

# EcoSystem Indicator Partnership

Information on change  
in the Gulf of Maine

## *Fisheries Issues in the Gulf of Maine*

### Why is it Important to Understand Fisheries Issues in the Gulf of Maine?

Many individuals in the Gulf of Maine (GOM) and Bay of Fundy depend on healthy commercial fisheries for their livelihoods in both direct and indirect ways.

Fisheries, consequently, have large impacts on our regional economy. Although the harvest is the most visible aspect of any fishery, land-based support industries are equally important. These include boat building, electronic development, and gear production for the fishers. In addition, individuals are employed in transporting and processing the harvest. In this way, the fishery underscores how important these interconnected economies are to the region.

Groundfish, lobsters, herring, and scallops have long dominated Gulf of Maine commercial fisheries landings, but are complemented by a multitude of other species including crabs, squid, skates, monkfish, tuna, mackerel, dogfish, hagfish, scup, sea bass, clams, and mussels. Smaller quantities of sea urchins, sea cucumbers, whelks, sea vegetables, rockweed, menhaden, bluefish, alewives (Gaspereau), and shad are also harvested. In addition, as Gulf of Maine waters warm, fishers occasionally catch species normally associated with the mid-Atlantic or South Atlantic regions.

In waters adjacent to the Gulf of Maine, a moratorium on Atlantic cod has resulted in major changes in Canadian communities. The Northeast United States has also seen landings plummet for specific species, such as lobster in Long Island Sound. These issues from the Gulf of Maine neighbors to the south and north emphasize how important it is to the state and provincial economies to have a healthy fishery.

Stock assessments in the Northeast United States suggests declines in the groundfish populations. In an attempt to rebuild the

fisheries, major management adjustments have been implemented. Actions, which include quotas and catch shares in the groundfish sectors, have resulted in significant fleet consolidation. Some displaced fishers have found alternative species to target, but overall, the fleet is “graying” and becoming consolidated with larger entities. To combat this, Nova Scotia has a program to bring in new, young, and energetic harvesters and processors.

Complicating the commercial fishery dynamics in the Gulf of Maine is the underlying ecosystem. Predator and prey relationships are interwoven – with species switching roles throughout their life cycle. For example, very small larval cod are eaten by zooplankton, and in turn prey on zooplankton as they grow larger.

Fish use different parts of the region over their life cycles. They move into and out of estuaries, and migrate from coastal to deep waters. Some species migrate to areas far from the Gulf of Maine, returning in summer to feed when temperatures warm.



PHOTO: Michael Theberge

### Why use indicators?

Indicators are metrics that help monitor conditions in the Gulf of Maine and are one of the best tools for understanding and characterizing ecosystem change. Like warning lights on a car's dashboard, indicators can work in concert with each other to provide an essential look at the larger system. They can be combined into complex calculations or be relatively simple. ESIP has chosen three indicators to assess fisheries in the GOM:

1. Ocean Jobs
2. Diversity
3. Dominant Species Metric

### Why GOMC/ESIP?

In 2006, the Gulf of Maine Council on the Marine Environment (GOMC) recognized the need to understand the status and trends of the Gulf of Maine ecosystem. The council created the EcoSystem Indicator Partnership (ESIP) to assess the health of this ecosystem through the use of indicators, and has applied several efforts to evaluate the health of the Gulf of Maine through monitoring and restoration. ESIP is an attempt to bring together information from these and other efforts in the region.

## Ocean Jobs

### Indicator 1

The ocean sector provides jobs to over 100,000 individuals in the Gulf of Maine. Living resources, marine construction and transportation, off-shore mineral extraction, ship and boat building, tourism and recreation define the US ocean sector. The combined employed and self-employed categories increased from employing around 138,000 individuals in 2005 for Maine, New Hampshire, and Massachusetts, to over 158,000 individuals in 2013 (the last year for which information is available). Job growth differs among the three states, with the largest growth occurring in New Hampshire – from 8,200 jobs in 2005 to over 14,000 in 2013. The sector with the highest number of jobs also differs among states. The largest number of jobs in Maine lies in ship and boat building. Marine transportation, tourism, and recreation constitute the largest number of jobs in New Hampshire. The largest number of jobs in Massachusetts comes from tourism and recreation.

