Fall 2017 Update: Annual Condition of the Northeast Shelf Ecosystem

Produced by the Ecosystem Dynamics and Assessment Branch

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Current Conditions of the Northeast Shelf Ecosystem -- Fall 2017 Update

Summary of Conditions of the Northeast Shelf Ecosystem

- Sea surface temperature (SST) in the Northeast Shelf Large Marine Ecosystem during the first half of 2017 continued to moderate compared to the record high temperatures that occurred in 2012; however, temperatures remain above the long-term mean based on both contemporary satellite remote-sensing data and ship-board measurements.

- The spring bloom was late and poorly developed in the Gulf of Maine and Georges Bank areas and above average on the eastern Gulf of Maine and Scotian Shelf.

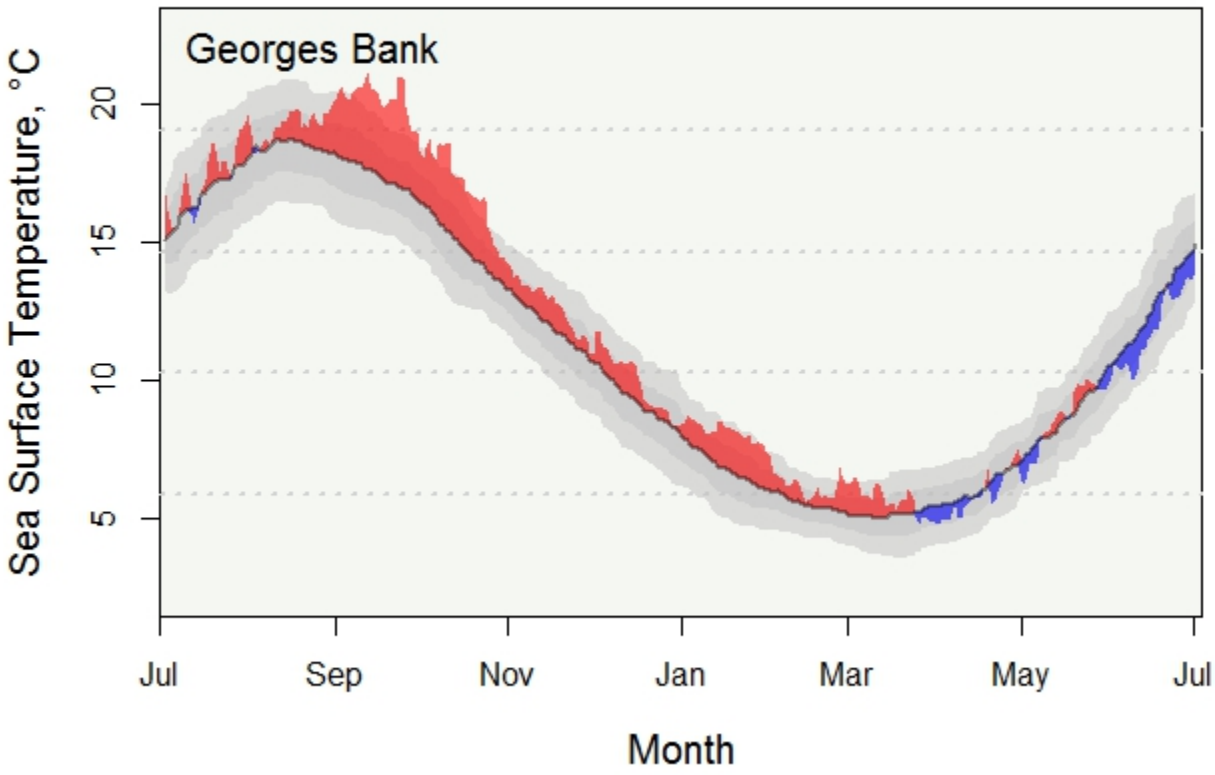
- Moderate spring temperature conditions have delayed the spring thermal transition dates for 2017 compared to recent years.

- The distribution of fish and invertebrate species sampled by the NEFSC bottom trawl survey has changed; utilizing data through the spring 2017 survey, kernel density plots and the assessments of species distributions both along- and across-shelf show mixed distribution movements over time.

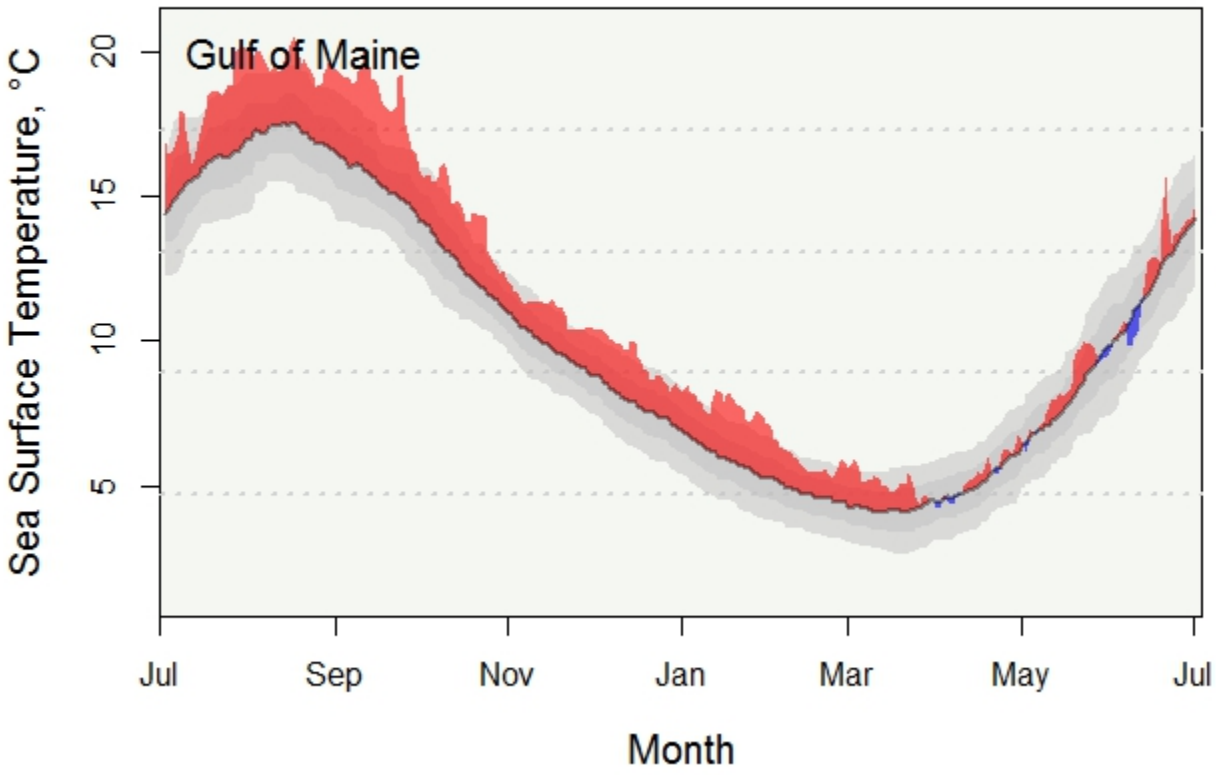
- Climate models suggest temperature condition will continue to be above average over the coming half year.

Spring Sea Surface Temperature - Northeast Shelf Ecosystem

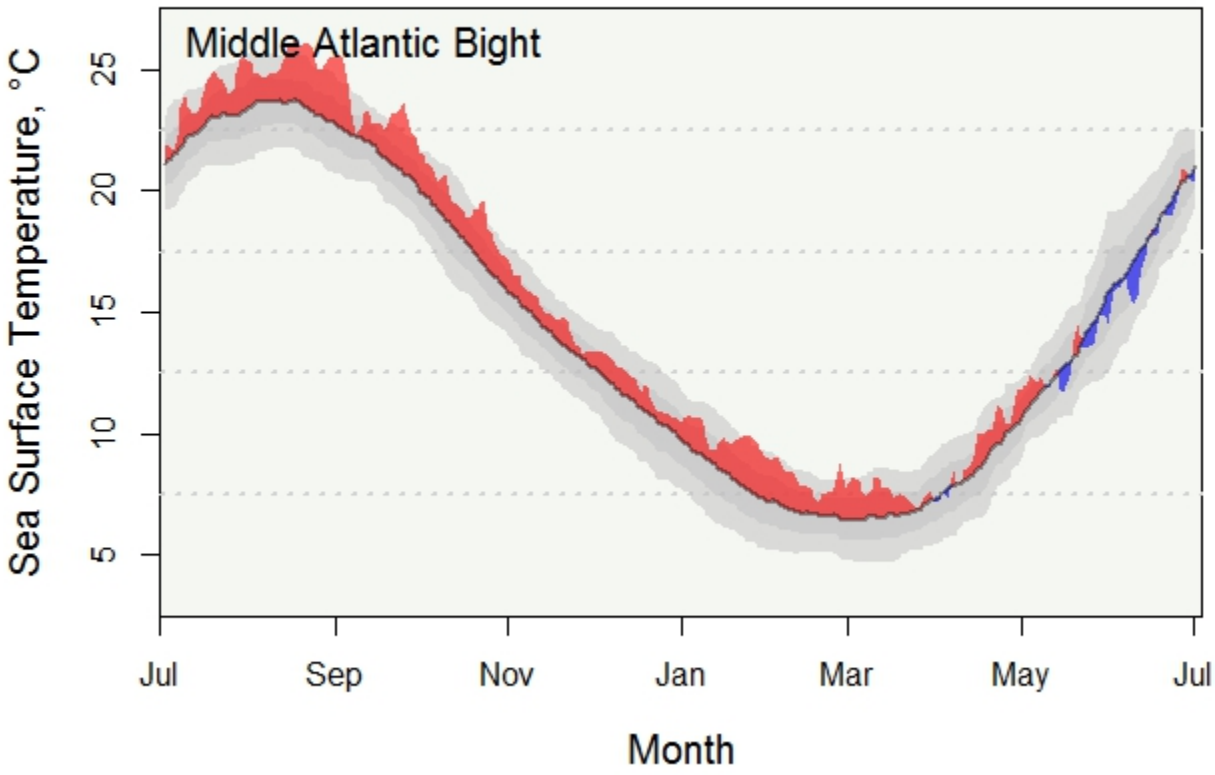
The Northeast Shelf Large Marine Ecosystem experienced average to below average sea surface temperatures during the spring of 2017 following the trend of above average temperatures seen during fall into winter seasons. In the graphs spanning the last half of 2016 and first half of 2017, the long-term mean sea surface temperature (SST) is shown as a dark gray line with areas representing plus and minus one and two standard deviations of the mean as progressive shades of gray, respectively (see figure). SSTs below the long term mean are shown in blue, above the mean in red. The Middle Atlantic Bight and Georges Bank would appear to have been slightly cooler then the Gulf of Maine, but overall, the Northeast Shelf ecosystem was at or near long term mean sea surface temperatures for much of the spring period.



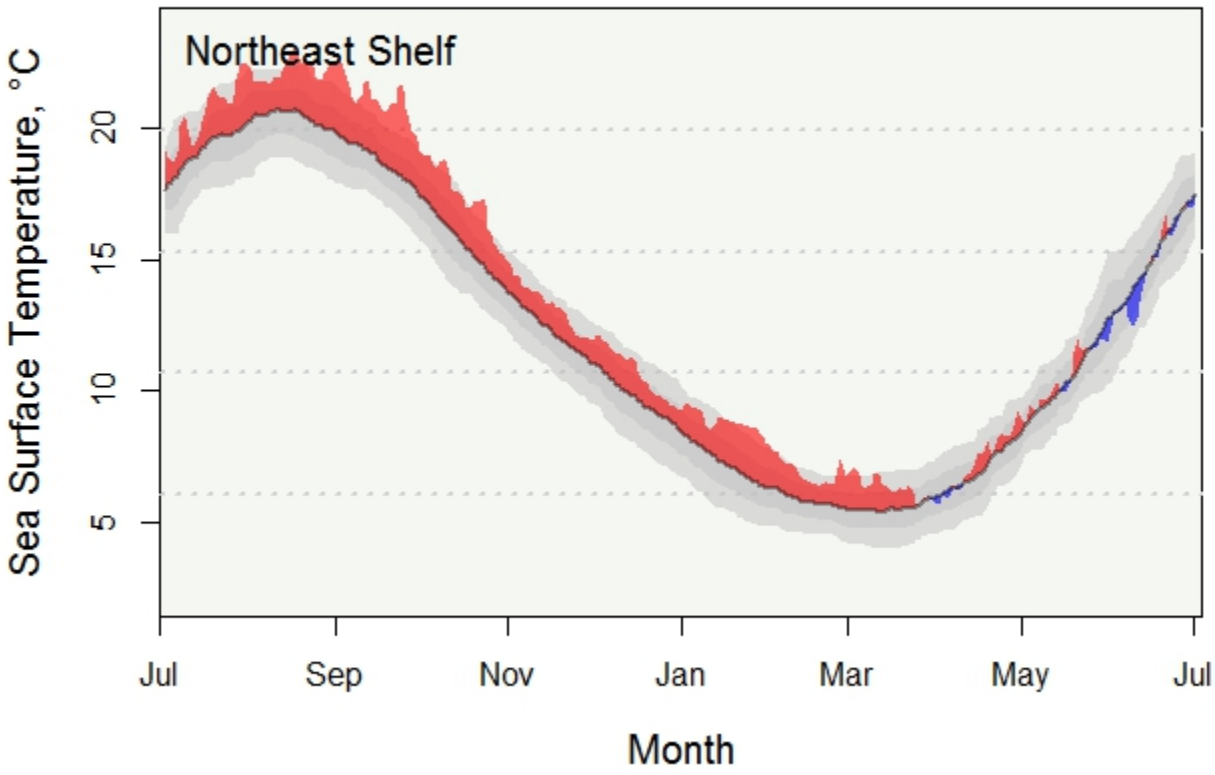
Georges Bank



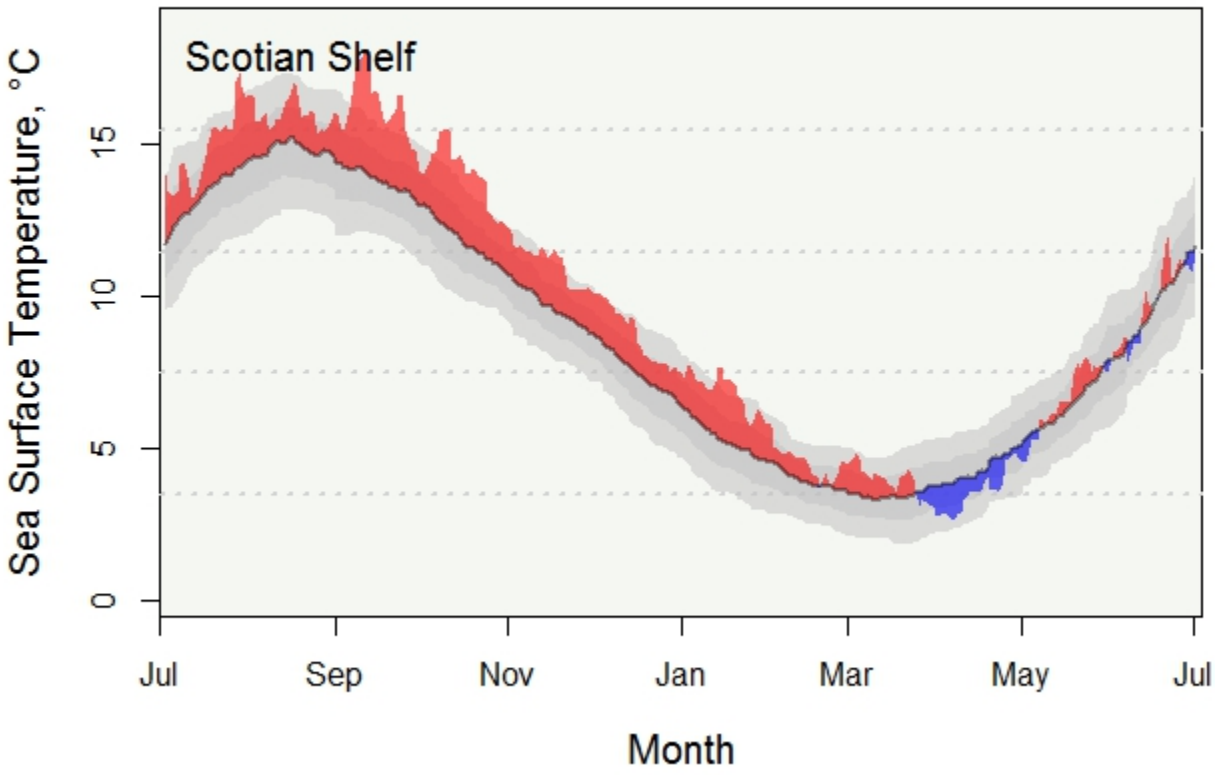
Gulf of Maine



Middle Atlantic Bight



Northeast Shelf



Scotian Shelf

Fall Sea Surface Temperature Distribution

The progression of spring sea surface temperatures for the months of January through June is shown in the interactive figure. SSTs appear as progressive shades of cyan to blue in the left hand icons. Anomalies of SST, those tending to exceed plus or minus one quarter of a standard deviation of the overall SST for the field, are in the right hand set of icons. This type of anomaly tends to highlight high SSTs in an area, the red shades, and low SSTs in an area, the blue shades. The Northeast Shelf was generally near or slightly above average SST during January through March whereas much of the shelf was at or below average during April and May, noting that warmer condition appeared to reestablish during June, especially in the Gulf of Maine.

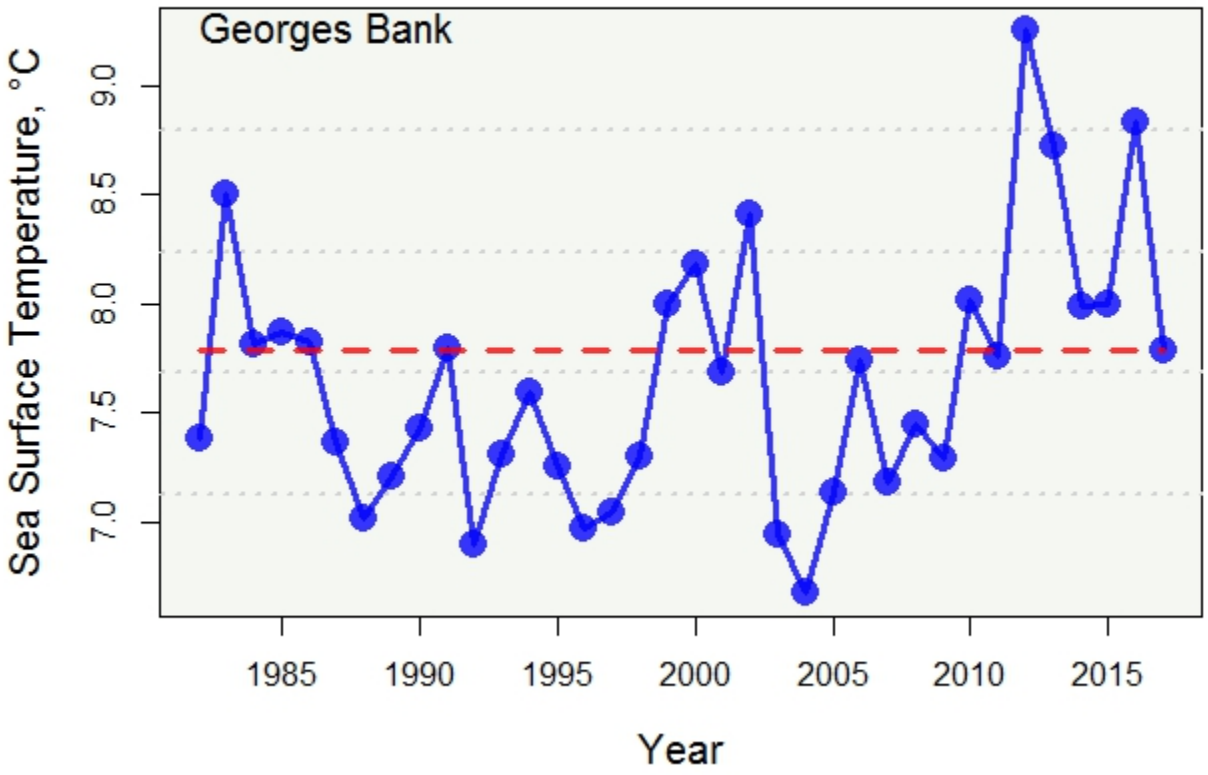
Spring Chlorophyll Distribution

The progression of spring chlorophyll concentrations for the months of January through June are shown in the interactive figure. Chlorophyll concentrations appear as progressive shades of green in the left hand icons. Anomalies of chlorophyll concentration, those tending to exceed plus or minus one quarter of a standard deviation of the overall concentration for the field, are in the right hand set of icons. Chlorophyll concentrations were below average over much of

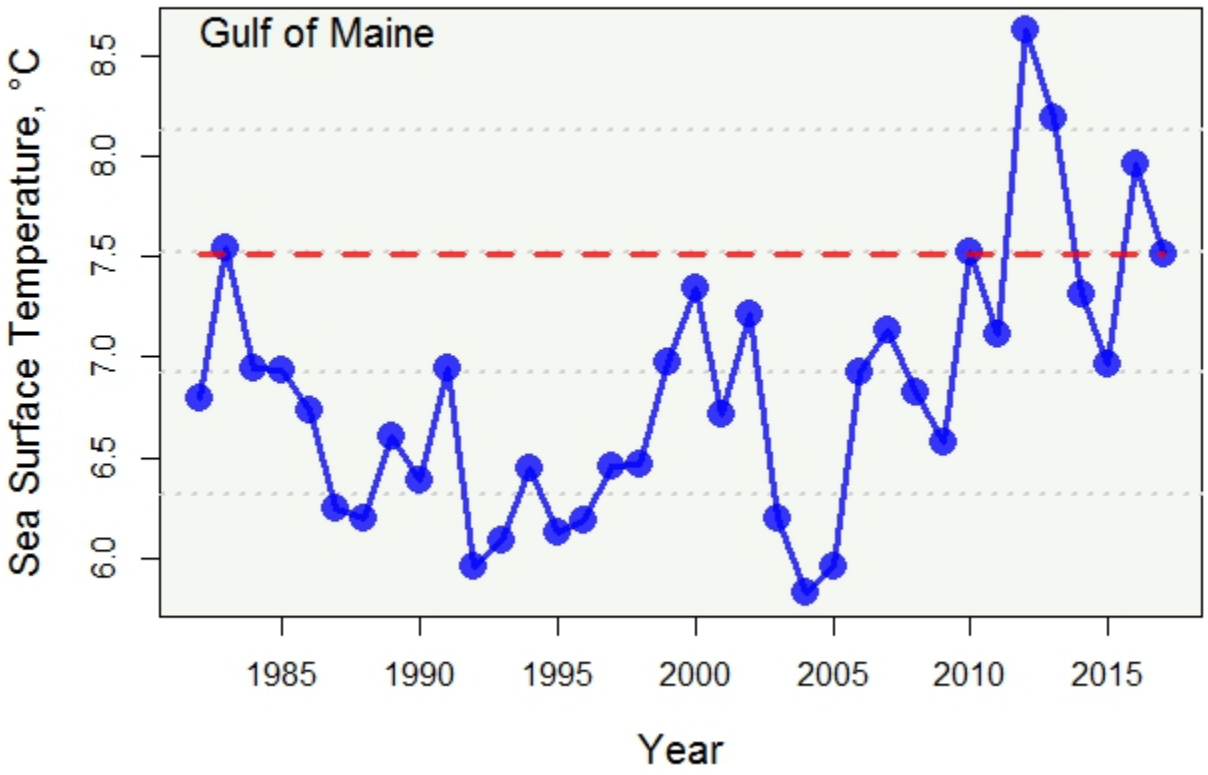
Georges Bank and in the western Gulf of Maine during March into April, the period of time usually associated with the spring bloom in those areas. The eastern Gulf of Maine appear to have bloomed in April and the only obvious bloom activity on Georges Bank did not occur until May, suggest a reduced and delayed bloom.

