Climate Change & Commercial Fisheries in Portsmouth, NH

Gulf of Maine Research Institute

INTRODUCTION

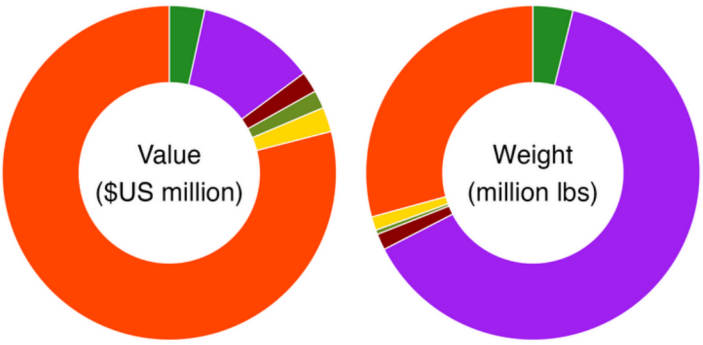
Climate change is altering the physical and chemical characteristics of our ocean and affecting marine ecosystems and fisheries. As environmental conditions continue to change, fishing communities may be affected by changes in the distribution and availability of species. This report summarizes the current status of fisheries in Portsmouth and shares information on changes in harvested species that may occur in the future. Used alongside the Climate Adaptation Resource Hub for Fishing Communities, this report provides information for understanding potential impacts on a fishing community, which can be used to consider ways to adapt to a changing climate.

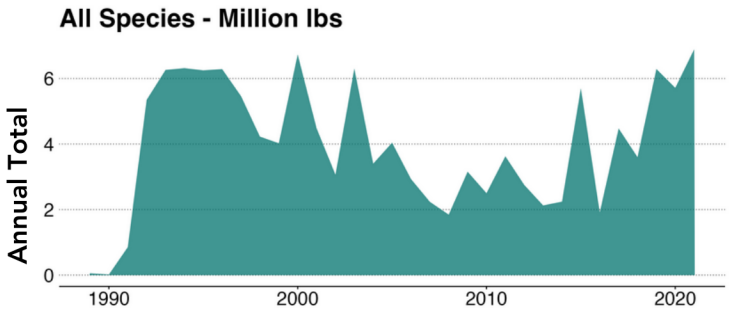
WHAT IS LANDED HERE?

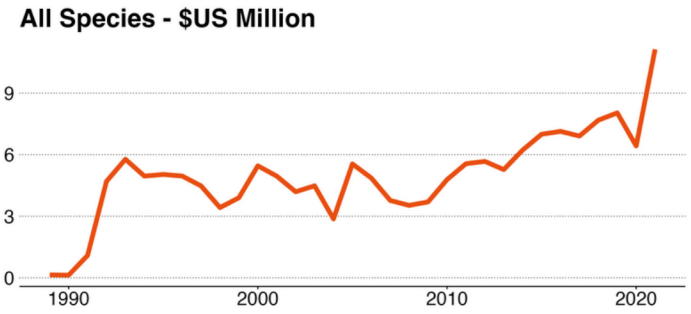
Commercial fishing vessels in Portsmouth landed an annual average 4.2 million pounds of shellfish and finfish, valued at $7.1 million per year from 2012-2021.* American lobster was the dominant species landed by volume and value; more than 1.2 million pounds per year on average were landed in Portsmouth, representing an average annual value of $5.6 million. The total volume of landings in Portsmouth has fluctuated between 2-6 million pounds since 1990. Despite the large variability in the volume of landings, the overall value was relatively stable throughout the early 2000s, fluctuating between $3-6 million; the annual average value of landings rose throughout the 2010s, surpassing $8 million in 2019 and 2021.

Species	Annual Average Value	Annual Average Volume
American lobster	$5,645,999	1,220,009 lbs
Pollock	$245,537	161,543 lbs
Atlantic cod	$170,682	55,043 lbs
Monkfish	$144,238	65,532 lbs
Bluefin tuna	$125,157	17,767 lbs
Other	$816,776	2,651,996 lbs

Above are the annual average value and volume for the top species landed at this port in each year from 2012-2021.







*Landings data were provided by NOAA Fisheries' Greater Atlantic Regional Fisheries Office. Due to confidentiality restrictions, some data may not be fully representative of the historical landings at a given location.

