

APPENDIX N

R. Aguilar, J. Mas & X. Pastor, *Impact of Spanish Swordfish Longline Fisheries on the Loggerhead Sea Turtle *Caretta Caretta* Population in the Western Mediterranean*

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IMPACT OF SPANISH SWORDFISH LONGLINE FISHERIES ON THE
LOGGERHEAD SEA TURTLE *CARETTA CARETTA* POPULATION IN THE
WESTERN MEDITERRANEAN.

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1. SUMMARY

More than 20,000 subadult loggerhead turtles are incidentally captured every year as a result of the Spanish longlining fishery activities. Turtles are usually released alive with the longline hook still lodged internally. However, at least 20% of the sea turtles captured by this fishing gear could eventually die, due to the injuries caused by the hooks.

Observers onboard 26 fishing boats during a period of 143 days, between the summer months of 1990 and 1991, recorded the captures of 1,098 loggerhead (*Caretta caretta*) and two leatherback (*Dermochelys coriacea*) sea turtles. 94% of the turtles captured while observers were onboard were tagged and released to investigate the origin of the Mediterranean sea turtle populations.

1. SUMARIO

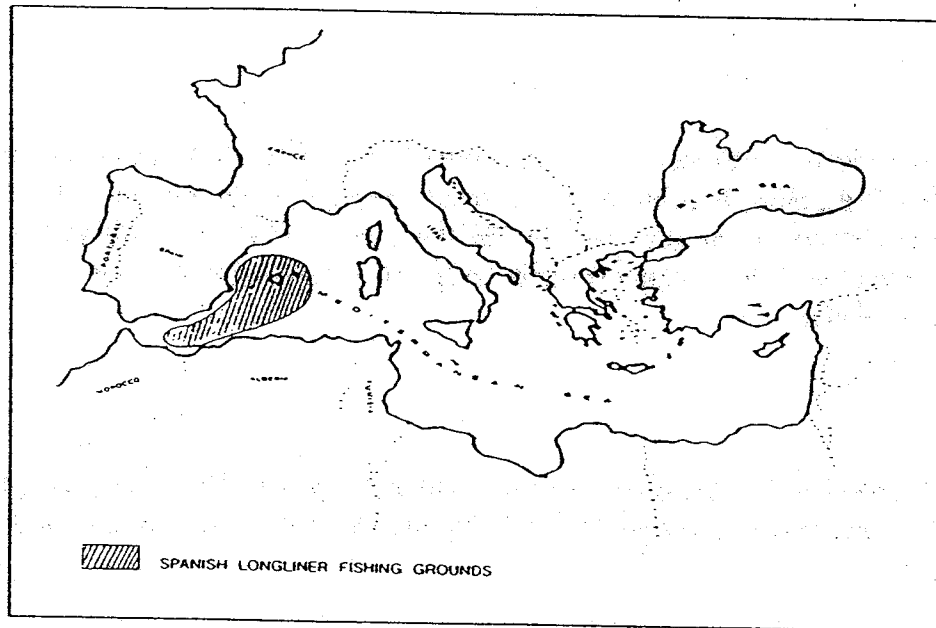
Más de 20.000 ejemplares subadultos de tortuga boba son accidentalmente capturados cada año por la flota palangrera española. Las tortugas suelen ser liberadas vivas con el anzuelo aún en su interior. Sin embargo, cabe la posibilidad de que al menos un 20% de las tortugas capturadas por este método de pesca mueran posteriormente a causa de las lesiones producidas por los anzuelos.

Los observadores, embarcados en 26 barcos pesqueros durante un total de 143 días, en los meses de verano de 1990 y 1991, registraron la captura de 1098 tortugas bobas (*Caretta caretta*) y dos tortugas laúd (*Dermochelys coriacea*). Mientras los observadores permanecieron a bordo, el 94% de las tortugas capturadas fueron marcadas y liberadas, con el fin de investigar el origen de las poblaciones mediterráneas de tortugas marinas.

