

Sea Turtle Restoration Project
Turtle Island Restoration Network

REPORT: Description of the Eastern
Pacific High-Seas Longline and Coastal
Gillnet Swordfish Fisheries of South
America, Including Sea Turtle Interactions,
and Management Recommendations.

Submitted to: James, R. Spotila, Drexel University

By: Randall Arauz
Central American Director
Sea Turtle Restoration Project
Turtle Island Restoration Network

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INTRODUCTION

Incidental capture and death of sea turtles during industrial fishery operations is now a global concern, as all sea turtle species are listed as threatened or endangered by the International Union for the Conservation of Nature (IUCN). The development of industrial fisheries during the late 50s increased human induced factors of adult sea turtle mortality, of which shrimp trawling was considered the greatest (Magnusun, 1990). Thus, until recently, most attention was drawn upon the shrimp-sea turtle issue, especially along the eastern coast of the United States, where efforts protect the world's most endangered sea turtle, the kemp ridley (*Lepidochelys kempfi*), were being inhibited by mortality of adults caused by shrimp trawling activities. After many years of research, the problem is well documented, and most encouraging, a technological solution exists that allows the capture of shrimp without catching sea turtles, the Turtle Excluder Device (TED). Currently, all United States shrimpers, as well as any nation with a shrimp fishery that interacts with sea turtles and that imports shrimp to the United States, must adopt the use of TEDs.

A more recent issue that is being addressed is the capture and mortality of sea turtles by high-seas driftnet (there is currently an international moratorium) and longline fisheries, which target swordfish in the North Atlantic (Witzel, 1999), the North Pacific (Wetherall, et. al. 1993) and the South Eastern Pacific (Weidner and Serrano, 1997), but including other billfish, shark, tuna and maji maji in the Central Eastern Pacific (INCOPECA, 1996; Segura and Arauz, 1995).

Incidental mortalities of sea turtles associated to these activities impede national and international efforts to recover marine turtle populations (Wetherall, et. al. 1993), and fishery managers and sea turtle researchers are urged to develop conservation strategies that mitigate sea turtle and longline interactions (Witzel, 1999), which implies international and regional cooperative efforts in the case of highly migratory species such as the pacific loggerhead (Bowen, et. al., 1995) and the Eastern Pacific leatherback (Sarti, et. al., 1998).

Unfortunately, the attention of the international scientific community has only recently been drawn upon the coastal gillnet and high seas longline fisheries of the South Eastern Pacific, due to the drastic decline of yet another population of sea turtle that seems to be going extinct before our very eyes, the eastern Pacific Leatherback (Spotila, et al). Scientists are now trying to explain the reason for this abrupt reduction, and high mortality of juveniles and adults caused by incidental capture by swordfish fisheries in the Eastern South Pacific, mainly the coastal gillnet fishery of Chile, seems to be responsible (Eckert and Sarti, 1997).

After nesting, leatherback turtles from Costa Rica head directly south, in a migratory corridor towards the Galapagos Islands and which probably continues to South America (Morreale, et. al, 1996). The authors consider that leatherbacks of the entire Central American region may utilize this corridor during their post nesting migration south. This

southward post-nesting migration towards the Galapagos Island is also displayed by Mexican leatherbacks (Eckert and Sarti). In this case, the authors were able to track leatherbacks for a longer period of time, and followed one turtle all the way to north Central coast of Chile, where the coastal gillnet fishery operates. Based on records regarding incidental catch and mortality of leatherbacks in this fishery by Frazier and Brito (1990), the behavior of the coastal swordfish fishery since the introduction of gillnets in 1984 (Oliva, 1993), its expansion during the late 80s and early 90s (Weidner and Serrano, 1997), and the reduction pattern of nesting leatherbacks in Mexico, they concluded that the Chilean gillnet fishery off the Central and Northern coast may have played an important role in the current reduction of the Eastern Pacific leatherback population.

Other sources of mortality have been identified as well. The Japanese began deploying high-seas tuna long lines off the South American coast since the mid 50s. The Spanish entered the longline fishery a little later, in a directed swordfish fishery. Local Chilean, Ecuadorean and Costa Rican long line fisheries initiated operations during the mid to late 80s, and the fleets of Costa Rica and Ecuador continue to expand. Furthermore, Peru had a legal active sea turtle fishery until 1995, in which leatherbacks were hunted at the very least by the hundreds each year (Brown and Brown, 1982). The effect of these fisheries on the Eastern Pacific leatherback population is unknown, however, what is important now is to determine their impact on current sea turtle populations, in the context of an expanding high seas industrial fishery which interacts with a critically endangered sea turtle, and establish conservation strategies that mitigate these interactions.

The objective of this report is to describe the pelagic long line and gill net fisheries of the countries that target the South Eastern Pacific swordfish (either as a main or secondary target), describe their interactions with sea turtles based upon interviews with fishermen and local fishery officials, and recommend on conservation strategies.

DESCRIPTION OF THE SWORDFISH FISHERY

Stock Structure

The stock structure of Pacific swordfish is not well understood. In spite of the occurrence of geographic clusters of high fishery yields, it is still unclear if they represent separate stocks. A southeastern Pacific stock is theorized, which appears to have a distinct genetic pattern, different - but not completely isolated - from a larger pan-Pacific stock. Current evidence suggests that the southeastern Pacific stock stretches from Colombia/Ecuador (5° N) south to central Chile (about 40° S), and may also extend a substantial distance offshore of up to 850 km from the Central coast of Chile and the southern coast of Peru (Weidner and Serrano, 1997).

Feeding habits of swordfish

Swordfish feed mainly at night, diving into cold deep waters. They tend to descend at sunset and feed during the night, returning to warmer surface waters at sunrise. They are often found off Chile feeding along the boundaries of the northerly flowing Humboldt Current where prey is particularly abundant, also in the upwelling region, where there is high productivity. Although squid has been reported to be an important food resource, in coastal Chile jack mackerel or “jurel” (*Trachurus murphyi*) appears to be the most important prey item, followed by long tailed hake (*macruronus magellanicus*). Other prey items include horse mackerel (*Scomber japonicus peruanus*), nylon shrimp, squid, and a wide range of finfish. Little is known about feeding habits at offshore latitudes off Chile (Weidner and Serrano, 1997).

Migration

Southeastern Pacific swordfish make significant migrations. The fish forage in the temperate latitudes off the Central coast of South America, but they must migrate out of the cooler water to spawn. The fish appear to move toward and away from the coast depending on the displacement of warm oceanic fronts from the northwest (Ponce and Bustos, 1991; in Weidner and Serrano, 1997). Swordfish approach the central coast of South America, and are especially abundant off Chile, from March through July. After August the number of fish gradually declines, and by late September the fish are gone, as they move northwest and west, away from the coast, presumably to spawn. Mature fish are only found west of 110 W (about 3000 km off the coastline) between 10 N and 30 S particularly during the first and fourth quarters of each year, when swordfish appear to be least prevalent off the Chilean coast. Precisely what drives migratory movements is unclear, but it appears to be

an interplay of currents, seasonal temperature shifts, feeding behavior and spawning needs, which are all interrelated (Weidner and Serrano, 1997)

DESCRIPTION OF THE SWORDFISH FISHERIES OF SOUTH AMERICA (INCLUDING COSTA RICA)

Ecuador

The Ecuadorean coast is bathed by a mass of superficial tropical waters from the north Pacific with temperatures above 25°C, and a mass of water formed from a mixture of superficial tropical water of the south Pacific and equatorial cold and saline surface waters. The convergence of these water masses, create a continental front with temperatures between 19°C and 25° C. These oceanographic characteristics promote an elevated primary production, which sustains a diversity of marine fish species, molluscs, crustaceans, quelonids, mammals, algae, etc (Crespo, 1997). However, swordfish are not as abundant in the coastal waters off Ecuador, as environmental conditions appear less favorable than the coastal grounds to the south, where the cold Humboldt Current is more pronounced (Weidner and Serrano, 1997).

There are approximately 8000 artisanal vessels that capture “white fish” (Crespo, 1997), a fishery that targets a wide range of fish, such as tunas (yellow fin, big eye), bill fish (swordfish, sailfish, black marlin, marlin), mahi-mahi, rock grunts, congrid, snook, jewfish, sole, among others, using a variety of fishing arts (surface and bottom drift nets, surface and bottom longlines, hand lines, and purseiners. 86% are built of wooden hulls and the other 14% are fiberglass. Unfortunately, little quantitative information exists on the structure of this sector, not even of the number of fishermen, vessels, motors or fishing art (VECEP, 1996).