Satellite SST for First Half of the Year

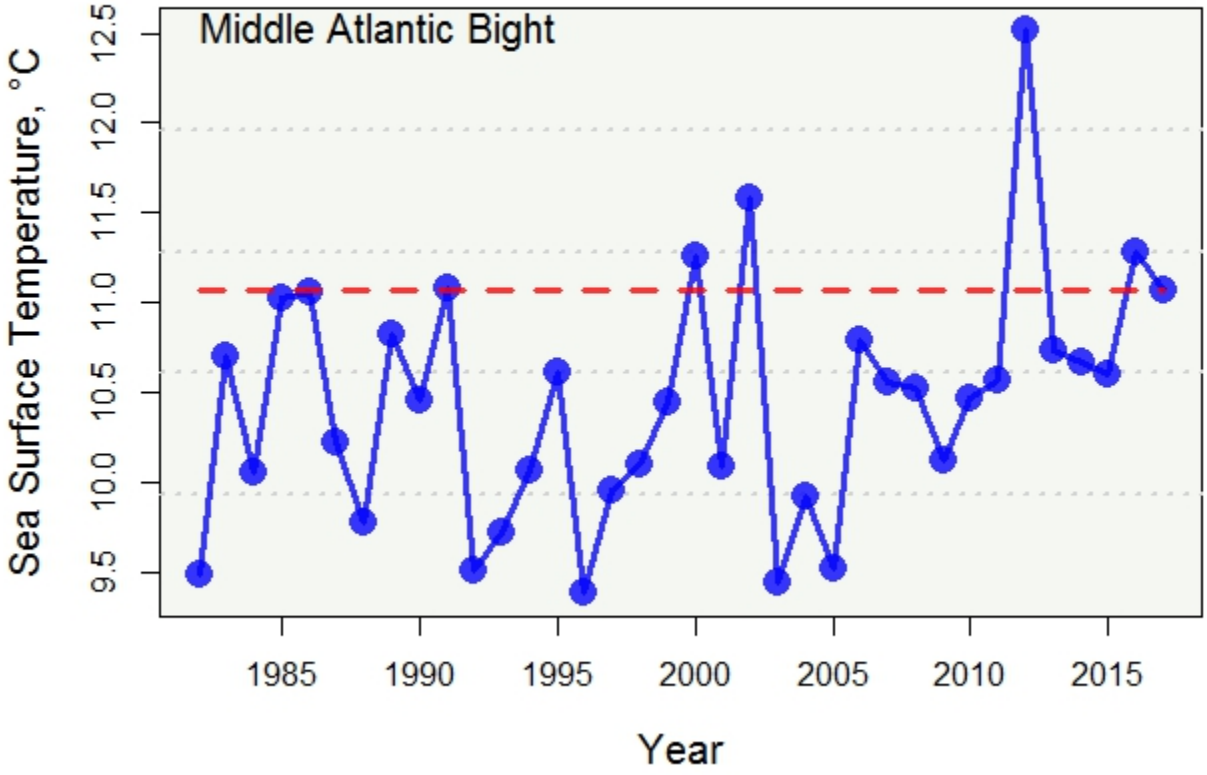
The OISTT sea surface temperature data is based on satellite measurements and provides high spatial and temporal resolution depictions of temperature trends. The SST conditions for the first half of 2017 were generally above average levels in all ecoregions, however noting that thermal conditions have moderated since the record high temperature recorded in 2012 and followed by high temperatures measure last year.



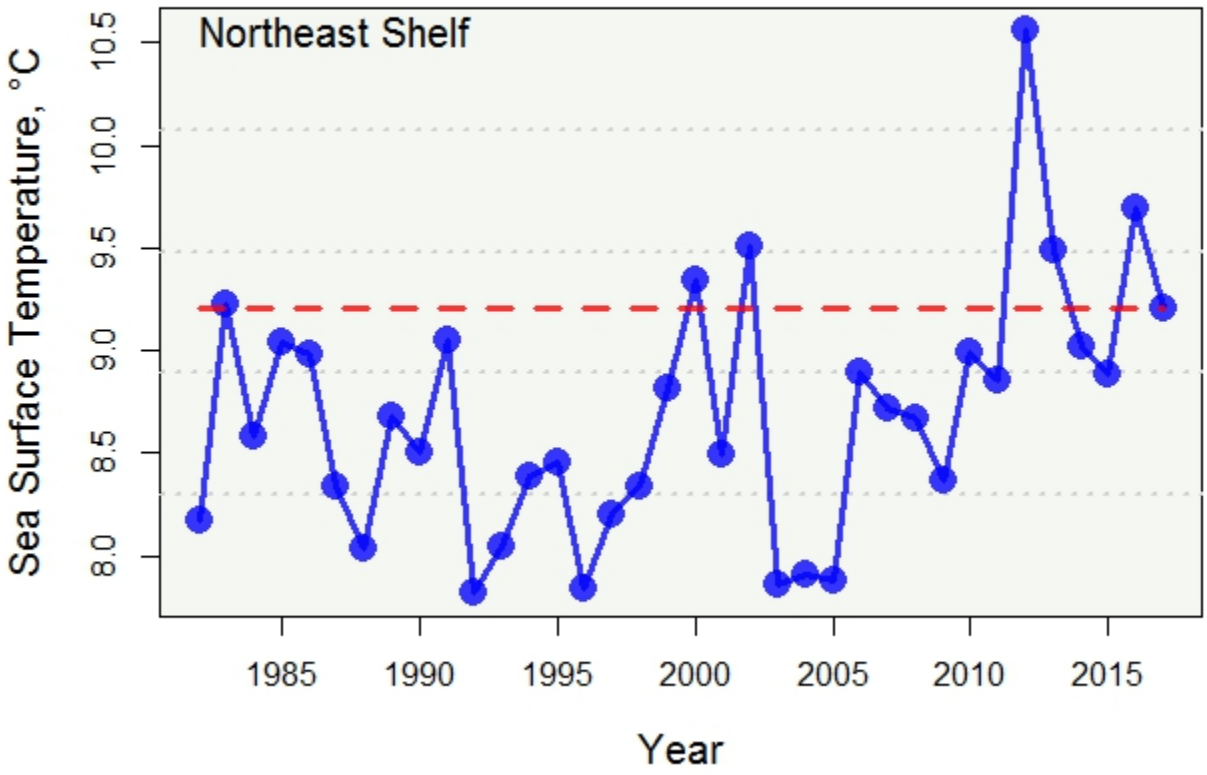
Georges Bank



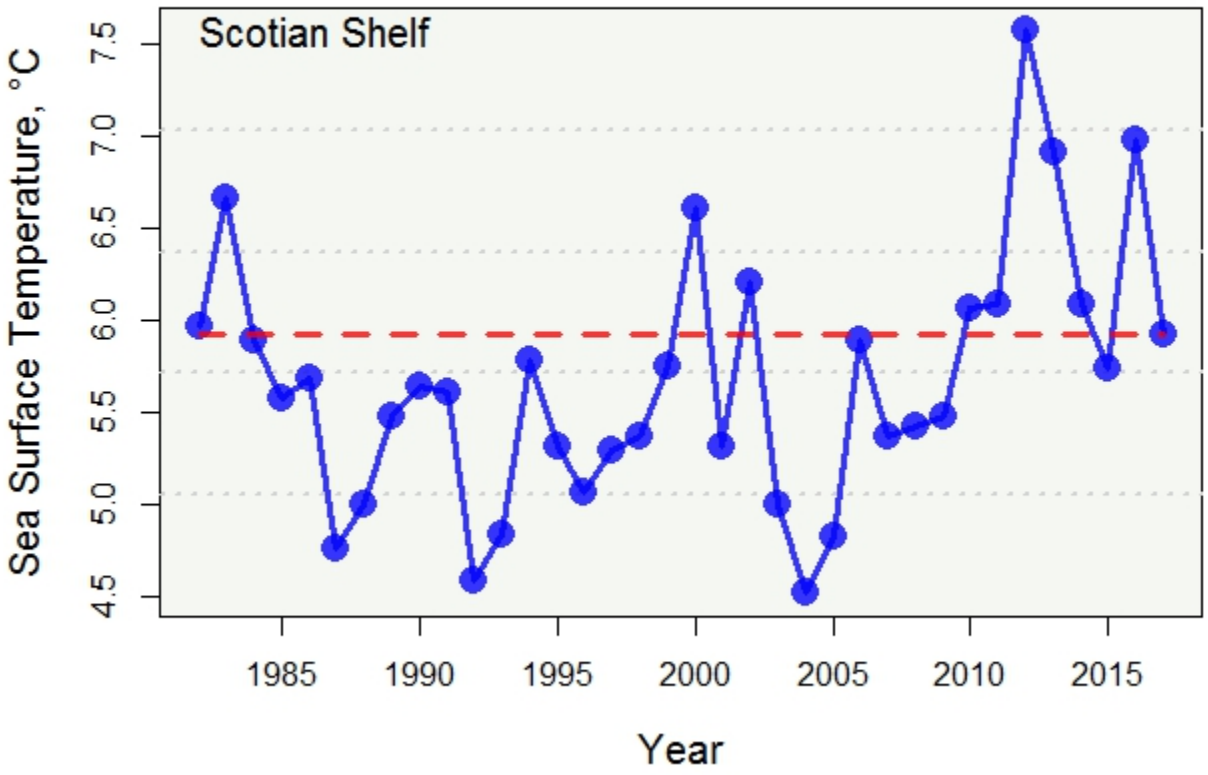
Gulf of Maine



Middle Atlantic Bight

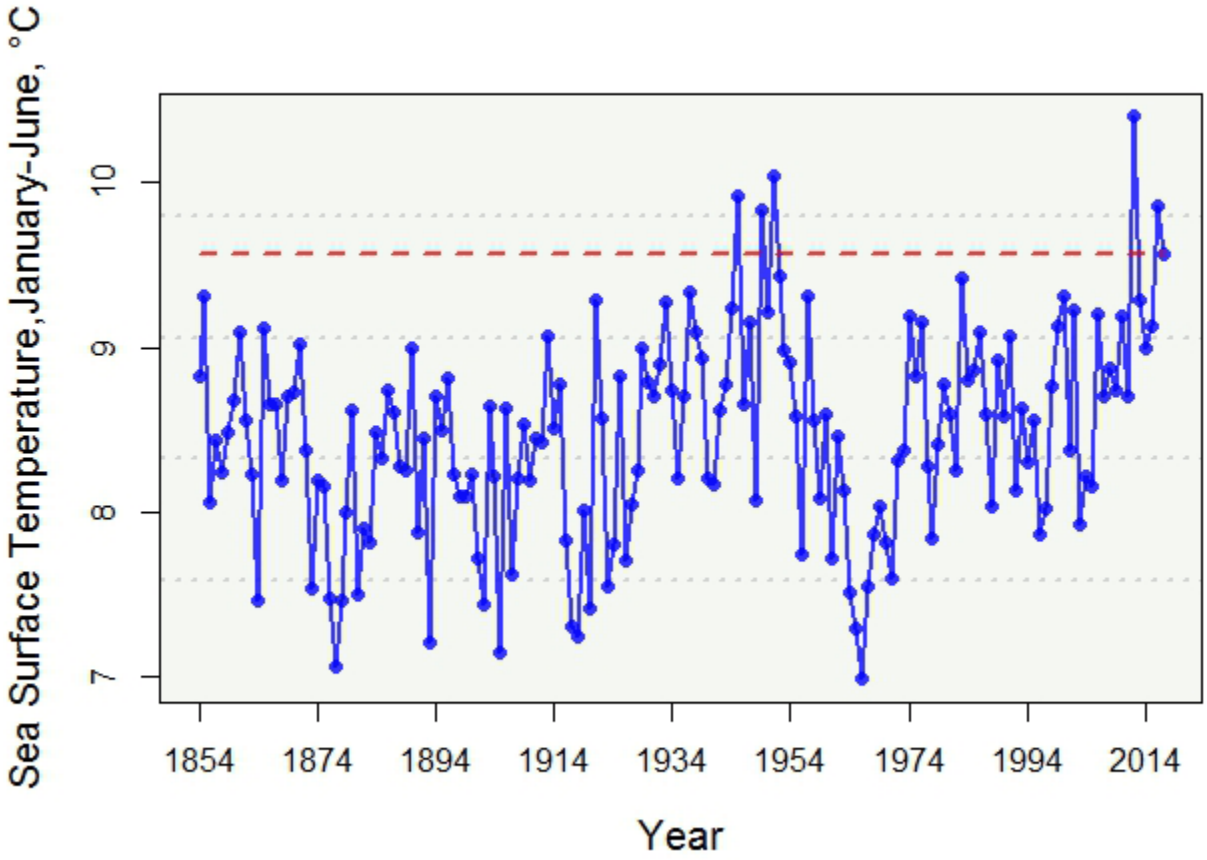


Northeast Shelf



Scotian Shelf

Extended Reconstruction SST for First Half Year



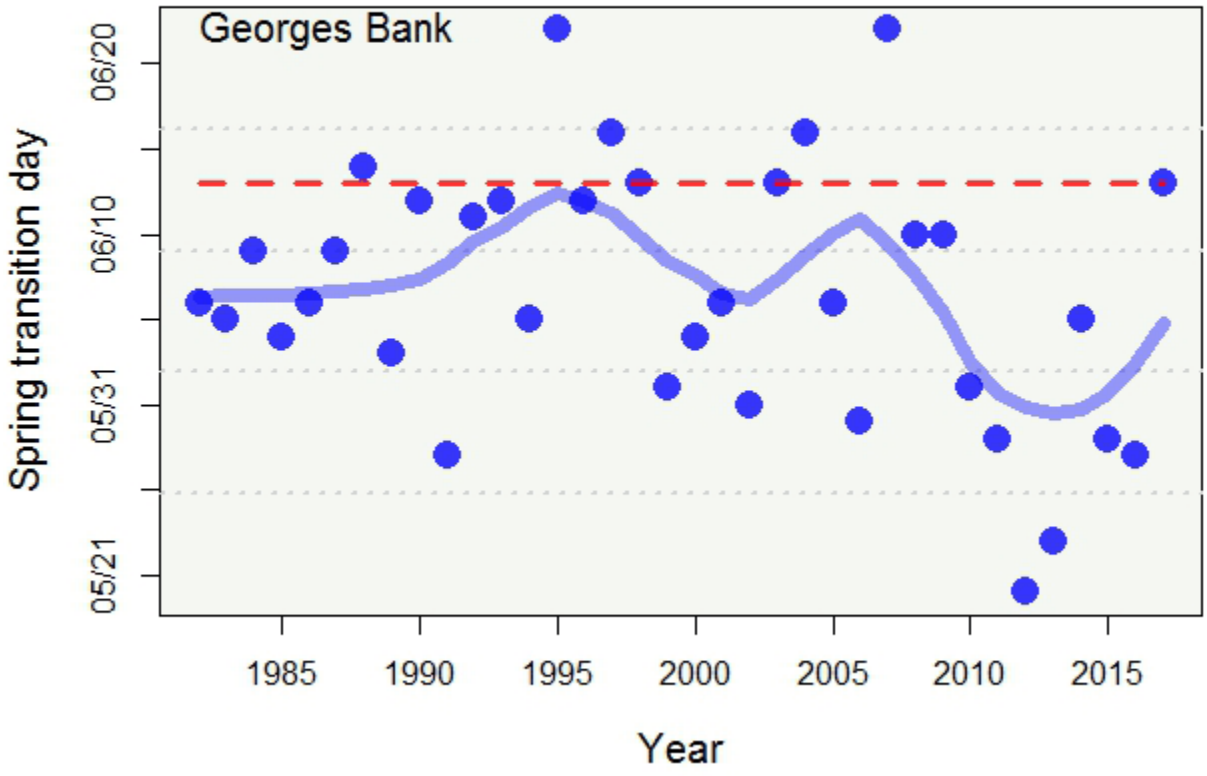
Extended SST

The ERSST temperature time series provides a low resolution depiction of sea surface temperature on the Northeast Shelf since the 1850s and is based on historical shipboard measures and augmented with other data in recent years. The SST conditions for the first half of 2017 were above average and generally match the sea surface temperatures seen during the warm period of the late 1940s and early 1950s.

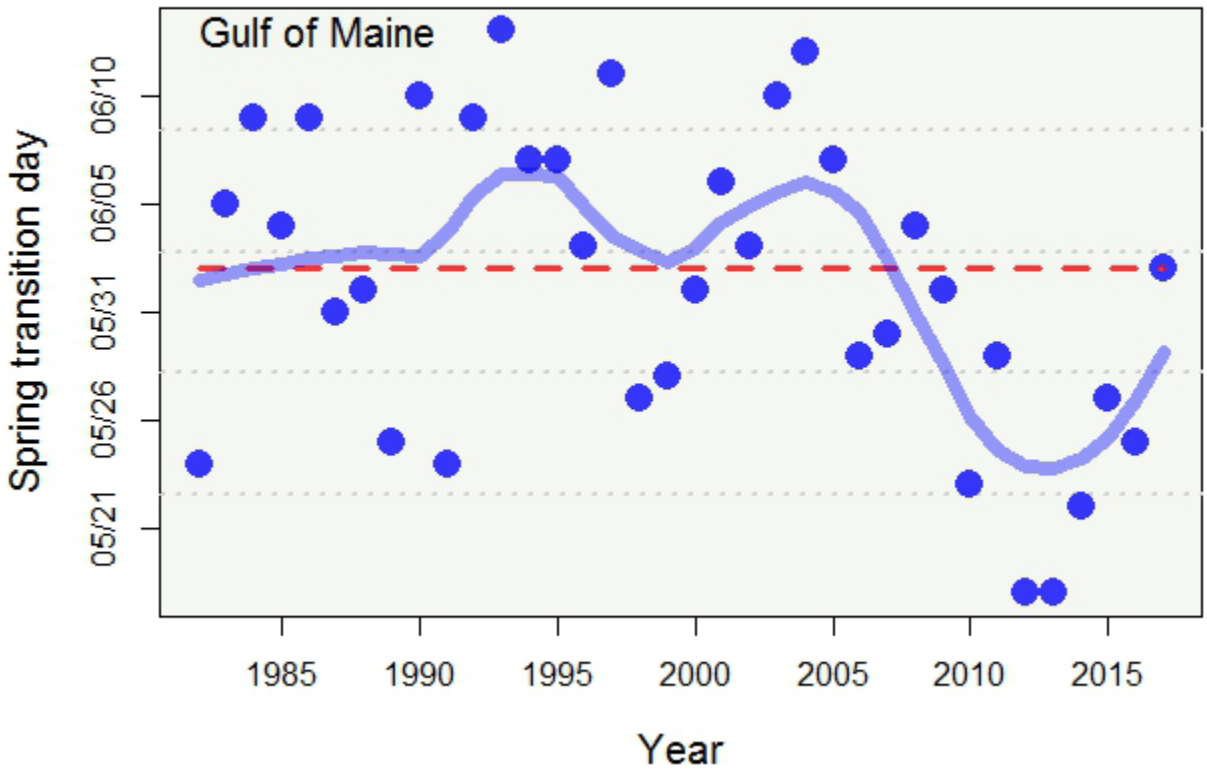
Spring Thermal Transition Date

Phenology is the climate influence on the timing between plant and animal production cycles. Many marine organisms time their reproductive cycles to best utilize seasonal phytoplankton blooms, like the spring bloom, and in turn temperature plays a role in the development of the spring bloom. One measure to characterize the change in the timing of thermal forcing is the date of arrival of a spring transition temperature, which will vary by region and is meant to mark the average temperature between winter and summer. The date of arrival of the spring thermal transition temperature has been relative constant since 1982 to approximately 2006 for the

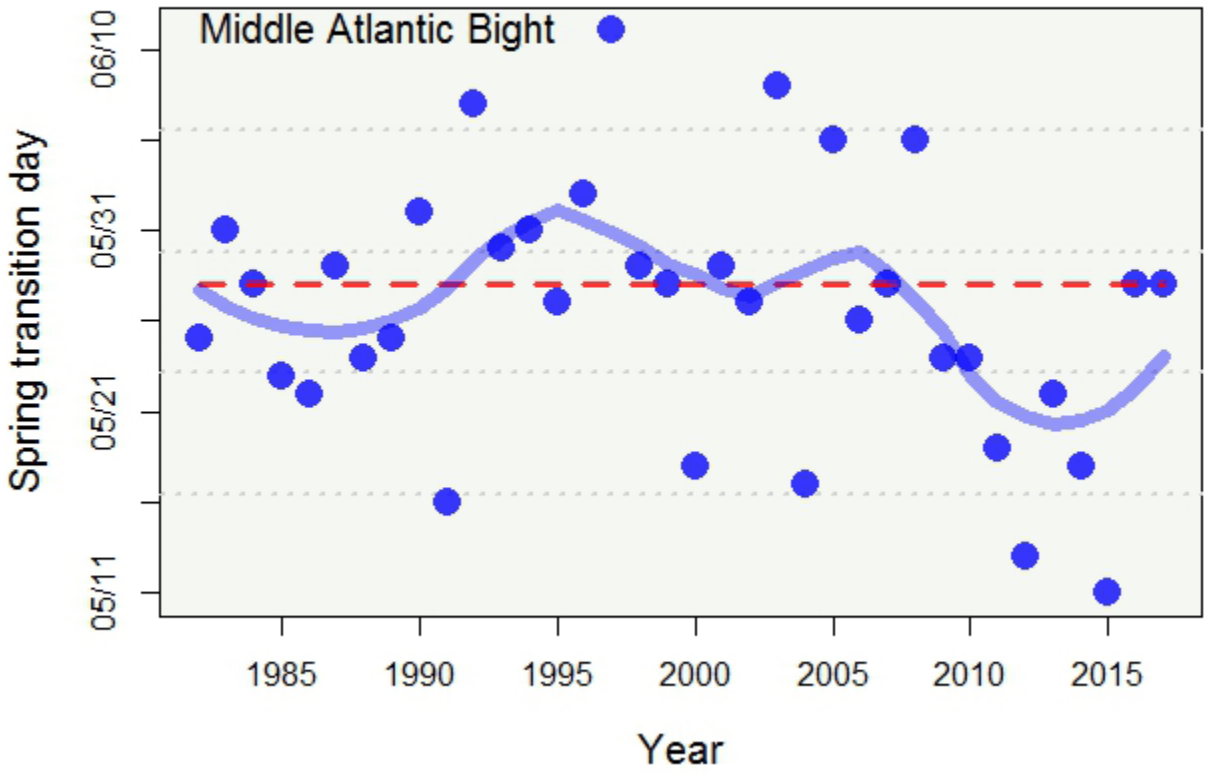
Northeast Shelf as a whole and its constituent ecoregions (see figure). Since 2006, spring transition date has advanced on the order of two weeks. The 2017 spring transition dates reflect the moderate temperature conditions observed this past spring and for many areas are more in line with the long term trend.