2. INTRODUCTION

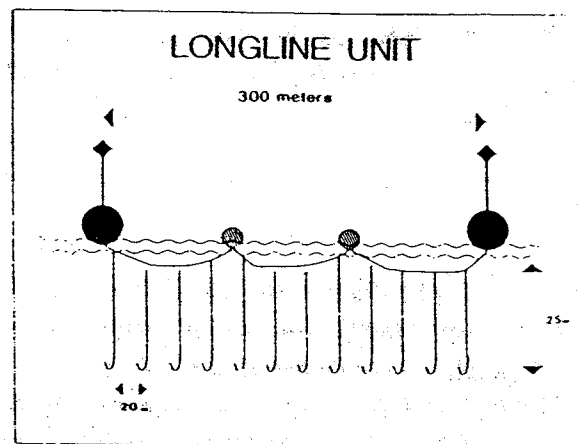
2.1. Description of the fishery

The waters of the South Western Mediterranean are the fishing grounds for a fleet of Spanish surface longliners dedicated to the capture of swordfish. The activities of this fleet seem to have an important impact on the population of loggerhead sea turtles (*Caretta caretta*) present in the area. The fleet is composed of some 30 boats using longlines throughout the year, and is joined during part of the year by a further 30 ships. The highest concentration of boats is during the summer months, when between 60 and 80 Spanish ships work in the area.



A typical Mediterranean swordfish longliner is a wooden boat of 15 meters length, with a gross tonnage of 40 tons and a 300 HP engine. The crew consists of approximately 8 persons.

The basic fishing gear is composed of a mother line 300 m long, stretched between two buoys. From this line hang 12 hooks, attached to thinner lines that secure them at approx. 25 meters depth. The distance between hooks is around 20 meters. As many as 200 of these longline units can be joined together, reaching a length of up to 60 kilometres, with a possible 2,400 hooks. The most usual baits are flying squid (*Todarodes sagittatus*), mackerel (*Scomber scombrus* and *S. japonicus*) and gilt sardine (*Sardinella aurita*). Hook size is 90mm per 35mm. The gear is set at sunset and the hauling-in operation begins just before sunrise. The hauling operation takes up to 7 hours.



species, such as loggerhead sea turtles (*Caretta caretta*), stingrays (*Dasyatis pastinaca*) and several species of tuna and sharks.

During the last six years, Greenpeace has been carrying out research work to determine the impact of this fishery on the sea turtle population. This work has been combined with a tagging programme attempting to determine the origin of the western Mediterranean loggerhead turtles population.

3. MATERIAL AND METHODS

3.1. Questionnaires

Questionnaires completed by the skippers of the longliners since 1986 have provided data on the number of sea turtles incidentally captured per boat and month for the duration of one year by the fleet landing its catches in the port of Alicante (SE Spain), the main harbour for this fishery. This information was later supplemented with the establishment of an observers programme onboard the boats.

3.2. Observers

In July, August and September 1990, observers were situated onboard 15 longline boats for a period of 73 days. In June, July and August 1991, 11 boats were monitored in the same way for a period of 70 days.

For every sea turtle captured by the longlines, the observers recorded several types of geographical and biological data, including date, location, species and size. Other data on parasites, pollution, wounds, etc... was also recorded. In 1991, information about the characteristics of the fishery (number of hooks, type of bait, gear setting and hauling times, time of every catch) and weather conditions (atmospheric and sea conditions, surface water temperature) was registered.

Locations were determined by the information provided by the skippers. Turtle shell sizes were measured using a flexible tape, and correspond to the curved carapace length of the individuals.

3.3. Tagging

The observers were provided with tags from the University of Florida, and 94% of the captured animals were tagged in one of their flippers. Immediately the animals had been measured and tagged, they were released into the sea. In some cases it was possible to remove the hook before their release, but in the majority of animals the hook was located deep inside the digestive tract making its removal impossible under field circumstances.