Currently, the industrial “white fish” fleet, is composed of 149 vessels, among purseiners (targeting small pelagic fish such as sardines and anchovy) and longliners (targeting large pelagic fish). 30 additional foreign vessels operate in association with local processing plants (Crespo, 1997). No information is provided on the proportion of these vessels that practice longline fishing.

Foreign industrial purse-seine and longline fishermen began fishing activities targeting tuna off Ecuador in the early 50s (Crespo, 1997), during which significant swordfish catch was also recorded (Weidner and Serrano, 1997). Historically productive yields have been reported in the southern Ecuadorean coast, but best catches are recorded in Oceanic waters, around and to the west and southwest of the Galapagos Islands (Weidner, 1998).

Ecuadorean artisanal and semi-commercial longline fishing, targeting tuna and dorado, did not begin until the mid 80's, although a limited catch of swordfish has existed since the 70's. After a brief production peak of 500 tons of swordfish in 1986 – 87, the fishery subsequently declined. Lack of data makes assessment difficult, but catches of swordfish during the 90s appears to have ranged from 250-350 metric tons. Since 1994/95 a sharp

increase has been reported as high as 500 tons. Increased production is due to the expanding fleet, and the initiation of directed swordfish sets by Ecuadorean companies in new fishing grounds to the west of the Galapagos. Ecuador exports swordfish mainly to the United States, but exports other billfish to Japan. There are also some swordfish exports to the European Union which seem to have increased in recent years (Weidner, 1998).

Peru

Peruvian fishermen once conducted one of the largest swordfish fisheries in Latin America. Historical catch data is limited, but available information suggests catches in 1950 of about 2500 tons, and some estimates are substantially higher, nearly 7000 tons. Most of this catch was conducted by harpoon fishermen, thus involving an enormous effort. However, current catch rates are minimal, and have been harvested incidentally (Weidner, 1998). In 1995 and 1996, only 7 and 4 tons respectively, of swordfish were landed (Flores, et. at. 1997.).

It is unclear why this fishery has declined so drastically, but it appears not to have been a resource problem, rather the diversion of effort. The allure of more attractive alternate job opportunities in the booming anchovy fishmeal and mining industries may explain reduced harpoon effort. Shifts in abundance and distribution may have been involved, which could have been influenced by a variety of factors, such as possible climatic changes or overfishing and subsequent depletion of other species, such as the anchovy (Weidner, 1998).

As of yet, Peru has not developed a substantial longline or driftnet fleet to target oceanic pelagic species such as swordfish or tuna. Artisanal and small scale commercial longline fishermen do target shark and dorado in coastal waters. Of the total 28082 artisanal fishermen recorded along the Peruvian coast, 3.5% used "espineles" (a lightweight version of a long line), while 40.2% used driftnets. (Escudero, 1997).

In contrast, foreign fishermen continue to catch swordfish off Peru, during operations conducted mainly off the southern coast, both inside and outside of the 200 mile limit. The Japanese and Spanish are the most active. The Japanese target mainly tuna and have obtained some Peruvian fishing licenses. The Spanish target swordfish (Weidner, 1998).

Colombia

Colombia has no directed swordfish fishery. The species does not appear to be abundant in the country's coastal waters, although some observers caution that this is only because of the lack of directed effort. While swordfish may tolerate a wide range of temperatures, the warmer waters in Colombia may not be ideal for the species which swordfish lead on. Other oceanic conditions also do not appear to be optimal, especially the lack of

pronounced oceanic temperature fronts during much of the year. Small quantities of swordfish are taken by foreign fishermen, mainly the Japanese longliners, targeting tuna. There is no domestic Colombian commercial longline fleet, but Colombian interest in a possible fishery appears to be growing. Colombia exports virtually no swordfish (Weidner, 1998).

Costa Rica

The long-line pelagic species fishery initiates in Costa Rica during the early 80's, with several factors converging and contributing to its rapid development. After 1986, due to an apparent over exploitation of existent coastal resources in the marine platform of Costa Rica, fishermen begin to explore waters that are farther and farther from the coast, in search of new fishing resources (Porrás, 1993). Most longliners began exploiting the waters of the Thermal Dome of Costa Rica, an area of upwelling and high biological productivity, located around 10°N and 150 to 200 km West from the coastline (Brenes, et. al. 1995). A Cooperative Agreement that dates back to 1982, among the National Institute of Training - Fishing Module (INA-MP) and the Chinese Cooperation Mission (MC), provided the foundation for a progressive conversion of the local fishing sector. To facilitate that process, in 1989, the MC together with INA-MP personnel, built the School-Ship *Amistad II* (INA, 1997), with characteristics that allows the theoretical instruction and practice of long line fishing. From 1988 to 1992 the long line fleet experienced an increase of 83% (from 309 vessels to 519) (Porrás, 1993). Another factor that impelled the development of high-seas long line fishing was the high price paid for pelagic species in the North American market (Porrás, 1993). Taiwanese companies initiated high-seas longline fishery operations in Costa Rica during the early 90s, attracted by the wealth of pelagic marine resources, and were responsible for introducing and fostering the construction of larger and more specialized long-line fishery vessels (Vallejos, pers. com; Segura, pers. com.).

Since current CPUE rates follow an increasing tendency, the industry is considered to be in a stage of sub exploitation (Segura y Campos, 1990; Campos, et. al., 1993; INCOPECSA, 1998). Having this consideration in mind, we can only expect the long-line pelagic-species fishery to increase during the near future. However, no procedures nor measures are taken to guarantee that this industry will not follow the same fate of other industrial fisheries which have caused the well documented depletion of coastal marine resources, which in fact has fostered the high seas longline industry as an alternative. No research is carried out, nor are records kept, on the impact of the high seas industrial long-line fishery on other marine resources.

Since 1994, the Costa Rican Fishery and Aquaculture Institute (INCOPECSA), keeps records of the national fishing fleet.

Small scale artisanal vessels. About 2045 vessels, which represents 18% of the total landing of fishing products of the country (INCOPECSA, 1998). The vessels are less than 5 ms long. The lonelines may be 700 meters long with 500 hooks. In some occasions two

lines may be united for a total of 1000 hooks. 1500 hooks is the maximum used. The license granted allows operation within 3 miles of the coast (INCOPECA, 1998; INA, 1997).

Medium scale artisanal vessels. Approximately 222 crafts, which represents 34% of the total landing of fishing products of the country. The length of the vessels varies between 11 and 23 ms. The long-lines may be from 1000 and 10000 meters long. Stationary motors are used with a power ranging from 70 to 350 HP. The storage capacity ranges from 1 to 10 tons. The license granted allows operation from 3 to 39 miles of the coast (INCOPECA, 1998; Porras, 1993).

Advanced artisanal vessels. Approximately 316 crafts, which represents 43.4% of the total landing of fishing products of the country. This is the most representative group in the high seas long-line fishery, and is considered the most important. Monofilament lines are used to build the central or “mother” line (Porras, 1993), which may be up to 70 km long. The length of the vessels varies between 20 and 28 ms. There are currently vessels with a storage capacity of 40 tons and an autonomy of 1 to 2 months. Their license allows them to fish 40 miles or more from the coast (INCOPECA, 1998).

Industrial vessels. 25 vessels that are dedicated to industrial shrimp trawl activities obtain a special authorization which allows them to fish large pelagic species using long-lines, depending on the fishing season. In other words, these are double purpose vessels. There are no exclusive long-line vessels in this category (INCOPECA, 1998). The length of the vessels is usually 30 to 35 ms. Some ships use lines that may be from 20 to 70 km long, with up to 30000 hooks, with crews of up to 10 men (Acevedo, pers. com.)

The long-line fishery has continued to expand during the 90s, so much in number of vessels as in sophistication, like the use of satellite information to locate schools of pelagic fish.

In 1996, the Costa Rican advanced artisanal fishery landed 6028.67 tons of pelagic species; 1727.46 tons of maji-maji (28.6%), 288.35 tons of white marlin (4.8%), 248.44 tons of pink marlin (4.1%), 280.79 tons of treacher shark (4.7%), 753.5 tons of sailfish (12.2%), 451.68 tons of swordfish (7.5%), 316.49 tons of tuna (5.2%), 1099.3 tons of shark (18.2%), and 826.66 tons of mako shark (13.7%) (INCOPECA statistics office, 1996).

Chile

Chile conducts the most important swordfish fishery in Latin America, despite significant reverses since the catch peaked in 1991. It is a resource of fluctuating value to both artisanal and industrial fishermen alike (Weidner, 1998).

