international agreements and conference documents, there is limited practical experience in implementing them.

The project GCP/RLA/140/JPN (Scientific Basis for Ecosystem-based Management in the Lesser Antilles Including Interactions with Marine Mammals and Other Top Predators) addresses one of the challenges related to the implementation of the ecosystem approach to fisheries, i.e. the development of management strategies that take into account biological interactions among species, including cetaceans and other top predators and any species that may be of no direct importance to fisheries but yet, may play an important role in maintaining ecosystem structure and functioning.

The **medium-term objective** of the project is to enable fishery institutions in the region, by 2007, to carry out improved assessments and monitoring of the status of the pelagic resources and fisheries and the ecosystem of which they form a part, for continuous adaptation and improvement of optimum management strategies. **Immediate objectives** include:

1. obtaining improved estimates of the abundance of key components of the Lesser Antilles pelagic ecosystem, including cetaceans and other top predators;

2. the formulation of a food web model of the ecosystem as a means of investigating ecosystem interactions and impacts;

3. the development of an ecosystem management plan for the pelagic waters of the EEZs of the participating countries, which will include management strategies for key species of fishery interest in the sub-region, as well as for other affected and dependent species, and

4. the development of research and management capacity for ecosystem-based management of their pelagic waters at a national and sub-regional level.

Project activities in support of Objective 1 included cetacean sighting surveys, both regional, offshore surveys and national, nearshore surveys. There was a pelagic acoustic/trawling survey to obtain estimates of abundance of forage

species and environmental information. Work towards Objective 2 included collection, compilation and analysis of data to estimate model parameters regarding diets, physiology, fisheries and primary production. These were incorporated into a mass-balance model of the pelagic food web using the Ecopath with Ecosim software. To address Objective 3 the LAPE project first completed a series of stakeholder consultations in each of the participating countries to identify fisheries management issues with a particular view towards ecological issues and prioritizing the identified issues. In most countries this process continued by developing performance reports, including specific indicators, for at least one of the high-priority issues. There remains work to be done in each case to complete this process for the pelagic fisheries, and other sectors have not been started. The development of national and sub-regional capacity in this regard (Objective 4) primarily included training sessions associated with specific activities i.e. 'on-the-job' training. There was also training for smaller groups involved in specific tasks e.g. GIS modellers or diet analysts.

INTRODUCTION

Catch data are required for estimation of fishing mortality and for representation of fleet dynamics in the Lesser Antilles Pelagic Ecosystem (LAPE) model. The relative extractions by country and fleet type are used to investigate a range of policy scenarios (effort control) for management of shared stocks of pelagic species. The price data are used to assign value to the catch, while the value of the catch is used to define the fixed, effort-related and sailing-related costs, as well as profit. These economic parameters are all represented in the model as a percentage of overall value of the fishery associated with the respective fleets.

Since the LAPE model represents average annual conditions between 2001 and 2005, previously reconstructed historical time series of catch and effort data for five LAPE countries (St Lucia, St Vincent and the Grenadines, Grenada and the Grenadines, Barbados and Trinidad and Tobago) over the period 1950 to 2000 could not be used. The LAPE Project sought to address historical, current and future estimations of fisheries statistics through a consultancy aimed at reviewing existing data collection, providing assistance for data management and development of estimation procedures, including uncertainties and providing recommendations for cost-effective improvements to the systems (S. Barnwell, pers. comm.). A summary of the findings of this exercise (Appendix 1, based on Barnwell, pers. comm.) showed that the use of the regional fisheries statistical system (CariFIS) database is still limited in the region. Although the LAPE project was able to resolve several issues related to the migration of various legacy systems (TIP/LRS, Excel, Access) to the CariFIS structure, there remain several data management issues which continue to be major impediments to fully functional fisheries statistics systems (FAO, 2007). The additional time and technical assistance required to solve these problems are outside the scope of the LAPE Project.

It was necessary therefore to acquire the data by either extraction from international databases at Food and Agriculture Organization (FAO) and the International Commission for the Conservation of Atlantic Tunas (ICCAT) or a re-examination of country data holdings in the variety of software used (CariFIS, MS Excel, MS Access). By preference, data were obtained from national sources; however, data were used from the international databases when individual country data proved inaccessible.

Purpose of the report

This report documents the modifications to available data and assumptions made in arriving at estimates of total catch and value of pelagic fisheries in the LAPE region. It is not intended to give a detailed analysis of catches in the region, but rather to provide information in the format necessary for input to the ecosystem model based on management issues to be examined. Four of

these issues were identified and prioritized at the fourth meeting of the Ecosystem Modelling Working Group:

1. Bait fishery issues: Can the required increase in catches of the small pelagic and flyingfish (bait) fisheries be sustained to meet the demands of an expanding large pelagic fishery?

2. Trophic linkage between flyingfish and dolphinfish: What would be the likely impacts of increasing effort in the flyingfish fishery on the biomass, catch and value of large pelagic fisheries? What would be the impact of increasing effort of fisheries targeting dolphinfish on the biomass, catch and value of the flyingfish fishery? Is there a potential for increasing flyingfish catches in the region? What are the likely impacts on the availability of other species to fisheries in the region? Would there be any benefits to a reduction of effort on the flyingfish fishery?

3. What would be the impact of increasing population growth rates of marine mammals on the available resources for fisheries? What would be the impact of a developing fishery for marine mammals on catches of fish species?

4. What would be the likely impact of increasing productivity on the biomass of fish available to fisheries in the region?

Re-scaling to account for migration

The estimated catch data would be re-scaled and represented per unit area (LAPE area = 610,000 km^2) in the ecosystem model. This re-scaling of catches, to represent the portion of total fishing mortality exerted both inside and outside the LAPE region, is the recommended solution for representing migratory species given that the modelled area represents only part of the distribution range and hence, fishing mortality, predation and consumption of the large, highly migratory pelagic species caught in the LAPE region (Mackinson, 2006). Since the re-scaling of the catch data renders the input data unrecognizable, this report provides the details of the original data prior to re-scaling. In addition, the report presents market price data as another input for the model and estimates of ex-vessel value to facilitate detailed calculations of fishing costs (effort-related, sailing and fixed) as a percentage of the overall value of the catch of the respective fleets in the model.

METHODS

The process of estimating catches in the LAPE region involved a review of possible sources of fishing mortality (Appendix 2). LAPE countries (Antigua and Barbuda, St Kitts and Nevis, Dominica, St Lucia, St Vincent and the Grenadines, Grenada and the Grenadines, Barbados and Trinidad and Tobago), non-LAPE countries (Martinique and Guadeloupe – French Overseas Departments) and foreign fleets of developed countries exploit the pelagic resources in the LAPE region.

Where possible, annual catches of LAPE countries were submitted by the respective Fisheries Departments for 2001 to 2005, or supplemented with data from the FAO database (FISHSTAT Plus Capture Production database accessed 12 June 2007) and ICCAT Task I database (accessed 4 June 2007). The ICCAT database was examined for catches of large pelagics while catches of small pelagics, coastal predators, turtles and marine mammals were taken from the FAO database. Catches of French Overseas Departments were taken from the FAO database. Catches of queen triggerfish, demersal and reef sharks from country submissions were omitted from the final data set. Diet information showed these species to have little or no trophic interaction with species of the pelagic realm (Heileman, 2007). Catch and price data were disaggregated by the respective fleets (Mahon and McConney, 2004; Appendix 3) and species specified in each functional group. Appendix 4 lists all functional groups in the LAPE model including species which are not caught. Catch data were standardized to tonnes and price data were standardized to United States dollars. Annual average exchange rates were taken from www.oanda.com/convert/fxhistory accessed 13 August 2007 (Table 1).

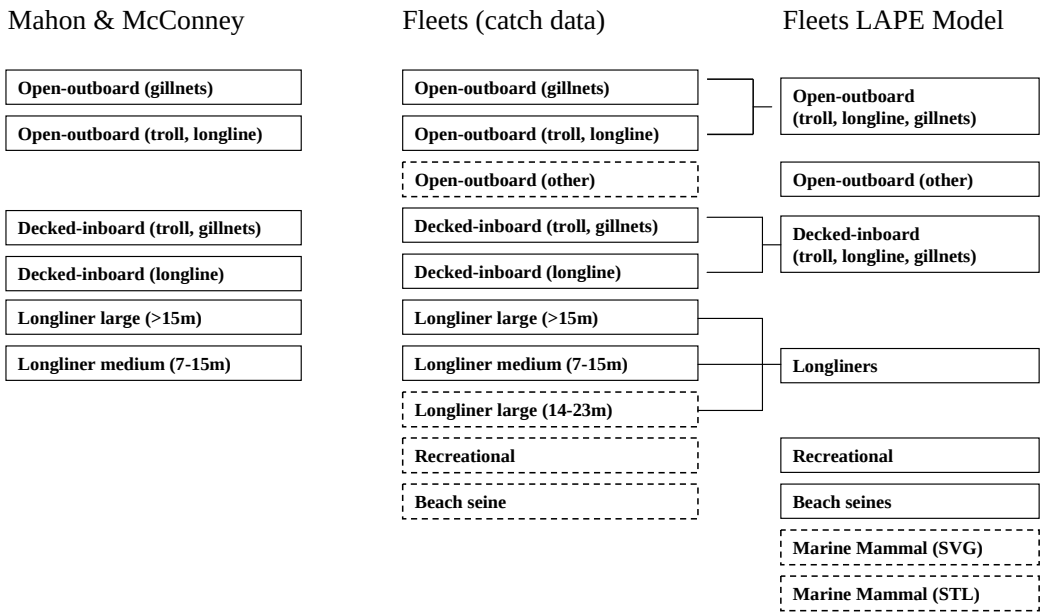
Table 1 Annual average interbank exchange rates for conversion to United States dollars.

Currency/Year	2001	2002	2003	2004	2005
Eastern Caribbean	0.3744	0.3748	0.3751	0.3748	0.3749
Barbados	0.5025	0.5026	0.5033	0.5027	0.5088
Trinidad and Tobago	0.1627	0.1639	0.1627	0.1616	0.1602

Country fleets were classified (Table 2), initially based on Mahon and McConney (2004). Additional classes were added to accommodate fleets identified in the catch data (beach seines, recreational fleets, large longliners (15-23 m)). For the purpose of management policy exploration using the LAPE ecosystem model the catches of these fleets were aggregated and marine mammal fleets were added for St Vincent and St Lucia. It should be noted that within each country there are two different fleets which take marine mammals, a fleet targeting finfish but which takes marine mammals opportunistically and a smaller fleet targeting marine mammals. Catches of these two fleets are grouped under the open, outboard (troll, longline, gillnets) fleet. Based on expert knowledge, it was assumed that 5 percent of the overall finfish catch of

the fleets operating in St Vincent and St Lucia was taken by those vessels which also catch marine mammals. The marine mammal and associated finfish component of the catch of open, outboard (troll, longline and gillnet) vessels was re-assigned to the marine mammal fleet.

Table 2 Correspondence of fleet classifications used in the LAPE project.



Antigua and Barbuda

Catch data were extracted from the FAO FISHSTAT Plus database (accessed 12 June 2007) and represented recorded, sample data. These data, however, were not disaggregated by fleet. Based on expert knowledge of the fisheries, assumptions were made to assign catches to functional groups and fleets. Catches of barracudas were disaggregated as follows: 80 percent from open, outboard vessels using hook and line or gillnets; 15 percent from inboard, decked boats using troll and gillnets and 5 percent from beach seines. Carangids are caught with beach seines and hook and line, with 50 percent of overall catch attributed to each gear. The beach seine component of the catch was assumed to comprise of small species of carangids and assigned to the "small pelagics" group, while line catches were assigned to the "coastal predators" group. Catches of sharks, rays and skates represent a combination of pelagic and demersal/reef species taken with gillnets, longlines and shark nets. It was assumed that 35 percent of overall catch represented pelagic species (pelagic sharks) and 65 percent represented coastal species (coastal predators). Catches of tuna-like fishes comprise about 35 percent yellowfin tuna and 65 percent small tunas (other offshore predators). About 80 percent of yellowfin catch is taken by open, outboard vessels using hook and line and the other 20 percent is taken by inboard, decked boats using longlines. Small tuna catches were disaggregated as follows: 10 percent to beach seines, 65 percent to open-outboard boats using troll and longlines; 25 percent to inboard, decked boats using troll lines.

Price data were not available in the FAO FISHSTAT Plus database. Based on expert knowledge of the fisheries, the following prices were assumed: dolphinfish - $9/lb; carangids - $6/lb; sharks, rays and skates - $5/lb; tuna-like fishes - $9/lb; barracudas are not sold.

At the Management Planning Workshop new information indicated that beach seine catches for Antigua and Barbuda had been overestimated, particularly the small coastal pelagic component. Based on expert knowledge, 90 percent of carangid catches should have been assigned to line gear and 10 percent to beach seines in 2001 and 2002. The number of seines being operated declined substantially following 2002. It was suggested that only 2 percent of carangid catches should have been assigned to beach seines, and 98 percent to line gear, for each of the following three years. The revised catch estimates are provided in Table 2 for the relevant groups and fleets. It is recommended that these data be included in future versions of the LAPE ecosystem model.

