Current Situation of Artisanal Fishing in the CCMPA
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Introduction

Artisanal fishing in Honduras has traditionally been a source of income for thousands of people, though there is no current information of the number of people involved. It has been estimated that nationally there are approximately 21,000 people engaged exclusively to fishing of whom 9132 are on the Caribbean coast and 11700 on the Pacific coast (FAO, 2003).

An important fishing area on the north coast is the archipelago of Cayos Cochinos, which contributes 5% of the annual catch in the fishery Honduras (Guzman and Jacome, 1998). In previous years the area was an area with strong pressure from fisheries activities commercial, industrial and artisanal fishing gear to capture many fish (longlines, gillnets, chichorros). These fishing activities were covered by the creation of protected area in the year 1993, which authorized only fishing with line and hook and established monitoring and surveillance activities carried out by authorities of the Naval Forces of Honduras (Guzman and Jacome 1998).

There is considerable documentation published, showing that protected areas are contributing to the increase in biomass, density, the amount taken and the diversity of animal and plant species in different ecosystems. Several investigators have determined that it has created a completely protected area permitting an increase on average of 446% of the biomass, the density in a 166%, the size of the body by 28%, diversity or the number of species is increased 21% (PISCO, 2008).

There have been several studies on the fishery of Cayos Cochinos. Guzman and Jacome (1998) conducted the first survey of artisanal fisheries in the area, as part of the effort of research conducted by the Smithsonian Tropical Research Institute during the months of May 1995 to January 1997. Gamboa (1997) as part of studies carried out by PROAMBIENTE attempted to design a management plan for the Cayos Cochinos. Later Medina (2000) and Medina et al (2000) conducted an evaluation of fishery resources within the protected area as part of study for university graduation (Bolanus and Mug, 2004).

Bolanos and Mug (2004) conducted a characterization of fishing communities and discussed some existing data generated by Medina et al (2000), as part of the preparation of the management plan 2003-2009. Medina (2005) conducted an analysis of the spatial variation of the communities of reef fish and the characteristics of the habitat in the archipelago of Cayos Cochinos as part of graduation thesis. Saragoza et al (2008) are in the process of analyzing and publishing data collected through direct visual censuses in 6 different areas of commercial fishing importance, in order to assess the state of the ecosystem and the ecological functions of different agencies who will inhabit the same areas and the fishery management plan with an ecosystem approach.

Analysis of the fisheries

Guzman and Jacome (1998) analyzed the fisheries of the three communities located within the protected area using information gathered during 11 months of monitoring. They calculated the catch per unit effort (CPUE), and also the size and weight of the species mostly represented in the catch. The overall effort in the protected area was 5.6 kg / boat / day and 0.85 kg / boat / hour. For the communities: CPUE of Bolanos was estimated at 5.6 kg / boat / day (0.83 kg / boat / hour); East End was 5.7 kg / boat / day (0.9 kg / boat / hour) and Chachahuate was estimated at 3.9 kg / boat / day (0.85 kg / boat / hour), which according to these figures reflect a significant difference for the CPUE between the communities. Furthermore, they calculated the average daily Cayucos (canoes) fishing within Cayos Cochinos, and the average number of fishing days per month per fisherman. The results show an average of 23 Cayucos per day and 20 days for the month. With these numbers and the average CPUE the protected area, Guzman and Jacome (1998) were able to calculate a monthly biomass extraction of 2530 kg and 30-year, 360 kg. However, the study did not include data from the communities of influence.

Gamboa (1997) determined the CPUE at 6.03 kg / boot / day (1.2 kg / boat / hour) for the entire protected area, and the CPUE for each community: Cayo Bolanos was 6.4 kg / boat / day (1.3 kg / boat / minute); Chachahuate was 5.94 kg / boat / day (1.1 kg / boat / hour); East End was 7.3 kg / boat / day (1.3 kg / boat / hour).