During the 1930s and 40s artisanal fishermen expanded a small existing harpoon fishery, responding to increased demand in the U.S. Catches reached over 2100 tons in 1946, then

dropped, due to marketing reasons and not to the decline of swordfish populations (Weidner, 1998).

A major change occurs during the 80s with the introduction of gillnets (Oliva, 1991), which fish far more efficiently than the hand thrown harpoon method. Fishermen rapidly adopted the improved fishing gear and significantly increased participation in the export market. By 1989, fishermen that once used harpoons, were now equipped with gillnets and modern fishing technology like LORAN and satellite information (Frazier y Brito, 1990; Oliva, 1991). The artisanal fishery thus developed as an export – oriented fishery. Shifting from harpoons to gillnets enabled the fishermen to lengthen the season, target new grounds, and increase fishing power. During the late 80s, and noting the success of the artisanal fishermen, industrial longliners enter the fishery (Weidner and Serrano, 1997).. According to government dispositions, coastal waters (80 miles) were reserved for artisanal fishermen.

Furthermore, Japanese have conducted a multi-species longline fishery focusing on tunas off the Chilean 200 mile limit for many years, and Spanish fishermen entered a directed swordfish fishery during the mid 80s (Weidner, 1998). However, both of these fisheries have been accused by local fishermen of fishing within the 200 mile limit (El Mercurio, 1990).

The fishery peaked in 1991 (Figure 1), with a catch of 7300 tons. Government efforts to limit fishing effort through gear and area restrictions have not succeeded in stopping the precipitous decline. Each year after 1991 the catch has fallen between 900 to 1700 tons annually (Weidner, 1998), to stabilize from 1995 to 1997 at about 3000 tons per year (INFOP, 1997).

In 1992, of the 6379 tons reported, 44% corresponded to artisanal catches, while 47% to industrial catches, and 9% to catches in international waters (Oliva, 1993). By 1995, the artisanal fishermen were landing 80% of the catch (Weidner). However, in 1996 a dramatic shift occurred. Fishermen reported the first annual swordfish catch increase in 6 years, taking over 3100 tons, most of which was taken beyond the country's 200 mile limit, a distinct shift in grounds which had previously been mostly within Chilean waters (Figure 2).

The Chilean catch is still less than half of that reported at the 1991 peak, despite the 1996 increase. The reason for the sharp decline in the Chilean catch is not fully understood, but intensive fishing effort seems to be the main reason. It appears most likely that the greatly expanded artisanal fishery during the late 80s and early 90s affected the stock, although some contend that it may have been caused by high mortality of juveniles and smaller fish caused by the longliners that operate beyond the 80 mile limit.

In 1997, a total of 272 artisanal vessels were recorded, together with 19 industrial longline vessels. In spite of a reduced fleet, fishing effort by gillnetters has remained constant throughout the last 3 years. However, in 1997 both coastal gillnetters and high-seas longliners increased the fishing season which usually ended in September, into November the former, and all the way into December the later. This prolonged fishing season was

prompted by an unusual abundance of sharks, presumably as an effect of El Niño that warmed the usually colder waters (IFOP, 1997).

RESULTS OF INTERVIEWS

The following information includes interviews with researchers, and fishermen in Chile, and Perú. In Ecuador it was only possible to interview fishermen, in addition to businessmen in the fish exporting business.

It must be mentioned that access to the fishermen was usually complicated, resulting in some cases much more difficult than anticipated. For instance, in Chile during the last two years the longline fishery was active in the northern ports, with few longliners in San Antonio or Valparaíso. Furthermore, access to the coastal gillnetters was difficult as a special permit was needed to enter the docks. In one occasion access was allowed (accompanied by Brito), but the following day I could not get in. A similar situation occurred in Valparaíso, where not even my connections with IFOP personnel could get me through to access the docks. In spite of it all, I was able to interview one longline Captain in Valparaíso.

In Peru the fishermen were easily accessible, thanks to the support of CEPEC in Pucusana. Fishermen in the communities visited (Pucusana, Cerro Azul and Pisco) were in general very polite and cooperative. Unfortunately, timing didn't work and meetings could not be arranged with IMARPE officials.

In Ecuador, I had the same problem as in Chile; I needed an official permit to visit the dock at Manta. Furthermore, a general national strike threatened any type of transportation as major highways were being blocked by protestors. In Mantas, the expedition of a permit by the Port Authorities required a typewritten request, with stamps, seals, photocopy of passport, letter explaining intentions, and a private interview with the "Admiral".

Because of the unique nature of the interviews, and also the fact that they are not enough to draw statistical conclusions, I have decided to provide a brief summary of each one. Figure 3 shows ports visited and other sites mentioned in this report.

Chile

Interview with José Luis Britto, Director of the Municipal Museum of Natural Science and Archeology of San Antonio, September 22, 1998, San Antonio, Chile.

José Luis Brito, in collaboration with Jack Frazier, were the first researchers to warn on the high capture of leatherbacks by the coastal gillnet fishery in Chile (Frazier and Brito, 1990).

Unfortunately, after the publication of this paper, the fishermen have not wanted to cooperate any more. Following are the results of a questionnaire carried out among the fishermen of San Antonio, describing the artisanal gill net fishery in 1989, after the publication of his paper with Frazier.

Description of the artisanal gill net fishery of San Antonio, 1989.

Range of fleet: From Los Vilos (32°) to the North, to Constitución (35°30') to the South.

Hull construction: Mainly wooden hull vessels, although there are now some fiber glass and steel hulls.

Length of vessel: 15 to 18 ms

Number of vessels: Approximately 500.

Ports of origin that landed in San Antonio: Quintero, Valparaíso, San Antonio and Constitución.

Refrigeration method: Ice shavings.

Crew members: 7-9, plus a Captain.

Description of nets. Drift nets, from 800 to 1200 fathoms long, by 16 fathoms deep.

Mesh dimensions: 20 to 22 inches.

Duration of fishing journey: 1-5 days.

of trips: 4 trips a month, 30 per season.

Depth of set: 10-40 meters.

% with navigational equipment (GPS): 25%

Description of sets: One set per night. 10-16 hours of active fishing. 3 to 4 hours retrieving net, usually 1 to 3 fish per set (extremely variable).

Hydraulic winches are used to haul in the net.

Furthermore, he released information on sea turtle reports after the publication of his paper:

Leatherbacks captured by the coastal gill net fishery of San Antonio, from March 12, 1990 to May 7, of 1991:

March 12, 1990. Vessel name: Aventura I, port: San Antonio. Site of capture: 110 miles West of Topocalma (almost 34°). Length of net 800 fathoms, 20 inch mesh, set at 10 fathoms deep. 5 leatherbacks caught, 4 released alive, 1 dead.

March 26, 1991. Site of capture: 33°31'S, 75°16'W, West of Santa María. 5 leatherbacks, 4 drowned, 1 alive. The net was set for 16 hours. Length of net: 1100 fathoms long, 31 fathoms high, set for 16 hours, at 10 fathoms of depth.

April 27, 1991. Site of capture: 37°05° S and 74°25W, West from Isla Santa María. One adult, no information on status.Length of net: 1000 fathoms. Surface temperature: 16°C.

April 29, 1991. Site of capture: 36°55'S, 74°19'W, West from San Vicente. 3 adult leatherbacks, all died. Surface temperature 14°C.

May 7, 1991. Same captain and vessel as April 29 report, approximate same location, West from San Vicente. 3 adults Dermochelys, all dead. Water Temperature 13°C.

In summary, 17 more leatherbacks were recorded in five additional reports, from March 12, 1990 to May 7, of 1991 (Figure 4). One report is of a single leatherback, but two are of triple captures, and two more of quintuplets in a single set. The observed mortality rate was 64%. These figures must be interpreted cautiously, as they are of opportunistic nature. However, it becomes evident that multiple captures of leatherbacks in single sets was common during the early 90s.

Interview with Rolando Brañas (Artisanal Fisherman of San Antonio), September 23, 1998, San Antonio, Chile.

Rolando Brañas has been in the swordfish industry since the harpooning days during the 70s. Currently, he still does occasional harpooning, but it is mostly opportunistic, as when setting nets sometimes one may encounter a basking fish.

Rolando claims that when he was a harpooner, he could catch from 4 to 5 fish a day during the peak of the season. When drift nets were introduced in the mid 80's, the catch increased to 10 or 15 fish in a single set. The job was definitely easier, however the fish caught using harpoon were always bigger.