St Kitts

The data submitted by the Fisheries Department represent estimates of total landings for 2002 to 2006, derived by applying a raising factor to recorded data to account for fishing days that were not recorded. "Nets" referred to beach seines. Catch data for 2003 were reported for January to September only. These data were adjusted to represent the annual catch assuming that the mean proportion of total landings attributed by the respective species from October to December in 2002 and 2004 was the same for corresponding months in 2003. Gear types were not specified for 2001 and 2005 catches. It was assumed that gars, ballyhoo and jacks were caught with nets (beach seines) and other species by troll gear. Jacks were assumed to be mainly of the species *Selar crumenophthalus* (bigeye scad). Mackerel and tuna catches were aggregated in the records of landings from beach seines and open, outboard boats utilizing troll gear and longlines (2002 to 2004). Catches were disaggregated into the respective species groups using the annual proportions of tunas and mackerels from similar gear for fisheries of other countries (excluding Trinidad, Barbados and Grenada). The aggregate tuna category was disaggregated into the respective species using the same method. Note that catch data from beach seines were available only for 2002, 2003 and 2004. Catches of dolphinfish and tuna/mackerel for 2001 and 2005 were aggregated for fleets utilizing both beach seines and troll gear. However, it was noted that the majority of the catch was derived from troll gear and an insignificant, though unknown, proportion was taken by beach seines, but not included in the statistics. This explains the zero catches of dolphinfish from beach seines in 2003 and 2004. Catches of miscellaneous species (Class D) represent a variety of species that are not identified when fishers report. Some species of large pelagics are included in this category; however, the associated proportion is not known.

Price data were not available for dolphinfish caught by troll gear in 2004 and tuna/mackerel caught by beach seines and troll gear in 2001 and 2005. A unit

price of $8/lb was assumed for dolphinfish and $7/lb for tunas and mackerels based on data for other years.

Nevis

The data submitted by the Fisheries Department represent estimates of total landings for 2002 to 2006, derived by applying a raising factor to recorded data to account for fishing days that were not recorded. However, only data for 2002 to 2005 were used, and it was assumed that the 2001 catches were the same as 2002. Catches were not disaggregated by fleet or gear type. Based on the species and gear association of catches in St Kitts it was assumed that gars, ballyhoo and small jacks (assumed bigeye scad) were caught in beach seines and dolphinfish, tunas and wahoo were caught by open, outboard boats using troll lines. The annual species composition of tuna catches from St Kitts was used to disaggregate the combined tuna catch of all species in Nevis.

Annual prices were provided for all species groups, but were not specified separately for the two fleet types. It was assumed that all tuna species were sold at the same annual price.

Dominica

The data submitted by the Fisheries Department represented total catches estimated from recorded data using general knowledge of the fisheries to arrive at the appropriate raising factors. Catch data were not available for 2002, the average of the 2001 and 2003 catches was assumed for the respective species. Catches of turtles are not recorded, but thought to be small.

Prices were based on discussions with staff of the Fisheries Division (personal communication with Mr Jullan Defoe and Mr Norman Norris) and were based on an annual average applicable to the period considered: bigeye tuna, blackfin tuna, skipjack, swordfish, other billfishes, other offshore predators (Atlantic bonito), mackerels (Cero mackerel, king mackerel and Spanish mackerel), wahoo, yellowfin tuna - $5/lb; coastal predators (blue runner, great barracuda, rainbow runner - $5/lb; ocean triggerfish - $3.50/lb; yellowtail snapper - $5.50/lb; snooks not sold); four-winged flyingfish - $1.75/lb; small pelagics (ballyhoo - $0.25/lb; mackerel scad and round scad - $5/lb).

St Lucia

Catch data for large pelagic species were extracted from the ICCAT Task I database (accessed 4 June 2007), while catches of dolphinfish and four-winged flyingfish were extracted from the FAO FISHSTAT Plus database (accessed 12 June 2007). These data represented total catches estimated from recorded data using the procedure outlined in Joseph (1999). Catches of small pelagics were estimated as half the difference between the total catches stipulated in the aggregate "other" category of national statistics and the sum of catches of marine mammals and turtles. The underlying assumption was that, except for

marine mammals and turtles, catches from beach seines and fish pots contributed equally to the aggregate "other" category. Catches were not disaggregated by fleet type as specified in Appendix 3, but rather as: all gears; other surf; Sport (HL + RR) and Troll in the ICCAT database. Based on Mahon and McConney (2004), it was assumed that "troll" and "all gears" represented the open, outboard fleet utilizing troll gear and longlines and "other surf" represented medium longliners (7-15m). It was assumed that dolphinfish were caught by open, outboard boats using troll gear and longlines, the four-winged flyingfish was caught by open, outboard boats using gillnets and small pelagics were caught with beach seines.

Catches of marine mammals were taken from the Draft Plan for the management of fisheries of St Lucia (Revised 2006). Catches were disaggregated into the respective species based on expert knowledge of the associated fishery. About 140 dolphins, 13 pilot whales (range 10 to 15) and one false killer whale are caught annually (assumed the average annual catch over the five-year period). A representative species composition of the dolphin catch was: *Stenella* spp. (6), bottlenose dolphin (3), long-snouted spinner (5), Atlantic spotted dolphin (3), rough-toothed dolphin (2), Clymene dolphin (1), pantropical spotted dolphin (1) and spinner dolphin (3). This composition was used to split the total catch of 140 animals into the respective species. The mean individual weight of each species (Trites and Pauly, 1998) was used to estimate the corresponding catch weights (Table 3). The species composition by weight was used to split the catches obtained from the fishery management plan into the corresponding species, assuming the same species composition throughout the five years. These catches were assigned to the open, outboard fleet which utilizes troll gear and longlines, assuming that marine mammals are caught opportunistically.

Table 3 Estimated annual marine mammal catches in St. Lucia from 2000 to 2005

mixed Stenella spp	1.94 t
bottlenose dolphin	3.15 t
long-snouted spinner dolphin	1.16 t
Atlantic spotted dolphin	1.12 t
rough-toothed dolphin	1.03 t
clymene dolphin	0.26 t
pantropical spotted dolphin	0.37 t
spinner dolphin	0.69 t
short-finned pilot whale	8.36 t
false killer whale	0.578 t

Price data were based on annual average species prices of other OECS countries for which data were available (Antigua, Dominica, Grenada, St Kitts and Nevis, and St Vincent and the Grenadines).

St Vincent and the Grenadines

The data submitted by the Fisheries Department represent total landings estimated after Jardine and Straker (2003) for St Vincent flagged vessels

operating within the LAPE area. Raising factors are applied to data recorded under a stratified sampling design to account for unrecorded fishing days and landing sites. Except for humpback whales which are not represented in the model (these do not feed in the region), baleen and deep-diving whales are not caught. Catches of killer whales and small cetaceans, except pilot whales, are aggregated and recorded as "porpoises", the data were incorporated under the group "false killer whale". Some little tunny are caught using beach seines and recorded as skipjack. It was assumed that half the "skipjack" catch comprised little tunny and this quantity was assigned to beach seines. Swordfish, other billfishes, yellowfin tuna, skipjack, albacore, bigeye and blackfin tuna are all caught with troll lines. The catches also comprise juvenile yellowfin (individuals about 10 lbs), albacore (individuals about 25 lbs and greater) and blackfin (individuals about 6 lbs and greater). Although catches of juveniles are recorded the relative quantities of juveniles and adults are not captured in the data. Sharks are caught opportunistically by open outboard boats fishing for demersals (snappers and groupers) with bottom longlines (palangue). The associated species include: sandbar, tiger, spinner, nurse, blacktip, silky, lemon and shortfin mako sharks. The species sandbar shark listed as *Carcharhinus milberti* was changed to *Carcharhinus plumbeus*. Flyingfish are caught, mainly by trolling boats, with dipnets. However, the catch is not landed, and therefore not recorded, but rather utilized as bait. Turtles are caught with harpoons and sometimes nets, but catches are not disaggregated by species. Turtle catches are aggregated under the group "other turtles".

It is difficult to separate catches of longliners (decked) from troll vessels (open, outboard). However, since the one or two longliners operated sporadically and little data were collected for these vessels it was assumed that the catches were taken by open, outboard vessels using troll lines. It is to be noted that two trawlers converted to longlines and began operations in 2006. These vessels also land in Trinidad, so current catch data is incomplete (underestimate) and still aggregated with that of other vessel types.

Fish prices were provided for 2001 only. However, since fish prices tend to remain consistent the 2001 prices were assumed the same for the respective species throughout the five-year period, with consideration to the fleet and gear utilized if applicable. However, there were still some species for which no price data were available resulting in the following assumptions about price per unit weight (lb) to fill the associated gaps: Cero mackerel (Open, outboard, troll, longline) - the same price as for the species caught in beach seines ($5); dolphinfish - the same price as Wahoo ($5.50); anchovy, bluntnose jack and sprat - the same as other small coastal pelagic species ($2.50); Atlantic sailfish – the same price as Atlantic white marlin ($6); sennet - the same price as other coastal predators caught in beach seines ($5); amberfish; queen triggerfish – the same price as coastal predators caught in open, outboard (troll, longlines), prices ranged between $4 and $5.50, am average of $4.75; blacktip shark, lemon shark, nurse shark, sandbar shark, shortfin mako, silky shark - prices of spinner

shark and tiger shark were $4.30 and $3.00 respectively. assumed other shark species sold at $3.65; green turtle and hawksbill turtle - assumed $5.

Grenada

Catch data for large pelagic species were extracted from the ICCAT Task I database (accessed 4 June 2007), while catches of dolphinfish, coastal predators, four-winged flyingfish, squids and turtles were extracted from the FAO FISHSTAT Plus database (accessed 12 June 2007). These data represent estimates of total landing, derived from application of a raising factor of 1.75 to recorded data of all fish except dolphinfish, king mackerel, wahoo, yellowfin tuna, sailfish, blue marlin, white marlin and swordfish. Recorded landings of these species are raised by a factor of 1.4. The designation of raising factors is based on expert knowledge of the operations of fisheries. Blank cells for annual catches of large pelagics in the ICCAT database were replaced by catches in the FAO database for corresponding years. Similarly, blank cells for annual catches of large pelagics in the FAO database were replaced by catches in the ICCAT database (see data source column in spreadsheet). Although catches were specified by fleet type in the ICCAT database, the fleet categories did not match exactly those of this study. Based on expert knowledge of the fisheries, catches of billfishes and large tunas were assigned to the longline fleets (75 percent to large longliners, >15 m and 25 percent to medium longliners, 7-14 m) and catches of skipjacks, blackfin tuna, 3 percent yellowfin tuna overall catch, small tunas (other offshore predators), wahoo, king mackerel and dolphinfish were assigned to the open-outboard (troll, longline) fleets. Catches of the four-winged flyingfish were assigned to the open, outboard fleet using gillnets and catches of small pelagics, rainbow runner, carangids and needlefish were assigned to beach seines. Shark catches were divided equally between the medium (7-15 m) and large (> 15 m) longliners and turtle catches were assigned to the open-outboard fleet using spears and turtle nets.

An estimate of annual catch of bait species (mainly *Decapterus* spp. and *Selar crumenophthalmus*) used by the three longline fleets (open pirogue, medium longliners and large longliners) was calculated as the product of the average quantity of bait per trip, the average number of trips per year and the number of vessels (Table 4).

Table 4 Estimate of annual quantity of bait consumed by the Grenada longline fleet with comparison (last column) to the corresponding catches.

Fleet type	Trip description	Bait per trip (lbs)	Trips per year	Details	# Boats	bait per year (tonnes)	catch per year (tonnes)
Open-outboard pirogue (troll, LL)	about 50 lbs bait used per day, about 1-2 trips conducted per day	25	208	About 4 trips per week, assume same pattern throughout year (52 weeks)	445	1 052	592
Longliner medium (7-15 m)	overnight trip	100	120	about 8 to 10 trips per month; used maximum estimate	135	736	351
Longliner large (> 15 m)	trips are of 3 to 4 days duration; about 6 buckets of bait used per trip; one bucket = 52 lbs	312	36	minimum estimate of 3 trips per vessel per month	74	378	593
TOTAL						2 166	1 536

Price data were provided by the Fisheries Department. However, no prices were listed for sharks, squids and turtles. The annual average price of shark in other OECS countries was used. Turtles and squids were assumed to be sold at \$5/lb and \$2.50/lb respectively.

