Effects of temperature on Black Sea Bass (*Centropristis striata*) metabolic rate: Integrating physiological studies and climate change models to predict potential changes in distribution

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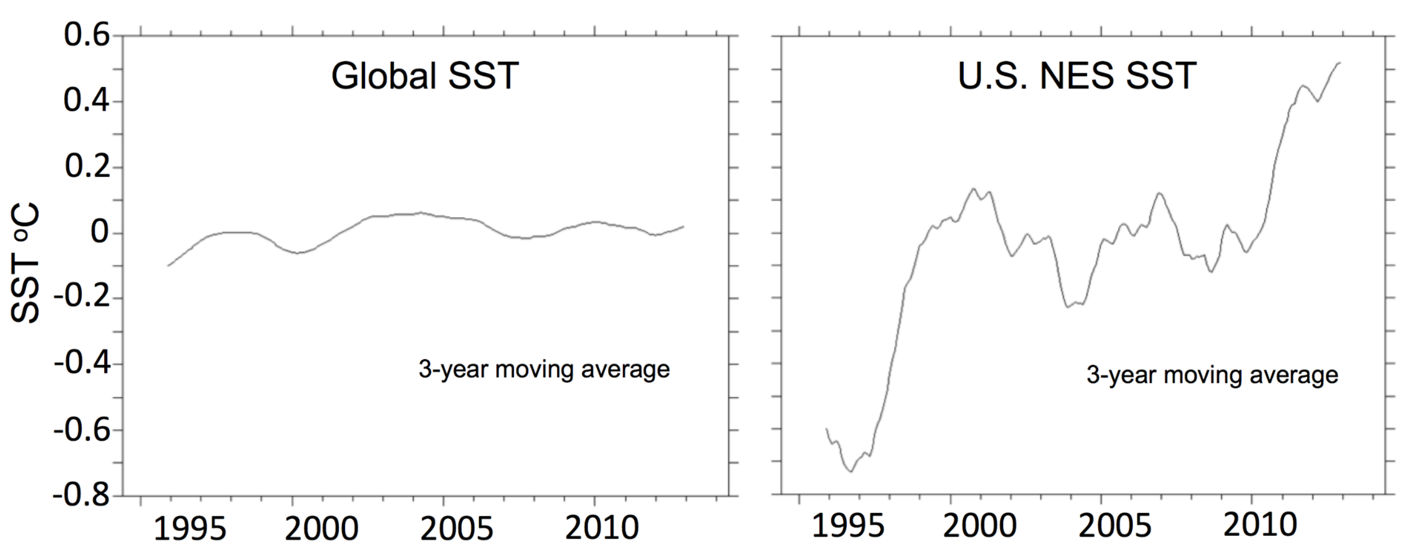
Introduction

Over the past 20 years, ocean surface temperature in the United States Northeast Shelf (U.S. NES) has warmed at a substantially higher rate than the global average. This can affect the abundance and distribution of living marine resources (LMRs) such as commercially important species.