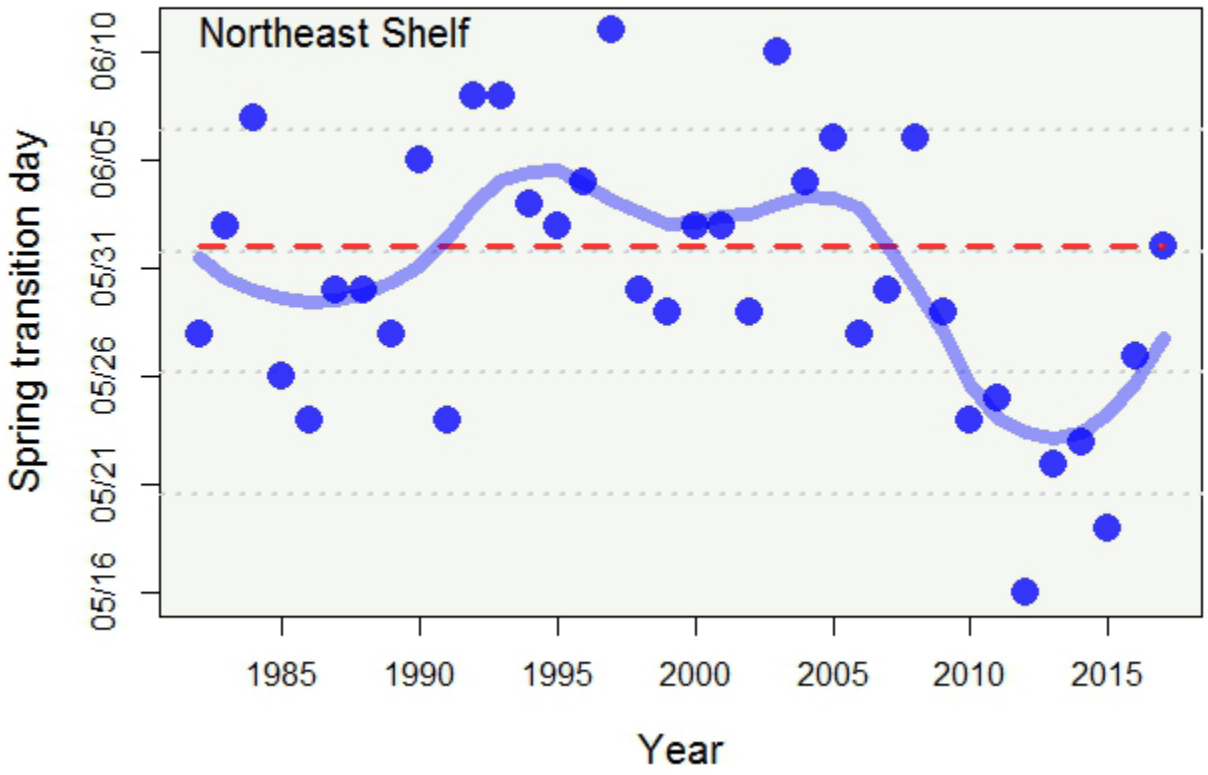
Georges Bank



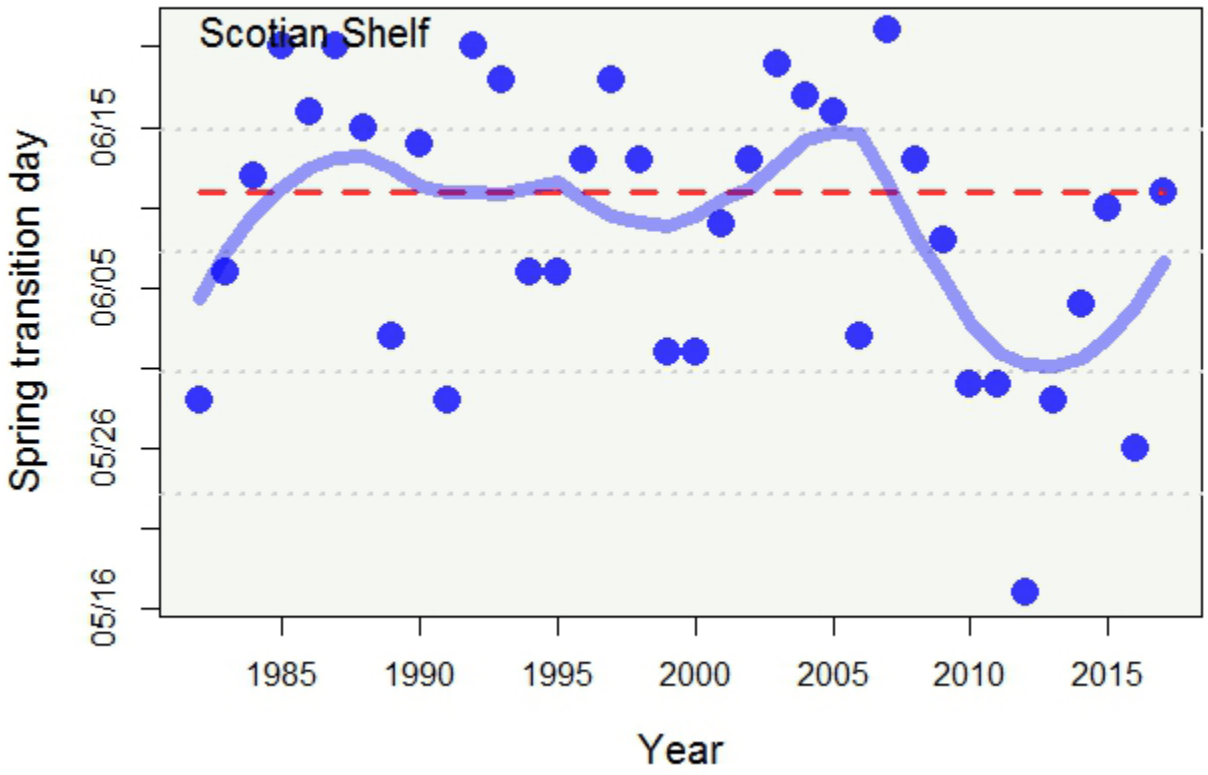
Gulf of Maine



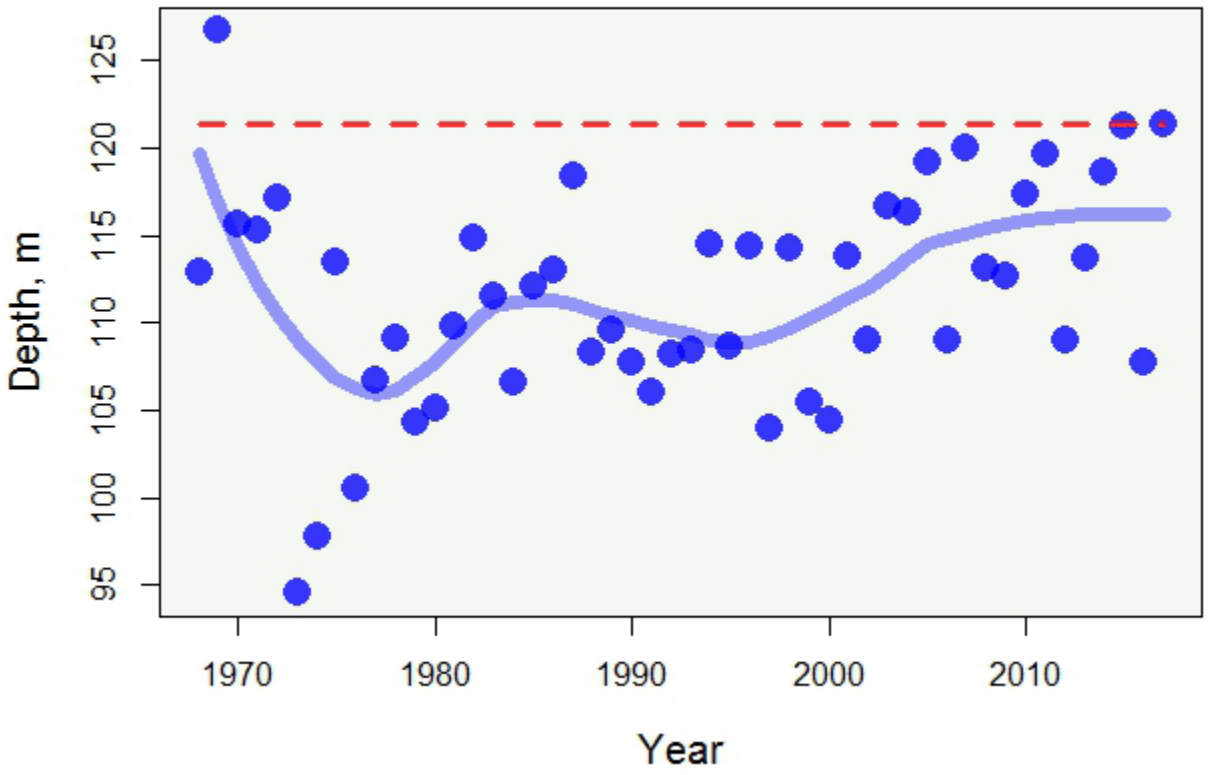
Middle Atlantic Bight



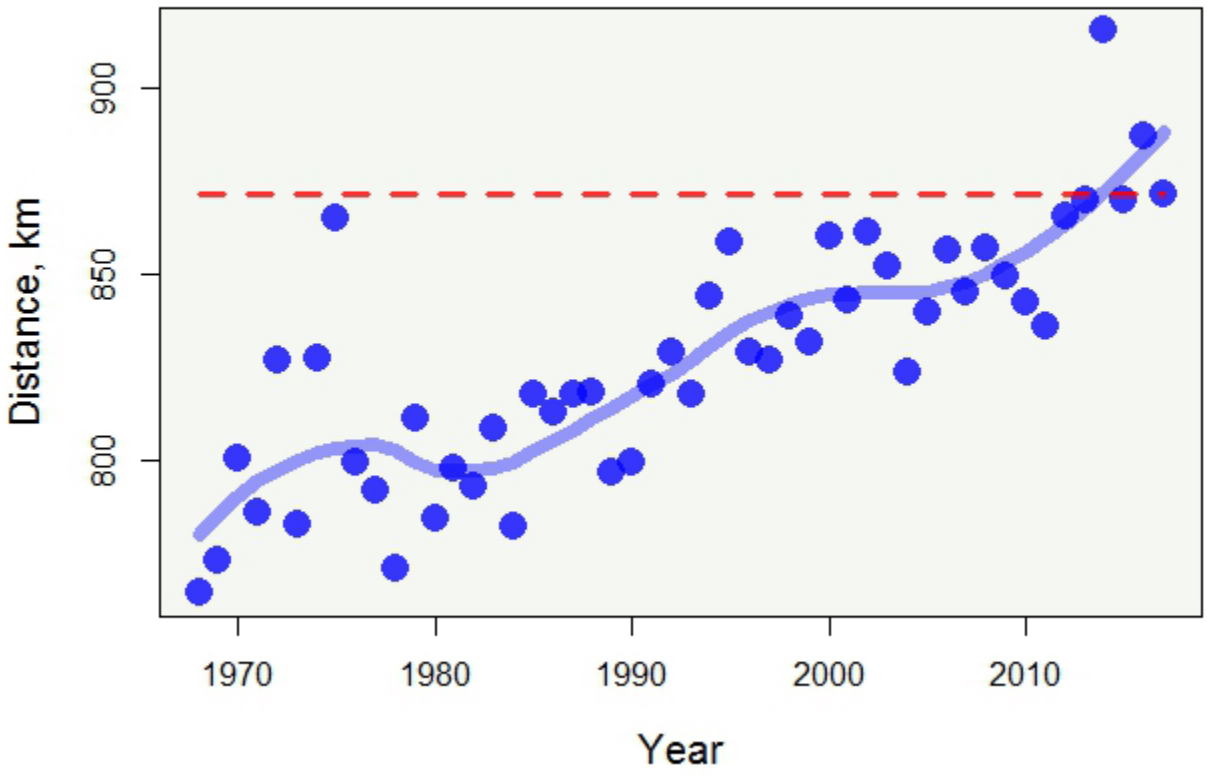
Northeast Shelf



Scotian Shelf



Along-shelf depth trend



Species distribution trend

Trends in Spring Species Distribution

The species of the Northeast Shelf ecosystem have shown changes in distribution over recent decades. Individual species have shifted distribution due to a number of reasons and these shifts can be characterized in a number of different ways. Two metrics that have been used to characterize distribution on the NE Shelf include:

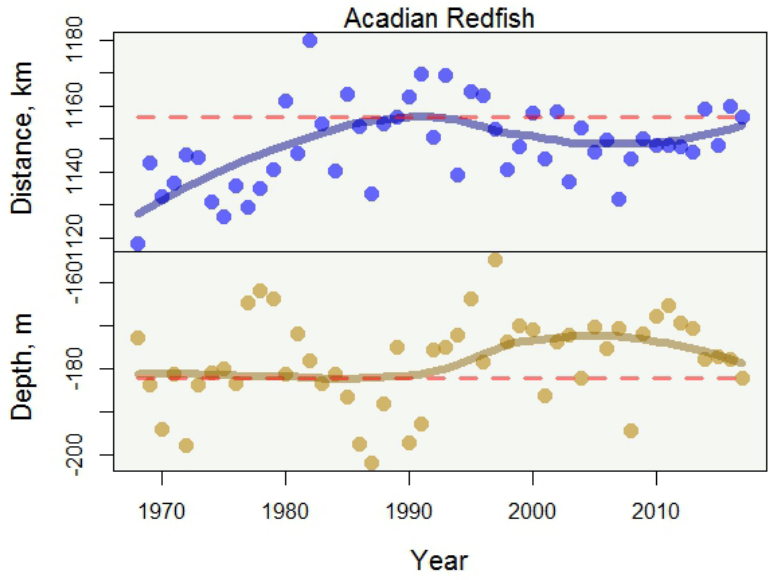
1. the position in the ecosystem along an axis oriented from the southwest to the northeast referred to as the along shelf distance; and
2. the depth of occurrence.

Along shelf distances range from 0 to 1360, which relates to positions along the axis from the origin in southwest to northeast in kilometer units. Depth ranges from 0 to -260, which relates to depth of occurrence in meters.

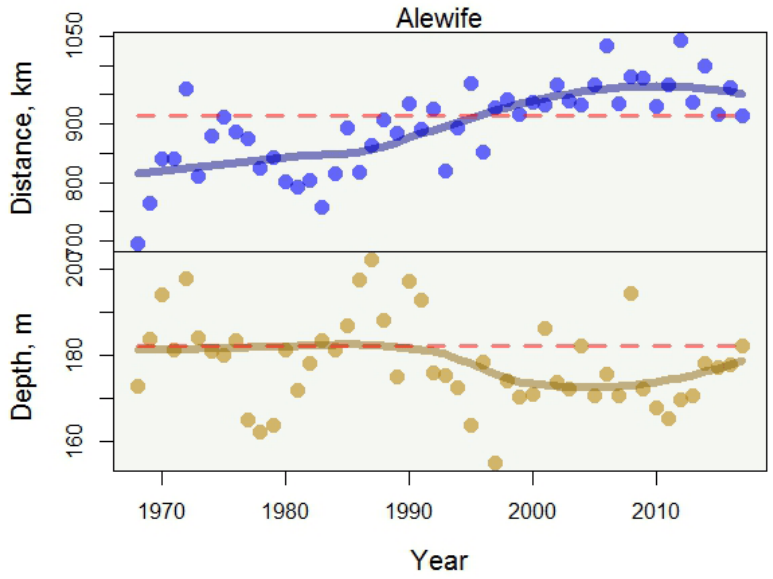
The mean along shelf distance and depth of occurrence for all species by year are shown in the two graphs, with the 2017 values marked with a dashed red line. As a group, these species had an along shelf distance of approximately 790 km at the beginning of the time series, they now have a distance of over 880 km. The change in the depth distribution of these species has been more

moderate going from a decadal average of approximate 110 m to an average of 115 m more recently.

