Pelagic Longline Fishery-Sea Turtle Interactions

Proceedings of an Industry, Academic and Government Experts, and Stakeholders Workshop held in Silver Spring, Maryland, 24-25 May 1994

Compiled by

Phil Williams
Paul J. Anninos
Pamela T. Plotkin
Karen L. Salvini

U.S. Department of Commerce
National Oceanic and Atmospheric Administration
National Marine Fisheries Service

NOAA Technical Memorandum NMFS-OPR-7
February 1996

This report documents the results from a workshop that examined the issue of incidental capture of threatened and endangered sea turtles by pelagic longline fisheries. It is a compilation of formal presentations by, and facilitated discussions among, government and nongovernment scientists, resource managers, and fishing industry representatives. This report documents the preliminary results and has not undergone external scientific review. The interpretation of the information presented at the workshop represent the opinions and views of the participants and not necessarily those of the National Marine Fisheries Service, NOAA.

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Compiled by

Phil Williams
Office of Protected Resources
National Marine Fisheries Service
Silver Spring, MD 20910

Paul J. Anninos
Office of Operations, Management,
and Information
National Marine Fisheries Service
Silver Spring, MD 20910

Pamela T. Plotkin*
Karen Salvini
Office of Protected Resources
National Marine Fisheries Service
Silver Spring, MD 20910

*Current address:
Drexel University
Department of Bioscience and Biotechnology
32nd and Chestnut Streets
Philadelphia, PA 19104

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U.S. Department of Commerce
Ronald H. Brown, Secretary

National Oceanic and Atmospheric Administration
D. James Baker, Under Secretary for Oceans and Atmosphere

National Marine Fisheries Service
Rolland E. Schmitten, Assistant Administrator for Fisheries

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Introduction and Workshop Goals

This workshop was convened to gain a better understanding of incidental capture and injury or mortality of threatened and endangered sea turtles in pelagic longline fisheries, and to identify ways to reduce, prevent, or mitigate this incidental capture. The purpose was to assist the National Marine Fisheries Service (NMFS) in carrying out its marine resource conservation responsibilities and statutory mandates under the Endangered Species Act (ESA) and the Magnuson Fishery Conservation and Management Act (FCMA).

NMFS has diverse responsibilities for marine resources including the conservation and management of commercial fisheries identified under the FCMA, and conservation and recovery of marine species listed as threatened or endangered under the ESA. These responsibilities overlap when listed species, such as sea turtles, are taken incidentally in commercial fishing operations. With some exceptions, the ESA prohibits the take of sea turtles. Take is defined in the ESA as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or to attempt to engage in any such conduct." Takes can be authorized through permits, regulations, or the consultation process under Section 7 of the ESA.

Throughout the world, longline fishing gear is hooking and entangling sea turtles. Although the full impacts of longline fishing on sea turtles is not well documented, it is estimated that the levels of incidental capture and mortality are high enough to affect the recovery of threatened and endangered sea turtles. Both a voluntary observer program and logbook records from the Hawaii-based longline fishery suggested that large numbers of sea turtles were being taken incidentally in the Pacific. Subsequently, NMFS initiated a Section 7 consultation, established a mandatory observer program to document the incidental takes, and began to implement a research plan to measure the impacts of hooking on sea turtles.

In the Atlantic and Gulf of Mexico, a number of voluntary and mandatory observer programs that have been in place for several years have recently reported large estimates of incidental sea turtle takes. The estimated impacts were large enough to conclude that current longline fishing operations in the Atlantic and Gulf of Mexico may affect, or even jeopardize the continued existence of certain species, such as the endangered leatherback sea turtle, *Dermochelys coriacea*.

The workshop participants included NMFS researchers in charge of observer programs and NMFS resource managers and technical experts, who were to consider the observer information and to help determine what can be done to reduce or mitigate the incidental capture of sea turtles in longline fisheries. Of equal importance in this discussion were the participation of representatives of the longline fishing industry, who would be affected by any action taken by NMFS. We hoped that what we learned during this workshop would assist NMFS in the identification of those measures necessary to ensure that longline fisheries can continue in a manner compatible with the protection of threatened and endangered species. We hoped that the workshop would result in recommended research and

management actions for NMFS to consider as it reinitiates Section 7 ESA consultation on the Atlantic and Gulf of Mexico longline fisheries. Further, we hoped that this exercise would be a prelude to the development and implementation of bilateral or multi-lateral agreements on sea turtle conservation measures in longline fisheries worldwide. International action is necessary because the U.S. effort represents only a small portion of the worldwide longline fishing effort.

Workshop Design and Methods

The NMFS Office of Protected Resources convened this workshop to identify the problems associated with longline fishery-sea turtle interactions. Four specific workshop objectives guided the facilitator and participants through their exploration of ideas which might lead to the resolution of these problems:

1. To share information on the biology of sea turtles and the interactions between sea turtles and the longline fishing industry.

2. To engage diverse viewpoints on the issues related to longline fishery-sea turtle interactions.

3. To identify problems and issues which relate to the prevention, reduction, and mitigation of incidental capture.

4. To identify strategies and options which could be employed to prevent, reduce, and mitigate incidental capture.

The workshop was held in Silver Spring, Maryland (NMFS Headquarters) on May 24-25, 1994 and was attended by 15 experts, representing perspectives of commercial longline fishermen, industry trade associations/lobbyists, government and nongovernment scientists, and resource managers with expertise in the pelagic longline fishery, fisheries by-catch issues, sea turtle biology, and protected species management (Appendix I). In addition to the 15 participants, there were other interested parties invited to attend the workshop to observe the dialogue of the participants.

The first phase of the workshop was devoted to technical presentations (A selection of these are summarized beginning on Page 9) given by each of the workshop participants. The presentations provided background information and served as a useful foundation for the subsequent workshop phases. The second phase involved nominal group technique, which allowed for balanced participation among all group members. The format was as follows:

1. Trigger Question: A trigger question was presented to the group. The group then silently generated ideas in response.

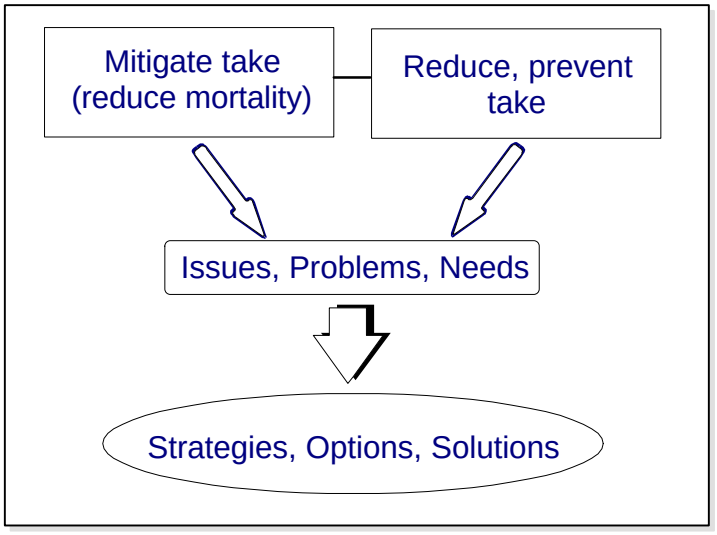
2. Sharing of Ideas: In a round-robin process, each participant stated one idea on their list and the facilitator recorded the idea on a flip chart in plain view of all participants. The facilitator proceeded around the table until all participants had contributed all ideas on their respective lists. This process allowed equal participation, separated the idea from the contributor, and encouraged the "hitchhiking" of ideas or the stimulation of new ideas after seeing the contributions of others. The final list of ideas had already started to become a depersonalized group product.

3. Clarification of Ideas: The contributor of each idea was asked to clarify its meaning. This was an opportunity to hear others' views on the idea but was primarily aimed at producing a clear understanding of each idea.

4. Voting on Ideas: Sometimes referred to as multi-voting, this was an opportunity for group members to express their individual preferences for the relative importance of the ideas which had been generated and clarified. Each participant had a total of five votes to cast, in order of priority -- their "favorite" idea received a vote of "5", second favorite idea received a "4", etc. This technique helped to rank the ideas, and allowed for aggregation of the individual judgements to form a "group" judgement. Results of these votes gave some insight into the development of a group consensus.

5. Discussion of preliminary vote: After votes were tallied and publicly displayed, the group had an opportunity to explore and discuss voting patterns. These discussions revealed new ways of looking at ideas and provided an initial understanding of where the group was converging. This phase also revealed any remaining misunderstanding or misinformation.

The remainder of the workshop followed the general model depicted below:



Workshop Content / Results

Three trigger questions were asked during the workshop. These were:

1) "In the context of **reducing, preventing, and mitigating** longline-sea turtle incidental takes, what are the **problems or issues** which must be addressed?"

2) "In the context of **mitigating** longline-sea turtle incidental takes, and reducing mortality, what are the **options, strategies, and methods** which might be employed?"

3) "In the context of **reducing or preventing** longline-sea turtle incidental takes, what are the **options, strategies, and methods** which could be employed?"

The first question sought to initiate dialogue on the range and depth of problems which might need to be solved in order to reduce, prevent, and mitigate incidental sea turtle takes. The second question was intended to invoke suggestions for lessening the impacts to sea turtles when incidentally taken by longline gear, while the third question asked for ideas to prevent such incidental takes from occurring.

1) "In the context of reducing, preventing, and mitigating longline-sea turtle incidental takes, what are the problems or issues which must be addressed?"

This trigger question resulted in a list of 62 issues (Page 67) . This listing of problems and issues provided an early and initial discussion of ideas, many of which were mentioned during the technical presentations (See Page 9). Group members did not vote on this list since the primary purpose was to get the participants actively and immediately engaged in discussing problems, needs, and issues.

There were a wide range of ideas generated, from the lack of information on sea turtle diet and feeding habits to the lack of data on the level of incidental take that would adversely affect sea turtle populations. Most of the problems identified in this phase pertained to the lack of information or the need for additional research on hooking and mortalities. The participants wanted more information on the different longline gear types available, historical documentation of changes in gear type, techniques for handling hooked sea turtles, and clear definitions of hooking, entanglement, and animal condition. In addition, it was suggested that more research was needed to determine why sea turtles are attracted to longline gear, the seasonality of turtle takes, the effects of different bait on hooking rates, the relative frequencies of entanglement, the environmental factors associated with multiple sea turtle captures, and any correlations between gear type and sea turtle interactions/mortality.

2) "In the context of mitigating longline-sea turtle incidental takes, and reducing mortality, what are the options, strategies, and methods which might be employed?"

This trigger question resulted in 52 responses (Page 70). Voting on this suite of ideas produced several revealing results (Page 76). Almost half of the group voted for idea #3, "Provide comprehensive, yet workable, retrieval, de-hooking, and/or release techniques to the fisherman." The following is a summary of the results:

7 votes:
3. Provide comprehensive, yet workable, retrieval, de-hooking, and/or release techniques to the fisherman.

4 votes:
2. Initiate gear research project to develop release and de-hooking techniques.
4. Provide education and advisory services for pelagic fisheries that encounter sea turtles.
16. Analyze existing gear description data to determine if a correlation exists between gear type and sea turtle mortality.
20. Implement tracking studies to determine fate of longline released sea turtles.

3 votes:
10. Temporary restriction on brand new entrants into the fishery that have no experience.
13. Require buoy line-to-leader-ratio to be a minimum of one-to-one.
15. Establish a panel consisting of researchers, fisherman, veterinarians, and managers to develop protocol for handling and releasing hooked sea turtles.

Another view of this list is presented in order of priority as revealed by the sum of the ranked votes cast by individuals. Taken in this light, idea #3 is still the most popular:

Rank (Score)	**Idea number and description [vote tally]**	
22	3.	Provide comprehensive, yet workable, retrieval, de-hooking, and/or release techniques to the fisherman. [5,5,4,4,2,1,1]
14	4.	Provide education and advisory services for pelagic fisheries that encounter sea turtles. [5,5,2,2]
12	10.	Temporary restriction on brand new entrants into fishery that have no experience. [5,5,2]
12	13.	Require buoy line-to-leader-ratio to be a minimum of one-to-one. [5,4,3]
12	15.	Establish a panel consisting of researchers, fisherman, veterinarians, and managers to develop protocol for handling and releasing hooked sea turtles. [5,4,3]

11	20.	Implement tracking studies to determine fate of longline released sea turtles. [4,3,2,2]
9	2.	Initiate gear research projects to develop release and de-hooking techniques. [4,3,1,1]
8	14.	Need to prioritize research and mitigation strategies within this fishery and between other fisheries. [5,3]
8	28.	Need a NMFS/industry working group to implement research and mitigation strategies. [4,4]

These high-priority ideas reveal an emphasis on communication-related issues, highlighting the need for improved communication between NMFS scientists and industry with respect to gear technology, sea turtle handling techniques, and especially in collaborative planning and prioritizing research and mitigation strategies.

3) "In the context of <u>reducing or preventing</u> longline-sea turtle incidental takes, what are the <u>options, strategies, and methods</u> which could be employed?"

The final workshop phase focused on identification and discussion of measures which could be used to prevent longline fishery-sea turtle interactions/incidental takes. The 40 responses to this question are found on Page 73. Voting results for this list of ideas is presented on Page 77. Ideas receiving 3 or more votes by workshop participants follow below:

5 or more votes:

1. No new entrants in the fishery -- U.S., Atlantic-wide.
14. Study gear: mono, color and size, buoys, high flyers, radio beacons, polypropylene rope, crimps, snaps, leads, glow beads, plastic squids and skirts, rattlers, and other ornaments (also, see #6).
37. Require international compliance with U.S. conservation measures.

4 votes:

6. Experiment both in lab and field with various gear/bait assemblies to reduce or eliminate attractiveness to sea turtles.
9. Make past longline fishery-sea turtle interaction data available to construct predictive models of sea turtle hot spots.
13. Develop and ground truth predictive models based on physical oceanography and sea turtle biology, sea turtle distribution patterns by species and size class, in order to close fishing areas where sea turtle densities are high.

3 votes:

10. Develop visual, chemical, and acoustical methods to deter sea turtles from longlines.
20. Encourage fishermen to communicate interactions in order to alert other boats.
40. Develop an educational program to encourage and promote voluntary efforts by fishermen to avoid areas of sea turtle interaction.

These priorities stress a desire for communication and sharing of information among scientists and fishermen. Also important are limited entry, management compliance, gear technology education and advancement, and the development and distribution of detailed information on fundamental causes of interactions. The following is the list presented by the sum of the ranked votes:

Rank (Score)	**Idea number and description [vote tally]**	
27	1.	No new entrants in the fishery -- U.S., Atlantic-wide. [4,5,4,5,4,5]
16	14.	Study gear: mono, color and size, buoys, high flyers, radio beacons, polypropylene rope, crimps, snaps, leads, glow beads, plastic squids and skirts, rattlers, and other ornaments (also, see #6). [5,3,2,3,3]
13	10.	Develop visual, chemical, and acoustical methods to deter sea turtles from longlines. [5,3,5]
12	6.	Experiment both in lab and field with various gear/bait assemblies to reduce or eliminate attractiveness to sea turtles. [4,5,1,2]
11	37.	Require international compliance with U.S. conservation measures. [4,1,1,3,2]
11	40.	Develop an educational program to encourage and promote voluntary efforts by fishermen to avoid areas of sea turtle interaction. [5,5,1]
10	9.	Make past longline sea turtle interaction data available to construct predictive models of sea turtle hot spots. [3,4,1,2]
9	13.	Develop and ground truth predictive models based on physical oceanography and sea turtle biology, sea turtle distribution patterns by species and size class, in order to close fishing areas where sea turtle densities are high. [2,2,4,1]
9	29.	Inform fishermen on a real-time basis about sea turtle migration patterns and areas of possible and/or current interactions. [5,4]

Summary and Conclusions

The workshop resulted in the sharing of different perspectives and new ideas on the issue of incidental capture of threatened and endangered sea turtles by pelagic longline fisheries. The strategies developed form a basis for solving the problems associated with longline fishery-sea turtle interactions. These strategies will help NMFS identify those measures necessary to ensure that longline fisheries continue in a manner compatible with the protection of threatened and endangered species. NMFS will be able to use the information from this workshop in conducting consultations on longline fisheries, setting research priorities, communicating with its constituents on the issues, and promoting sea turtle conservation by fisheries in other nations.

Recommendations

The workshop participants agreed on numerous measures to reduce or prevent incidental capture of sea turtles in longline fisheries and mitigate the effects of such take. The most popular ideas in preventing captures included closing longline fisheries to new entrants, studying various gear types, and ensuring international compliance with U.S. conservation measures. The most popular measure to mitigate captures was to provide comprehensive yet workable retrieval, de-hooking, and release techniques to fisherman.

All of the ideas resulting from this workshop deserve further consideration. Follow-up workshops would allow the opportunity to build on the wealth of information provided by this workshop, and develop the ideas into a more focused plan of action. In fact, a workshop on the care and handling of hooked turtles was held this past year in Hawaii, and the results of that workshop are now available.

Acknowledgments

Colleen Coogan provided the idea for this dialogue between NMFS and the fishing industry and participated in the workshop. Phil Williams and Pamela Plotkin organized and convened the workshop. Paul Anninos guided the development and planning of the workshop, managed the workshop process and agenda, and also moderated and facilitated the workshop discussion. Beverly Johnson and Karen Salvini provided logistical and administrative support. We would like to thank Bill Fox for his support of this workshop and Charles Karnella for his “keynote address.” Finally, we would like to thank all of the workshop participants for their contributions and assistance during the workshop and during completion of this workshop report.

Section 7 of the Endangered Species Act and Pelagic Longline Fisheries

Colleen C. Coogan

U.S. Department of Commerce
National Marine Fisheries Service
Southeast Region
9721 Executive Center Dr.
St. Petersburg, FL 33702

The National Marine Fisheries Service (NMFS) has diverse responsibilities, including the management of commercial fisheries and oversight of marine species listed as threatened and endangered under the Endangered Species Act (ESA). These components of NMFS responsibilities sometimes come into apparent conflict when listed species are taken incidentally to commercial fishing operations. The purpose of this workshop is to discuss specifically the incidental capture of listed sea turtle species in pelagic longline fisheries. I am going to briefly describe the requirements of Section 7 of the ESA as it relates to the management of pelagic longline fisheries.

The ESA

Five species of sea turtles are found in U.S. waters in which pelagic longline fisheries occur. Leatherbacks, *Dermochelys coriacea*; hawksbills, *Eretmochelys imbricata*; Kemp's ridleys, *Lepidochelys kempii*; and Florida green turtles, *Chelonia mydas*; are listed as endangered under the ESA. Because we cannot distinguish Florida greens from others, all green turtles in U.S. Atlantic waters are treated as endangered. The loggerhead turtle, *Caretta caretta*, listed as threatened, is the most common sea turtle species. The ESA defines endangered as in danger of extinction throughout all or a significant portion of its range. Threatened species are those likely to become endangered within the foreseeable future throughout all or a significant portion of their range.

The ESA prohibits, with some exceptions, the take of endangered species of sea turtles. Take is defined as harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in such conduct. Takes can be authorized through scientific research permits, regulations, or through Incidental Take Authorization issued through the ESA Section 7 consultation process.

Section 7

My main objective is to explain the Section 7 process, and discuss the need to reinitiate consultation on pelagic longline fisheries at this time. In addition to consultation requirements, however, I would like to remind you that NMFS is responsible for promoting the recovery of listed species through implementation of tasks identified in Recovery Plans, and in any other methods under NMFS purview. The Section 7 consultation process is schematically illustrated in Figure 1. In brief, Section 7 of the ESA states that Federal agencies are required to insure that actions they conduct, fund, or permit, are not likely to jeopardize the continued existence of any listed species. The consultation process begins when the action agency determines whether or not listed species are present in an area in which a Federal project (or one permitted or funded by a Federal agency) is conducted. In this case, pelagic longline fisheries are permitted by NMFS, and fishery operations occur in areas in which listed species of whales and sea turtles occur.