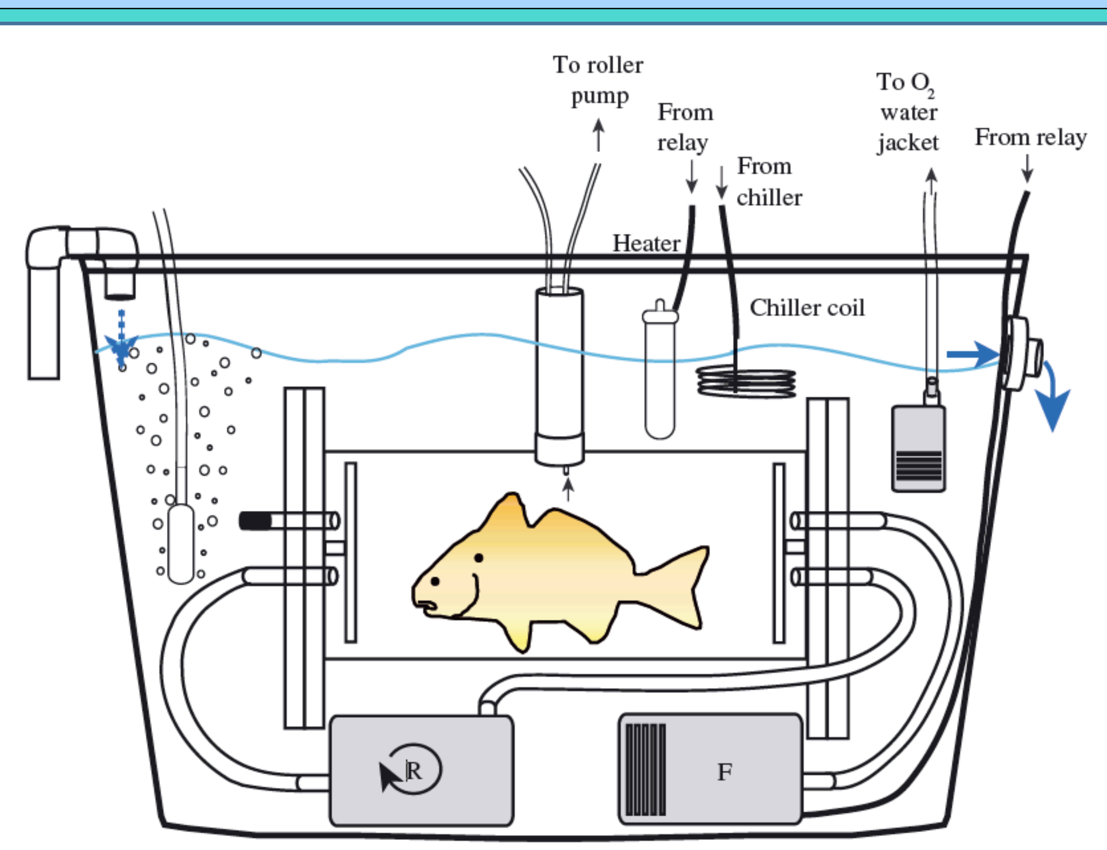
Comparison of sea surface temperature (SST) anomalies in the global ocean and the U.S. NES. Anomalies are based on the mean Reynold's SST (daily, 25 km) 1994-2014. (Source: NOAA)

Achieving improved habitat metrics of commercially important species based on laboratory studies can produce hindcast simulations and climate change projections of habitat quantity and quality that can ultimately guide existing and future management decisions.

Focal species of this study:

Black sea bass (*Centropristis striata*)

