JIMAR – PFRP ANNUAL REPORT FOR FY 2006

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

Funding Agency: NOAA

NOAA Goal (Check those that apply):

- **X**☐ To protect, restore, and manage the use of coastal and ocean resources through ecosystem-base management
- ☐ To understand climate variability and change to enhance society's ability to plan and respond
- ☐ To serve society's needs for weather and water information
- ☐ To support the nation's commerce with information for safe, efficient, and environmentally sound transportation

1. Purpose of the Project (one paragraph)

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:

i. Extend the longline trip level time-series data set to 2002.
ii. Re-estimate the technical and economic interrelationships among different species landed and the entry/stay/exit behavior.
iii. Estimate the catch-effort relationships for each species and for each fleet.
iv. Analyze the factors, rate, and degree of protected species interaction (e.g., turtles, and seabirds) with longline fishing activities.
v. 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 2006 (One-two paragraphs, including a comparison of the actual accomplishments to the objectives established for the period, and the reasons for slippage if established objectives were not met):

The following summarizes the major activities:

i. Modification and improvement of the existing fleet effort dynamic model in maximizing fishery welfare by incorporating protected species, seasonal and

spatial features in the longline fishery has been completed and an abstract of the work (submitted to *Applied Economics*) is reproduced below:

Accounting for endangered and protected sea turtle interactions with the pelagic longline fishery by the fishery management has become an important policy goal recently. A multi-objective programming model for Hawaii's longline fishery that incorporated sea turtle interactions (Pradhan and Leung, in press) has been extended with spatial and seasonal dimensions. As a result, the synergetic effect of these added features indicate that there exists better economic and environmental efficiency gains in terms of higher profit and reduced turtle interactions compared to the base case and without these added dimensions by reconfiguring fishing efforts across space and seasons. There also exists a trade-off between fleet-wide profit and turtle interactions. The current fishery policy related to sea turtle interactions disallows capturing all the potential efficiency gain, as the number of turtles allowed to get interacted severely limits swordfish-targeted longline fishing that uses conventional technologies. Restricting longline fishery to operate sub-optimally has average per turtle shadow value of $15,957 and $60,908 in terms of lost profit and revenue, respectively. Adaptation to 'turtle-friendly' fishing technologies is among the many strategies that would allow for higher optimal fishing efforts and also leading to higher overall welfare and towards more responsible fishery.

ii. A distance function approach has been employed 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. Such information can be useful in analyzing tradeoffs between number of incidental take of sea turtles and the marginal cost of sea turtle bycatch. The results are summarized in a paper submitted to the *Journal of Environmental Management* (under revision) and the abstract of the paper is reproduced below:

Interactions with sea turtles have occurred at an alarming rate in swordfish longlining in Hawaii in recent years and various regulations have been put forward to protect sea turtles. In order to understand the cost of reducing sea turtle interactions, methods have been developed to derive the shadow price of sea turtle bycatch based on fisher's welfare loss from a specific regulation. This paper illustrates an alternative method of calculating temporal and trip-specific cost of sea turtle bycatch reduction. The advantages of this method lie in the computation of shadow price without assuming specific regulation implementation and its relatively modest data requirement. A parametric output distance function is used to simultaneously model desirable and undesirable catches. Using the duality argument, the revenue-related shadow price of sea turtle bycatch can be derived from the estimated distance function. Average shadow price of sea turtle bycatch for the period 1991-1999 is estimated to be US $30,873 in 1991 dollars. Average shadow price of sea turtle bycatch by trip characteristics, such as fishing year, trip type and location are also estimated. Such information can be useful for policy makers to analyze tradeoffs and make appropriate policy decisions.

iii. Two presentations reporting the results of (a) economic linkage impacts of Hawaii's longline fishing regulations and (b) incorporating sea turtle interactions in a multi-objective programming model with seasonal and spatial dimensions for Hawaii longline fishery have been made at the November PFRP PI meeting.

iv. Four journal articles from the current project have been published/in press and another two are under peer review (please see publication list below).

3. Plans for the next fiscal year (one paragraph):

Complete the two journal articles submitted and prepare summary of overall project findings by December 31, 2006.

4. List of papers published in refereed journals during FY 2006.

i. Pradhan, N.C. and P.S. Leung. 2006. "A Poisson and negative binomial regression model of sea turtle interactions in Hawaii's longline fishery," *Fisheries Research, 78 (2006)309-322.*

ii. Pradhan, N.C. and P.S. Leung. 2006. "Incorporating sea turtle interactions in a multi-objective programming model for Hawaii longline fishery" *Ecological Economics* (In Press).

iii. J. Cai, P.S. Leung, M. Pan and S. Pooley. 2005. "Economic linkage impacts of Hawaii's longline fishing regulations," *Fisheries Research, 74:234-242.*

iv. P.S. Leung. 2006. "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, 6(1/2):96-110.*

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

i. J. Cai, P.S. Leung, M. Pan and S. Pooley. 2005. *Linkage of Fisheries Sectors to Hawaii's Economy and Economic Impacts of Longline Fishing Regulations*, Pelagic Fisheries Research Program, JIMAR Contribution 05-355, 24 pp. [*Paper presented at the PFRP PI Meeting in November, 2005*]

ii. Pradhan, N.C. and P.S. Leung. 2006. Sea turtle interactions with Hawaii's longline fishery: An extended multiobjective programming model incorporating spatial and seasonal dimensions (*Applied Economics* – in review). [*Paper presented at the PFRP PI Meeting in November, 2005*]

iii. Huang, H. and P.S. Leung. 2006. Modeling protected species as an undesirable output: The case of sea turtle interactions in Hawaii's longline fishery (*Journal of Environmental Management* – under revision).

iv. A paper entitled "Sea turtle interactions with Hawaii's longline fishery: An extended multiobjective programming model incorporating spatial and seasonal dimensions" is accepted for presentation at the International Fishery Economics and Trade conference to be held in Plymouth, United Kingdom in July 11-14, 2006.

v. Pradhan, N.C. and P.S. Leung. 2006. Trade-offs between Sea Turtle Interactions and Profitability of the Hawaii-based Longline Fleet (A short article submitted to *PRFP Newsletter*).

6. Graduates (Names of students graduating with MS or PhD degrees during FY 2006. Provide titles of their thesis or dissertation):

None.

7. Awards (List awards given to JIMAR employees or to the project itself during the period):

None.

8. Publication Count (Total count of publications for the reporting period and previous periods categorized by NOAA lead author and Institute (or subgrantee) lead author and whether it was peer-reviewed or non peer-reviewed (not including presentations):

	JL Lead Author			NOAA Lead Author			Other Lead Author		
	FY03	FY04	FY06	FY03	FY04	FY05	FY03	FY04	FY05
Peer-reviewed			4						
Non-peer reviewed			1						

9. Students and Post-docs (Number of students and post-docs that were associated with NOAA funded research. Please indicate if they received any NOAA funding. For institutes that award subcontracts, please include information from your subgrantees):

2 graduate research assistants and 1 post-doc supported by the project.

10. Personnel:

i. Number of employees by job title and terminal degree that received more than 50% support from NOAA, including visiting scientists (this information is not required from subgrantees): 0

ii. Number of employees/students that received 100% of their funding from an OAR laboratory and/or are located within that laboratory. 0

iii. Number of employees/students that were hired by NOAA during the past year:
0

11. Images and Captions (JIMAR will be including images in the annual report. Please send two of your best high-resolution, color images (photo, graphic, schematic) as a JPEG of TIFF with a caption for each image. Hardcopies of images can be dropped off at the JIMAR office if no electronic versions are available.

None.