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Nader A. S. Abo-Tubikh
Promoteo Project – Senescyt
Facultad Ciencias Del Mar,
Departamento Central De
Investigacion Universidad Laica
“Eloy Alfaro” De Manabi,
Manta, Ecuador.

Status and improvement of artisanal fisheries in Manabi province, Ecuador: a case study

Nader A. S. Abo-Tubikh

Abstract

The present paper is concerned with an annual catch of artisanal fisheries in Manabi Province, Ecuador during the period from 2008 to 2011 based on landing statistics provided by Sub-secretary of Fisheries Resources (Subsecretaria de Recursos Pesqueros SRP), National Institute of Fisheries (Instituto Nacional de Pesca INP) and Viceministerio de Acuicultura y Pesca in Manta. The pursuit of the artisanal fisheries was monitored by means of the landings of big pelagic fishes along with incidental fishing of sharks and rays in the main fishing ports of Manabi Province (Manta, Pedernales, Pto. Lopez and Bahia). Different fish species were studied, and categorized into major and minor species. Among the major are: Bonito *Katsuwonus pelamis*, Albacora (Chapuleta) *Thunnus albacores*, (Patudo). *T. obesus*, Dorado *Coryphaena hippurus*, and Wahoo *Acanthocybium solandi*. The minor landing species include: Meramelindo *Lepidocybium flavobrunneum*, Picudo *Makaira nigricans*, Espada *Xiphias gladius* and Gacho *Kajikia audax*. The principal Shark species which are caught on artisanal longline and gillnets are: Thresher (Alopiidae), Requiem shark (Carcharhinidae), White shark (Lamidae) Hammerhead (Sphyrnidae), Scoophead shark (Triakidae).

Keywords: Artisanal, Fisheries, Manabi, Ecuador

1. Introduction

According to recent FAO report about Ecuador's profile of fisheries, total fisheries production was 663 600 tonnes in 2011, of which 391 700 tonnes were derived from capture fisheries (FAO, 2013). The fisheries industry contributes significantly to the economic and social development of the country and is an important source of employment. At 2012, exports of fish and fishery products were valued at USD 2.9 billion, representing 12 percent of total trade. The fisheries sector, on average contributes 7% of the total supply of protein animals. The estimated per capita consumption ranged from 5 to 8 kg per annum.

There are two main types of fishing in Ecuador:

- Industrial fishing using big fishing vessels and modernized gears by commercial companies in the off-coast open ocean.
- Artisanal or small-scale fishing involving fishing by households and using relatively small amount of capital, relatively small fishing vessels, making short fishing trips with relatively low level technology, close to shore, mainly for local consumption.

Ecuador's artisanal fishery Consists of 15 500 fishing boats generating an average catch of 30 000 tonnes to 70 000 tonnes of pelagics (63 percent), demersals (29 percent) and other species (18 percent). Their catches are landed in 138 different landing sites. Some 58 000 people are employed in this fishery (FAO, 2013). More than 300 marine species constitute the bulk of the artisanal fishing catch. Genus *Thunnus* (albacore) and *Katsuwonus* (bonito bonito), with *Coryphaena hippurus* (gold) represent the main species. According to fish statistics of National Fisheries Institute (INP, 2010), the yield for this subsector ranged from 8,200 to 16, 800 metric tons annually from 2001 to 2007. The fish resources and habitats remain increasingly threatened by various stressors such as dredging / reclamation, fishing operations, and industrial effluents. Of all the environmental impacts, overfishing poses by far the greatest environmental threat representing a major adverse stressor to fisheries productivity in Ecuador (LeMay *et al.*, 2008).

Correspondence:
Nader A. S. Abo-Tubikh
Promoteo Project – Senescyt
Facultad Ciencias Del Mar,
Departamento Central De
Investigacion Universidad Laica
“Eloy Alfaro” De Manabi,
Manta, Ecuador.

Artisanal fishing is important for the economy of Manabi Province and hence for the whole Ecuador because many families might benefit from it. In Manabi Province, where the present study is conducted, the tuna catches exceed 200,000 MT / year transferring Manta port to a capital of the world tuna. The fisheries sector in Manabi generates annually more than 300 million dollars in foreign exchange. Currently there are averages of 3,000 man-made fibers, which together with dozens of shrimp boats are the largest fleet of Ecuador. Artisanal landings mainly supply the domestic market for consumption of fish (SRP, 2010).