Barbados

The data provided by the Fisheries Department were deemed provisional and subject to change. The statistics represent estimates of total landings derived from applying a raising factor of 1.2, based on knowledge of fisheries operations, to recorded data for all species besides large tunas and billfishes. Catches of some categories of fish could not be separated to the species level: sharks, billfish and Carangids. Tuna catches are not recorded to the species level at landing sites. Disaggregation of the associated data into the respective species (yellowfin, bigeye and albacore) was based on a sample survey of longliner catch records in 2002 (Fisheries Department, Barbados unpublished data). A number of small tunas, mainly skipjack and black fin tunas, are categorised as "bonito" in Barbados. While relatively few true bonito (*Sarda sarda*) are landed, it was not possible to disaggregate this category which has been listed as "small tunas".

Large tunas and billfish are landed in a processed form, although a total census of landings is recorded. Dressed weights were converted to round weights

using the following conversion factors: yellowfin, bigeye and albacore tunas (x1.25); billfish (x1.2; ICCAT conversion factor); swordfish (x1.33; ICCAT conversion factor); wahoo (x1.075; George *et al*., 2001); dolphinfish (x1.127; Parker *et al*., 2006 based on personal communication with Sarah George in 2000); shark (x1.5; Mohammed, 2003). All other species were landed whole.

Price data were available only for the period 2003 to 2005. The data represent mean prices for each respective year, although there are seasonal (intra-annual) variations in prices. All species within the broader categories (billfish etc.) tend to be sold at about the same price. Prices for 2001 and 2002 were assumed the same as 2003 for the respective species, with consideration to the associated fleet and gear, if applicable. Prices of small coastal pelagics and swordfish were not available for 2001 to 2003, and hence the same price for 2004 was assumed. Price data were not available for albacore and bigeye in 2004, hence the average of the 2003 and 2005 prices (BDS$9.76) was used. Prices of spotted ocean triggerfish from 2001 to 2003 were assumed to be the 2004 price of $2.62/kg.

At the Management Planning Workshop it was noted that beach seine and recreational fleets exist in Barbados (Appendix 3) but no corresponding catches were listed. Data for these fleets are not recorded but reference was made to a study on the Barbados recreational fishery (Antia *et al*., 2002) from which catch data may be available. There are currently 29 recreational boats operating from various locations in Barbados (Parker, pers. comm.). It is recommended that the catch statistics be updated accordingly in future versions of the LAPE ecosystem model.

Trinidad

The data submitted by the Fisheries Department were representative of total landings. Recorded data were adjusted to account for fishing days which were not enumerated each month at recorded sites and for unrecorded landing sites using the procedure outlined in Ferriera (2003). Tuna catches were not well disaggregated into the respective species for the artisanal fleet. However, since this fleet is more likely to catch small tunas (due to the restricted geographical range of operation), albeit there may be some mixing of a small catch of large species of tunas, it was assumed that "mixed species of tunas" caught by the artisanal fleet represented the group "other offshore predators".

Several species were included in the catch data, apart from those in the initial list of functional groups in the LAPE region. Two species initially listed under "Small pelagics", Palometa pompano (*Trachinotus goodeii*) and American harvestfish (*Peprilus paru*) were placed under "Coastal predators". Turtle catches are underestimated as most landings are not recorded. Although the data are aggregated across species, the majority of the catch is comprised of leatherback turtles (Lee Lum, 2003). It was assumed that 95 percent of the catch comprised leatherbacks and 5 percent other turtles. Landings of squid species are small and not disaggregated by species. Catches of the recreational fleet are underestimated as data are collected at tournaments only.

Prices of species caught by the semi-industrial longline fleet were available only for 2002. Hence, the 2002 prices were assumed throughout the entire five-year period for this fleet. There were still, however, some data gaps for this fleet. No prices were quoted for Atlantic sailfish and mixed species of shark. A unit price of $3/kg was assumed based on prices of similar species. Missing prices of bigeye tuna were assumed $22/kg as listed for the species in 2002. It was assumed that blackfin tuna caught in 2005 were sold at $3/kg, the same as other non-target species. The catch of king mackerel in 2004 was assumed sold at $19.69/kg, the same as for the artisanal multi-gear fleet (trolling and "a-la-vive" or live bait fishing). An unknown portion of the recreational catch is thought to be sold commercially. However, price data were not available for this fleet and tournament catches were assumed not to be sold. Prices of species in the small coastal pelagic group (*Etrumeus teres*, *Harengula* spp. and *Opisthonema oglinum*) in 2001 and 2002 were assumed the same as those recorded in 2003 ($2.22/kg).

Martinique & Guadeloupe (French Overseas Departments)

Catch data were extracted from the FAO FISHSTAT Plus database (accessed 12 June 2007) and assumed to represent recorded data, as is the case for some countries in the eastern Caribbean. No catches of Atlantic bonito and blackfin tuna were recorded for Martinique, and blackfin tuna for Guadeloupe, in 2003 and 2005. The 2002 catches of the species in the respective countries was assumed the same for years with missing data. However, it is noted that there was little variation in the reported annual catches of the various species. Catches were also not disaggregated by fleets. It was assumed that small pelagics were caught with beach seines and other species caught with pelagic lines (open, outboard vessels using troll and longlines). Price data were not available. The annual average regional species prices (OECS countries) were assumed.

Although catch data for the French Overseas Departments are estimated by the FAO, to fill data gaps, at the Management Planning Workshop (MPW) it was the view that the magnitude of such catches were representative for the countries based on observed fisheries operations in the LAPE region. It was noted that catches taken in the Grenadines are landed in Martinique and Guadeloupe, but not incorporated in the catch data for the exploiting country. It was also noted at the MPW that prices of fish sold in the Overseas French Departments were considerably higher than fish sold in OECS countries. As a result, the unit price and associated value of the catch of these countries were under-estimated. It is therefore recommended that future versions of the LAPE ecosystem model be adjusted accordingly.

Countries outside the LAPE area

Data for the appropriate stocks were accessed from the ICCAT Task I Dataset. Catches from countries participating in the LAPE project were excluded from the dataset (as country submissions were used instead). Catch data for non-participating countries in the LAPE area were not included in the ICCAT

database. It was assumed that only catches of countries located in the LAPE area were taken from this area (see Vasconcellos et al. 2004). The remaining catches, by non-LAPE countries, was used as the catch outside the LAPE. Information was extracted from the ICCAT database if the stocks of the respective species were partly distributed in the LAPE. Information for unknown areas was not used. Catches of small tunas (other offshore predators) and mackerels were extracted for the Western Tropical Atlantic area only, assuming that the associated stocks are regional. Although the ICCAT database was used as the source for most large pelagic species, it was necessary to extract missing catch data for dolphinfish, four-winged flyingfish, sharks and non-fish groups from the FAO Fishstat Plus database.

RESULTS

The average annual catches taken by the nine fleets operating in the LAPE region between 2001 and 2005 are given in Table 5 and the associated annual average value in Table 6. Country specific results for the fleets are provided in Tables 7 to 15.

Table 5 Average annual catch (tonnes) taken by regional fleets in the LAPE (2001-2005).

Functional Group	Beach Seine	Decked inboard (troll, longline, gillnets)	Longliners	Open outboard (other)	Open-outboard (troll, longline, gillnets)	Recreational	Marine Mammal SVG	Marine Mammal STL	Total Outside LAPE	TOTAL	Percent catch inside LAPE
Killer whales							5.628	0.319		5.947	100.00
Shallow-diving small cetaceans					0.593		0.508	15.670		16.771	100.00
Swordfish		1.900	176.485		3.519				10,997	11,178.905	1.63
Other Billfishes	0.115	11.360	376.983		59.578	5.077	0.035		5,282	5,735.149	7.90
Yellowfin	0.075	29.038	1,087.035		136.210	0.056	1.239	0.022	127,521	128,774.675	0.97
Skipjack	0.034		138.363		109.707		2.257		27,300	27,550.361	0.91
Albacore		1.240	49.406		9.222		0.187	0.292	26,445	26,505.347	0.23
Bigeye		2.480	24.830		1.840		0.002		77,960	77,989.152	0.04
Blackfin tuna	0.018		0.044		1,408.032	0.020	0.773	5.941	1,338	2,752.828	51.40
Other offshore predators	55.411	59.763	27.351		1,434.143	0.051	0.021	0.194	2,023	3,599.435	43.81
Mackerels	8.434		0.224	0.370	2,871.265	0.307	0.013	0.389	7,840	10,720.747	26.87
Wahoo	0.023	26.180	142.910		314.521	2.647	2.103	10.320	222	720.370	69.23
Dolphinfish	0.663	534.720	50.145	0.173	1,593.340	1.947	1.959	16.890	1,330	3,529.837	62.32
Pelagic sharks		8.940	68.524	0.135	891.763	0.040	0.216	0.442	761	1,730.860	56.04
Flyingfish	0.339	1,392.180	59.540	0.000	211.939			6.740		1,670.738	100.00
Coastal predators	204.093	2.920		0.433	381.048		0.517			589.011	100.00
Small coastal pelagics	3,289.864	14.720		0.223	230.565		2.036			3,537.407	100.00
Leatherback turtles	1.279				2.136		0.000			3.415	100.00
Other turtles	1.346			6.800	12.514	0.106	0.106	0.434		21.306	100.00
Large squid					4.000					4.000	100.00
TOTAL	3,561.694	2,085.444	2,201.840	8.133	9,675,937	10.250	17.599	57.654	289,018	306,636.262	
% regional catch	20.22	11.84	12.50	0.05	54.92	0.06	0.10	0.33			

Table 6 Average annual catch value (US$) in the LAPE (2001-2005). Totals are in units of thousands of dollars.

Functional Group	Beach Seine	Decked inboard (troll, longline, gillnets)	Longliners	Open out-board (other)	Open-outboard (troll, longline, gillnets)	Recreational	Marine Mammal SVG	Marine Mammal STL	Total Outside LAPE ($1000s)	TOTAL ($1000s)	Percent value inside LAPE
Killer whales							20,882	1,185		22	100.00
Shallow-diving small cetaceans					2,182		1,870	57,666		62	100.00
Swordfish		7,531	699,524		13,950				43,588	44,309	1.63
Other Billfishes	488	47,981	1,592,253		251,639	21,445	146		22,309	24,223	7.90
Yellowfin	339	131,052	4,905,905		614,732	251	5,593	101	575,516	581,174	0.97
Skipjack	131		541,740		429,543		8,836		106,889	107,869	0.91
Albacore		4,771	190,091		35,482		720	1,122	101,748	101,980	0.23
Bigeye		11,015	110,284		8,173		7		346,263	346,393	0.04
Blackfin tuna	82		197		6,289,783	88	3,452	26,538	5,977	12,297	51.40
Other offshore predators	157,434	169,797	77,709		4,074,685	145	59	552	5,746	10,227	43.81
Mackerels	30,785		816	1,350	10,480,112	1,121	48	1,420	28,615	39,131	26.87
Wahoo	116	132,223	721,771		1,588,492	13,366	10,624	52,120	1,120	3,638	69.23
Dolphinfish	3,594	2,898,010	271,772	935	8,635,392	10,552	10,617	91,538	7,208	19,130	62.32
Pelagic sharks	0	11,368	87,138	171	1,133,998	51	274	563	967	2,201	56.04
Flyingfish	414	1,701,004	72,748		258,953			8,235		2,041	100.00
Coastal predators	522,440	7,475		1,109	975,412		1,324			1,508	100.00
Small coastal pelagics	7,867,101	35,200		533	551,353		4,868			8,459	100.00
Leatherback turtles	1,667				2,784		0			4	100.00
Other turtles	5,144			25,989	47,829	405	405	1,660		81	100.00
Large squid					8,241					8	100.00
TOTAL	8,589,735	5,157,426	9,271,946	30,888	35,402,735	47,425	69,724	242,700	1,245,948	1,304,759	
% regional value	14.61	8.77	15.77	0.05	60.20	0.08	0.12	0.41			

Table 7 Average annual catch (tonnes) taken by Antigua and Barbuda in the LAPE (2001-2005)

Functional Group	Beach Seine						Decked inboard (Troll, LL, Gn)						Open-outboard (Troll, LL, Gn)					
	2001	2002	2003	2004	2005	Avg	2001	2002	2003	2004	2005	Avg	2001	2002	2003	2004	2005	Avg
Yellowfin tuna							1.96	0.84	0.91	0.35	4.13	1.64	7.84	3.36	3.64	1.40	16.52	6.55
Other offshore predators	1.82	0.78	0.85	0.33	3.84	1.52	4.55	1.95	2.11	0.81	9.59	3.80	11.83	5.07	5.49	2.11	24.93	9.89
Dolphinfish													4.00	7.00	7.00	10.00	13.00	8.20
Pelagic sharks													2.80	5.95	12.60	10.15	5.95	7.49
Coastal predators							0.90	1.20	3.90	4.95	1.95	2.58	39.70	48.05	127.50	108.95	117.49	88.34
Small coastal pelagics	3.30	3.40	1.70	1.30	1.96	2.33												
TOTAL	5.12	4.18	2.55	1.63	3.85	43.13	7.41	3.99	6.92	6.11	15.67	8.02	47.77	44.78	92.03	82.56	119.80	120.47

Table 8 Average annual catch (tonnes) taken by Barbados in the LAPE (2001-2005)

