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**INTERACTIONS OF SEA TURTLES WITH TUNA FISHERIES, AND
OTHER IMPACTS ON TURTLE POPULATIONS**

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1. INTERACTIONS IN THE LONGLINE FISHERIES

Sea turtles get caught in longlines when they take the bait on a hook (hooking), or are snagged accidentally by a hook or line while swimming or when the gear is being retrieved (snagging). The proportion of those caught that dies depends on the characteristics of the fishing operation, the type and size of hook and bait, and the availability and use of equipment to improve the survival of those released.

It is known that many of the longline fisheries in the Pacific Ocean have incidental catches of sea turtles. In this regard, probably the most important fisheries, because of the magnitude of their effort, are those that capture tunas, swordfish, sharks, billfishes, and other species on the high seas, and many coastal fisheries that capture these species and others such as dorado. They cover the range from artisanal to industrial, and a vast geographic area. In the eastern Pacific, the major industrial tuna longline fisheries deploy about 200 million hooks per year. The staff does not have records of the effort for swordfish, and the effort of artisanal fisheries is very poorly known.

2. ESTIMATION OF INCIDENTAL MORTALITY

To estimate the impact of longline fisheries on species taken incidentally, we need to know the fishing effort and the rates of bycatch per unit of effort. The spatial and temporal distribution of effort can be obtained from logbook data for many of the fleets operating in the Pacific, but not for most of the artisanal fleets. However, bycatch data with sufficient coverage, and a good representation of the different flags, regions, target species, etc., are not available, and can only be estimated by extrapolation from other fisheries. Even with observer data, uncertainty regarding the proportion of released turtles that survive (estimates vary widely), adds to the error in the estimates. Studies of post-release survival are essential to estimating adequate correction factors.

Data from the United States observer programs have shown that the proportion of sea turtles that are dead when the line is retrieved may be quite low, although this may vary with the type of fishery and other factors, and recent studies in Costa Rica have shown high survival rates for turtles released from circle hooks. Even though more research is needed, there is clearly an opportunity for changes to improve the survival rates of sea turtles caught in the longline fishery.

With populations and fisheries changing, the staff is not able to estimate the mortality of sea turtles caused by longline fishing. Given the precarious status of the populations of several sea turtles, particularly the leatherback, efforts to reduce incidental mortality should be undertaken in any case, at the same time as data collection and research to produce such estimates. If post-release survival is low, the

options would be seriously restricted.

Another drawback of the lack of observer data or other similar data sources is that there is very little information on factors leading to incidental mortality, and on the spatial and temporal distribution of bycatches.

The long experience of working to reduce dolphin bycatch in the purse-seine fishery highlighted the crucial importance of two components: (1) working with the fishers, whose experience and knowledge is essential to solving the problem; and (2) a solid database, not only to estimate incidental mortality but, more importantly, to identify its causes. Because many variables can be involved, and interactions are frequent, a large amount of data is needed to identify these causes. In the tuna-dolphin case, observers provided that information. Tens of thousands of sets can now be analyzed to test a hypothesis, to examine individual vessel performance or differences, or to explore habitat or gear issues. The lack of an equivalent data set for longlines, gillnets, and other types of gear, limits the options.

Additionally, longliners vary from small artisanal craft to large industrial vessels, and operate from many different ports. Consistent databases on effort, catches, etc., do not exist for many of these fisheries.

3. OPTIONS TO REDUCE THE IMPACT OF FISHERIES

There are three main ways to reduce the mortality of sea turtles in the longline fisheries, specifically:

- (a) reduce the number of turtles that come into contact with the hooks, by changing patterns of fishing effort and fishing practices;
- (b) reduce the number of turtles that are caught, by changes in fishing practices and fishing gear; and
- (c) reduce the mortality of turtles released from the hooks, by changes in fishing practices and use of suitable equipment.

More generally, the dissemination of information about sea turtles, and the effects of fishing on the populations, among the fishing industry, fishing communities, and other interested parties can contribute to the reduction of mortality.

3.1. Changes in effort

A targeted reduction in effort would reduce bycatches of sea turtles. The main contribution science can offer in considering any such decision is to assess and compare the impacts of different levels of reduction. For instance, seasonal closures of certain areas may redistribute the effort to locations where the impact on some turtle species is high.

