Report of the NMFS Technical Gear Workshop to Reduce the Incidental Capture of Sea Turtles in the Atlantic Pelagic Longline Fishery

January 17 - 18, 2001
Silver Spring, Maryland

United States Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service
Highly Migratory Species Management Division

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Welcome and Introduction

The technical gear workshop was called to order on Wednesday, January 17, at 1:00 PM by Dr. Christopher Rogers, Acting Chief of the Highly Migratory Species Management Division, Office of Sustainable Fisheries, National Marine Fisheries Service (NMFS). The workshop was facilitated by Mr. Spencer Garrett, Director of the NMFS National Seafood Inspection Laboratory. Mr. Garrett requested that all the workshop attendees introduce themselves. The agenda (Appendix 1), a list of attendees (Appendix 2), a list of papers provided (Appendix 3), and two submitted comments (Appendix 8 and 9) are attached to this report.

Summary of Recent Events Prompting Workshop

Dr. Rogers explained the objective of this workshop, to facilitate discussion among scientists, fishermen, and interested parties on the technical and scientific aspects of reducing pelagic longline fishery interactions with sea turtles. The Atlantic pelagic longline fishery primarily targets swordfish, yellowfin tuna, or bigeye tuna in various areas and seasons. Although this gear can be modified (i.e., depth of set, hook type, etc.) to target either swordfish or tuna, like other hook and line fisheries, it is a multi-species fishery. Pelagic longline gear sometimes attracts and hooks non-target finfish, such as billfish, and protected species such as marine mammals and sea turtles. NMFS is committed to working cooperatively with the industry to explore ways to reduce these interactions and maintain a viable pelagic longline fishery.

The Endangered Species Act (ESA) requires that federal agencies conducting activities that may affect listed species (species that are listed as threatened or endangered) consult with the NMFS or the U.S. Fish and Wildlife Service (USFWS) under Section 7 of the ESA. In the case of fishery actions, the NMFS Office of Sustainable Fisheries must consult with the NMFS Office of Protected Resources regarding the impacts of these activities on listed sea turtles and any other listed marine species. The Section 7 consultation results in either a jeopardy finding, meaning that the action is likely to jeopardize the continued existence of the species, or a no-jeopardy finding, meaning that the action may adversely affect the species but does not jeopardize its continued existence. A jeopardy finding requires that reasonable and prudent alternatives (RPAs) to the proposed action be identified to ensure that the action would not be expected to reduce the likelihood of both the survival and recovery of the listed species. Due to a new rulemaking on time and area closures that may affect listed species in ways not previously considered and the incidental take statement being exceeded, a consultation was requested in November 1999 to

review the new regulations. The result of this consultation was the June 30, 2000, Biological Opinion, which concluded a jeopardy finding for the Atlantic pelagic longline fishery for loggerhead and leatherback turtles.

After issuing the Biological Opinion, NMFS concluded that further analyses of observer data and population modeling were needed to determine more precisely the impact of the Atlantic pelagic longline fishery on loggerhead and leatherback turtles. Consequently, NMFS reinitiated the consultation process on September 7, 2000. To reduce sea turtle bycatch and bycatch mortality in the interim, NMFS issued an emergency rule on October 10, 2000, that established a limited time and area closure in the Grand Banks and required all pelagic longline vessels to carry on board and use dipnets and line clippers to remove gear from incidentally captured sea turtles. A new Biological Opinion is being prepared and NMFS expects that measures would be implemented for the Grand Banks fishing season in 2001.

Differences Between Swordfish and Tuna Fishing

Dr. John Hoey of the NMFS Office of Science and Technology provided an overview of U.S. pelagic longline fishing and how observer data are used to monitor fishing practices and the resulting catch of target and non-target species. The Captain's Report: Multi-Species Characteristics for the U.S. Atlantic Pelagic Longline Fishery[1] provides similar information in greater detail. Dr. Hoey described general fishing practices and areas where fishing effort is concentrated, with a particular emphasis on oceanographic features that concentrate target species and, in some cases, protected species as well. Some of the techniques and practices for rigging and deploying gear were reviewed to demonstrate that where fishing occurs (area and depth contour), when gear is deployed (season and time of day), and how it is set (type of bait, hooks between floats, gangion and dropper lengths, distance to oceanographic fronts) can affect the rate and composition of species that are caught. Lightstick use, hook size and style, and bait type can also affect species and size selectivity. Fishermen often adjust their operating practices based on what is being caught and the oceanographic features in the region. Generally, to target swordfish, fishermen concentrate effort along the edge of the continental shelf and around the time of the full moon. Dr. Hoey pointed out that in the observer database, a small number of trips had accounted for a disproportionately high number of interactions with protected species (sea turtles or marine mammals) and that these events were associated with oceanographic features (e.g., warm core eddies). To address this problem, he recommended that managers consider the relationship between life history stages of protected species and seasonal oceanographic features and how these relationships influence vulnerability to the fishing gear.