The action agency makes a determination regarding whether or not the activity has an affect on listed species. Incidental takes of listed species have been documented in longline fisheries in Gulf of Mexico and Atlantic waters, therefore this Federally permitted activity "**may affect**" listed species. A "may affect" determination results in a more detailed, "formal" consultation process. NMFS requests an assessment of the impacts of the project from the "action" agency. Formal consultation is initiated when the assessment of impacts is submitted to NMFS. NMFS considers the assessment, as well as any additional material that constitutes the best available information, to prepare a **Biological Opinion**. The Biological Opinion represents the agency opinion on the impacts of the action, and concludes with a finding regarding whether or not the action may jeopardize the continued existence of any listed species.

There are two possible conclusions to a Biological Opinion. The most common conclusion is that the activity may affect, but is **not likely to jeopardize**, the continued existence of any listed species (or critical habitat). If listed species may be taken incidentally through the activity, the Biological Opinion may include an **Incidental Take Statement**. The Incidental Take Statement allows a low level of incidental take, and has associated **reasonable and prudent measures** that must be taken to assess, reduce and minimize incidental take. Incidental takes of listed species are illegal if the reasonable and prudent measures are not implemented. **Conservation recommendations** are also given in most Biological Opinions. These recommendations generally list tasks identified in Recovery Plans for which the action agencies are responsible. Additional studies needed to fill data gaps identified in the consultation may also be recommended.

Occasionally, a **jeopardy** opinion is issued. Federal agencies cannot conduct, fund or permit activities that may jeopardize the continued existence of listed species (or critical habitat) without getting an exemption through a specially formed committee. Therefore a jeopardy opinion contains "**reasonable and prudent alternatives**" to the proposed action

that must be taken to allow the action to legally occur by reducing impacts and avoiding jeopardy to listed species. Incidental take statements, reasonable and prudent alternatives, and conservation recommendations are also issued with jeopardy opinions.

Consultation on Longline Fisheries

Consultations on pelagic longline fisheries have been conducted as part of the preparation of the target species' management plans (shark, swordfish) or the promulgation of regulations (bluefin tuna). Because problems and related measures are associated primarily with gear types, rather then target species, consultations will be conducted on similar gear types. Although pelagic and coastal gillnets, and coastal longline fisheries will also be coming under ESA Section 7 scrutiny, this discussion will be confined to reinitiation of consultation on pelagic longline fisheries.

Background: Formal consultations on the swordfish and shark fisheries, and associated Fishery Management Plans, were conducted in 1991. A formal consultation on the bluefin tuna fishery and associated regulations was conducted in 1992. Those consultations considered the impacts of management measures, as well as the effects of both longline and gillnet gear on listed species. The consultations concluded that management measures associated with these fisheries were not likely to adversely affect listed species. The use of pelagic longline and gillnet gear was determined to have adverse impacts on listed species, but based on the best available information, were considered unlikely to jeopardize the continued existence of any species.

Because of the limited available data and the continued low level of observer effort in pelagic longline fisheries, the level of incidental take authorized in the Biological Opinion issued on highly migratory species fisheries was very low. The Incidental Take Statements authorized the documented incidental take by injury or mortality of 2 Kemp's ridleys, 2 hawksbill, 4 greens, 4 leatherbacks or 10 loggerheads for each fishery (including the gillnet components of the fisheries). Observer data were not collected in a manner that allowed the precise determination of the condition of animals upon release from pelagic longline gear. However, these incidental take levels were established after review of the annual number of incidental takes observed at existing observer effort: from two to 29 sea turtles were observed taken incidentally in pelagic longline gear in any year for which reports were received between 1979 and 1990, and 94% were released alive. Three loggerheads were reported dead in one year. Fewer injuries or mortalities were reported in other years. Additionally, an endangered sperm whale was taken incidentally on longline gear, although it was alive after the encounter.

New information: Observer effort was initiated by the Southeast Fisheries Science Center (SEFSC) in mid-1992. In 1992 and 1993, the Northeast Fisheries Science Center and SEFSC pelagic longline (all fisheries) observers reported a total of:

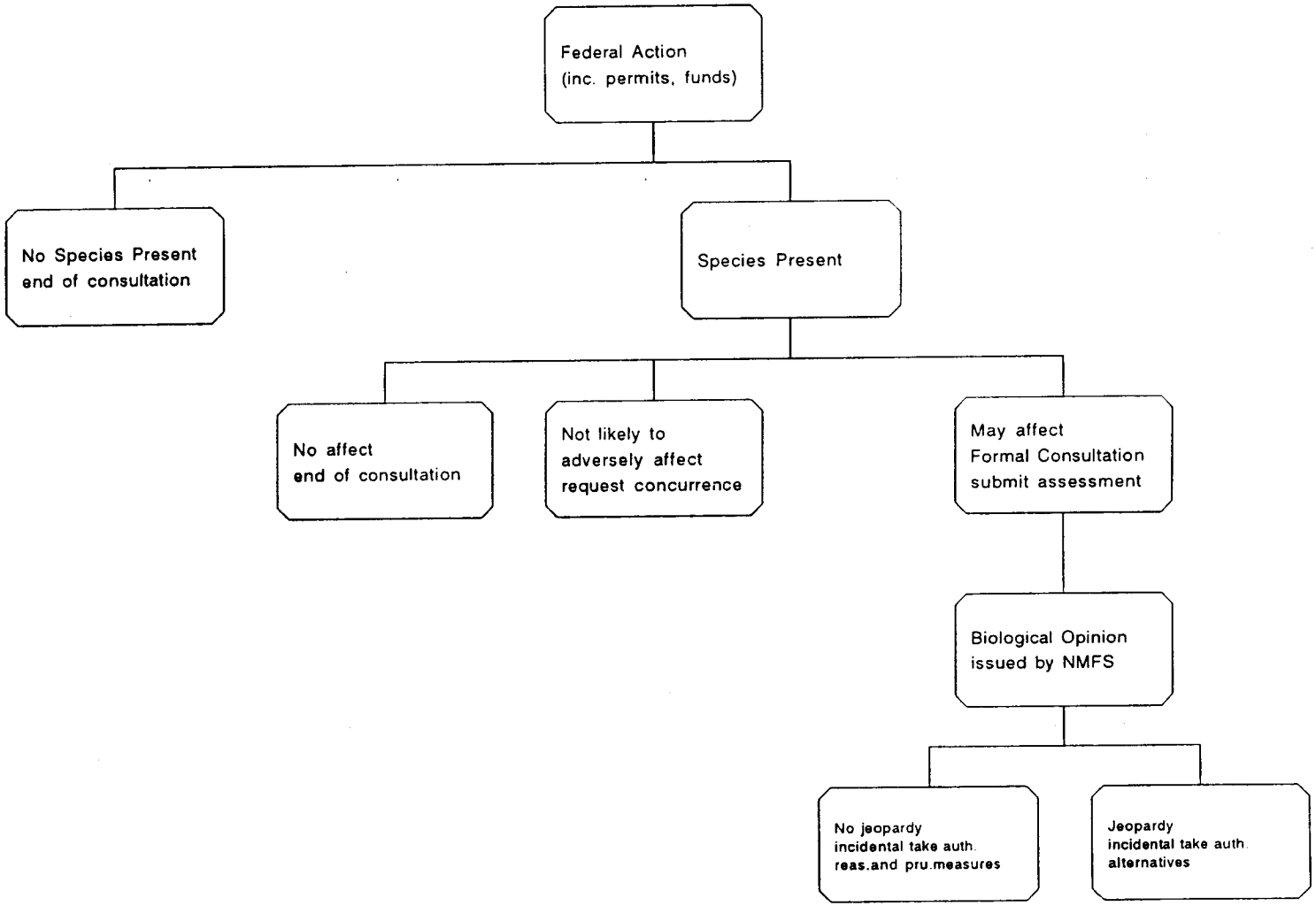
28 loggerheads (3 released in unknown condition, 1 dead),
12 green turtles (10 were likely loggerheads, 1 released in unknown condition, 1 dead)
94 leatherbacks (24 released in unknown condition, 1 injured and 2 dead)

Sea turtles released in unknown condition would likely be counted as injured to be consistent with our Section 7 procedures, which require a conservative interpretation of the best available information in favor of the species. The observer data did not clearly identify the fishery target species associated with these incidental takes. Leatherback incidental take levels, if considering unknown release condition as an incidental take by injury or mortality, exceeded the allowed incidental take levels.

The SEFC summarized swordfish logbook data in response to Headquarter's request for information on longline fishery-sea turtle interactions. These data listed 360 leatherback incidental takes in 1992 including 6 injured, and 149 leatherback incidental takes in 1993 including 2 injured. Numerous loggerheads and a few of all other species, were also listed. While logbook data were not considered in the establishment of the 1991 Incidental Take Statements, they provide new information which, in addition to the exceedance of the authorized incidental take level, are sufficient to require reinitiation of consultation.

Further analyses of the observer data are needed to assess the impact of the pelagic longline fisheries. The purpose of this workshop is to begin to identify data and data gaps, and to develop measures that can be implemented by the longline fishery to reduce the affects of their actions on sea turtles. Information gathered at this workshop will be included in NMFS' review of the best available information. Proposed measures and studies developed here will be considered in the formulation of reasonable and prudent measures or alternatives, and conservation recommendations.

Section 7 Consultation
simplified flow chart



Incidental Take of Sea Turtles in Northeast U.S. Waters

Patricia Gerrior

U.S. Department of Commerce
National Marine Fisheries Service
Northeast Fisheries Science Center
Chief, Sea Sampling Investigation
Woods Hole, MA 02543

Northeast Fisheries Science Center (NEFSC) data from observed pelagic longline trips were reviewed and summarized for 1991, 1992, and 1993 for the longline fishery-ESA interaction workshop[1]. All data provided were preliminary. There were five pelagic longline trips observed in 1991, 14 in 1992, and 35 in 1993. Captains on the observed trips targeted swordfish, tuna, sharks, and mixed pelagic species (swordfish, tuna, and shark). Observers recorded 56 leatherback, *Dermochelys coriacea*, 15 loggerhead, *Caretta caretta*, 10 green, *Chelonia mydas*, 1 hawksbill, *Eretmochelys imbricata*, and 3 unidentified sea turtles from the 54 observed pelagic longline trips. Sea turtle incidental takes were reported by species, quarter, animal condition[2], and tag status. Plots of the location of observed hauls and sea turtle incidental takes were provided for each year. Additionally, observer hooking and entanglement comments were listed for incidental sea turtle takes during the three years. These comments include documentation on sea turtle hookings in front flippers, hind flippers, head, mouth, neck, and carapace. Longline caught sea turtles were observed entangled with mainline or buoy line around the head, neck, flippers, and shell. It should be noted that observers did not provide comments on all incidental sea turtle takes observed nor were all sea turtles brought aboard or alongside the vessels. The number of observed longline hooks set and hauled and the number of lightsticks used were summarized by year and quarter. Lightsticks were not used on all hauls with incidental sea turtle takes.

[1]Data included in this report are preliminary and thus are subject to change.

[2]Animal condition codes used by observers for incidental sea turtle takes were revised and redefined during the 1991-1993 data collection period.

Table 1. Target Species of NEFSC Observed Pelagic Longline Trips for 1991, 1992, and 1993.

YEAR	# SWORDFISH TRIPS	# TUNA TRIPS	# SHARKS TRIPS	# MIXED* TRIPS	TOTALS
1991	0	2	0	3	5
1992	7	1	0	6	14
1993	8	14	2	11	35

***MIXED=**Swordfish, sharks and tuna.

Table 2. Number of NEFSC observed trips in the pelagic longline fishery by SEFSC Area for 1991, 1992, and 1993.

YEAR	NORTHEAST COASTAL	MID-ATLANTIC BIGHT	NORTHEAST DISTANT	SOUTH ATLANTIC BIGHT	OTHER
1991 *	3	1	1	0	0
1992**	3	6	5	0	0
1993***	6	25	1	3	0
TOTALS	12	32	7	3	0

* Two trips fished in Northeast Coastal and Mid-Atlantic Bight Areas.
** One trip fished in the Northeast Coastal and Mid-Atlantic Bight Areas.
*** One trip fished in the Mid-Atlantic and South Atlantic Bight Areas.
One trip fished in the Mid-Atlantic and South Atlantic Bights, Northeast Coastal and "Other" Areas.
One trip fished in Mid-Atlantic and "Other" Areas.

Table 3. Number of NEFSC observed hauls with turtle takes in the pelagic longline fishery by area for 1991,1992, and 1993.

YEAR	NORTHEAST COASTAL	MID-ATLANTIC BIGHT	NORTHEAST DISTANT	SOUTH ATLANTIC BIGHT	OTHER
1991	5	1	1	0	0
1992	2	13	15	0	0
1993	6	13	7	1	2
TOTALS	13	27	23	1	2

Table 4. NEFSC observed pelagic longline trips by year, number of observed hauls, number of observed hauls with turtle takes, number of turtle takes and animal condition.

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592* 14 * 161 * 30  * 39  * 16  *  22   *   0   *  0 *  1  5
K))3))))3)))))3)))))3)))))3)))))3)))))))3)))))))3))))3)))))M
593* 35 * 276 * 29  * 37  * 14  *  20   *   2   *  0 *  1  5
944N4444N44444N44444N44444N44444N4444444N4444444N4444N444448
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Table 5. NEFSC Observed Turtle Takes from Pelagic Longline Fishery by Year and Quarter for 1991, 1992, and 1993.

YEAR	QTR	LEATHER BACK TURTLE	LOGGERHEAD TURTLE	GREEN TURTLE	HAWKSBILL TURTLE	UNIDENT	TOTALS
1991	1	0	0	0	0	0	0
	2	0	0	0	0	0	0
	3	3	4	0	0	7	7
	4	0	1	0	0	2	2
1992	1	0	0	0	0	0	0
	2	1	0	0	0	1	1
	3	10	3	2	0	16	16
	4	12	1	8	1	22	22
1993	1	0	0	0	0	0	0
	2	9	2	0	0	11	11
	3	11	2	0	0	14	14
	4	10	2	0	0	12	12
TOTALS		56	15	10	1	85	85

Table 6. Sea turtles caught on pelagic longline trips and tagged by NEFSC observers, 1991-1993.

	YEAR			
	1991	**1992**	**1993**	**TOTALS**
NUMBER OF OBSERVED TRIPS	**5**	**14**	**35**	**54**
NUMBER OF LOGGERHEADS CAUGHT	5	4	6	15
TAGGED	2	2	1	5
NUMBER OF LEATHERBACKS CAUGHT	3	23	30	56
TAGGED	1	0	0	1
NUMBER OF GREENS CAUGHT	0	10	0	10
TAGGED	0	7	0	7
NUMBER OF HAWKSBILLS CAUGHT	0	1	0	1
TAGGED	0	0	0	0
NUMBER OF UNIDENTIFIED CAUGHT	1	1	1	3
TAGGED	0	0	0	0
TOTAL CAUGHT	9	39	37	85
TOTAL TAGGED	3	9	1	13

Table 7. NEFSC observed number of hooks set / hauled and light sticks used in pelagic longline fishery by year and quarter 1991, 1992, and 1993.

YEAR	QUARTER	HOOKS SET #	HOOKS HAULED #	LIGHT STICKS #
1991	1	-	-	-
	2	-	-	-
	3	21239	20536	6882
	4	11256	10074	2050
TOTALS		32495	30610	8932
1992	1	-	-	-
	2	3849	3653	1850
	3	53432	50694	23251
	4	61679	60096	26210
TOTALS		118960	114443	51311
1993	1	28086	25490	4660
	2	25271	24501	2990
	3	69406	67603	9540
	4	59631	54627	13196
TOTALS		182394	172221	30386

Table 8. Location of sea turtle hookings and nature of entanglements on pelagic longline trips obserbed by NEFSC observers.

HOOKINGS	**ENTANGLEMENTS**
FRONT FLIPPER(S)	MONOFILAMENT AROUND
HIND FLIPPER(S)	- HEAD
HEAD	- FLIPPERS
MOUTH	
NECK	MAINLINE AROUND
CARAPACE	- SHELL
	- FLIPPERS
	BALL DROP/BUOY LINE AROUND
	- NECK
	- SHELL

Table 9. NEFSC Observer Comments on Sea Turtle Captures - 1991

HAUL DATE	SPECIES	# CAUGHT	OBSERVER COMMENTS
07/14	Loggerhead	3	Turtles were hooked, gangions cut as close as possible to hook- all turtles swam off vigorously having suffered no apparent damage

Table 10. NMFS Observer Comments on Sea Turtle Captures - 1992

HAUL DATE	SPECIES	# CAUGHT	OBSERVER COMMENTS
05/15	Leatherback	1	Not hooked, turtle tangles in mainline, line was cleared & turtle released unharmed
06/18	Green	1	Neck broken as crew brought closer to vessel to get id
06/20	Unidentified	1	Can't id, moss-covered back, hook in throat
10/03	Leatherback	1	Balled up in gear, 35 yards away when came up, captain cut gangion
10/03	Leatherback	1	Caught on flipper
10/08	Loggerhead	1	Caught on hook, wrapped around right front flipper
10/09	Leatherback	1	Gangion parted before turtle to surface, swam before determined if hooked
10/12	Leatherback	1	Caught under & around neck, crew cut 90% away
10/15	Leatherback	2	Hook in head-large & small mono cut and animal swam away Hook in left front flipper, gangion broke before crew could get out
10/16	Leatherback	2	Had gangion line around hind flipper, line cut, swam away Line around shell & back flippers-swam hard away from vessel
10/18	Leatherback	1	Pretty sure this was a leatherback.It was fighting hard & broke 400 lb. test line. Only surfaced once about 1501 from vessel.
10/20	Leatherback	1	Leatherback had drop line around neck & was pulling hard, line was cut approx. 3 fm from turtle. Swam away, took air in about 1 minute later.
10/15 10/18 10/21 10/22	Green	8	All released alive and in very good condition. All caught with a hook in the mouth. All hooks removed except 1.
10/25	Leatherback	1	Caught on gangion not necessarily hooked. Crew pulled turtle closer to boat manually, line was cut & turtle dove. From one view of turtle, knew to be leatherback by distinctive ribbed shell & large size.
12/10	Hawksbill	1	Turtle had hook in mouth-weather did not permit bringing aboard-was alive and swam away.