Functional Group	Decked inboard (Troll, LL, Gn)						Longliners						Open-outboard (Troll, LL, Gn)					
	2001	2002	2003	2004	2005	Avg.	2001	2002	2003	2004	2005	Avg.	2001	2002	2003	2004	2005	Avg.
Swordfish	0.4	0.5	2.0	1.6	5.0	1.90	18.1	9.8	19.3	23.6	38.9	21.94	0.5		0.1	0.1	0.1	0.20
Billfishes	6.3	8.7	13.4	10.2	18.2	11.36	76.6		66.7	63.2	137.7	86.05	2.0	0.3	1.8	0.7	1.3	1.22
Yellowfin	11.2	23.4	27.5	28.5	46.4	27.40	151.7	100.8	148.7	181.4	242.5	165.02	2.9	1.1	2.0	1.0	2.8	1.96
Albacore	0.5	1.1	1.2	1.3	2.1	1.24	6.9	4.6	6.8	8.2	11.0	7.50	0.1	0.1	0.1		0.1	0.10
Bigeye	1.0	2.2	2.5	2.5	4.2	2.48	13.8	9.2	13.5	16.5	22.0	15.00	0.3	0.1	0.2	0.1	0.3	0.20
Other offshore predators	45.4	6.5	48.8	77.2	61.9	55.96	0.6	1.7	1.4	5.6	2.0	2.26	0.4	3.0	2.3	1.6	1.4	1.74
Wahoo	18.5	32.6	24.1	37.0	18.7	26.18	3.9	3.4	3.3	4.2	2.2	3.40	2.9	7.7	6.8	4.3	5.4	5.42
Dolphinfish	631.3	600.3	508.3	515.5	418.2	534.72	65.9	65.7	47.2	36.1	20.6	47.10	20.8	25.0	17.0	16.8	7.0	17.32
Pelagic sharks	9.8	9.0	8.4	9.1	8.4	8.94	3.7	4.2	3.0	3.0	8.7	4.52	0.7	0.5	0.7	0.5	0.6	0.60
Flyingfish	1,547.8	1,488.8	1,752.7	1,111.6	1,060.0	1,392.2	84.6	59.8	100.5	38.7	14.1	59.54	40.7	41.8	59.2	35.4	37.8	42.98
Coastal predators	0.6	0.7	0.2	0.1	0.1	0.34							1.0	0.3	1.4	0.9	1.0	0.92
Small coastal pelagics	8.8	7.7	14.7	29.6	12.8	14.72							0.9	0.9	10.9	2.4	2.5	3.52
TOTAL	2,281.6	2,221.5	2,403.8	1,824.2	1,656.0	2,077.4	425.8	259.2	410.4	380.5	499.7	412.33	73.2	80.8	102.5	63.8	60.3	76.12

Table 9 Average annual catch (tonnes) taken by Dominica in the LAPE (2001-2005)

Functional Group	Beach Seine						Open-outboard (Troll, LL, Gn)					
	2001	2002	2003	2004	2005	Avg	2001	2002	2003	2004	2005	Avg
Swordfish							1.99	0.99		0.13	0.21	0.83
Other Billfishes		0.04	0.08			0.06	48.57	53.87	59.17	51.35	51.50	52.89
Yellowfin tuna		0.06	0.12		0.04	0.08	27.58	58.79	90.01	109.90	138.52	84.96
Skipjack	0.02	0.01		0.01	0.03	0.02	83.53	61.22	38.91	37.19	23.01	48.77
Bigeye							3.21	1.60		0.02		1.61
Blackfin tuna								16.40	32.80	24.93	44.18	29.58
Other offshore predators	0.11	0.28	0.46	0.10	0.01	0.19	28.89	24.92	20.94	4.75	19.03	19.71
Mackerels							0.93	0.72	0.52	0.41	0.05	0.52
Wahoo	0.03	0.02				0.02	11.32	9.47	7.63	7.22	9.74	9.08
Dolphinfish	0.02	0.01				0.02	130.31	106.64	82.98	25.72	63.59	81.85
Flyingfish	0.09	0.21	0.34	0.10	0.95	0.34	79.35	54.31	29.28	10.90	5.00	35.77
Coastal predators	17.19	8.94	0.69	2.52	1.19	6.11	5.03	4.23	3.42	4.25	5.35	4.46
Small coastal pelagics	140.27	148.46	156.64	70.71	27.81	108.78	23.95	16.68	9.42	10.52	12.84	14.68
TOTAL	157.73	158.03	158.34	73.44	30.04	115.61	444.64	409.85	375.07	287.30	373.02	384.70

Table 10 Average annual catch (tonnes) taken by Grenada in the LAPE (2001-2005)

Functional Group	Open-outboard (Troll, LL, Gn)						Longliners					
	2001	2002	2003	2004	2005	Avg	2001	2002	2003	2004	2005	Avg
Swordfish							73.0	53.8	88.0	73.1	55.5	68.70
Other Billfishes							305.3	227.2	257.3	190.2	198.9	235.78
Yellowfin tuna	22.76	17.78	22.47	13.81	14.77	18.32	736.0	575.0	726.4	446.6	477.6	592.31
Albacore							20.8	22.9	46.1	24.7	28.5	28.59
Bigeye							0.2	0.3	1.0	2.4		0.98
Skipjack	15.30	14.43	15.50	20.85	21.71	17.56						
Blackfin tuna	222.70	254.58	334.73	267.59	306.32	277.18						
Other offshore predators	10.70	10.30	3.00	16.00		10.00						
Mackerels	4.00	5.19	5.00	11.00		6.30						
Wahoo	71.10	59.22	44.08	60.00		58.60						
Dolphinfish	221.00	178.00	130.00	164.00	160.00	170.60						
Pelagic sharks							28.8	12.0	17.0	15.0	18.0	18.16
Flyingfish	10.00	5.00	4.00	3.00	3.00	5.00						
Coastal predators	43.00	52.00	58.00	39.00	40.00	46.40						
Large squids	5.00	3.00				4.00						
TOTAL	625.56	599.51	616.77	595.25	545.79	613.96	1,164.1	891.2	1,135.9	751.9	778.5	944.52

Functional Group	Beach Seine						Open-outboard (other)					
	2001	2002	2003	2004	2005	Avg	2001	2002	2003	2004	2005	Avg
Coastal predators	29.0	46.0	28.0	35.0	35.0	34.6						
Small coastal pelagics	2,316.0	2,312.0	2,276.0	2,228.0	2,236.0	2,273.6						
Other turtles							7.00	8.00	8.00	6.00	5.00	6.80
TOTAL	2345	2358	2304	2263	2271	2308.2	7.00	8.00	8.00	6.00	5.00	6.80

Table 11 Average annual catch (tonnes) taken by French Overseas Departments in the LAPE (2001-2005)

Functional Group	Guadeloupe						Martinique											
	Open-outboard (Troll, LL, Gn)						Beach Seine						Open-outboard (Troll, LL, Gn)					
	2001	2002	2003	2004	2005	Avg	2001	2002	2003	2004	2005	Avg	2001	2002	2003	2004	2005	Avg
Blackfin tuna	500	500	500	500	500	500					500	500	470	470	470	470	470	470
Other offshore predators													530	530	530	530	530	530
Mackerels	1,600	1,600	1,600	1,600	1,600	1,600					320	320						
Dolphinfish	700	700	700	700	700	700					700	700	220	220	220	220	200	216
Pelagic sharks													40	40	40	40	35	39
Small coastal pelagics							4,000	4,000	4,000	4,000	3,200	3,840						
TOTAL	2,800	2,800	2,800	2,800	2,800	2,800	4,000	4,000	4,000	4,000.	6,800	6,800	1,260	1,260.	1,260	1,260	1,235	1,255

Table 12 Average annual catch (tonnes) taken by St Kitts and Nevis in the LAPE (2001-2005)

Functional Group	Beach Seine						Open-outboard (Troll, LL, Gn)					
	2001	2002	2003	2004	2005	Avg	2001	2002	2003	2004	2005	Avg
Yellowfin tuna							0.11	0.17	0.56	0.56	0.84	0.45
Skipjack		0.02	0.01	0.03		0.02	0.39	0.27	0.65	0.49	0.68	0.50
Albacore							0.01	0.01	0.06	0.03	0.01	0.02
Blackfin tuna				0.01		0.01	2.22	2.28	5.01	4.24	4.83	3.72
Other offshore predators		6.03	10.09	4.19		6.77	1.27	1.28	2.76	2.26	2.74	2.06
Mackerels			1.66	1.13		1.39	2.05	2.11	2.17	3.64	6.03	3.20
Wahoo							4.46	4.46	3.75	5.47	7.08	5.04
Dolphinfish		0.65				0.65	32.01	44.85	25.77	33.47	40.51	35.32
Coastal predators	36.92	43.19	73.10	83.47	66.98	60.73						
Small coastal pelagics	91.31	101.07	46.07	82.18	62.20	76.57						
TOTAL	128.24	150.96	130.93	171.02	129.18	146.15	42.53	55.42	40.74	50.15	62.71	50.31

Table 13 Average annual catch (tonnes) taken by St Lucia in the LAPE (2001-2005)

Functional Group	Beach Seine						Longliners					
	2001	2002	2003	2004	2005	Avg	2001	2002	2003	2004	2005	Avg
Swordfish										1.60	2.63	2.12
Other Billfishes							0.00	8.90		16.82	20.69	11.60
Yellowfin tuna							144.53	93.70		147.00	171.64	139.22
Skipjack							151.43	106.20		136.72	159.10	138.36
Albacore							3.06	2.30	2.47			2.61
Bigeye							0.65	2.10		0.14	1.56	1.11
Other offshore predators									18.09			18.09
Mackerels									0.20			0.20
Wahoo									138.82			138.82
Small coastal pelagics	309.71	309.71	311.28	344.78	360.11	327.12						
TOTAL	309.71	309.71	311.28	344.78	360.11	327.12	299.67	213.20	159.57	302.27	355.62	452.12

Average annual catch (tonnes) taken by St Lucia in the LAPE (2001-2005) - continued

Functional Group	Open-outboard (Troll, LL, Gn)						Marine Mammal						Recre-tional
	2001	2002	2003	2004	2005	Avg	2001	2002	2003	2004	2005	Avg	2001
Killer whales							0.42	0.31	0.34	0.28	0.25	0.32	
Shallow-diving small cetaceans							20.84	15.02	16.79	13.50	12.21	15.67	
Other Billfishes													4.60
Yellowfin tuna	0.28		0.40	0.87	0.16	0.43	0.01		0.02	0.05	0.01	0.02	
Albacore			9.60		1.49	5.54			0.51		0.08	0.29	
Blackfin tuna	102.13	91.30	160.14	91.14	119.67	112.87	5.38	4.81	8.43	4.80	6.30	5.94	
Other offshore predators	1.48	10.91	0.60	0.67	0.44	2.82	0.08	0.57	0.03	0.04	0.02	0.15	
Mackerels	6.18	26.29	2.00	0.83	1.68	7.39	0.33	1.38	0.11	0.04	0.09	0.39	
Wahoo	202.37	230.77	160.91	226.10	160.22	196.08	10.65	12.15	8.47	11.90	8.43	10.32	
Dolphinfish	405.65	381.90	271.70	357.20	188.10	320.91	21.35	20.10	14.30	18.80	9.90	16.89	
Pelagic sharks			3.87	11.60		7.74			0.20	0.61		0.41	
Flyingfish	306.85	183.35	71.25	10.45	68.40	128.06	16.15	9.65	3.75	0.55	3.60	6.74	
Leatherback turtles													
Other turtles				5.01	11.49	8.25				0.26	0.60	0.43	
TOTAL	1,024.93	924.52	680.47	703.88	551.64	790.09	75.21	63.98	52.94	50.82	41.50	56.89	4.60

Table 14 Average annual catch (tonnes) taken by St Vincent and the Grenadines in the LAPE (2001-2005)