Bolanos and Mug (2004) conducted a characterization of the fishing communities in the catchment area and within the protected area, conducting 283 direct surveys to fishermen, of which the majority of fishermen who are registered to communities of land (89 %) and a lesser amount (11%) who live within the protected area (Chachahuate and East End). The community of Cayo Bolanos has no permanent residents. Starting from the community with the highest number of fishermen, New Armenia had 95 fishers (34%), Rio Esteban with 21%, Sambo Creek with 14%, Corozal with 10%, Chachahuate with 7%, Balfate with 5%, East End with 4% and Cacao with 3%, while the community with fewer fishermen is Roma with the 1%. They also conducted an analysis about the growth of species of highly targeted fisheries (yalatel and Calale) using data generated by Gamboa (1997), Guzman and Jacome (1998) and Medina et al (2000). Bolanos and Mug (2004) determined that the development rates of the target fish extracted by the fishing communities operating within the protected area are low for the first optimal maturation and size, there are few big fish (major players: these fish can put up to 10 times more eggs than a fish of 26 cm), exists on fishing on growth, the fishery is maintained by the recruitment and fast growth of fish (Bolanos and Mug, 2004).

Brondo and Bown (2007), as part of the research program conducted by Operation Wallacea, have been looking at the economic structure and attitude of the coastal commuities in relation to the conservation of Cayos Cochinos. Their preliminary results have determined that the communities of East End and Chachahuate are most dependent on fishing within the protected area, generating 80% of its economic structure. The communities of New Armenia and Rio Esteban are dependent to a lesser extent on the fishery (30%).

In this study we have discussed a preliminary catch and effort of the communities that fish within the protected area and areas of influence, with the purpose of analyzing the current situation of the extraction of fishery resources in the Natural Monument Marino Cayos Cochinos.

Materials and Methods

Field site: The CCMPA is located on the north coast of Honduras (15'57'N-86'29'O) within the jurisdiction of the Municipality of Roatan, Department of Bay Islands. It has an area of 485,337 km2, which covers the entire archipelago and 5 nautical miles around it. It is part of the Mesoamerican Reef, which stretches from the Bay Islands to the northern tip of the Yucatan Peninsula, Mexico. The Cayos Cochinos is within the sub-region of the north coast of Honduras, which is defined by the rivers Ulúa and Patuca, including the Bay Islands (Kramer and Kramer 2002, taken from the management plan, 2003). The protected area includes two forested islands of metamorphic origin solidified sediment (Cochino Grande or Greater and the Lesser or Little Cochino, known colloquially as Cayo Mayor and Cayo Menor, respectively), and thirteen coral cays of origin.

Cayos Cochinos has an area of influence that includes the communities of Sambo Creek, Nueva Armenia and Rio Esteban, from the municipalities of La Ceiba and Jutiapa (Department of Atlantida), and Balfate (Department of Colon), respectively. Marine ecosystems of the best quality of the CCMPA are found in the area surrounding the islands and cays. This zone is formed mainly by coral reefs and sea grasses, at depths ranging between 1 and 25m. Outlying islands and cays show mainly sandy areas with some patches coral deep enough, or except for the west side that presents a large area dominated by soft corals (octocorals), coral reefs and sea grasses, at depths of between 3 and 18m. The kind of reefs in Cayos Cochinos is fringe or edge, due partly to this archipelago is located within the continental shelf. Although its development is limited to generally offshore it extends to a depth of 25m, to be better developed on the north side of the archipelago. The increased size of the strip depends on the growth and regeneration of massive hard corals, which form the basis of this reef type.

For this archipelago have been reported in 66 species of corals hermatipicos, 44, octocorals and 5 Antipatharians (Guzman 1998). Detailed lists can be found in Jimenez (1997), and Odgen Ogden (1998) and Rojas (2000). The species of hard corals (escleractineos) more common in Cayos Cochinos are corals *Montastraea* star of the genre's brain coral genera and species *Diploria* and *Colpophyllia natans* (Management Plan, 2003).

Data collection and analysis

The information in this study corresponds to 6 months of monitoring (June-August) and (February to April) in two communities engaged in fishing activity in the Cayos Cochinos, one within the protected area (Chachahuate) and the other in the area influence (New Armenia), obtained through surveys to fishermen (Aronne 2007 and Aronne and Galo 2008). With the help of volunteers from the Regional University of the Atlantic Coast (CURLA) and the private Metropolitan University of Honduras (UMH), trained by biologists were made to conduct periodic surveys for 22 days of each month to fishermen during the landings of catches daily in their respective communities. The samples were conducted simultaneously in the 2 communities and other communities including Sambo Creek, Rio Esteban and East End were visited sporadically in order to observe the behavior of fishers in relation to communities of greatest fishing activity. The information obtained in these communities was not analyzed in this study, just as no conidero is the analysis of the community because the Bolanos fishermen come from Sambo Creek that have diverse sources of income.