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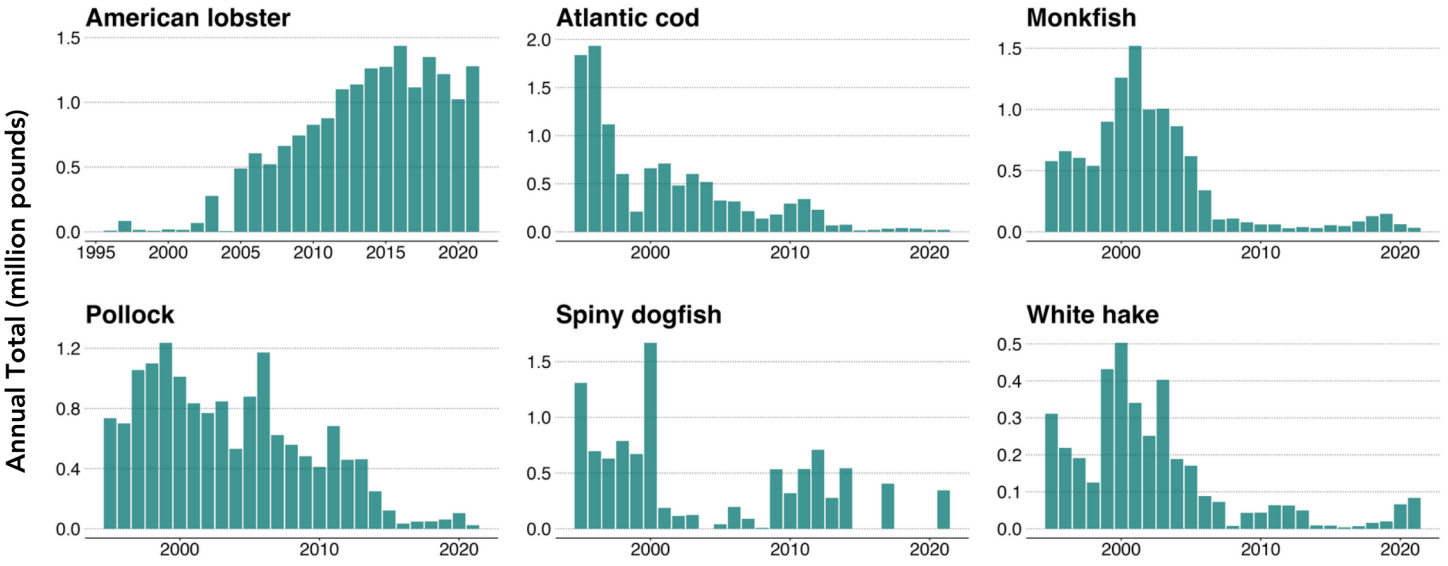
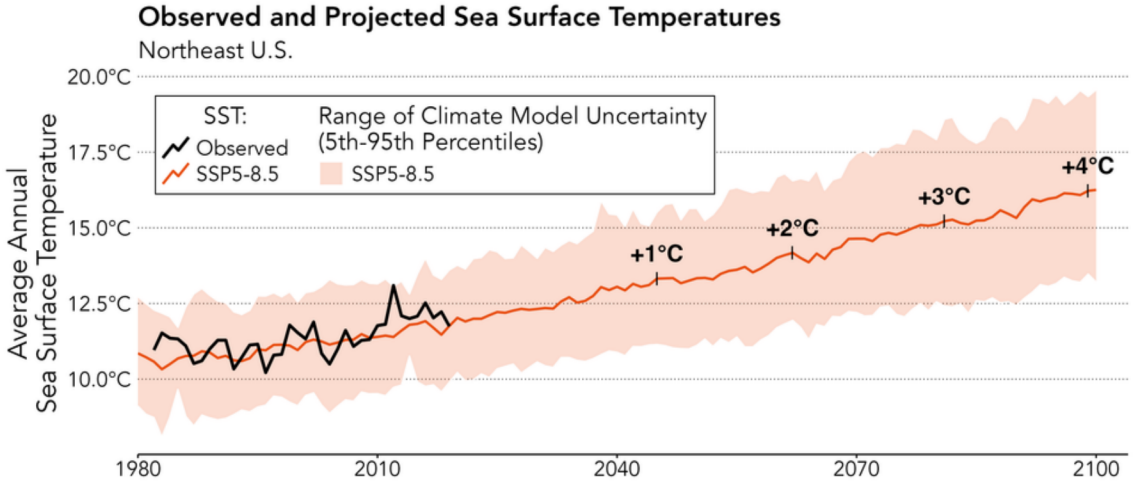
LANDINGS OVER TIME

Lobster landings in Portsmouth increased from 1995 to 2015 and have fluctuated near 1 million pounds in the years since. Atlantic cod landings were high in the late 1990s but declined throughout the 2000s and have been at very low levels in recent years. Monkfish landings peaked in 2001 and then declined through the mid-2000s before stabilizing at low levels since. Pollock landings declined gradually from a high in 1999 to very low levels after the mid-2010s. Landings of spiny dogfish have been variable, with a few years of landings exceeding 1 million pounds but generally below 0.5 million pounds for most years. White hake landings peaked in the early 2000s, dropping to below 100,000 pounds by the mid-2010s.



