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Project Proposal Title: Mixed-resolution models for investigating individual to population spatial dynamics of large pelagics

Funding Agency: NOAA.

1. Purpose of the project and indicative results.

This project proposes mathematical and programming developments in movement and spatial population dynamics models including a post-doctoral grant devoted to the development of an individual-based model (IBM) for investigating the behaviour of tuna in a realistic environnment predicted from a coupled physical-biogeochemical model (ESSIC, Univ Maryland) and a spatial environmental model (SEPODYM, SPC) simulating tuna forage and tuna populations dynamics.

Though not included in the budget, a second post-doctoral study is closely associated to this project, as it will develop technics of local stretching for a grid generator that will be embedded into SEPODYM and the coupled biogeochemical model.

The ESSIC model (co-P.I. R. Murtugudde, Univ. Maryland) will provide fields of predicted data (currents, temperature, primary production and zooplankton biomass) with several areas of focus at higher resolution. These predicted data will serve as input in SEPODYM that will provide predicted distributions of tuna forage (~micronekton) biomass and tuna (skipjack, albacore, yellowfin, bigeye) biomass. The IBM will use the oceanic environment predicted by the ESSIC coupled physical-biogeochemical model (temperature, currents, plankton) and the SEPODYM model (forage). Behaviour of tuna or other large pelagics predicted with the IBM will be compared to observed movements of individuals marked with electronic tags in selected study areas, and to spatial patterns generated by ADRMs.

2. Progress during FY 2004.

Selection of candidates to the post-doctoral position was a lengthy process and recruitment to this position was delayed by administrative procedures and the request by SPC to have funds from the PFRP project in hand prior to being able to offer a contract to the post doc researcher. The first advance for this project was received in January 2004. Finally, the selected candidate (Dr Gwenael Allain) is due to begin work at SPC on 15 May 2004.

During the months that preceeded the first transfer of funds for this project, Dr. R Murtugudde provided to the PI the predicted fields from the coupled biogoechemical model for the period 1948-2002. Analyses of model primary productivity reproduced most of the observed interannual to decadal climate variabilities including the 1976 regime shift. A further simulation for 1970-2003 is completed where 6-day and 10-day mean primary production are being analyzed.

In related synergistic activities, the salinity, iron, heat content, and freshwater fluxes in the North Pacific are being analyzed for their long-term behavior over 1948-2003. Dr Inna Senina, who has been recruited on the 'multi-grid' post-doctoral position, started her work in April 2004, at the University of Maryland under the supervision of R. Murtugudde.

As planned in the initial budget, US$ 32,275 will be transferred to the University of Maryland. The rest of the advance (US$ 35,250) will be used for covering travel, salary and computer cost of the IBM post-doctoral researcher.

3. Plans for the next fiscal year.

Given the delay in the implementation of this project, the first advance related to half the personnel cost of the post doctoral researcher (year 1) will cover his salary until October 2004. During the next fiscal year, we plan to require the advance for the second half of year 1.

Research activities will include:

- Simulations at different time and space resolutions based on predicted fields from the coupled physical-biogeochemical model (ESSIC, Univ. Maryland) and the model SEPODYM (SPC).
- Development of three forage components in SEPODYM instead of one currently for a better description of the vertical structure in the pelagic ecosystem.
- Analyses of these simulations and evaluation of the predictions
- Development of the IBM model and first simulations using the predicted environment from ESSIC and SEPODYM.
- Development of a multi-grid technique to be used in ESSIC and SEPODYM models.