Functional Group	Beach Seine						Open-outboard (Troll, LL, Gn)						Marine Mammal					
	2001	2002	2003	2004	2005	Avg	2001	2002	2003	2004	2005	Avg	2001	2002	2003	2004	2005	Avg
Killer whales													7.44	7.33	6.02	4.46	2.89	5.63
Shallow-diving small cetaceans													0.26	0.38	0.49	0.77	0.63	0.51
Other Billfishes							0.75	0.42	0.08	0.60	1.44	0.66	0.04	0.02		0.03	0.08	0.04
Yellowfin tuna							22.52	12.65	23.11	22.21	37.24	23.54	1.19	0.67	1.22	1.17	1.96	1.24
Skipjack							46.34	27.52	44.46	37.99	58.09	42.88	2.44	1.45	2.34	2.00	3.06	2.26
Albacore							0.33			6.79		3.56	0.02			0.36		0.19
Bigeye							0.03					0.03						
Blackfin tuna							23.02	9.77	14.79	16.41	9.43	14.68	1.21	0.51	0.78	0.86	0.50	0.77
Other offshore predators	48.78	28.96	46.80	39.99	61.15	45.1		0.29	0.32		0.59	0.40		0.02	0.02		0.03	0.02
Mackerels	0.10		0.61	0.36	0.03	0.28	0.24	0.25	0.01	0.07	0.04	0.12	0.01	0.01				0.01
Wahoo							53.55	15.93	36.71	56.59	37.06	39.97	2.82	0.84	1.93	2.98	1.95	2.10
Dolphinfish							0.93	31.19	49.03	62.21	42.75	37.22	0.05	1.64	2.58	3.27	2.25	1.96
Pelagic sharks							2.09	2.37	0.74	0.27	2.45	1.58	0.11	0.12	0.04	0.01	0.13	0.08
Coastal predators	6.43	5.63	5.45	2.44	1.81	4.4	11.73	7.55	4.33	9.72	0.66	6.80	0.62	0.40	0.23	0.51	0.03	0.36
Small coastal pelagics	248.2	291.0	321.3	258.5	173.7	258.5	37.18	31.43	46.39	43.30	35.08	38.68	1.96	1.65	2.44	2.28	1.85	2.04
Other turtles								4.10	0.91		0.95	1.99		0.22	0.05		0.05	0.10
TOTAL	303.5	325.6	374.2	301.3	236.7	308.3	198.7	143.4	220.9	256.1	225.8	212.1	18.2	15.3	18.1	18.7	15.4	17.31

Table 15 Average annual catch (tonnes) taken by Trinidad in the LAPE (2001-2005)

Functional Group	Beach Seine						Longliners						Open outboard (other)					
	2001	2002	2003	2004	2005	Average	2001	2002	2003	2004	2005	Average	2001	2002	2003	2004	2005	Average
Swordfish							75.00	92.47	77.73	82.66	90.80	83.73						
Other Billfishes							23.25	20.21	28.33	26.33	21.16	23.86						
Yellowfin tuna							122.00	125.32	186.37	223.96	294.78	190.49						
Albacore							11.00	9.16	11.99	12.24	9.13	10.71						
Bigeye							11.00		6.46	4.80	8.69	7.74						
Blackfin tuna											0.04	0.04						
Other offshore predators	0.59	4.25	0.53			1.79	15.00	13.03	3.72	1.67	1.60	7.00						
Mackerels	8.91	6.59	7.34	5.71	5.29	6.77				0.01	0.04	0.02		0.64			0.10	0.37
Wahoo							0.80	1.00	0.72	0.66	0.29	0.70						
Dolphinfish								2.52	2.51	3.28	3.87	3.05		0.01			0.34	0.17
Pelagic sharks							47.80	60.96	49.58	24.60	26.80	41.95		0.11		0.16		0.13
Coastal predators	96.00	131.8	82.75	96.86	31.1	87.71								0.30	0.84	0.03	0.11	0.32
Small coastal pelagics	179.3	99.61	31.97	2.17	34.6	69.54								0.22				0.22
Leatherback turtles			1.28			1.28												
Other turtles			1.35			1.35												
TOTAL	284.8	242.3	125.2	104.7	71.0	168.42	305.9	324.7	367.4	380.2	457.2	369.28		1.28	0.84	0.19	0.55	1.22

Average annual catch (tonnes) taken by Trinidad in the LAPE (2001-2005) - continued

Functional Group	Open-outboard (Troll, LL, Gn)						Recreational					
	2001	2002	2003	2004	2005	Average	2001	2002	2003	2004	2005	Average
Shallow-diving small cetaceans		0.59				0.59						
Other Billfishes	3.13	6.51	4.60	3.25	6.55	4.81		0.09	0.40	0.79	0.15	0.36
Yellowfin tuna								0.03	0.07		0.07	0.06
Blackfin tuna										0.01	0.05	0.03
Other offshore predators	749.67	1,746.4	706.34	670.14	409.87	856.48		0.04	0.01	0.08		0.04
Mackerels	1,467.5	1,618.3	803.44	883.62	1,491.6	1,252.9		0.28	0.42	0.38	0.09	0.29
Wahoo	0.10	0.22	0.56	0.64	0.20	0.34		4.10	2.69	1.80	1.99	2.65
Dolphinfish	3.84	8.62	3.97	7.61	5.57	5.92		1.95				1.95
Pelagic sharks	855.68	1,136.6	767.31	964.44	423.49	829.51					0.04	0.04
Flyingfish	0.13					0.13						
Coastal predators	320.34	362.94	195.02	186.42	249.19	262.78						
Small coastal pelagics	319.83	160.32	88.76	106.87	177.72	170.70						
Leatherback turtles		0.06	0.78	0.02	7.69	2.14						
Other turtles		0.06	0.82	0.02	8.09	2.25						
TOTAL	3,720.2	5,040.7	2,571.6	2,823.0	2,780.0	3,388.6		6.50	3.60	3.05	2.39	5.41

Annual catches in the pelagic fishery of the countries in the LAPE varied between 19,000 and 23,000 tonnes between 2001 and 2005 (Table 16). Catch data confirm the important role of small coastal pelagics, both in terms of food security and as a source of bait for offshore fisheries (Table 16, Figure 1). This functional group contributed 34% to the cumulated catch over the five years. Average annual catch was about 7,000 tonnes. Mackerels and dolphinfish also contribute substantially to overall catch, accounting for 14% and 10% respectively of the cumulated catch over the five years. Other species or groups such as whales, shallow-diving cetaceans, swordfish, albacore, bigeye tuna, leatherback and other turtles as well as large squids accounted for less than 10% of the cumulated catch (Figure 1).

Table 16 Annual catches (tonnes) of pelagic and associated species from combined fleets of countries in the LAPE area

Functional Group	2001	2002	2003	2004	2005	Total
Killer whales	8	8	7	5	3	31
Shallow-diving small cetaceans	18	19	19	19	19	93
Swordfish	169	158	187	183	193	890
Other Billfishes	471	326	432	363	458	2,050
Yellowfin tuna	1,253	1,014	1,234	1,179	1,450	6,129
Skipjack	299	211	102	235	266	1,113
Albacore	43	40	79	54	52	268
Bigeye	30	16	24	26	37	133
Blackfin tuna	1,327	1,350	1,527	1,380	1,461	7,044
Other offshore predators	1,451	2,436	1,404	1,358	1,129	7,778
Mackerels	3,090	3,262	2,423	2,507	3,105	14,388
Wahoo	382	382	440	419	253	1,877
Dolphinfish	2,457	2,396	2,082	2,174	1,876	10,985
Pelagic sharks	991	1,272	903	1,079	530	4,776
Flyingfish	2,086	1,843	2,021	1,211	1,193	8,353
Coastal predators	596	700	545	546	506	2,892
Small coastal pelagics	7,694	7,498	7,358	7,214	6,686	36,450
Leatherback turtles		0	2	0	8	10
Other turtles	7	12	11	11	26	68
Large squids	5	3				8
TOTAL	22,377	22,945	20,801	19,963	19,250	105,335

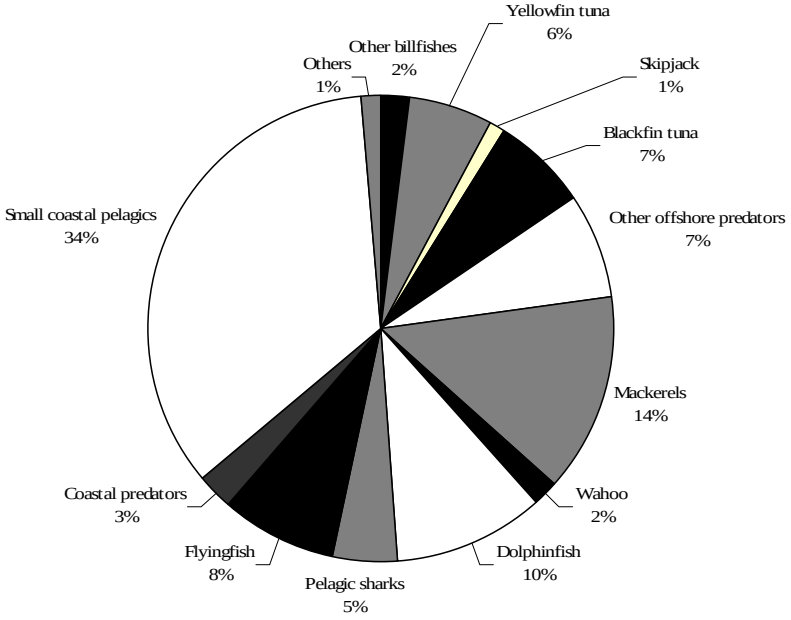


Figure 1 Percent contribution of pelagic and associated species to catch (2000–2005). Species or group catches of less than 300 tonnes are aggregated under "others"

Annual prices by species or functional group are given in Table 17. The annual value of the pelagic fishery ranged between US$64 and US$69.5 million (Table 18). Small coastal pelagics accounted for 26% of the cumulated value over the five years (Figure 2), with dolphinfish, mackerels and blackfin tuna accounting for 18% 16% and 10% respectively.

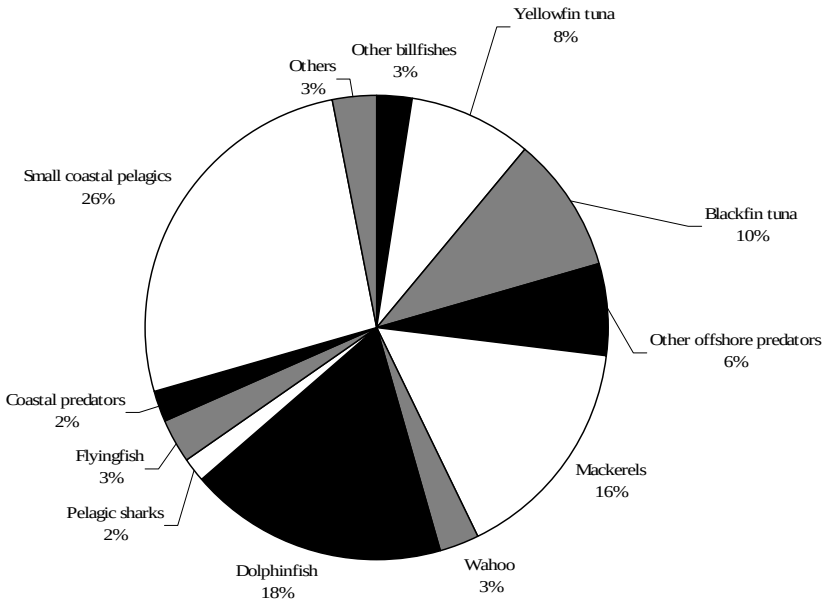


Figure 2 Percent contribution of pelagic and associated species to annual average catch value (2000–2005). Species or groups valued at less than US$5 million are aggregated as "others"

Table 17 Annual average prices (US$/kg) for pelagic and associated species (or functional groups) caught by countries in the LAPE area

Functional Group	2001	2002	2003	2004	2005	Average
Killer whales	3.71	3.71	3.71	3.71	3.71	3.71
Shallow-diving small cetaceans	3.71	3.63	3.71	3.71	3.71	3.69
Swordfish	3.92	3.71	3.96	3.90	4.32	3.96
Other Billfishes	4.08	4.02	4.00	4.10	4.92	4.22
Yellowfin tuna	4.45	4.41	4.38	4.42	4.92	4.51
Skipjack	3.99	4.05	3.61	3.95	3.99	3.92
Albacore	3.46	3.57	3.90	3.73	4.57	3.85
Bigeye	4.04	4.34	4.10	4.63	5.10	4.44
Blackfin tuna	4.29	4.43	4.43	4.44	4.75	4.47
Other offshore predators	2.86	1.95	2.97	2.88	3.55	2.84
Mackerels	3.39	3.40	3.84	3.88	3.73	3.65
Wahoo	4.56	4.90	5.18	5.05	5.56	5.05
Dolphinfish	5.00	5.21	5.38	5.55	5.96	5.42
Pelagic sharks	1.27	1.09	1.23	1.30	1.47	1.27
Flyingfish	1.14	1.10	1.05	1.60	1.21	1.22
Coastal predators	2.20	2.07	2.76	2.77	3.00	2.56
Small coastal pelagics	2.08	2.28	2.39	2.42	2.78	2.39
Leatherback turtles		1.46	1.09	1.44	1.23	1.30
Other turtles	4.12	4.11	3.53	4.12	3.23	3.82
Large squids	2.06	2.06				2.06

Table 18 Annual and cumulative (2001-2005) value (ex-vessel: US$ x 103) of pelagic and associated species (or functional groups) caught by countries in the LAPE area

Functional Group	2001	2002	2003	2004	2005	Total
Killer whales	30	29	25	19	13	115
Shallow-diving small cetaceans	68	69	69	70	69	345
Swordfish	662	585	742	714	835	3,537
Other Billfishes	1,922	1,310	1,728	1,490	2,251	8,701
Yellowfin tuna	5,569	4,473	5,399	5,204	7,128	27,774
Skipjack	1,195	854	367	929	1,059	4,404
Albacore	148	143	307	200	240	1,038
Bigeye	122	67	97	122	188	596
Blackfin tuna	5,691	5,983	6,760	6,124	6,937	31,495
Other offshore predators	4,145	4,762	4,165	3,909	4,006	20,987
Mackerels	10,487	11,097	9,318	9,736	11,571	52,208
Wahoo	1,744	1,872	2,281	2,114	1,409	9,421
Dolphinfish	12,284	12,482	11,194	12,074	11,179	59,213
Pelagic sharks	1,260	1,386	1,108	1,403	780	5,936
Flyingfish	2,386	2,033	2,124	1,937	1,444	9,925
Coastal predators	1,311	1,448	1,505	1,511	1,517	7,292
Small coastal pelagics	16,038	17,099	17,616	17,431	18,596	86,780
Leatherback turtles		0	2	0	9	12
Other turtles	29	51	39	47	85	250
Large squids	10	6				16
TOTAL	65,099	65,752	64,846	65,032	69,316	330,045

The major contributors to regional catch among the countries participating in the LAPE Project between 2001 and 2005 (Figure 3a) are Trinidad (19%), Grenada (18%) and Barbados (12%). However, Martinique and Guadeloupe (French Overseas Departments) contribute substantially to regional catches (24% and 13% of regional catch respectively). Grenada, Trinidad and Barbados realized the highest ex-vessel value (Figure 3b), accounting for 18%, 10% and 10% respectively of the overall value of pelagic fisheries in the region. Details of country contributions to overall catch and value of each functional group are given in Appendices 5 and 6.