3 surveys were conducted in the fishing areas, as set out in fishing management plan for boat fishermen, vessel type, start time and end of the trip, the time for the process of downloading and cleaning the catch, the morphometric measures of fish, such as length (height) Total (cm), weight (kg), and the vernacular name (local) of fish species to make a list of species of fish (Hummer, 1994). In order to obtain the sizes a 90 cm capacity measure was used, and weight measured using electronic scales with a capacity of 5 kg, calibrated daily.

The data was calculated by analysis of central tendency, which in the case of catch per unit effort (CPUE) fishing expressed in kg / boat / day (each corresponding to a survey boat or fisherman) and per kg / boat / hour. The results present the catch data by area, by community, and by fishing gear for both communities. Analysis of the size and weight was done for the species mostly represented in catches, which were arbitrarily classified according to the interval of 6 cm, taking as the initial size specimens smaller than 20cm, and to complete a total of 7 classes. Information obtained regarding the reproductive stages was not analyzed in this study.

Results

Effort and catch: The participation by community was: 42% (n = 168) community of Nueva Armenia and 58% (n = 230) for the community of Chachahuate. 137 fishermen participated, 51% (n = 71) from Neuva Armenia and 49% (n = 66) from Chachahuate, with an average of 6.19 hours per person, with a maximum 15 hours. 398 surveys were conducted which were all with complete information, this corresponds to 113 days of sampling, spread over 6 months of monitoring. The total fishing was analysed for 7668 fish. 82% of boats are canoes with sails, 13% are canoes with motors, and 5% are tiburoneras? Boat types distributed by communities are as follows: 85% (n = 30) canoes with sail, 9% (n = 3) canoe with motor and 2% (n = 2) tiburoneras in Nueva Armenia; 80% (n = 66) canoes with sails, 15% (n = 12) canoes with motors and 5% (n = 4) tiburoneras in Chachahuate.

Catch per unit effort (CPUE): For the community of Chachahuate using canoes with sails was 39.12 kg / boat / day and 6.77 kg / boat / hour, and canoes with motor was 8.68 kg / boat / day and 1.52 kg / boat / hour, with a difference of 30.44 kg between the two types of fishing gear where boats used to sail need more hours of labour, and maybe because of the little use of such vessels to fish. In the case of the community of Nueva Armenia CPUE using canoes with sails was 32.81 kg / boat / day and 4.72 kg / boat / hour, and canoes with motor was 3.57 kg / boat / day and 0.50 kg / boat / hour, with a difference of 29.24 kg between the two types of boat. Whereas both fishing communities within the protected area will feel an overall average effort between the two communities of 7.48 kg / boat / day and 1.22 kg / boat / hour, for the communities there was an average CPUE of 8.53 kg / boat / day and 1.51 kg / boat / hour for Chachahuate and 6.42 kg / boat / day and 0.92 kg / boat / hour for Nueva Armenia.

In presenting the data on catches (Table 1), the northern and southern zones have the biggest catch inside the protected area. Chachahuate concentrates most of its effort in the north (23%) and Nueva Armenia concentrates its efforts in the north and south (31%).

Table 1: Average length (cm) of catch or catch per unit effort (CPUE, kg / boat / day), for community and fishing areas. Number (N) and percentage of surveys (%) fishing by fishing grounds and fishing communities.

Community	Zone	N	%	kg	Average length	Max. length	Min. Length	Average CPUE
Chachahuate	North	124	23	477	32.00	118.00	12.00	23.84
	Central	96	18	250	30.09	150.00	12.00	12.48
	South	112	21	297	26.00	118.00	15.00	14.87
Totals		332						51.19/17.07
Nueva Armenia	North	80	15	263	23.00	100.00	14.00	13.14
	Central	37	7	175	23.00	175.00	14.00	8.74
	South	88	16	333	24.00	94.00	14.00	16.65
Totals		205						38.53/12.84
Totals for both		537						89.72

