JIMAR ANNUAL REPORT FOR FY 2000

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PROJECT TITLE:

Population Biology of Pacific Oceanic Sharks: 653457

1. Purpose of this Project:

This project will provide biological information needed for simulation models of shark populations and their ecosystem relationships, and for stock assessment of pelagic shark species taken by foreign and U.S. longline fisheries in the central North Pacific. The purpose is also to provide species identification and whole shark size estimation techniques that can be applied via monitoring of fins, as shark catches are poorly reported in many fisheries and fins are frequently the only identifiable portion of shark catches that ever reach shore. Evaluation of the population status of species other than the predominant blue shark requires novel approaches including simulations of productivity based on an understanding of differences in life history characteristics and ecology. Analyses of shark catch-per-unit-effort (CPUE) in relation to fishing depth and subsurface temperature structure provided from field studies deploying time-depth-temperature recorders (TDTRs) will be provided for CPUE standardization methods applying hook-depth versus vertical habitat structure. Habitat data will also be obtained through archival tagging. Archival tagging data will provide movement data needed to identify the range of stocks for stock assessment purposes as well as estimates of post-release mortality.

2. Progress in FY 2000:

The primary year-1 objective of reviewing the existing information was aided by attendance at the International Pelagic Shark Workshop in February 2000. Among the salient findings were that

mako shark growth rates are poorly known and that species identifications based on fins are inadequate for the individual species of mako and thresher sharks. Dr Mahmood Shivji at Nova Southeastern University (Florida) has agreed to collaborate in genetic identification of these species. An inventory of fin specimens collected on NMFS research cruises revealed a predominance of blue shark and a lack of specimens of other species. Based on literature review, the project clarified which are the truly oceanic species of sharks in Hawaii's fisheries and provided options for various management classification schemes to the Fishery Management Council. The project helped design a NMFS observer study of a demersal shark longline fishery that operated in 1999 based on a legal opinion that all carcharhinid sharks were pelagic. DNA samples of shark species from that fishery were curated positive genetic identifications. The identification of several are in question. Based on review of shark habitats, the project encouraged the Inter American Tuna Commission to resolve a species identification problem which incorrectly indicated that black-tipped sharks were the dominant pelagic shark bycatch in eastern Pacific purse seine fisheries. These are probably silky sharks, consistent with purse seine shark catches in other parts of the tropical Pacific.

Longline set depth and subsurface temperature data from TDTRs were analysed in relation to catch rates of 10 elasmobranch species. Results indicated a rank order (from shallow to deep) of blue, oceanic white tip, shortfin mako, common thresher, pelagic thresher, pelagic stingray, crocodile, bigeye thresher, sandbar, and longfin mako sharks. A manuscript was drafted on these results, and reviews suggested further analyses should be included before publication.

The ongoing joint NMFS-Japan shark tagging effort with conventional tags was reviewed and indicated that shark tag recovery rates are similar to swordfish. Therefore pop-up archival tag technologies will be required. Popup tags were beta-tested in the field during FY 1999-2000 on both tunas (yellowfin & bigeye) and sharks (tiger). Preliminary evaluations of the tags indicated a serious flaw in the electrical engineering, which was corrected. Testing revealed that the ability to determine when tagged animals die, and when tags prematurely fall off is essential. Mechanisms for indicating the death of a tagged subject by making the tag popup when a carcass sinks below a specified depth were suggested to vendors. These devices are just now being produced, along with on-board software to determine when recorded data is indicative of a free-floating tag, not fish behavior.

In collaboration with an NSF-sponsored grant to Jim Kitchell (University of Wisconsin) we modeled the population dynamics of three broad categories of pelagic sharks: 1) large mako-like sharks, 2) blue sharks, and 3) brown silky-like or oceanic white tip-like sharks) in an ecosystem context. The results of the modeling exercise suggested that sharks can be very sensitive to fishing but the ecosystem in which they are apex predators is very resilient to their removal. In other words fishing is bad for sharks but shark depletions do not have powerful effects on the rest of the system. The relative vulnerability to exploitation of sharks with different life-history strategies was explored with a rebound potential index developed by NMFS. The project wasn able to estimate this index for two additional species in the Hawaii longline fishery, bigeye thresher shark and longlfin mako shark, indicating a very high vulnerabiltiy of these species compared to their congeners and the more common blue and oceanic white-tipped sharks.

3. Plans for FY 2000:

The project will continue to review the literature and consult with collaborators and advisors to identify the most important gaps in knowledge of the life history and ecology of oceanic sharks impacted by central North Pacific longline fisheries, and provide collaborators and associates with biological samples for studies of growth and maturation, stock structure, and trophic ecology and species identification. Ecosystem modeling of sharks in the central North Pacific will continue with an emphasis on the role of sharks as predators of sea turtles. Further analysis will be conducted on the effect of longline hook position on shark capture depth for application to CPUE standardization analysis by other researchers. Now that the appropriate technology is available, we will begin to measure habitat preferences, geographic movements, and mortality rates of sharks through the application of popup archival tags.

4. List of Papers Published in Referred Journals during FY 2000:

Musyl, M..K., R. W. Brill, D. S. Curran, J. S. Gunn, J. R. Hartog, R. D. Hill, D. W. Welch, J. P. Eveson, C. H. Boggs, and R. E. Brainard. 2000. Ability of archival tags to provide estimates of geographical position based on light intensity. ***Reviews in Fish Biology (In Review)***

5. Other Papers, Technical Reports, etc.

Kitchell, J.F., T.E. Essington,C.H. Boggs, D.E. Schindler, and C. J. Walters. 2000. Sharks and Shark Fisheries in an Ecosystem Context. Proceedings of the International Pelagic Shark Workshop, Feb 14-17, 2000, Asilomar, CA.

Ecosystem modeling results on sharks were also presented at the recent NMFS Stock Assessment Workshop in Seattle (abstract will be published).

Musyl, M.K., and D.S. Curran. 2000. Depth and temperature distributions of pelagic fishes caught on longlines in Hawaii. Draft manuscript under NMFS review.

6. Students graduating: None