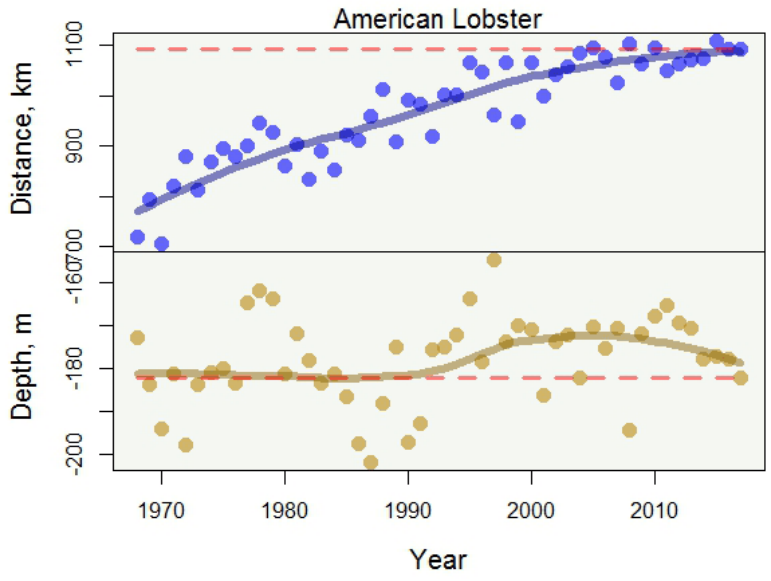
Acadian redfish



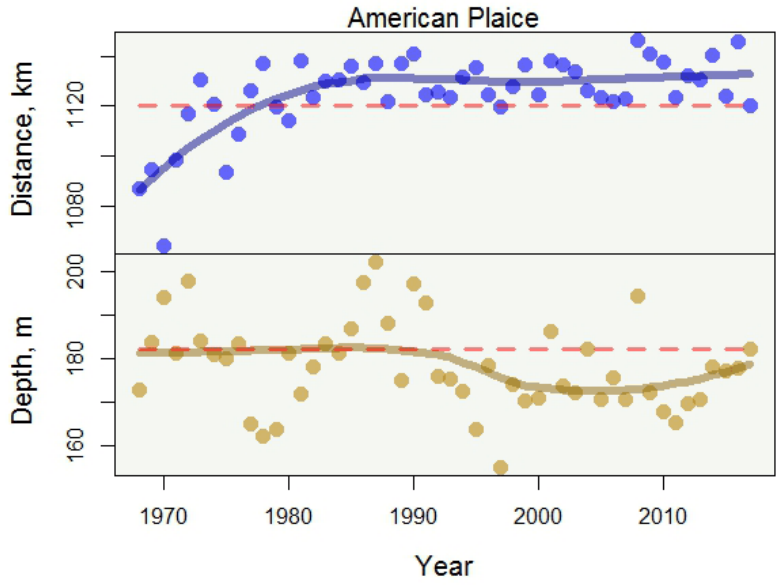
Alewife



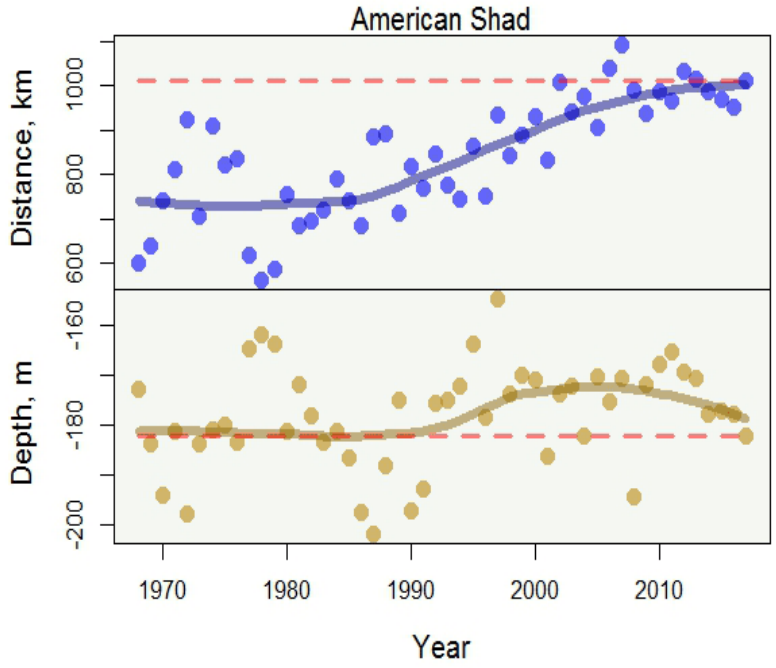
American lobster



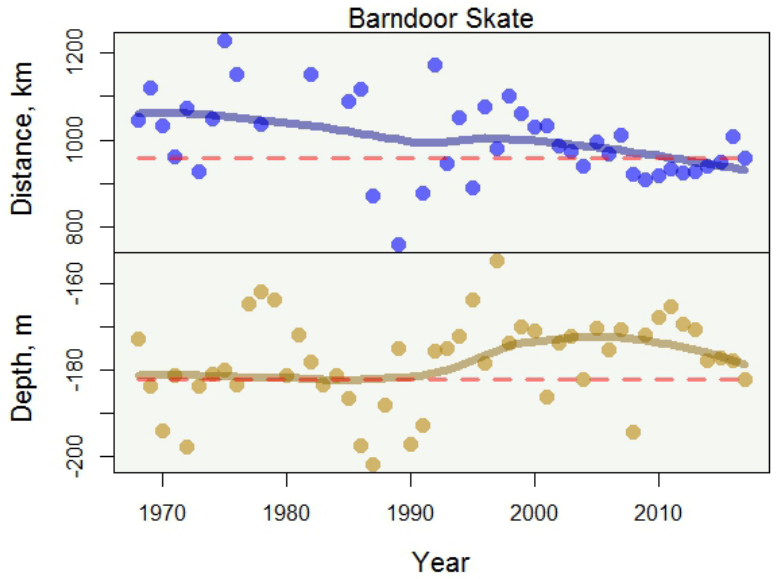
American plaice



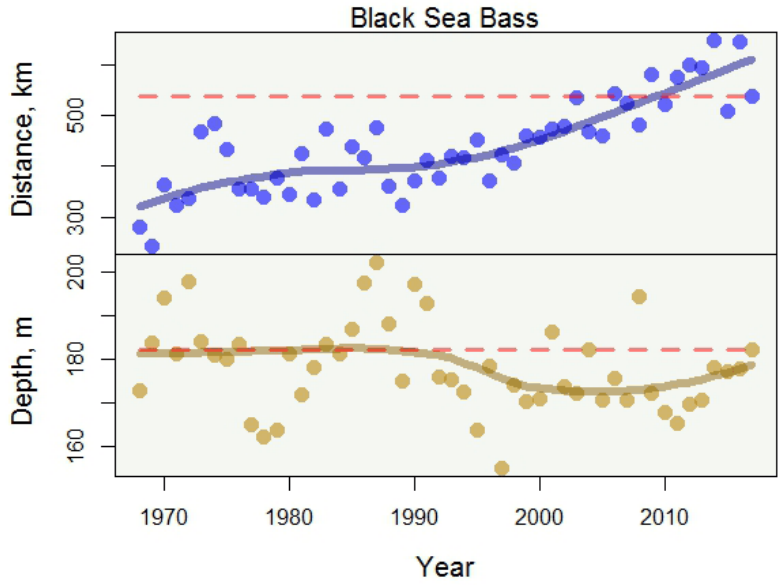
American shad



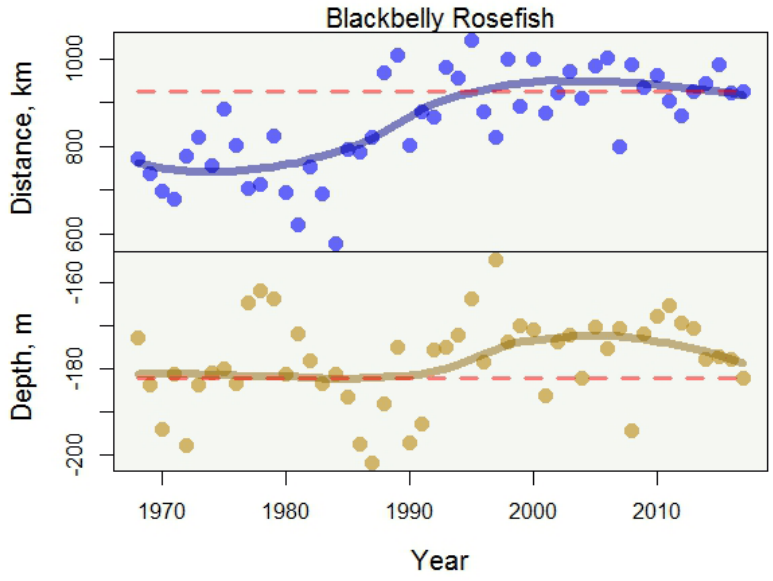
Barndoor Skate



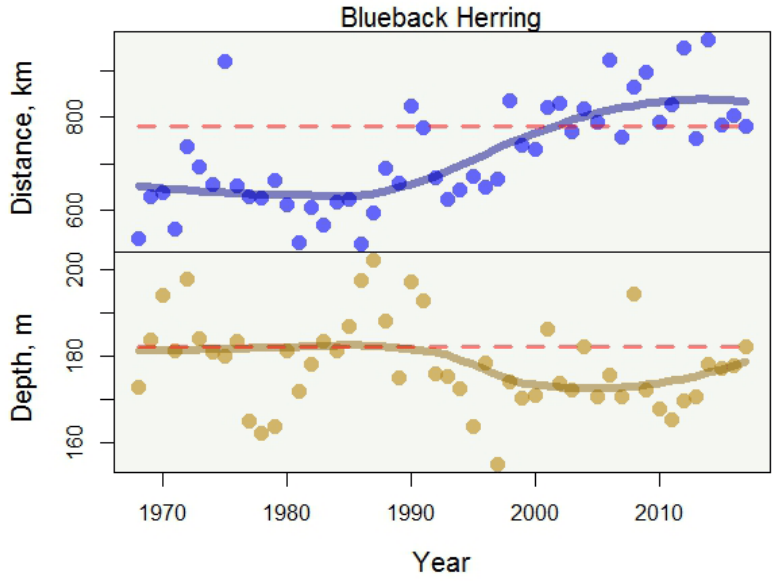
Black sea bass



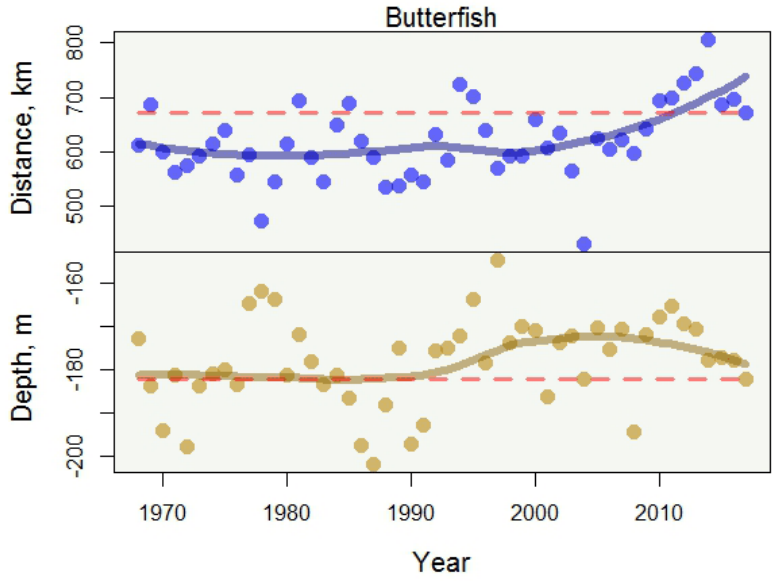
Blackbelly rosefish



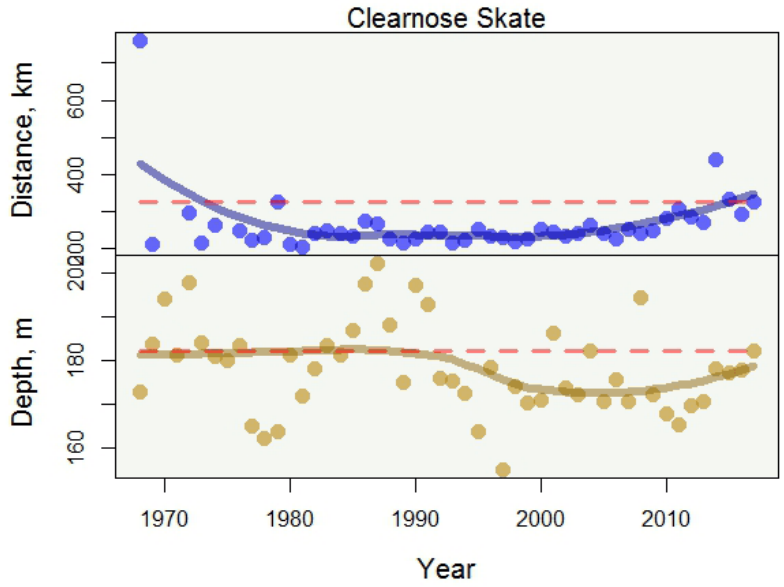
Blueback herring



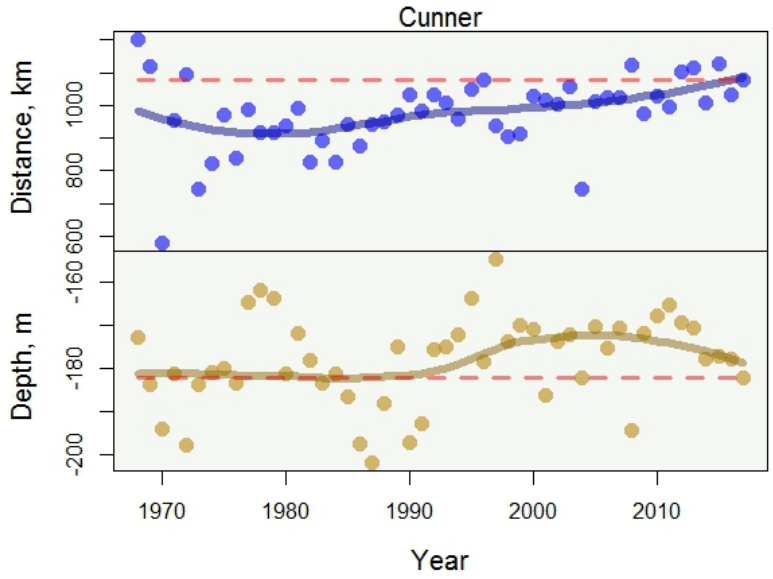
Butterfish



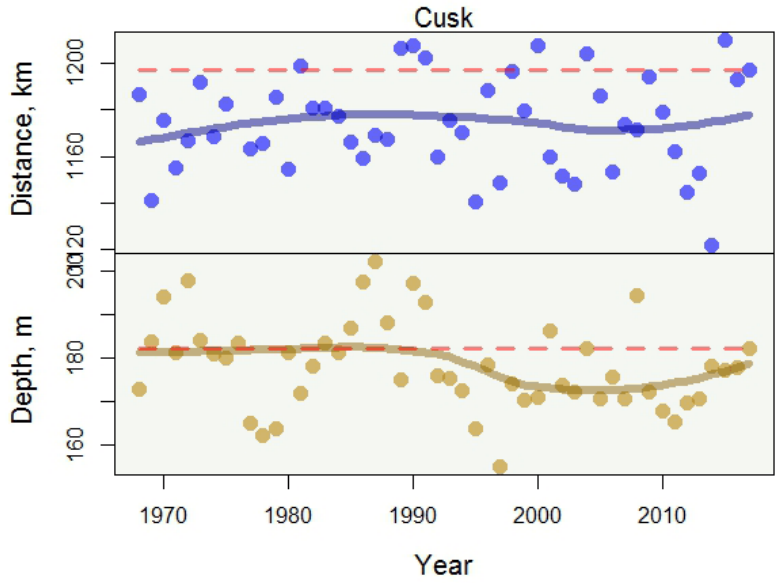
Clearnose skate



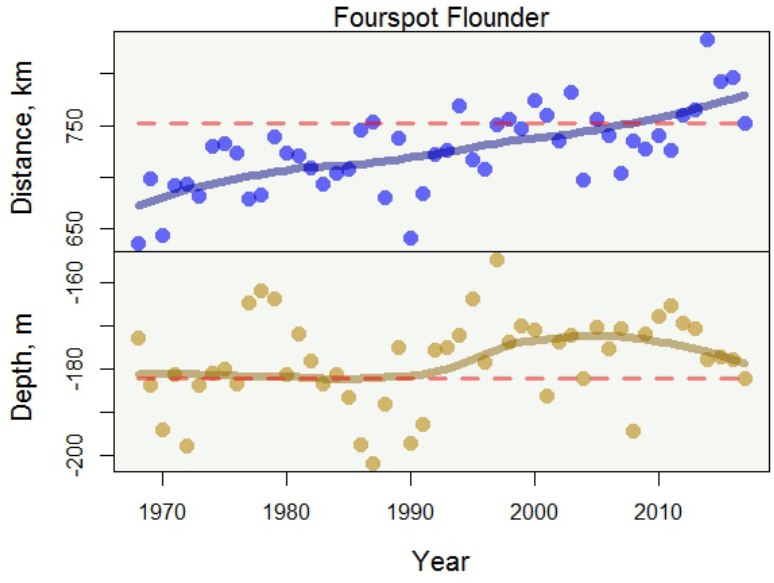
Cunner



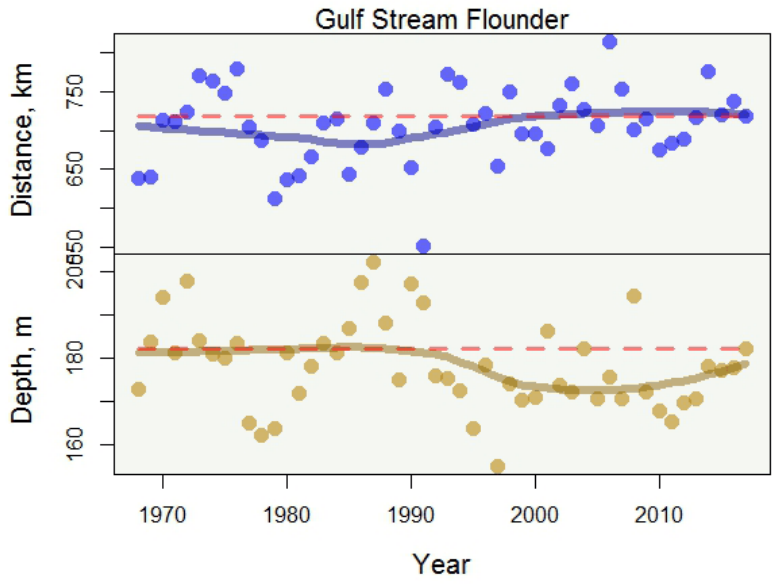
Cusk



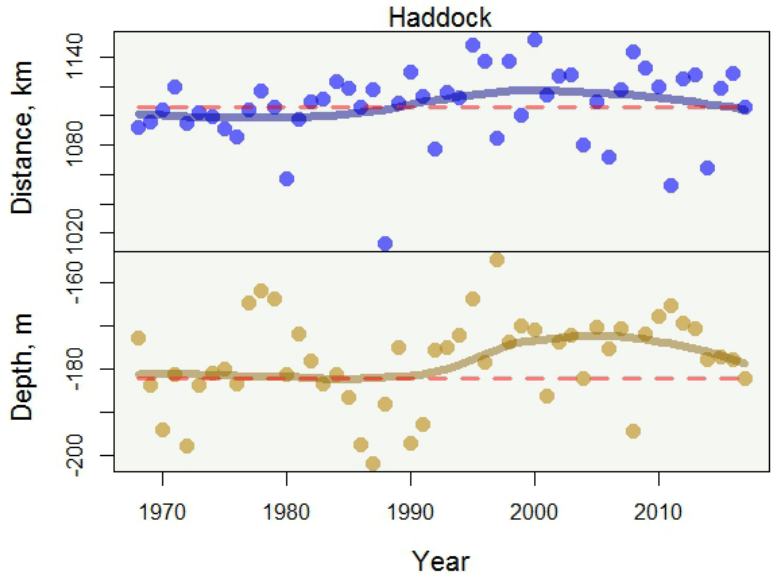
Fourspot flounder



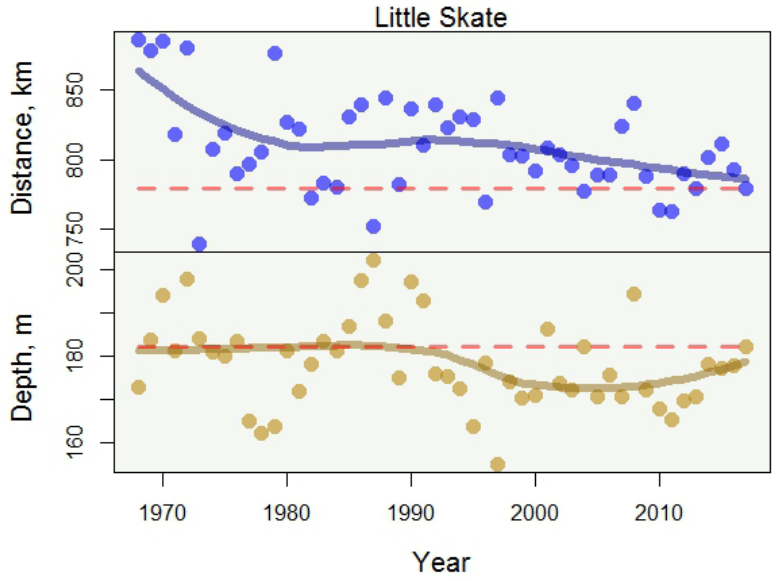
Gulf Stream flounder



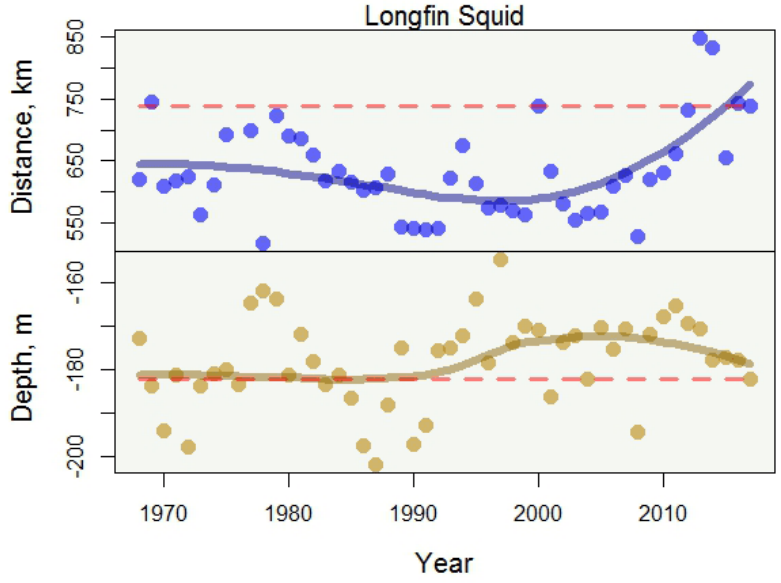
Haddock



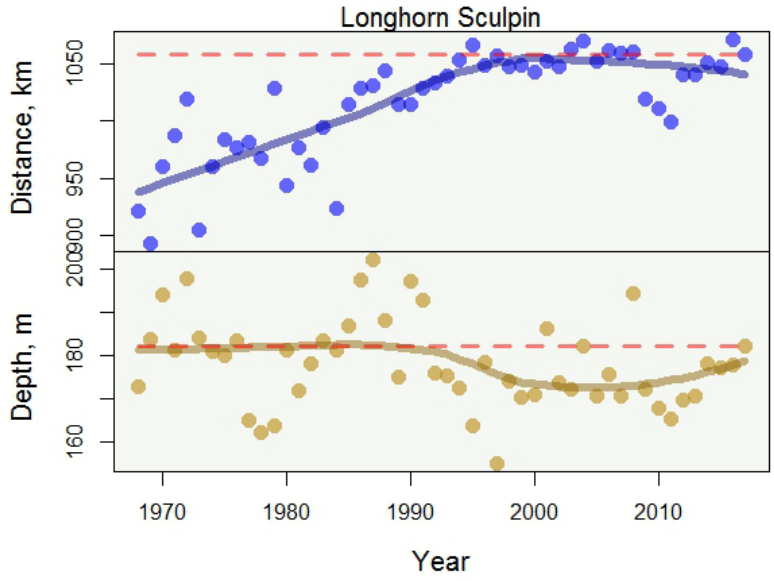
Little skate



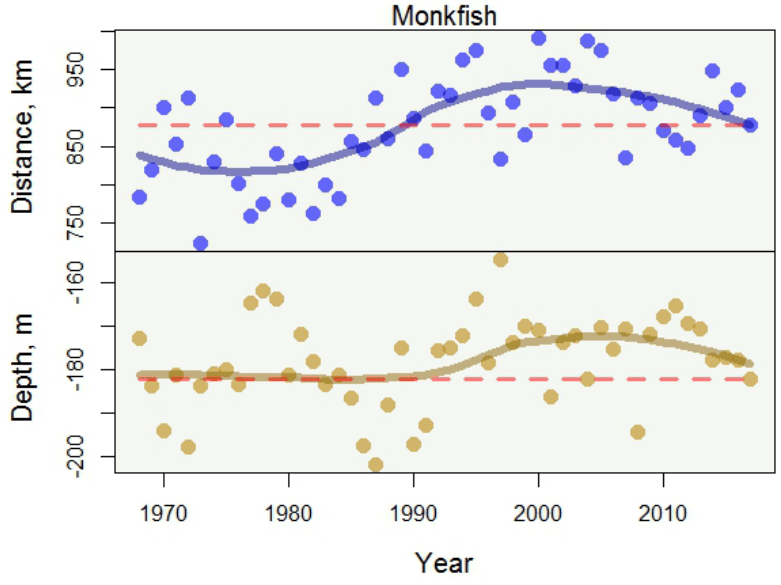
Longfin squid



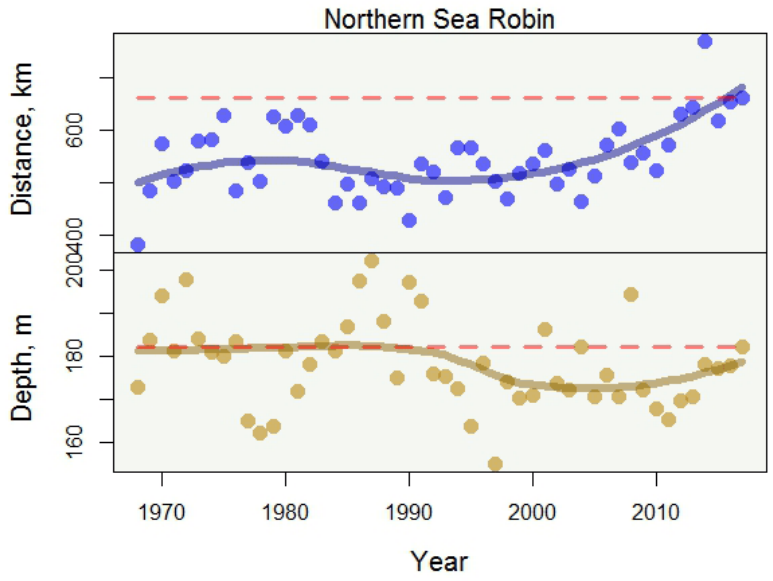
Longhorn sculpin



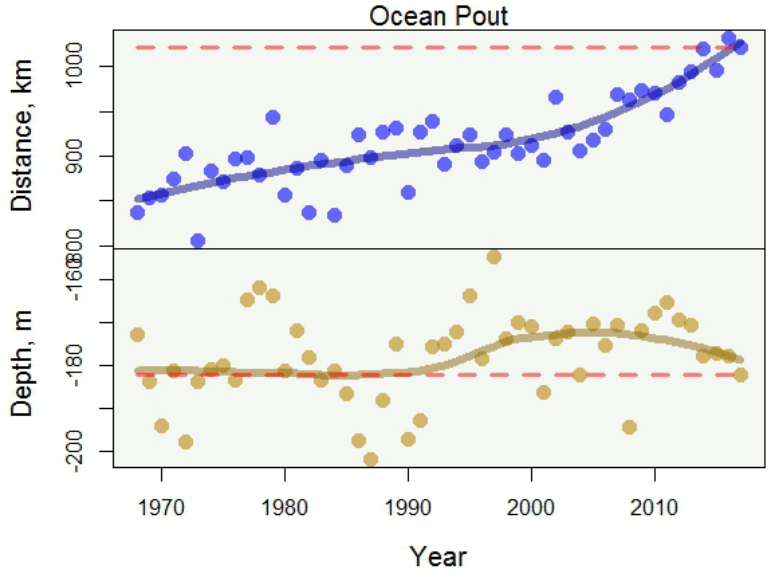
Monkfish



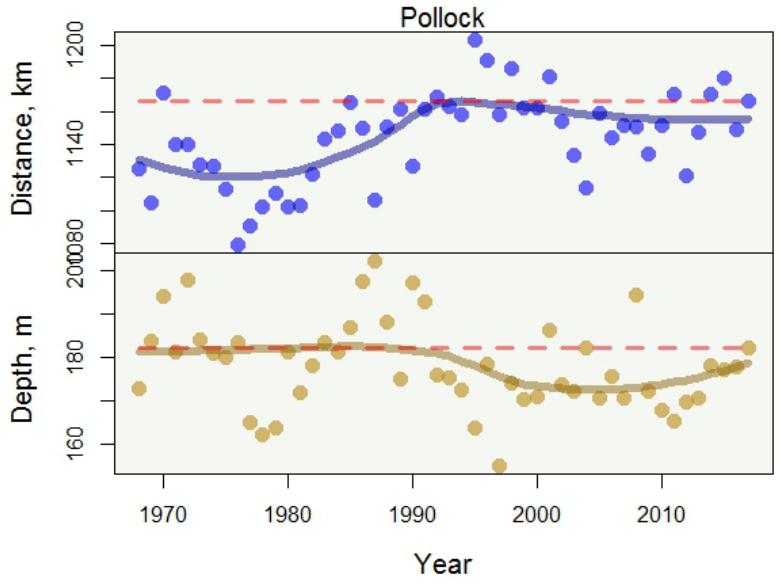
Northern sea robin



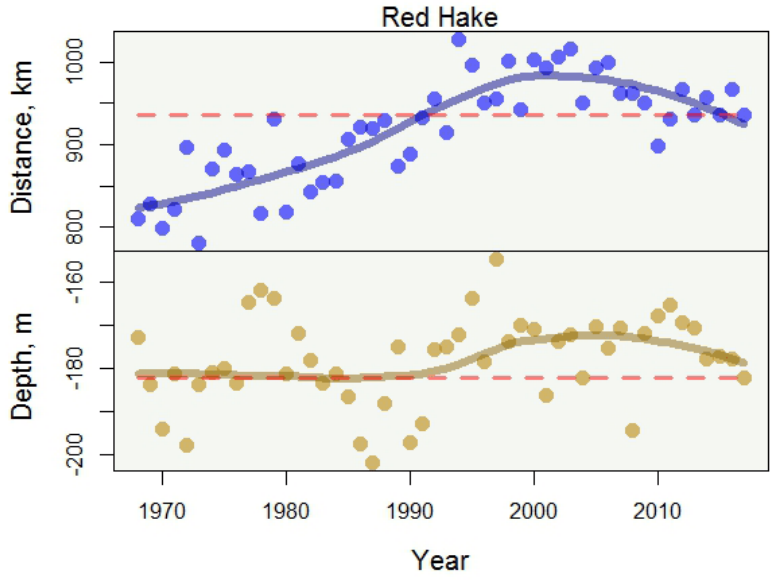
Ocean pout



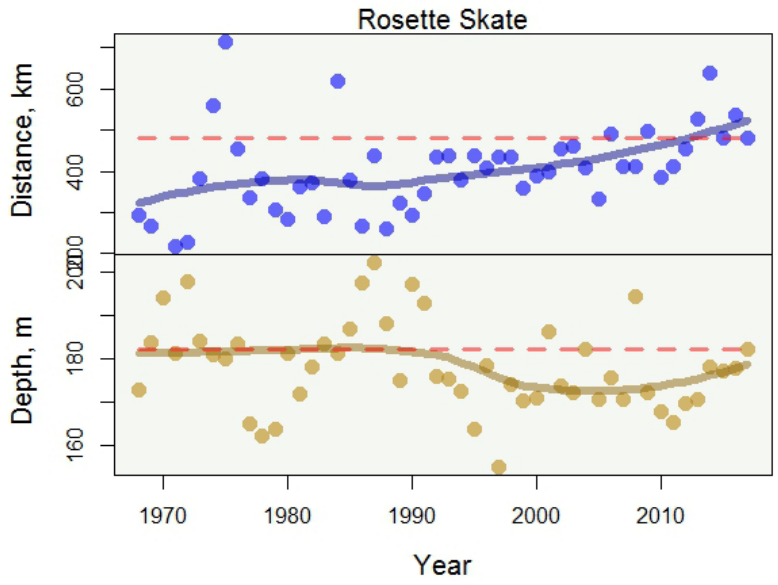