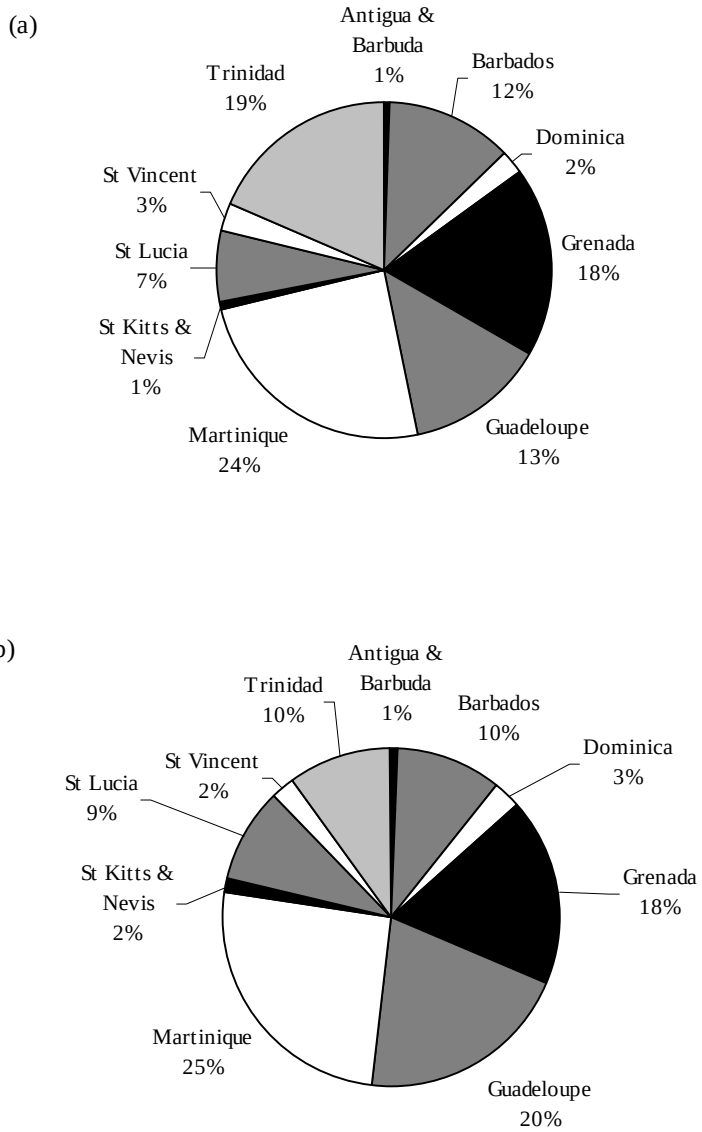


Figure 3 Country contributions to (a) cumulated catch and (b) cumulated value of pelagics fisheries in the LAPE area (2001-2005)

DISCUSSION

Average annual catch of pelagic fisheries by countries in the LAPE was about 21,000 tonnes between 2001 and 2005, with a corresponding value of about US$66 million. The main country contributors to overall catch by weight are Martinique, Trinidad, Grenada, Guadeloupe and Barbados. Foreign catches were substantial, averaging about 289,018 tonnes, over the same period, for those species or groups with distribution beyond the LAPE. In fact, the greater portion of catches of migratory groups was taken by foreign fleets (98% of billfishes, large tunas and skipjack). Foreign fleets accounted for 49%, 56%, 73%, 31%, 38% and 44% of total catches of blackfin tuna, other offshore predators, mackerels, wahoo, dolphinfish and pelagic sharks respectively. Although mackerels and other offshore predators are important commercially in the LAPE, it is worth noting that more than 50 percent of the associated catches are taken by foreign fleets. Catches of flyingfish, coastal predators and small pelagics were taken only by regional fleets. In the absence of data, it was assumed that catches of marine mammals, turtles and large squids were taken solely by regional fleets operating within the LAPE. Within the LAPE the majority of the catch is taken by the open, outboard (troll, longline, gillnet) fleet which accounts for, on average 42 percent, overall catch by regional fleets. It is worth noting, that based on expert knowledge the quantity of small pelagics caught in the bait fishery supplying the Grenada longline fishery was calculated in this report at 2,166 tonnes per year. The associated catch of the longline fleet is only 1,536 tonnes. Although the relative prices offered for small coastal pelagics compared to large pelagics may make this activity economically viable, there is cause for concern regarding the population impacts on small coastal pelagics and the availability of these species as a food source.

Several options are available for representation of fleet dynamics in the LAPE ecosystem model to explore policy options for management of large pelagic species in the region. However, the utility of these options is dependent on the quality of available information. At the fourth meeting of the Ecosystem Modelling Working Group four management policy issues, pertaining to the small pelagic fishery, flyingfish and dolphinfish trophic linkage, marine mammal and fisheries interactions and climate change, were identified for exploration using the Ecopath with Ecosim software. Given the time constraints of the project, and the fact that not all input data from the various subprojects were available for the model, it was necessary to structure the fleets in a manner which would facilitate exploration of all four policy scenarios without need for further modification. The structure agreed upon, with some adjustment to account for between-country fleet variations, would facilitate policy exploration at two levels, regional and national. The associated regional fleets include: (a) beach seines (targeting small pelagics); (b) decked, inboard (troll, longline and gillnets); (c) longliners; (d) open, outboard (troll, longline, gillnets); (e) open, outboard (other); (f) recreational; (g) marine mammal (St Vincent); (h) marine mammal (St Lucia). One fleet was included in the model to represent catches of

large tunas, billfishes and other species, with distribution beyond the LAPE, that were taken by fleets operating outside the LAPE area (foreign).

The quality of data varies throughout the region, for some countries only recorded (sample) data were available while others provided estimates of total landings based on different systems for modifying recorded statistics. Mahon and McConney (2004) noted that due to the complex, diverse nature of regional fisheries adequate statistical coverage is often not possible. As a result few CARICOM countries are in a position to provide regular comprehensive reports of fishery landings by species group and fleet component (Mahon and MCConney, 2004). Indeed, the multi-fleet, multi-gear nature of regional fisheries posed a challenge in disaggregating catches to represent the various fleet types. Nevertheless, the reclassification of fleets based on Mahon and McConney (2004) provided some level of comparability among regional fleets and maintained consistency with previous efforts at documenting aspects of the large pelagic fishery. In some cases it was necessary to assume species catch-fleet linkages based on expert knowledge of the fishery.

The data presented in this report should be interpreted with consideration to the following limitations:

1. An unknown proportion of the catch from regional fleets is not reported.

2. Global databases (e.g., ICCAT Task I) may underestimate catches of small tunas and tuna-like species which have not been the subject of assessment studies. As well, catches of pelagic sharks are under-estimated as these have not been the subject of assessment until quite recently.

3. Catches of recreational fleets are not well documented, being limited in all instances to fishing tournaments. As well, catches of the growing charter-boat fishing operations in the tourism industry are not documented (Mahon and McConney, 2004).

4. Catches from large longliners which offload directly at exporters or processors are possibly underestimated. Mahon and McConney (2004) proposed the implementation of a logbook system to capture this information.

5. Lack of information on catches of non-fish groups e.g., seabirds, marine mammals, turtles and squids.

6. Illegal, unregulated and unreported catches are not considered.

7. The quantities of small coastal pelagic species and flyingfish utilized as bait are not recorded.

8. Uncertainties in species identification of the catch. Species identification remains an important issue e.g., both king mackerel (*Scomberomorus*

cavalla) and wahoo (*Acanthocybium solandri*) are locally called "kingfish" in several countries and as such the quantity of the catch attributed to each species is uncertain; while little tunny (*Euthynnus alletteratus*) caught in the beach seine fishery is recorded as skipjack (*Katsuwonus pelamis*). Although such a problem is minor when both species are assigned to the same functional group the situation is exacerbated when local names create uncertainty between widely different groups e.g., in St Kitts *A. solandri* is locally called "robin" with reference to the pelagic fishery as opposed to scads (*Decapterus* spp.) which are also locally called "robin" but with reference to the small coastal pelagic fishery (FAO, 2006). There is also a problem when reported catches are aggregated across different species groups within the same family e.g., reported catches of scombrids which include large tunas, small tunas and mackerels, all represented as different functional groups in the model.

9. Lack of data on catches of juveniles of large pelagic species in the LAPE region. Although the capture of juveniles of large pelagic species is known to occur in the region, either in beach seines or by troll lines, the catch statistics are not disaggregated to facilitate representation of the relative impacts of fishing on adults and juveniles, and the possible impacts of juvenile exploitation on the associated adult population.

10. Catch data for Montserrat and Tobago are not included.

The limitations listed above should be considered in future efforts towards improvement of the data collection systems in the region.

Examination of country data submissions suggested limited review of the data collected. This was evident by zero catches of some species or functional groups in some years and non-zero catches in others. Unless a species has gone extinct, there is no gear capable of catching it or its distribution renders contact with fishing gear unlikely, zero catches are not realistic. Efforts should be made to address this situation as a matter of priority. The zero catches and values are disregarded in deriving average annual estimates over the period 2001 to 2005 in this report. It is also necessary that country data submissions be interpreted in the context of the operations of the associated data collection systems e.g., increases in catch may be a product of both fisheries development as well as improvement of data collection systems.

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APPENDIX 1 SUMMARY OF REVIEW OF STATISTICAL SYSTEMS IN LAPE PROJECT PARTICIPATING COUNTRIES

Country	Objective	Result	Conclusions and Recommendations
Antigua	Catch reconstruction	No data identified prior to 1995 Data in TIP (1995 to 2000) considered inaccurate by FD, advise against use for catch estimation Raw data loss due to natural disasters Reconstruction not conducted	
	Methodology for estimating total catch from recorded data	Since 2001 data considered representative of catch Data entered in Excel Annual frame surveys since 2001 to estimate raising factor CPUE standardized by vessel size	Limited sampling effort (80 fishing days per year) seems sufficient for useful estimation with appropriate design Suggest consider design in Murray and Barnwell (1994)
	Migration of data from TIP and LRS into CariFIS	FD has reservations regarding use of CariFIS as its data management software Catch data stored in EXCEL is summarized and cannot be fully migrated to CariFIS The 1995 to 2000 data (considered inaccurate) in TIP and LRS can be automatically migrated to CariFIS Existing data in LRS can be migrated to CariFIS successfully	Current data in EXCEL of good quality but does not allow for ease of Transfer to CariFIS Current data in LRS should be migrated to CariFIS and updated with recent data but need to have registration and licensing data archived annually Include "year purchased" field in vessel component to CariFIS More data collectors and better training required
Barbuda	Catch reconstruction	No data collectors Landings data extrapolated from export data	
	Methodology for estimating total catch from recorded data		
	Migration of data from TIP and LRS into CariFIS		