OUR CHANGING CLIMATE AND WARMING WATERS

Greenhouse gas emissions around the world are a primary contributor to the warming the planet has been experiencing over the past century. This warming affects the health and distribution of species that support fisheries in coastal communities. Scientists around the world use a common set of scenarios to project climate impacts into the future. These scenarios represent multiple global social and economic development patterns paired with different levels of greenhouse gases in Earth's atmosphere. The scenario representing the largest build-up of greenhouse gases, labeled SSP5-8.5, indicates global average temperatures will warm by approximately 4°C (7°F) above pre-industrial levels by the end of this century. We use this scenario to understand how species may respond to changes in ocean temperatures in the Northeast U.S. relative to those experienced during 2010-2019. These species projections allow us to explore different potential futures of fisheries and support decisions now that can buffer the severity of future climate change impacts on fishing communities.



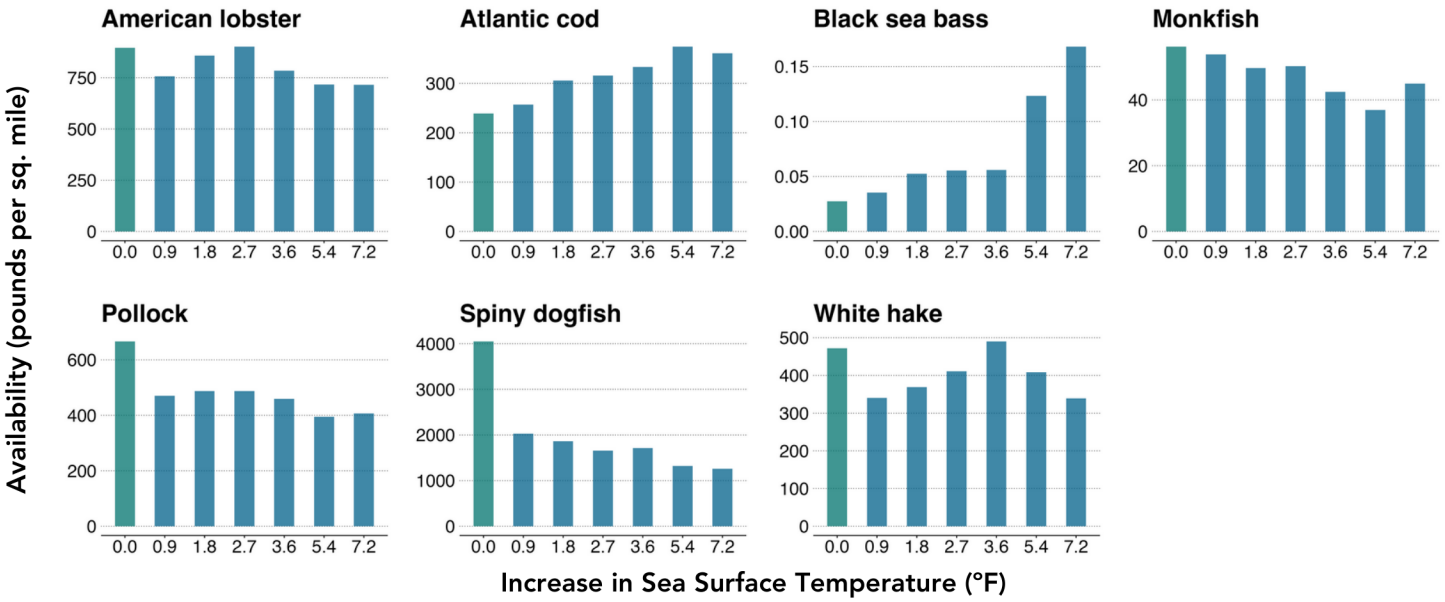
Temperature Crossing Points

Based on SSP5-8.5 Climate Projections

Celsius	Fahrenheit	As soon as
0.5°C	0.9°F	2034
1.0°C	1.8°F	2045
1.5°C	2.7°F	2056
2.0°C	3.6°F	2062
3.0°C	5.4°F	2081
4.0°C	7.2°F	2099

FUTURE CHANGES IN AVAILABILITY

As the abundance and distribution of certain species changes with warming waters, communities may need to respond to ensure the continuity of the fishing industry. By combining historical species observations with future climate information, we can estimate how the availability of certain species may change, and what new opportunities may emerge. Availability is given here as the total estimated weight of a particular species of fish in a given area, as modeled from bottom trawl survey data. Warming ocean temperatures may affect the availability of some commercial species in the waters near Portsmouth. The availability of Atlantic cod and black sea bass may increase with increasing ocean temperatures. Lobster and white hake availability may decline at most levels of warming. Monkfish, pollock, and spiny dogfish may experience progressive declines with increasing levels of warming.