Different data are used to define the ocean sector in New Brunswick and Nova Scotia. The US values above include employment in sectors outside of living resources. The information reported here for the Bay of Fundy portions of New Brunswick and province-wide for Nova Scotia includes living resources only. These numbers are not comparable to the US but are equally important to understanding ocean jobs in the Gulf of Maine. The living resources category is defined as commercial fisheries, aquaculture, and fish processing. In Nova Scotia, the ocean sector accounted for 18,000 jobs in 2010, with a slight downward trend from 2007. Information for New Brunswick is available only for 2003 to 2008, with 4,700 jobs in 2008 for the sector. As the provinces and states move into the future, certain sectors (like tourism, recreation, and offshore energy) are likely to grow in importance as others decline.

## Obtaining Data

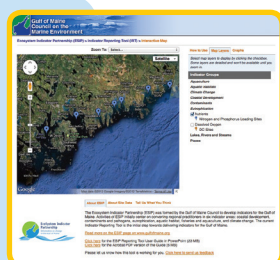
### Obtaining Data for Yourself via the Indicator Reporting Tool

Data used for the indicators presented in this fact sheet are available online through ESIP's Indicator Reporting Tool ([www.gulfofmaine.org/esip/reporting](http://www.gulfofmaine.org/esip/reporting)).

The tool uses familiar mapping platforms to enable users to locate fisheries data in the region. The data snapshots that users produce with the tool can provide critical information in a timely fashion for those faced with making management decisions.

The tool can help to answer questions such as:

1. What species of fish make up the bulk of New Hampshire landings?
2. How many people worked in the ocean sector in Maine 10 years ago as opposed to last year?
3. Where can I look at the American Lobster Settlement Index in more detail?

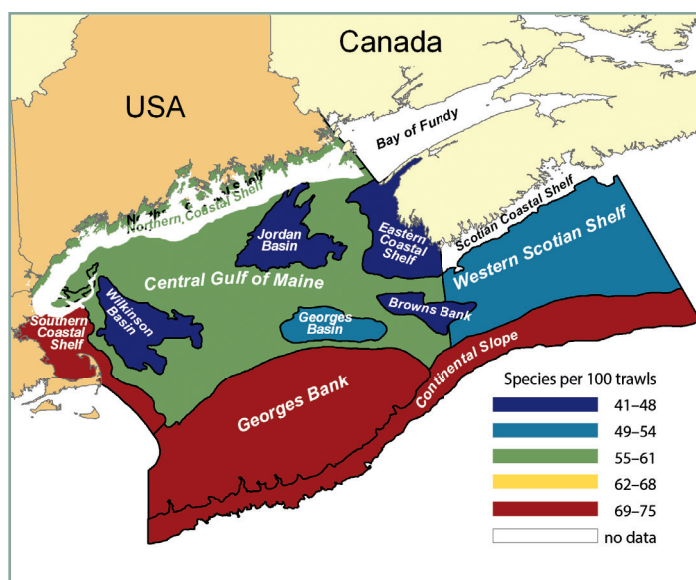


## Diversity

### Indicator 2

In the early 2000s, a far-reaching study was undertaken to conduct a global census of marine life. One program within that global project focused on the Gulf of Maine Area. Researchers looked at biodiversity at genetic levels and at broader communities. Analysis within specific geographic areas noted the largest number of species (defined as species per 100 trawls) in the Gulf of Maine was at the outer portions (Georges Bank and the Continental Shelf) and more southern areas (Southern Coastal Shelf). Biodiversity is important with respect to catch and can be an indicator of resilience within the fisheries. Included below is a figure from the report (Figure 1).

Further information is available at:  
[www.gulfofmaine-census.org](http://www.gulfofmaine-census.org)



**FIGURE 1: LARGE-SCALE PATTERNS OF DIVERSITY**

Based on bottom trawl surveys from more than four decades of sampling, the diversity of fish varies among physiographic regions (shown here: number of species expected per 100 trawls). From [www.gulfofmaine-census.org](http://www.gulfofmaine-census.org)



PHOTO: E. Craddock

# Dominant Species Metric

## Indicator 3

Landings of commercial species in the Gulf of Maine have become slightly less diverse over the past 15 years. The top three species' contribution to the percentage of total landings weight has increased in both Massachusetts and Maine, and may be increasing in Nova Scotia and New Brunswick as well as New Hampshire. Currently, the top three species contribute almost 90 per cent of the total landings weight in Maine, with lobster landings alone contributing almost half of the total landings weight. This species specialization is likely due to many factors, including the price of lobster and the expense of fishing trips. However, there is risk in basing harvests on only a few species, which makes communities less resilient when availability of stocks changes.