Before ever using nets, leatherbacks were extremely odd, some fishermen perhaps couldn't even tell them apart from other sea turtles. Rolando can't even recall ever seeing a leatherback turtle before he entered the coastal gillnet fishery. With the use of gill nets, fishermen became increasingly aware of the presence of leatherbacks in their waters. He claims that they do everything possible to release the turtle safely, but this is not always possible as many times the turtle drowns and is found dead upon recovery of the net.

During the years when coastal gillnetting was booming, in the late 80's and early 90's, Rolando estimates that about 30 leatherback turtles could be caught per vessel per year. He states, however, that at least 25 would be alive and released without harm.

Greatest turtle capture was noticed from March to August. When asked if this was not just a coincidence, as this is the peak of the swordfish fishery, Rolando insisted not. He states that the occurrence of leatherbacks, as well as their abundance, coincides with the swordfish, because they both exploit the same resources. Peak swordfish catches coincide with peak turtle catches.

He has also been on longline vessels, and he thinks the catch of leatherbacks is insignificant, when compared to gill nets. He estimated that longliners perhaps catch 3 or 4 turtles a year. However, he sadly admits that today the leatherback is rare. During the latest years (95, 96, 97) he doubts he has even caught a single leatherback during the whole

year. There is also less swordfish. He has now changed his fishing activity to shark, palometa or reineta (Carangidea) and merluza (Merluccius. sp), using light weight long lines, known as “espineles”. These are no threat to the turtles, as the hooks are small, only $\frac{3}{4}$ of an inch.

Another point he wants to stress, is that they do not purposely harm the turtles, they don't even keep sea turtles to eat, not even their eggs.

Interview with Miguel Donoso, of the governmental Institute of Fisheries Promotion (IFOP). (September 24, 1998, Valparaíso, Chile.

Miguel is the director of INFOP's swordfish fisheries study. He is also in close contact with Peter Dutton, of NMFs, whom he is working with in a cooperative effort. Miguel has received training in Hawaii, and he is currently preparing a document to be published on all the records of sea turtles in Chilean waters (Donoso, in press).

There are currently 12 industrial long line vessels, 6 are national and 6 Spanish. Most of these operate out of Coquimbo, while only one operated out of Valparaíso and another out of San Antonio. National vessels use monofilament mother lines and 2000 hooks, while Spanish vessels use polypropylene lines and 1200 hooks. Fishing trips may last up to 21 days.

As for the artisanal fishery, there are currently about 200 vessels (that use gill nets). In the past there have been up to 2000 of these vessels. The industry boomed in 1991, only to decline since. On one hand, restrictions were imposed by the US due to high Hg content, while on the other hand, coastal gill netting suffered as fish catches drastically declined, and the fish now are caught farther away from the coast. Many fishermen don't have the resources to fish in these farther away fishing grounds. Alternative fisheries are developing, using “espinel”, a type of light weight long-line, and other techniques.

Industrial Long line Captain Interview, September 25, 1998, Valparaíso, Chile.

I was able to contact a longline vessel Captain in Valparaíso. However, due to the delicate matter, that he did not have permission of the vessel owner, and the conversation was held in a very informal personal environment in his home, his name will not be released as for right now.

He operates a commercial long line vessel, hull length 60 feet. He sets long lines that may range from 20 to 40 miles, targeting swordfish and other large pelagics like shark. One of his favorite fishing grounds is around Islas Juan Fernández (about 270 km West from Valparaíso). Fishing trips may last from two to three weeks. He estimates that an industrial long line vessel captures about 8 leatherbacks per season (from March to December) in the mid coastal waters off Chile. Most of the turtles are alive, and he has noticed that many times they are not caught by hook ingestion, but by being hooked in another part of the body, or entanglement. Usually the line is cut and the turtle swims away

unharmful. He is a well educated person, with University studies, and expresses concern for the ecological fate of the oceans. He believes that his company would be open to talk about a possible study. He is all for it. He is open to talk to his boss and introduce any researchers to him in the future, and collaborate in any form.

Interview with Arturo Monzalvez, September 26, 1998, Puerto Montt, Chile.

Arturo Monzalvez is a marine biologist who has been living in Puerto Montt since 1996. He points out that Puerto Montt is the farthest port south where swordfish was ever landed, however, catches were always minimal, even during the boom in the early 90s. Currently, most of the fishermen in Puerto Montt fish with “espineles” a light weight longline designed to catch fish such as merluza (merluccius sp). Apparently, these “espineles” pose no harm to the turtles, and anyway he doesn’t think leatherbacks come so far south. He recommends I contact Carlos Gonzalez, at the local IFOP office in Puerto Montt.

Interview with Roberto Reyes, fisherman of Puerto Montt. September 27, 1998, Puerto Montt, Chile.

Roberto started working in the coastal gill net swordfish fishery during the boom in 1990 and 1991, when he lived in Valdivia.. He now works on trawl vessels. He remembers that leatherbacks were regularly caught during the coastal gill net swordfish fishery. Because of local fishermen belief, that killing sea turtles is bad luck, most were released unharmed if possible, but these beliefs are not shared by the modern fishermen, much less the long liners, who catch juvenile fish, and don’t care about the resource. His opinion is that industrial longline fishing should never have been allowed. He claims that gillnetters only killed adult fish, whereas the longliners kill many young ones. Now it is no longer possible to catch swordfish, so he is dedicated to other activities. Back to the turtles, he said their capture varies enormously according to many factors. For instance closer to Valparaiso and to the north there are more leatherback captures. He also claims there is a leatherback season, from April to November. In any case, he says maybe two or three leatherbacks were captured per year back in the early 90s, when he fished mainly out of Valdivia. However, when he retired from the coastal gill net fishery four years ago, no leatherbacks were ever caught any more. In his case, he always tried to do anything possible to release the turtle unharmed. He hasn’t seen any turtles in years.

Carlos Gonzalez, September 28, 1998. IFOP office in Puerto Montt, Chile.

He provided little information. He referred me to Miguel Donosso, the swordfish/sea turtle expert in IFOP. He also claims that leatherback are extremely rare in the fishing ports of Puerto Montt, but one was brought “several” years ago by a fisherman. Apparently, it was considered an oddity, showing up in the local news and papers. No copies of any articles, however.

Peru

Interview with Joahana Alfaro, of the Peruvian Center for Cetacean Studies (CEPEC) September 29, 1998, Pucusana, Perú.

Joahana acted as my main contact in Pucusana, a small fishing village in Peru. As the name suggests, their main focus is on cetaceans. However, they have contributed enormously to increase knowledge in Peru on marine conservation issues, including sea turtles. Fishermen used to catch dolphins and sea turtles for consumption in Peru. The main turtle captured for consumption is the Pacific Green (quotes), although sometimes live leatherbacks were also brought to port for sale. This practice is now forbidden (El Peruano, 1995). Records of leatherback captures that CEPEC holds include 2 individuals in Ancon (one in March of 1991 and another on December 7, 1992), one adult male (CCL 146, CCW 83) in Chancay (February 10, 1993), and one adult female (CCL 156, CCW 78) in Chimbote (February 13, 1993). Ports where Pacific Green turtles had been captured for sale in markets include Vidal, Chancay, Chimbote, Cerro Azul, and Santa Rosa. Details on these catches, regarding fishing art and effort, are not available. In Pucusana the trade of meat still occurs, yet on a minor scale and is not open. The Fishery authorities have an office at port, which apparently discourages the landing of any turtle products. There is still an active fishery of sea turtles in Pisco, to the South.

CEPEC has relied heavily on education, especially in Pucusana, where they have developed a very good relationship with the fishermen, who were open to speak and very cordial during the visit.

Interviews with Artisanal fishermen of Pucusana September 29, 1998:

The artisanal fishermen of Peru use mainly “espineles” and large mesh drift nets, targeting shark. Most of the fishermen used to fish “merluza”, but the resource has been depleted, and they have shifted. The espineles in Peru are somewhat different from the ones used in Chile. In Peru they use 2” hooks, with a distance of 15 fathoms between hooks. They set an average of 500 hooks, usually at the water’s surface.

Most of the fishermen may also temporarily switch to the use of “animaleros”, or large mesh gill nets for shark.

Robinson Urdanivia Ramos: Former “merluza” fisherman with drift nets, but since the resource has been depleted, he now catches sharks (blue and “diamond”) using espinel. He complains about “the good old days” when fish was plentiful, now he has to target shark. He also complains that the shark get smaller and smaller. Usually he goes out fishing with espineles for 3 or 4 days at a time, rarely using the nets. The sets last from 4 to 5 hours, using 200 to 400 hooks. Turtles are definitely caught using both methods, but he refused to

come up with any sort of number. It varies too much from season to season, for instance during the last Niño event (1997-98), many sea turtles came close to these waters, as well as other fish like maji-maji.