Laboratory Studies

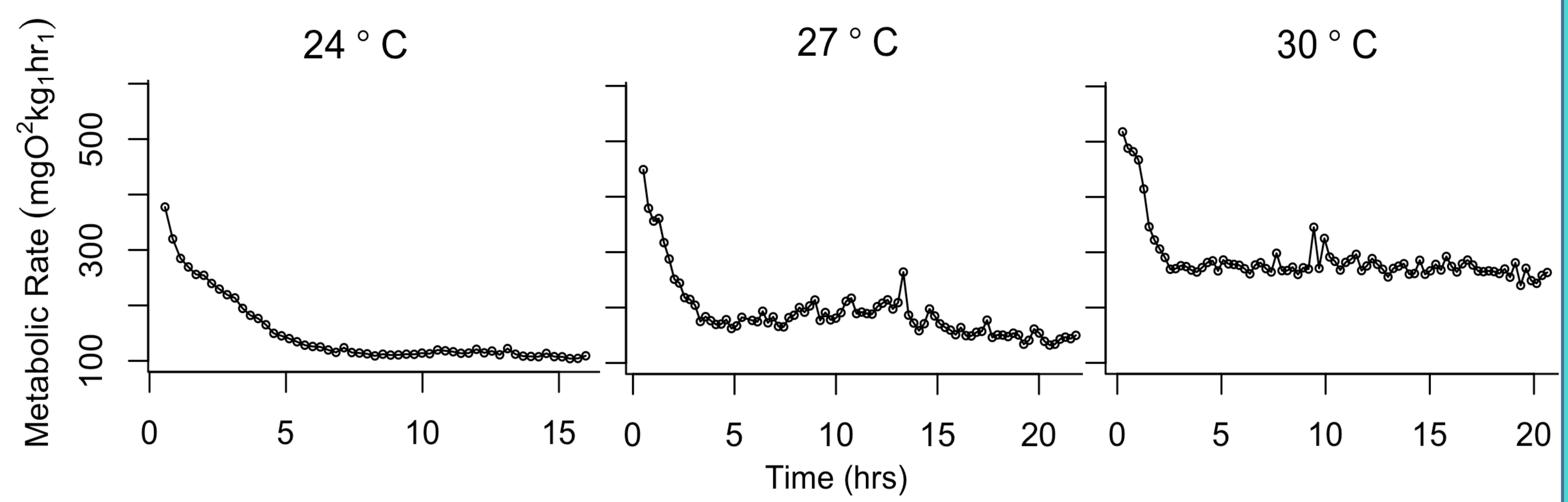


From Horodysky et al. 2011

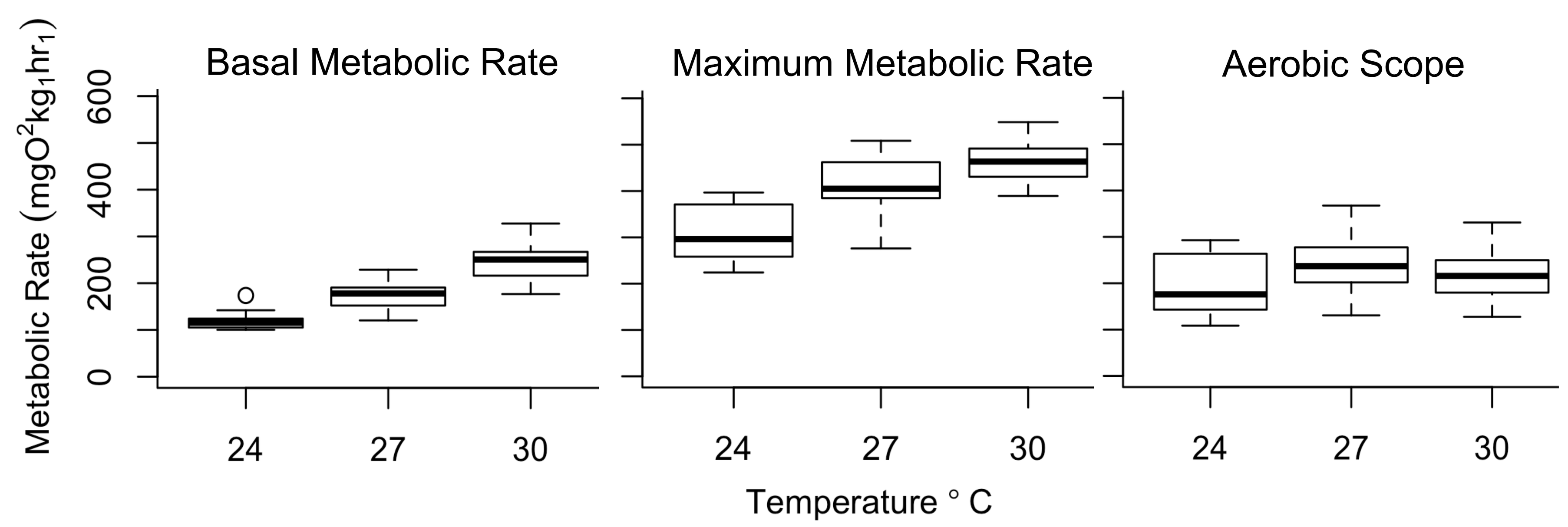
We use intermittent respirometry to determine the metabolic functional response of black sea bass to a range of temperatures.