Fish caught

32 species are registered under different local names and 10 species were unidentified in the community of Neuva Armenia, in Chachahuate 27 species were recorded with local names and without only 3 species unidentified. Most of the unidentified species were captured at sites associated with estuarine ecosystem. The species in the fishery for Nueva Armenia include *Lutjanus synagris*/calale/lane snapper (50.82%), *Caranx crysos*/culila/blue runner jack (12.70%), whitefish (9.14%), Cynoscion sp./white curbina/whitemouth croaker (4.04%), *Albula vulpes*/macabi/bonefish (3.10%), *Cephalopholis cruentata*/saraza/coney (2.92%), *Scomberomorus regalis*/pez sierra/kingfish mackerel (2.81%), *Ocyrus crysurus*/yalatel/yellowtail snapper (1.32%), *Trachinotus goodei*/palometa/jack (1.29%), *Haemulon striatum*/caulas/striped grunt (1.26%) and *Haemolium macrostomun*/ronco piedra/ Spanish grunt (1.03%), the remaining 21 species with catches of less than 0.8% (Table 2.1). Chachahuate highlighted the capture of *Lutjanus synagris*/calale/lane snapper (28.72%), *Ocyrus crysurus*/yalatel/yellowtail snapper (25.16%), *Haemulom plumieri*/ronco/ white grunt (17.06%), *Calamus calamus*/pejepluma/saucereye porgy (11.1%), *Cephalopholis cruentatus*/saraza/coney (6.44%), *Caranx crysos*/culila/blue runner jack (1.36%) and *Cephalopholis gattatus*/jimmy hind/grouper (1.16%), the remaining 20 species with catches of less than 0.8% (Table 2.2).

Table 2.1: Number of individuals (N) analyzed and percentage (%) contribution to the fisheries in the CCMPA for Nueva Armenia, and the corresponding vernacular name for fish species. Average height (cm) and weight (kg).

Common name	Scientific name	Number	% of catch	Average length	Average weight
Calale/lane snapper	*Lutjanus synagrys*	1773	51.04	29.89	0.171
Caulas	*Haemulon striatum*	44	1.27	16.01	0.059
Culila/blue runner jack	*Caranx crysos*	443	12.75	37.11	0.324
Palometa	*Trachinotus goodie*	45	1.3	30.27	0.233
Pejepluma/saucereye porgy	*Calamus calamus*	31	0.89	36.67	0.325
Ronco/white grunt	*Haemulon plumieri*	27	0.78	37.27	0.312
Bermuda	*Kyphosus sectrtriz*	21	0.60	15.00	0.100
Pampano	*Chaetodipterus faber*	22	0.63	21.00	0.113
Robalo	*Centropomus undecimalis*	19	0.55	53.32	1.282
Blanca	*?*	319	9.18	30.47	0.154
Picuda	*Shhyraena picudilla*	11	0.32	24.00	0.060
Jurel Ojudo/horseeye jack	*Caranx latus*	20	0.58	48.03	1.024
Saraza	*Cephalopholis cruentata*	102	2.94	28.57	0.149
Yalatel/yellowtail snapper	*Ocyrus crysurus*	46	1.32	38.18	0.291
Barbon	*Mulloidichthys martinicus*	8	0.23	22.50	0.106
Macabi	*Albula vulpes*	108	3.11	39.05	0.216
Pargo/mutton snapper	*Lutjanus analis*	40	1.15	42.55	0.755
Curbina blanca	*Cynoscion sp.*	141	4.06	38.40	0.20

Tiburon	*Carcharinus limbatus*	5	0.14	61.40	1.241
Cubera roja/mahogany snapper	*Lutjanus mahogoni*	9	0.26	43.73	0.452
Agujeta	*Tylosurus crocodilus*	2	0.06	62.00	0.270
Pez sierra	*Scomberomorus regalis*	98	2.82	95.14	3.323
Mantequilla/seabass	*Cephalopholis fulva*	2	0.06	17.00	0.085
Guembere Amarillo/yellow jack	*Carnax hippos*	3	0.09	38.00	0.998
Guembere/bar jack	*Carangoide rubber*	23	0.66	35.22	0.414
Yaramo	*?*	27	0.78	18.19	0.094
Bontio/mackerel	*Euthynnus alletteratus*	12	0.35	36.08	0.404
Ronco piedra/Spanish grunt	*Haemulon macrostomun*	36	1.04	19.81	0.151
Cubera diente de perro/dog snapper	*Lutjanus joci*	6	0.17	26.33	0.271
Wawanka	*Sphyraena guachancho*	15	0.43	29.00	0.132
Ocro	*Rhomboplites aurerubens*	10	0.29	21.53	0.188
Others		6	0.17	18.50	0.067

Table 2.2: Number of individuals (N) analyzed and percentage (%) contribution to the fisheries in the CCMPA for Chachahuate, and the corresponding vernacular name for fish species. Average height (cm) and weight (kg).

