HABITAT MODELING FOR FISHERIES INDEPENDENT TRAP SURVEYS

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INTRODUCTION:

The objective of this IOOS – SECOORA research was to integrate oceanographic information into regional stock assessments and habitat characterizations by developing improved fisheries management tools for fisheries managers and policy makers that incorporate real-time oceanographic observations (in situ and satellite).

One major goal is to evaluate if the habitat classification modeling can improve on existing stock assessment standardizations (e.g., habitat based standardization, statistical habitat based models, and generalized linear modeling).

Species specific habitat models were derived to determine if they would enhance the fish stock assessments for South Atlantic Fishery Management Council (SAFMC) for four economically and ecologically important species in the snapper-grouper complex: black sea bass (*Centropristis striata*), gray triggerfish (*Balistes capriscus*), red porgy (*Pagrus pagrus*), and vermilion snapper (*Rhomboplites aurorubens*).

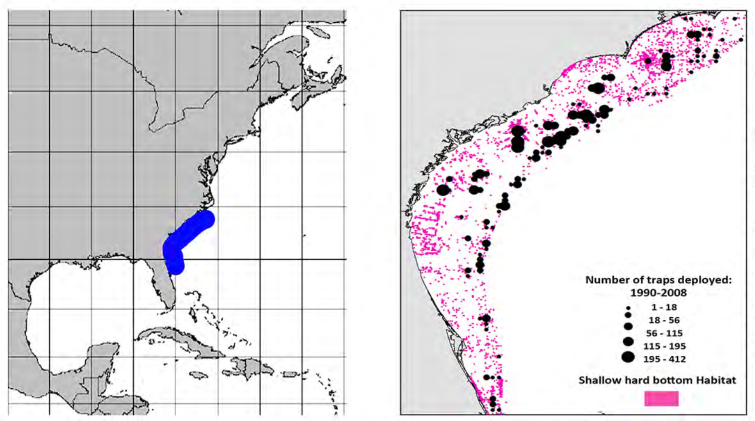


Figure 1. Plot of the distribution and number of the MARMAP Cheveron fish trap sampling stations, 1990-2008, along the U.S. southeast coast from North Carolina to central Florida over shallow hard bottom habitat. Traps deployed in groups of six during spring and summer fishery independent research cruises

Biological responses to environmental variables are frequently non-linear, and include strong interactions. Thus, multivariate, non-parametric methods are a good choice for habitat models. In this project, we used artificial neural networks, and boosted classification trees from DTREG. Both methods are well suited for large datasets containing complicated nonlinear relationships.

RESULTS:

Figure 2. Predicted probabilities of occurrence of each predictor variable scored in order of importance (/100). For each species the important variables were different.

Gray Triggerfish		Black Seabass		Red Porgy		Vermillion Snapper	
Variable	*Importance*	*Variable*	*Importance*	*Variable*	*Importance*	*Variable*	*Importance*
Bottom temperature	100	Water depth	100	Water depth	100	Longitude	100
Latitude	76.1	Longitude	16.2	Latitude	50.4	Water depth	97.9
Water depth	56.8	Latitude	9.8	Longitude	42.7	Latitude	85.6
Date	29.0	Date	5.4	Date	10.2	Bottom temperature	82.3
Predator biomass	26.4	Surface temperature	4.4	Time	7.8	Date	39.2
Longitude	23.2	Predator biomass	3.1	Surface temperature	7.5	Wind speed	38.0
Soak duration	16.5	Time	2.3	Moon phase	7.4	Time	31.9

Positional variables   Sampling variables   Environmental variables   Biological variables

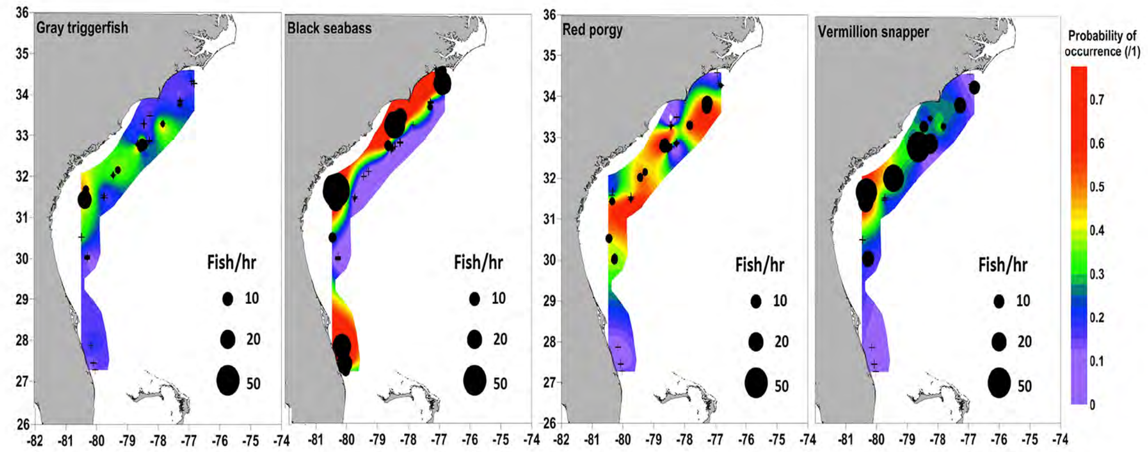


FIGURE 3. Habitat model predictions were overlaid on observed catches June- August 2008 showing good agreement between the model and catch data. Triggerfish, porgy, and snapper were most abundant in the central northern study area, while sea bass was most common in shallower waters over the entire region.