Country	Objective	Result	Conclusions and Recommendations
Barbados	Catch reconstruction	Addressed by another study for 1940 to 2000 (Mohammed et al., 2003a)	
	Methodology for estimating total catch from recorded data	Data collected at markets (census)	
	Migration of data from TIP and LRS into CariFIS	Data in TIP completely migrated to CariFIS, current data entry in CariFIS Access DB used for vessel licensing and registration	Require that CariFIS utilize Access DB in estimations. Technically possible.
Dominica	Catch reconstruction	Data from Government Statistical Office reflects import figures only. No data identified prior to 1995 Reconstruction not conducted	
	Methodology for estimating total catch from recorded data	Existing methodology not documented nor discussed as responsible staff on leave.	FD should document methodology for estimating total landings from recorded data
	Migration of data from TIP and LRS into CariFIS	LRS no longer used by FD, data entered in Access and password protected Consultant unable to retrieve data to determine compatibility with LRS. Responsible staff on leave. C/E data entered in TIP from 1994 to date excluding 1997 and 2000 data but vessel identification incomplete No backup of data previously entered in TIP and LRS available. Previous in-country training in use of CariFIS (CRFM) not applied to improve data management system, software not used therefore no feedback	Data in TIP can be migrated to CariFIS but vessel id issues must be addressed possibly by comparing data in legacy LRS and recent Access databases Archiving of registration and licensing data annually is required in CariFIS Need to improve knowledge and skills of data collectors Greater commitment o monitoring/supervision, quality control activities, data storage and a strong data management system Need for systematic back-ups Process for estimating total landings from recorded data must be documented Need for systematic vessel census

Country	Objective	Result	Conclusions and Recommendations
Grenada	Catch reconstruction	Addressed by another study for 1942 to 2001 (Mohammed and Rennie, 2003)	
	Methodology for estimating total catch from recorded data	Data collected at 6 primary landing sites and from 3 exporters. These account for 90% large pelagic data. RF of 1.7 applied across the board, hence large pelagic landings overestimated Several errors/inconsistencies noted with respect to vessel marking, type, port and owner in current data (Excel) and 1995 data (LRS)	
	Migration of data from TIP and LRS into CariFIS	TIP and LRS are not in operation and backup of the databases do not exist Excel used for computerization of catch data No plans for a vessel census or inventory exist. Vessel information exists for 1995 in LRS and 2005 data in Excel Some catch data in TIP for 1994 and 1995 Previous in-country training in use of CariFIS (CRFM) not applied to improve data management system, software not used therefore no feedback Lack of data entry staff and current staff lacks motivation and interest Limited training in CariFIS provided to data entry staff	Data management program requires major attention 1994 and 1995 TIP data incomplete therefore migration to CariFIS unjustified Catch data in Excel (TIP-like format) can be migrated to historical CariFIS database but additional data entry required Available data does not justify cost of migration Archiving of registration and licensing data annually is required in CariFIS
St Kitts	Catch reconstruction	No data identified prior to 1995 Production data from national archives aggregated for agriculture Damage to FD due to tropical storms resulted in loss of data Reconstruction not conducted	

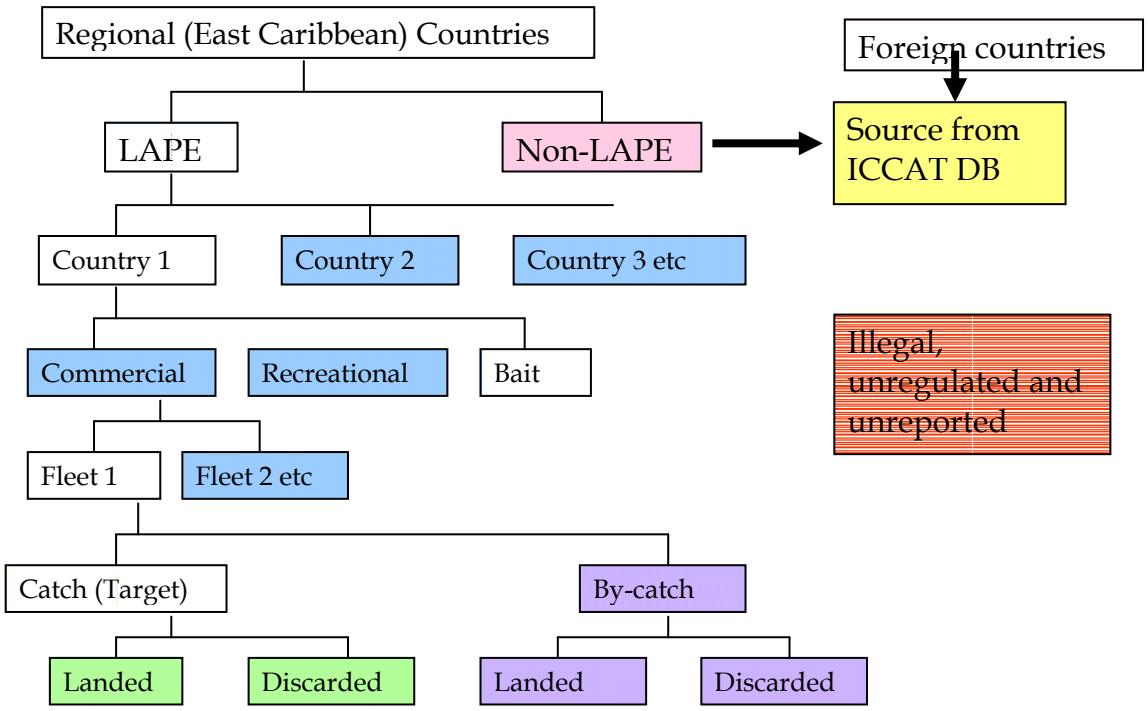
Country	Objective	Result	Conclusions and Recommendations
	Methodology for estimating total catch from recorded data	Data entered in TIP (when working) and Excel (2004 to 2005). Raising factor based on total number of fishing days sampled used in Excel to estimate total landings.	RF applies to the 5 major sites, need to consider estimate for 8 minor sites
	Migration of data from TIP and LRS into CariFIS	LRS and TIP not used since 2005 due software and hardware problems Data loss resulting from 1. but limited data retrieved from backup Existing LRS data recovered and transferred to Excel where it is currently updated Existing data in TIP for 1995 to 1999 but annual records limited; no back-up of 1999 to 2004 data Current landings data entered in Excel but with little detail Previous in-country training in use of CariFIS (CRFM) not applied to improve data management system, software not used therefore no feedback	Need to improve knowledge and skills of data collectors Greater commitment o monitoring/supervision, quality control activities and a strong data management system Greater co-ordination required between enforcement and data management staff Need for systematic back-ups
Nevis	Catch reconstruction	No data identified prior to 1995 Reconstruction not conducted	
	Methodology for estimating total catch from recorded data	Data entered in TIP and LRS (when working) FD indicates that annual catch is estimated but methodology not discussed	FD should document methodology for estimating total landings from recorded data
	Migration of data from TIP and LRS into CariFIS	Computer malfunction Data retrieval not possible Current data in hard copy only Previous in-country training in use of CariFIS (CRFM) not applied to improve data management system, software not used therefore no feedback	Need for updated computer Need for vessel census to estimate total landing Catch data in Excel reviewed and can be migrated to CariFIS but some re-entry of past data required Archiving of registration and licensing data annually is required in CariFIS

Country	Objective	Result	Conclusions and Recommendations
St Lucia	Catch reconstruction	Addressed by another study for 1942 to 2001 (Mohammed and Joseph, 2003)	
	Methodology for estimating total catch from recorded data	Total estimates generated using data in TIP and Excel. Each of 9 recorded sites treated individually and monthly RF generated based on proportion of vessels at the site that were sampled ; further adjustments to estimate the number of fishing days Estimated totals grouped for reporting but available at species level Separate RF for lobster and conch as data from Fish Marketing Corporation used RF estimated for non-sampled sites based on similarity in fishing activity and no. of vessels Estimates for months with missing data based on same month in previous year	Procedure for estimating total landings well documented. Good systems for quality control, monitoring/supervision and management exist
	Migration of data from TIP and LRS into CariFIS	LRS and TIP systems fully functioning and updated Reports generated from LRS CariFIS not used Initial reservations regarding use of CariFIS as data management tool but review of reporting capabilities generated interest	Migration of data in TIP and LRS will be straightforward. Archiving of registration and licensing data annually is required in CariFIS Training of data entry staff in CariFIS required
St Vincent & Grenadines	Catch reconstruction	Addressed by another study for 1942 to 2001 (Mohammed et al., 2003b)	
	Methodology for estimating total catch from recorded data	A stratified sampling program is in effect for landing sites and a random sample design for sampling days Monthly RF generated for each site based on proportion of total fishing days sampled Direct sale of fish from Grenadines to yachts and hotels results in underestimation of total landings	Method for estimating total landings from recorded data already implemented Good data collection, monitoring and supervision, quality control and data management in St Vincent Improvements required to data collection system in Grenadines

Country	Objective	Result	Conclusions and Recommendations
	Migration of data from TIP and LRS into CariFIS	LRS system used and updated, a good representation of vessel inventory Landings data computerized in TIP Recent computer problem resulted in temporary entry in Excel FD participated in testing of CariFIS but has not implemented the system	Training required for data entry staff in manipulation of CariFIS Migration of data in TIP and LRS to CariFIS is straightforward 2005 data entered in Excel will require separate migration after main data migrated and CariFIS established as data management system Archiving of registration and licensing data annually is required in CariFIS
Trinidad	Catch reconstruction	Partially addressed by another study for 1908 to 2002 (Mohammed and Chan A Shing., 2003)	
	Methodology for estimating total catch from recorded data	A stratified system of sampling along with regular vessel census used to derive RF to account for non-recorded fishing days and non-recorded landing sites Methodology for estimating total landings from recorded data is well documented	Method for estimating total landings from recorded data already implemented Good data collection, monitoring and supervision, quality control and data management
	Migration of data from TIP and LRS into CariFIS	Catch data computerized and reports of total landings generated using an Oracle-based system Licensing and registration data entered in LRS and database already migrated to CariFIS Problems identified with data manipulation were addressed.	
Tobago	Catch reconstruction	Partially addressed by another study for 1908 to 2002 (Mohammed and Chan A Shing., 2003)	
	Methodology for estimating total catch from recorded data	Methodology for estimation of total landings from recorded data well documented (similar to Trinidad) but applied only to the drifting fishery from 1988 to 1996 using Dbase IV. O Current data are entered in Excel and available in nominal form only	

Country	Objective	Result	Conclusions and Recommendations
	Migration of data from TIP and LRS into CariFIS	TIP and LRS not currently operational Data already entered is incomplete and LRS information is inaccessible as computer is non functional Vessel registration in hard copy only Landings data computerized in Excel and summed by species and month for reporting Previous in-country training in use of CariFIS (CRFM) not applied to improve data management system, software not used therefore no feedback	Six years of landings data in Excel can be migrated to CariFIS but there is no corresponding effort data Non-participant status of Trinidad and Tobago limits the effort the project can contribute to migration of data to CariFIS Storage, manipulation and reporting of registration and catch and effort data can be better managed through the utilization of a database system such as CariFIS Archiving of registration and licensing data annually is required in CariFIS

APPENDIX 2 SCHEMATIC DIAGRAM OF SOURCES OF FISHING MORTALITY ON MARINE FISHERIES RESOURCES IN THE LAPE REGION



APPENDIX 3 FISHING FLEETS OF COUNTRIES IN THE LAPE REGION

Fleet category (Mahon and McConney, 2004)	Corresponding country local names for vessel types and numbers of vessels							
	Trinidad and Tobago (data for Trinidad only)	Barbados	Grenada	St Vincent	St Lucia	Dominica	Antigua and Barbuda	St Kitts & Nevis
Open-outboard (troll, longlines)	artisanal multi-gear (troll; a-la-vive; other pelagic lines 99	Moses (troll, gillnet) 485	pirogue 445	pirogue (figure includes boats using palangue) 337	canoes; pirogues; shallops; transoms and whalers 642	fibreglass pirogues; keel boats 169	open boat with or without cabin (some are also charterboats) 4	pirogues (multi-gear) 36
Open-outboard (gillnets)	artisanal multigear (gillnets) 121		pirogue	pirogue (figure includes boats using palangue) 22		fibreglass pirogues; keel boats; canoes (small) 439		
Open-outboard (other)	artisanal multigear (fishpots; diving) 14	n.a.	n.a.	n.a.	n.a.	n.a	n.a.	n.a.
Decked-inboard (troll, gillnets)	Semi-industrial mutli-gear; iceboats 2	dayboats iceboats (troll, gillnet) 414	sloops (troll off east coast for regional pelagics) - nos assumed 8	n.a.		n.a.	launch; charterboats (commercial /tourism) 13	inboard decked; sportfishers (commercial) 2
Decked-				n.a.		n.a.		