Carlos Contreras: He owns an 18 meter vessel, dedicated mainly to the “espinel” shark fishery (diamond shark, blue shark, maji-maji). At the moment he is using 500 hooks, but he says it may vary from 100 to 500. He also uses “animaleros”. With his boat, he can travel 24 hours from the port, about 100 miles. Capture of turtles varies greatly. From 20 to 30 turtles a year with longlines, maybe more with nets, but only one or two of the yearly total would be a leatherback. Most of the turtles are alive. Turtles are captured from January to February, but depending on certain currents, they can be seen until August.

Carlos Carrillo, Carlos Sernaque, Angel Lobatón, Artisanal fishermen of Pucusana: This was a group interview. They all set espineles, but they also do the animaleros on the side. After a debate, they all agree that each espinel vessel must “incidentally” catch about 50 sea turtles a year, of which ALL are alive. Sometimes the hooks are deeply imbedded in the animal’s throat, in which case they to kill it to recover their hook and to alleviate the animal’s suffering (they claim). Leatherbacks are very rare, perhaps 1 a year at the very most. March to June is supposed to be the turtle season.

Oscar Mendoza, “Compañía” He works mainly with “animaleros”. He estimates that these nets must catch about 50 turtles in a season. He uses 6 inch mesh, set at the surface, targeting shark. Mortality of sea turtles is estimated to be about 50%. Live turtles are released unharmed, but dead turtles are kept on board for food. Leatherbacks are rare, he has only seen two leatherbacks in his lifetime.

Wilbur Marin, IMARPE Inspector in Pucusana. Sea Turtle hunting is now a forbidden activity, and he never sees any turtle meat at the docks. However, he knows it continues to a certain degree, just that it is not an open activity. He points out that the problem is greater in other communities, like Pisco, to the south. Records were kept of turtle capture at fishing ports by IMARPE officials when it was legal. All this information was sent to the IMARPE office in Callao. Leatherbacks were rarely recorded, but he can’t come up with a figure, not even an estimate.

Interview with Artisanal fisherman of Cerro Azul, September 30, 1998:

Cesar Manco Mendoza, Community of Cerro Azul . Board Member of the Fishery Syndicate of Cerro Azul September 30, 1998, Perú. He uses “animalero” nets, 90 fathoms long, 8 inch mesh, 50 meshes high, set at the surface. Most turtles are alive when captured, depending on the fishing situation (the economics), they return it to the sea or not. Leatherbacks are NEVER caught. He remembers one from 5 or 6 years ago, which was brought to the port for sale, but nobody wanted to buy it because locals prefer “white turtles” (probably greens). He claims that they may catch 1 or 2 white turtles a year, incidentally.

Interviews with Artisanal fishermen of Pisco, Perú, September 30, 1998:

Ricardo Torres, fisherman of Pisco, Perú. He uses nylon gill nets, 40 fathoms long and 2 fathoms high, 6 inch mesh. Surface nets. He sets them from 20 to 200 miles from the coast, depending on the fish he is targeting. Turtles are caught frequently during the summer, from January to March. At least 20 turtles or more are captured a year, most of which are alive. Very few leatherbacks are ever captured, because they are too far away for their small vessels.

2 years ago he used to be a turtle fisherman (when it was legal). He would use thread nets, 30 to 50 fathoms length, designed to catch sea turtles. They would set the nets close to Pisco, in a locality where turtles are abundant. Curiously, he mentioned that the nets had to be placed perpendicular to the coastline. He would catch from 30 to 40 turtles in two days. It was easy to sell because it looks like beef, and its cheaper. Leatherbacks were never caught in this fishery.

Francisco Eusubio, fisherman of Pisco: Artisanal fisherman, uses gillnets with 7 inch mesh spread. He travels about 80 to 100 miles from the coastline, mostly targeting shark. He sees about 2 or 3 turtles a year, and releases them alive. Leatherbacks are hardly ever captured, not even at a rate of 1 per year. We finally settled for 2 every three years.

Pedro Ronaldo García García, fisherman of Pisco: Former sea turtle fisherman. He would use 6 inch mesh nets made of twine, 500 to 800 ms long, fishing at a distance of about 3 to 4 miles from the coastline. Lots of turtles during the summertime (January-March). Leatherbacks were seldom caught, and even when they were, people would not like to buy them, although they could “sneak it in” with other sea turtle meat. About 10 years ago, leatherbacks were more abundant, catching perhaps 10 to 20 during the turtle season, but he recalls that just before the prohibition of turtle fishing a few years ago he would catch perhaps two or three a year, at the most. Nobody continues with this commercial practice, but anyone who incidentally catches a turtle will keep it.

Visit to the Pisco Dump, September 30, 1998.

In spite of the prohibition, the slaughter of turtles continues:

25 turtle carapaces were observed in a dump near the fishing port of San Andres in Pisco. 17 were green turtles, and 8 olive ridleys. No leatherback shells. Curiously, many had signs of having been sacrificed recently, well beyond the season in which turtles are supposed to incidentally occur in the artisanal fisheries.

Attempted Interview with IMARPE officials:

Interview with Marco Sánchez, IMARPE, Perú. I tried to speak with several officers at the IMARPE building in Callao. However, the officials I had been recommended (Renato

Guevara, Chief of Pelagic Resources, and Jaime Yanque) were not at the office. I was going to interview Marco Sánchez, but after learning what I was doing in Peru, he said I could find the information I wanted in the IMARPE library. Unfortunately, data relevant to turtles was non-existent. Only figures of tons of sea turtle landed were found, without a description of species components.

Ecuador

Leonardo Castillo, of the Direction of the Merchant Marines of the Ecuador Army, in Guayaquil, October 2, 1998. He didn't know much about the subject, but he referred me to the coastal city of Mantas, as the easiest accessible port (especially because of the strike) as well as to important persons in the exporting industry.

Ramón Montaña, President of the Association of White Fish Exporters (large pelagics, and demersal fish), Port of Manta, October 6, 1998. He acknowledges that sea turtles are caught by long lines, and that now there is increased fishing effort around the Galapagos Islands, but they would like research to be done in this respect, to evaluate the problem and take actions. During our conversation, the most important point Ramón wanted to get through was that they were open to conservation and research. His organization believes in responsible fishing, and would be willing to cooperate with any work, as long as it considers working closely with the fishermen and it is done in a strict scientific fashion. He would like to be kept informed of the progress done in this field, and offers his support in case future cooperative efforts are needed.

Carlos Velez Escobar, President of the Association of Ecuadorean Tuna Fishermen (ATUNEC), and Gonzalo Mora, General Coordinator ATUNEC, October 7, 1998: The interview with both of these officials was very cordial. As Carlos Velez explained, they were very much aware of the international environmental movement, especially to protect dolphins. They don't use long lines, only purseiners, so they don't catch many turtles. However, there is an interest in their company to promote conservation issues. The town of Manta suffers great pollution by sewage. There are many environmental problems in the town, and sea turtles could be one way to address them, as a global issue. After a very brief interview, Mr. Velez had to leave, but Mr. Gonzalo Mora asked me to stay so that I could be interviewed for a publication in their magazine "Atún y Mar".

Interviews with Manta fishermen, Ecuador, October 7, 1998.

Alfonso Angulo, Industrial fisherman of Manta. He has been a longline fisherman for 4 years. His main objective is tuna, using 25 mile lines, with Japanese style hooks every 10 fathoms, at 5 fathoms of depth, and a distance from 200 to 300 miles from the coast, sometimes even all the way to Galapagos Islands. Whenever turtles are captured, he lets them go unharmed. If the hook is difficult to recover, he prefers to let the turtle go with hook and all. Most of the turtles are white turtles (greens), and they get hooked by directly biting the bait (squid). The turtle "season" starts in January or February, and he may catch

1 or 2 per trip. Usually a trip may last 8 to 10 days, but if he goes all the way to Galapagos it may take him a month. He usually sets 1 set per day. Very few leatherbacks are ever caught, except when fishing very far away, like around Galapagos. He estimates he catches 1 leatherback a year. Leatherbacks are not eaten, but the other species are.

Esteban Sergio Torrentes (Costa Rican boat Captain, living in Mantas for 5 years). Vessel Isis. After introducing myself, he abruptly interrupted me, complaining about the Turtle Tag Project in Costa Rica. He has returned at least 30 tags to the UCR program, but he has never received a reply. He says that in Costa Rica he received some environmental education in school in Puntarenas, and he tries to take care of the turtles. Thus, he is discouraged by the lack of interest of the UCR that has not informed him of his tags.