Apart from the tuna stocks managed by Inter-American Tropical Tuna Commission (IATTC), and the chub mackerel and threadfin herring; there is little information about target reference points for other fisheries. There is no published information that uncertainty analyses are a regular part of any stock assessment employed in Ecuador. Some papers from outside the country have employed such work. The lack of scientific evidence about the status of stocks and the level of fishing effort has precluded any support for management measures. The present study aims to present an analysis of the status of artisanal fisheries in Ecuadorian waters near Manabi Province for the period 2008-2013 and make suggestions for future needs and development of this sector.

2. Materials & Methods

2.1 Data Collection

The data used to prepare this study comes from the

monitoring process of artisanal fisheries carried out by Sub secretary of Fisheries Resources (Subsecretaria de Recursos Pescqueros SRP), Vice-Minister for Aquaculture and Fisheries (Viceministerio de Acuicultura y Pesca VMAP) and the National Fisheries Institute (Instituto Nacional de Pesca) and INP) in the main landing ports of Manabi Province: Manta, Puerto Lopez, Pedernales and Bahia between 2008 and 2011. For studying the artisanal fishery status in Manabi, the following statistics, were used:

- The annual reports of artisanal fisheries by SRP and INP.
- Fishery statistics for the period between 2008 and 2011.

In addition to data provided by SRP and INP, visits to the main ports were performed to record fishing activities, inspecting fishing gears and status of fishing operations in those ports.

2.2 Study area

The coastal areas of Ecuador are vast, containing more than 138 fishing port which cannot be covered in a single investigation. Instead, the present study dealt with the coast line adjacent to Manabi Province (Fig. 1). Four important ports were selected in the area starting from North of manabi to the South. In descending geographic order the ports are: Pedernales, Bahia, Manta, and Porto Lopez.



Fig 1: Study area in Manabi Province showing fishing ports from North to South: Pedernales, Bahia, Manta and Puerto. Lopez.

3. Results & Discussion

3.1 Fishing operation

Tools used by artisanal fishermen are locally made. They include hooks, lines, nylon, pockets, batteries, tape duct, light cable and nozzles. The fishermen pay for the cost of all these tools which may not be covered by the fishing profit. Out of the 138 ports or landing sites 25% are located in Manabí Province as seen in Table (1) which summarizes the various characteristics of the artisanal fishing in Manabi Province. Nearly half of the Ecuadorian artisanal fishermen are working in Manabi Province. Also half of the fiberglass boat used for fishing in Ecuador based in this province.

3.2 Fishing seasons

There are two major fishing seasons for the artisanal fleet as mentioned by Largacha (2005):

- a. Warm water fishery from November to April (peaking in January-February) to catch with dolphin fish (*Coryphaena hippurus*) as the main target.
- b. Cold water fishery from May to October, targeting mainly Bigeye tuna (*Thunnus obesus*), but may include several

species of billfishes or sharks.

Data of Table (2) summarizes the fishing seasons and gears used to capture the main fish species of the artisanal fisheries.

Table 1: Number of artisanal fishing fleet, ports and fishermen in Manabi Province compared with total number of fleets in whole Ecuador Source: SRP (2007).

Feature	Manabi	Ecuador
Number of inlets	35	141
No. of fishermen	22 183	57 299
Raft	-	36
Bongo	224	3285
Canoe Mountain	132	1466
Canoe Enhanced		2261
Panga	551	1431
Wooden Boat	110	2082
Fiberglass	2446	5224
Sloop	94	144
Total Vessels	3 557	15 929

Table 2: Fishing seasons and gears used to capture the main fish species of the artisanal fisheries.

Fish species	Fishing gear	Fishing season
Mahi-mahi	Longline	January to April November & December
	Surface gillnet	January to May
Tunas	Longline	May to October
	Surface gillnet	January to May
Billfish	Longline	April to October
	Surface gillnet	January to May
Swordfish	Longline	June to December
	Surface gillnet	November and December

3.3 Fishing Vessels

a) Types and numbers of fishing vessels

As seen in Fig. (2), two typical vessel types are used in the artisanal longline fleet in Manabi Province:

- 1. Small fiberglass vessels called “Fibras” can operate independently close to shore, generally 7.5 m to 7.7 m in length, although they reach a length of up to 12 meters, predominant outboard motor is Yamaha 75 HP, tend to

use lines less than 4.5 nm in length.