[1] Hoey, J. and N. Moore. 1999. Captain's report: Multi-species catch characteristics for the U.S. Atlantic pelagic longline fishery. August 1999. 78 pp.

Sea Turtle Bycatch Rates and Patterns

Mr. Dominy Hataway from the Pascagoula Laboratory, Southeast Fisheries Science Center, NMFS, presented information concerning the different sea turtle species and their distribution in the north Atlantic Ocean. The species that occur in the same geographic location as pelagic longline operations are primarily the leatherback and loggerhead, with captures of green, hawksbill, and Kemp's ridley turtles occurring less frequently[2]. The leatherback turtle has a large range, from Iceland to the Caribbean, and occurs from Cape Hatteras north in the summer. In the winter, they migrate south to the Gulf of Mexico and the Caribbean. They nest primarily in French Guiana, Surinam, Costa Rica, with some occurrences on the Florida East Coast and the Caribbean. The most encountered hard-shell turtle is the loggerhead sea turtle, which ranges from Newfoundland to Argentina, including the Gulf of Mexico and the Caribbean Sea, and nests primarily in the United States from North Carolina to Florida. The other species of sea turtles are predominantly located south of Cape Hatteras, with the exception of the Kemp's Ridley, which can be found as far north as Nova Scotia.

Mr. Hataway explained the estimates of sea turtle bycatch extrapolated from observer reports provided by the Southeast Fisheries Science Center, NMFS, show a total of 6544 (with a range of 215 to 2233) for loggerheads and a total of 5003 (with a range of 313 to 992) for leatherbacks from 1992 to 1995. About 75 % of the loggerhead sea turtles and 40% of the leatherback sea turtles were caught on the Grand Banks and the peak months of capture were June through November. Pelagic logbook data show high levels of capture in the mid-Atlantic bight, the northeast coastal, and northeast distant statistical sampling areas, with the latter having the highest catch per effort for both loggerhead and leatherback sea turtles. Observer data correlate closely with the logbook information regarding the concentrations and locations of the interactions.

Following Mr. Hataway's presentation, industry participants had questions concerning the locations and levels of protection of sea turtle nests outside the United States, such as islands in the Caribbean and beaches in Oman and the Indian Ocean. They also expressed concern about the new method of analyzing observer data to determine the amount of incidental take of protected species. The accuracy of extrapolating catches and interactions from different times and areas of the Atlantic Ocean to the northeast distant statistical sampling area was questioned due to differing environmental conditions. Finally, industry participants were concerned about the levels of turtle interactions estimated by the new extrapolation method. They feel that under the previous technique, interactions declined as the number of trips declined, which is not the case using the new method. In 1990, there were 400 to 450 swordfish permits; the number of directed swordfish permits declined to 243 permits under the limited access permit system implemented in 1999, with 202 being pelagic longliners. There are currently about 160 active boats and 50 or

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[2] Loggerhead sea turtles may be the only hard-shell sea turtle encountered by U.S. pelagic longliners. Rare reports of other species (2 Kemp's, 3 hawksbill, and 15 green versus 362 loggerheads observed from 1990 to 1999 in the Atlantic Ocean) may represent mis-identifications.

more of those expect to go out of business when the East Coast of Florida, DeSoto Canyon, and Charleston Bump area closures become effective. On the Grand Banks, there were in excess of 60 boats in 1990, but these numbers had declined to 10 to 12 in 2000. Industry participants feel that this trend of decreasing effort is not expressed in the amount of estimated sea turtle takes.