Common name	Scientific name	Number	% of catch	Average length	Average weight
Calale/lane snapper	*Lutjanus synagris*	1017	28.72	33.56	0.209
Ronc/white grunt	*Haemulon plumieri*	604	17.06	39.37	0.356
Yalatel/yellowtail snapper	*Ocyurus chrysurus*	891	25.16	43.13	0.327
Pejeluma/saucereye porgy	*Calamus calamus*	393	11.10	37.00	0.351
Saraza	*Cephalopholis cruentatus*	228	6.44	29.89	0.176
Negra	*Kyphsus sectatrix*	26	0.73	41.04	0.912
Ronco Piedra/Spanish grunt	*Haemulon macrostomun*	18	0.51	26.50	0.238
Barracuda	*Sphyraena barracuda*	17	0.48	88.41	2.887
Mantequilla/seabass	*Cephalopholis fulva*	29	0.82	37.19	0.341
Pejepiedra	*Mycteroperca venenosa*	3	0.08	37.17	1.123
Cubera diente de perro/dog snapper	*Lutjanus locu*	21	0.59	59.68	1.755
Pargo	*Lutjanus analis*	31	0.88	65.94	1.966
Ocro	*Rhomboplites aurerubens*	17	0.48	19.92	0.082
Jurel Ojudo/horse eye jack	*Caranx latus*	10	0.28	79.88	2.481
Culila/blue runner jack	*Caranx crysos*	48	1.36	50.57	0.559
Caula	*Haemulon striatum*	12	0.34	17.50	0.046
Pez sierra	*Scomberomorus regalis*	14	0.40	112.14	3.663
Jimmy Hind/seabass	*Cephalopholis guttatus*	41	1.16	43.97	0.516
Bonito/mackerel	*Euthynnus alletteratus*	5	0.14	32.80	0.274
Vieja	*Balistes vetula*	7	0.20	43.75	0.743
Cubera yupa/schoolmaster snapper	*Lutjanus apodus*	7	0.20	35.83	0.588
Cubera roja/mahogany snapper	*Lutjanus mahogoni*	25	0.71	34.80	0.617

Cubera ala negra/blackfin snapper	*Lutjanus buccanella*	29	0.82	31.72	0.216
Sierra	*Scomberomorus maculates*	17	0.48	50.74	0.894
Barracuda	*Sphyraena barracuda*	8	0.23	91.31	2.967
Guembere/bar jack	*Carangoide rubber*	4	0.11	39.38	0.655
Others	?	19	0.54	-	-

For Nueva Armenia, the most important species caught are *Lutjanus* (52.62%), *Caranx* (13.41%), whitefish (9.18%), *Cynoscion* (4.06%), *Haemulon* (3.08%), *Cepholopholis* (2.99%), *Scomberomorus* (2.82%), *Ocyurus* (1.32%), and *Trachinotus* (1.3%) (Table 3.1). In Chachahuate, the most important species are *Lutjanus* (31.91%), *Ocyurus* (25.16%), *Haemulon* (17.90%), *Calamus* (11.10%) and *Cepholopholis* (8.42%) (Table 3.2).

Table 3.1: Number of individuals (N) measured and a percentage (%) contribution of the fisheries in the community of Nueva Armenia using generic name groups. Average height (cm) and weight (kg).

Scientific name	Common name (added by Nat)	Number	% of catch	Average length	Average weight
Albula	Bonefish	108	3.11	39.05	0.22
Calamus	Porgies	31	0.89	36.67	0.33
Carangoide	Jacks	23	0.66	35.22	0.41
Caranx	Trevally	466	13.41	97.81	1.68
Carcharinus	Sharks?	5	0.14	61.40	1.24
Centropomus	Snooks	19	0.55	53.32	1.28
Cephalopholis	Grouper	104	2.99	31.29	0.16
Chaetodipterus	Batfish/spadefish	22	0.63	21.00	0.11
Cynoscion sp.	Seatrout	141	4.06	38.40	0.28
Euthynnus	Mackerels	12	0.35	36.08	0.40
Haemulon	Grunts	107	3.08	59.88	0.42
Kyphosus	?	21$	0.60	15.00	0.10
Lutjanus	Snappers	1828	56.62	122.75	1.45
Mulloidichthys	Goatfish	8	0.23	22.50	0.11
Ocyurus	Snapper?	46	1.32	38.18	0.29
Rhomboplites	Snapper?	10	0.29	21.53	0.19
Scomberomorus	Mackerel?	98	2.82	95.14	3.32
Sphyraena	Barracuda	26	0.75	38.5	0.13
Trachinotus	Jacks	45	1.30	30.27	0.23
Tylosurus	Needlefish	2	0.06	62.00	0.27
Blanca	Whitefish	319	9.18	30.47	0.15
Yaramo	?	27	0.78	18.19	0.09
Others	?	6	0.17	-	-

Table 3.2: Number of individuals (N) measured and a percentage (%) contribution of the fisheries in the community of Chachahuate using generic name groups. Average height (cm) and weight (kg).