- 2. Larger boats called “Botes” or Wooden hulls, often tow 5-10 fibras. They range in length from 15 m to 22 m and tend to use lines 2.5 to 6 nm in length. They use 140-155 HP motors. Artisanal fishermen depend on these commercial “mother ships” to pull their fibras to more productive offshore grounds (Largacha, 2005).



Fig 2: Fibras (fiberglass) and Botes (wooden), the main artisanal fishing fleets of in Manta port, Manabi.

Recent survey by (Viceministerio de Acuicultura Y Pesca, VMAP) for the type of vessels used in artisanal fishing in Manabi showed that the type Fibra is dominant with 40-60%

followed by Barco, Bongo, Panga and Canoa with percentage of less than 20%. The use of certain type depends on the port such as the use of Canoa and Panga in Pedernales and Puerto

Lopez rather than Manta where fiberglass and wooden boats are dominant (Fig. 3). As for their numbers, the total numbers of artisanal fishing vessels reached around 15000 of them 7000 are Fibra type in all ports around Manabi Province. Manta port

contains the larger number followed by Puerto Lopez and Pedernales.

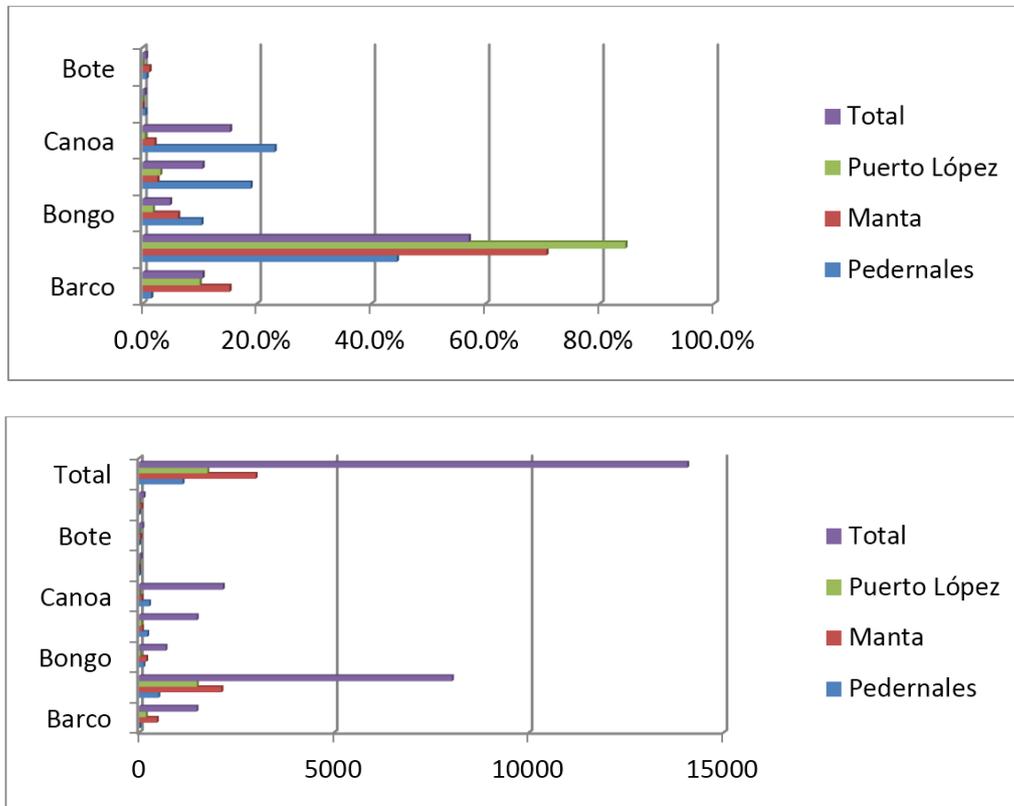


Fig 3: Number and percentage of fishing vessels used in artisanal fisheries in three ports of Manabi Province.