Measures and Research Currently Considered and Implemented in Hawaii

As in the Atlantic Ocean, sea turtle populations in the Pacific Ocean are also depleted. Dr. Richard Brill of the Southwest Fisheries Science Center, NMFS, presented some background information and provided details concerning the research focus of the NMFS Honolulu Laboratory on the interactions between longline gear and sea turtles. In the Pacific, the United States contributes two to three percent of the pelagic longline effort. Under the ESA, the United States is required to initiate conservation measures in fisheries that take endangered species. By conserving sea turtles in domestic fisheries, the United States can encourage other countries to do the same. Dr. Brill proceeded to give a summary of the closed areas imposed by court order to reduce sea turtle takes off Hawaii in the Pacific Ocean.

Currently, the Honolulu Laboratory is developing improved statistical models to estimate sea turtle take and mortality, conducting genetic studies, and analyzing factors associated with pelagic longline interactions. Satellite tags are being utilized to determine the level of mortality following sea turtle release from a pelagic longline interaction. The tags provide location, depth, and water temperature, which can be correlated with observer data on hook location and the condition of the sea turtle at the time of releas,e to attempt to generate the level of survivability for each type of interaction. The future use of pop-up satellite archival tags will allow for a better estimation of sea turtle post-release mortality due to the decreased probability of tag or attachment failure.

Dr. Brill also described a second study testing the effectiveness of dyed bait in mitigating sea turtle take. A simulated longline was strung over a tank containing several sea turtles and untreated squid were presented as were several colors of dyed squid. Preliminary results suggest that the blue dyed baits reduce the attractiveness to sea turtles (64 presentations to non-habituated green turtles before the blue bait was taken). These dyed baits were also presented to tuna to assess fishes' attraction to the bait. No change was determined when compared to untreated baits. Studies are also currently being conducted with artificial baits and chemical additives, and the researchers hope to replicate some of their preliminary findings with captive loggerhead turtles. Dr. Brill concluded his presentation by saying that researchers should further investigate if certain chemicals are repulsive to turtles and then test the chemicals with longline baits to determine if they result in a more effective deterrent.

Industry participants suggested assessing the effectiveness of garlic and natural squid ink as a deterrent. Also, they asked about the attractions for leatherback versus loggerhead sea turtles. Dr. Brill mentioned that leatherbacks may be attracted to lightsticks, the floats, or jellyfish entangled on the line. As loggerheads are also entangled near floats, it could be beneficial to

assess the impacts of hooks near floats and float color. Industry participants suggested modifying the float shape to resemble a predator, examining the effect of using mackerel instead of squid bait, or the potential for acoustic deterrents.

Preliminary Azores Study

The following study, "Preliminary Results of an Experiment to Evaluate Effects of Hook Type on Sea Turtle Bycatch in the Swordfish Longline Fishery in the Azores,"[3] was summarized by Ms. Barbara Schroeder, National Sea Turtle Coordinator with the Office of Protected Resources, NMFS, as the agency's technical representative for the study contract.

A commercial swordfish longline vessel was contracted to conduct the experiment in the waters around the Azores. The experimental set-up consisted of the following: up to 100 sets were to be conducted between 15 July – 15 December 2000 (approximately 20 sets per month); 1500 hooks per set; bait was squid. Three hook types were tested: Straight J (Mustad # 76800 D 9/0), Reversed/Offset J (Mustad #76801 D 9/0), and Circle (Mustad # 39960 ST 16/0). The hooks were individually alternated along the set (for example, A, B, C, A, B, C, A, B…). There were 8 hooks between the buoys so that the relationship between the hook type and hook position on the gear varied.

Preliminary Results:

- 237 turtles were captured in 93 sets (232 loggerheads, 4 leatherbacks, and 1 green turtle)
- Catch rate was calculated as 2.5 turtles per set (1.7 turtles per 1000 hooks); or 3.8 turtles per set for sets with turtles (2.5 turtles per 1000 hooks)
- The size range of loggerhead turtles caught was significantly different (Kolmogorov-Smirnov test, $p = 0$) from the overall loggerhead population in the area (see figure below). The size range of loggerheads caught represents the largest turtles in the area.
- There was no significant difference in the total numbers of turtles caught by each hook type (Chi-square test, $p = 0.136$)
- There was a significant difference among the 3 hook types in the location of the hooks in the turtles (Chi-square test, $p = 0$): 57% of the loggerheads caught on J hooks were hooked in the throat; 81% of the loggerheads caught on Circle hooks were hooked in the mouth. This difference may have important implications for sea turtle mortality.
- There was a significant difference among the hook types in the numbers of swordfish caught (Chi-square

[3] Authors: Alan Bolten, Helen Martins, Eduardo Isidro, Rogerio Ferreira, Marco Santos, Ana Giga, Brian Riewald, and Karen Bjorndal. Archie Carr Center for Sea Turtle Research, University of Florida, Gainesville, FL, USA and Department of Oceanography and Fisheries, University of the Azores, Horta, Azores, Portugal.

test, p = 0). The Circle hook caught 262 swordfish compared with 381 for the J hook.