His vessel, the "Isis", is a 60 ft. florida type vessel. He uses 40 mile lines, at a about 600 to 700 miles from the coast, West of Galapagos, targeting swordfish and shark. Sometimes he hits "turtle spots", mainly when the lines are placed close to the surface. He says that catches as high as 80 turtles in a single set are not uncommon, mainly of green turtles, including some ridleys. Most are alive, and if released carefully, unharmed. About 8 years ago he would catch an average of 10 to 15 a year. Now, perhaps one a year. The problem is that they may get tangled in the mother line, making release difficult.

He also strongly called my attention towards the Costa Rican maji-maji long line fishery. They set their lines on the surface, and the capture of turtles is much higher than other arts. However, these high catches are mainly constituted of greens and ridleys.

Rafael Mero Delgado (Mantas industrial fisherman). He has been fishing with longlines for 15 years, when bait was easy to get (8 to 10 years ago). Now, he has changed to using "multiple lines". These are 4 or 5 separate lines with only 1 hook, set around the boat, at about 25 fathoms of depth. This method is applied at night, and a strong light is lit on the deck to attract the fish. He has been fishing with this method for 3 years, and has never caught a turtle. Before, any green turtles caught were kept to eat. Nowadays, fishermen show more respect and let many go. Leatherback turtles are very rare, only encountered when fishing far from the coast, west of the Galapagos Islands. In his case, he only goes from 150 to 200 miles from the coast.

DISCUSSION

The incidental capture and death of leatherback turtles by the coastal gillnet fishery of Chile has been implicated in the drastic decline of this species in the Eastern Pacific. However, information is insufficient regarding the mortality of adults in nesting beaches, the poaching of eggs, the capture of leatherbacks during directed artisanal fisheries in Peru, historic industrial longline catches in International waters of the Eastern Pacific, and movement patterns and habitat needs to assess the true responsibility of each factor (Eckert and Sarti, 1997; NMFS, 1998).

Japanese longliners initiated operations around Chile in the late 1950s, targeting mainly tuna (Weidner and Serrano). In 1978, about 4×10^8 hooks were deployed by the Japanese in the entire Ocean within 35°N and 35°S , with a recorded turtle catch rate of 0.1 /100 hooks, which represents a catch of 40,000 turtles, 13.7% (5200) of which are leatherbacks (Nishemura y Nakahigashi, 1990). Thus, well before the involvement of the coastal gillnet fishery in the mid 80s, leatherbacks were being caught by Japanese longliners in offshore waters.

Frazier and Brito (1990) were the first to warn on the swordfish fishery in Chile, when they recorded 31 leatherbacks captured by the coastal gillnet fishery of central Chile. They estimated a catch of 1 leatherback per vessel per season, which translates to 250 turtles per year in San Antonio alone (in 1989). However, the new information including data from 1990 to 1991 shows a considerably higher catch rate. 17 leatherbacks more were recorded in 5 reports, from May 12, 1990 to May 7, of 1991. It becomes evident that multiple captures of leatherbacks in single sets were common during the early 90s. One coastal gillnet fisherman interviewed estimated a total of 30 leatherback turtles during the early 90s. Currently, leatherback captures by gillnetters is rare, perhaps one or two a year per vessel.

With the decreased catch rates of swordfish in coastal waters, and the inability to catch fish offshore, artisanal fishermen are shifting activities to the use of “espineles”, targeting entirely different species. From close to 500 vessels in 1991, in 1998 there were close to 200 (Donoso, pers. com., 1998). However, this reduced fleet does not translate into reduced fishing effort, which has remained constant during the last three years (IFOP, 1997). The fewer vessels dedicate more days at sea (Brito, personal communication). Thus, the take of leatherbacks by the current coastal gillnet fishery may be from 100 to 300 leatherbacks a year.

An industrial Chilean longline Captain also reports capture of leatherbacks, up to 8 per year in the high seas longline fishery. Since there are only 10 – 15 vessels in the fleet, this may represent about 80 to 120 leatherbacks per year.

Attention must be drawn to the artisanal fishery of Peru. A directed sea turtle fishery using gillnets has existed in Perú for a number of years, where adult turtles, mainly greens, and to a lesser degree leatherbacks, are captured for human consumption (Aranda y Chandler, 1989; Brown and Brown, 1979). In October of 1978, 167 leatherback carapaces were

found in a Canyon near Pucusana, which were captured during the summer months from January to March, and it was estimated that at least 200 leatherbacks were captured per season (Brown and Brown, 1979). In 1995, the last year of legal turtle harvest of sea turtles, 2 tons of turtle meat were landed, but there is no description regarding species composition (Flores, et. al., 1997). Information provided by CEPEC, shows that leatherbacks were still captured by local fishermen for sale at ports in Ancon, Chancay and Chimbote, as recently as February 1993.

Local Peruvian fishermen continue to catch very high rates of green and olive ridleys sea turtles, either as by-catch or in directed fisheries. However, according to the interviews, the number of leatherback captures has decreased in recent years. In fact, leatherbacks are currently considered an oddity by the fishermen. Even though artisanal fishermen report that “maybe 1” leatherback a season may be caught, it must be kept in mind that there are more than 28,000 artisanal vessels, of which 40% use gillnets and 3% espineles.

An issue that needs to urgently be addressed is the expanding high-seas longline fisheries of Ecuador and Costa Rica.

Local artisanal fishermen of Ecuador are already setting long lines in coastal waters, mainly targeting maji-maji. The impact of this fishery on turtles is unknown. All Ecuadorean fishermen interviewed claimed that leatherback captures were very rare in coastal waters. However, swordfish captures are reportedly higher in waters West of the Galapagos Islands, as well as leatherbacks. Ecuador is currently expanding its fleet, targeting swordfish which are abundant West of the Galapagos Islands.

These new fishing grounds should be a major concern. Morreale et. al. (1996) and Eckert and Sarti (1997) have demonstrated the existence of a corridor for leatherbacks of the Central American region and Southern Mexico on their southward post-nesting migration toward South America. Turtles that have been satellite tracked head towards the Galapagos Islands, where they “taper” into higher concentrations of turtles in space and time, to disperse again towards South American waters, perhaps in a feeding migration. The clustering of many individuals in space and time along migratory corridors greatly increases the vulnerability of the species, but could at the same time facilitate protection of regional and world stocks, simply by restricting potentially harmful activities within the spatial and temporal corridor (Morreale, et. al., 1996).

Costa Rica too, is targeting fish in this area. Costa Rica’s 200 mile Exclusive Economic Zones extends all the way to Cocos Island, giving Costa Rica an extra 200 mile extension into the Pacific. However, the resources in Costa Rica’s ZEE are showing signs of depletion, and now fishermen must operate beyond the EEZ and into Ecuadorean waters, to the North and West of the Galapagos Islands, increasing the fishing effort on the fishery resources. Arauz, et. al (1999) reported two juvenile leatherbacks, with carapace lengths no greater than 60 to 65 cm, captured off the West coast of the Galapagos Islands (0° 45’ 87” S, 92° 13’ 16” W) (Figure 4) during a single long line operation on November 11 of 1997. Evidence of this capture exists on video. Previously, Segura and Arauz (1992) had reported captures of olive ridleys and green turtles in Costa Rica’s longline fishery in the EEZ during two fishing excursions, with a catch rate of 0.3 turtles/100 hooks, three times greater

than the average catch rate of sea turtles reported by Nishemura y Nakahigashi (1990) for the Japanese longline fishery.

Furthermore, Costa Rican vessels are known to operate as far west as the Clipperton Islands (approximately 11°N, 109°W), which also seem to be in the post nesting migratory path of leatherbacks from Mexico (Eckert and Sarti, 1997), before they head over to the Galapagos Islands on their route south.

The precarious state of the Eastern Pacific Leatherback demands immediate attention. Fishery managers and sea turtle researchers need to develop conservation strategies that mitigate sea turtle longline interactions (Witzel, 1999). Moreover, the lack of information on the movement patterns and habitat needs of this entirely pelagic species (leatherbacks are the only species which remains pelagic throughout its life) is severely hampering recovery efforts and must be addressed as a high priority (NMFS, 1998).

Adequate conservation strategies must include the involvement and cooperation of the fishery sector. Fishermen may be an excellent source to obtain much needed information on population movements and behavior at sea, and their participation will foster environmental awareness. James (1999) carried out a successful study called “Distribution and Conservation of the leatherback turtle (*Dermochelys coriacea*) in Atlantica Canada, Research Partnerships with the Fishing Community”, in which data collection relied heavily on fisherman participation. Such partnerships are urged in the fisheries of South America, as a solution that may have a mid term impact.