Data supplied by NIP about the active fishing vessels during fishing seasons in two main ports are shown in Table (3). They described the composition of the artisanal fleet per port and vessels, over the period of 2008-2013 in the province of Manabi. Data showed a higher activity of craft from type "Barco" boat (59.7%), which is bigger boats followed by small fiberglass (37.4%). Monthly variations were noticed without any clear trend of certain months that represent the peak fishing season. This is probably because of the interaction of fishing seasons among various fish species. Again this, will allow a continuous fishing activity all around the year.

It can be seen that there was a progressive increase of number of vessels operating in Lopez port. The numbers increased by 3 folds during five years indicating a massive expand of fishing activities. The same trend can be seen in Manta where number of vessels increased from 500 to 800 from 2008-2010. The following years, however, showed a decline in vessel number to less than 500 in 2013. The real reason for such decline is not known and could be related to many factors. Nevertheless, there was intensive fishing activity during 2010, 2011 and 2012 in Manta port.

Table 3: Variation in number of fishing vessels operates in the two main ports in Manabi Province during the period 2008-2013.

Year	Manta Barco	Manta Fibra	Puerto Lopez Fibra
2008	599	79	208
2009	504	47	174
2010	806	18	460
2011	713	0	476
2012	651	7	602
2013	435	0	726

b) Dimension of vessels length

From survey among fishermen about the dimension of their boats, it seems that most of the boats (37%) are between 6-9 m in length followed by boats of 3-6 m in length comprising 25%. These data are shown in Figure (4). These medium size boats are favorable to fishermen as they provide more space for tools and living needs beside reasonably low construction and maintenance costs. Small size boats (<3 m) and very large ones (>12 m) comprise only 5% of the total boats because of the previously mentioned reasons.

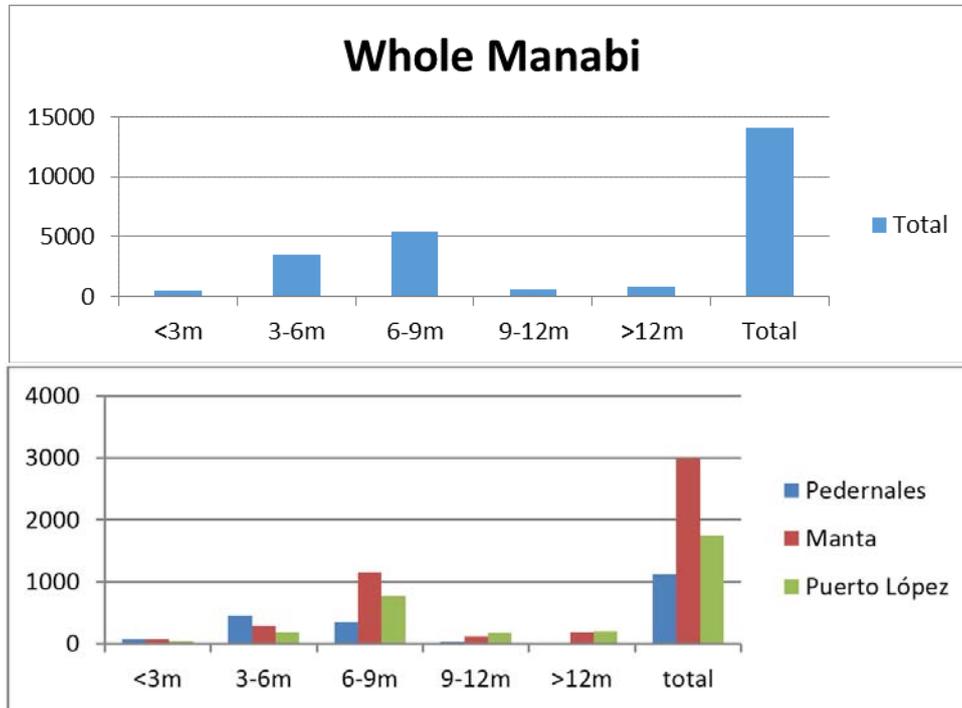


Fig 4: Number of fishing boats in Manabi Province and its main ports grouped according to their dimensions.

c) Communications Equipments on fishing vessels

Another survey about the communication equipments, revealed that the compass, radio, GPS and cell phones are the main communication tools.