### Landings by Economic Value

The species composition of the total landings' economic value has also become less diverse. The top three species that make up the most landings values have increased in all Gulf of Maine regions, although Maine, New Hampshire, Nova Scotia, and New Brunswick have been fairly stable since 2005 (Figure 2). New Hampshire, Nova Scotia, and New Brunswick regions currently have the highest species specialization, with over 90 per cent of their catch value coming from the top three species (Figure 3).

### Landings by Weight

Top species by weight have changed somewhat over time. Atlantic herring has been the species with the highest landings weight for most regions across the years. In Nova Scotia, herring has generally been followed by scallops, lobsters, and, in some years, haddock. Lobster has overtaken the landings weight of herring as the primary species landed in Maine since 2008, and landings weight of rockweed and shellfish have been higher than blue mussels in recent years. Species catch weights are a bit more diversified in New Hampshire, with lobster catch weights exceeding herring for most years since 2006, and pollock, spiny dogfish, cod, and goosefish alternating as the second- and third-highest catch weights over time. Catch weights of herring have maintained species dominance in Massachusetts throughout most of the past 15 years, with scallops generally being the second-most important species for catch weights, although Atlantic mackerel was the second-highest catch for a number of years in the mid to late-2000s.

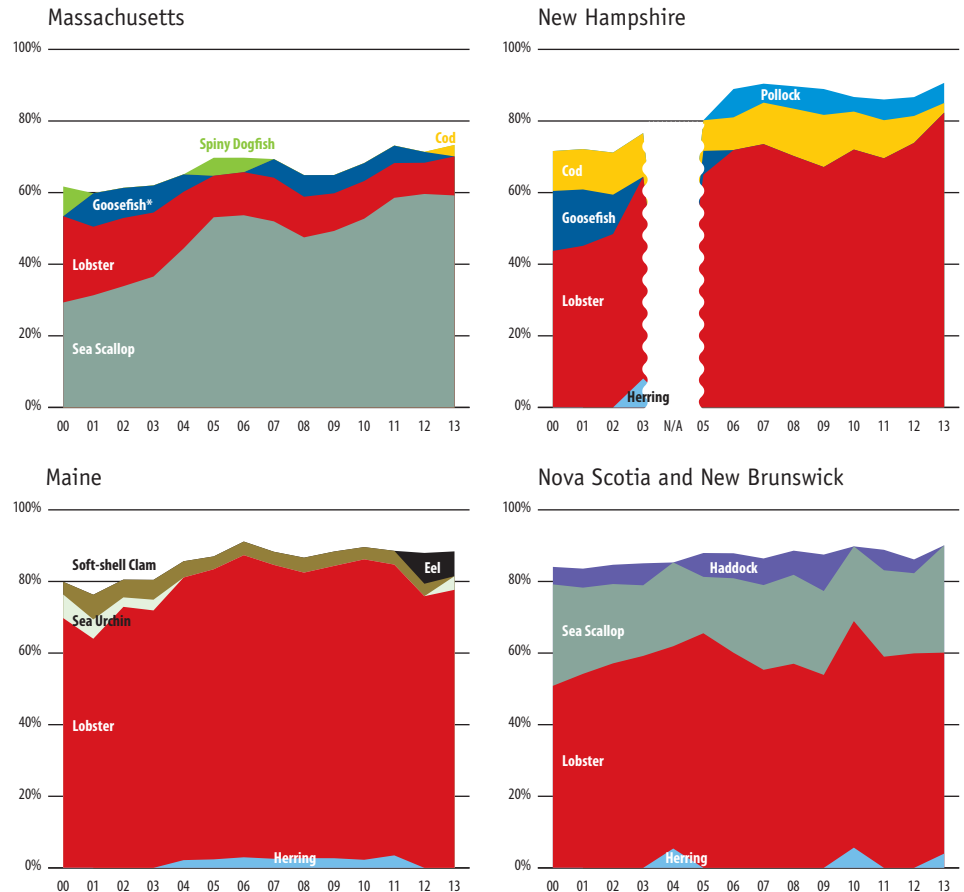


FIGURE 2: Top three landed species as a percentage of total landings dollar value. Y-axis represents percentage of dollars from all species landed. It is of note how frequently certain species are in the top three and the associated risks with basing harvest on only one or two species. Canadian data include the following NAFO areas: 4 X P, 4 X Q, 4 X R, 4 X S, 5YB, 5YC, 5YD, 5YF, 5ZEG, and 5ZEH. \* Goosefish is also called monkfish