The highest probability of encounter happens in circumstances of simultaneous high densities of turtles and of hooks, such as the vicinity of nesting beaches, any well-defined migratory corridors, or preferred habitats. Switching fishing effort away from such areas and seasons could reduce mortality. In particular, during the nesting season reproductive females, especially important from the point of view of maintaining the populations, will lay eggs on a beach, then spend about two weeks in the waters close to that beach before returning to lay eggs in a new nest. Prohibiting fishing in such areas and seasons could achieve significant reductions in mortality with little loss to the fishers.

3.2. Changes in fishing practices and fishing gear

These include setting lines deeper, and reducing soak time during daylight hours. Tracking data have shown that sea turtles spend most of their time in the upper layers, and that they are in shallower strata at night, so deeper lines may intercept fewer turtles. However, the mortality of turtles caught at greater depths may be higher than that of turtles caught nearer the surface.

Habitat differences: if there are differences in the habitat preferences of the target species and the sea turtles, it may be possible to develop fishing strategies using that knowledge. Research is being carried on using data from tracked sea turtles and environmental data.

3.2.1. Reducing detection or attraction of fishing gear

Dyeing bait to reduce detection or attraction. Several experiments were performed with mixed results, and a new experiment is being carried out in Costa Rica. During the experiments turtles rejected blue-dyed bait for several days, but afterwards there were no differences.

Deterrents (noise, smells, taste, and appearance). Several substances, including acids, squid ink and other chemicals, have been tested, but without positive results.

Research is also ongoing on the sensory systems of sea turtles and target species, looking for attractants and deterrents.

3.2.2. Reducing hooking and snagging

Technological changes (circle hooks, “weedless” hooks, wider hooks): One of the most promising approaches is the replacement of the traditional J-hooks with circle hooks. Research in the Atlantic has shown that wider hooks are better than narrow hooks, circle hooks cause less mortality, and that bait types also influence the hooking rates.

3.2.3. Reducing the impact of hooking

Circle hooks. Circle hooks not only reduce the hooking rate, but are also more likely to lodge in the mouth and in the lower jaw than further inside the turtle; this facilitates the removal of the hook and the turtle’s survival.

Dipnets, dehookers, and line cutters. These instruments have been tested in some fisheries with positive results. **Dipnets** facilitate handling turtles and bringing them aboard for processing, including removing the hook and line. The **dehooker** is an ingenious instrument that allows hooks to be removed easily and safely from within the turtle, and **line cutters** are used to free entangled turtles that cannot be easily reached or brought aboard the vessel and to cut excess line that the turtles might otherwise ingest. Other tools are used to manipulate hooks or to cut the barb, and to keep the turtle’s mouth open.

3.3. Dissemination of information

Fishers: No change can be instituted without the participation of the fishing community. The IATTC staff has been organizing seminars for tuna fishers on reducing dolphin mortality for 17 years, and recently participated in 9 workshops in Ecuador on sea turtle issues. The elements of these seminars are:

- Introduction: present the problem and discuss the reasons for change. Briefly introduce the species involved, emphasizing aspects of their biology and ecology (migrations, vertical movements, etc.) that may contribute to their incidental capture; describe their distribution and areas of concentration, and seasonal patterns.
- Fisheries information: trends, changes.
- Mortality: Estimates, time series. Causes of mortality, temporal distribution of effort and of bycatch rates .
- Solutions: Technological and operational solutions to problems: gear modifications, recommended procedures during capture and release. Major emphasis is placed on this section, and on the practical demonstrations of gear and instruments; the aim is to show that the alternatives proposed will produce acceptable catch rates of target species, and are economically accessible.
- Ongoing research and proposed ideas: proposals from fishers, clarification of requirements.
- Observer functions and responsibilities, interactions with crew; management and regulations.
- Questions and answers, discussion. Identification of issues for future research. Feedback from fishers.

Fishing community and fishers leadership: In artisanal fisheries the role of the community in maintaining the motivation, and giving continuity to the effort is critical. Both family and community bonds are strong, and if the perception is developed that the actions of each individual influence the fate of all, this would add to the motivation of the group and to its sense of social responsibility. This type of education should emphasize the reasons for improving performance, and the risks of failing to change.

Coastal communities: Since sea turtle conservation also requires improvements in coastal zone management, beach and nest protection, and even careful disposal of plastic bags and other types of refuse that can be swallowed by turtles and cause additional mortality, it is important to involve other communities that can affect these processes. The main issue is that the efforts of the fishers must be accompanied by attacks on all sources of mortality. The media could play a significant role in this effort.

Academic and research community: it is very important to convey to them the need for applied research on many issues relating to bycatch of sea turtles. Among others, studies on trophic webs in coastal systems that may be impacted by fisheries and other activities, studies of nesting beaches and other critical habitats, are needed. Work on building capacity in the region is needed.