3.4 Fishing Gears

Coastal and oceanic artisanal fishers utilize a wide range of fishing gear. Artisanal fishermen use seines, cast nets, trammel nets, traps and drawers. They have a varied fleet (fiberglass canoes, bongos and larger vessels such as ships and sloops) and a variety of fish species. Gear type that used in Manabi provincial coastal communities with their percent of total Ecuadorian gears are listed in Table (4). Data from recent

survey (Fig. 5) provided by Fisheries authority (VMAP) in Manta, indicated that the use of gill net is dominant (51%) in artisanal fishing of Manabi followed by the use of Hook and Line (28%). Other types of nets compose less than 10%. Variation between ports is obvious, with dominance for Hook and Lines in Manta (62%) and gill nets in Pedernales (75%) and Puerto Lopez (55%).

3.5 Catch Composition

3.5.1 Large pelagic species

The principal large pelagic species which are caught in artisanal longline and gillnets are shown in Table (5)

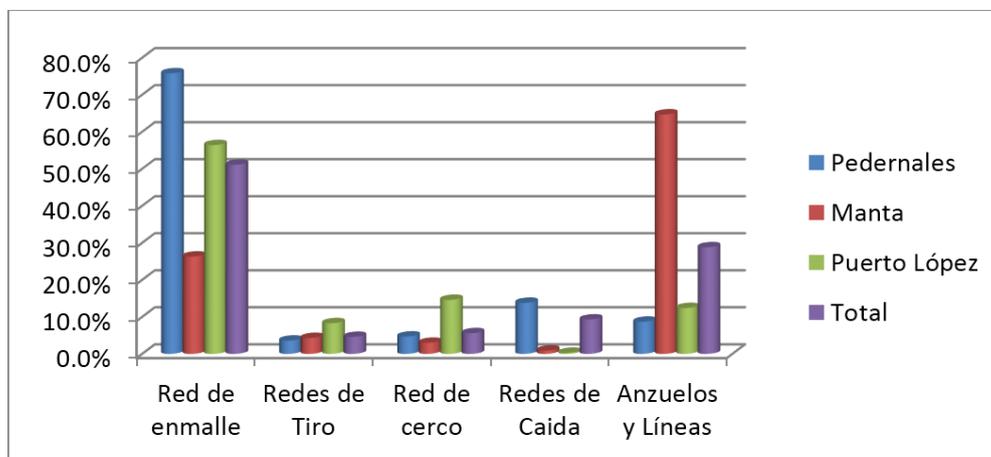


Fig 5: Percentage composition of different types of fishing gears used by artisanal fishermen in Manabi Province

Table 4: Gear type that's used in Manabi coastal communities and their percent of total Ecuadorian gears

Gear type	%
Surface Gillnets	38
Demersal Gillnets	
Multifilament	52
Monofilament	48
Surface long line	27
Bottom longline	48
Hand line	
Pelagic	10
Demersal	17
Chinchorro de playa	20
Larvae nets	3

Table 5: The main large pelagic species in the artisanal catch of Manabi Province.

Scientific name	Family	Common name
<i>Coryphaena hippurus</i>	Coryphaenidae	Golden
<i>Ruvettus pretiosus</i>	Gempylidae	Lija
<i>Lepidocybium flavobrunnerum</i>	Gempylidae	Miramelindo
<i>Makaira sp.</i>	Istiophoridae	Weevil
<i>Istiophorus platyotera</i>	Istiophoridae	Weevil flag that
<i>Tetraoterus audax</i>	Istiophoridae	Weevil slouch
<i>Makaira mazara</i>	Istiophoridae	Billfish white
<i>Makaira indica</i>	Istiophoridae	Black weevil
<i>Thunnus sp.</i>	SCOMBRIDAE	Albacore
<i>Thunnus albacares</i>	SCOMBRIDAE	Yellowfin tuna
<i>Thunnus obesus</i>	SCOMBRIDAE	Big Eye Tuna
<i>Pelamis katsiwonus</i>	SCOMBRIDAE	Nice barrel
<i>Euthynus lineatus</i>	SCOMBRIDAE	Nice dry leg
<i>Sarda orientalis</i>	SCOMBRIDAE	Nice Saw
<i>Scomberomorus sierra</i>	SCOMBRIDAE	Saw
<i>A. solandri</i>	SCOMBRIDAE	Wahoo
<i>Xiphiasgladius</i>	XIPHIDAE	Swordfish