Pollock



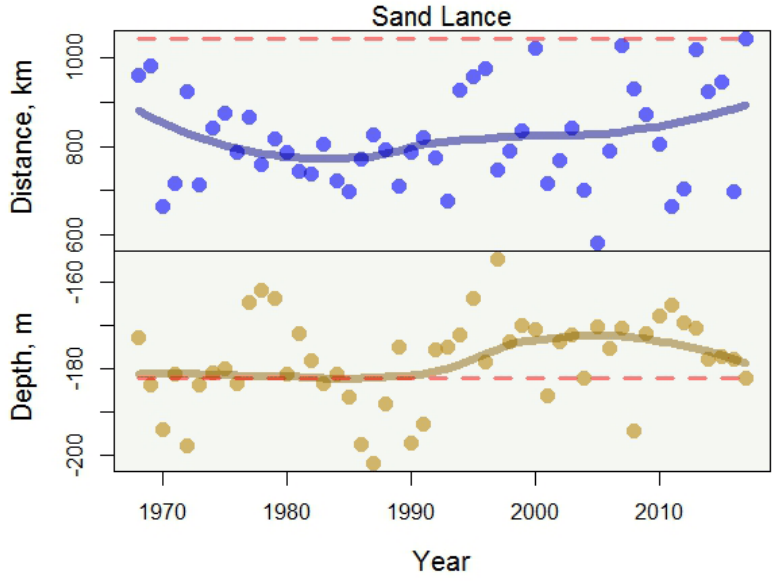
Red hake



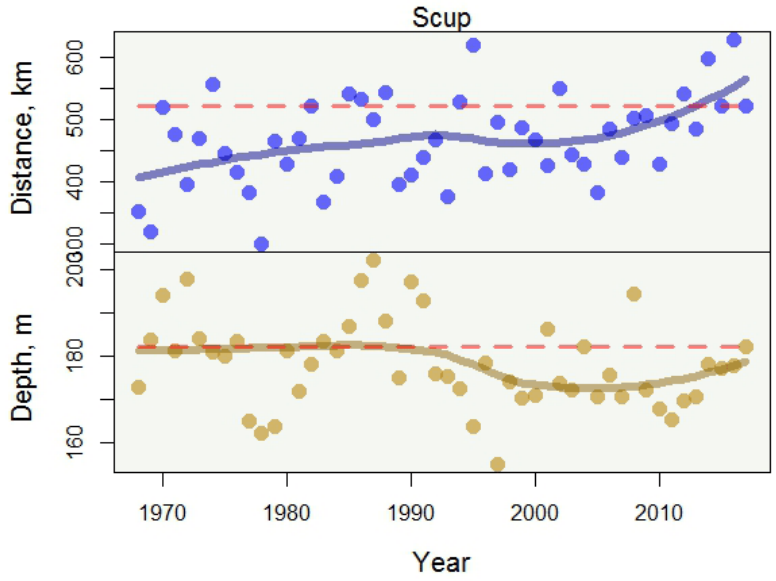
Rosette skate



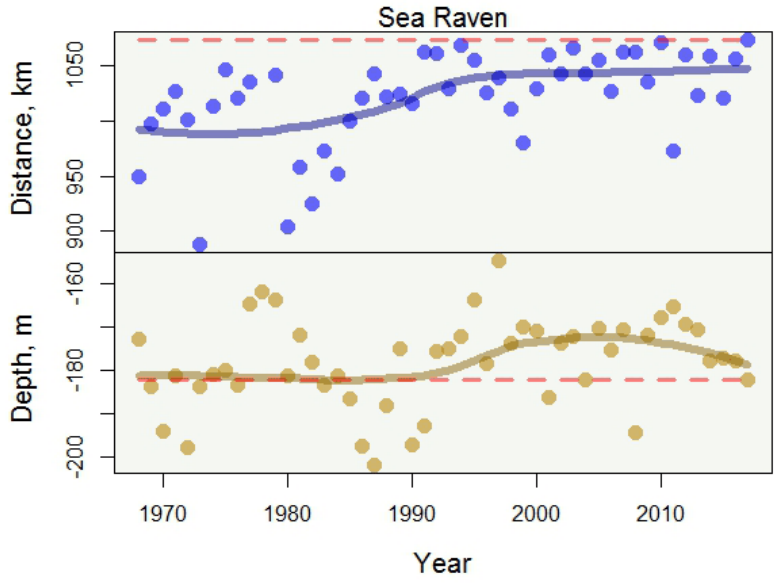
Sand lance



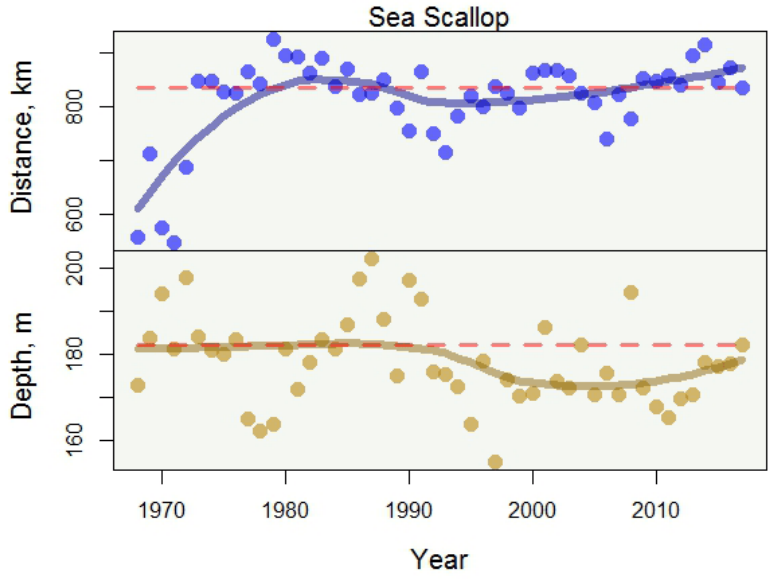
Scup



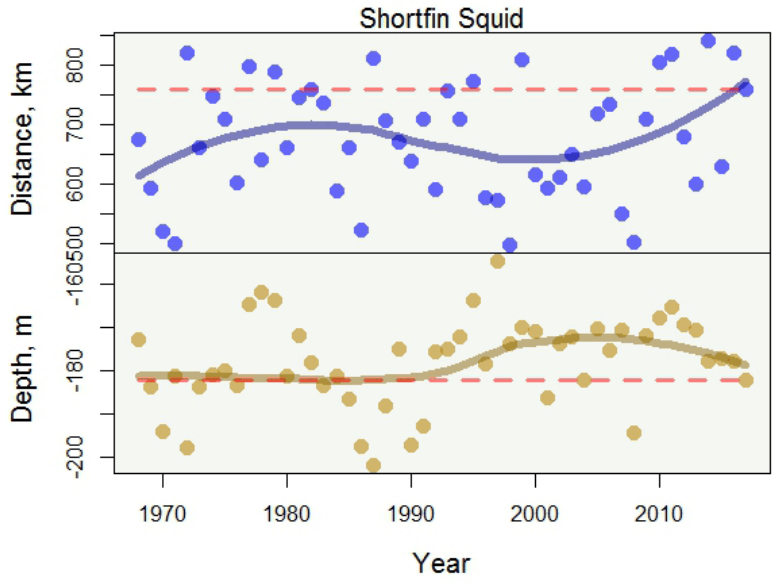
Sea raven



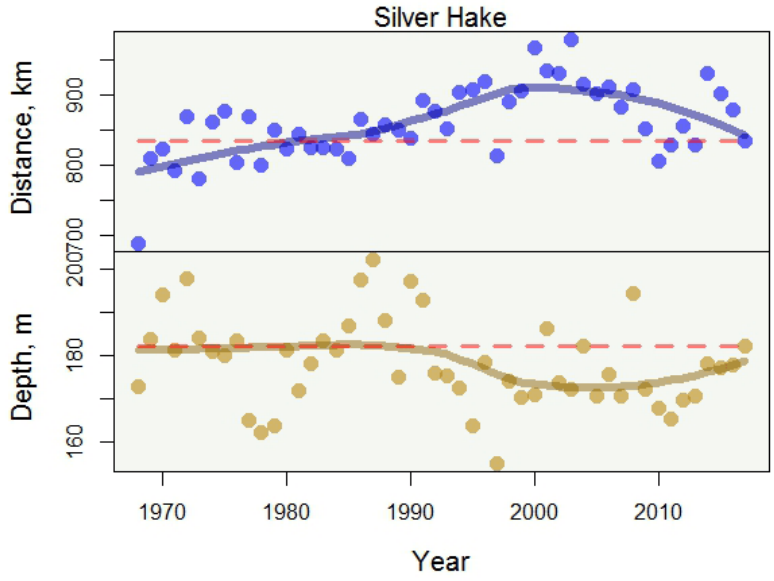
Sea scallop



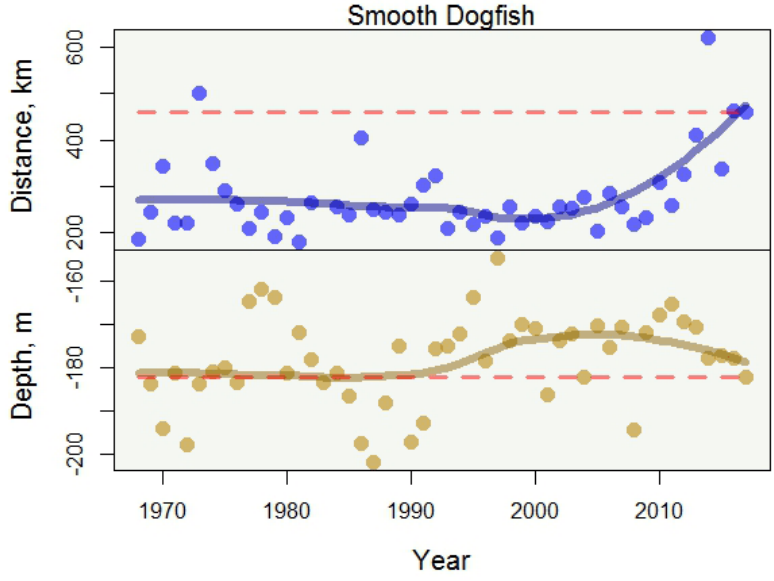
Shortfin squid



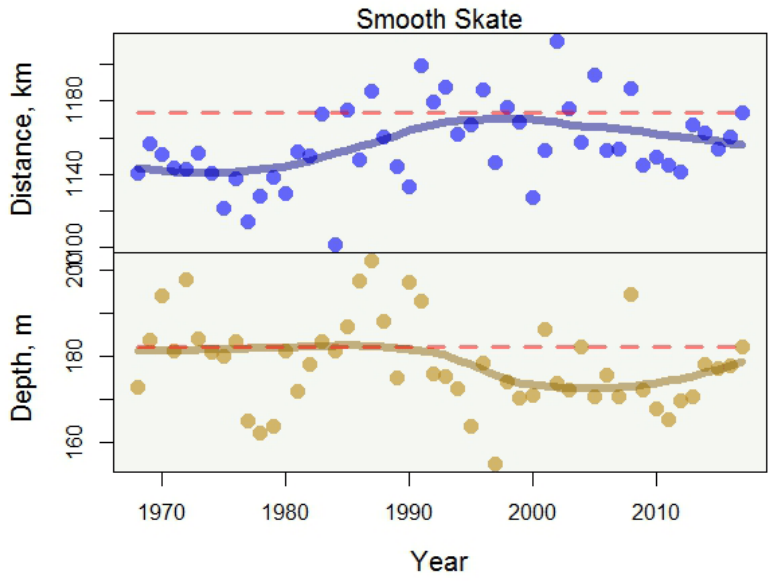
Silver hake



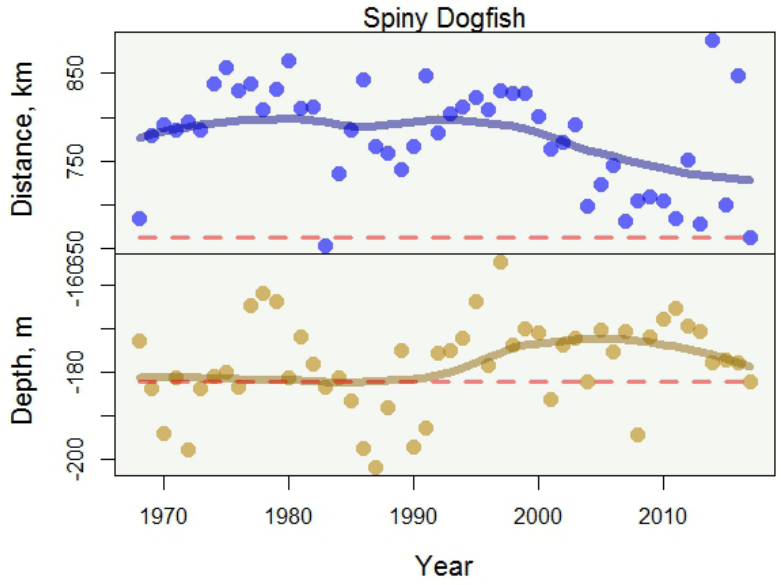
Smooth dogfish



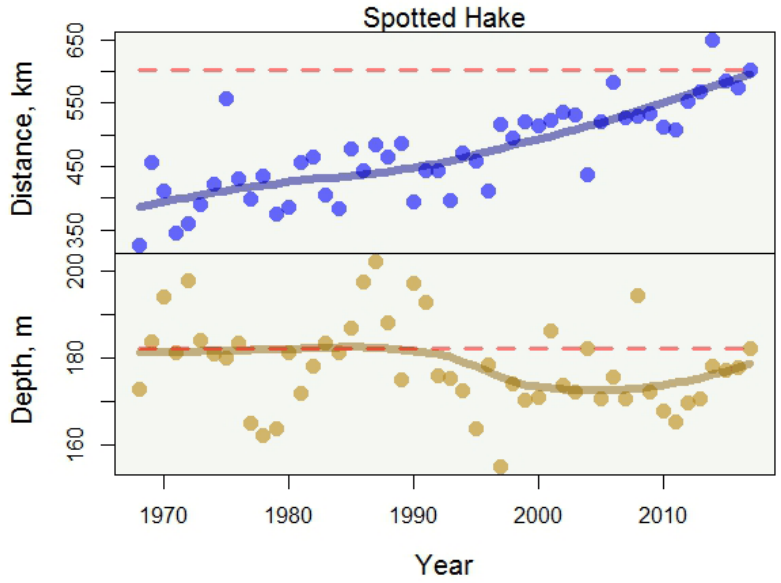
Smooth skate



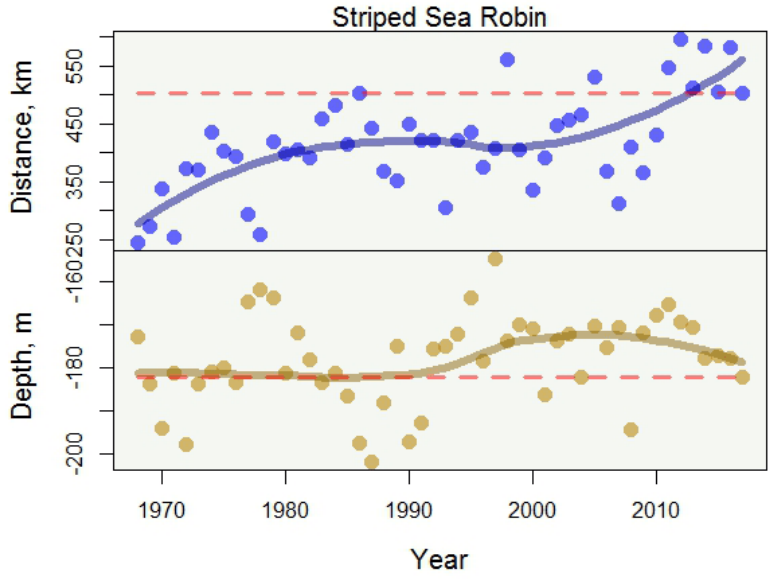
Spiny dogfish



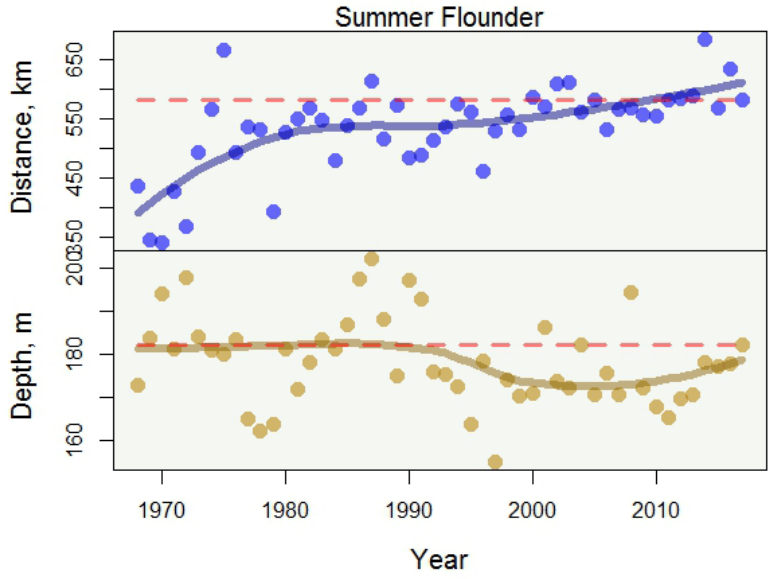
Spotted hake



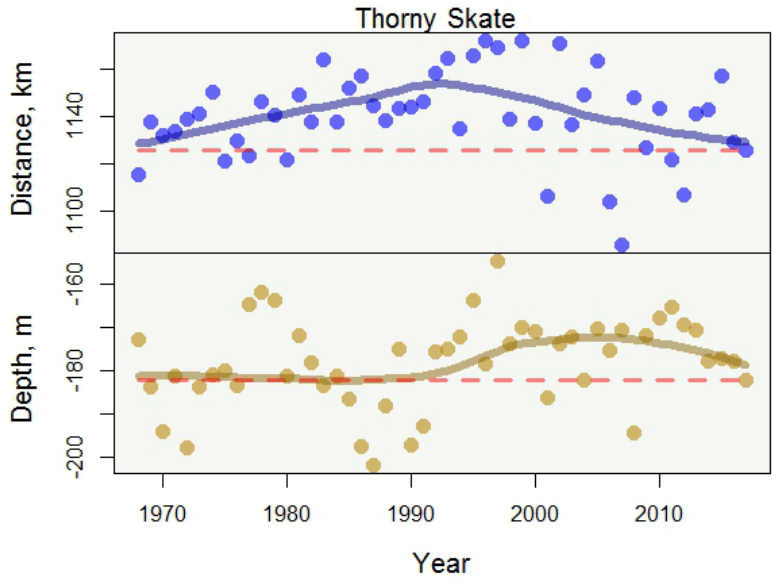
Striped sea robin



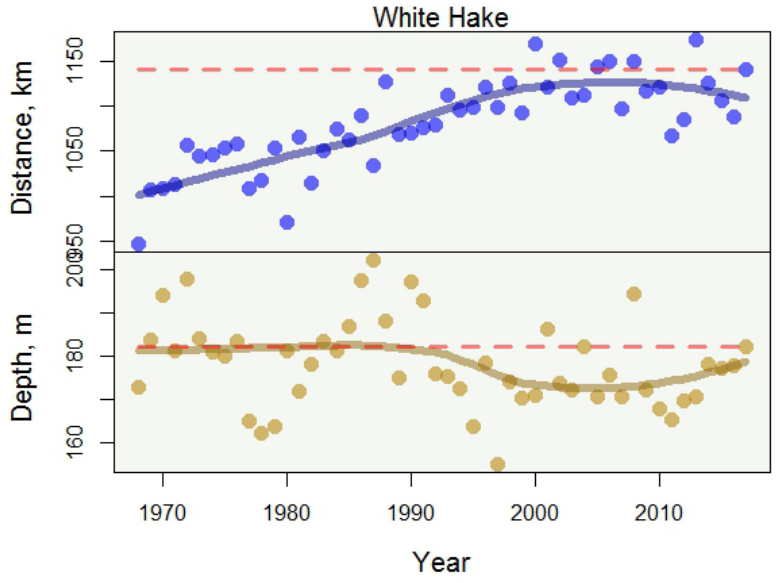
Summer flounder



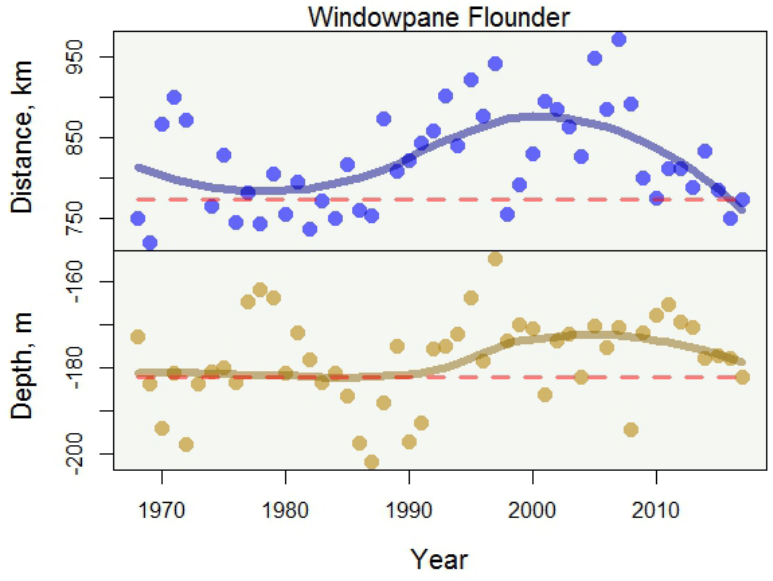
Thorny skate



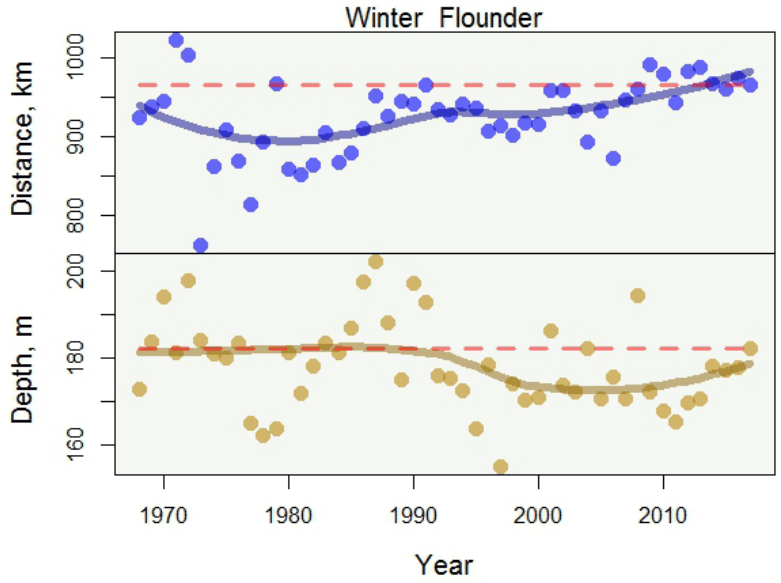
White hake



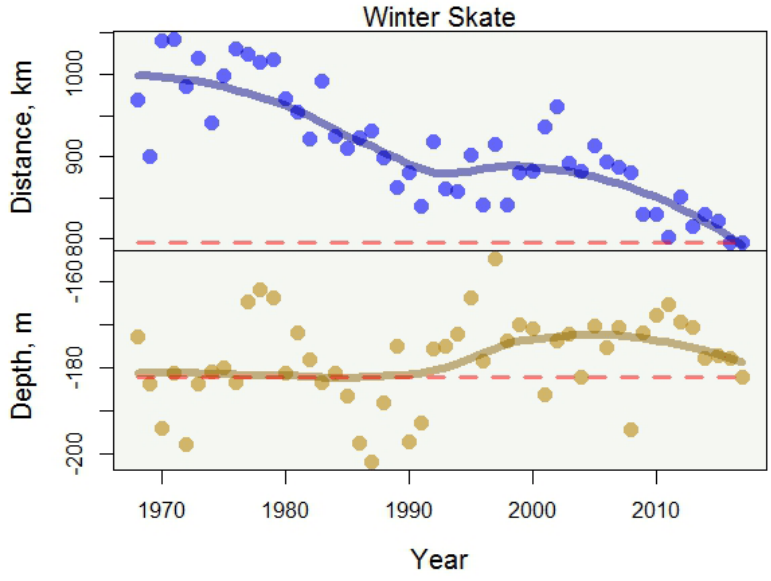
Windowpane flounder



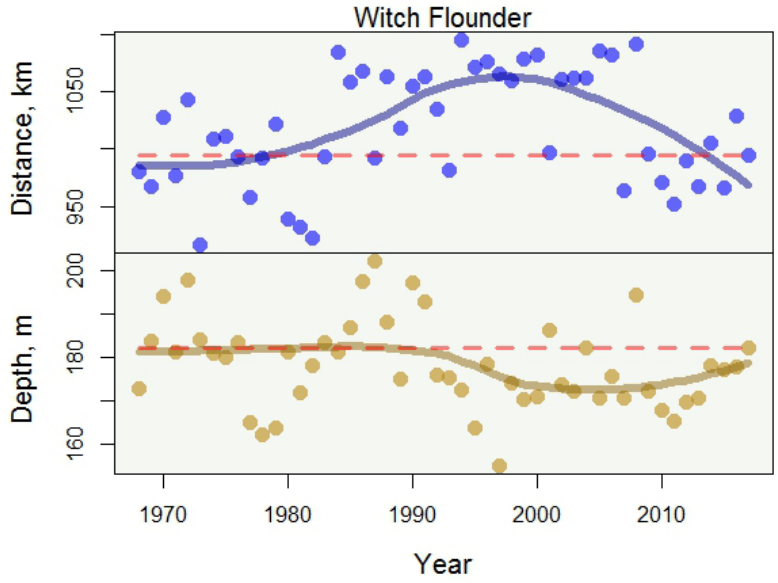
Winter flounder



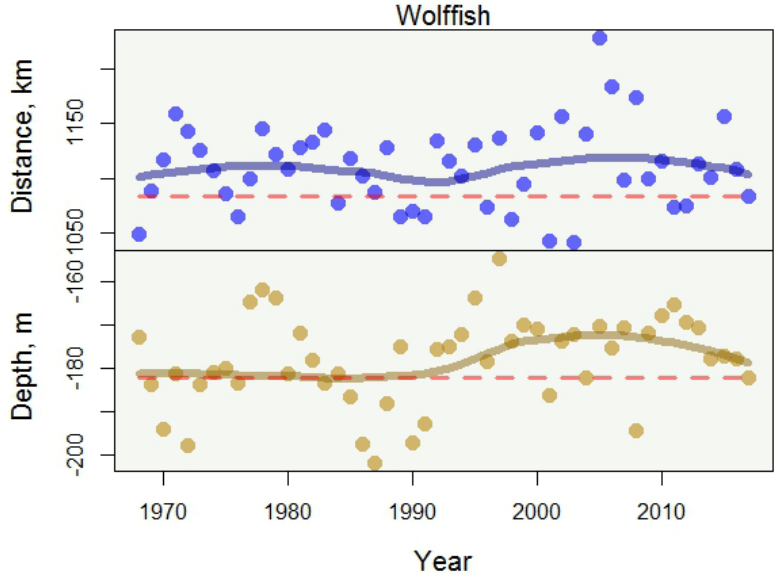
Winter skate



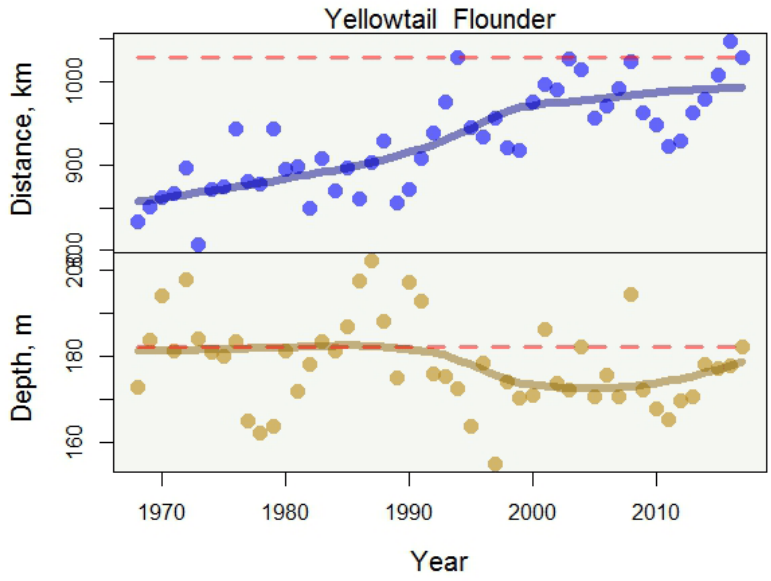
Witch flounder



Wolffish



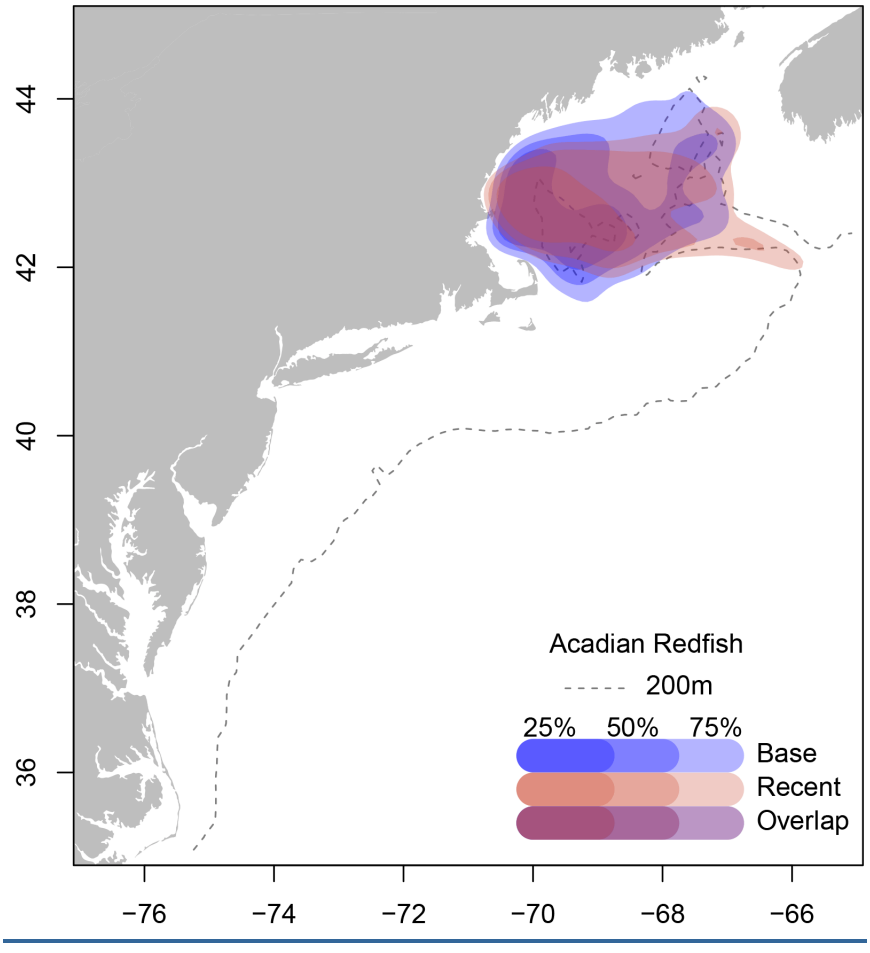
Yellowtail flounder



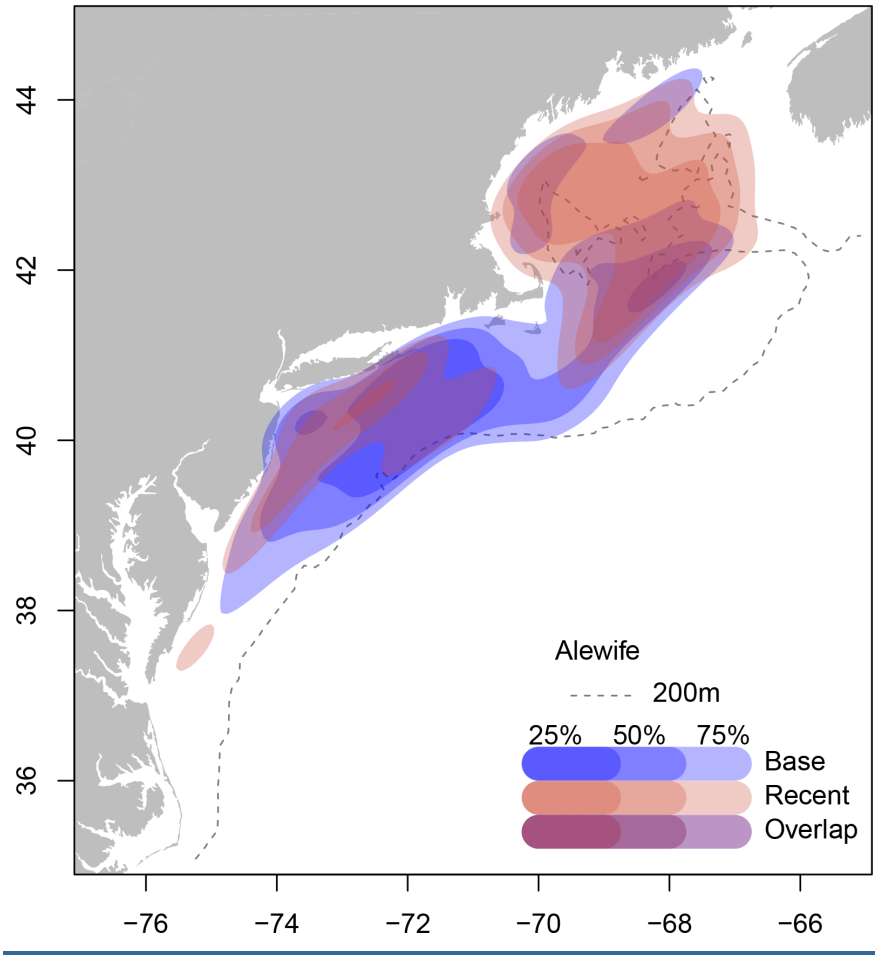