3.4. Mortality monitoring

Since 1986, a number of sea turtles captured by this fishery, with hooks still present in their bodies, have been kept alive in captivity in large aquaculture pools with the aim of estimating the mortality rate of the individuals released with hooks still in their bodies. The capacity of each pool is 7,000 litres. The salinity ranges between 43.056 ‰ and 48.070 ‰, and the temperature range is between 9.60 C and 27.62 C. The bottom of the tanks is cleaned once a day to monitor the presence of expelled hooks and the state of digestion of food in faeces.

4. RESULTS

4.1. Sea turtles by-catch

In the period between July 7th and September 9th, 1990, a total of 673 loggerhead turtles was incidentally captured by the boats while observers were onboard. Between June 21st and August 30th, 1991, the number of loggerheads captured was 425. During that period, two leatherback turtles (*Dermochelys coriacea*) were also captured.

Of the total of 1,098 loggerheads, only 4 were dead when hauled onboard. 1,035 animals were tagged before being released back to the sea. The removal of the hook was only possible in 171 cases, when the hook was found in the mouth, the tongue or, in a few cases, in which it was attached externally to the flippers or to other parts of the body.

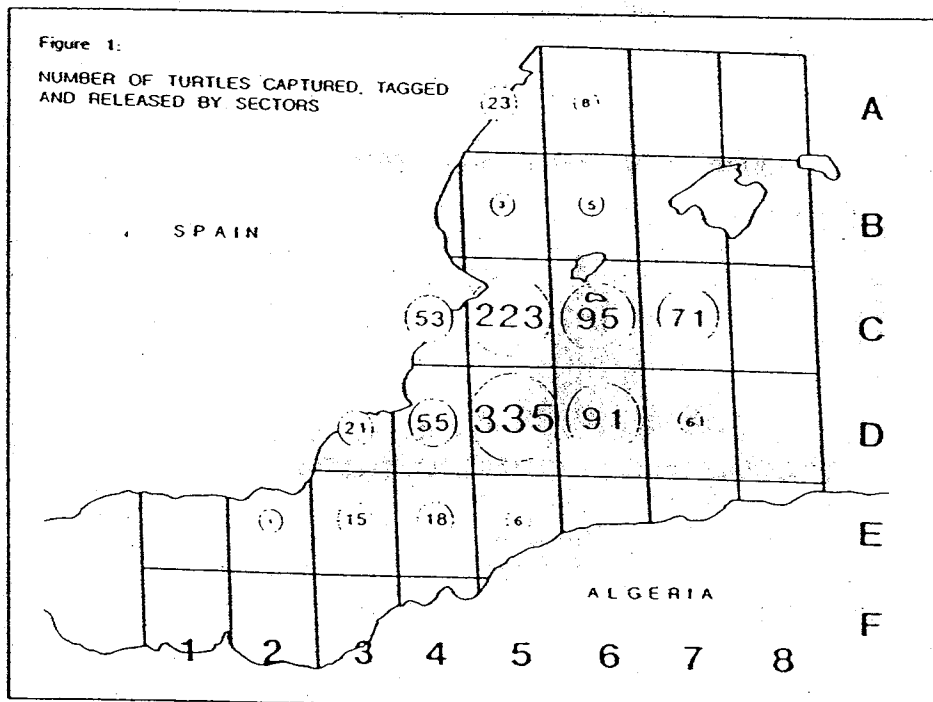
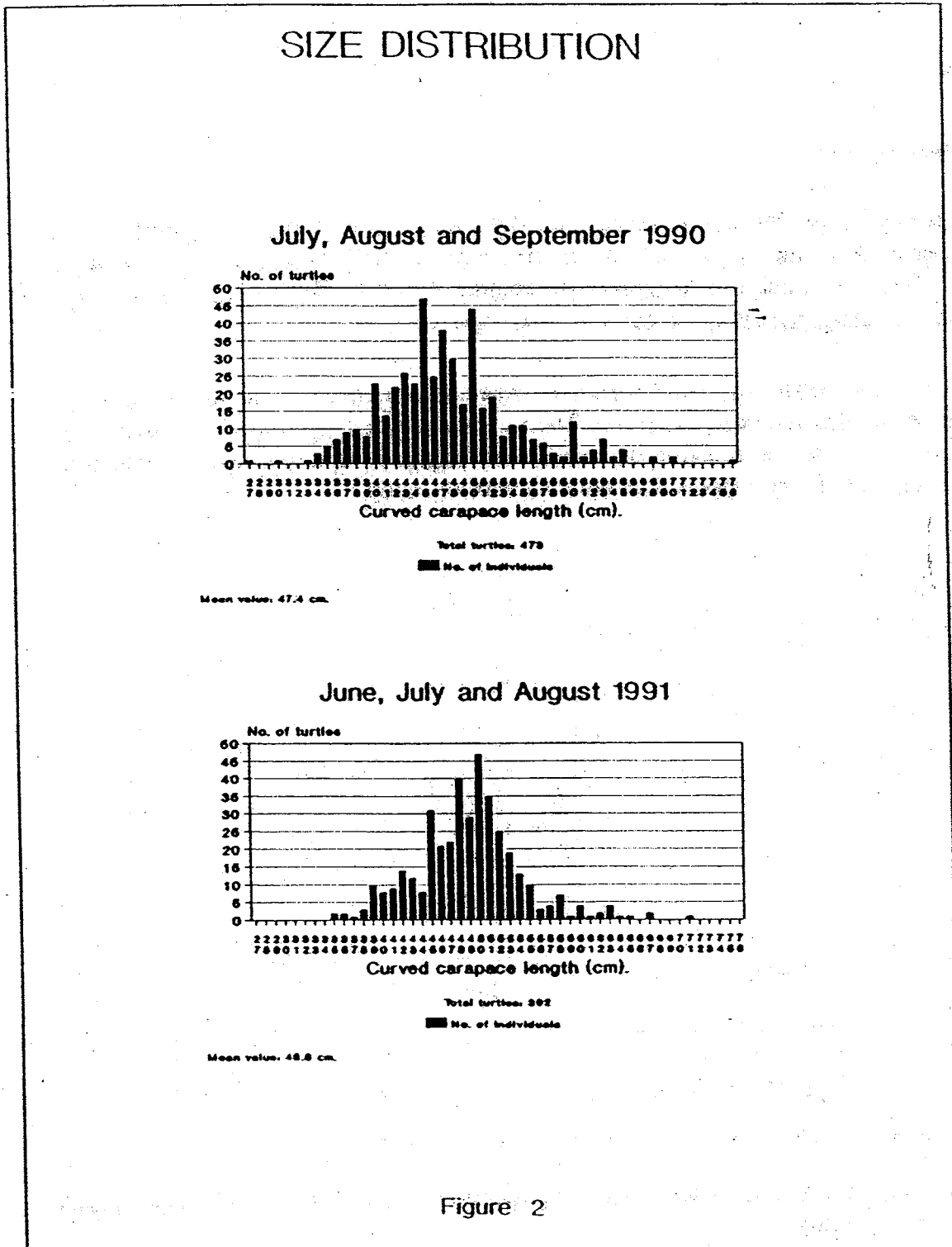


Figure 1 shows the fishing area, divided in sectors, and the number of turtles captured, tagged and released in each sector.