Source: National Fisheries Institute (INP)

3.5.2 Sharks and Rays

The main sharks species are:

- Thresher (Alopiidae)
- Requiem sharks (Carcharhinidae)
- White sharks (Lamidae)
- Hammerhead (Sphyrnidae)
- Scoophead sharks (Triakidae)

However, the catch composition of the artisanal fisheries in Manabi Province is rich and composed of more than 110 species of fish and other marine animals such as crustacean, mollusks and other marine organisms. Table (6) showed the main composition of those organisms caught by artisanal fishermen. Species contribute less than 1% are not counted in the table.

Table 6: Percentage contribution of various fish and other marine species in the catch composition of artisanal fishing in Manabi Province and its main port Manta

Tipos De Especies	Total	Manta
Shrimp	14.2%	2.1%
Pescado	3.7%	2.0%
Sardine	5.7%	1.4%
Pesca blanca White fish	9.7%	9.9%
Dolphinfish (<i>Coryphaena hippurus</i>)	11.6%	31.2%
Picudo <i>Acanthocybium solandri</i>	3.9%	9.9%
skipjack (<i>Katsuwomuspelamis</i>)	6.3%	4.7%
Yellow fin (<i>Thunnus albacares</i>)	6.6%	10.9%

3.6. Fishing Effort

Varied numbers of hooks are used by fibras or botes in tuna fishery. Botes deploy fewer hooks per line (averaged 130)

than fibras (averaged 163). In the dolphinfish fishery, a total of 280 hooks were used per line in 2004 and 383 in 2005 (Largacha, 2005). The average soaks time on the artisanal

longline sets in the tuna fishery was about 10 – 12 hours while the average time in the mahi-mahi fishery is ranging from 8-10 hours. Catch per unit effort (CPUE) ranged from 12.6-13.9 per 1000 hooks for Tuna and 96.3- 149.8 for Dolphin fish (Largacha, 2005).

According to survey carried out by fisheries authority in Ecuador, number of crew on each boat differs markedly. It varied from solo (1 person) to 15 persons. However the most common number of crew is 3-6 which comprise 56 % (7879 person) followed by boats operated by 2 persons which comprise 22% (3180) followed by more than 15 people (10% or 1500) in the fishing boats worked in artisanal fishing in Manabi Province.

3.7. Analysis of Catch (2008-2011)

Contribution of Manabi Fisheries

In the industrial fisheries with large vessels landing at a few ports, it is often possible to use sophisticated models to assess the state of the stocks and to predict the short-term effect of possible changes in fishing activities (MacLennan, 1998). In the artisanal fisheries however, the uncertain data and the nature of the fishery mean that the most sophisticated population models are not useful. The MSY was not calculated due to inadequate data. Instead, it was necessary to adopt a more basic approach, through the study of gross trends.

The exact state of a fish stock is unknown, as is often the case

with artisanal Fisheries in Manabi Province; trend analysis may still indicate the need for management measures to sustain fishing activities in the long-term. The series of available data for the period from 2008-2011 which was obtained from the published statistics of the fisheries authority and listed in Table (7), are not enough to do Maximum Sustainable Yield (MSY) analysis. It was decided instead to study the trends in landings, fleet structure and fishing effort during this period.

It was found that catches had increased recently to levels unlikely to be sustainable in the long term without some management action to control fishing effort. For the four years in the present study, catches of large pelagic species and chondrichthyes have risen, especially between 2008 and 2010 (Table, 7). Records of increases and decreases in catches do not necessarily reflect similar changes in the exploited stock. The catches depend on several factors, and such as the introduction of new fishing methods or more powerful vessels can increase the catch from the same size of stocks, leading to overexploitation and possible collapse of the fishery unless appropriate controls are introduced (Martinez Ortiz *et al.*, 2010). The analysis should, therefore, include investigation of trends in fishing effort and changes in fishing methods to provide a comprehensive overview of the fishery.