Kernel Density Plots of Spring Species Distribution

The habitats used by species of the Northeast Shelf ecosystem have changed over recent decades. Species have moved in response to a complex set of factors resulting in changes in distribution in respect to latitude and depth, among a number of habitat indicators. Kernel density plots provide a way of characterizing where a species is distributed by defining an area with an associated probability that a species will be found there. We compared the kernel densities for three probability levels between two time periods. The three probably levels were 25, 50, and 75% kernel densities; the 25% kernel defines the core area of the distribution whereas the 75% defines the broader use of the ecosystem. The two time periods were a base distribution period based on species distribution during the 1970s (shown as blue kernel densities) and a contemporary distribution period based on the last three years (2014-2016) for the spring survey (shown as red kernel densities). The table below shows the species analyzed, click on a species name to see kernel density plots.

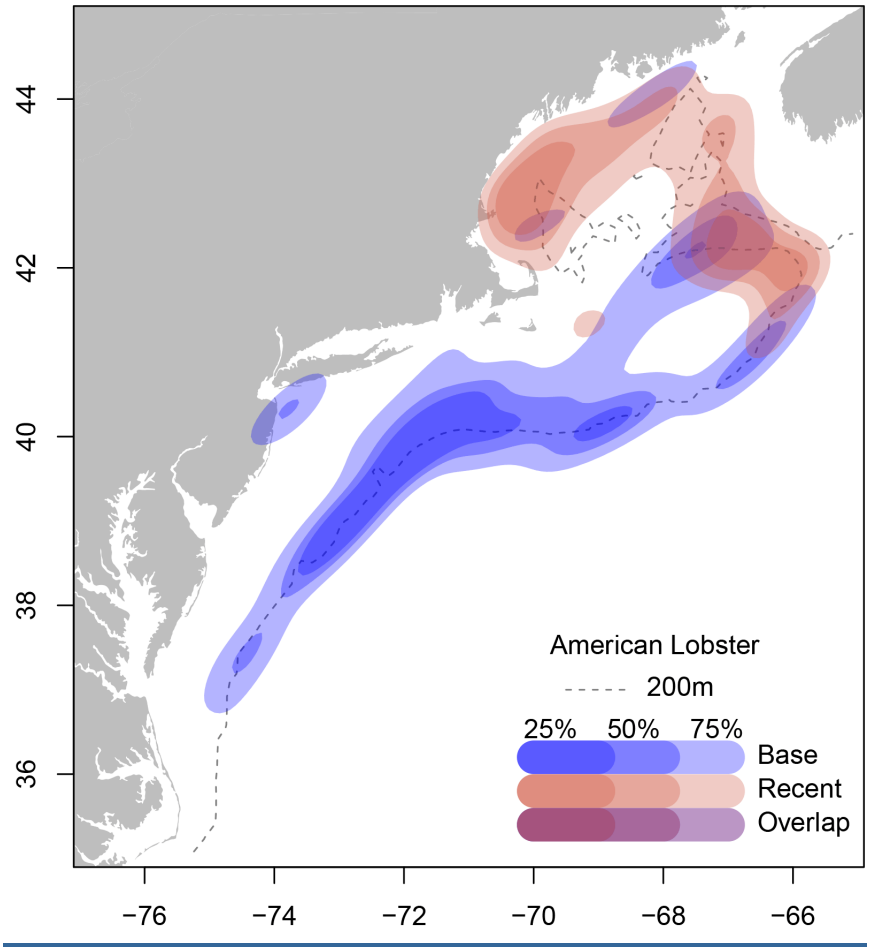
Acadian redfish



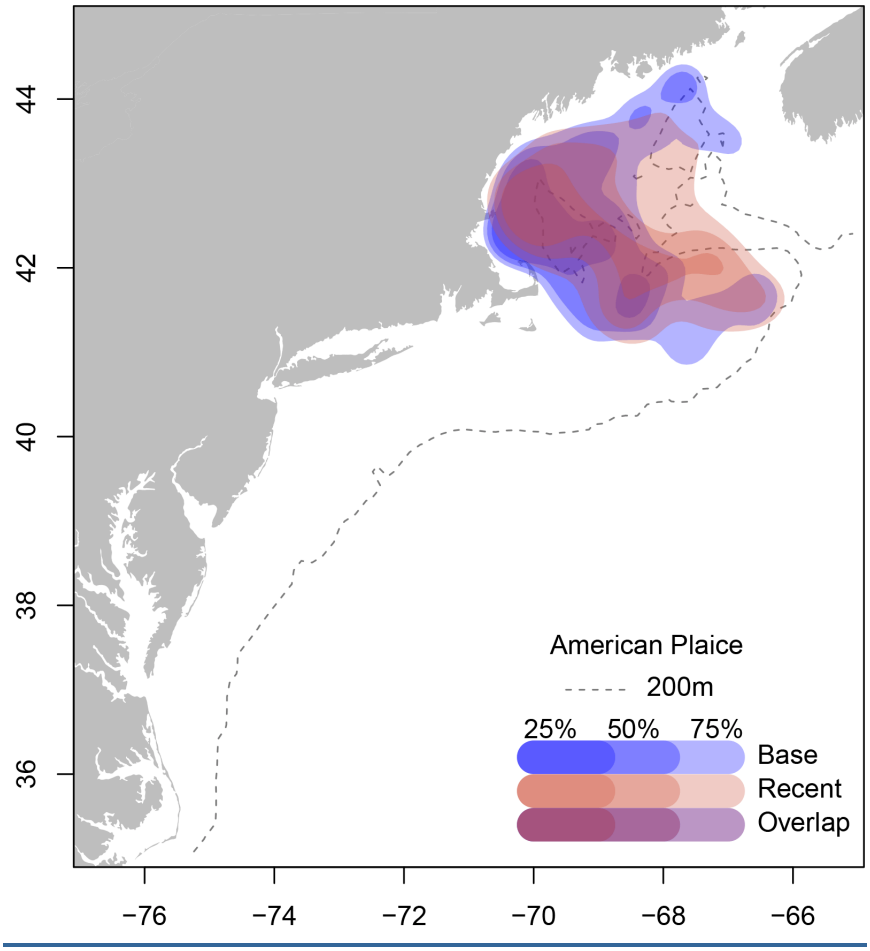
Alewife


44
42
40
38
36
−76
−74
−72
−70
−68
−66
Alewife
200m
25%
50%
75%
Base
Recent
Overlap