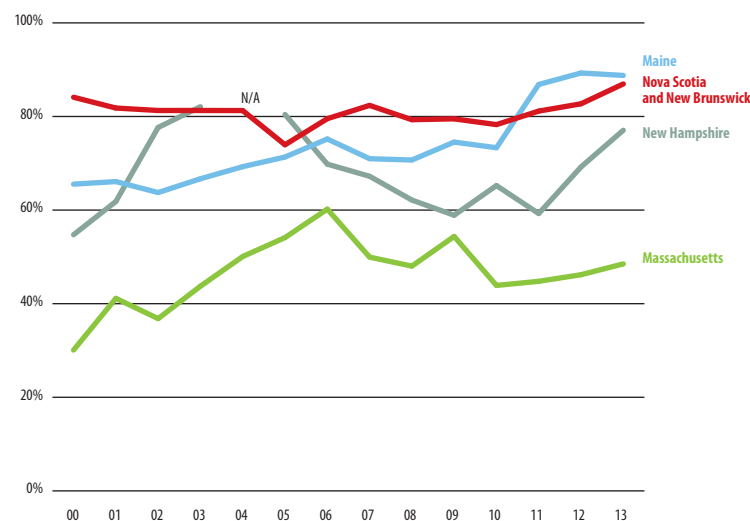


FIGURE 3: Percentage of total annual landed weight that the top three species contributed by region. Species are not the same for the states and provinces. Further information on specific species is included with the previous figures from this section.



# Lobster

Lobster abundance and landings are at, or near, record high levels in the Gulf of Maine (US and Canada). Lobster landings in the state of Maine have increased fivefold since 1985 and exceeded \$500 million in landed value in 2015. In Atlantic Canada, the landed value of the lobster fishery is the highest of any fishery in Canada, with commercial catches in Canada also increasing throughout the 2000s.

The widespread and protracted expansion of lobster abundance, despite being intensely targeted for over a century, is quite unusual. Managers, scientists, and fishers have some concern that lobsters are experiencing this increase in part because of the decline in cod and other fishes that prey on them. As those predator populations are rebuilt, there may be changes in lobster populations.

Despite current abundance, there is concern about lobster stocks in the Gulf of Maine. A lobster settlement index that measures the density of young-of-year lobsters in standardized cobblestone nursery plots recorded recent declines in both the US portions of the Gulf of Maine and the Canadian Bay of Fundy (Figure 4). In contrast, the Maine and New Hampshire inshore trawl survey is recording steadily rising abundances of lobsters.

Maine's ventless trap surveys also show steadily increasing lobster abundances (Maine DMR). Assessments of Canadian Gulf of Maine lobster stocks also show very high abundance, with no indication of decline.

It is possible that as seawater temperatures increase throughout the region (Figure 5A) that the warm 12°C thermal threshold necessary for lobster settlement will expand to greater depths and in more northern portions of the Gulf of Maine and Bay of Fundy. It is not known if the expansion of the potential nursery habitat dilutes the settlement in shallow zones (Figure 5B). One potential result of climate change might be a shift in the species distribution and associated impacts to the commercial fishery and associated food webs. It is impossible to predict these potential responses, but recent warm years and associated changes to the timing of the fisheries have provided managers with examples of how this region and iconic species might change.

In southern New England, where sea surface temperatures exceed 20°C in the summer, lobsters become stressed, exit the region, or succumb to epizootic disease. There is concern that a similar story is unfolding in the Gulf of Maine.