Scientific name	Common name (added by Nat)	Number	% of catch	Average length	Average weight
Balistes	Triggerfish	7	0.20	43.75	0.74
Calamus	Porgies	393	11.10	37.00	0.35
Carangoide	Jacks	4	0.11	39.38	0.66
Caranx	Trevally	58	1.64	105.16	2.76
Cephalopholis	Grouper	298	8,42	81.70	0.69
Euthynnus	Mackerels	5	0.14	32.80	0.27
Haemulon	Grunts	634	17.90	71.71	0.61
Kyphosus	?	26	0.73	41.04	0.91
Lutjanus	Snappers	1130	31.91	235.10	5.17
Mycteroperca	?	3	0.08	37.17	1.12

Ocyurus	Snapper?	891	25.16	43.13	0.33
Rhomboplites	Snapper?	17	0.48	19.92	0.08
Scomberomorus	Mackerel?	31	0.88	137.51	4.11
Sphyraena	Barracuda	25	0.71	134.07	4.37
Others	?	19	0.54	-	-

The sizes for the two species of higher extraction in Nueva Armenia are *Lutjanus sinagrys* ranging from 17-33cm and *Caranx crysos* ranging from 40-18cm (Table 4.1), For the same species in Chachahuate, the sizes are *Lutjanus sinagrys* ranging from 19-27cm and *Ocyurus chrysurus* ranges from 18-40cm (Table 4.2). Lutjanidae (1874 individuals), Carangidae (534 individuals), Albulidae (108 individuals), Haemulidae (107 individuals) and Serranidae (104 individuals) families are most often caught in Nueva Armenia. In Chachahuate families that are often caught include Lutjanidae (2021 individuals), Haemulidae (634 individuals), Sparidae (393 individuals) and Serranidae (301 individuals). The most abundant species in the fisheries of the Cayos Cochinos zone of influence are: *Lutjanus sinagrys*, *Calamus calamus*, *Haemulon plumieri*, *Cephalopholis cruentatus*, *Cynoscion sp*, Whitefish, *Carnax crysos* and *Ocyurus chrysurus*. Classification of the species by size, at intervals of 6cm, is given to appreciate that individuals in the first 6 species are mainly in classes 1 and 3 (18-31cm) (Table 4.1 and 4.2), while *Caranx crysos* and *Ocyurus chrysurus* individuals are distributed in 7 classes, with more percentage (71%) in the Class 2 for *Caranx crysos* (Table 4.1) and *Ocyurus chrysurus* with a percentage (94%) between classes 2-6 (Table 4.2).

Table 4.1: Average size (cm) and weight (kg) for the six most important species in the fishery in Nueva Armenia. The species were classified in 7 categories for each size 6cm.

Species	Size class	Number	% of catch	Length	Weight
Lutjanus sinagrys	20 <	1081	61.46	17.65	0.08
	20.1 – 25	475	27.00	22.41	0.15
	25.1 – 31	179	10.18	27.89	0.27
	31.1 – 37	19	1.08	32.95	0.36
	37.1 – 43	2	0.11	38.00	0.34
	43.1 – 49	0	0	0	0
	> 49	3	0.17	140.00	1.68
Caranx crysus	20 <	25	5.36	18.50	0.09
	20.1 – 25	332	71.24	22.83	0.13
	25.1 – 31	32	6.87	28.56	0.26
	31.1 – 37	21	6.65	33.87	0.39
	37.1 – 43	34	7.30	40.65	0.65
	43.1 – 49	6	1.29	44.67	0.79
	> 49	6	1.29	60.67	2.15
Blanca/whitefish	20 <	130	40.75	19.02	0.08
	20.1 – 25	182	57.05	21.88	0.12
	25.1 – 31	6	1.88	27.50	0.17
	31.1 – 37	0	0	0	0
	37.1 – 43	0	0	0	0
	43.1 – 49	1	0.31	48.00	1.05
	> 49	0	0	0	0
Calamus calamus	20 <	28	13.66	19.39	0.12
	20.1 – 25	84	40.98	22.77	0.19
	25.1 – 31	61	29.76	27.88	0.35
	31.1 – 37	32	15.61	33.69	0.43
	37.1 – 43	0	0	0	0
	43.1 – 49	0	0	0	0
	> 49	0	0	0	0
Haemulon plumieri	20 <	37	20.44	24.51	0.22
	20.1 – 25	56	30.94	23.09	0.18
	25.1 – 31	74	40.88	27.38	0.29
	31.1 – 37	14	7.73	32.21	0.43