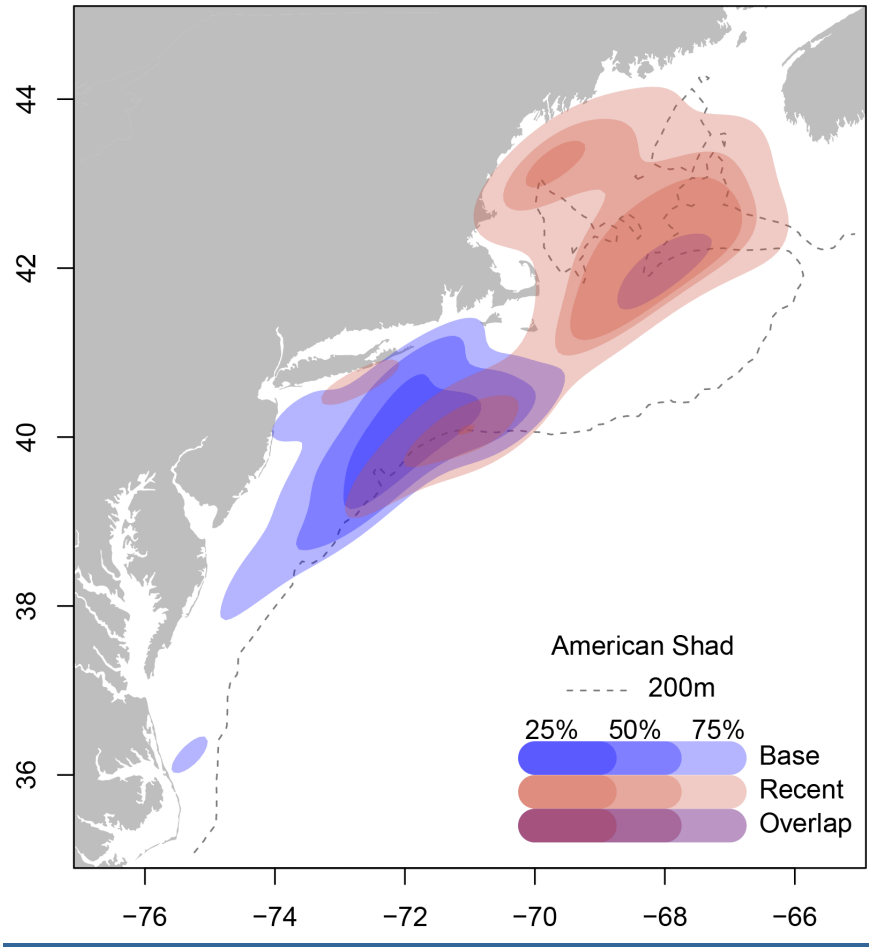
American lobster



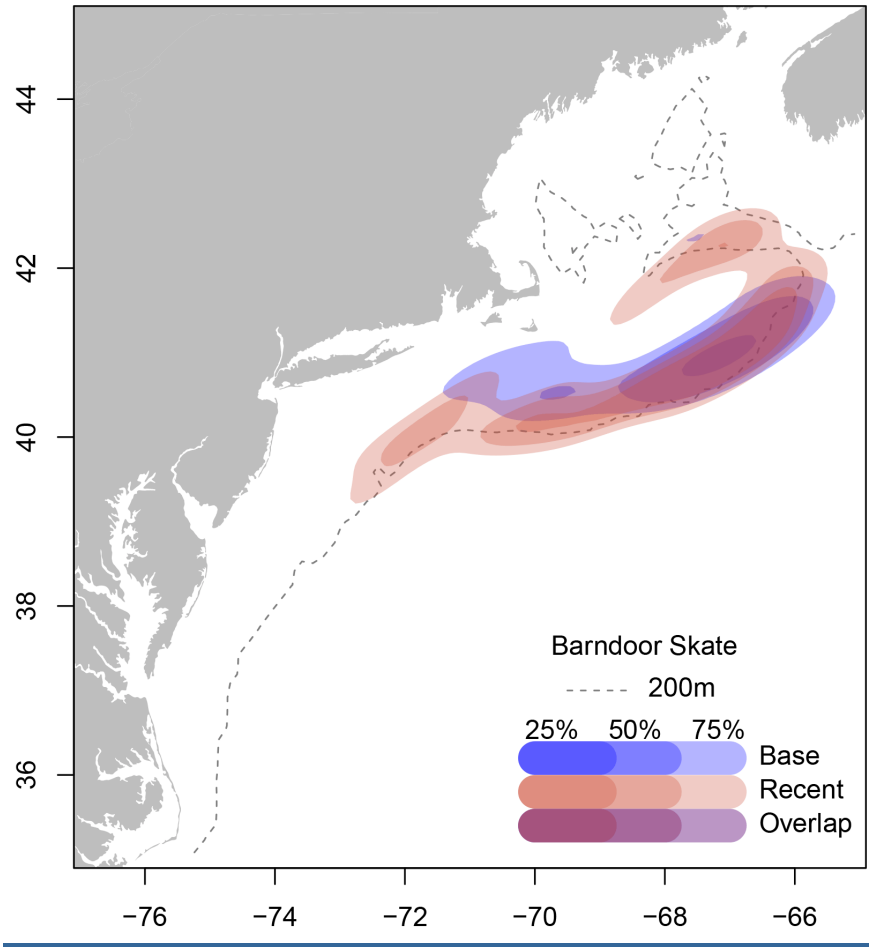
American plaice



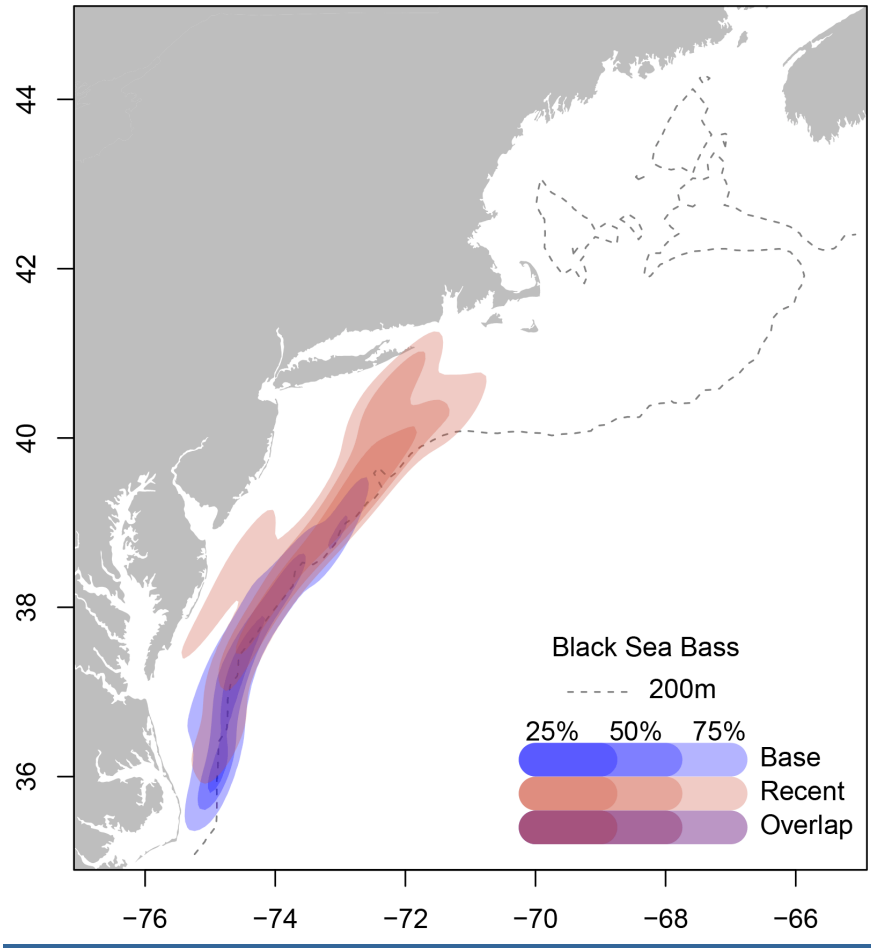
American shad



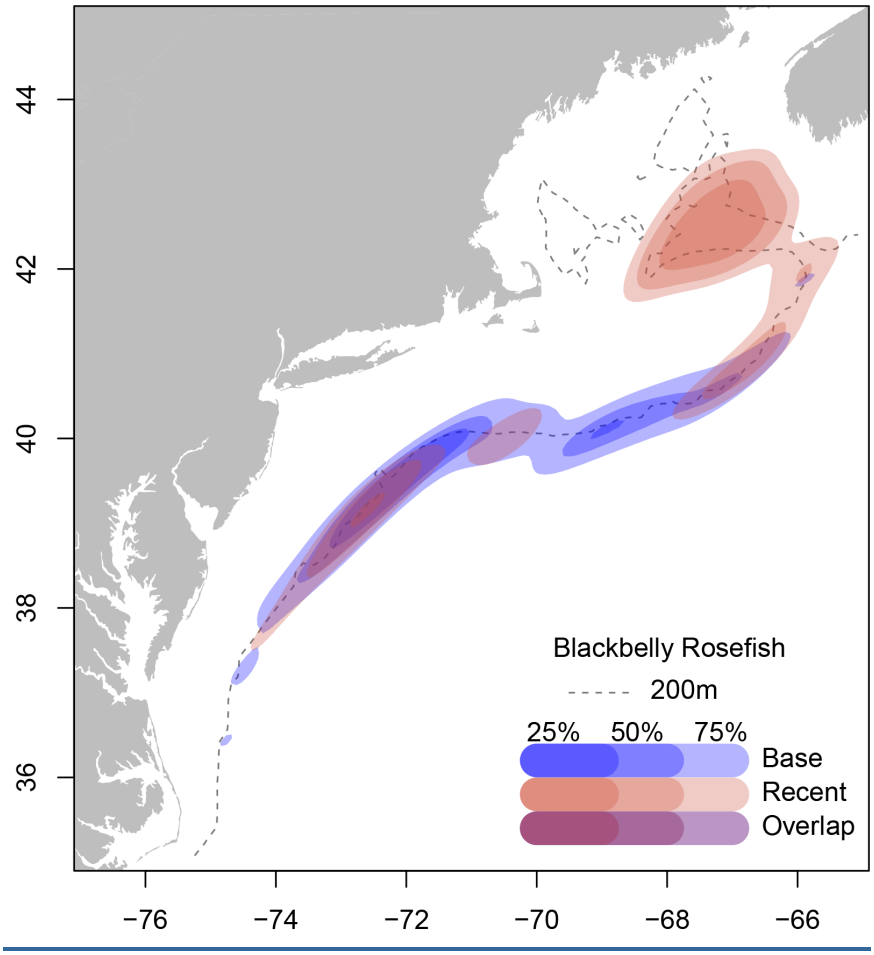
Barndoor skate



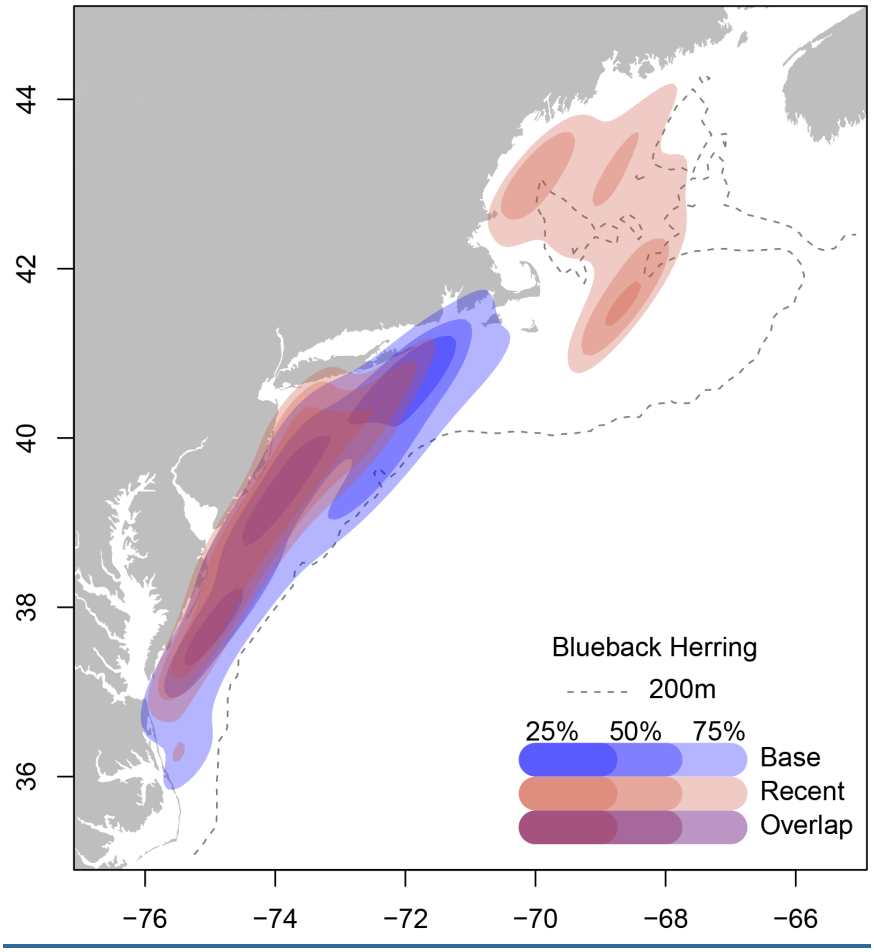
Black sea bass



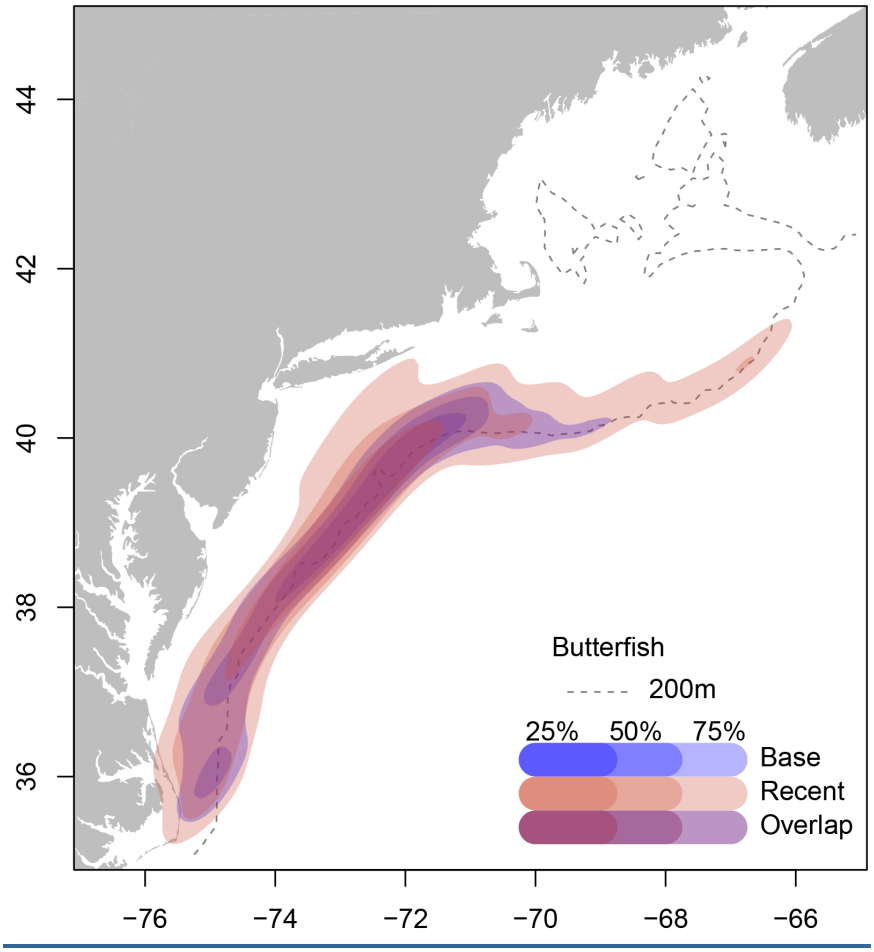
Blackbelly rosefish



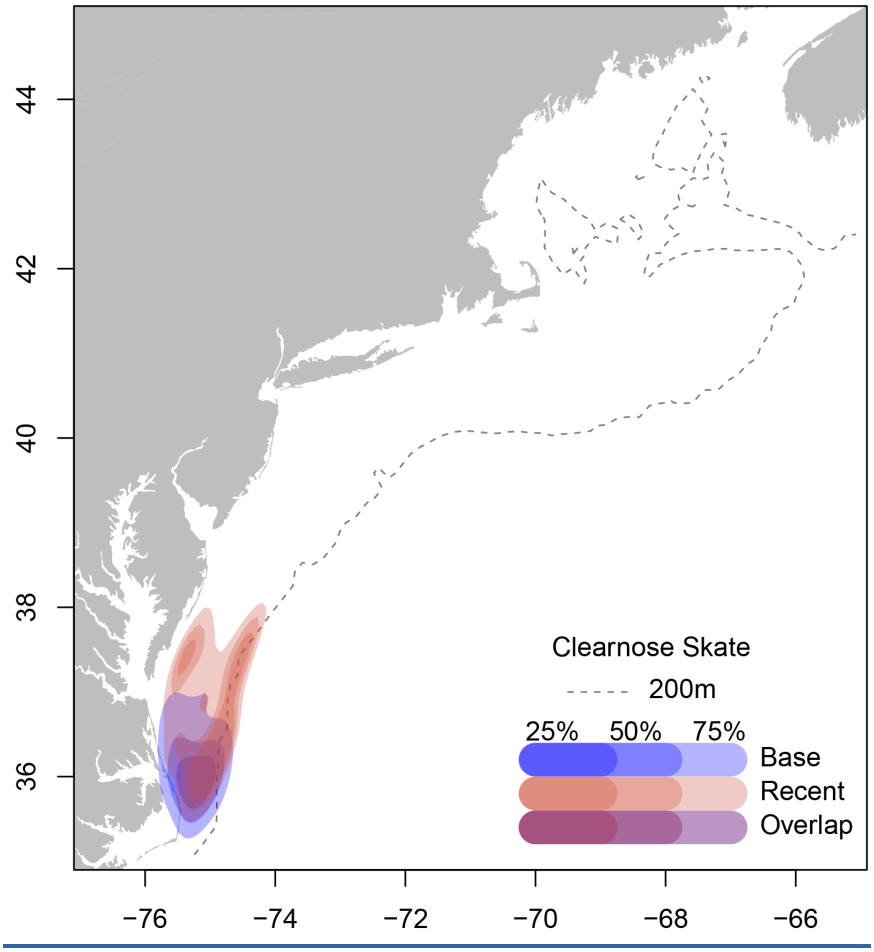
Blueback herring



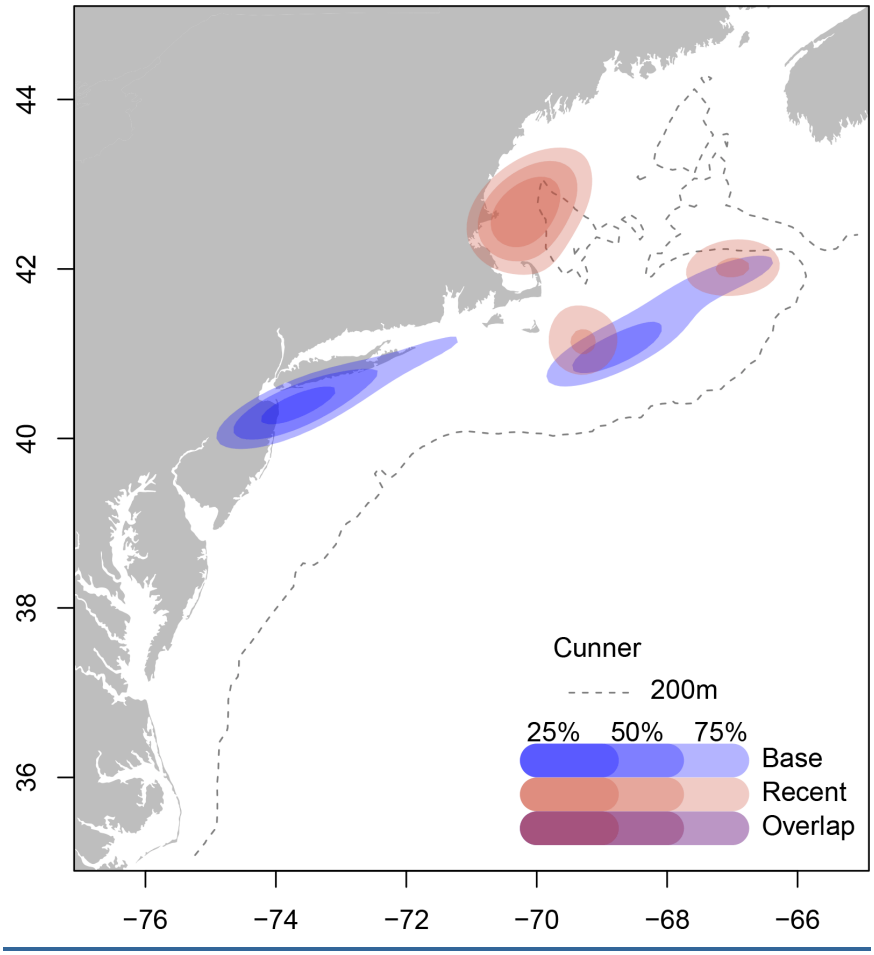
Butterfish


44
42
40
38
36
−76
−74
−72
−70
−68
−66
Butterfish
200m
25%
50%
75%
Base
Recent
Overlap