- The effect of hook position along the mainline on turtle bycatch was not significant (Chi-square test, p = 0.518). There was a trend for increased numbers of loggerheads to be caught on the hook closest to the buoy line but this was not significant.

- Based on satellite telemetry, there are significant differences in the behavior of hooked turtles vs. controls with respect to dive depth and dive time.

Recommendations for future research:

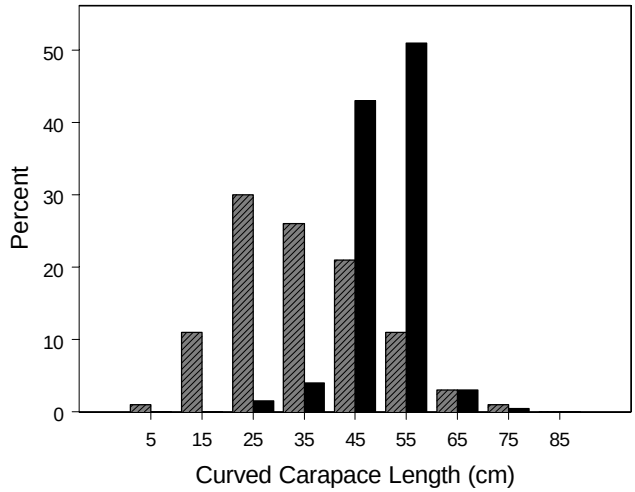
- Test for the effect of bait (squid vs. mackerel) on the catch of the target species and turtles

- Test for the effect of a larger Circle hook 18/0 vs 16/0 on the catch of the target species and turtles

- Test for the effect of offset Circle hooks on the catch of the target species and turtle

- Test for the effect of a stiff leader to reduce leatherback entanglement

- Test for effect of light sticks on the catch of the target species and turtles



Hatched bars = Azores, n = 1692;
from Bjorndal, Bolten & Martins. 2000. Marine Ecology Progress Series 202:265-272.

Solid bars = Longline Experiment 2000, n =224

Kolmogorov-Smirnov Test, KS = 0.6522
Significant, p = 0

The discussion following the presentation concerned the type of gear used and the choice of study location. Several of the industry participants felt that because the gear used for pelagic longlining in the Azores is not identical to gear used by U.S. fishing vessels, the results are not applicable to the U.S. fishery. In addition to questions concerning the gear specifications, there was a discussion concerning the choice of study location. Ms. Schroeder explained to the group that loggerhead turtles inhabiting the eastern Atlantic originate from U.S. nesting beaches and therefore their conservation is critical to the recovery of the U.S. loggerhead population. Incidental capture of loggerheads in the Azores fishery is a threat to the recovery of the loggerhead population and conducting gear experiments in the Azores fishery to reduce this incidental capture is an important recovery action. Bycatch rates for loggerheads in the Azores fishery were sufficient to allow for a statistically rigorous experiment testing three hook types.

Preliminary Gear Design Results

Mr. John Watson of the Pascagoula Laboratory, Southeast Fisheries Science Center, NMFS presented preliminary results of the development of line clipping and dehooking prototypes for the pelagic longline fishery. To improve the function and operation of the prototype devices, NMFS staff have met with longline gear manufacturers and field tested line clipping prototypes. The developments to date are pictured in Appendix 4 and include: two mechanical line cutters, an inline de-hooker, a rotating de-hooker, a pneumatic hook and line cutter, and an electric line cutter. Before the designs can be finalized, more input from industry is needed regarding the feasibility and practicality of some of the prototypes.

Some of the gear parameters to be evaluated in the future include making the branch lines longer than the float lines, and incorporating less flexible branch lines, guarded hooks, corrodible hooks, light stick modifications, changing bait type, decoys and/or attractants, deterrents, and weights on branch lines. The goal of the work is to evaluate and improve methods to reduce both post-release mortality and the level of incidental capture of sea turtles. Mr. Watson concluded that, ideally, some of these methods could be exported to other countries engaged in pelagic longlining to help decrease the overall number of sea turtles captured globally.