South American fishermen in the past have cooperated with tagging programs by providing tag returns, mainly during shrimp operations. Some shrimpers would even request that the reward be educational books on sea turtles (Cornelius, 1986). Keeping up a similar program, fosters the interest of the fishermen, and draws their attention to environmental issue. Costa Rican longliners have also expressed to be open to a cooperative research project to assess the capture and mortality of sea turtles by the Costa Rican longline fishery as well.

It is necessary to cultivate friendly and informative relationships with the fishermen. Observer programs also allow to have direct contact with the fishermen and educate them on board. Fishermen of all nations, however, must be approached with caution, studying common goals and interests.

The coastal gillnetters of Chile for instance, are already reluctant to provide any turtle information. Furthermore, a debate is currently being held over a new Ecuadorean Law that extends the exclusion limit for commercial fishing operations around Galapagos from 15 to 40 miles. This situation has polarized the position of environmentalists and businessmen. While all export fisheries in and around the Galápagos are urged to be banned (Camhi, 1995), Ecuadorean businessmen claim the new law has no scientific backup, and they accuse local environmentalists of selling out to the interests of international environmental organizations (Atún y Mar, 1998; Vélez, 1998; Mora, 1998). Obviously, any precipitated effort to protect leatherbacks around Galapagos will not easily be supported by local fishermen.

Fortunately, during personal talks with Ecuadorean industry officials (tuna and “white fish” exporters), they claim to be open to conservation and will cooperate with research efforts. They also want to carry out environmental education efforts. Any work, they insist, must be done in close collaboration with them. This in fact, would be an ideal situation.

Cooperative work with the fishermen must be based on recognition and good publicity. The achievements reached based on information provided by fishermen must be acknowledged as such, at local and international forums. Furthermore, many sea turtles captured during longline operations are alive upon recovery, but mortality increases due to injuries inflicted by fishermen when the fishing equipment is recovered. For instance, a video filmed on board a Costa Rican longliner when two juvenile leatherbacks were caught shows how in one occasion the turtle was brought on board and released virtually unharmed, as it had been hooked on the shoulder (it did not try to ingest the hook). However, the video also shows how the fishermen were about to cut the turtle’s front flipper with a machete to recover the hook in an easier and faster fashion, before being stopped. Good publicity could change these negative practices, and reduce leatherback mortalities, as apparently these turtles are commonly attracted to longlines by photochemical lights, and not the bait as such. Thus, the hooks are not imbedded in the mouth nor are they ingested, where serious injuries may be inflicted. Rather, the turtle is hooked somewhere along the body. The efforts of fishermen who are patient enough to release hooked turtles, untangle them, or use techniques to safely release hooked turtles should be acknowledged.

Currently, the coastal gillnetters of Chile would be the most important group to work with, followed by the Chilean longliners, the Ecuadorean and Costa Rican longliners, and finally the Peruvian artisanal fishermen. Even though the Peruvian fishery does not have a longline fleet, they used to catch substantial numbers of leatherbacks in the past, for food. These turtles apparently foraged on jellyfish which occur off the coast in large quantities during the summer season (December to March) (Brown and Brown, 1982), and interviews suggest that small but unknown quantities of leatherbacks may still occur in these waters.

CONCLUSIONS

Evaluating capture rates of leatherback turtles both in space and time, by high-seas longline and coastal gillnet fisheries which target pelagic species of fish, and working in close collaboration with the fishing industry during this evaluation, will draw important information on migratory paths, interesting behaviour, and post nesting migrations, information which is much needed to establish management strategies at sea.

In spite of the reduced number of vessels in the coastal gillnet fishery of Chile, fishing effort has remained constant for the last three years. Even if the leatherback populations are severely reduced and catch rates are not even close to those recorded during the early 90s, these fishermen probably still catch the highest number of leatherback turtles in the Eastern South Pacific, as they operate in coastal waters where the Humboldt Current provides cold currents, rich in nutrients and high productivity, where leatherbacks are expected to forage.

Longline operations off Chile also catch leatherbacks. During prolonged seasons when the waters are unusually warm and it is possible to catch shark, the capture of leatherbacks is also to be expected.

The new longline fishing grounds West of the Galapagos Islands deserves special attention. If in fact the leatherbacks of Central America and Mexico travel south using a migratory corridor towards the Galapagos Islands, this means they are subject to being incidentally captured by the expanding longline fishery of Ecuador, and by the expanding multispecific longline fishery of Costa Rica as they migrate south through the waters of the EEZ. Furthermore, Mexican leatherbacks seem to head to Clipperton Island, where the Costa Rica longline fleet also operates, before heading south to Galapagos.

The elaboration of regional strategies to evaluate catch rates by the different fisheries and infer other aspects of turtle biology at high seas, in collaboration with the fishery sector to guarantee efficient management and regulation of these activities, will be fundamental to the survival of the eastern Pacific Leatherback.

Many times actions are taken too late. The high catch rate of leatherbacks by the coastal gillnet fishery of Chile has been known since 1990. However, our attention has been drawn upon the issue only until recently, now that the populations of Eastern Pacific leatherbacks have declined so abruptly and drastically. Dealing with such a depleted population, and an ever expanding long line industry, even minimal captures of adult leatherbacks may impact the population. Actions must be carried out immediately, to strengthen the activities carried out by local researchers, environmental educators and networks of organizations that work in this field and geographic area, so they may interact with the decision makers and especially the fishermen of their nations, who will have the ultimate responsibility during fishing operations at high-seas, of saving that turtle on the hook!

FIGURES

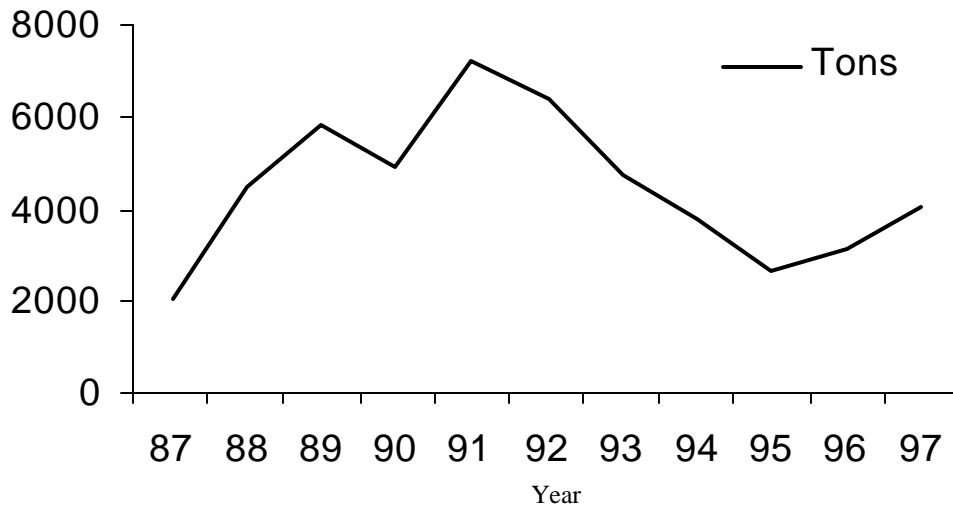


Figure 1. Swordfish production (tons) in Chile, from 1987 to 1997 (SERNAPESCA, 1998).

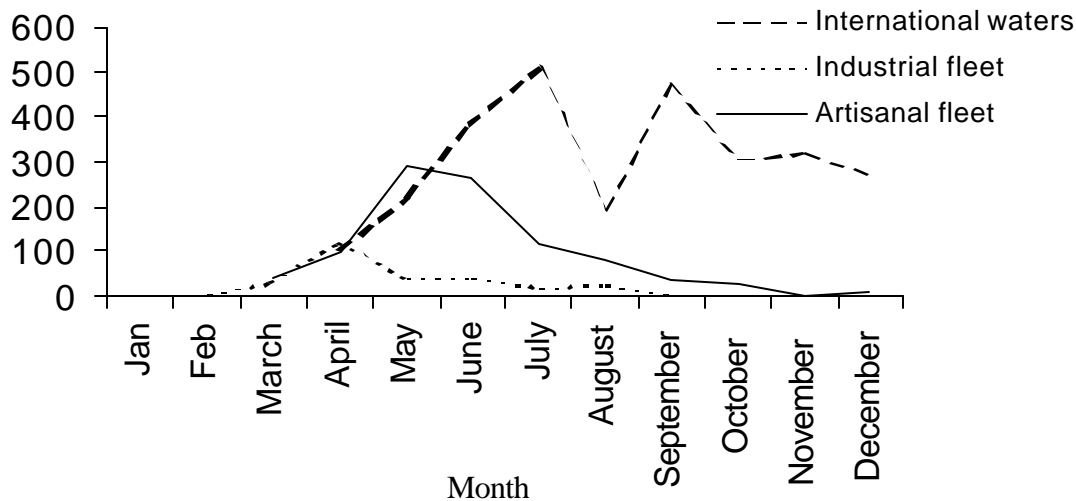


Figure 2. Capture of swordfish per month in 1997, by the artisanal fishery in coastal waters, and the industrial longline fisheries, in both national and international waters off Chile (SERNAPESCA, 1998).

