Habitat suitability for highly migratory species
Northwest Atlantic Ocean
October 2024

Prepared for:
Northeast Regional Ocean Council (NROC)
www.northeastoceandata.org

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as part of the NASA-funded Fisheries and Climate Toolkit (FaCeT)
https://fisheriesclimatetoolkit.sdsu.edu/

1. INTRODUCTION

This data product was developed as part of the NASA-funded Fisheries and Climate Toolkit (FaCeT, https://fisheriesclimatetoolkit.sdsu.edu/). FaCeT is a set of products to visualize and explore how climate change will impact highly migratory marine species and fisheries, bridging the gap between fisheries and climate science to support climate resilient and sustainable fisheries.

Covering more than 70% of Earth's surface, oceans absorb the majority of atmospheric heat and are disproportionately affected by climate change. This absorption process has led to a changing ocean as evidenced by increasing temperatures across the world's oceans. One of the key ways we measure climate change in the ocean is using temperature anomalies, large shifts in temperature relative to a reference period. Anomalies identify ocean areas where temperatures have deviated from historical baselines.

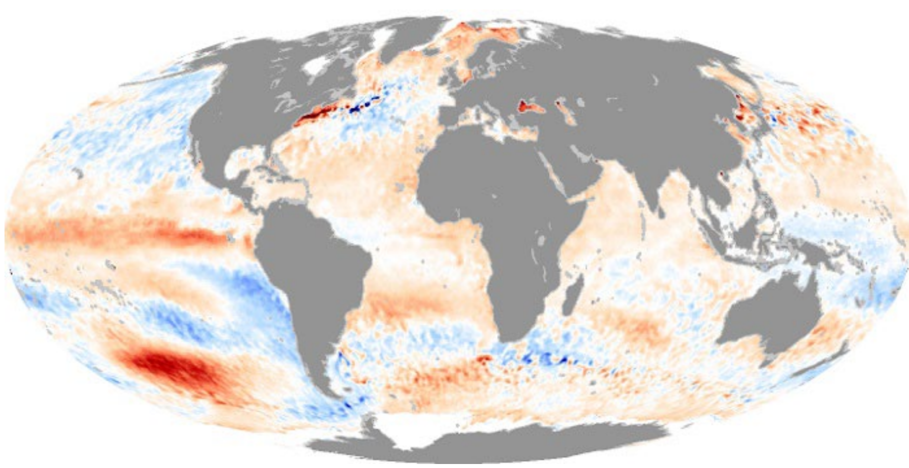

Figure 1. *Global ocean temperatures, where red areas indicate anomalously warm and blue areas are anomalously cool.*

Climate change threatens both ocean ecology and economies: ocean ecosystems support 50-80% of total biodiversity on Earth and ocean economies support billions of people's livelihood and subsistence. Despite the growing evidence of a warming, there remain many unanswered questions in terms of how fisheries are and will continue to be impacted by climate change. Understanding the current and future impacts of climate change on fisheries has tremendous conservation and economic implications.

These data products represent predictions of habitat suitability for a given species using species distribution models. In general, these models are used to develop quantitative links between observation data for a species (e.g., fishery catch data, conventional or electronic tagging data) and the environmental conditions that species occupies. By leveraging these links, the model can then be used to make predictions about how suitable an ocean habitat should be, given its environmental characteristics. This model-predicted suitability can be projected into the future using climate models that represent future ocean conditions. Here, these model predictions represent the decadal mean predictions for a contemporary period (1990s to 2010s) and a future period (2070s-2090s) as a way to quantify expected changes to species' habitat under climate-induced change to ocean systems.

2. PURPOSE

The purpose of calculating predicted habitat suitability at these timescales is to understand potential climate-induced redistribution of marine species. By quantifying these expected changes, this information can contribute to critical challenges in marine spatial planning and fishery management in a changing ocean.

3. SOURCES AND AUTHORITIES

These products are derived from two peer-reviewed scientific publications:

Braun, C. D., Arostegui, M. C., Farchadi, N., Alexander, M., Afonso, P., Allyn, A., Bograd, S. J., Brodie, S., Crear, D. P., Culhane, E. F., Curtis, T. H., Hazen, E. L., Kerney, A., Lezama-Ochoa, N., Mills, K. E., Pugh, D., Queiroz, N., Scott, J. D., Skomal, G. B., … Lewison, R. (2023a). Building use-inspired species distribution models: using multiple data types to examine and improve model performance. *Ecological Applications*, *e2893*. https://doi.org/10.1002/eap.2893

Braun, C. D., Lezama-Ochoa, N., Farchadi, N., Arostegui, M. C., Alexander, M., Allyn, A., Bograd, S. J., Brodie, S., Crear, D. P., Curtis, T. H., Hazen, E. L., Kerney, A., Mills, K. E., Pugh, D., Scott, J. D., Welch, H., Young-Morse, R., & Lewison, R. L. (2023b). Widespread habitat loss and redistribution of marine top predators in a changing ocean. *Science Advances*, *9*(32). https://doi.org/10.1126/sciadv.adi2718

4. DATABASE DESIGN AND CONTENT

Dataset Status: Complete

Native storage format: ESRI ArcGIS Mosaic Dataset
Columns and rows: 579,551
Number of bands: 1
Cell size: 10.2 km, 10.2 km
Pixel type: double
Linear Unit: Meter (1.000)
Angular Unit: Degree (0.01745329)
Statistics:
 Minimum: 0
 Maximum: 1

Habitat suitability values are on a continuous numerical scale from 0 to 1 where 0 represents unsuitable habitat and 1 represents highly suitable habitat.

5. SPATIAL REPRESENTATION

Projected Coordinate System: WGS_1984_Web_Mercator_Auxiliary_Sphere
Geographic Coordinate System: GCS_WGS_1984
Horizontal Datum: D_WGS_1984
Spheroid: WGS_1984

Geographic extent: - 97.88 to - 44.77, 9.89 to 51.63

IS0 19115 Topic Category: environment, oceans, biota

Place Names:
 Atlantic Ocean, Cape Cod Bay, Cape May, Chesapeake Bay, Connecticut, Delaware, Delaware Bay, Florida, Georgia, Gulf of Maine, Gulf of Mexico, Hudson River, Long Island Sound, Maine, Maryland, Massachusetts, Massachusetts Bay, New Hampshire, New Jersey, New York, North Carolina, Pennsylvania, Rhode Island, Rhode Island Sound, South Carolina, United States, Virginia

Recommended Cartographic Properties:
(Using ArcGIS ArcMap nomenclature)

Stretched symbology, Stretch type: minimum/maximum (0-1), Color Scheme:
Continuous color scheme (RGB)
 Dark blue: 42-24-110
 Light yellow: 251-238-151
 Algorithm: HSV
 Polar direction: Longest path

Scale range for optimal visualization: 1:20,000,000

6. DATA PROCESSING & QUALITY CONTROL

Full details for data processing and quality control can be found in Braun et al., 2023a (link) and implementation of those methods for climate-scale projections is detailed in Braun et al., 2023b (link).