	37.1 – 43	0	0	0	0
	43.1 – 49	0	0	0	0
	> 49	0	0	0	0
Cynoscion sp.	20 <	34	23.29	18.38	0.09
	20.1 – 25	64	43.84	22.69	0.14
	25.1 – 31	48	32.88	27.67	0.23
	31.1 – 37	0	0	0	0
	37.1 – 43	0	0	0	0
	43.1 – 49	0	0	0	0
	> 49	0	0	0	0

Table 4.2: Average size (cm) and weight (kg) for the six most important species in the fishery in Chachahuate.. The species were classified in 7 categories for each size 6cm.

Species	Size class	Number	% of catch	Length	Weight
Lutjanus sinagrys	20 <	315	30.97	18.87	0.08
	20.1 – 25	503	49.46	22.67	0.14
	25.1 – 31	193	18.98	27.47	0.24
	31.1 – 37	4	0.39	32.15	0.32
	37.1 – 43	2	0.20	39.75	0.58
	43.1 – 49	0	0	0	0
	> 49	0	0	0	0
Ocyurus chrysurus	20 <	18	2.06	18.75	0.08
	20.1 – 25	213	24.40	23.58	0.13
	25.1 – 31	363	41.58	28.14	0.20
	31.1 – 37	164	18.79	34.01	0.32
	37.1 – 43	86	9.85	39.95	0.50
	43.1 – 49	21	2.41	45.43	0.75
	> 49	8	0.92	61.25	1.59
Calamus calamus	20 <	38	9.67	19.14	0.11
	20.1 – 25	196	49.87	23.30	0.20
	25.1 – 31	150	38.17	27.66	0.32
	31.1 – 37	9	2.29	33.11	0.43
	37.1 – 43	0	0	0	0
	43.1 – 49	0	0	0	0
	> 49	0	0	0	0
Haemulon plumieri	20 <	23	3.81	18.82	0.10
	20.1 – 25	221	36.59	23.37	0.18
	25.1 – 31	328	54.30	27.80	0.28
	31.1 – 37	31	5.13	32.83	0.41
	37.1 – 43	1	0.17	40.00	0.70
	43.1 – 49	0	0	0	0
	> 49	0	0	0	0
Cephalopholis cruentatus	20 <	150	65.79	18.33	0.07
	20.1 – 25	69	30.26	22.12	0.13
	25.1 – 31	7	3.07	26.86	0.22
	31.1 – 37	1	0.44	33.00	0.50
	37.1 – 43	1	0.44	38.00	0.85
	43.1 – 49	0	0	0	0
	> 49	0	0	0	0

Discussion

The information generated from the two selected communities reveal trends in the composition and use in the protected area by the largest resource users fishers, however it is necessary to generate more information from other communities who are in the zone of influence to understand dynamics of the entire fishing area.

Catch per unit effort: was recording an average of 38 canoes in daily chores in Nueva Armenia and 42 canoes in daily chores in Chachahuate The study found a total of 3038 kg / month (6697.6 lbs) based on reports provided by the buyers of which 1814 kg / month (4000 lbs) in Nueva Armenia, 544 kg / month (1200 lbs) registered in Chachahuate and approximately 680 kg / month (1500 lbs) in East End. It shows a projection of 36,456 kg annually catch (36.4 TM). Such information does not match the results of direct surveys where a daily catch of 7.48 kg / boat / day was found. Considering that an average of 20 days are spent fishing per month, a catch of 298 kg / month (657 lbs), of whom 170 kg / month in Nueva Armenia, and 128 kg / month in Chachahuate. One of the reasons for these differences in catch is due to the lack of catch data in the hour of landings and little cooperation from the fishermen to provide information especially Nueva Armenia. Despite that catches reported by buyers coincides with the data recorded by Guzman and Jacome (1998), for communities that operate within the protected area, as no analysis is conducted by the communities of influence.