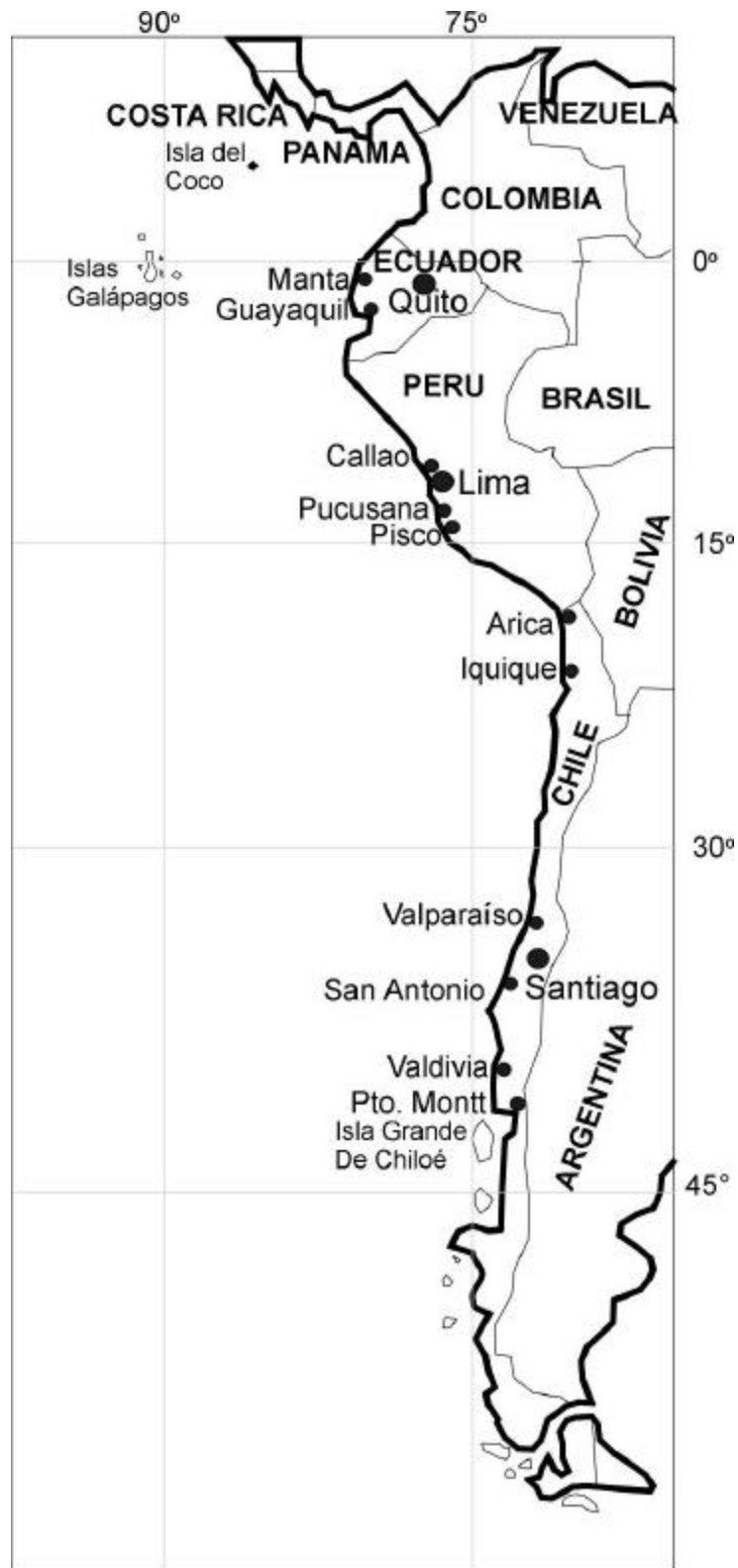


Figure 3. Location of ports visited, as well as other ports mentioned in this report. 1999

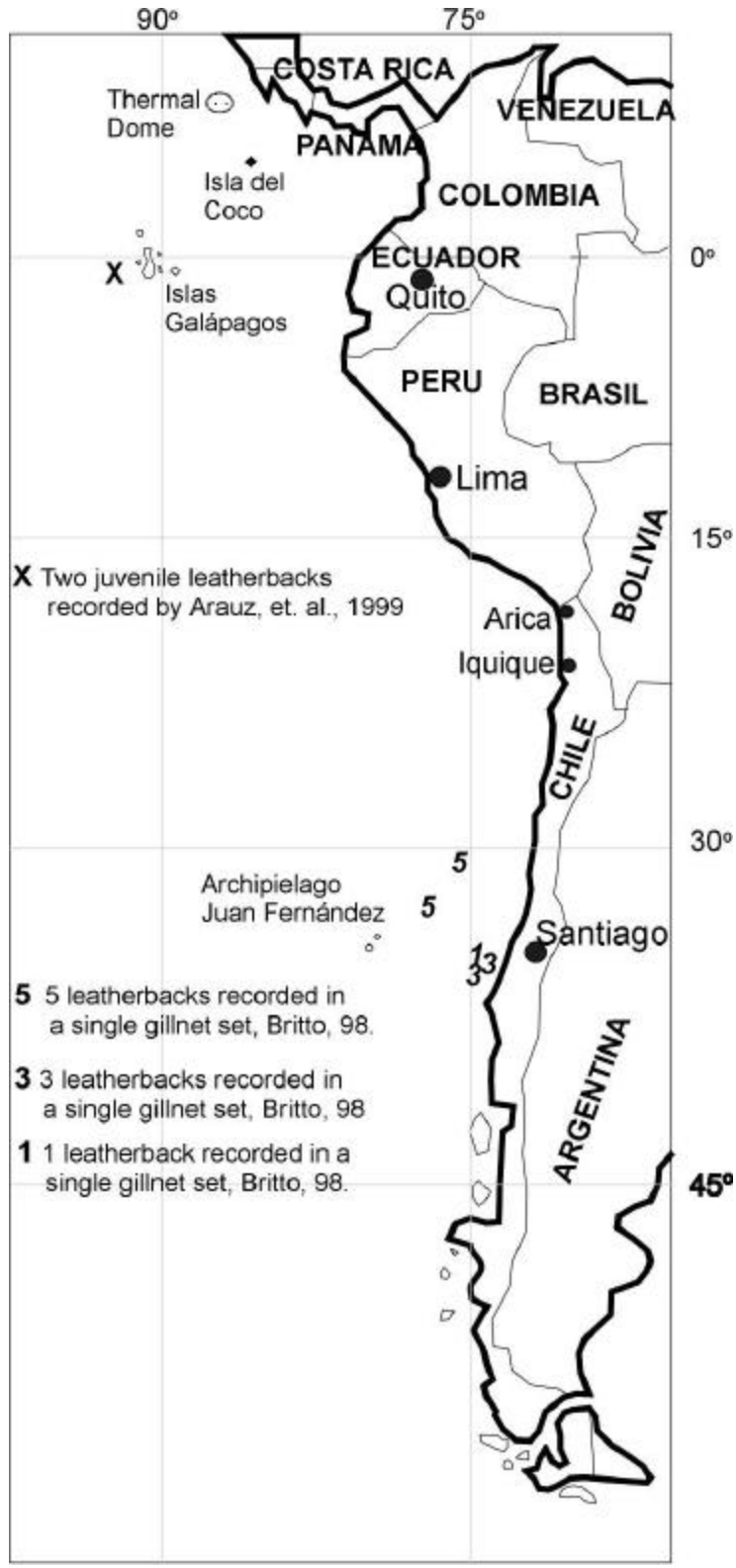


Figure 4. New records of leatherbacks captured by the longline fishery of Costa Rica (Arauz, et. al., 1999) and the coastal gillnet fishery of Chile (Brito, pers. com. 1998).

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