Table 11. NEFSC Observer Comments on Sea Turtle Captures - 1993

HAUL DATE	SPECIES	# CAUGHT	OBSERVER COMMENTS
07/29	Leatherback	1	Cut from gangion as soon as animal broke surface, took 1 breath & dived, active& healthy.
07/30	Unidentified	1	Rough sea conditions made id difficult; definitely not leatherback or hawksbill- Color could indicate loggerhead, active,released with hook in mouth.
08/28 08/29 08/30	Leatherback	7	Right flipper, gangion cut 51 & left with hook. Gangion cut 201 & left with hook. Not seen where turtle caught-twenty ft of gangion & hook. Seemed to be caught in the head area - 20' of gangion & hook left. 201 of gangion left with hook, did not see hook. Mono around head & r f flipper, crew cut most of mono from turtle.
07/31	Loggerhead	1	Bit at hook as leader was being hauled & snagged in neck.
08/01	Leatherback	1	Foul hooked in front flipper, in good condition otherwise
09/10	Leatherback	2	Foul hooked left front flipper. Hook was cut leaving only couple of inches of mono. Animal swam away seemingly uninjured. Wrapped around mainline with two turns, main line was cut &turtle went free, no cuts & it swam away.
09/24	Loggerhead	1	R, f, flipper, 201pieceofmono&hook left with turtle.
09/26	Leatherback	1	Around neck & fr flippers, captain & crew got all mono from around turtle.
09/30	Leatherback	1	Did not see where caught. captain cut leader at snap.
10/01	Leatherback	1	Caught by ball drop, buoy drop was wrapped around backwithbuoyontopof back, line parted at snap, 5 fm stayed on turtle with buoy.
10/06	Loggerhead	1	Brought on board, no injury other than hook in throat.
10/10	Leatherback	1	Turtle dove before saw where caught and ganglion broke about 3 fm from hook.
10/23	Leatherback	1	Hook caught on edge of carapace. Line cut & animal released unharmed.
10/25	Leatherback	1	Leader cut and released unharmed.
10/29	Leatherback	1	Leader cut & released unharmed.

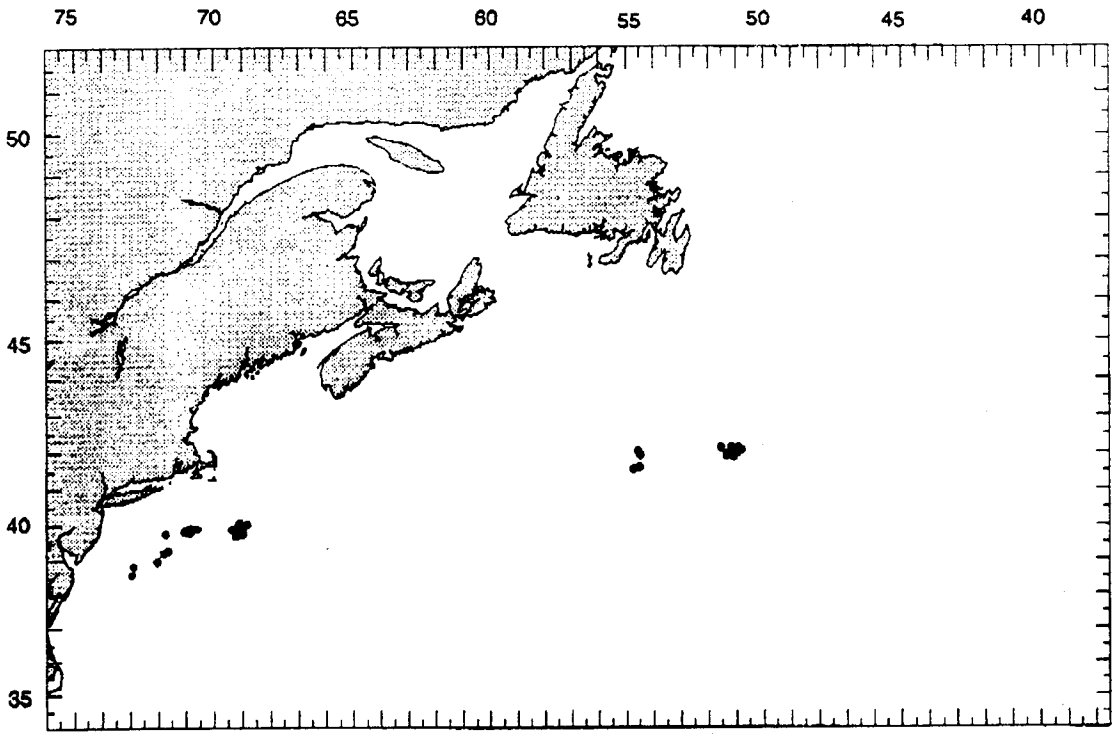

Figure 1. Location of NEFSC observed pelagic longline hauls from 1991.

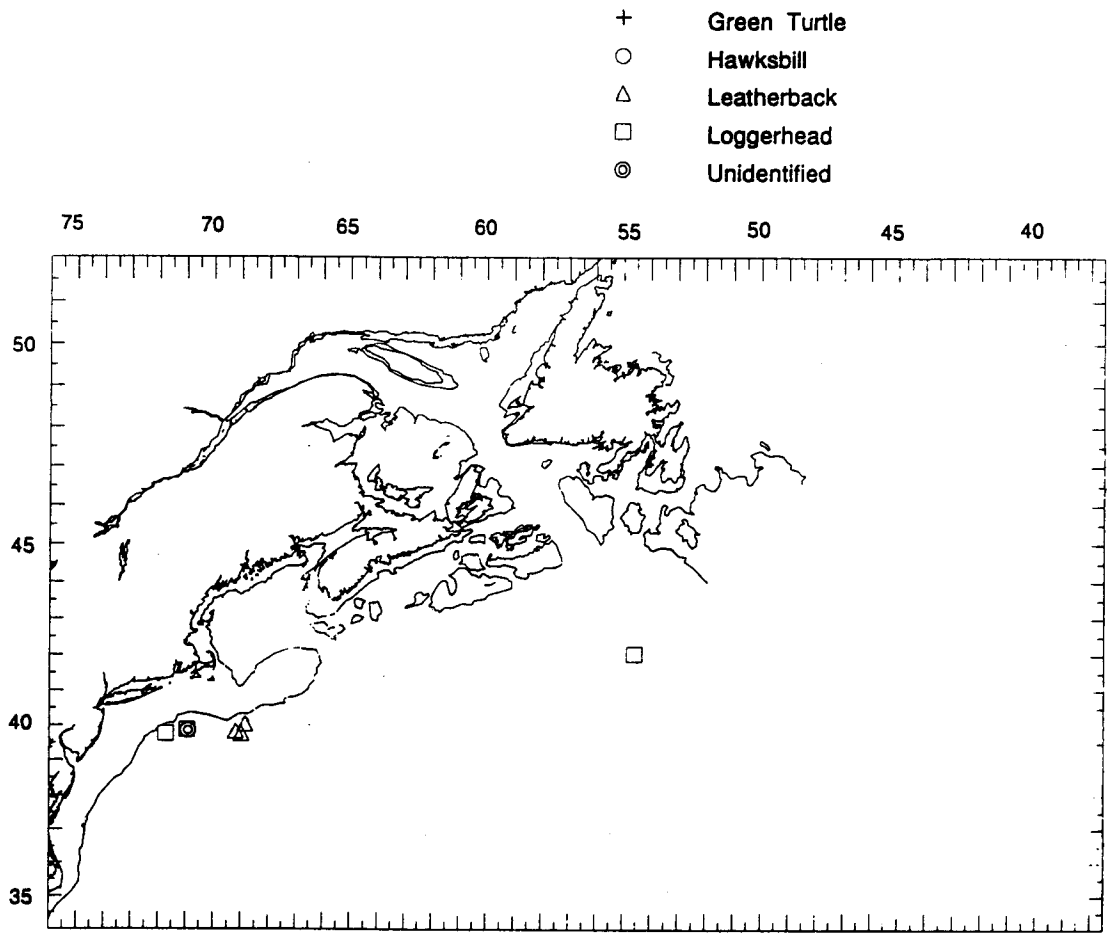

Figure 2. Sea turtle interactions by species from NEFSC observed pelagic longline trips in 1991.

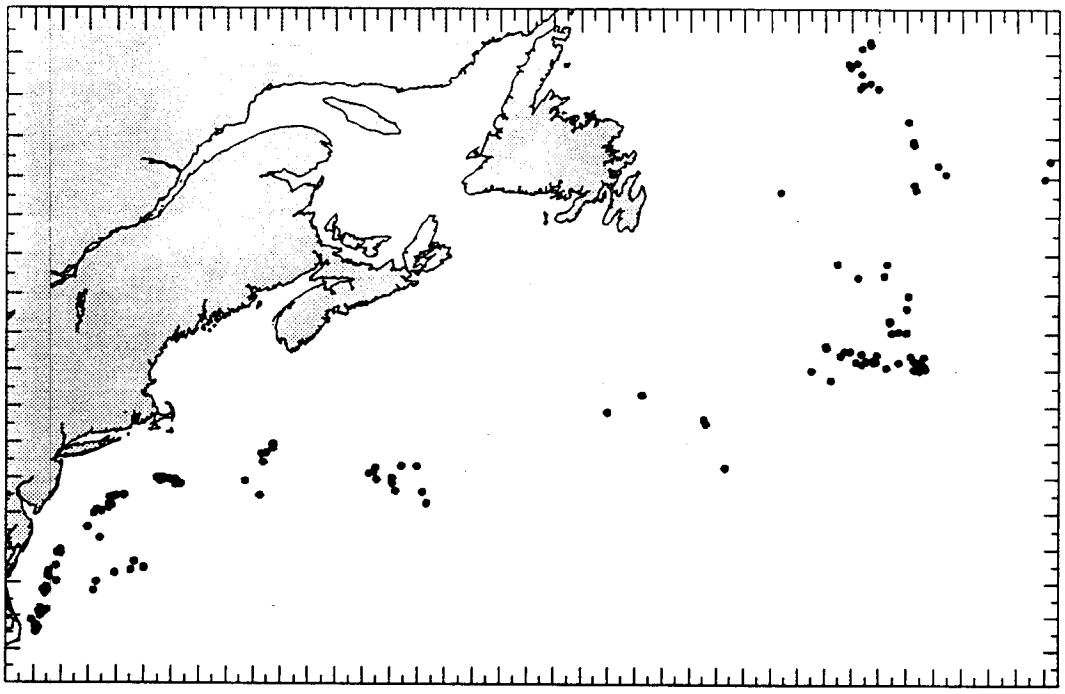

Figure 3. Location of NEFSC observed pelagic longline hauls from 1992.

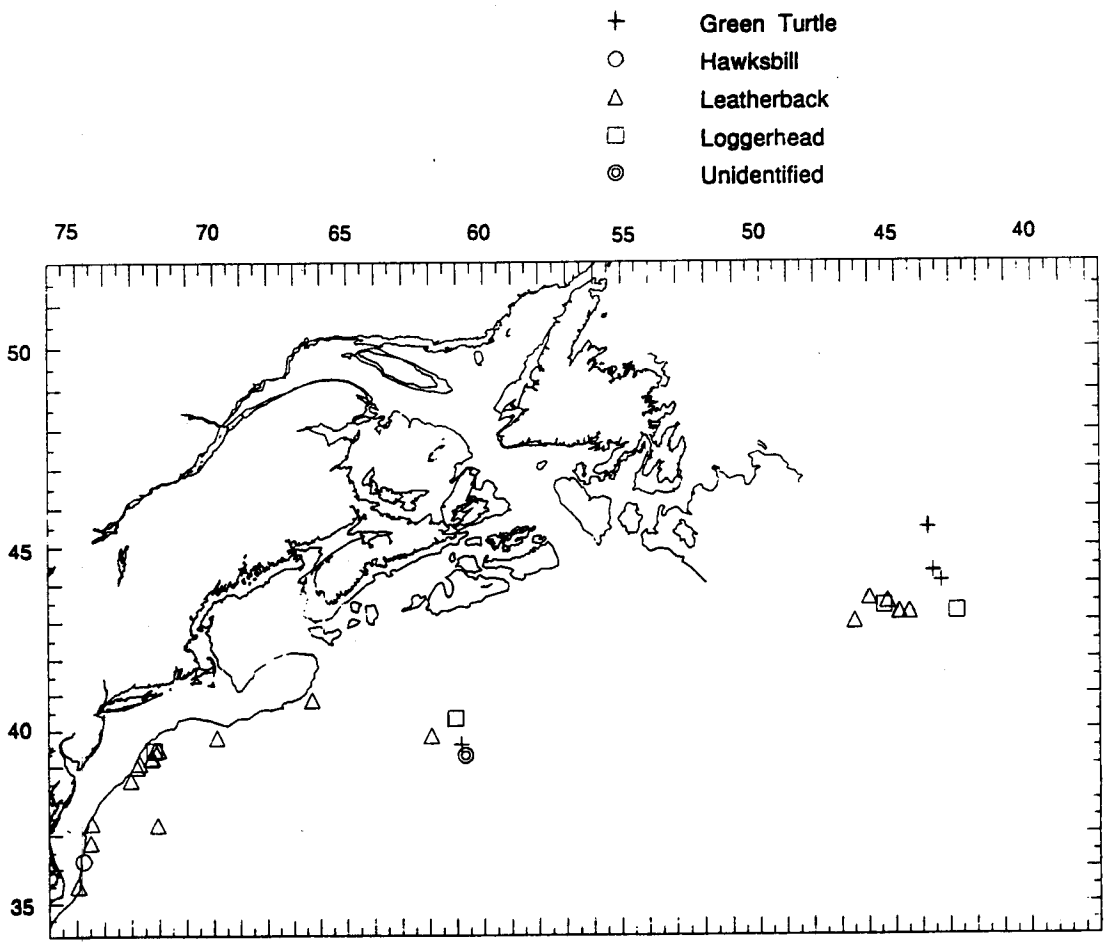

Figure 4. Sea turtle interactions by species from NEFSC observed pelagic longline trips in 1992.

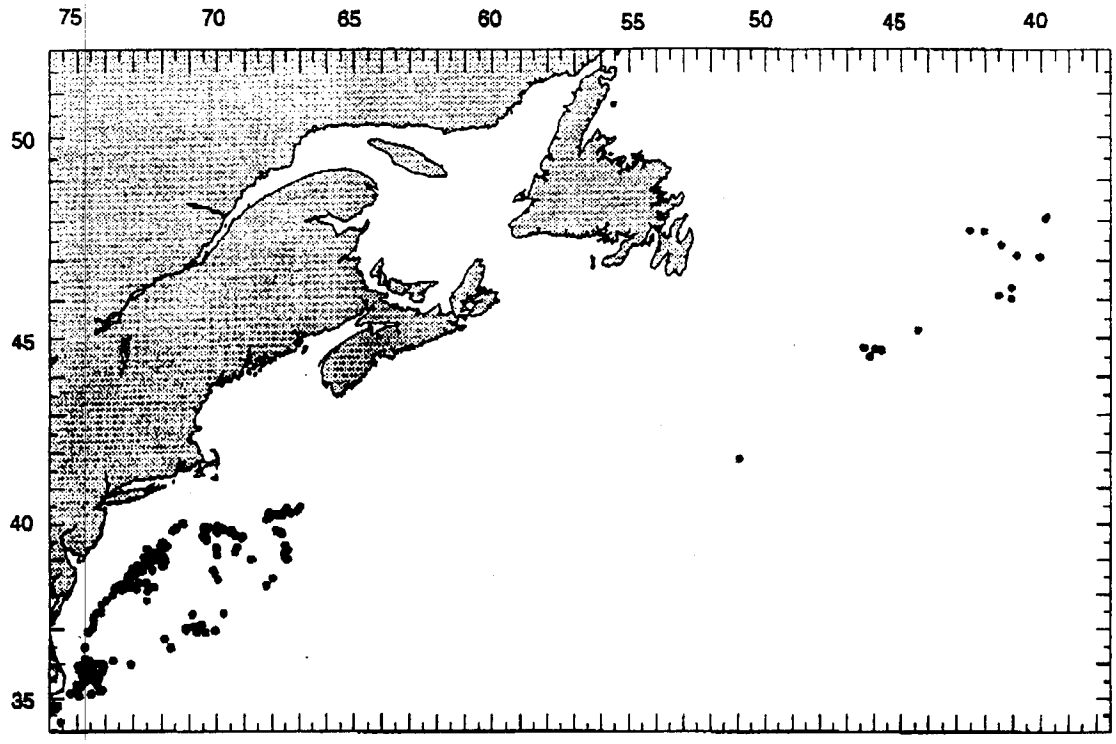

Figure 5. Location of NEFSC observed pelagic longline hauls from 1993.

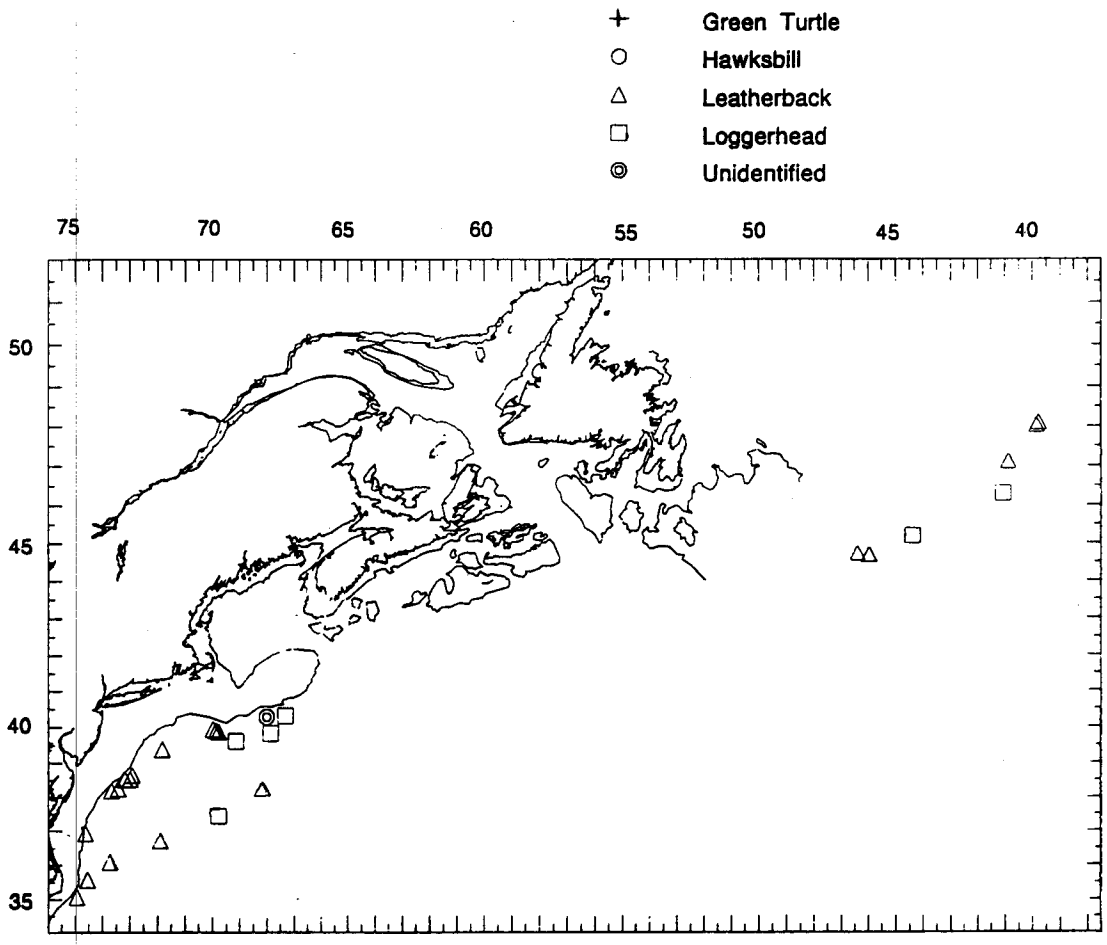

Figure 6. Sea turtle interactions by species from NEFSC observed pelagic longline trips in 1993.