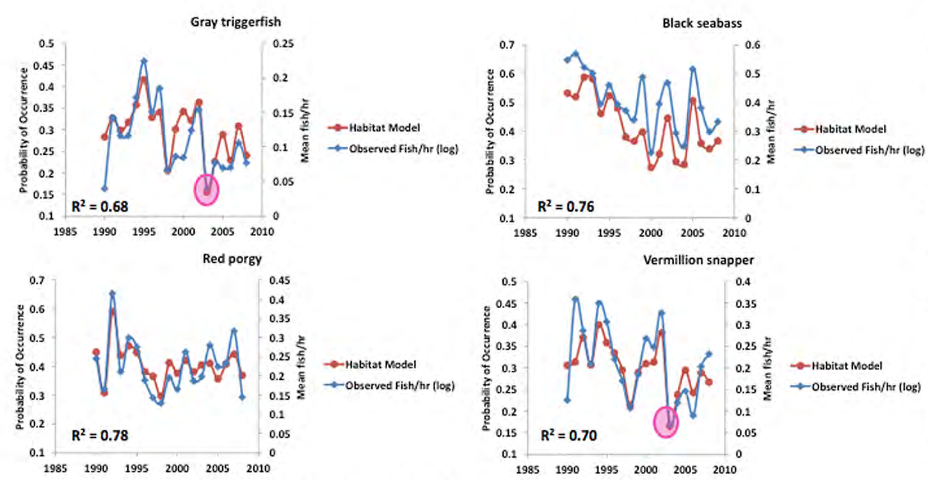


Figure 4. Interannual comparison

Interannual series were derived showing the good fit of the of the model compared with the observed catch data (fish/hr.) for the months of June - August (Figure 4). The effect of relatively cooler bottom temperatures during the summer of 2003 for triggerfish and snapper became apparent especially when comparing 2003 to 2002 (Figure 5). This is important when trying to understand changes in catch rate which are used to derive indices of abundance and illustrates the need to provide quantitative indices of the habitat derived from ocean observations for catch standardization.

It appears that the cooler bottom temperatures are likely related to topographic upwelling from stronger geostrophic Gulf Stream flow derived from HYCOM models (Fig. 6).

Figure 5. Triggerfish and bottom temperature

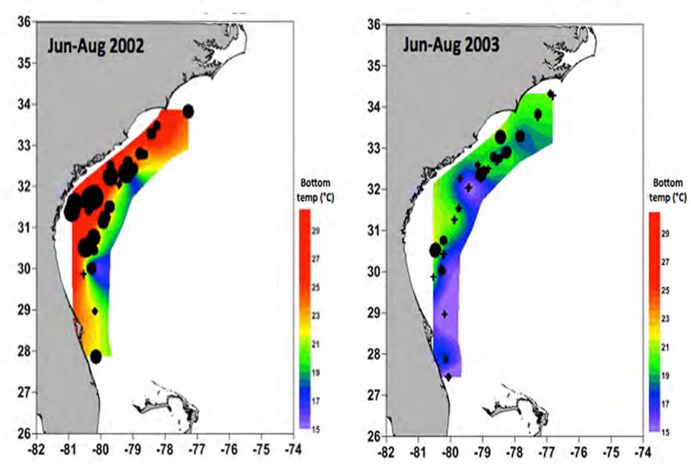
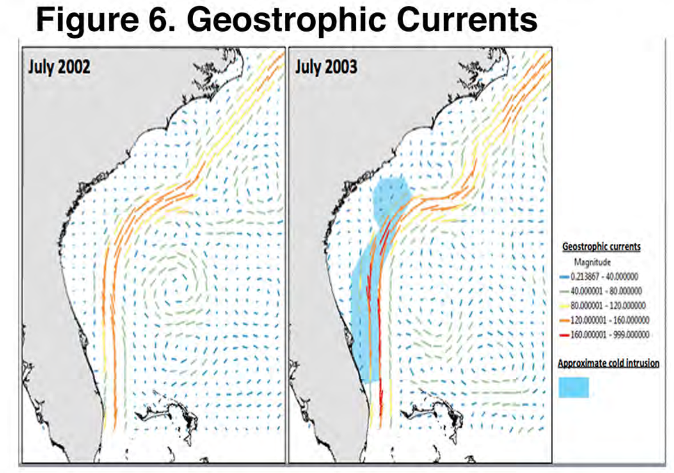


Figure 6. Geostrophic Currents



Final Thoughts, Next Steps and Conclusions

It was shown that the occurrences of four target species were influenced by several interacting environmental and geographic variables. Bottom temperature was important to distributions of gray triggerfish and vermillion snapper. Occasional upwelling of cold water onto the continental shelf affects availability of fish to traps, and potentially the derived stock indices.

Current standardization is done using a delta-GLM models and/or zero-inflated negative binomial models. As a result of this project it has been recommended that a comparison of the CPUE standardization using existing models, and using the "habitat" covariate (derived in this study), become part of the The SouthEast Data, Assessment, and Review (SEDAR) research plan for grey triggerfish. If the "habitat" covariate for triggerfish improves the standardization of trap catch relative apparent abundance, then we suggest that it be evaluated for vermillion snapper.