Incorporating Sediment and Hydrography Data in Assessments for Tilefish and Lobster

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Related NOAA Goal Plan:
Goal 1. Protect, Restore and Manage the Use of Coastal and Ocean Resources through Ecosystem-based Management

CINAR Theme:
Theme II. Ecosystem Monitoring

PROJECT OVERVIEW

The objectives of this study as identified in the original proposal include employing a generalized additive modeling approach to 1) identify habitat associations for Gulf of Maine (GoM) American Lobster and Gulf of Mexico (GoMex) golden tilefish, 2) develop maps for lobster and tilefish in relation to various sediment and hydrographic factors, 3) improve precision of CPUE estimates by including habitat in index standardization, and 4) develop prior distributions for virgin biomass or recruitment (tilefish) for use in assessment models, leading to improved data quality and stock assessment.

We used a two-stage generalized additive models (GAMs) to identify key habitats influencing lobster distributions. This two-stage GAM, an extension that parallels delta-lognormal modeling approaches, allows for the explicit modeling of the probability of occurrence and the density given a positive observation and preserves the information content associated with of zero observations, but avoids problems associated with unrealistic assumptions such as assumed monotonic responses and normality of the predictors. Data are obtained from various sources including fisheries-independent surveys.

During the report time period, we focused our research efforts on American lobster, but also started to compile and analyze tilefish data.

ACCOMPLISHMENTS

We have accomplished the following tasks for the American lobster:

- The Maine-New Hampshire inshore trawl survey data for 2000 to 2009 were analyzed by season and sex;
- Lobster survey density for each tow record was log transformed and standardized by tow distance;
- The derived survey density was then standardized using GAM model with Gaussian error structure and identity link function. Four models, fall-female, fall-male, spring-female and spring-male models were constructed and seven variables, latitude, time of the day fishing, depth, bottom temperature, bottom salinity, wave condition, and year, were included in the models;
- In order to compare the standardized year coefficient to the non standardized ones, besides the full model with seven variables, a model with only year variable was also constructed for each of the four modeling groups;
- For the fall models, the seven variables were all significant with 47.1% and 48.5% deviance explained for females and males, respectively (Fig. 1);
- For the spring models, wave condition and time of the day fishing were not significant and were not retained in the final models. The spring model explained 44.5% and 45.9% of the deviances for females and males, respectively (Fig. 2);
- The trend of standardized year coefficients was similar to the non standardized ones. Reverse trends were only found for between 2000 to 2001 and 2006 to 2007 for both sexes in the fall and 2005 to 2006 for both sexes in the spring (Fig. 3).

We are currently using the standardized survey CPUE data to run the stock assessment for the lobster in the Gulf of Maine. We have found that the assessment model cannot be converged with the new standardized survey CPUE, indicating that the impacts of environmental variables on survey catchability may have large impacts on the stock assessment. We are currently conducting simulation study to quantify such impacts. We are preparing a manuscript to describe this study.

For the tilefish, we have started to identify key habitat variables and compile the data. A trip has been planned in May 24-27 for two PhD students (Jui-Han Chang and Sam Truesdell) to work with Dr. John Walter and Dr. John Quinlan in the NOAA Miami Lab. All the computer program codes have been developed and will be re-fined at the meeting.

HIGHLIGHTS

- Habitat variables can greatly influence distribution of American lobster in the Gulf of Maine

- The lobster habitat model we have developed provides us a capacity to project how spatial distribution of American lobster may change with changes in temperature fields in the Gulf of Maine (climate changes)

- Although temporal trend is similar between nominal and standardized lobster survey abundance indices, standardized survey abundance index tends to show more temporal variability and may greatly affect the lobster stock assessment results.

SOCIETAL BENEFITS

This study provides us with a better understanding of how fish distributions may be affected by environmental variables. The model developed in this study allows us to project potential consequences of changes in some key habitat variables such as temperature and bottom type. As a result, society can have a better understanding of dynamics of ecosystems.

EDUCATION AND OUTREACH ACTIVITIES

Two PhD students (Jui-Han Chang and Sam Truesdell) are involved in this project, which helps them understand the importance of habitats and modeling skills.
No presentations have been made, but we plan to present some results in a fine-scale stock structure workshop in June 2011 and some results on the lobster work will be presented at UMaine School of Marine Sciences Graduate Symposium in May 2011. More presentations will be planned once we have completed work in the tilefish.

PUBLICATIONS
We are preparing a manuscript for the lobster work described in this study.