NOAA Fisheries - Sea Sampling Program
Incidental Take Log for Marine Mammals, Sea Birds and Sea Turtles

Obsvr/Trip ID	Domestic ( ) Foreign: Direct ( ) J/V ( )	Vessel Name	Vessel Number	Date Landed (m/d/y) ____/____/____	Page No. ____of____

Haul No.	Species Name	PANEL No.	PANEL Seg	Time Brought Up	STATUS Cond Code (See blw)	STATUS Onbrd No =0 Yes=1	STATUS Est. Length (cm)	Tail Tag or Band Number	TAG CODE See below	PHOTO INFORMATION Taken No =0 Yes=1	PHOTO INFORMATION Cam or Roll No.	PHOTO INFORMATION Frame Number Range Beg	PHOTO INFORMATION Frame Number Range End	Meas. Samp. Taken No =0 Yes=1	Captain Notified No = 0 Yes = 1	Captain/ Designee Particp No = 0 Yes = 1
				:												
				:												
				:												
				:												
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				:												

6. Condition Code:
Indicate the condition of the animal as it came up in the gear, whether it was brought onboard or not, by recording the appropriate code found in the Animal Condition Code Table (Table 2).

Condition Codes:
00 = Unknown
10 = Alive, condition unknown
11 = " not injured
12 = " moderately injured
13 = " severely injured
20 = Dead, condition unknown
21 = " fresh
22 = " moderately decomposed
23 = " severely decomposed

Tag Codes:
0 = Taken without tag, not tagged
1 = Taken without tag, tagged
2 = Taken with this tag

03/29/90

NOAA Fisheries - Sea Sampling Program
Marine Mammal, Sea Turtle, and Sea Bird Incidental Take Log

Obsvr/Trip ID	Domestic ( ) Foreign: Direct ( ) J/V ( )	Vessel Name	Vessel Number	Date Landed (m/d/y) ____/____/____	Page No. ____of____

	Haul No.	Species Name	GEAR SECT. (see below) No.	Qr/Sc prev. Seg	Time Brought Up	STATUS Cond Code (See blw)	STATUS Onbrd No =0 Yes=1	Est. Length (cm)	Animal Tag or Band Number	TAG CODE See below	PHOTO INFORMATION Taken No =0 Yes=1	PHOTO INFORMATION Cam or Roll No.	PHOTO INFORMATION Frame Number Range Beg End	Meas. Samp. Taken No =0 Yes=1	Captain Notif. No = 0 Yes = 1	Captain Desig. Particp No = 0 Yes = 1
1					:											
2					:											
3					:											
4					:											
5					:											
6					:											
7					:											
8					:											
9					:											
10					:											

Comments:

12. STATUS - CONDITION CODE:
Record one of the following codes that describes the condition of the animal as it came up in the gear, whether it was brought onboard or not(Animal Condition Code Table 9. and on the form).

00 = Unknown(specify in comments).

Seen by observer:
10 = Alive, condition unknown.
11 = Alive, not injured.
14 = Alive, injured.
20 = Dead, condition unknown.
21 = Dead, fresh.
22 = Dead, moderately decomposed.
23 = Dead, severely decomposed.

Not seen by observer:
30 = Alive, seen by captain/crew only.
40 = Dead, seen by captain/crew only.

Gear Codes - Trawl: 1 = Mouth, 2 = Belly, 3 = Codend
Dredge: 4 = Inside of Dredge, 5 = On Top of Dredge

Condition Codes: 00 = Unknown(specify in comments); 10 = Alive, condition unknown; 11 = Alive, not injured; 14 = Alive, injured; 20 = Dead, condition unknown; 21 = Dead, fresh; 22 = Dead, moderately decomposed; 23 = Dead, severely decomposed; 30 = Alive, seen by cpt/crew ONLY; 40 = Dead, seen by cpt/crew ONLY

Tag Codes: 0 = Taken without tag, not tagged; 1 = Taken without tag, tagged; 2 = Taken with this tag, not retagged; 3 = Taken with this tag, retagged

09/01/92

NMFS FISHERIES OBSERVER PROGRAM
MARINE MAMMAL, SEA TURTLE AND SEA BIRD INCIDENTAL TAKE LOG

05-01-94

SSINC

OBS/TRIP ID	VESSEL NAME	VESSEL NUMBER	DATE LANDED mm/dd/yy	TRIP TYPE	PAGE #
	#1	#1		Domestic 1___	
			/ /	Dom/Dom JV 2___	
	#2	#2		Dom/For JV 3___	_____ of _____
				Foreign 4___	

HAUL #	GEAR #	GEAR # OF FLOATS	TIME 24 hours	SPECIES NAME	SPECIES CODE	TAG NUMBER(S)	TAG CODE	EST LENGTH cm	STATUS ENTANG SIT	STATUS ANIM COND	STATUS ON? 0 = No 1 = Yes	PHOTO INFORMATION TAKEN? 0 = No 1 = Yes	PHOTO INFORMATION CAM/ ROLL #	PHOTO INFORMATION FRAME # RANGE Beg - End	SAMP? 0 = No 1 = Yes	CAPT NOTIF? 0 = No 1 = Yes	CAPT PART? 0 = No 1 = Yes	# OF BIRDS
			:											-				
														-				
														-				
														-				
														-				
														-				
														-				
			:											-				

COMMENTS? NO 0____ YES 1____

ENTANGLEMENT SITUATION CODES:

00 = Unknown

01 = Fell From Gear at a Point Unknown

02 = Fell From Gear Before Exiting Water

03 = Fell From Gear Once Hauled Out of Water

04 = Fell From Gear Due to Force of Roller

05 = Removal Requires Cutting of Gear/Animal

06 = Removal Does NOT Require Cutting of Gear/Animal

Longline Fishery Only

07 = Foul Hooked, Cut From Gear

08 = Foul Hooked, Removed From Gear

10 = Sea Bird Caught, Ganglon Attached to Mainline

11 = Sea Bird Caught, Ganglon Unattached to Mainlin

99 = Other

ANIMAL CONDITION CODES:

00 = Unknown

01 = Alive, Condition Unknown

02 = Alive, Not Injured

03 = Alive, Injured

04 = Alive, Gear In/Around Mouth

05 = Alive, Gear In/Around Flipper

06 = Alive, Gear In/Around Another Single Body Part

07 = Alive, Gear In/Around Several Body Parts

08 = Alive, Seen by Captain/Crew ONLY

10 = Dead, Condition Unknown

11 = Dead, Fresh

12 = Dead, Moderately Decomposed

13 = Dead, Severely Decomposed

14 = Dead, Seen by Capt/Crew ONLY

99 = Other

TAG CODES:

0 = Unknown

1 = Taken Without a Tag and Tagged

2 = Taken Without a Tag and Not Tagged

3 = Taken With a Tag and Retagged

4 = Taken With a Tag and Not Retagged

ENTANGLEMENT SITUATION CODES:

00 = Unknown

01 = Fell From Gear at a Point Unknown

02 = Fell From Gear Before Exiting Water

03 = Fell From Gear Once Hauled Out of Water

04 = Fell From Gear Due to Force of Roller

05 = Removal Requires Cutting of Gear/Animal

06 = Removal Does NOT Require Cutting of Gear/Animal

10 = Sea Bird Caught, Ganglon Attached to Mainline

11 = Sea Bird Caught, Ganglon Unattached to Mainlin

99 = Other

Parts

03 = Alive, Injured

04 = Alive, Gear In/Around Mouth

05 = Alive, Gear In/Around Flipper

06 = Alive, Gear In/Around Another Single Body Part

12 = Dead, Moderately Decomposed

13 = Dead, Severely Decomposed

14 = Dead, Seen by Capt/Crew ONLY

99 = Other

The Incidental Capture of Sea Turtles by the U.S. Pelagic Longline Fleet in the Western Atlantic Ocean

Wayne N. Witzell

U.S. Department of Commerce
National Marine Fisheries Service
Southeast Fisheries Science Center
75 Virginia Beach Drive
Miami, FL 33149

The Southeast Fisheries Science Center (SEFSC) has the NMFS lead role in conducting large pelagic fisheries assessments in the western North Atlantic Ocean. This area has been partitioned into nine geographic zones for analytical purposes (Figure 1). The SEFSC has maintained several commercial and scientific pelagic longline data bases since the 1960's, the two most currently active data sets discussed here are the Pelagic Logbook system (Cramer, 1993) and the domestic Pelagic Observer Program (Lee et al., 1994). The observer program began in late 1992 (Figure 2) and the Logbook system, although initiated in 1991, began collecting sea turtle interaction data in 1992 (Figure 3).

The incidental capture of sea turtles by pelagic longliners from this area was first reported for the Japanese bluefin tuna fleet in the early 1980's (Witzell, 1984). Further scrutiny of this issue indicated that the incidental catch rates of sea turtles probably varied considerably between season, location, target species, and gear fished (Witzell, 1992).

Leatherback interactions occur in almost all areas but are concentrated from the Mid-Atlantic Bight to the northeast distant areas (sections 5-7), areas north of 35°N (Tables 1 - 3). Seasonally, most interactions are in the summer and fall months. Atlantic leatherback sea turtles do not commonly eat the longline bait (usually squid), only one out of 41 leatherbacks observed had apparently taken the bait. Instead, they become entangled in the main and branch lines and are usually released alive and uninjured. Catch rates vary slightly, but ranged from only 0.02 to 0.09 sea turtles per 1,000 hooks. Preliminary observer data indicate that a small percentage (10-15%) of these entangled sea turtles may have had a hook embedded in the flipper, but the fishermen cut the ganglions as close to the hook as safely possible. Subtracting leatherbacks, *Dermochelys coriacea*, which comprise 79.6% of the reported catch (65% observed), from the total incidental sea turtle take considerably reduces the numbers of sea turtles impacted by the longline fleet. Essentially, the U.S. pelagic longline fleet currently does not adversely affect these leatherbacks to any threatening degree.

Loggerhead, *Caretta caretta*, interactions appear concentrated in the northeast coastal and distant areas and in the Gulf of Mexico (sections 2, 6, and 7). Average CPUE values ranged from 0.009 to 0.05. The incidental capture of loggerheads, however, is of a different nature than the leatherbacks because they frequently do consume the bait and become hooked

in the mouth or throat. Even though these are almost always released alive, they are released with the hooks still imbedded in their mouths and their ultimate fate is unknown. Assessing the impacts of the longline fishery on the loggerhead population, however, is difficult and a proper stratified analysis of the available CPUE data would be difficult, and possibly inconclusive. The CPUEs reported from the logbook program are possibly low because fishermen are less inclined to voluntarily report endangered species and marine mammal interactions. The observed CPUEs however, are apparently too high because observer records indicate that some sea turtles were caught as many as two or three different times, raising the number of sea turtle interactions, but not the total number of sea turtles. Although vessels usually go for extended periods without seeing a sea turtle, it is not uncommon to suddenly capture (or recapture) two or more sea turtles. Loggerheads, particularly in the Grand Banks area, may be closely associated with discrete pockets of warm water spun off from the Gulf Stream, and may have a higher chance of being caught multiple times because swordfish boats routinely fish these thermal fronts.

It is recommended that the new Section 7 Consultation have higher, more realistic total allowable incidental take estimates, for this fishery (particularly for loggerheads) because: 1) leatherbacks are not adversely impacted, and 2) because the overall loggerhead CPUE and total incidental take are relatively low. The analysis and interpretation of current U.S. pelagic longline data sets and the development of a safe and effective dehooking protocol is recommended. It is further recommended that this relatively minor problem be approached with calm deliberation and foresight, and prioritize research requirements with all other fisheries that have proven incidental takes of seriously endangered sea turtles (e.g., NC-VA pound nets and VA-FL coastal gill nets).

Literature Cited

Cramer, J. 1993. Large pelagic logbook newsletter - 1992. NOAA Tech. Mem. NMFS-SEFSC-322:16p.

Lee, D.W., C.J. Brown, A.J. Catalano, J.R. Grubich, T.W. Greig, R.W. Miller, and M.T. Judge. 1994. SEFSC Pelagic longline observer program data summary for 1992-1993. NOAA Tech. Mem. NMFS-SEFSC-347:19p.

Witzell, W.N. 1984. The incidental capture of sea turtles in the Atlantic U.S. Fishery Conservation Zone by the Japanese tuna longline fleet, 1978-81. Mar. Fish. Rev. 46:56-58.

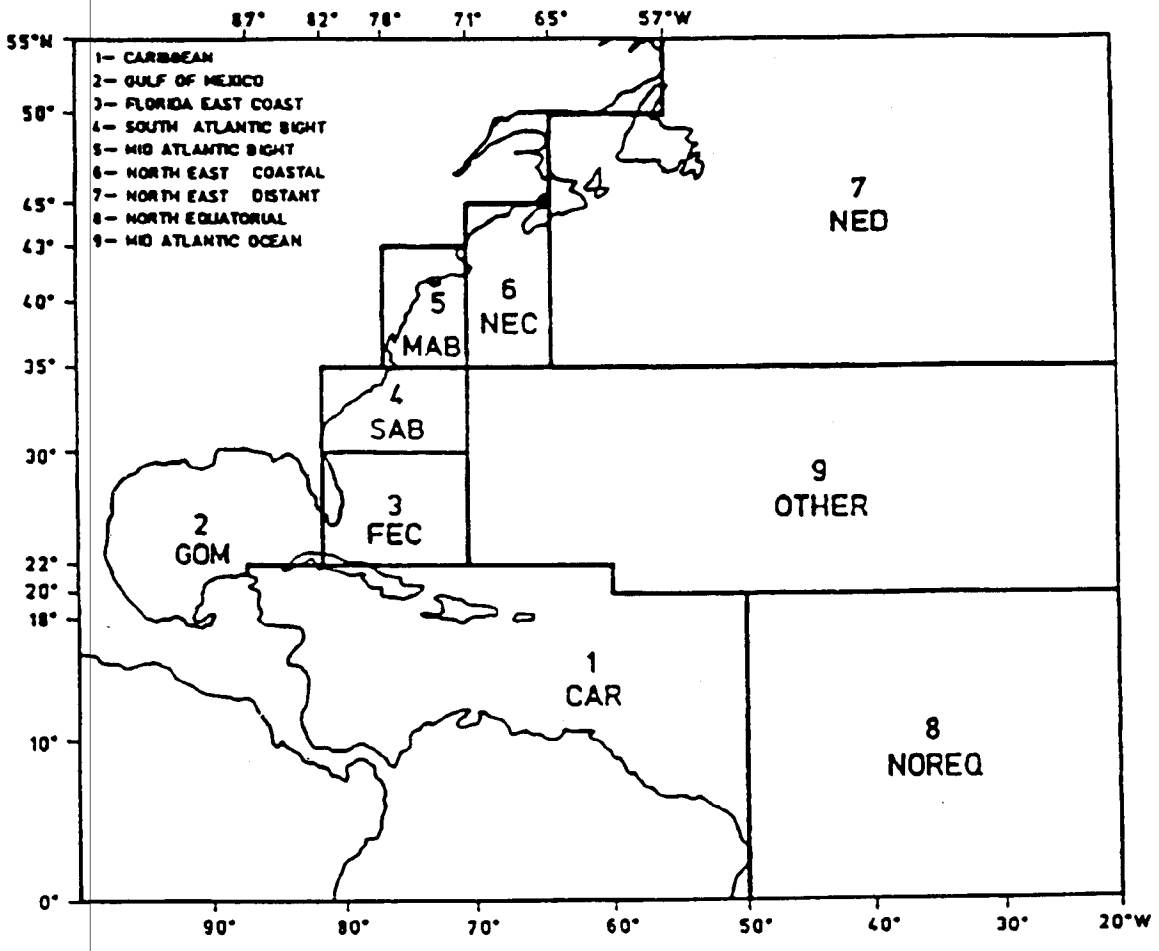


Figure 1 The fishing area definitions used to classify the U.S. pelagic longline effort.

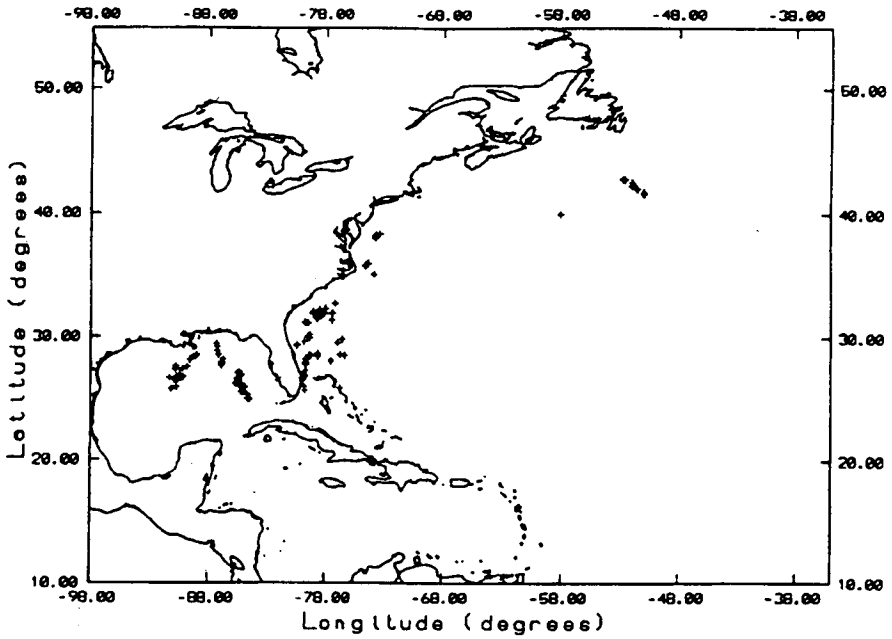


Figure 2 Location of sets from 31 pelagic longline trips observed during 1992.

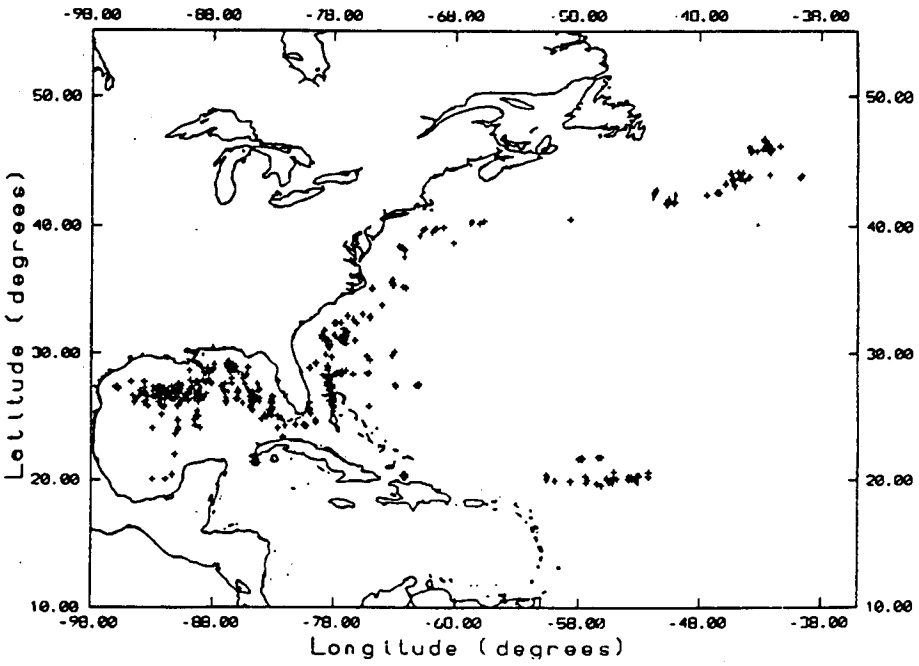


Figure 3 Location of sets from 75 pelagic longline trips observed during 1993.