A good example of how to involve the fishing communities is the initiative undertaken by the Subsecretaría de Recursos Pesqueros of Ecuador and the Ecuadorian national On-Board Observer Program in October 2003. They organized nine workshops on sea turtles, held in various locations on the Ecuadorian coast, which generated a great deal of interest among the fishing community, and were attended by almost 800 fishers. The IATTC staff participated, with the support of researchers from the United States and Ecuador. The conclusions of the participants, national and international, were that this initiative marked a turning point, and that it should be continued and expanded.

At the workshops, beside the explanations and practical demonstrations, the feasibility of and the obstacles to change were discussed, including economic constraints. For instance, the price of hooks is very high in relative terms (4-6 times the price in the United States). However, if it can be demonstrated that the change will not cause any economic loss, this will facilitate its acceptance, and if it may bring an economic benefit, this will act as an incentive.

These educational activities are a good starting point for change; they build awareness, communicate the solutions available, and get feedback from the fishers. Ideally, they should be accompanied by the provision of tools such as dehookers and dipnets, well-prepared guidelines on the best handling techniques, and perhaps replacement of hooks when needed, as a way to facilitate the transition.

These activities should be extended to other countries of the region, and to all fishing nations, and should include artisanal and industrial fisheries. By working in close cooperation with fisheries authorities, the fishing industry, artisanal fishers, and local environmental groups, a common message can be developed that is much stronger than isolated individual efforts.

4. ACTIONS FOR CONSIDERATION BY THE COMMISSION

These proposals are intended to advance the discussion of conservation measures for sea turtles, and to some extent are organized along the lines of the meeting agenda, i.e., longer term measures, and measures that can be implemented soon. Some of the proposals are ideas that emerged following the series of workshops held in Ecuador in October 2003, and others are already in force for the purse-seine fishery under the [*Consolidated Resolution on Bycatch*](#):

4.1. Immediate measures

1. Require fishers to promptly release unharmed all sea turtles caught during fishing.
2. Require fishers to make every effort to remove any hooks and line from captured sea turtles before releasing them.
3. Require fishers to make all appropriate efforts to assist in the recovery of sea turtles brought aboard

the vessel before returning them to the water.

4. Require all longline vessels to carry equipment to assist in the rescue and safe release of sea turtles, including dehookers, dipnets and line cutters.
5. Facilitate the acquisition by the fishers of new equipment for the protection, rescue and safe release of sea turtles.
6. Train fishers in the use of equipment to facilitate the release of hooked sea turtles.
7. Develop or continue educational campaigns with the fishers.
8. Prohibit the disposal of plastic trash and fishing gear at sea by all tuna-fishing vessels.

4.2. Short-term measures

1. Standardize data collection systems for longline vessels, including information useful for identifying factors affecting bycatches of sea turtles.
2. Identify times and areas near nesting sites and migratory corridors used by sea turtles which could be closed to fishing.

4.3. Longer term measures

1. Initiate observer programs for longline tuna fleets.
2. Collate all available data on distributions of sea turtles, and identify areas of high density of sea turtles that should be avoided to reduce bycatches.

4.4. Research

In coordination with other competent institutions:

1. Test circle hooks and other types of hooks in all fisheries where their use might reduce the incidence of harm to sea turtles, and promote their adoption if appropriate.
2. Investigate the effects of different bait types on target species and sea turtles.
3. Conduct research to produce reliable estimates of mortality of released sea turtles, and identify the factors that determine its magnitude.
4. Develop a program to study migrations and movements of sea turtles.
5. Develop an international research effort focused on aspects of sea turtle biology and ecology related to bycatch, and based upon the results, explore ways to reduce bycatch of sea turtles.
6. Participate in cooperative studies aimed at identifying stocks of sea turtles Pacific-wide.
7. Develop a program to produce credible population models and stock assessments for sea turtles, identifying the impacts of different sources of mortality.

5. CONCLUSIONS

It has been demonstrated that certain combinations of hook type, size, and bait can reduce hooking rates by 60% to 90% for some species of sea turtles, without substantial effects on the catch rates of target species .

It is also clear that better techniques for removing hooks and for handling turtles that are captured could improve their rates of survival.

Many of the proposed actions are clearly beneficial, with no evident disadvantages, and could be implemented immediately. Several others could be carried out soon, and the results would be useful for both fishing and conservation in the eastern Pacific. The standardization of longline data would require a

technical evaluation, but efforts are already underway, and a meeting could be held at short notice if required.