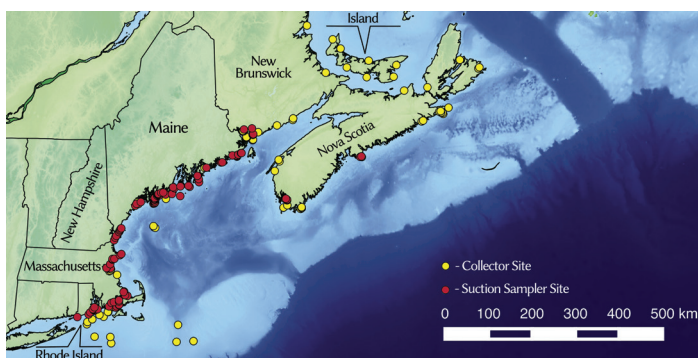
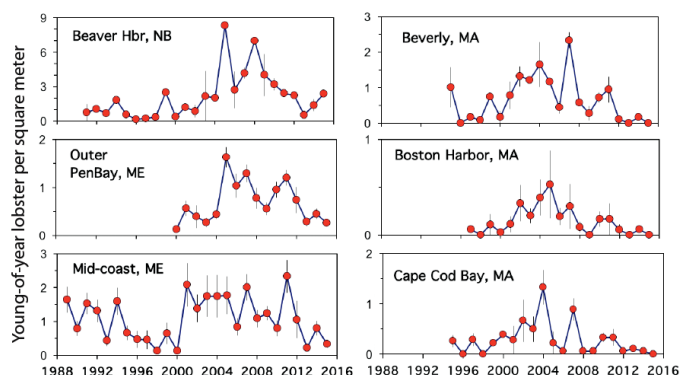
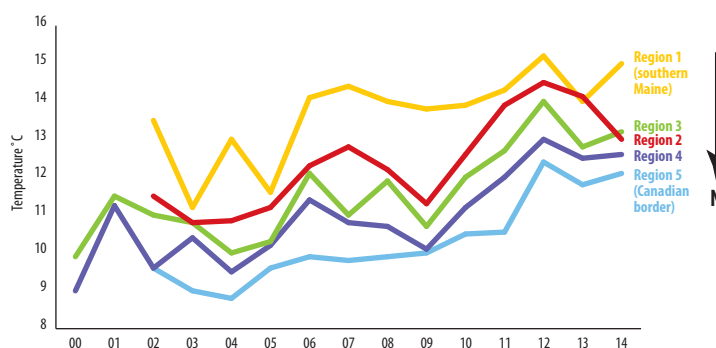


FIGURE 4: American Lobster Settlement Index (ALSI: <http://umaine.edu/wahlelab/american-lobster-settlement-index-alsi/american-lobster-settlement-index/>) for selected sites in coastal Maine. For this, cobblestone habitat at 10 m depth was sampled annually for number of lobsters settled.

## Temperature records (falls surveys)



## Increasing nursery habitat with warming seas

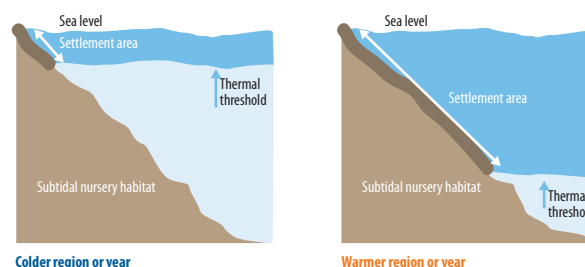


FIGURE 5A: Near-bottom temperatures reported in the Maine/New Hampshire inshore trawl survey. Note that the eastern-most Region 5 went from a temperature less than 9°C to greater than 12°C over the 15-year period. 5B: Potential expansion of lobster nursery habitat as thermal threshold deepens.



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**Gulf of Maine Council on the Marine Environment**

[www2.gulfofmaine.org/esip](http://www2.gulfofmaine.org/esip)

In 2006, the Gulf of Maine Council on the Marine Environment created the EcoSystem Indicator Partnership (ESIP) to assess the ecological integrity of the Gulf of Maine through the use of indicators. This fact sheet is one outcome supporting this goal. Funding, in part, was provided by the Department of the Interior (DOI) including USGS grant G16AC00025, Environment and Climate Change Canada (ECCC), Fisheries and Oceans Canada (DFO), and the US Environmental Protection Agency (EPA). The views and conclusions contained in this document are those of the authors and should not be interpreted as representing the opinions or policies of funders. For more information on any of the ESIP products, please visit our website at [www2.gulfofmaine.org/esip](http://www2.gulfofmaine.org/esip).

You may also contact the ESIP Program Manager at [ESIPmail@gulfofmaine.org](mailto:ESIPmail@gulfofmaine.org). We always welcome new members to our work.