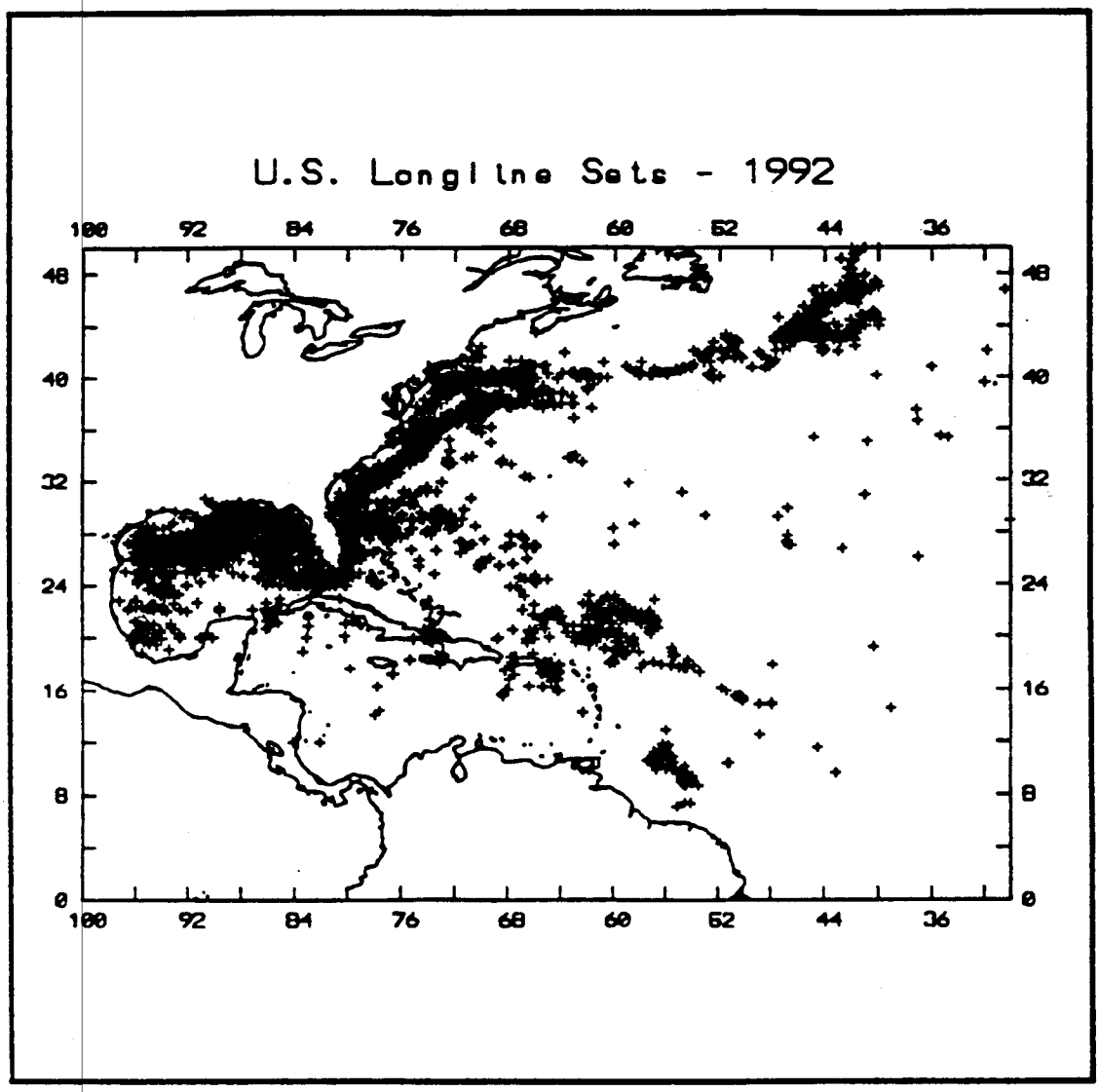


Figure 4. Map showing the location of reported fishing effort in 1992.

Table 1. 1992 Pelagic Logbook Data.

AREA	D. coriacea	C. caretta	# HOOKS	LB/CPUE/1000HKS	LH/CPUE/1000HKS
CAR	18	3	525,596	0.0342	0.0057
GOM	21	7	2,556,718	0.0082	0.0027
FEC	3	1	730,998	0.0041	0.0013
SAB	8	1	363,084	0.0220	0.0027
MAB	159	14	1,397,696	0.1137	0.0100
NEC	67	7	839,013	0.0789	0.0083
NED	82	44	839,629	0.0976	0.0524
NOREQ	0	0	6,357	0.0000	0.0000
OTHER	5	0	15,453	0.0327	0.0000
TOTAL	363	77	7,411,544	0.0489	0.0103

440 TURTLES CAPTURED TOTAL TURTLE CPUE (1,000HKS) = 0.0593

Table 2. 1993 Pelagic Logbook Data.

AREA	D. coriacea	C. caretta	# HOOKS	LB/CPUE/1000HKS	LH/CPUE/1000HKS
CAR	11	6	547,587	0.0200	0.0109
GOM	23	6	2,214,827	0.0103	0.0027
FEC	6	2	543,608	0.1098	0.0036
SAB	2	1	575,011	0.0034	0.0017
MAB	48	6	1,392,162	0.0344	0.0043
NEC	25	18	677,615	0.0368	0.0265
NED	66	23	642,653	0.1026	0.0357
NOREQ	0	1	21,500	0.0000	0.0465
OTHER	4	0	216,157	0.0185	0.0000
TOTAL	185	63	6,831,120	0.0270	0.0092

248 TURTLES CAPTURED TOTAL TURTLE CPUE (1,000HKS) = 0.0363

Table 3. 1992-93 NMFS-SEFSC Pelagic Longline Observer Data.

AREA	# TURTLES	# HOOKS	T/CPUE/1000HKS
CAR	7	31,837	0.2198
GOM	15	240,633	0.0623
FEC	4	41,243	0.0969
SAB	5	26,795	0.1866
MAB	4	10,520	0.3802
NEC	3	7,150	0.4195
NED	24	55,038	0.4360
NOREQ	0	0	0
OTHER	1	23,563	0.0424
TOTAL	63	436,799	0.1442

41 leatherbacks = 0.0938/1,000hks
22 loggerheads = 0.0503/1,000hks

Operations of and Challenges Facing the Longline Fishery

Nelson Beideman

Blue Water Fishermen's Association
1525 Wilson Blvd. Suite 500
Arlington, VA 22209

BWFA Background Information

Blue Water Fishermen's Association (BWFA) represents a substantial portion of the commercial hook and line pelagic longline fishermen, vessel owners, fish dealers and supporting supply companies with an interest in Atlantic highly migratory marine species, with members from Maine to Texas and California to the Caribbean Islands. These family-run small businesses are comprised of hard-working Americans who, despite the tough economic times, are proud to carry on the tradition of providing healthy food for other Americans who cannot or do not want to catch their own.

BWFA was formed in 1989, to provide a united voice to respond to proposed management measures that would have effectively closed the U.S. Swordfish fishery. BWFA members have always supported conservation measures that are practical, effective, and based on a reasonable interpretation of the available scientific data. BWFA is extremely active in voluntary scientific data and specimen collection programs, fish tagging, and in the fisheries conservation and management process. The Association has developed a voluntary pilot program to donate dead swordfish (that fishermen are currently required by government regulations to discard) to hungry Americans, especially the poor and homeless in our urban areas. This program is designed to help improve the available scientific information for the swordfish fishery.

The current condition of the swordfish stock and BWFA's record of participation in the management process over the past four years clearly establishes that cooperation and responsible involvement of the industry provides conservation and management benefits faster than confrontation and conflict.

My name is Nelson Beideman. I have been a fisherman all my life. Until last April when my vessel was tragically lost, I have spent the majority of my time upon the ocean. At the age of seven, I began working as a mate on the two charter vessels my family owned. As fisheries in the mid-Atlantic area evolved, so did my involvement from charter to commercial, inshore to offshore; however, I have always been involved in hook and line fisheries.

Like the vast majority of fishermen, I enjoy sharing the ocean with these strange creatures called sea turtles. I first encountered hooked sea turtles years ago chumming for bluefish on the Barnegat Light Ridge and drifting for summer flounder along the beaches of the mid-Atlantic. I was taught to handle sea turtles carefully and not to harm any living

creatures that I did not intend to responsibly utilize. Even in those days, hooks were not removed but the line was cut as close to the mouth as possible. Every practical attempt was made to untangle the sea turtle from the fishing line or any debris the sea turtle had encountered elsewhere. These rare events were not viewed as being harmful. But now, with attention to sea turtles increasing over the years, fishermen get negative chills and extreme anxiety about sea turtles because they are concerned about how even their helpful interactions will be viewed.

During the eighteen years I have been a longline fisherman, sea turtle encounters within the swordfish and tuna longline fleet have been rare events. Because we mostly live our lives aboard a boat in the middle of the ocean, our only human contact is with the 3-4 crew members aboard our vessels and the captains and crews of the rest of the fleet via the radio. Because our fleet is relatively small, we end up pretty much knowing what is taking place around the fleet. Since forming BWFA, I have personally kept in touch about what is happening out on the fishing grounds. Our members range from Texas through the Caribbean along the east coast out to the Grand Banks of Newfoundland and beyond. We also have a significant number of members fishing offshore of California. BWFA provides a communications network through a regional system of Director and Alternate Directors to serve a fishery whose participants spend most of their lives at sea. This system affords me the opportunity to discuss issues with segments of the fishery in all areas.

The U.S. pelagic swordfish and tuna longline fishery is distinct from other longline fisheries. We are working to have fisheries managers recognize these differences. Directed large coastal shark, bottom longline for snapper, grouper, tilefish, New England groundfish, etc., are different gear types and are set differently. Please separate these vessels from our database, especially the directed shark fishery which is required to fill out swordfish information in case they should interact with a swordfish. This step will help immensely to clarify these issues.

Once you recognize that these are separate fisheries, we must then discuss the real differences among gear components, bait, style, and deployment within the U.S. pelagic longline fisheries. The yellowfin tuna fishery in the Gulf of Mexico, South Atlantic swordfish/tuna fishery, mid-Atlantic bigeye tuna fishery and the distant water directed swordfish fisheries all have distinct gear characteristics and deployment techniques which need to be understood. Later, I will give a presentation on the evolution of U.S. longline gear.

In general, U.S. pelagic longline gear has evolved into ever lighter materials which have helped us to increase live retrieval of both our target and by-catch species. This gives us a better seafood product and a higher price. Our gear is fished at relatively shallow hook depths compared to other pelagic longline gear. A sea turtle on our line can remain on the surface until the line is retrieved. A very small percentage of the sea turtles are killed, much smaller than your estimates indicate. Relatively few mortalities result because our lighter,

shallower gear presents little resistance through the water and sea turtles can move to the surface.

The nature of longline fishing and our gear components as well as variations of technique allow our gear to be quite flexible. By making subtle changes, we may obtain beneficial effects to avoid unwanted hook-ups. Our target species is more valuable when retrieved alive, therefore, we often have the option of tag and release for many of our by-catch interactions. We also collect other scientific information and samples under controlled conditions. The problem is that our focus must be to harvest fish for food. Group after group has suggested altering our gear this way and that way. Keep it shallow, make it deep. Catch big fish says one agency, catch all small fish say another. The gear is flexible but let's be realistic.

We are not opposed to gear engineering and innovation to make an already clean fishing method even better. This will require substantial industry involvement. The industry cannot afford to do it on their own and it would be ineffective for a group of scientists to come up with say, a hook with a guard over the point. You would probably need to subsidize these fishermen for the loss of targeted catch. To be effective, the process must have substantial two-way involvement from start to finish.

Our fishermen have repeatedly requested a temporary restriction on new entrants into the fishery in order to obtain a reasonable control on participation. This would create an incentive to begin serious work on by-catch and other issues relevant to the long-term sustainability of the renewable resources we harvest. Our fishermen have been sitting on the edge of their seats, for many years now, as one group after another places our livelihood and futures under a microscope. Those in the fishery who have invested their lives in the long-term viability of this fishery are willing to work toward practical solutions to real problems. In contrast, new entrants may lack the experience to avoid by-catch and the skill to handle gear interactions with them if they occur. While there is open access to this fishery, it is difficult to begin the work necessary to resolve by-catch issues.

What we see in regard to sea turtles is that the very rare interactions with our gear in the past seem to have been increasing in the last few years. Mortality is still negligible but we are certainly seeing more sea turtles, especially at the surface. The fishermen theorize this increase may be caused by one or a combination of the following:

1. Shifting migratory or foraging patterns.
2. Increasing sea turtle populations, and/or
3. Hungrier sea turtles in the areas of longline activity than in the past.

Many interactions are not the result of a sea turtle taking the bait in the mouth, but of becoming fouled in the mainline gear and the branch lines including ganglions and especially the ball drop lines near the floats. This is especially true for leatherbacks. Since longlines are

tended daily, this hazard to sea turtles is mitigated. Many times, a hook is not even involved. It will be very important to have observers distinguish exactly what is involved with each interaction. If hooked, the details of location of the hook will be critically important. Many fishermen have not yet even seen a sea turtle or a mammal take a bait, although others have experienced this.

Our fishermen are in the early stages of determining the best way to deal with these rare interactions. We would like to be helpful, however, we must insist that the importance of our livelihoods to supply fresh wholesome seafood product for the consumers of our nation and abroad be recognized as a worthy and necessary occupation. If this group can acknowledge this fact, we can establish a cooperative basis to productively address the issue. The greatest progress can be made in the shortest time by giving us reasonable guidelines and instructions on how to best release the rare hooked sea turtle. We have a number of questions about the material we've read on sea turtles recently, especially information supposedly relating to our fishery. Clearly, education and training for fishermen and research priorities should be discussed. I will touch on a few of these things, however John Hoey and Alex Sutton will provide additional information.

According to the information provided to us for this workshop, it seems that, at least for the northeast, your concern is based on the non-lethal cluster encounters from four trips. My first reaction is, why didn't the captains move off the particular edge or piece of water that was creating this problem? I can understand if you caught a cluster in one day; your gear is already set, so the only thing you can do is haul it back. Most fishermen take any available steps to avoid interacting with unwanted species. However, in this case, the fishermen may be untangling live leatherbacks, and thinking that they are doing no harm. Also, please recognize - we never realized that if you catch a sea turtle on one day, it appears that you have a greater chance of catching another sea turtle later in the haulback or on the next day. We are not even sure that the sea turtle biologists are aware of this fact.

My last encounter with sea turtles occurred in July of 1991. It was a cluster encounter, the first and only that I have ever experienced in my career on the water. Three very small sea turtles (50-75 pounds), probably loggerheads, came to the boat with hooks in the side of their mouth. They were all released unharmed and quite lively after snipping the line off at the hook. A fourth similar sea turtle came up holding onto the end of the bait and paddled the length of the boat holding this bait up out of the water and watched us while we pulled the hook out of the bait. It was a totally unique experience which occurred on my one and only voyage with an observer. Prior to, during and after this unusual encounter, I was in communication via radio with the rest of our U.S. fleet fishing off the Grand Banks and the mid-Atlantic. There were no other interactions with sea turtles taking place. I promptly moved off that particular piece of water which prevented any further interactions. **NMFS must take a realistic approach to extrapolating out these rare events to the fleet. Your current number do not reflect reality. They will not lead to realistic estimates.**

We need educational brochures and workshops to consider practical approaches to reduce unwanted interactions and guidance to handle those interactions which do occur. If you involve fishermen, you may gain the knowledge that you seek faster and easier and at less expense to the taxpayers. Our fishermen may need de-hooking devices and lifting slings if advised to remove hooks. Fishermen have repeatedly inquired if a tagging device can be made available with enough reach to deal with a sea turtle alongside the vessel. Very little information on proper identification or other guidance on sea turtles has been made available to us. Thank you for these identity sheets I obtained from NMFS/SEFSC and sent out to BWFA members in March of this year. It would be helpful if these keys could be laminated for use on deck with wet hands. Except for leatherback identification, keep in mind that many fishermen, myself included, lack the experience with sea turtles to make proper identifications.

A few fishermen in our fleet are better qualified to identify sea turtles because they have taken an interest in looking at the problems and working toward solutions. There are some who have stopped their fishing operations to lift smaller sea turtles onboard to remove a hook and/or to fully untangle a snarled sea turtle. Contrary to what I have read, they do not lift them onboard by the line. Most fishermen are simply cutting the leader as close to the hook as possible. You may learn more from those fishermen that have overcome their anxiety and are trying to be more **helpful to the sea turtle** than simply cutting off the problem. Your group needs to consider these types of options, and how to open a two way exchange of knowledge to U.S. fishermen, both recreational and commercial.

There has been some discussion concerning the use of different baits as possibly compounding interactions. Some fisheries or fishery segments raise this argument in defense of their preferred bait. As for the U.S. fishery, we have been using the same baits for many years. Squid and other baits are part of some sea turtles' diets. It is difficult to imagine a sea turtle, especially a leatherback, being able to naturally feed on many of these bait species unless the bait were **densely congregated**. Sea turtles can be pretty quick, but not compared to many of these baitfish including squid and mackerel. I don't believe these baitfish are a consistent part of the sea turtle diet but rather an opportunistic food item. I am interested in any materials you may have on their diet in the wild.

Speaking of diet, according to the literature, jellyfish seem to be a large part of the diet for some sea turtles. There is growing demand for Cannon Ball Jellyfish in China, Japan, Taiwan and other Pacific rim countries. Not only are they valued as a delicacy but their collagen content may be a marketable substitute for current sources. Fisheries are being developed worldwide for these species, including in the U.S. Yet another in a long list of concerns surrounding sea turtles.

We believe that you will find that infrequent sea turtle interactions do occur throughout many fisheries; both recreational and commercial. These problems exist throughout the world's oceans. You must not make the fishing industry bear the brunt of criticism for the status of these species, when there are so many factors that have more direct negative effects

on sea turtles. Dredging, coastal development, beach restoration, and vessel collisions all have much greater impacts.

All high-speed vessel traffic may result in collisions with sea turtles on the surface. It could be years before you realize, **how many sea turtles are affected by fast boats,** especially in Florida and other areas of intense recreational vessel activity. Anyone who has spent time at sea has observed sea turtles waking up as a vessel approaches within feet of the sea turtle at slow to moderate speeds. They scoot away unharmed and perhaps learn to be more wary. However, I have been aboard fast vessels and have lived among many angler who have experienced a "hard thud" while traveling at 20-30 knots and reflected, "What was that?" I have also seen sea turtles flopped up in a wake, the lucky ones that did not encounter a deadly propeller. Operating a boat, especially one with any substantial speed has no comparison to driving a car. The available reaction time upon sighting an object and how a boat handles to avoid a sighted object are completely different than land vehicles.

Both recreational and commercial fishermen have been slow to take this issue seriously. Many are aware of continued harvests of eggs and sea turtles throughout the Caribbean and other third world countries. **Our fishermen are willing to be protective of sea turtles and to work toward realistic goals.** But every new shore development and source of pollution seems to be working against sea turtles. Now the Office of Protected Resources has singled out a fishery that has a very low interaction rate with these species, most of which are released, unhooked, tangled leatherbacks.

Why? Can it be justified by extrapolating rare clustered encounters that are non-lethal into a great number throughout the fleet? This is totally unrealistic. Is it politics? Does anyone really believe that a sea turtle can tell the difference between a dead bait dangling from longline gear and a dead bait dangling from a rod and reel? Are we just an easy target because we are already permitted, submitting logbooks, and taking observers? Or is it convenience to justify research budgets? **Where is the logic and the equity in singling out this fishery?**

As world populations demand more and more protein from our world's oceans to sustain our growing human populations, we must be aware that ecosystem impacts may affect behavior patterns of the species that we are attempting to conserve and manage. **The U.S. commercial fishing industry is being worked into an unrealistic box.** Fishery managers must recognize that if U.S. attempts to rebuild Marine Mammal and Endangered Species populations are successful, and there are more animals in the marine environment, simple logic and probability will dictate that interactions with human activities, including commercial fishing operations, will increase - not necessarily decrease - despite the best efforts we all may make. Our goals need to be practical and attainable.

