FIFTH REGULAR SESSION
8-12 December 2008
Busan, Korea

EC – SCIENTIFIC STUDIES ON SEA TURTLE INTERACTION WITH SWORDFISH FISHERIES

WCPFC5-2008/DP32
10 December 2008

SUMMARY OF THE SCIENTIFIC ACTIVITIES FOR THE STUDY OF THE INTERACTION BETWEEN SEA TURTLES AND COMMERCIAL SURFACE LONG-LINE FISHING TARGETING SWORDFISH IN THE ATLANTIC, MEDITERRANEAN, INDIAN AND PACIFIC OCEANS AND TESTS FOR MINIMIZING INTERACTION WITH SEA TURTLES USING CIRCULAR HOOKS.

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1. ABSTRACT.

Several research projects have been developed over the last few years in the EU to test circular hooks and other factors in the surface longliners of European fisheries targeting tuna and tuna-like species. The goal was to reduce the incidental bycatch and mortality of sea turtles. Most of these studies were carried out by independent Scientific bodies of the Member States, but some activities were also directly outsourced to private consultancies by DG Fish-Mare.

The Instituto Español de Oceanografía (Spain), at that time governed under the Ministerio de Investigación y Ciencia, was in charge of several scientific experiments with the support of the Secretaría General del Mar, covering broad areas in the Western Indian, Western Mediterranean, North and South Atlantic and most recently in the SE Pacific Ocean. Over the course of several years different hook types were tested in all of these experiments, including circular (G) and traditional (J) hook types. Most of this information has already been presented either to the SCRS of the ICCAT in recent years for evaluation by this Scientific Committee or to the S.C. of the CTOI. Around 1.5 million hooks were tested and individually observed in the different surveys using surface longline gears in the cited areas.

Additionally, DG Fish-Mare has recently negotiated a contract (nearly 1 M €, Contract FISH/2005-A) to test circular versus a type of traditional hook in the Atlantic and Mediterranean. An external consultant[2] was commissioned to carry out this contract. Although the number of observations was more limited than in other previous surveys, the conclusions proved to be similar despite the statistical limitations owing to the small number of sets tested. Another EU project is now underway. Conclusions are expected sometime in the near future.

<u>The main conclusions reached were consistent in all the European projects cited:</u>

-The use of the circular or semi-circular “G” hooks being tested did not point to a reduction in the interaction with or catch rates of sea turtles in the different areas surveyed where the European fleet engages in the fishery of tuna or tuna-like species vs. the traditional “J” hooks used.

-Increases in these catch rates (internal and external hooking) were generally observed in some circular hooks, particularly in combination with squid used as bait.

-The combination of squid as bait would seem to produce a substantial increase in the internal and external hooking rates of sea turtles in most areas observed, regardless of the hook type used.

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-In the Mediterranean Sea, where the interaction with sea turtles was found to be relatively higher, when a specific type of smaller circular hook was used in some of the experiments, factors other than hook type were significant and clearly observed to be far more crucial in terms of reducing the interaction of fishing activities, involving the use of the longline type-style and squid, with sea turtles and swordfish juveniles.

-On the other hand, circular hooks, especially in combination with squid, generally decrease the catch rates of the most important fish-target species. However, at the same time, they seem to lead to an increase in the catch rates of certain bycatch species in some areas, such as billfish.

This conclusions are not coincident to those reported in other areas-fleets. The 2007 SCRS report present a summary of the conclusions obtained in different experiments all over the world to the ICCAT Commission. The subcommittee of Ecosytems has also considered this issue recently. Some factors were pointed out by the SCRS to explain discrepancies between several experiment carried out in different countries-fleets, using a variety of fishing practices and scientific strategies. The lack of standardization in the types of hooks-baits tested in the different experiments, protocols or schemes used to perform the respective experiments at sea, the different areas-times used, the lack of statistically significant results in some cases, etc., might help to explain the discrepancies obtained among fleets-authors.

On the basis of the experiments carried out on the EU fleets to date, it would not be considered advisable to recommend the use of circular hooks (as a general and practical criterion) to reduce interaction with or mortalities of sea turtles. The opposite effect was even detected in most cases, especially when squid is combined as bait. Additional experiments will be needed to identify other factors that might help reduce these interactions and hooking rates of the fishing activities with sea turtles. However, at this time, this alternate type of circle hook should not be recommended for use by the EU fleet and other alternate and effective options should be evaluated.