Preliminary Results

We measured oxygen consumption rates immediately after exhaustive exercise (maximum metabolic rates, MMR) and rates when the animal is resting (basal metabolic rates, BMR). Aerobic scope = MMR-BMR



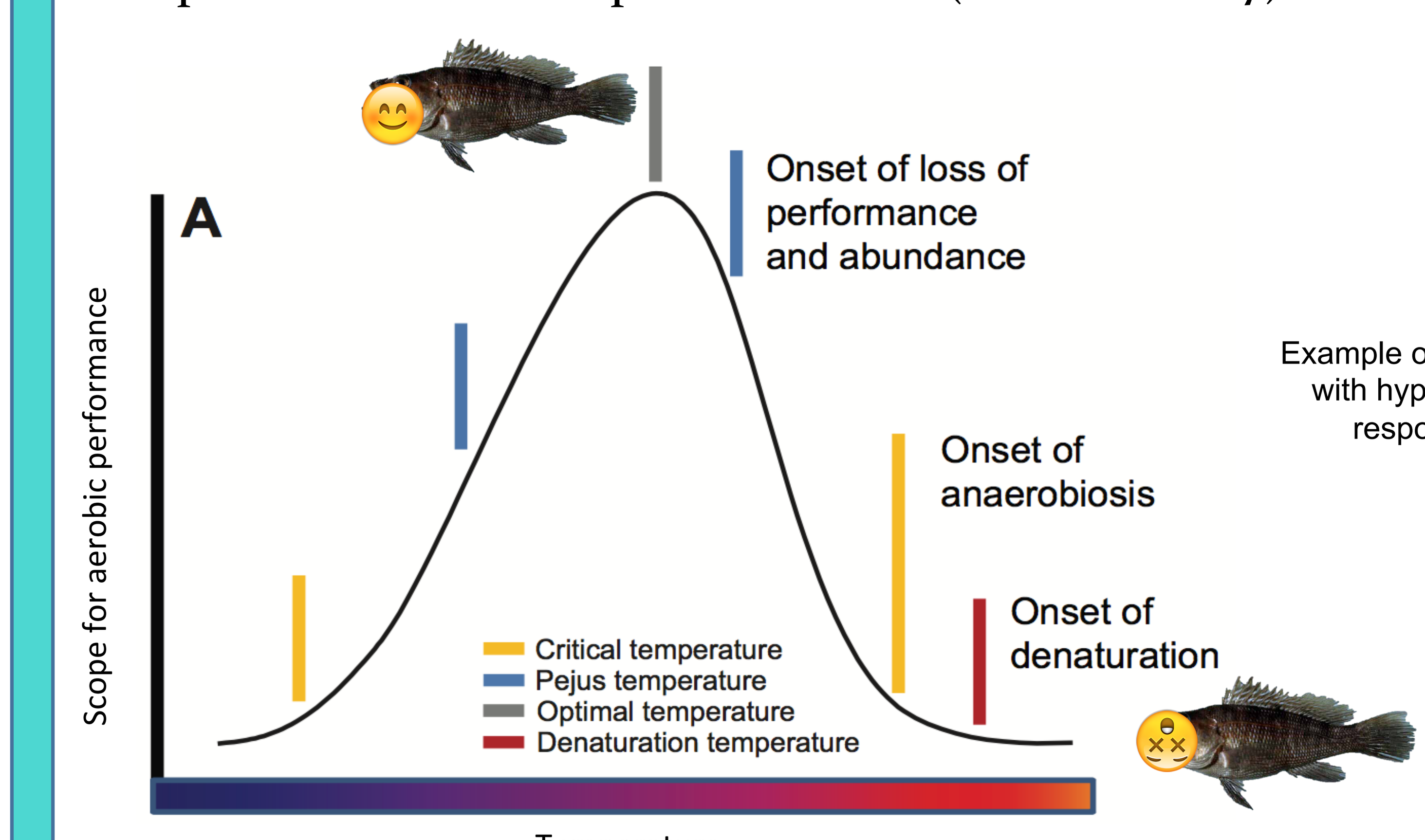
The metabolic rate (maximum to basal) for three different fish at three experimental temperatures.



BMR, MMR, and aerobic scope of black sea bass at 24, 27 and 30 ℃. BMR and MMR were significantly different between temperatures ($p < 0.001$), but aerobic scope was not ($p > 0.05$; post-hoc Tukey HSD: 24-27 = 0.05).

Next Steps

We will perform the same analysis at a range of temperatures (10 – 33℃) to complete the thermal optimum curve (Summer 2017).