Suggestions for Longline Fisherman During Sea Turtle Encounters

1. Slow down or begin to stop vessel at first sighting of a sea turtle on the line.

2. Alert manpower to man the rail in case needed. Two long gaffs should be available to recover the opposite side of the mainline as soon as it is available.

3. Stop vessel within range of sea turtle.

4. Gently bring sea turtle alongside.

5. If a tangle exists, gaff up other side of mainline and attach to vessel or float ball in order to isolate the vessel and sea turtle from any tension on the remaining gear in the water.

6. Work tangle off of the sea turtle. If a hook is involved, cut line as close to hook as possible.

7. Remove all line from sea turtle.

8. Have a person available to stand-by with Identity Guide and paper, transfer as much information about

   Length
   Width
   Weight
   Any sores or peculiarities
   Tag numbers if tags are present

9. Immediately following clearance of sea turtle and securing to remainder of gear in the water, properly record all pertinent information concerning this interaction in your daily log. Including:

   Specifics of sea turtle (above)
   Details of interaction
      tangled/hooked
      position on gear/mainline/ball drop/ganglion
      probable depth of segment involved
   Observations in area
   Other vessels interacting in area

10. **Move!** If you have more than one sea turtle interaction in a haulback or on consecutive days, or if by observation or via radio communication interactions have occurred on this particular edge or piece of water.

Distant Water Vessel Captain

Alexander Sutton
PO Box 96
Remsenburg, NY 11960-0096

A sea turtle on North American longline gear is not displaced from its natural element. We do not and indeed cannot lift large sea turtles to the deck. To release a sea turtle, we only have to pull it to the side of the vessel and lean down to cut it free. Nor does our longline gear ensnare a sea turtle to the extent that it cannot reach the surface, a necessity for the survival of the reptile. On a large leatherback it is normally impossible to remove a hook simply because of the size of the creature. However, it is simple to cut the line from the sea turtle. A small loggerhead is easier to deal with because it can normally be brought onto the deck and can be completely freed. An interaction like this will result in a sea turtle that is perhaps bewildered, but alive. A small released loggerhead will normally sprint off in a healthy manner. A leatherback does the same in a more stately leatherback-like way. A released sea turtle from a longline vessel at sea returns immediately to its natural habitat in the same location where it started and has plenty of sea room to make navigational circles and reorient itself to its habitat. A sea turtle takes at most approximately ten minutes to handle. Gear damage is minimal. A sea turtle will typically only tangle one leader or buoy line and a small portion of the mainline. Normally, once the sea turtle has been cut free, the tangled section is simply removed from the line. Because of this simple process there is no resentment against sea turtles by longliners. A sea turtle does not eat or otherwise damage the catch. They are not a major by-catch problem to a longliner. Catching them is a rare and unpredictable event. There is a certain friendliness towards sea turtles by man, even fishermen, that I cannot account for. Even the swarthiest crew of an American longliner seem to have this sea turtle bug.

What can be done to mitigate sea turtle mortality on a longline? I have been thinking about this issue all week. The first thing I would recommend would be to study hook deterioration. I have a piece of corkboard upon which I have tacked several hooks. On one side are the hooks used by American fishermen and on the other are hooks used by Japanese fishermen. The first hook on the American side is the Mustad 7698B. This is a cadmium plated “bent-in” hook with a welded eye. It is a size 9/0. There are three versions of it, brand new, fished but not lost, and from the mouth of a fish. You can see that there is significant deterioration in the hook, even as it is fished and is not actually in a fish’s mouth. These hooks are infamous among fishermen for rusting. This hook has been, with with some exceptions, the U.S. industry standard for perhaps the last 6 years. The second set of hooks is a brand called Eagle Claw. Previous to about two years ago, the cadmium plating was the standard for all hooks used by pelagic U.S. longliners. Two years ago, the Eagle Claw company produced the second hook: it is in the shape identical to the Mustad hook. It has a different coating on it, which is more rust resistant. When the hooks come new they are shiny as you can see. The first hook in this row is brand new. The three below it came from the

mouths of fish I caught. As you can see the deterioration of the Eagle Claw is substantially less than that of the Mustad. In the next row are Japanese hooks that I procured in 1992. The first hook is a giant tuna hook taken off a Japanese longline I tangled with on the tail of the Grand Banks in November of 1992. Below it are two hooks taken out of fish I caught in 1992 or previously. The extensive deterioration, especially at the hook eye is evident. The next row of hooks are Japanese hooks that I procured in 1993. On these two hooks you can see the zinc attached to the shaft of the hook. On the deteriorating hook you can see how the 1993 eye has lasted quite a bit better than the similar 1992 version. The last row is a hook from a Canadian longliner, which I got in November of 1993 also. This hook is a Mustad 7698B 10/0. They apparently are still using the older, more corrosive hooks.

This is not a scientific study, yet it shows two things. One, the fishing nations of the world are switching to hooks that last longer. This is a natural economic evolution of fishing gear. While these less corrosive hooks will not necessarily catch more fish, they will be fishable longer. As a captain, I switched from the Mustad to the Eagle Claw simply because the Eagle Claw was $ 0.20 cheaper. As we use thousands of hooks per year, this was not a hard decision to make. The second thing it shows is that fish and other by-catch that get released are now swimming around with a longer-lasting hook in their mouth. It would seem to me that this is the wrong direction to be heading in a fishery with the potential to reduce by-catch of several species by releasing them alive, especially protected species. Some in the industry may balk at losing their shiny hook, yet this small action may be an easy way to aid in the survival of any released creature.

Preliminary data that I have seen for the Japanese longline fishery in the Gulf of Mexico indicates a higher mortality rate than I have experienced. In eight years of pelagic longlining, I have seen many sea turtles at the surface, encountered some on the gear, and yet I have never seen a dead sea turtle. We caught a sea turtle once a few years ago that was very weak. It was a leatherback that was trussed up in the mainline and a buoy. The buoy was right up against the sea turtle, wound-up tight. I stopped the boat alongside the sea turtle and isolated it from the rest of the mainline. It was approximately 1:00 PM in the afternoon and the weather was beautiful. I got on my stomach at the edge of the boat and leaned out over the sea turtle and untangled it. As I started, I was struck by the fact that it did not struggle. There was no bleeding as indeed I have never seen a bleeding sea turtle, no doubt a factor of its hardy, reptilian body. It was definitely alive as I could tell by the normal, gasping-like breathing of a sea turtle, the result of the mist in its breath, much like the blow of a whale. As I got it untangled, it began to move its flippers. I finally got the buoy unwound which freed up the sea turtle's movements as the buoy was no longer wedged against its front flippers. Now it began normal leatherback-like struggling as I cut it free. It slapped me in the head and gave me a mid-afternoon shower. As it swam off I felt confident that it would survive. That sea turtle was the weakest of any sea turtle I have ever seen.

Most American longliners that I have talked to say the same thing. They catch a few sea turtles that are almost always alive. I am puzzled as to how any longline gear could produce a

significant boatside mortality rate in that my personal gear in eight years of fishing has never yielded a dead sea turtle. There are several explanations that I can proffer. The first would be the difference of the depth of the gear that is fished. As you can see from my diagram, there are significant differences in various international gear types. For example, Japanese bluefin gear is fished much deeper than North American swordfish gear and there is more distance and line between floats. A second characteristic of gear to examine would be gear weight. In an albeit unscientific analysis, I have attempted to weigh a sample of American gear, Taiwanese gear and Japanese gear. The type of lay that the line has would be another significant factor. A typical North American longline is dragged out behind the boat by the weight of the line already in the water. This results in a tight longline that will stretch out straight on the current edges when laid correctly. A typical "Japanese"-style longline mainline is literally propelled off the stern of the fishing vessel by what is called a "line shooter" to be laid slack in the water, with lots of "sag" in the line. This line I would call laid out "slack". In my hauling experience, when our line is parted or broken for some reason, the line comes back "slack". This results in both the catch and any by-catch being excessively tangled. A tight longline comes back "clean" with almost no tangles at all, no matter what size or characteristic the catch has. The last possible explanation I can render for a mortality rate difference between any two gear types might be because of the time of haulback and the time that sea turtles are feeding.

I do not have any other suggestions for mitigating the incidental take of sea turtles. I believe the sea turtles are on the same current changes that guide all pelagic creatures in the North Atlantic Ocean. The sea turtles must be feeding in the Gulf Stream and following the warm temperature burst of current that breaks off the stream south of Newfoundland and split to the northeast into the North Atlantic current. The large leatherbacks seem to be in their element in these waters, eating alongside killer whales, swordfish, and tuna. These eddy-like formations seem to be unpredictable in that some years they have many sea turtles and some years they have almost none. There is a lot at work in nature, propelling these sea turtles across the ocean. I once fished a warm eddy in November that broke up into the cold Labrador Sea current, getting 100 miles north of the warm North Atlantic current. We fished this piece of water for 9 days before we were forced to take three days off to avoid a hurricane. We caught one small loggerhead in this piece of water during the second day of fishing, when this water mass was still connected to the main stream. By the ninth day, we were seeing 15-20 loggerheads a day, all on the surface, with their heads out, just drifting. We would haul by them, within ten feet and they did not move. When we first fished that eddy, the core water temperature was 70 degrees. When we finally gave up fishing and faced the stern into the air to avoid the storm, the core water temperature was 58 degrees. We had a hard time in that dying eddy and I imagine the sea turtles did also.

I am not leading to any mitigating suggestion here. I only suggest that the sea turtles, like the fishermen and the fish, are following the warm water as it cuts across the southern edge of the cold water. If there is a specific pattern to how they move in opposition to the fish so that a fisherman could avoid a sea turtle by following that pattern, I do not see it. I

would suggest that scientists use longline fishermen to tag leatherbacks. Find out the mysteries of their migrations. Use longline by-catch as a ruler to measure sea turtle populations, analyze all this new available data, and ascertain what gear type is the best at mitigating mortality. Take measures, but calculated action, and work with us to solve these problems.

Distribution of Pelagic Longline Fisheries in the Western Atlantic Ocean

John J. Hoey

Blue Water Fishermen's Assoc.
National Fisheries Institute, Inc.
1525 Wilson Blvd.
Suite 500
Arlington, Virginia 22209

Within the context of the workshop goal, "To identify methods to reduce interactions and mitigate takes, including non-lethal encounters and interactions that result in injury and in some cases death", this report provides background information on longline gear, fishery characteristics, and recent trends in the U.S. pelagic longline fishery. It is important that differences between operational and gear characteristics and regional-seasonal fishing patterns, and differences between U.S. and other international pelagic longline fisheries be recognized. These and other factors will undoubtedly influence interaction rates and any analysis that attempts to quantitatively evaluate the biological consequences of these interactions. Comments are provided on research needs that relate both to existing data and future cooperative field research. The absence of comprehensive analyses of existing observer data, from the U.S. and other world fisheries, limits the scientific guidance that might be provided to guide workshop discussions. In addition, analytical results could help identify and prioritize options to reduce interactions and mitigate takes and can provide fertile ground for cooperative efforts between fishermen and scientists.

U.S. Longline Fishery

Preliminary information has been generated by analyzing data from established monitoring programs, including vessel logbooks, landing reports, and observer and fishermen sampling programs. Most of the material is taken from NMFS reports or documents from the Standing Committee on Research and Statistics (SCRS) of the International Commission for the Conservation of Atlantic Tunas (ICCAT). Supplementary material and preliminary summaries were provided by NMFS personnel and are subject to revision. Some of the information presented at the workshop on trends in the U.S. pelagic longline fishery was subsequently revised and submitted to the ICCAT-SCRS during the 1994 meetings (Hoey, Bertolino, Cramer, and Rogers 1995).

Many management regulations (quotas and size limits) affecting the U.S. Atlantic longline fishery are recent (1990 or later), whereas fishery reporting regulations (permits, logbooks, and trip landing receipts) were implemented earlier. Data collection and processing is time-consuming and labor-intensive, sometimes resulting in a backlog of one year or more before summaries can be provided. Logbook formats and reporting requirements change. In

many cases, similar information was provided voluntarily by interested captains, owners and dealers prior to the establishment of mandatory reporting. It is important to recognize these changes over time so that decisions relating to the appropriateness of the sampling records can be made before that data is used in quantitative analyses. In particular, regulatory changes have influenced compliance rates between identifiable fleet components. The Atlantic longline fishery has several components, including a Gulf yellowfin fishery, a mixed swordfish-tuna fishery along the Atlantic coast, and a distant water swordfish fishery. Additionally, shark fishery management plan regulations have increased reporting from smaller coastal longliners that had not been traditionally captured in the swordfish reporting system. Each of these fishery components can be characterized by different operating patterns (time and space) and gear configurations which will influence interaction rates with sea turtles.

Fleet Size

Swordfish permits and logbooks have been required since 1987. There are no qualifying criteria for these permits and many more are issued than are used. Table 1 summarizes permit information with respect to fishing activity. Fleet size and vessel activity peaked in 1989 and has subsequently declined. The increase in the number of vessels that reported fishing at least once (fished), from 339 in 1992 to 418 in 1993, may reflect increased reporting by shark longliners.

Table 1. Numbers of permitted longline vessels and records of activity in the fishery. Permit lists the number of permits issued, fished is the number of vessels reporting fishing, > 1 swf is the number of vessels that caught at least 1 swordfish, and > 1 swf 5 mn is more than 1 swordfish in each of 5 months. Total hooks are listed in millions. **Values listed for 1993 are preliminary.** (Source: Cramer, 1993, and preliminary data NMFS-SEFSC).

YEAR	PERMIT	FISHED	> 1 SWF	>1 SWF 5mn	HOOKS
87	616	290	273	173	6.541 m
88	684	390	339	197	7.016 m
89	721	457	416	227	7.942 m
90	610	419	363	195	7.500 m
91	549	342	309	164	7.736 m
92	515	339	303	182	9,040 m
93	874	418	298	147	7,552 m

Differences between the numbers of permits issued and the vessel counts associated with at least one report of fishing and reports of successful swordfish fishing highlight the significance of seasonal part-time involvement in pelagic longline fisheries. In light of international quota restrictions and deteriorating conditions in other U.S. fisheries, participants in the pelagic longline fisheries for swordfish and tuna have been working with NMFS Highly Migratory Species Management Division to establish an access limitation program that would eliminate inactive permits and limit participation to currently active, economically dependent vessels. License limitation will provide an incentive for the industry to proactively address bycatch issues such as sea turtle interactions.

Longline Effort

Previous reports have summarized logbook recorded effort in numbers of daily sets and total hooks fished by year, month, area, and combinations of these variables (Cramer et al., 1993; Cramer, 1993; Cramer, 1994). In this report the minimum number of hooks per set criteria was increased from 100 to 150 hooks per set. This criteria is used in summarizing logbook reports to exclude non-longline effort from charter vessels, bandit rig or handline effort from other commercial vessels, and non-pelagic longline effort by smaller coastal vessels, especially part-time activity targeting bluefin, yellowfin, and pelagic sharks by charter vessels and others involved in chunking operations. In addition, all trip summaries (multiple sets reported on a single daily sheet) and reports of tended line effort were excluded when they could be identified. Bottom longline records were identified and deleted when possible. Additional information on the characteristics of the various data sets that can provide information on effort and fleet participation is provided in Hoey et al., 1995. The procedures used to summarize the reported logbook data have attempted to exclude all non-pelagic longline effort and a limited number of very small sets so that these trends accurately reflect effort for the offshore U.S. longline fleet that targets swordfish and tuna.

The total number of logbook reported pelagic longline sets with more than 150 hooks per set has declined 16% from 1989 to 1993, from 17,780 sets to 14,970 sets, with little apparent change in proportional effort by region, except that northeast sets have increased slightly while southeast sets have declined (Table 2). While the number of longline sets or days fished has apparently declined, the reported longline effort in terms of hooks set has increased (Figure 1). The increase results primarily from the Northeast and Gulf of Mexico regions where tuna effort has increased in importance. Effort has also increased in the areas that correspond to tropical central Atlantic areas identified as "OTHER" and "NOREQ" in Cramer 1993 (annual logbook report). This reflects offshore movement of the larger U.S. vessels to avoid gear conflicts and congestion in the Caribbean basin, while searching for larger swordfish and productive tuna fishing conditions associated with convergent current zones. In the Gulf of Mexico reporting has improved, especially among the Vietnamese-American fleet. In addition, throughout the southern areas of the fishery, increased reporting by shark vessels, and/or increased activity by small coastal longline vessels displaced from snapper and grouper fisheries, has influenced patterns in participation and estimates of total annual effort by area. Within each area effort levels

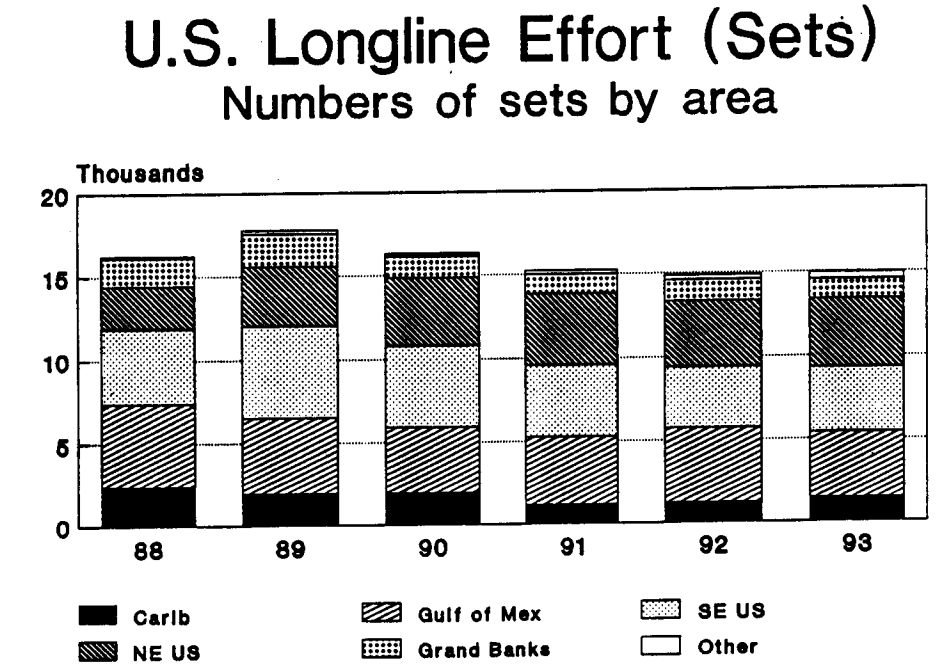
vary by month, with greater seasonal variability evident in the northern areas and in the distant water fishing regions.

vary by month, with greater seasonal variability evident in the northern areas and in the distant water fishing regions.

Table 2. Number of pelagic longline sets reported in mandatory logbooks from 1988 through 1993.