4.2. Size distribution

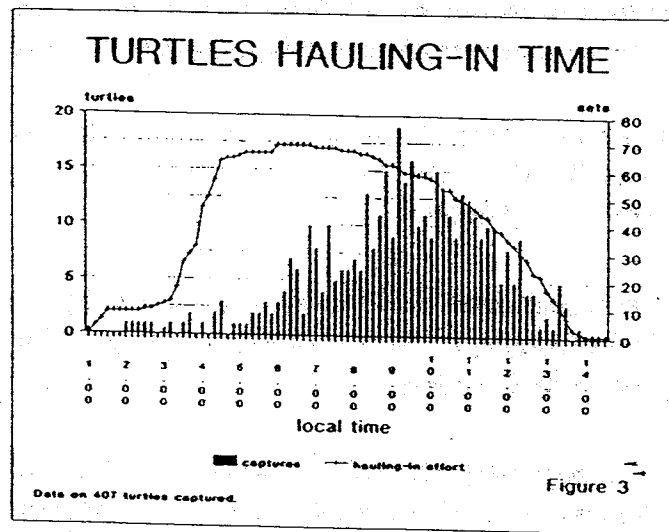
A total of 865 individuals were measured. Of those, 473 correspond to 1990 and 392 to 1991.

Figure 2 shows the carapace length distributions for 1990 and 1991. The range of length values was between 27 cm. and 76 cm., with a concentration of values between 40 cm. and 55 cm. Mean length values were 47.4 cm. for 1990 and 48.8 cm. for 1991.



4.3. Turtles hauling-in time

Figure 3 shows the time of day when turtles were landed, compared to the total period of hauling back the hooks. Despite the fact that the largest effort happens between 0400 and 0800 h (LT), the largest concentration of turtles hauled in happens between 0800 and 1100 h.



4.4. Mortality of hooked turtles.

Table I describes the results of the experience of captivity monitoring of individuals with the hook in the body. It shows: number of turtles kept by year, number of deaths, number of individuals which expelled the hook, number of days in captivity that the hook remained in the body before expulsion, and number of days that hooks have been in the bodies of live individuals still under observation.

MORTALITY ON HOOKED LOGGERHEAD SEA TURTLES (Observations in captivity)				
Year	No. Turtles	Deaths	Hooks expelled	Observations
1986 *	5	1	4	Hook expelled after 53, 82, 109 and 123 days
1987 *	3	2	1	Hook expelled after 285 days
1988 *	6	1	1	Hook expelled after 55 days 4 turtles released without expulsion after 93 days (1) & 123 days (3)
1989 *	7	2	0	5 turtles released without expulsion after 73 days (2) & 116 days (3)
1990	8	2	0	6 turtles released without expulsion after 81 days (2), 98 days (1) & 106 days (3)
1991	9	3	0	6 individuals still under observation.

(*) Mas & Garcia (1990)

TABLE I

5.1. Estimation of total loggerhead incidental catch in this fishery.

Only the data from the months of July and August have been taken into account to estimate the number of loggerhead turtles incidentally captured by the Spanish Mediterranean longline surface fleet. This is the period in which, during both years, there were Greenpeace observers onboard some of the boats. These months are not only those with a larger concentration of boats - at least 60 - but also the months in which, due to the favourable weather conditions, the number of sets per month is higher than average, reaching 20 sets per month and boat.

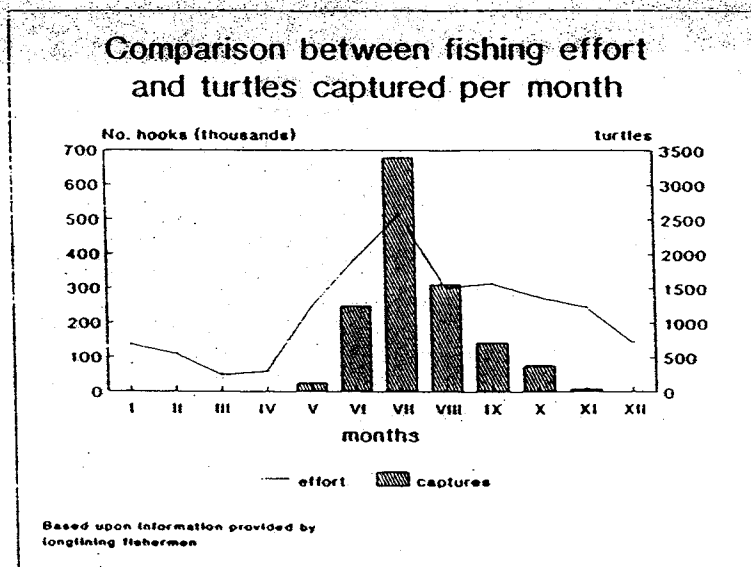
In 1990 in the monitored boats, a total of 655 loggerheads were captured in 67 sets, with a mean catch of 9.8 turtles per day and boat. In 1991, 414 loggerheads were captured in 64 sets, with a mean catch of 6.5 turtles per day and boat.