Fleet category (Mahon and McConney, 2004)	Corresponding country local names for vessel types and numbers of vessels							
	Trinidad and Tobago (data for Trinidad only)	Barbados	Grenada	St Vincent	St Lucia	Dominica	Antigua and Barbuda	St Kitts & Nevis
inboard (longlines)								
Longliner medium (7-15 m)		longiner 37	launch 135 (o.b.)	longliners (from 2006 onwards)	longliner 4	longliner 2	n.a.	
Longliner large (>15 m)		longliner	trawlers 74 (converted to longlines)	trawlers (converted to longlines from 2006)		n.a.	n.a.	
Longliner large (14-23 m)	Semi-industrial longlines 17			n.a.	n.a.	n.a.	n.a.	
Beach Seines	artisanal multi-gear (beach seines, italian seines, bait seines) 10	seine 3	beach seines 37	double-enders 102	canoes; pirogues; shallops; transoms and whalers 32	canoes 179	ballyhoo nets 1	pirogue (beach seine/ballyhoo net; purse seine type) 7
Recreational	recreational; pirogues; decked sport fishing boats n.a.	charterboats; sportfishing	sportfishers 30	charterboats	shallops; pirogues and sport fishing vessels or Bertrams	sport fishers and charterboats (from 2007)	launch (decked with cabin, inboard) 29	sportfisher/ aunch (involved in charters) 17
TOTAL	263	939	729	461	678	789	47	62

APPENDIX 4 FUNCTIONAL GROUPS PRESENT IN THE LAPE ECOSYSTEM MODEL.

Group	Functional Group	Common Name	Scientific Name
1	Seabirds	Black-capped petrel	Pterdroma hasitata
		Brown pelican	Pelacanus occidentalis
		Cayenne tern	Sterna eurygnatha
		Common tern	Sterna hirundo
		Gull-billed tern	Galechelidon nilotica
		Royal tern	Sterna maxima
		Least tern	Sterna antillarum
		Sandwich tern	Sterna sandvicensis
		Roseate tern	Sterna dougalli
		Bridled tern	Sterna anaethetus
		Sooty tern	Sterna fuscata
		Laughing gulls	Larus atricilla
		Black noddy	Anous minutus
		Masked booby	Sula dactylatra
		Red-footed booby	Sula sula
		Brown noddy	Anous stolidus
		Red-billed tropicbird	Phaethon aethereus
		White-tailed tropicbird	Phaethon lepturus
		Audubon's shearwater	Puffinus lherminieri
		Magnificent frigatebird	Fregata magnificens
2	Baleen whales	Bryde's whale	Balaenoptera edeni
3	Deep-diving whales	Sperm whale	Physeter catodon
		Gervais' beaked whale	Mesoplodon europaeus
4	Killer whales	False Killer whale	Pseudorca crassidens
		Killer whale	Orcinus orca
		Pygmy killer whale	Feresa attenuata
5	Shallow-diving small cetaceans	Shortfin pilot whale	Globicephala macrorhynchus
		Atlantic Spotted Dolphin	Stenella frontalis
		Bottlenose dolphin	Tursiops truncatus
		Spinner dolphin	Stenella longirostris
		Pantropical spotted dolphin	Stenella attenuata
		Fraser's dolphin	Lagenodelphis hosei
		Striped dolphin	Stenella coeruleoalba
		Melon-headed whale	Peponocephala electra
		Clymene dolphin	Stenella clymene
		Rough-tooth dolphin	Tursiops truncatus
6	Swordfish	Swordfish	Xiphias gladius
7	Other Billfishes	Atlantic blue marlin	Makaira nigricans
		Atlantic white marlinx	Tetrapturus albidus
		Atlantic sailfish	Istiophorus platypterus
		Black marlin	Makaira indica
		Longbill spearfish	Tetrapturus pfluegeri
8	Yellowfin tuna	Yellowfin tuna	Thunnus albacares
9	Skipjack	Skipjack	Katsuwonus pelamis
10	Albacore	Albacore	Thunnus alalunga
11	Bigeye	Bigeye	Thunnus obesus
12	Blackfin tuna	Blackfin tuna	Thunnus atlanticus

Group	Functional Group	Common Name	Scientific Name
13	Other offshore predators	Atlantic bonito	Sarda sarda
		Bullet tunas	Auxis spp.
		Little tunny	Euthynnus alletteratus
		Spotted oceanic triggerfish	Canthidermis maculatus
		Ocean triggerfish	Canthidermis sufflamen
14	Mackerels	Serra Spanish mackerel	Scomberomorous brasiliensis
		King mackerel	S. cavalla
		Cero mackerel	S. regalis
		Spanish mackerel	S. maculatus
15	Wahoo	Wahoo	Acanthocybium solandri
16	Dolphinfish	Common dolphinfish	Coryphaena hippurus
		Pompano dolphinfish	Coryphaena equiselis
17	Pelagic sharks	Blue shark	Prionace glauca
		Bigeye thresher	Alopias superciliosus
		Thintail thresher	Alopias vulpinus
		Longfin mako	Isurus paucus
		Shortfin mako	Isurus oxyrhinchus
		Bluntnose sixgill shark	Hexanchus griseus
		Great hammerhead	Sphyrna mokarran
		Porbeagle	Lamna nasus
		Smooth hammerhead	Sphyrna zygaena
		Tiger shark	Galeocerdo cuvier
		Blacktip shark	Carcharhinus limbatus
		Oceanic whitetip	Carcarhinus longimanus
		Silky shark	Carcharhinus falciformis
		Sandbar shark	Carcharhinus plumbeus
		Spinner shark	Carcharhinus brevipinna
18	Fourwing flyingfish	Fourwing flyingfish	Hirundichthys affinis
		Margined flyingfish	Cheilopogon cyanopterus
		Sailfin flyingfish	Parexocoetus brachypterus
19	Coastal predators	Keeltail needlefish	Platybelone argalus argalus
		Redfin needlefish	Strongylura notata notata
		Agujon needlefish	Tylosurus acus acus
		Atlantic needlefish	Strongylura marina
		Blue runner	Caranx crysos
		Black jack	Caranx lugubris
		Hound needlefish	Tylosurus crocodilus
		Crevalle jack	Caranx hippos
		Bar jack	Caranx ruber
		African pompano	Alectis ciliaris
		Yellowtail amberjack	Seriola lalandi
		Rainbow runner	Elegatis bipinnulata
		Leatherjacks	Oligoplites spp.
		Amberfish	Seriola dumerili
		Great barracuda	Sphyraena barracuda
		Guachanche barracuda	Sphyraena guachancho
		Sennet	Sphyraena picudila
		Common snook	Centropomus undecimalis
		Yellowtail snapper	Ocyurus chrysurus
		Tripletails (Lobotidae)	Lobotidae
		Bermuda sea chub	Kyphosus sectatrix
		Palometa pompano	Trachinotus goodei
		Permit	Trachinotus falcatus
		Pompano	Trachinotus carolinus

Group	Functional Group	Common Name	Scientific Name
20	Small offshore pelagics	Includes juveniles of several pelagic species identified in other functional groups as well as juveniles of reef species while in the pelagic state (listed in the Ecosystem Survey report)	
21	Small coastal pelagics	Atlantic bumper Mackerel scad Round scad Bluntnose jack Bigeye scad Threadfin scad False herring Redear herring Scaled herring Spratt Dwarf round herring Atlantic thread herring American coastal pellona Yellowfin herring Round sardinella Brazilian sardinella Broad-striped anchovy Little anchovy Common halfbeak Sargassum pelagicus Balao halfbeak Ballyhoo American harvestfish	Chloroscombrus chrysurus Decapterus macarellus Decpaterus punctatus Hemicaranx amblyrhynchus Selar crumenophthalmus Dorosoma petenense Harengula clupeola Harengula humeralis Harengula jaguana Harengula pensacolae Jenkinsia lamprotaenia Opisthonema oglinum Pellona harroweri Pliosteostoma lutipinnis Sardinella aurita Sardinella brasiliensis Anchoa hepsetus Anchoa parva Hyporhamphus unifasciatus Syngnathus pelagicus Hemiramphus balao Hemiramphus brasiliensis Peprilus paru
22	Small Mesopelagic fish	(lanternfish) Topside lanternfish (lanternfish) (lanternfish) Warming's lanternfish	Diaphus dumerilii Notolychnus valdiviae Lepidophanes guentheri Lampanyctus alatus Ceratoscopelus warmingi
23	Large Mesopelagic fish	Snake mackerel Longnose lancetfish Oilfish Atlantic pomfret	Gempylus serpens Alepsaurus ferox Ruvettus pretiosus Brama brama
24	Leatherback turtles	Leatherback turtles (entirely pelagic, feed on gelatinous zooplankton)	Dermochelys coriacea
25	Other turtles	Hawksbill (juveniles pelagic 1-2 yrs) Loggerhead Olive ridley (juveniles pelagic) Green turtle (juveniles pelagic 2-4 yrs)	Eretmochelys imbricata Caretta caretta Lepidochelys olivacea Chelonia mydas mydas
26	Small squid	Gonatidae (Mantle Length < 50 cm)	
27	Large squid	Onychoteithidae and Architeuthidae Mantle Length > 50 cm	
28	Small Zooplankton	micro-meso-plankton (< 3-4 cm) copepods, small euphausids, etc.	

Group	Functional Group	Common Name	Scientific Name
29	Large Zooplankton	macroplankton (> 4 cm) Decapods Large euphausiids Mysids Gelatinous plankton	
30	Phytoplankton		
31	Detritus		

APPENDIX 5 COUNTRY CONTRIBUTION (TONNES) TO OVERALL PELAGIC CATCHES IN THE LAPE REGION (2001-2005)

Functional Group	Antigua & Barbuda	Barbados	Dominica	Grenada	Guadeloupe	Martinique	St Kitts Nevis	St Lucia	St Vincent	Trinidad	TOTAL
Killer whales								3	28		31
Shallow-diving small cetaceans								90	3	1	93
Swordfish		120	3	343				4		419	890
Other Billfishes		407	265	1,179				51	3	145	2,050
Yellowfin tuna	41	972	425	3,053			3	559	124	953	6,129
Skipjack			244	88			3	553	226		1,113
Albacore		44		143			0	19	7	54	268
Bigeye		88	5	4			0	4	0	31	133
Blackfin tuna			118	1,386	2,500	2,350	19	594	77	0	7,044
Other offshore predators	76	300	99	40		2,650	31	33	226	4,323	7,778
Mackerels			3	25	8,000		19	39	2	6,300	14,388
Wahoo		175	45	234			25	1,171	210	16	1,877
Dolphinfish	41	2,996	409	853	3,500	1,080	177	1,689	196	44	10,985
Pelagic sharks	37	70		91		195		16	8	4,358	4,776
Flyingfish		7,474	181	25				674		0	8,353
Coastal predators	313	6	53	405			304		58	1,754	2,892
Small coastal pelagics	158	91	617	11,368		19,500	383	1,636	1,496	1,201	36,450
Leatherback turtles										10	10
Other turtles				34				17	6	10	68
Large squids				8							8
TOTAL	666	12,743	2,467	19,280	14,000	25,775	962	7,154	2,671	19,617	105,335

APPENDIX 6 COUNTRY CONTRIBUTION (US$) TO THE OVERALL VALUE OF PELAGIC CATCHES IN THE LAPE REGION (2001-2005)

Functional Group	Antigua and Barbuda	Barbados	Dominica	Grenada	Guadeloupe	Martinique	St Kitts & Nevis	St Lucia	St Vincent	Trinidad	TOTAL
Killer whales								10,723	104,401		115,124
Shallow-diving small cetaceans								335,213	9,426	596	345,235
Swordfish		608,167	15,044	1,603,458				20,290		1,290,104	3,537,064
Other Billfishes		1,958,287	1,199,922	5,193,420				245,963	18,854	84,449	8,700,896
Yellowfin tuna	303,887	4,644,022	1,927,859	14,251,387			17,067	2,626,032	613,077	3,390,446	27,773,778
Skipjack			1,105,937	416,048			16,553	2,307,494	558,259		4,404,291
Albacore		212,074		671,922			756	90,359	37,041	26,047	1,038,199
Bigeye		425,199	21,897	17,797			18	21,111	75	110,175	596,271
Blackfin tuna			536,720	6,538,123	11,008,550	10,348,037	121,344	2,639,453	302,593	21	31,494,841
Other offshore predators	564,362	428,415	423,866	181,341		14,450,194	184,523	179,373	558,259	4,016,255	20,986,587
Mackerels			11,887	114,237	35,211,127		108,396	172,989	7,226	16,582,284	52,208,146
Wahoo		851,821	205,972	1,062,768			207,821	6,132,485	953,828	5,934	9,420,630
Dolphinfish	304,288	14,590,928	2,024,416	3,999,849	20,260,912	6,243,988	1,171,142	9,668,428	888,604	60,860	59,213,416
Pelagic sharks	154,425	221,847		282,588		630,006		55,801	27,011	4,564,175	5,935,853
Flyingfish		8,453,310	260,410	62,442				1,148,524		166	9,924,852
Coastal predators	1,066,119	14,160	208,943	1,896,884			1,674,370		216,976	2,214,304	7,291,757
Small pelagics	779,330	238,538	989,148	22,472,856		52,829,998	1,467,033	4,293,768	2,832,530	876,432	86,779,634
Leatherback turtles										11,840	11,840
Other turtles				140,169				71,629	25,898	12,463	250,158
Large squids				16,480							16,480
TOTAL	3,172,412	32,646,768	8,932,023	58,921,771	66,480,588	84,502,222	4,969,023	30,019,634	7,154,060	33,246,550	330,045,050