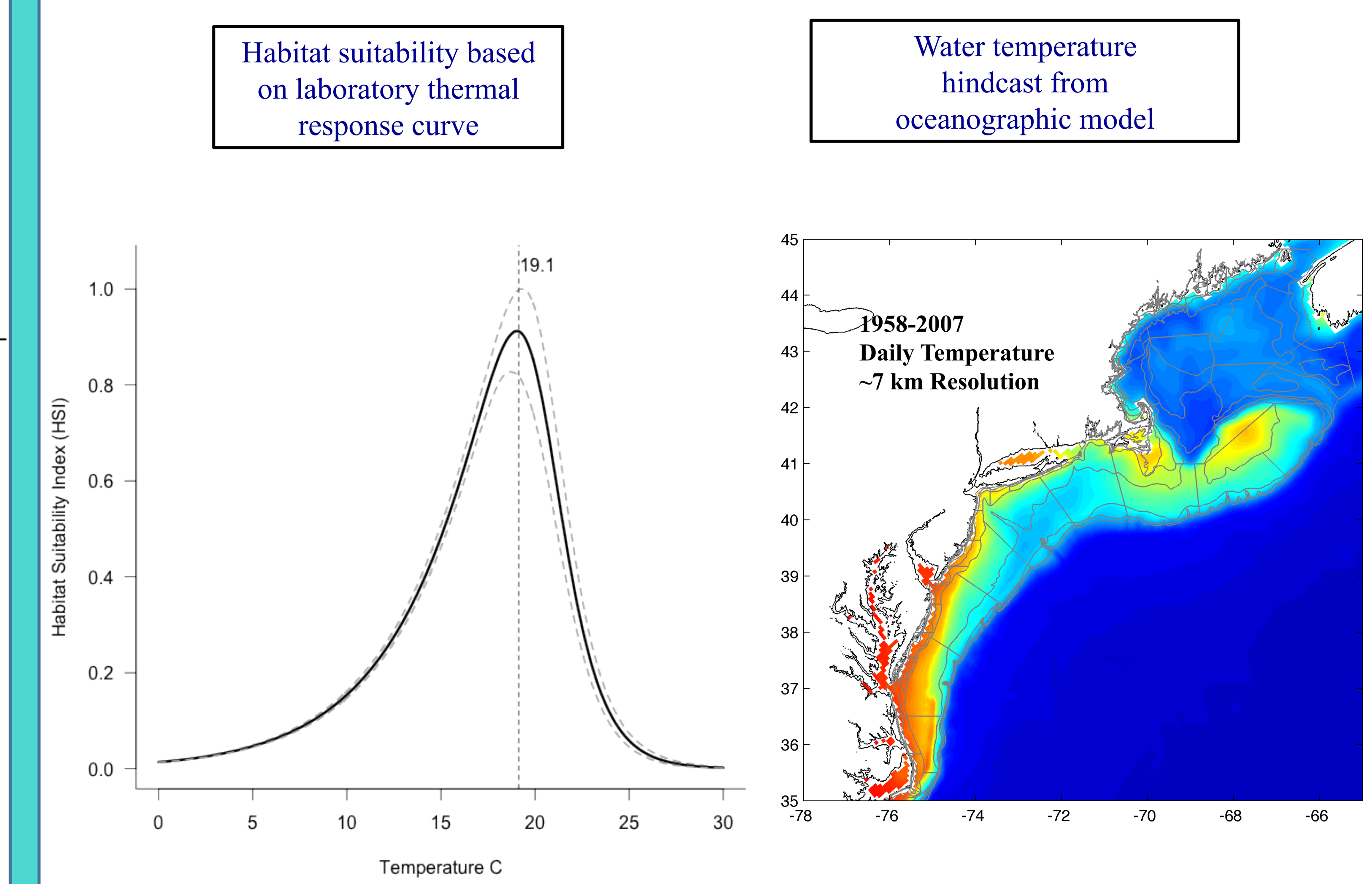


Example of a thermal optimum curve with hypotheses of physiological responses to temperature.