EMERGING OPPORTUNITIES AND ADAPTATION OPTIONS

Harvesting emerging species and diversifying catch are some ways individual harvesters can adapt to changing fisheries. In the table below, we outline other potential adaptation options spanning the different scales of the fishery system. As the climate continues to change, new impacts will take shape, requiring re-evaluation and revision of goals in order to respond to climate change. For more information on adaptation options in fishing communities, please visit the Climate Adaptation Resource Hub for Fishing Communities.

Individual Harvester Actions

- Shifting fishing locations
- Shifting harvested species
- Diversifying livelihood (alternative fisheries, aquaculture, non-fishing jobs)

Industry Actions

- Improving product handling
- Developing supply chain capacity
- Diversifying markets and building consumer demand

Management Measures

- Reassessing quota allocations
- Altering permit access and availability
- Developing adaptive reference points
- Applying dynamic and ecosystem-based management

Community Initiatives

- Maintaining and securing shoreside infrastructure
- Improving transportation networks
- Developing local seafood initiatives
- Conducting vulnerability and resilience assessments
- Using early warning monitoring
- Community adaptation and resilience planning

Projected Changes in Species Availability in Portsmouth

Values represent percent change in modeled species availability at potential levels of warming relative to *2010-2019* baseline conditions.
Species in gray had low availability *(<5 lbs/sq. mile)* during the baseline period.

	Increase in Sea Surface Temperature			
Species	0.9°F	1.8°F	3.6°F	5.4°F
Acadian redfish	−5.8%	−7.0%	−35.8%	−52.3%
American lobster	−15.5%	−4.2%	−12.4%	−19.9%
American plaice	−5.2%	−4.8%	−13.8%	−16.8%
Atlantic cod	7.7%	28.1%	39.5%	56.8%
Atlantic halibut	5.9%	1.1%	−1.8%	−12.9%
Atlantic herring	−28.5%	−28.8%	−44.2%	−36.8%
Atlantic mackerel	19.8%	45.5%	78.0%	59.8%
Black sea bass	28.6%	90.9%	103.4%	348.5%
Butterfish	−13.4%	25.8%	27.8%	24.0%
Deep sea red crab	−26.6%	−14.8%	−33.6%	−37.1%
Haddock	−1.1%	34.9%	12.8%	−13.2%
Hagfish	26.8%	56.5%	28.5%	12.3%
Jonah crab	8.5%	−15.8%	−19.2%	−46.8%
Little skate	−9.1%	−8.9%	−10.1%	−1.7%
Longfin squid	−15.2%	−10.2%	−53.2%	179.7%
Monkfish	−4.2%	−11.6%	−24.5%	−34.2%
Ocean quahog clam	−33.5%	5.1%	21.7%	−52.2%
Pollock	−29.5%	−26.9%	−31.0%	−40.7%
Red hake	28.6%	1.5%	1.0%	−9.8%
Rock crab	62.8%	67.5%	72.2%	135.0%
Sand lance	−50.2%	−80.5%	−72.7%	−72.9%
Scup	40.7%	93.1%	92.4%	271.4%
Sea scallop	19.0%	2.9%	9.1%	−30.7%
Shortfin squid	−41.1%	−22.7%	−13.0%	16.4%
Silver hake	−27.5%	−28.5%	−24.6%	−32.0%
Smooth skate	−21.4%	−25.4%	−24.4%	−22.6%
Spiny dogfish	−50.0%	−54.0%	−57.6%	−67.4%
Summer flounder	11.9%	25.1%	65.9%	149.9%
Thorny skate	−13.2%	−9.7%	−16.0%	−23.6%
White hake	−27.9%	−21.8%	3.8%	−13.5%
Windowpane	22.5%	39.2%	38.8%	53.2%
Winter flounder	4.3%	9.6%	14.9%	2.0%
Winter skate	−21.5%	−16.6%	−8.5%	−3.1%
Witch flounder	−11.8%	−31.6%	−36.9%	−40.0%
Yellowtail flounder	−23.9%	−26.0%	−36.1%	−34.6%

MAKING SENSE OF CLIMATE PROJECTIONS AND SPECIES DISTRIBUTION MODELS

The species results shown here were developed using a spatio-temporal species distribution model, which can estimate the current and future distribution of marine species through time and space. The model uses projected regional sea surface and bottom temperature data from the globally coordinated Coupled Model Intercomparison Project (CMIP6) and species data from bottom trawl surveys conducted by the Northeast Fisheries Science Center and the Department of Fisheries and Oceans. Estimated species biomass densities are then averaged over an area fished by vessels from the port of interest. This enables us to interpret local changes in availability of a species at a specific time or temperature.

LEARN MORE

For more information regarding climate change, species distribution change, fisheries adaptation options, and adaptation barriers and enablers, please visit:

gmri.org/adaptationhub

ASK QUESTIONS

For specific questions regarding your community, contact Kathy Mills at:

kmills@gmri.org

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Science. Education. Community.