Table 7: Total artisanal landing in four fishing ports of Manabi Province for the period 2008-2011 compared with whole Ecuador

Year	Port	Large Pelagic	Sharks and Rays	Total Landing
2008	Manta	11792	5376	17168
	Lopez	101	92	193
	Pedernales	47	31	78
	Bahia	0.25	0.67	0.92
	Total in Manabi	All	11942	5500
Total in Ecuador	All ¹	16350	6820	23170
% Manabi		73.0	80.6	75.3
2009	Manta	12229	6174	18403
	Lopez	330.3	67.2	397.5
	Pedernales	33.5	42.2	75.7
	Bahia	0.4	0.9	1.3
	Total in Manabi	All	12593	6284
Total in Ecuador	All	19683	7406	27089
% Manabi		64.0	84.8	70.0
2010	Manta	8543	9059	17603
	Lopez	254	272	526
	Pedernales	67	84	151
	Bahia	0.9	1.6	2.5
	Total in Manabi	All	8865	9417
Total in Ecuador	All	15154	11051	26205
% Manabi		58.5	85.2	70.0
2011	Manta ²	1221	2532	3753
	Lopez	294	66	360
	Pedernales	115	91	206
	Bahia	3.4	4.4	7.9
	Total	All	1633	2693
Total in Ecuador	All	17937	10812	28749
% Manabi		9.1	24.9	15.0

1. Ports included: Esmeraldas, Muisne, Pedernales, Bahia, Manta, Puerto Lopez, Santa Rosa, Anconcito, Puerto Bolivar
2. Data available for Manta in 2011 are for only four months.

Artisanal landing of large pelagic fisheries in Manabi Province for the period 2008-2013 is analyzed in the present study. The landing of large pelagic species (PPG) estimated for the province of Manabi in 2008-2013 was 67 805.0 tons

(INP, 2014). Five families were recorded: coryphaenidae, Scombridae, Xiphiidae, Istiophoridae and Gempylidae, is the most representative with coryphaenidae 63.4%. The ports of Manta, Puerto Lopez recorded the greatest contributions to

the estimated catch in 2011 with approximately 17 327.5 tons, and in 2012 14 699.2 tons, large pelagic had greater

representation in the port of Manta 66 025.5 t corresponds to 97.4% of the total catch, Figure (6).

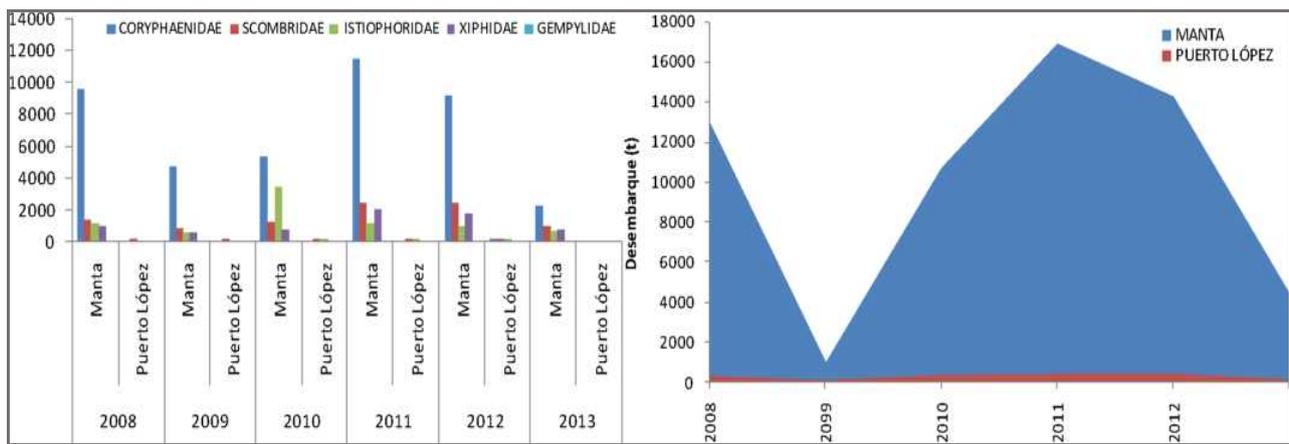


Fig 6: Landings of the main large pelagic fishes (t) in Manta and Puerto Lopez ports in Manabi Province during 2008 to 2013 (left by family and right as total) (INP, 2014).

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