2. SUMMARY OF THE SURVEYS CARRIED OUT BY THE INSTITUTO ESPAÑOL DE OCEANOGRAFÍA.

2.a. North and South Atlantic areas:

During 2005 and 2006 tests were conducted in extensive areas of the North and South Atlantic with 3 different types of hooks and 2 baits in order to study their effect on the catch rates of fish, turtles and sea birds. The purpose of the experiment was to achieve the maximum possible interaction on turtles. The results achieved interaction with 435 turtles, 93.3% of which were released alive. Two swordfish long-line fishing boats were used for *480 days at sea in 5 regions of the North and South Atlantic*. A total of around half a million hooks were tested. Two alternative types of hooks (half-circle and circle) were used versus the conventional J type (reference) hook. The hooks were mostly combined with two types of bait: squid and mackerel (reference).

The standard mean CPUE data suggest that the use of the alternative (half-circle and circle) hooks could produce variations in swordfish catch rates (+14% and –11%), depending on the bait that is combined. The combination of circular hooks and squid generally reduces the catch rates of commercial species. However, the catch rates of billfish and sea turtles usually increase with the alternative hooks-bait tested. The circle hook was found to produce losses in swordfish (-11% and -1%) depending on the bait that is combined.

The standardized catch rates for sea turtles suggest that *the use of alternative (half-circle or circle) hooks, maintaining the same type of bait would cause unwanted increases in the external*

and internal hook rates of some of the most prevalent turtles. In addition, *their combination with squid as the bait would give rise to much more significant increases (up to +450%) in the external and internal hooking rates of some of the most prevalent species of sea turtles in the experimental areas.* The use of squid as the bait represented, in general, substantial increases in both the external and internal hooking rates of the most prevalent species of turtles, irrespective of the hook used. There was no interaction with sea birds during the whole experiment.

The conclusion of this experiment was that the semicircular or the *circular hooks tested do not reduce the catch rates* or *the internal and external "hooking" of sea turtles in the broad areas of the North and South Atlantic observed.* An increase in the catch rates of sea turtles was detected using these alternative hook types, especially if these hooks are combined with squid as bait, producing a substantial increase in internal and external hooking rates.

2. b. Mediterranean areas:

The results of the experimentation of different potential items of selectivity (hook type and size, bait type and size, catch depth, etc) related to catches of young swordfish and the incidence and mortality of sea turtles were presented. A total of 676,700 hooks (515 line sets) were observed in the Western Mediterranean. During the year 2005 tests were carried out in extensive areas of the Western Mediterranean with ten different types of hooks (including straight, half-circle and circle) and four types of baits, to study their effect on the catch rates of swordfish, turtles and sea birds.

The conclusion of this experiment was that the standardized catch rates indicate that bait and line type (longline style) were significant factors when it comes to explaining the variability of the incidence rate (CPUE in number of individuals) of sea turtles, with substantial increases for squid (bait) and the American type line. On the other hand, the *type of hook does not appear as a statistically significant factor*. Furthermore, *the interaction of bait with type of line was also highly significant* in the explanation of the variability of turtle incidence rates: the standard rates suggest increases in a range of between +60% for the combination American style longline baited with small mackerel to +127% for the combination traditional "marrajera" type longline baited with small squid. Although sightings of 1,181 individual sea birds, belonging to 10 species, were recorded during the pilot action, no sea birds were caught over the course of the experiment.

2.c. Western Indian Ocean.

A fishing action with surface long-line gear was carried out between December 2004 and December 2005 in waters of the Subwestern Indian Ocean. Five hook types were tested, one occasionally and the others on a continuous basis. The four used in all the fishing operations were two circle and two conventional or J-type hooks. The baits used in all the fishing operations were coarse squid/common squid and mackerel, half of the hooks being baited with each type of bait in each fishing operation. A total of 531,916 hooks were tested in 539 line sets.

Insofar as the incidental catch of sea turtles is concerned, to which special attention was devoted, the results were the capture of only 25 specimens of five different taxa, accounting for a rate of 0.047 turtles per 1,000 hooks or 0.046 turtles per fishing operation or 0.089 % of the total number of specimens caught (28,106 specimens of various species). They were all returned alive to the sea in apparently good condition. It should be mentioned that *only 4* turtles were caught due to biting the hook, whereas the vast majority (19 turtles) were caught as a result of some part of their body becoming entangled in the fishing gear, mainly the front extremities. The way in which the remaining two specimens were caught is unknown.

The conclusions of this experiment on sea turtles indicate that the low incidence of turtle catch rate makes it impossible to carry out statistical analyses on the suitability of a particular type of hook and bait to reduce these incidental bycatches. But as for turtles entangled in the gear, 15 of the 17 specimens were *Dermochelys coriacea* and they were hooked in the area of the longline *baited with squid*.

