SEFSC-AOML biogeochemical modeling project overview

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Although the Atlantic bluefin tuna (Thunnus thynnus) is widely distributed, spawning in the western Atlantic has been recorded predominantly in the Gulf of Mexico from April to June. While bluefin tuna can better tolerate colder waters than other tropical tunas, they are adversely affected by warm water (>28°C) and avoid warm features in the Gulf of Mexico such as the Loop Current. As presented in Muhling et al. (2011), direct applications of the IPCC-AR4(5) climate model simulations for the 20th century, mid 21st century, and late 21st century onto the bluefin tuna larvae habitat model indicate that the preferred area of spawning habitat of bluefin tuna larvae may be almost completely lost by the late 21st century due to the impact of anthropogenic global warming (AGW). However, since the IPCC-AR4(5) models have a very coarse resolution, the simulated changes in the strength, position, and eddy-shedding characteristics of the Loop Current, which are important factors for the upper ocean temperature response to the changing climate, are not realistic.

Therefore, Liu et al. (2012) used a dynamic downscaling approach to show a regionally enhanced view of potential future changes in the Gulf of Mexico under the impact of AGW. The highlight of our findings is that the Loop Current may be drastically reduced by as much as 20% by the late 21st century, resulting in a mitigation of AGW-induced surface warming, particularly in the northern Gulf of Mexico, a known spawning ground for Atlantic bluefin tuna. Applications of the downscaled model results onto the habitat model reveal that the reduction of the Loop Current effectively delays the total loss of the bluefin tuna larvae habitat in the northern Gulf of Mexico (Figure 1) by up to 20 years or so. The collaborative work between SEFSC and AOML will continue with the new focus on the biogeochemical modeling.
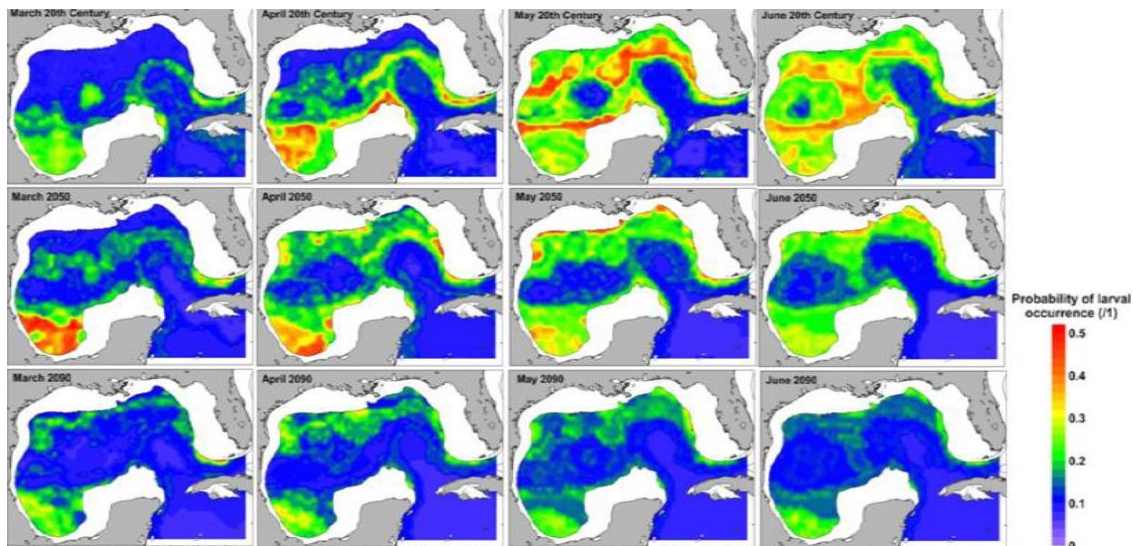

Figure 1. Prediction of the extent of habitat suitable for the occurrence of larval bluefin tuna in the Gulf of Mexico using the downscaled model results under late 20th century conditions (1971–1999) and projected conditions in 2045–2055 and 2085–2095, for the months of March, April, May, and June. The probability of occurrence (%) is illustrated, based on output from the boosted classification-tree model using weighted mean temperature values.