Composition of fish in the catch: Most of the important species for fishing by both communities belong to carnivorous families: For example, *Lutjanidae, Carangidae, Serranidae, Haemulidae* (Campo et al, 1994, taken from Guzman and Jacome, 1998) Very similar to Guzman and Jacome (1998) and Medina et al (2001), these results could indicate an imbalance in the composition of species and changes in the structure of the ecosystem. Another important aspect is the fact that most of the individuals frequently captured as representative of the species in Nueva Armenia are size medium and small. To do the analysis for the species *Lutjanus sinagrys* (Calale) the 61.46% are captured with an average length of 17.65 cm, which according to Bolanos and Mug (2003), when the Calale reaches the height of the first maturation (Lm = 20.2 cm LT) has a theoretical weight of 225 grams (0.5 lib. When it reaches the optimal size (Lopt) of 27.6cm LT, it has a weight of 491 grams (1.08 pounds), this means that the fish are caught below the sizes smaller than the size at maturation (lm) and 88.46% are extracted with sizes smaller than the optimal size.

In Chachahuate Calale represents the greatest species in the catch (28.72%), which represent in previous years the species in fourth place of importance (6%) according to Guzman and Jacome (1998), third (10%) according to Gamboa (1997) and second (25%) according to Medina et al (2000). In relation to the size of catches Calale records an average length of 33.56cm, of which 49.46% are of the length of 22.67cm, which means that fish are smaller than the size at maturation (Lm) and 80.4% are extracted with optimal sizes smaller size (Lopt) and 19% are extracted within the optimum size (Lopt). In comparison to previous years, the extraction of Calale with sizes smaller than the size at maturation (Lm) was reported by 50% in 2000, however, now the catch has reduced the percentage of fishes extracted below optimal size (lOPT) from 94% in 2000. This could mean a slight increase in size of catch of Calale after 7 years from the last monitoring, which could indicate that might be beneficial to increase the production of eggs and the recruitment of Calale in the protected area.

In the case of *Ocyurus chrysurus* (yalatel) in Chachahuate, it represents the catch in second place (25.16%), which represent in previous years the species first catch (52.65%) according to Guzman and Jacome (1998), 52 % according to Gamboa (1997) and 43% according to Medina et al (2000). In relation to the size of catches yalatel records an average length of 43.13cm, of which 42% is recorded average length of 28.14cm, which means that fish are larger than the size at maturation (Lm) according to Bolanos and Mug (2003), when the yalatel reaches the size at maturation (Lm = 26cm in length standard) and 207g (0.6 pounds). Furthermore, when the yalatel reaches optimal size (Lopt = 31.5cm in length standard), it weighs 440g (0.97 pounds) and 26.46% are extracted with sizes smaller than the optimal size (Lopt). In comparison to previous years this study shows that the extraction of yalatel with sizes smaller than the size at maturation (Lm) has been reduced from 50% in 2000 to 42% currently registered, recorded 71% below the optimal size (Lopt), at 26.46% currently. This could mean an increase of about 2m in length of maturity in relation to previous years and an increase of optimal length to 10cm (Lopt).

Conclusions

1. It is necessary to continue with long-term monitoring to determine the effectiveness of the rules of protected area management. Monitoring must be continued during all months of the year, because there are not sufficient information to identify trends that are occuring .
2. In the case of the community of Nueva Armenia, the sizes are smaller than those recorded in previous years, despite that the presence of estuarine species of fast growth as *Caranx crysos* and other species. This requires a specialist to identify the species caught to really get a sense of what species are being caught.
3. Communities in Cayos Cochinos conducted fishing activities catching 7.84kg per boat as a product of the daily work. This amount per month is a valuable contribution to the artisanal fisheries in the Caribbean and the Honduran family income of the archipelago.
4. Fishing in the protected area is concentrated on carnivorous species, affecting the natural balance of reefs. In the case of Chachahuate increasing the sizes of maturation and optimal length, could mean that are generating the greatest players in the ecosystem and therefore a greater number of eggs. The cause of this might be inferred that this increase has possibly been initiated by the process of change or transition of productive activity in which the appeal of fishing 'was left to rest,' and taking advantage of the opportunities created by tourism as generator of income for families.