2.d. S.E. Pacific Areas.

Three types of hooks (2 circular "G" and 1 traditional "J") and 2 baits (mackerel and squid) were tested on two swordfish longliners over a period of 240 days at sea in areas of the South East Pacific Ocean. A total of 356,600 hooks were observed during a total of 183 sets.

"Zone" was the most important statistically significant factor explaining the variability in the catch rates of all the species of fishes analysed. The data would suggest that the overall catch rates in weight of the swordfish target species (*Xiphias gladius*) would be reduced with the alternative hooks by –23.4% and would produce increments in the shortfin mako catch rates (+7.5%) as well as in billfishes (+60%). An increment of more than +12% was observed. in the catch rate of the sea turtle *Caretta* caretta. The use of the alternative bait (squid) instead the conventional one (mackerel) would reduce the catch rates in general for all fish species, except for billfish and *Caretta caretta* with increments of +58% and +27%, respectively. The mean standardized CPUE data also suggest that the use of alternative hook-bait combinations could decrease the catch rates of swordfish between –16% and –36%, depending on the type of bait combined. Nevertheless other fish species as well as the sea turtle *Caretta caretta* would increase their catch rates with increments of +56%. No seabird interaction was recorded during the whole experiment.

The conclusions of this experiment are similar to those obtained in the Atlantic. The catch rates of swordfish are negatively affected by the use of circular hooks and squid as bait, while billfish catch rates could increase, although minor catches of these species were taken to get conclusions. Despite the low degree of interaction with sea turtles during this experiment, the results suggest that *circular hooks, especially in combination with squid, lead to an increase in the catch rates of the most abundant sea turtle species in the area*. The results also suggest that 'bait' is an important factor affecting the incidental catch rates of sea turtles. The circle hooks tested do not appear to reduce the incidental catch rate of the turtle species combined.

3. A STUDY OF THE EVOLUTION OF POST-CATCH LESIONS IN TURTLES

In the framework of the Project being carried out by the Fundación CRAM on the evolution of post-catch lesions in sea turtles, a clinical trial is being conducted on animals with the hook anchored and its evolution over one year.

The Project was initiated in July 2007, so it is still too early to draw any conclusions. What we may affirm, however, is that irrespective of the type of hook, the post-catch lesion survival of sea turtles will be increased if we avoid:

1. tensile stresses and hoisting on board
2. cutting the line flush with the mouth

In the studies we are carrying out at this time based on the analysis of the relation between the type of hook and the lesion that it causes, it has been observed that if points 1 and 2 are complied with, there are no significant differences in the chances of post-catch survival. The studies are based on J4, J5 and C12 size hooks, normally used in the bonito fleet.

4. UE-FISH/2005/28-A. SERVICE CONTRACT SI2.439703. "ASSESSMENT OF TURTLE BYCATCH"

This experiment was contracted by the EU to test circular hooks in the Atlantic and Mediterranean areas. Despite the limited number of days at sea covered, the conclusions are as follows:

-The results do not support the promotion of a shift from the 'J' hooks used in these fisheries to either of the two circle hooks (16/0 0° offset and 18/0 10° offset) tested in the trials, as these hooks did not consistently or significantly reduce turtle catch rates and had negative impacts on swordfish catches in the three regions.

-The greatest reduction in turtle bycatch in surface longline fisheries targeting swordfish in the regions where the trials were carried out would be achieved by replacing mixed squid and mackerel bait by mackerel bait alone.

-Timing a shift in bait type to mackerel during the summer periods (in the Mediterranean), when the incidence of turtles in the fishing grounds of EU vessels is at its highest, may provide the greatest benefits to loggerhead turtle conservation.

-Further investigation of post-hooking mortality in loggerhead turtles is required to determine the side effects of J and circle hook types on the overall impact of these fisheries on turtle populations in the Mediterranean and Atlantic.

-A detailed exploration of gear configurations and current practices in all EU fleets targeting swordfish in the Mediterranean and Atlantic, in addition to a more extensive evaluation of the acceptability within the industry of potential turtle bycatch reduction measures is recommended. Options to be addressed should include a shift to mackerel from mixed or squid baits, in addition to those identified through responses to our questionnaire, such as setting the gear deeper and promoting closed seasons or areas.

-By raising awareness of the availability of kits to de-hook turtles and providing training materials on the use of this equipment, particularly in distant water fleets which are unlikely to be able to board turtles easily due to vessel size and species of turtles caught incidentally (e.g. leatherback turtles), it might be possible to increase the numbers of turtles from which the gear is successfully removed once hooked and potentially aid their survival.

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