JIMAR, PFRP ANNUAL PROGRESS REPORT FY 2005

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Project Proposal Title: Modeling Longline Effort Dynamics and Protected Species Interaction

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1. Purpose of the project and indicative results.

The general aim of the proposed study is to refine and extend the existing fleet dynamic model, and the specific objectives and tasks are as follows:

(1) Extend the longline trip level time-series data set to 2002.
(2) Re-estimate the technical and economic interrelationships among different species landed; and the entry/stay/exit behavior.
(3) Estimate the catch-effort relationships for each species and for each fleet.
(4) Analyze the factors, rate, and degree of protected species interaction (e.g., turtles, and seabirds) with longline fishing activities.
(5) The information generated above will be incorporated into the existing fleet dynamic model in maximizing fishery welfare and fishing effort considering broader implications on protected species and stock conditions.

2. Progress during FY 2005. Provide a thorough discussion of accomplishments <u>and</u> problems.

The following summarizes the major activities:

(1) Modification and improvement of the existing fleet effort dynamic model in maximizing fishery welfare by incorporating protected species as well as the newly estimated catch-effort relationships has been completed. An abstract of the work (submitted to *Ecological Modeling*) is presented as below:

> *There has been a growing concern about the interactions of endangered sea turtles with Hawaii longline fishery very recently. Some tougher measures including swordfish harvest ban have been put into effect since 2000 to protect these species. Accounting for protected species interactions by fishery management has, therefore, become equally important policy goal recently. A multi-objective programming model has been extended to incorporate sea turtle interactions as one of the fishery management goal. The model results indicate that there is a tradeoff between fleet-wide profit and turtle interactions, and a significantly higher profit and reduced turtle interactions possibility by reconfiguring fishing efforts compared to the base scenario. However, the current fishery policy related to sea turtle interaction disallows the tapping of all the potential efficiency gain as illustrated from the model results, as the number of turtles allowed to get interacted severely curtails swordfish targeted longline fishing activities that use the conventional technologies. Banning longline activities is also not costless, as the average*

shadow price per turtle in terms of lost profit is about $9,120 and in terms of lost revenue is about $56,060. Adaptation to 'turtle-friendly' fishing technologies is among the many strategies that would allow for higher optimal fishing efforts leading to higher overall welfare.

(2) A distance function approach has been adopted to model sea turtle interaction as an undesirable output in Hawaii's longline fishery. This approach provides a method of calculating temporal and trip-specific cost of sea turtle bycatch reduction without assuming any policy intervention. The major component of this analysis is a parametric input distance function that incorporates both desirable and undesirable catches. Using a duality argument, the cost-related shadow price for sea turtle bycatch can be derived from the estimated distance function. The major finding of this analysis is that the average shadow price of sea turtle bycatch from the period 1991-1999 is about $32,561 (expressed in 1991 dollars). Empirically, this method also provides temporal estimates of the average shadow price of sea turtle bycatch by trip characteristics, such as catch season, trip type and location. Such information can be useful in analyzing tradeoffs between number of incidental takes of sea turtles and the marginal cost of sea turtle bycatch. A paper documenting this analysis and its results is being finalized at this time.

(3) A more detailed analysis of catch and effort relationship for each species in each trip type than the one used in (1) above is current underway. Stock indices will be created using CPUE standardization method, and will be integrated into a system of catch-effort regressions to account for the interactions between trip types in the Hawaii's longline fishery. Preliminary results are under evaluation at this time.

(4) Two presentations reporting the preliminary results of (a) the distance function estimation and (b) incorporating sea turtle interactions in a multi-objective programming model for Hawaii longline fishery have been made at the November PFRP PI meeting.

(5) Two journal papers from the current project are under peer review and one manuscript is in the final stage of preparation for journal submission (please see the publication list below). In addition, two journal papers related to the project are in press.

3. Plans for the next fiscal year.

(1) Seasonal and spatial extension of the modified and improved fleet effort dynamics model that focuses on welfare measures and protected species interactions with the longline fishery.

(2) Finalize the manuscript on modeling protected species as an undesirable output using the distance function approach.

(3) Finalize the analysis of multi-species and multi-trip-type catch-effort relationship and stock indices estimation.

(4) Analyze the factors, rate, and degree of sea bird interactions with the longline fishery if time permits.

(5) Prepare manuscripts summarizing results from (1) through (4) above for possible conference presentations and journal publications.

4. List of papers during FY 2005.

1) Pradhan, N.C. and P.S. Leung. 2005. "Incorporating sea turtle interactions in a multi-objective programming model for Hawaii longline fishery" *Ecological Modeling (In Review)*. [*Paper presented at the PFRP PI Meeting in November, 2004*].

2) Pradhan, N.C. and P.S. Leung. 2005. "A Poisson and negative binomial regression model of sea turtle interactions in Hawaii's longline fishery," *Fisheries Research* (*In Review*). [*Paper presented at the PFRP PI Meeting in December, 2003*].

3) Huang, H. and P.S. Leung. 2005. "Modeling protected species as an undesirable output: The case of sea turtle interactions in Hawaii's longline fishery". [*Paper presented at the PFRP PI Meeting in November, 2004 and in final stage of preparation for journal submission*].

4) J. Cai, P.S. Leung, M. Pan and S. Pooley. 2005. "Economic linkage impacts of Hawaii's longline fishing regulations," *Fisheries Research*, in press.

5) P.S. Leung. 2005. "Multiple-criteria decision making (MCDM) applications in fishery management," invited paper in a special issue on Planning Support Systems for Environmental Management, *International Journal of Environmental Technology and Management*, in press.

5. Other papers, technical reports, meeting presentations, etc.

1) Two presentations have been made at the November PFRP PI meeting (papers 2 and 3 listed in section 4 above).

2) A paper entited "Modeling entry, stay, and exit decisions of the longline fishers in Hawaii" was presented at the International Fishery Economics and Trade conference held in Tokyo, Japan on July 21-30, 2004.

6. Names of students graduating with MS or Ph.D. degrees during FY 2004. Include title of thesis or dissertation.

None