FIGURES/PHOTOGRAPHS/ILLUSTRATIONS

(See attached figures that are cited in Accomplishment section)

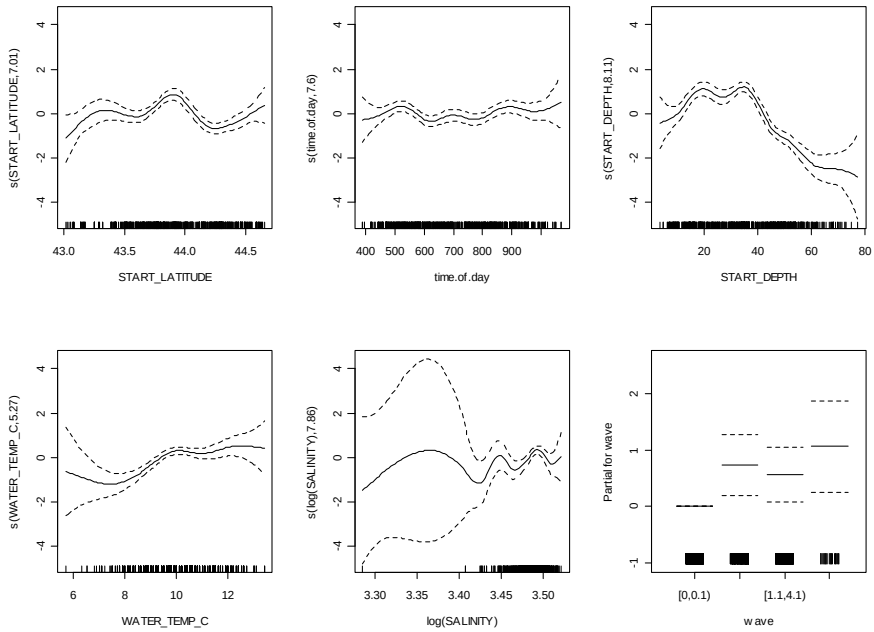

Fig. 1-a Estimated smoothing of the six environmental variables (latitude, time of the day fishing, depth, temperature, salinity, and wave condition) on the density of female lobster in the fall.

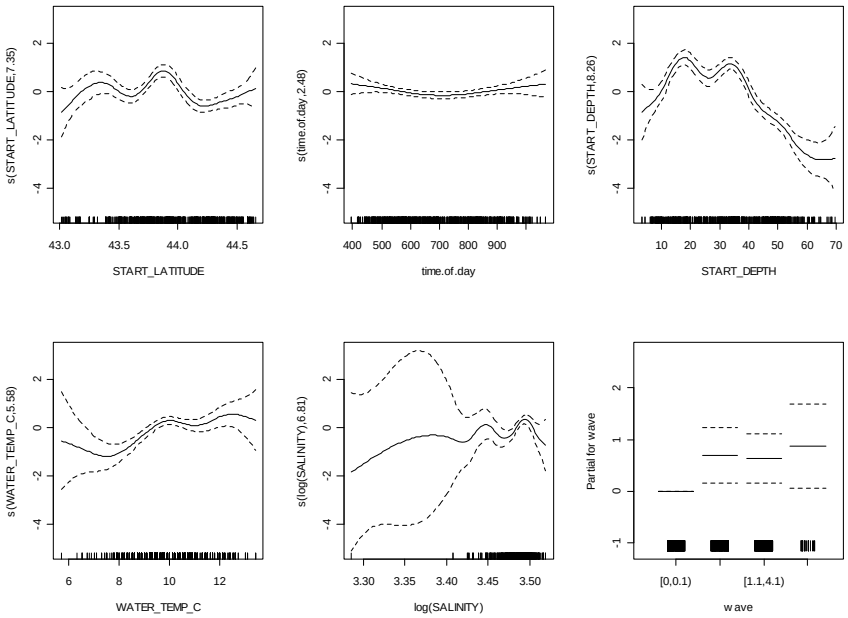

Fig. 1-b Estimated smoothingof the six environmental variables (latitude, time of the day fishing, depth, temperature, salinity, and wave condition) on the density of male lobster in the fall.