YEAR	CAR	GOM	SE US	NE US	GRB	OTH	TOTAL
1988	2,417	5,000	4,502	2,530	1,683	82	16,214
1989	1,929	4,590	5,556	3,503	1,962	240	17,780
1990	1,931	4,017	4,891	4,033	1,285	185	16,342
1991	1,155	4,124	4,321	4,230	1,163	230	15,223
1992	1,197	4,530	3,676	3,928	1,248	301	14,880
1993	1,439	3,972	3,904	4,101	1,128	426	14,970

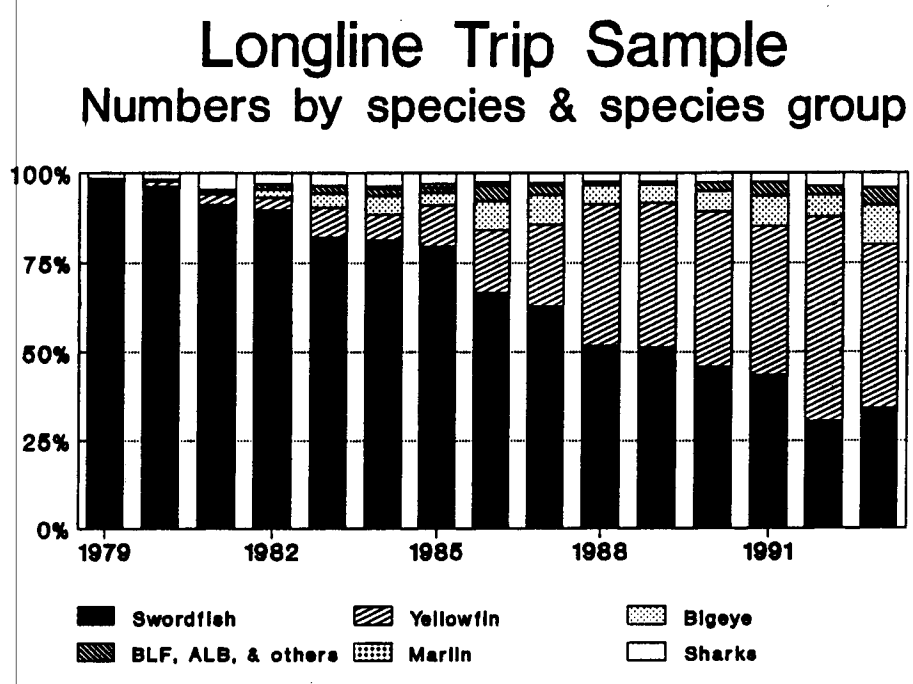
Figure 1. Numbers of hooks set (in millions) for pelagic longline sets reported in the mandatory logbooks from 1988 through 1993 by area.



Trends in the Species Composition of U.S. Longline Landings

The importance of swordfish to the longline fishery, as reflected in the species composition of the catch monitored from the unloading receipts, has consistently declined since the mid-1980s in terms of the proportion of the sampled catch in numbers (Figure 2), the absolute numbers of individuals, and biomass sampled. The total number of fish (of several species) documented in the unloading reports has increased from less than 100,000 individuals prior to 1986 to about 200,000 individuals in the most recent two years. Although the unloading reports are not a census and the proportion of the fleet sampled has changed over time, the number of trips sampled annually and by region is significant. These records have included more than 2,800 trips in each of the past six (6) years (Hoey et al., 1995). Prior to 1988 when landings reports became mandatory, longline trips in the Gulf of Mexico were apparently not being sampled as effectively as in other regions by the voluntary program that was in place. Although it was more likely that swordfish trips would be reported in the early part of the time series, the general pattern indicated in Figure 2 is consistent with increased representation of tunas in the reported total U.S. longline landings of swordfish, yellowfin, bigeye, albacore, and bluefin. Concomitant with the shift in landings composition towards tuna, operational (set and haul times) and gear changes (lightstick, hook, and bait changes) occurred within the fleets operating in the Gulf of Mexico and off the northeast coast of the U.S.

Figure 2. Proportional species composition (weight) for sampled U.S. Atlantic longline trips sampled between 1978 and 1993.



Factors that Influence Sea Turtle - Longline Fishery Interactions

Cross-referencing logbook reports, landings records, and observer information can help establish appropriate stratification variables for both fishing effort and observer records that differentiate between the components of the offshore longline fishery. It is particularly important to recognize the differences between gear and operating styles, especially for those factors which will influence encounter rates with turtles (season, region, target species, set and haul time, bait, hook, lightstick use, etc.). Table 3 provides preliminary summaries for some observer records from Japanese and U.S. fisheries in the western North Atlantic that illustrate different encounter rates. These differences must be kept in mind when you evaluate estimates of total longline effort provided in annual summary reports from monitoring programs. U.S. longline sets occur seasonally from off the north coast of South America, throughout the Gulf of Mexico, along the eastern seaboard and offshore to the tail of the Grand Banks eastward toward the Azores (1992 effort distribution plotted in Figure 4, Witzell, this volume). Much of the preliminary data that has been provided on longline - sea turtle interactions has not accounted for differences between seasonal interaction rates within regions or differences between effort targeting tuna as compared to swordfish within the same region-season strata.

Preliminary information indicates that the majority of turtles involved with the gear, especially leatherbacks, can be released alive. While leatherback and loggerhead interactions have been confirmed, there apparently are questions about the reliability of identifications of other species. A comprehensive review of available Atlantic observer data sets is needed to examine differences in interaction rates between areas, seasons, and operating characteristics. This review would also provide information on sizes/life stages of the turtles and any fine scale environmental anomalies that influence interactions, especially multiple interactions as mentioned by Witzell (this volume). Information on gear and operating styles associated with the different types of interactions; entanglement (not hooked), foul-hooked (fins or shell), hooked in jaw, throat, or abdomen, could suggest operating guidelines that would reduce interactions or improve the condition and survivability of the turtles that are caught.

In terms of assessing the biological consequences of these interactions, a reliable estimate of the total number of interactions (lethal vs. non-lethal and by hook location) and total number of mortalities must be compared against population estimates for the size/age classes that are represented in the interactions. There are a number of analytical issues that relate to the reliability of estimates based on the expansion of an observer data set that is statistically characterized by infrequent events that appear clustered and contiguous in time and space. Appropriate estimation procedures depend on the distributional characteristics of the interaction rate (catch per set or day or catch per 1,000 hooks). Distributional characteristics undoubtedly differ by season, region, and fishery. In general, the distributions will be skewed (i.e., non-normally distributed) with a predominance of zero observations. In addition, the positive observations are clustered and contiguous in time and space. The use of mean and median observed catch rates may lead to overestimates of total interactions. Alternative distributional assumptions (poisson, negative binomial, delta lognormal) or additive models that independently model zero frequencies and positive observations should be evaluated. While the total number of interactions (non-lethal + lethal) may be estimated with reasonable precision, estimating lethal interactions directly may not be possible given the previously-

described data characteristics and the fact that the vast majority of the interactions are non-lethal.

In terms of survivability, the key variables are the style of interaction, hook location, and the degree to which the turtles can be completely released and untangled from the gear. Advice from scientists and managers on specific steps that fishermen could take to increase the survival of released turtles would immediately help to reduce mortality. Fishermen have suggested: immediately slowing down the vessel and gear retrieval, minimize the strain on the leader, cut the leader free as close to the hook as practical, and remove hooks when possible. Unfortunately, because of the political sensitivity of sea turtle interactions and the absence of reasonable and official scientific guidance from the appropriate management agency, captains are extremely hesitant to do anything but cut the leader and release the turtle quickly. Questions of particular interest to captains include: should hooks be removed from flippers? Should attempts be made to remove hooks from the jaw? Should hook removal efforts be done on deck (for appropriate sized turtles) or in the water? Should a de-hooking device be used if the hook is in the throat? Under what conditions should resuscitation techniques be tried? Clearly, improved communication between managers, interested scientists, and fishermen is needed to effectively and rationally address this issue. Interested scientists and managers should develop outreach documents in a format suitable for U.S. and foreign fishermen (pamphlets or videos) describing appropriate procedures for handling turtles, including resuscitation and hook removal techniques.

As a final comment, U.S. commercial fishermen are especially sensitive about being isolated on environmental issues when their perception is that other fisheries are also involved, including other commercial fisheries using different gear, recreational fisheries, and fisheries conducted by vessels from other nations that would impact the same stock of concern. Since both the loggerhead and leatherback sea turtles are distributed within the North Atlantic current gyre, other north Atlantic pelagic longline fisheries for highly migratory species and other offshore fisheries (purse seine, driftnet, pair-trawl, bait-boat, rod and reel, and handline) probably interact with the same sea turtle stocks. Other north Atlantic fishing longline fleets are deployed by Canada, Portugal, Korea, Taiwan, Mexico, Cuba, Venezuela, Trinidad and Tobago, Barbados, Grenada, St. Vincent, St. Lucia, and several artisinal fisheries. ICCAT landing statistics can provide an indication of the significance of Atlantic longline fisheries. While U.S. fishermen are committed to working cooperatively with U.S. scientific and management groups to evaluate the extent of the problem and consider effective mitigation options, it seems inevitable that international cooperation will be required to effectively address sea turtle mortality resulting from interactions with pelagic longline gear.

Table 3. Preliminary Summary of Western North Atlantic Pelagic Longline Observer Records from the Canadian Department of Fisheries and Oceans and the U.S. National Marine Fisheries Service.

Japanese Longline Fishery

1) Inside Canadian EEZ
Approximately 4,055 sets observed between 1978 and 1992. Forty-six (46) turtles were observed. Information on mortality rates was not available at this time. Interaction rate .0113 turtles/set. (J. Porter DFO St. Andrews, pers. comm.)

2) Inside U.S. EEZ in Gulf of Mexico
765 sets observed between 1978-1981. Thirty-two (32) turtles observed, 91% released alive. Interaction rate .0418 turtles/set.

3) Inside U.S. EEZ North of 35 N
4,634 sets observed between 1978-1988. One hundred and thirteen (113) turtles observed, 67% released alive. Interaction rate .0244 turtles/set.

U.S. Longline Fishery*

1) Gulf of Mexico only.
349 sets (196,744 hooks) observed between 1987 and 1991. Three (3) turtles observed, all released alive. Interaction rate .0086 turtles/set. No interactions reported on 159 observed sets prior to 1990. Data includes 320 sets from LSU observer program which included 252 yellowfin tuna sets, 12 swordfish sets, 33 shark sets, and 1 snake eel set.

2) Gulf of Mexico, Caribbean, Southeast U.S., and Northeast U.S.
1992 SEFSC Observer program. 171 sets (80,426 hooks) observed. Seven (7) turtles recorded. Interaction rate .0409 turtles/set.

1993 SEFSC Observer program. 548 sets (356,353 hooks) observed. Fifty-six (56) turtles recorded. Interaction rate .1022 turtles/set.

3) Northeast U.S. north of 35 degrees north including Grand Banks.
1992 NEFSC Observer program. 161 sets observed. Thirty-six (36) turtles recorded with one (1) documented death. Interaction rate .2236 turtles/set.

1993 NEFSC Observer program. 278 sets observed. Thirty-seven (37) turtles observed (1 dead, 1 alive injured, 17 alive not injured, and 12 alive condition unknown). Interaction rate .1331 turtles/set.

* SEFSC and NEFSC observer data will be combined and summarized consistently by area and season.

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Distribution and Ecology of Sea Turtles in the Western Atlantic Ocean

Stephen J. Morreale

Cooperative Research Unit
Department of Natural Resources
Cornell University
Ithaca, NY 14853

Of the six species of sea turtles that occur in the western Atlantic, five are found in North American waters. These sea turtles range in size from the huge leatherback, *Dermochelys coriacea*, which can exceed 500 kg; to the intermediate-sized loggerhead, *Caretta caretta*, and green sea turtle, *Chelonia mydas*, weighing more than 150 kg as adults; to the more diminutive hawksbill, *Eretmochelys imbricata*, and Kemp's ridley, *Lepidochelys kempii*, rarely exceeding 85 and 60 kg respectively. In addition to the obvious size differences, the leatherback with its pliable shell is the only species among these belonging to a different taxonomic family. All five of these sea turtles currently are listed in the Federal Register as either threatened or endangered, however the individual species range greatly in abundance within North American waters.

Despite their large size, sea turtles generally are not highly visible. Except for very brief periods in the lives of adult females when they come ashore to nest, sea turtles spend virtually their entire lives at sea. This unique behavior results in great difficulties in accurately determining their distribution and abundances. Additional complexities in the ecology of these sea turtles, such as ontogenetic behavioral and geographic shifts and long-distance migratory movements, have further contributed to obscuring natural patterns of timing and distribution of sea turtles to observers. Thus, any single method used to assess the ecology or abundance of sea turtles that depends upon observation will almost necessarily yield incomplete data. Much better estimates and more complete data result from the use of many different methods simultaneously.

Among the most often used source of data for estimating sea turtle abundance is enumeration and extrapolation of numbers of nesting females. Although the popularity of this method probably stems from the relative accuracy that can be achieved by counting sea turtles or their nests on land, from such a census only weak inferences can be made about relative numbers of juveniles and adult males. Moreover, estimating species distribution ranges and timing of occurrence based on nesting beach surveys can lead to some gross misconceptions, since they only deal with a specific component of the overall population. No information can be obtained from this method about other individuals that are not reproductively active at the time of the survey. In the eastern U.S., loggerhead nesting areas extend from the Gulf of Mexico to North Carolina, with most nesting activity occurring along the Atlantic coast of Florida. Green sea turtles, leatherbacks, and hawksbills nest in much smaller numbers, also primarily on Florida's east coast. Kemp's ridley nesting is negligible on U.S. beaches.

Separate but overlapping data on sea turtle distribution and ecology can be derived from stranding records. Along with nesting females, stranding data also include adult males and juveniles of a wide range of size classes. In addition, stranded sea turtles often are representative of the populations that are present within nearshore waters close to the location

and timing of stranding. Therefore, these data provide a more extensive view of overall geographic range of the species and of seasonal and age related movements. In the case of all five species present in eastern U.S. waters, the distribution and timing of occurrence of stranded sea turtles is much more extensive than would be indicated merely by nesting activity. Thompson (1988) reported that nearly one fourth of all loggerhead strandings occur in the Gulf of Mexico and in the Northeast, well outside of the primary nesting areas. Similarly, nearly one third of the stranded green sea turtles are found in the Gulf of Mexico. The most striking example is that of the Kemp's ridley, which doesn't even nest in the U.S. but has been found stranded throughout the Gulf and along the Eastern Seaboard in large numbers. The stranding records further indicate that large numbers of young Kemp's ridleys are present each summer at least as far north as New York (Morreale et al., 1992).

Another important source of data comes from records of incidental captures of sea turtles in commercial fisheries. Because sea turtles captured in this mode presumably have been intercepted during their normal activities, such records contain valuable information on sea turtle ecology and distribution. At the least, fishing records provide timing and location of occurrence of individuals. Often these data also can be used to estimate demographic features such as species composition, size structure and sex ratio in addition to providing biological data such as feeding behavior and habitat usage. For conservation purposes, such data are frequently included in quantification of impact on a species and formulation of management strategies (Witzell, 1984).

The widespread distribution along the continental margin from the Gulf of Mexico to Georges Bank has led to the extensive use of aerial surveys as a fourth means of censusing populations. If performed carefully, an aerial survey can offer valuable information that can not be obtained in other ways, such as shipboard observation. Using such a careful survey, Shoop and Kenney (1992) presented extensive data on loggerhead and leatherback abundances over an area encompassing northeastern U.S. waters. These data demonstrated that both of these species occur off the northeastern coast throughout the waters extending from the coast out to the shelf break. Moreover, it was noted that there was a strong seasonal component to sea turtle distribution in the Northeast, with peak abundance for both species occurring during the summer and almost no individuals being observed in the winter.

Data from an extensive study of sea turtle ecology and behavior in the Northeast by Morreale and Standora (1994) were highly complementary to those from the aerial surveys. Using a combination of mark-recapture techniques, radio and satellite telemetry, and stranding data, sea turtles were monitored both in inshore waters during the summer and as they migrated along extensive oceanic routes during the fall. Unlike aerial surveys, these techniques enabled specific individuals to be monitored through time and were not limited by aspects such as amount of time sea turtles spent at the surface, visibility of individuals, or weather conditions. In addition, because these studies included many sea turtles too small to be seen from aerial surveys, new and important information was obtained about earlier life stages of loggerheads, Kemp's ridleys, and green sea turtles. Not only was there a pronounced seasonal influence on occurrence and activity of sea turtles, but there were indications that many sea turtles in northeastern inshore waters are representative of a group of individuals that recently shifted from pelagic surface feeders to shallow-water benthic foragers. After benefiting from abundant resources in northeastern coastal waters during

warm months, these sea turtles emigrate to southern coastal waters where they can overwinter until the next spring when they can begin their coastal migratory movements again.

Summary

Each of the above techniques of monitoring sea turtles conveys important information about species distribution and ecology. However, each individual method has its attendant limitations. Therefore, a judicious approach in assessing sea turtle populations would necessarily include several different modes of collecting data. From the wide array of techniques that have been employed, some general conclusions can be made. There have been five species of sea turtles recorded in U.S. waters extending from the Gulf of Mexico to the Atlantic Coast as far north as New England. The loggerhead is likely the most abundant, with leatherbacks and Kemp's ridleys being numerous and widespread far into northern waters. Green sea turtles probably become more abundant in southern waters and hawksbills are not often encountered north of the Gulf of Mexico.

The overall range of a species, however, is not necessarily representative of all individual members. Sea turtles exhibit complex life cycles, thus, the occurrence of a sea turtle in a specific region is dependent upon diverse ecological elements. Many small sea turtles of all species probably spend the earliest portions of their lives in pelagic waters, primarily those associated with the Gulf Stream. Large individual loggerheads and leatherbacks utilize the coastal waters extending out to the shelf break. Kemp's ridley, loggerhead, and green sea turtles of intermediate sizes utilize coastal and inshore waters where they exhibit seasonal migrations which may persist throughout their juvenile lives. Hence, both ontogenetic factors such as life stage of the individual and environmental factors such as season within the year can exert strong influence on the occurrence and behavior of sea turtles.

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Research Plan to Assess Sea Turtle Hooking Mortality: Results of an Expert Workshop Held in Honolulu, Hawaii

George H. Balazs

U.S. Department of Commerce
National Marine Fisheries Service
Southwest Fisheries Science Center
Honolulu Laboratory
2570 Dole Street
Honolulu, Hawaii 96822

Sea turtles, *Cheloniidae* and *Dermochelyidae*, are known to ingest baited hooks or become entangled and hooked externally in association with longline fishing. All sea turtles under U.S. jurisdiction are listed and protected under the U.S. Endangered Species Act of 1973. However, the number of sea turtles captured in longlining, the level of mortality and injury caused by these interactions, and the resulting impact to the affected stocks, are currently unknown. Mortality and injury of sea turtles from incidental capture in certain other fisheries are already recognized as important issues to the conservation and recovery of these threatened and endangered species. Recently there has been increased concern by the National Marine Fisheries Service over reports of sea turtles hooked in the North Pacific by the Hawaii-based longline fishery. The limited information available on this subject has been summarized in a formal Section 7 Biological Opinion prepared by the National Marine Fisheries Service.

Objective

The research plan identifies a coordinated series of research activities to estimate mortality and physiological impacts on sea turtles hooked and/or entangled by Hawaii's domestic longline fishery.

Planning framework

The sea turtle Hooking Mortality Workshop held November 16-18, 1993 was sponsored by the Honolulu Laboratory, Southwest Fisheries Science Center, National Marine Fisheries Service, NOAA. Scientists from across the U.S.A., as well as from three foreign nations, met to propose and discuss activities that can be used to estimate mortality and injury to sea turtles from longlining. Longline fishermen and industry representatives were also invited to attend. Using an interactive planning methodology, a research plan was prepared as a first step in developing a comprehensive research strategy on sea turtle impacts from longlining. No formal organization of the participating scientists exists, but individual researchers and their agencies may use the research plan as the framework for research coordination.

Recommendations

The research plan recommends a schedule of activities ranging from 1.5 to 5 years in duration that would result in substantial progress in determining the level of mortality and physiological impact to sea turtles from longline hooking. The estimated cost of this research program is $2.5 million in specific research activities and a minimum of $640,000 in ship time for field work. It is assumed that much of the required research will take advantage of existing programs where ship time is available at no additional cost.