Based on this information, the incidental catch of 60 boats working during 40 days gives an estimation of 23,520 loggerheads captured by the fleet in July and August 1990. For 1991, the same method gives an estimation of 15,600 turtles.

A second method of estimation can be used taking into account the total number of hooks set in July and August 91 by 10 boats for which Greenpeace observers recorded the number of hooks that were set. 367 turtles were captured with 82,146 hooks in 60 sets, with a mean of 1 turtle every 224 hooks and 1,369 hooks per boat and set.

60 boats setting 1,369 hooks during the 40 fishing days corresponding to those two months represent 3,285,600 hooks set by the whole fleet during that period. The estimated incidental catch would therefore amount to 14,668 turtles.

The data provided by the questionnaires completed by the longline skippers indicates that 66% of the captures of turtles occurs during the months of July and August. Taking this into account, it is estimated that in the whole of 1990, the number of turtles incidentally captured was 35,637 and in 1991 the number ranges from 22,225 to 23,637, depending on which of the two methods of calculation is used for that year.



These high levels of loggerheads by-catches were already suggested by Caminas (1988) and Mayol et al. (1988).

ESTIMATE OF INCIDENTAL LOGGERHEAD CAPTURES IN SURFACE LONGLINES

Author (year)	Argano et al. (1983)	Mayol et al. (1988)	Caminas et al. (not published)	Caminas (1988)	Mas et al. (1990)
Year (estimate)	1978 (650 - 3,750)	1985 (17,712)	1984 (17,092)	1986 (16,697)	1989 (5,935 - 7,568)
			1985 (20,326)	1987 (16,315)	

(*) The fishermen called a strike during the months of June and August of this year. As a result, the level of incidental captures decreased considerably.

5.2. Mortality

An unknown number of individuals are repeatedly captured by the longlines. This has been proven by the fact that some of the observed turtles were carrying other hooks and few of the tagged and released turtles were recaptured in the same area.

The data shown in Table I - which is based on a small number of individuals - seems to indicate that between 20 and 30% of the sea turtles may die after having been captured by a longline. These results are similar to those obtained by Mayol (1990), also with a limited number of individuals.

5.3. Concentration of subadults.

Based on the length distribution shown in figure 2 it can be determined that all the loggerheads captured by this fishery are subadults. Although the ongoing intensive tagging programme to determine the origin and movements of this population is not expected to provide short term results, it is possible to surmise that in the South-Western Mediterranean there is an important concentration of subadult loggerheads.

5.4. Turtle by-catches produced by other fisheries

It is important to remember that the estimation of incidental captures of loggerhead turtles presented in this study deals only with the Spanish swordfish longline fleet. It is known that sea turtle by-catches also occur in relation to the longline fleets of other Mediterranean countries, particularly those of Italy and Malta. The turtle population almost certainly suffer in addition the effects of the activity of a fleet of 30 large Japanese tuna longliners and a similar number of boats of the same type under convenience flags, which enter the Mediterranean following the migration of bluefin tuna (*Thunnus thynnus*).

Mediterranean driftnet, gillnet and trawler fleets, among others, are known to incidentally capture sea turtles in the Mediterranean. Therefore, the total number of sea turtle which are incidentally caught in the Mediterranean is undoubtedly much higher than that suggested by the present study.

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