Evaluation of Research and Management Options

After reviewing the list of recommendations presented at previous workshops (Appendix 5), industry participants offered to meet as a group after the workshop adjourned on the first day to discuss and narrow the scope of issues for consideration to those that they considered feasible or realistic. They expressed concern about how the results of the discussion would be used in future regulatory actions and wanted more time to evaluate each option. Also, industry participants stressed the need for socio-economic impact analyses prior to the implementation of any of these options.

The options that were presented by the industry participants on the second day of the meeting were compiled in a table (Appendix 6) during the meeting and assigned a priority level. Industry participants indicated that their highest priority activity involves assessing measures that have already been implemented, such as the effect of the dipnets and line clippers, and examining proposed measures for effectiveness and economic impact. They believe that research needs to be conducted to determine additional methods for avoiding or minimizing harm to sea turtles. It was felt that some of the measures had the potential to be implemented in the short term, such as moving after the catch of a sea turtle, using circle hooks in the tuna fishery, educating the pelagic longline fleet on avoiding areas with high sea turtle concentrations, communication among the fleet when sea turtles are encountered, requiring gangions to be longer than float lines, and developing dehooking devices. Many comments given during this discussion focused on what avenues might be feasible and what might require more research or attention.

Workshop participants discussed corrodible and circle hooks. Pelagic longline gear

manufacturers indicated the need for specifications on what type of performance is needed and how quickly the hook must corrode before they can produce an effective product. Also, information concerning any sea turtle factors that might speed corrosion would be helpful. Several vessel captains in attendance mentioned that circle hooks may cause more harm to captured sea turtles. They commented that while the circle hooks may not hook in the throat as frequently, they are more difficult to remove, and if lodged in the beak, can cause chaffing damage. Several of the captains in attendance said that more research is needed to assess the requirements for corrodible hooks and the impact of circle hooks on sea turtles.

The effect of oceanography on sea turtle distribution was discussed in conjunction with a requirement that vessels move a certain distance following the incidental take of a sea turtle. Several of the industry participants stated that it is difficult to determine what constitutes an adequate distance to move following a sea turtle interaction. Generally, the captain will target colder water, but this varies depending on environmental conditions. They felt that it is not possible to determine accurately a specific temperature range that will allow pelagic longlines to avoid sea turtles completely. In some cases, a boat might be able to move several hundred feet to avoid an interaction, while in other cases it may have to move many miles. They said that more study on the oceanography of these areas via satellite would allow researchers to get a better picture of the natural environment and its impact on sea turtles. For example, wave height and plankton concentrations may impact turtle movements similar to sea surface temperatures. They recommended that NMFS request that satellite data be archived because private companies do not save it without a request.

Several non-industry participants mentioned the need for more sea turtle-specific resources to improve the current level of information available. By dedicating more funding to this area, a long-term interdisciplinary study conducted by U.S. fishermen on U.S. fishing grounds could be supported. A summary of potential funding sources for these type of experiments is contained in Appendix 7. By conducting experiments with fishing behavior and gear modifications, they believe that managers can assess what measures can be implemented to protect sea turtles without severely damaging the economic viability of the affected fishermen. They also said that any developed technology that is found to be effective should be exportable to help reduce the number of incidental sea turtle takes internationally.

Following the discussion concerning the revised list of options addressing the interactions between the pelagic longline fishery and sea turtles, Alberto Dominici of Hydrosphera (a sea turtle rehabilitation center in Italy) gave a presentation on sea turtle interactions by the Italian longline fleet. The rehabilitation center provides veterinary care to sea turtles taken by the longline fleet. He presented cases involving sea turtles that died from ingested hooks as well as cases where the hook passed through without apparent harm. While there is uncertainty about the frequency of this occurrence, he would like to find methods to minimize the number of interactions in general.

Conclusion

NMFS believes that the workshop resulted in a valuable exchange of ideas between fishery participants, gear manufacturers, environmental constituents, and agency scientists and managers. The workshop successfully highlighted several gear modification and configuration research priorities to be addressed in the future. NMFS may consider these comments in future research on technology and fishing methods to reduce the incidental catch of sea turtles in pelagic longline fisheries. To help in determine the degree of sea turtle injury that results from fishing interactions, NMFS plans to host a workshop to examine the direct and indirect effects of longline interactions on sea turtles.