The major activities in the research plan consist of studies relating to: (1) mortality models; (2) hooking mechanics; (3) clinicopathology of hooked sea turtles; (4) hooking physiology; (5) impact assessment of hooked sea turtles in captivity; (6) biotelemetry of hooked sea turtles; (7) live sea turtle collection; (8) pelagic sea turtle ecology; and (9) predation of hooked sea turtles.

At present, there is very little research being conducted on longline hooking mortality of sea turtles. The research plan lays out the logical sequence of steps and conceptual roadwork for success, but funding sources are not identified. The proposed work must be balanced against competing and important research interests within the same issue, such as hooking mitigation and sea turtle treatment measures. However, it is apparent that much needs to be learned about hooking mortality which will be applicable not only in the North Pacific but also to sea turtles on a worldwide basis.

Appendix I. Workshop Participants and Observers

Workshop Participants:

George Balazs
Honolulu Laboratory
Southwest Fisheries Science Center
NMFS
2570 Dole Street
Honolulu, HI 96822

Nelson Beideman
Blue Water Fishermen's Assoc
910 Bayview Avenue
Barnegat Light, NJ 08006

Dr. Alan Bolten
Archie Carr Center for Sea Turtle Research
Bartram Hall
University of Florida
Gainesville, FL 32611

Colleen Coogan
Southeast Regional Office
NMFS
9721 Executive Center Dr.
St. Petersburg, FL 33702

Dr. Scott Eckert
Hubbs - Sea World Research Institute
1700 South Shores Road
San Diego, CA 92109

Patricia Gerrior
Northeast Fisheries Science Center
NMFS
Woods Hole, MA 02543

Dr. John Hoey
Blue Water Fishermen's Association
National Fisheries Institute
1525 Wilson Blvd. Suite 500
Arlington, VA 22209

Dr. Molly Lutcavage
New England Aquarium
Pelagic Group
195 State Street
Boston, MA 02110

Stephen Morreale
Cooperative Research Unit
Department of Natural Resources
Cornell University
Ithaca, NY 14853

Ralph Owen
5 Fordham Road
Sag Harbor, NY 11963

John Watson
Pascagoula Laboratory
Southeast Fisheries Science Center
NMFS
P.O. Drawer 1207
Pascagoula, MS 39568

Phil Williams
Office of Protected Resources
NMFS
1335 East-West Highway
Silver Spring, MD 20910

Wayne Witzell
Southeast Fisheries Science Center
NMFS
75 Virginia Beach Drive
Miami, FL 33149

Facilitator

Paul Anninos
NMFS
1335 East-West Highway
Silver Spring, MD 20910

Workshop Observers:

Dr. Alonso Aguirre
PO Box 1522
Fort Collins, CO 80622

Rod Dalton
Southeast Regional Office
NMFS
9721 Executive Center Drive
St. Petersburg, FL 33702

Marydele Donnelly
Center for Marine Conservation
1725 DeSales St.
Washington, DC 20036

Tim Eichenberg
Center for Marine Conservation
1725 DeSales St.
Washington, DC 20036

Svein Fougner
Southwest Regional Office
NMFS
501 W. Ocean Blvd. Suite 4200
Long Beach, CA 90802

Bob Harman
Western Pacific Regional Fishery
Management Council
1164 Bishop Street
Room 1405
Honolulu, HI 96813

Gail Johnson
Pocahontas, Inc.
RFD #1 Box 321
South Harpswell, ME 04079

James McCallum
Honolulu Laboratory
Southwest Regional Office
NMFS
2570 Dole Street
Honolulu, HI 96822

Eugene Nitta
Honolulu Laboratory
Southwest Regional Office
NMFS
2570 Dole Street
Honolulu, HI 96822

Chuck Oravetz
Southeast Regional Office
NMFS
9721 Executive Center Dr.
St. Petersburg, FL 33702

Jason Patlis
Office of General Counsel for Fisheries
NMFS
1335 East-West Highway
Silver Spring, MD 20910

Dr. Pamela Plotkin
Office of Protected Resources
NMFS
1335 East-West Highway
Silver Spring, MD 20910

Chris Rogers
Office of Fisheries Conservation and
Management
NMFS
1315 East-West Highway
Silver Spring, MD 20910

Karen Salvini
Office of Protected Resources
NMFS
1335 East-West Highway
Silver Spring, MD 20910

Heather Weiner
Office of Protected Resources
NMFS
1335 East-West Highway
Silver Spring, MD 20910

Appendix II. Participant Responses

Unstructured responses to question: "In the context of reducing, preventing, and mitigating longline-sea turtle incidental takes, what are the problems and issues which must be addressed?"

1. Need to find the current commercially-produced hook which yields the least sea turtle mortality.

2. Need to identify the oceanic locations, by season, of highest and lowest incidental take.

3. Gear and operating differences and condition at retrieval.

4. Need for use of standardized database collection by NMFS on the incidental take of sea turtles by areas (Northeast, Southeast, Pacific).

5. Need to develop techniques to validate sea turtle identification.

6. Need to understand why sea turtles are attracted to longline gear.

7. Need guidance for interaction.

8. Need to be guided by ESA requirements.

9. What are the relative frequencies of entanglement, foul-hooking, and mouth-hooking?

10. Need to get fisherman to feel okay about reporting accurately.

11. Need to look for environmental linkages occurring with multiple sea turtle captures.

12. Clarify definitions of recovery as it pertains to re-evaluating stock assessment.

13. Need to collect more specific data on types of gear employed.

14. Need to develop methodologies to estimate survivorship of hooked (swallowed) and released sea turtles.

15. Need to analyze all CPUE data to estimate total incidental sea turtle take by species.

16. Do current mortality rates for all Atlantic longline fisheries show similar rates of boatside sea turtle death?

17. Need to develop practical and humane techniques for removal of hooks from sea turtles.

18. Need to identify sea turtle species' differences in hook location.

19. Need for standardized observer training by NMFS (on sea turtles).

20. Improve the sea turtle interaction data collection, without increasing observer burden.

21. Need to look for physical effects of implantation on the hook.

22. Investigate sea turtle diet.

23. Understand how to handle all sea turtles that are caught.

24. Encourage careful study of gear modifications during normal fishing operations.

25. Consider enforceability in the development of management measures.

26. Consider the value of longline fishery as a platform of opportunity for data collection and tagging.

27. Identify the recreational aspect that affects incidental sea turtle take.

28. Develop efficient sea turtle release procedures and apparatus.

29. Need to determine the effects of different bait on hooking rate (e.g., squid vs. mackerel).

30. Need to develop realistic authorized incidental take figures.

31. Need information from previous and future necropsies on dead hooked sea turtles.

32. Need to develop chemical bait repellents to deter sea turtles without reducing finfish catch.

33. Need for sea turtle life history, size, age, etc. characteristics of interactions.

34. Need to develop population estimates comparing data and interactions pre- and post-TED requirements.

35. How do we get industry acceptance of proposed mitigation measures?

36. Document history of changes in gear type, seasonality, and fleet size of the longline fishery in relation to incidental sea turtle take.

37. Temporary restriction on new entrants to the fishery.

38. Need for information on effects of different longline fishing methods on incidental sea turtle takes.

39. Need a consensus on leatherback stock status in Gulf of Mexico and the western Atlantic.

40. Implement standardized, mandatory tagging programs for all Atlantic longline fisheries.

41. Investigate fishing tactics as a means to reduce sea turtle interaction.

42. Study the behavioral ecology of pelagic-stage sea turtles.

43. Study evidence of longline fishery-sea turtle interactions at sea turtle nesting sites.

44. Need to devise practical and safe methods for lifting hooked/tangled sea turtles onto the deck of the boat.

45. Conflict with need for best scientific data is too time consuming and expensive: in the absence we assume the worst.

46. Need to develop clear definitions on entanglement/hooking and animal condition.

47. Lack of coordination with other groups and agencies seeking solutions to the problem.

48. An understanding among fishermen that saving sea turtles will benefit them in the future.

49. Need to test de-hooking device.

50. Ensure response to ESA requirements is based upon current stock assessments.

51. Analyze gear description data to determine if correlation exists between gear type and sea turtle interaction/mortality.

52. Need to determine what level of incidental take is detrimental to the loggerhead sea turtle population.

53. Need for mandatory shipboard observer programs to collect statistically reliable data.

54. Need to communicate accurate information to the public.

55. Negative industry perception of a lack of commercial U.S. representative in Hawaiian longline workshop.

56. Worldwide moratorium on expansion of fisheries for scientifically determined fully and overexploited populations of fish.

57. Lack of information on effects of incidental takes on different sea turtle life stages.

58. Technology transfer of reduced longline incidental take technology to other nations.

59. Need for Section 7 consultations to be peer reviewed.

60. Need to understand why longline vessels relocate to distant areas.

Unstructured responses to question: "In the context of mitigating longline-sea turtle incidental takes, and reducing mortality, what are the options, strategies, and methods which could be employed?"

1. Determine medical procedures to follow by evaluating differential mortality of released sea turtles by species, size class, and hook location.

2. Initiate gear research project to develop release and de-hooking techniques.

3. Provide comprehensive, yet workable, retrieval, de-hooking, and/or release techniques to the fisherman.

4. Provide education and advisory services for pelagic fisheries that encounter sea turtles.

5. Identify commercially available hardware for assessment of de-hooking and dis-entanglement techniques.

6. Compare existing longline fishing patterns and sea turtle capture data to know patterns of behavior and distribution.

7. Assist industry to develop bycatch strategies through gear engineering.

8. Develop statistically viable mandatory observer program specifically designed to address problems/issues # 2, 3, 4, 9, 11, 18, 19, 20, 26, 29, 33, 38, 51, 53, and 57.

9. Examine existing gear configuration data sets where interactions have occurred.

10. Temporary restriction on brand new entrants into fishery that have no experience.

11. Enhance communication with and technology transfer to competing international fisheries.

12. Request voluntary closures of fishing in sea turtle dense areas.

13. Require buoy line-to-leader-ratio to be a minimum of one-to-one.

14. Need to prioritize research and mitigation strategies within this fishery and between other fisheries.

15. Establish a panel consisting of researchers, fisherman, veterinarians, and managers to develop protocol for handling and releasing hooked sea turtles.

16. Analyze existing gear description data to determine if a correlation exists between gear type and sea turtle mortality.

17. Provide real time sea turtle distribution information such that it might be incorporated into fishing plans.

18. Develop forecasting techniques for sea turtle movement.

19. Compile lists of de-hooking techniques used in fish tag-release programs.

20. Implement tracking studies to determine fate of longline released sea turtles.

21. Develop education techniques for identification and handling of sea turtles on vessels.

22. Promote an understanding of sea turtle problems among all fisherman.

23. Develop a program to understand the diet of pelagic sea turtles by lavaging and studying foraging behavior at sea using remote technology.

24. Test potential sea turtle decoy and repellent gears.

25. In areas and times of high sea turtle interactions, and/or clustering, recommend the use of least number of light sticks as practical.

26. Place tree lopper and lifting net on all longline vessels.

27. Create regulatory language that requires maximum possibility of sea turtle survival by releaser without jeopardizing human life.

28. Need a NMFS/industry working group to implement research and mitigation strategies.

29. Require use of bait/gear configuration that reduces gut hooking.

30. Initiate data collection on specific gear types, circumstances, related to sea turtle mortality.

31. Impose import sanctions as necessary to ensure international compliance with requirements imposed on its fleet.

32. Explain levels of incidental take that might cause rendering of jeopardizing species.

33. Use disentanglement techniques developed for longline fishery to disentangle sea turtles observed in other gears.

34. Implement statistically designed field tests of different hooks and baits by fishermen.

35. Require that NMFS give higher priority to sea turtle observer programs.

36. Clarify a way for a vessel to document moving due to sea turtle interaction.

37. Implement the recommendations of the Honolulu workshop world-wide.

38. Decrease/eliminate amount of trailing fishing gear attached to sea turtles released from the line.

39. Recommend that NMFS continue to use open cooperative ESA discussions and not to go into the closet after consultation to ensure the cooperation of fishermen.

40. Prepare and distribute education and instructional videos.

41. Compile fishermen's bible consisting of the following: all applicable CFRs for all applicable species, all tag and release information for all species, summary of species biology for all species possibly encountered, and complete instructions for logbook requirements.

42. Develop visual, chemical, and acoustical methods to deter sea turtles from longline.

43. Develop predictive models for sea turtle distribution by species and size class in pelagic habitat.

44. Apply these methodologies to all relevant hook and line fisheries.

45. Request voluntary submission of all entanglement/hooking case histories to NMFS.

46. Revise regulations for resuscitation and handling sea turtles based on recommendations of expert panel referred to in item #15.

47. Establish federal scientific position and support staff position to disseminate biological and regulatory information to fishing industry on sea turtles; respond to industry grievances; keep abreast of current scientific information on sea turtle biology; and promote federal funding of sea turtle/fishery interaction, mitigation activities, and research.

48. Enhance photographing and tagging of sea turtle interactions with or without an observer on board.

49. Require direct, permitted biological incidental take to be halted and let longline bycatch where possible supplant it.

50. Require NMFS to provide mechanism to make it legal for fisherman to bring injured sea turtles to shore.

51. Develop a hook that decomposes within one month of insertion into a sea turtle and that exhibits no difference in catch capability and target species.

52. Design laboratory experiments for determining biologically realistic decomposition times for commercially manufactured hook types.

Unstructured responses to question: "In the context of reducing, preventing longline-sea turtle incidental takes, what are the options, strategies, and methods which could be employed?"

1. No new entrants in the fishery -- U.S., Atlantic-wide.

2. Promote technology exchange with the Japanese (and other nations) longline fishery.

3. Study fine-scale sea surface temperature across fronts.

4. Study light sticks' possible attraction of sea turtles.

5. Relocate fishing operations from areas of incidental sea turtle takes.

6. Experiment both in lab and field with various gear/bait assemblies to reduce or eliminate attractiveness to sea turtles.

7. Work with fishermen to develop broader understanding and two-way network of sea turtle knowledge.

8. Consider time/area closures or gear restrictions in sea turtle hot spots.

9. Make past longline fishery-sea turtle interaction data available to construct predictive models of sea turtle hot spots.

10. Develop visual, chemical, and acoustical methods to deter sea turtles from longlines.

11. Provide real-time sea turtle distribution information such that it might be incorporated into fishing plans (#17 from list #2).

12. Educate fishermen regarding the need to avoid fishing in areas of high sea turtle density.

13. Develop and ground truth predictive models based on physical oceanography and sea turtle biology, sea turtle distribution patterns by species and size class, in order to close fishing areas where sea turtle densities are high.

14. Study gear: mono, color and size, buoys, high flyers, radio beacons, polypropylene rope, crimps, snaps, leads, glow beads, plastic squids and skirts, rattlers, and other ornaments (see #6).

15. Study possible hook shield designs (similar to Japanese albatross problem).

16. Distribute predictive model regarding strength and number of eddies per year.

17. Educate and train sea turtles to stay away from longline gear (breed and clone).

18. Retrieve ghost longline gear.

19. Investigate relationships between target species and sea turtles.

20. Encourage fishermen to communicate interactions in order to alert other boats.

21. Investigate effectiveness of gear haulback in sea turtle clusters.

22. Provide funds for all proposed research.

23. Increase observer coverage of longline fishery to document reductions in incidental take and mortality rates.

24. Provide economically viable alternative fishing strategies for the fleet that do not result in incidental take (e.g., spatial change or target species replacement).

25. Test potential sea turtle decoy and repellant gears (#24 from list #2).

26. Technology transfer to other nations of the new developments in gear that reduces incidental take; including education and legal instruments).

27. In-tank loggerhead experiments looking for temperature, salinity, and dissolved oxygen preferences.

28. Depth studies relating sea turtle feeding depths and hook depths.

29. Inform fishermen on a real-time basis about sea turtle migration patterns and areas of possible and/or current interactions.

30. Investigate the availability of sea turtle's basic food chain.

31. Eliminate inactive or unused permits in longline fishery.

32. Employ newly developed gear modifications which are mutually beneficial to sea turtles and fisheries.

33. Analyze existing longline gear use to determine if a correlation exists between gear type and sea turtle interactions (#16 from List 2).

34. When conducting area studies and/or sea turtle area closures, consider several CPUEs: sea turtles per hook, sea turtles per day, sea turtles per dollar landed, by vessel.

35. Study of long-term viability, possible overcapitalization of U.S. and global longline fisheries.

36. Evaluate cost-effectiveness of direct industry subsidies, time area closures and other restrictive measures compared to long-term research costs.

37. Require international compliance with U.S. conservation measures.

38. Apply all these methodologies to all relevant hook and line fisheries.

39. Require use of new tasmanian bait box for longline fisheries bait.

40. Develop an educational program to encourage and promote voluntary efforts by fishermen to avoid areas of sea turtle interaction.

Table 1. Detailed results of voting applied to unstructured list of 52 strategies and measures which could be employed in **mitigation** of incidental sea turtle takes and reduction of mortality; includes results of individual rankings [5=highest priority, 1=lowest priority].

Idea #	# of votes	Votes (rankings)	Total Score	Idea #	# of votes	Votes (rankings)	Total Score
1	1	5	5	27	1	4	4
2	4	4,3,1,1	9	28	2	4,4	8
3	7	5,5,4,4,2,1,1	22	29	1	3	3
4	4	5,5,2,2	14	30	0		0
5	1	5	5	31	1	1	1
6	2	5,1	6	32	0		0
7	2	4,1	5	33	0		0
8	2	3,3	6	34	1	2	2
9	1	4	4	35	1	5	5
10	3	5,5,2	12	36	0		0
11	1	2	2	37	1	3	3
12	1	3	3	38	1	2	2
13	3	5,4,3	12	39	1	2	2
14	2	5,3	8	40	1	1	1
15	3	5,4,3	12	41	0		0
16	4	2,2,1,1	6	42	1	4	4
17	0		0	43	2	3,1	4
18	1	3	3	44	1	5	5
19	0		0	45	0		0
20	4	4,3,2,2	11	46	1	4	4
21	2	4,1	5	47	0		0
22	2	3,3	6	48	2	1,1	2
23	0		0	49	0		0
24	0		0	50	2	3,1	4
25	1	2	2	51	1	5	5
26	1	2	2	52	2	4,1	5

Table 2. Detailed results of voting applied to unstructured list of 40 strategies and measures which could be employed in **reducing or preventing** incidental sea turtle takes; includes results of individual rankings [5=high, 1=low].

Idea #	# of votes	Votes (rankings)	Total Score	Idea #	# of votes	Votes (rankings)	Total Score
1	6	5,5,5,4,4,4		21	0		0
	27			22	1	5	5
2	1	3	3	23	2	2,1	3
3	0		0	24	1	1	1
4	1	4	4	25	2	3,2	5
5	1	3	3	26	2	4,1	5
6	4	5,4,2,1	12	27	0		0
7	2	5,5	7	28	1	3	3
8	2	5,1	6	29	2	5,4	9
9	4	4,3,2,1	10	30	1	1	1
10	3	5,5,3	13	31	0		0
11	0		0	32	2	4,1	5
12	1	1	1	33	1	4	4
13	4	4,2,2,1	9	34	1	4	4
14	5	5,3,3,3,2	16	35	0		0
15	2	4,1	5	36	1	3	3
16	1	2	2	37	5	4,3,2,1,1	11
17	1	5	5	38	2	3,2	5
18	0		0	39	0		0
19	2	3,2	5	40	3	5,5,1	11
20	3	3,2,2	7				