North American marine species distribution projections during the 21st century

Website: https://www.bco-dmo.org/dataset/753124
Data Type: model results
Version: 1
Version Date: 2019-03-21

Project
» Adaptations of fish and fishing communities to rapid climate change (CC Fishery Adaptations)

Contributors	Affiliation	Role
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Table of Contents

Coverage

Spatial Extent: **N**:62 **E**:-42 **S**:26 **W**:-175
Temporal Extent: 2007 - 2100

Dataset Description

Projections for Atlantic and Pacific marine species for representative concentration pathways (RCP) 2.6 and 8.5. These data were published in Morley et al. (2018).

Links to download .RData files:
* see "GENERAL FILE DESCRIPTION" paragraph in the Methods & Sampling section for details about these files.

RCP26_Atlantic.tar.gz (19.2 GB, 382 files)
https://datadocs.bco-dmo.org/data/305/CC_Fishery_Adaptations/753124/1/da...

RCP26_Pacific.tar.gz (12.2 GB, 303 files)
https://datadocs.bco-dmo.org/data/305/CC_Fishery_Adaptations/753124/1/da...

RCP85_Atlantic.tar.gz (19.2 GB, 382 files)
https://datadocs.bco-dmo.org/data/305/CC_Fishery_Adaptations/753124/1/da...

RCP85_Pacific.tar.gz (12.2 GB, 303 files)
https://datadocs.bco-dmo.org/data/305/CC_Fishery_Adaptations/753124/1/da...

Methods & Sampling

SUMMARY OF METHODS
Projections for shifts in thermal habitat for marine species on the North American continental shelf during the 21st century were conducted by coupling models of species thermal habitat with climate projection model output. Habitat models for each species were based on extensive trawl survey data from the continental shelf of the U.S. and Canada. Each haul from this survey dataset was paired with environmental data, including five ocean temperature variables and two seafloor characteristics. Generalized additive models(GAMs) were used to statistically describe each species' thermal habitat preference. The habitat model of each species was applied to projections of future climate, to predict how the distribution of suitable habitat will shift during the 21 st century. Two future carbon emissions scenarios (RCP 2.6 and 8.5) were used, which represented a potential best and worst case outcome for future ocean warming. Within each future scenario, sixteen different general circulation models (GCMs) were used to project future ocean temperatures annually from 2007-2100 on the continental shelf. The spatial resolution of the GCMs were standardized to a resolution of 0.25 degrees latitude and longitude based on historical climatology data, by using statistical downscaling. The projection grid was further refined to ~6 km based on seafloor characteristics. A total of 32 possible future ocean climate outcomes were generated for projecting species habitat shifts. Annual projections of thermal habitat were calculated for each species by applying the habitat models to projections of climate from 2007 to 2100. Annual values were aggregated into 20 year mean values within each RCP and GCM.

GENERAL FILE DESCRIPTION
Each file contains 21st century projection data for a single species and one of two RCPs (representative concentration pathway). The files are stored as .RData files and each contains a single data frame to be used with R computing software. Each row of data consists of projected catch-per-unit-effort for 16 different general circulation models (mean1 through mean16) within a specific latitude-longitude referenced grid cell, for one of five time periods (2007-2020, 2021-2040, 2041-2060, 2061-2080, 2081-2100).

FILENAME CONVENTION (separated by _)
The beginning of each file contains the species scientific name.
The Atlantic (including the Gulf of Mexico) and Pacific Ocean species are identified by Atl or Pac, respectively
rcp26 or rcp85 identifies the two carbon emission scenarios used.
jas indicates that these projections are for the months of July-August-September
prediction_AGG indicates that these are predictions aggregated into 20 year time periods.

COLUMNS IN DATA FRAMES
year-range - projections are mean annual values within five time periods
latitude and longitude - reference grid cell locations
mean1 through mean16 - the projected values of catch-per-unit-effort within each of 16 different general circulation models (i.e., each column represents one general circulation model). Mean values are calculated with the annual estimates within that year-range. The order of the general circulation models: bcc-csm1-1-m', 'bcc-csm1-1', 'CanESM2', 'CCSM4', 'CESM1-CAM5', 'CNRM-CM5', 'GFDL-CM3', 'GFDL-ESM2M', 'GFDL-ESM2G', 'GISS-E2-R', 'GISS-E2-H', 'IPSL-CM5A-LR', 'IPSL-CM5A-MR', 'MIROC-ESM', 'MPI-ESM-LR', 'NorESM1-ME.