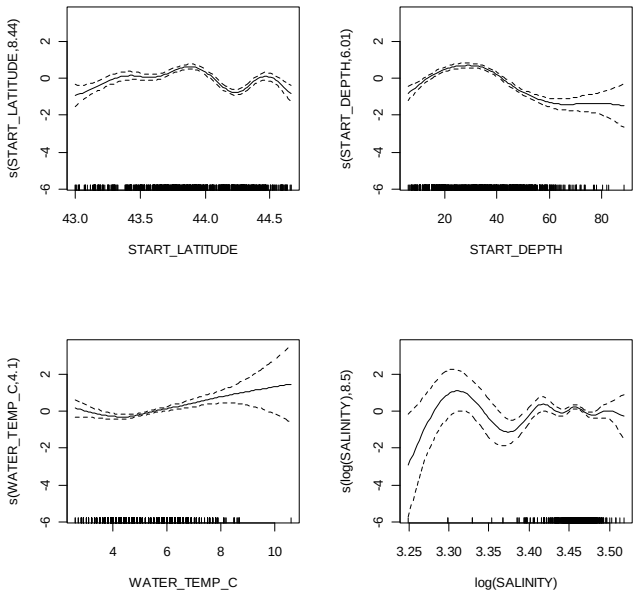

Fig. 2-a Estimated smoothing of the six environmental variables (latitude, depth, temperature, and salinity) on the density of female lobster in the spring

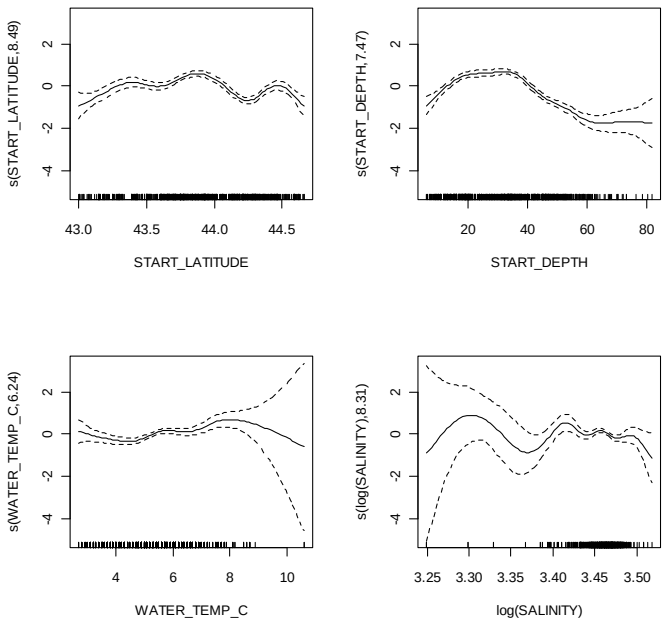

Fig. 2-b Estimated smoothing of the six environmental variables (latitude, depth, temperature, and salinity) on the density of male lobster in the spring.

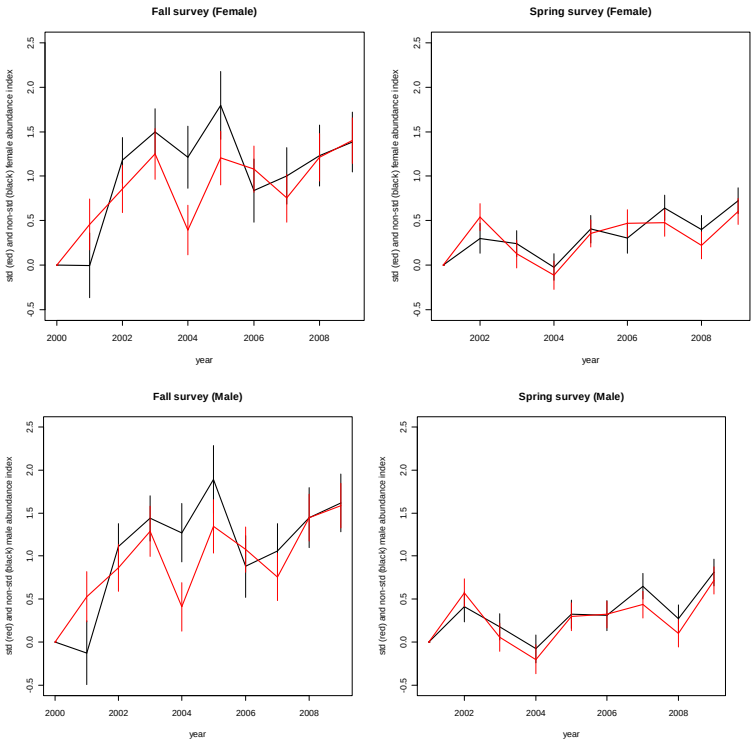

Fig. 3 Plot of standardized and non standardized year coefficient of lobster survey density by sex and season.