From Clark et al. 2013

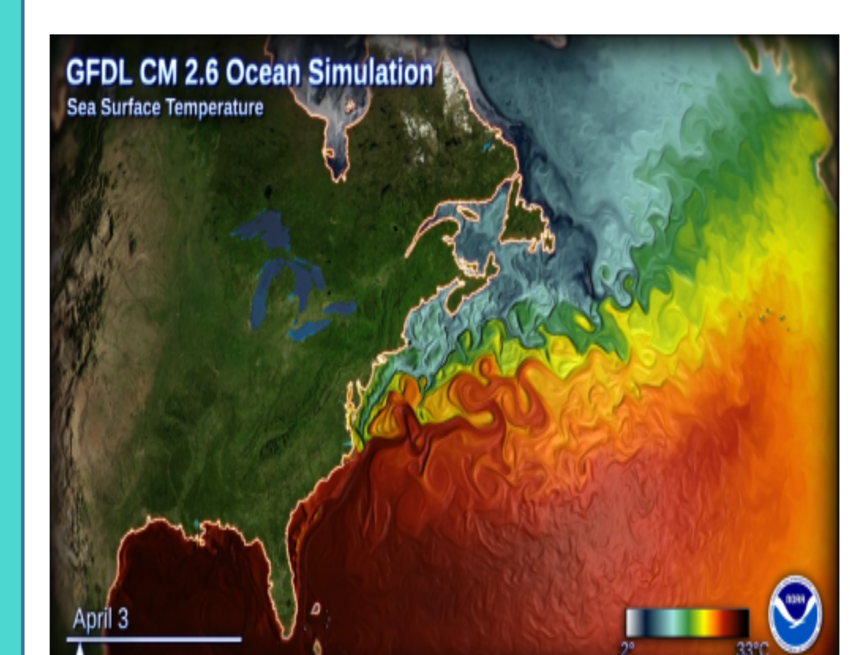
Habitat Assessment and Hindcasts

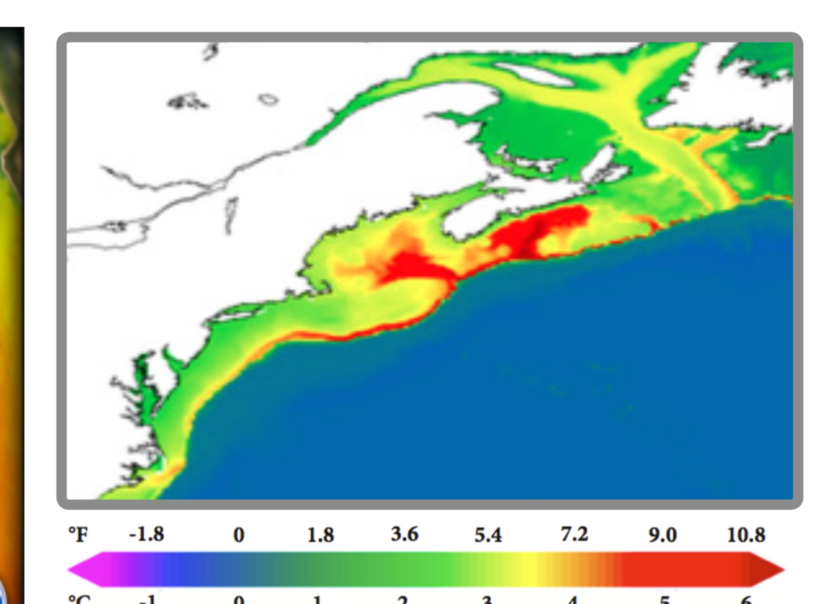
The thermal response curves will be applied to an existing 50-year, three-dimensional hindcast of the U.S. NES (ROMS). We will use the hindcast simulations to develop and assess habitat metrics with respect to changes in population distribution, size, and variability.



Habitat Projections

We will project habitat quality and quantity and calculate relevant habitat metrics over various climate change scenarios. This will involve the use of a high-resolution global climate model developed by NOAA GFDL.





NOAA high-resolution global climate model projection of bottom ocean temperature change under an atmospheric carbon dioxide doubling experiment.

Habitat hindcasts and projections of black sea bass will advance our understanding of climate (variability and change) on this economically important LMR that may already be changing.