BCO-DMO Processing Description

* Checked species name in RData filenames against the World Register of Marine Species (WoRMS) on 2019-02-19. After communication with data submitter about unaccepted and unmatched names, changed species names in RData filenames to the correctly spelled, accepted species names. See supplemental documents for a list of filenames with associated species names and identifiers.
* Species list for this dataset attached as a supplemental document.
* Files were compressed and bundled into .tar.gz for users to download.

[table of contents | back to top]

Supplemental Files

File	
Filelist with species names filename: filename_list_with_species_ids.csv	(Comma Separated Values (.csv), 111.83 KB) MD5:334e664ff92878c63dca431edf70be56
Filelist with the associated species names and identifiers. Identifiers are the aphiaID from the World Register of Marine Species (WoRMS).	

[table of contents | back to top]

Related Publications

Morley, J. W., Selden, R. L., Latour, R. J., Frölicher, T. L., Seagraves, R. J., & Pinsky, M. L. (2018). Projecting shifts in thermal habitat for 686 species on the North American continental shelf. PLOS ONE, 13(5), e0196127. doi:10.1371/journal.pone.0196127
Results

[table of contents | back to top]

Parameters

Parameters for this dataset have not yet been identified

[table of contents | back to top]

Project Information

Adaptations of fish and fishing communities to rapid climate change (CC Fishery Adaptations)

Coverage: Northeast US Continental Shelf Large Marine Ecosystem

Description from NSF award abstract:
Climate change presents a profound challenge to the sustainability of coastal systems. Most research has overlooked the important coupling between human responses to climate effects and the cumulative impacts of these responses on ecosystems. Fisheries are a prime example of this feedback: climate changes cause shifts in species distributions and abundances, and fisheries adapt to these shifts. However, changes in the location and intensity of fishing also have major ecosystem impacts. This project's goal is to understand how climate and fishing interact to affect the long-term sustainability of marine populations and the ecosystem services they support. In addition, the project will explore how to design fisheries management and other institutions that are robust to climate-driven shifts in species distributions. The project focuses on fisheries for summer flounder and hake on the northeast U.S. continental shelf, which target some of the most rapidly shifting species in North America. By focusing on factors affecting the adaptation of fish, fisheries, fishing communities, and management institutions to the impacts of climate change, this project will have direct application to coastal sustainability. The project involves close collaboration with the National Oceanic and Atmospheric Administration, and researchers will conduct regular presentations for and maintain frequent dialogue with the Mid-Atlantic and New England Fisheries Management Councils in charge of the summer flounder and hake fisheries. To enhance undergraduate education, project participants will design a new online laboratory investigation to explore the impacts of climate change on fisheries, complete with visualization tools that allow students to explore inquiry-driven problems and that highlight the benefits of teaching with authentic data. This project is supported as part of the National Science Foundation's Coastal Science, Engineering, and Education for Sustainability program - Coastal SEES.

The project will address three questions:
1) How do the interacting impacts of fishing and climate change affect the persistence, abundance, and distribution of marine fishes?
2) How do fishers and fishing communities adapt to species range shifts and related changes in abundance? and
3) Which institutions create incentives that sustain or maximize the value of natural capital and comprehensive social wealth in the face of rapid climate change?

An interdisciplinary team of scientists will use dynamic range and statistical models with four decades of geo-referenced data on fisheries catch and fish biogeography to determine how fish populations are affected by the cumulative impacts of fishing, climate, and changing species interactions. The group will then use comprehensive information on changes in fisher behavior to understand how fishers respond to changes in species distribution and abundance. Interviews will explore the social, regulatory, and economic factors that shape these strategies. Finally, a bioeconomic model for summer flounder and hake fisheries will examine how spatial distribution of regulatory authority, social feedbacks within human communities, and uncertainty affect society's ability to maintain natural and social capital.

[table of contents | back to top]

Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1426891

[table of contents | back to top]