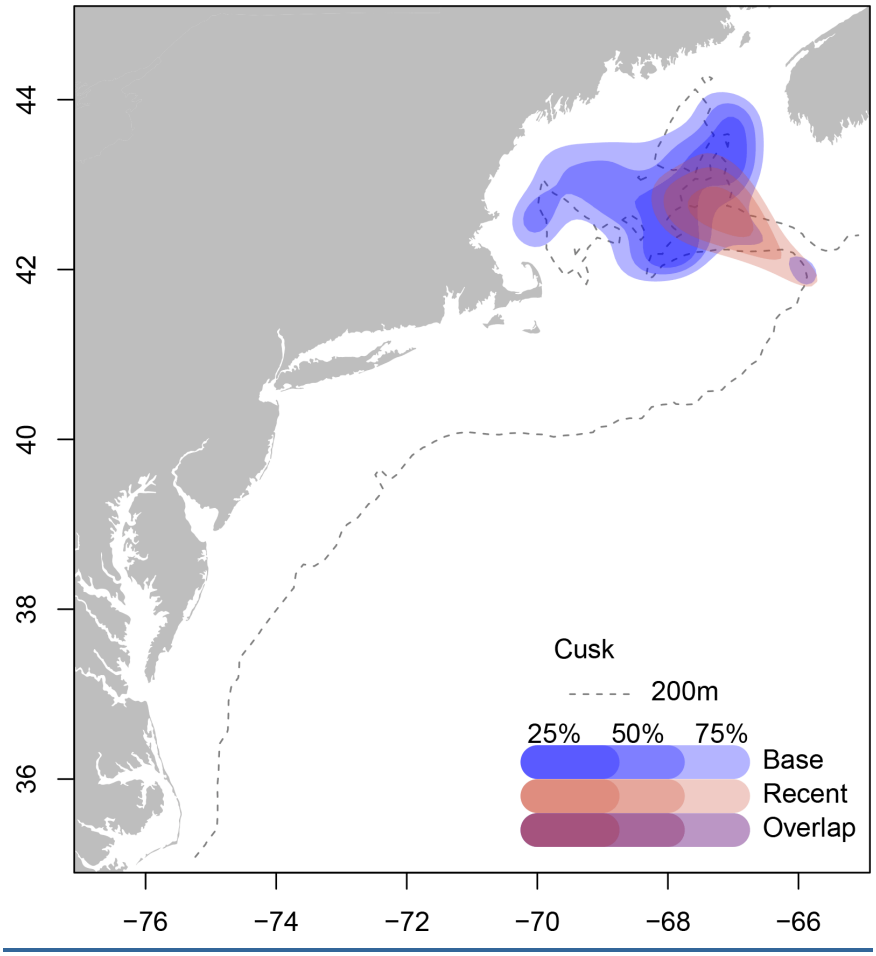
Clearnose skate



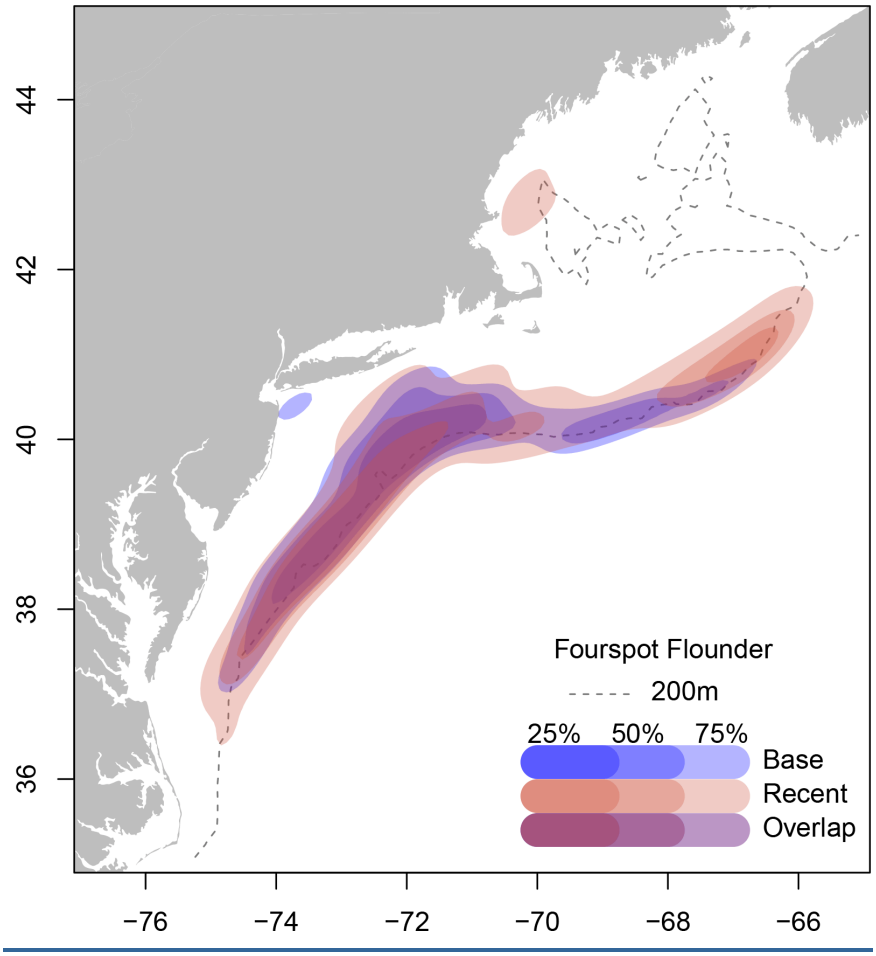
Cunner


44
42
40
38
36
−76
−74
−72
−70
−68
−66
Cunner
200m
25%
50%
75%
Base
Recent
Overlap

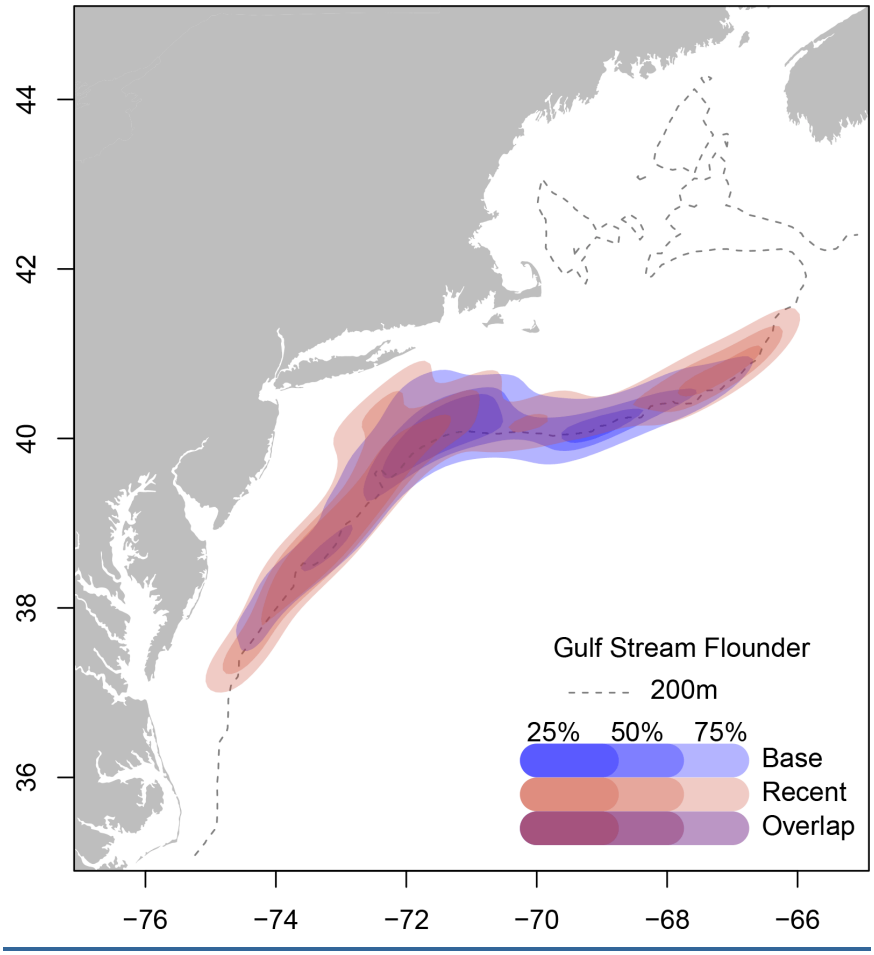
Cusk


44
42
40
38
36
−76
−74
−72
−70
−68
−66
Cusk
200m
25%
50%
75%
Base
Recent
Overlap

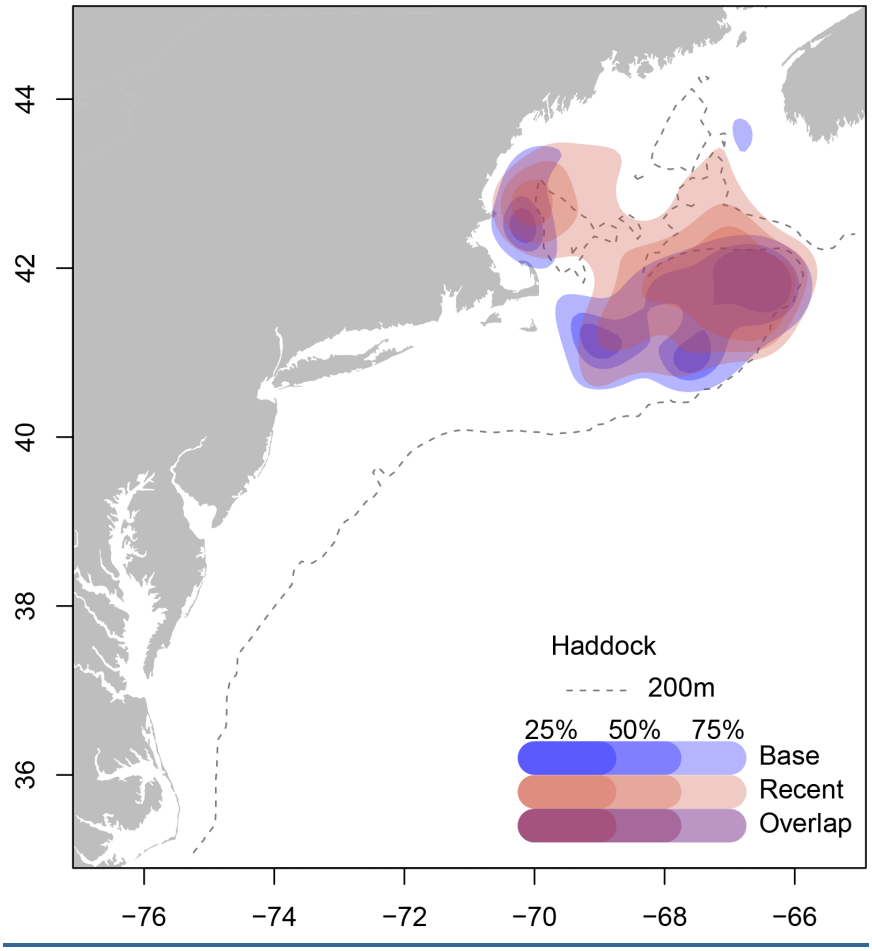
Fourspot flounder



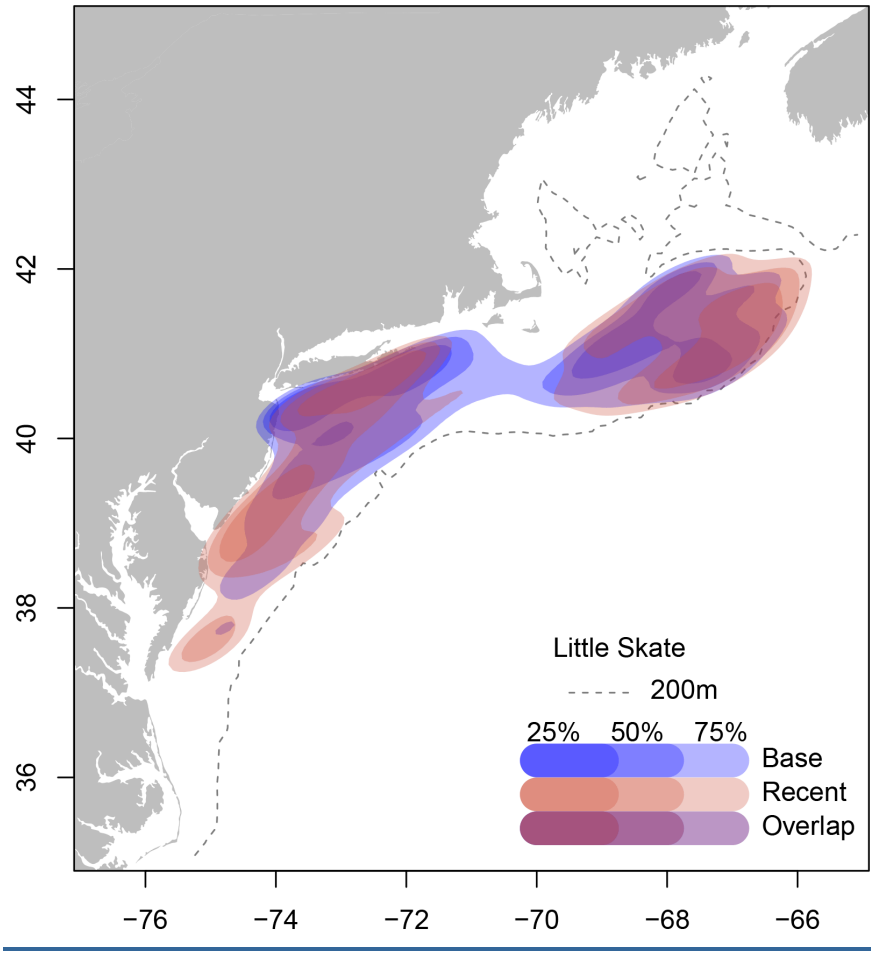
Gulf Stream flounder



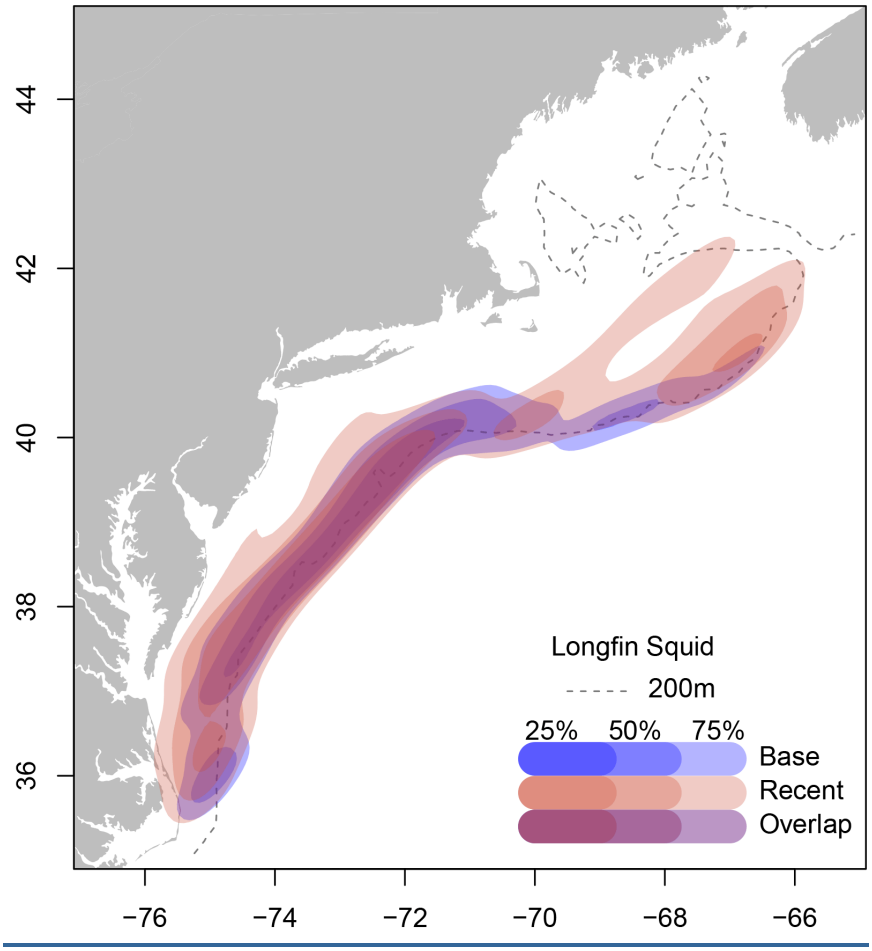
Haddock


44
42
40
38
36
−76
−74
−72
−70
−68
−66
Haddock
200m
25%
50%
75%
Base
Recent
Overlap

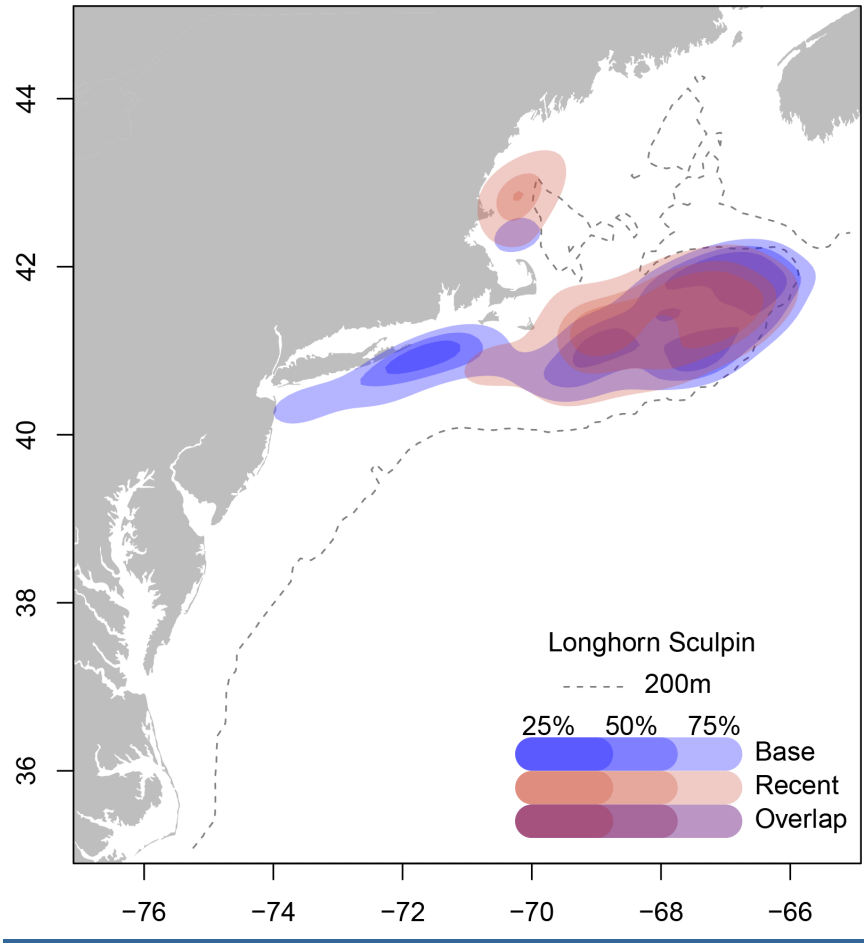
Little skate



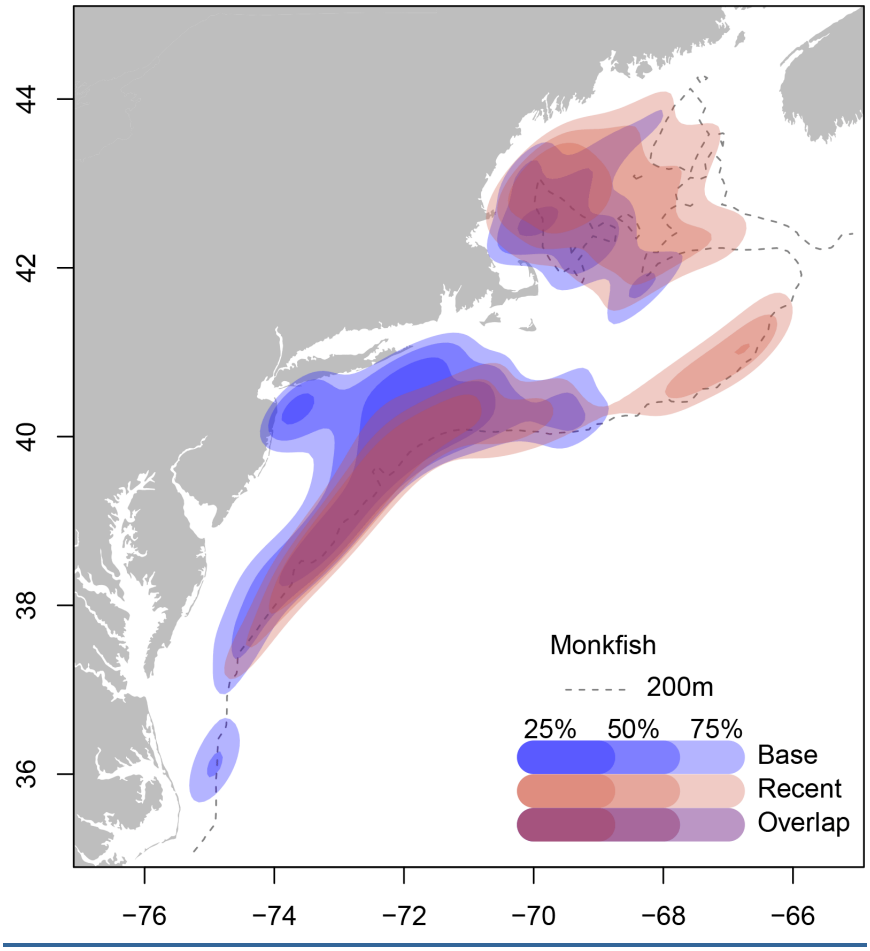
Longfin squid



Longhorn sculpin



Monkfish


44
42
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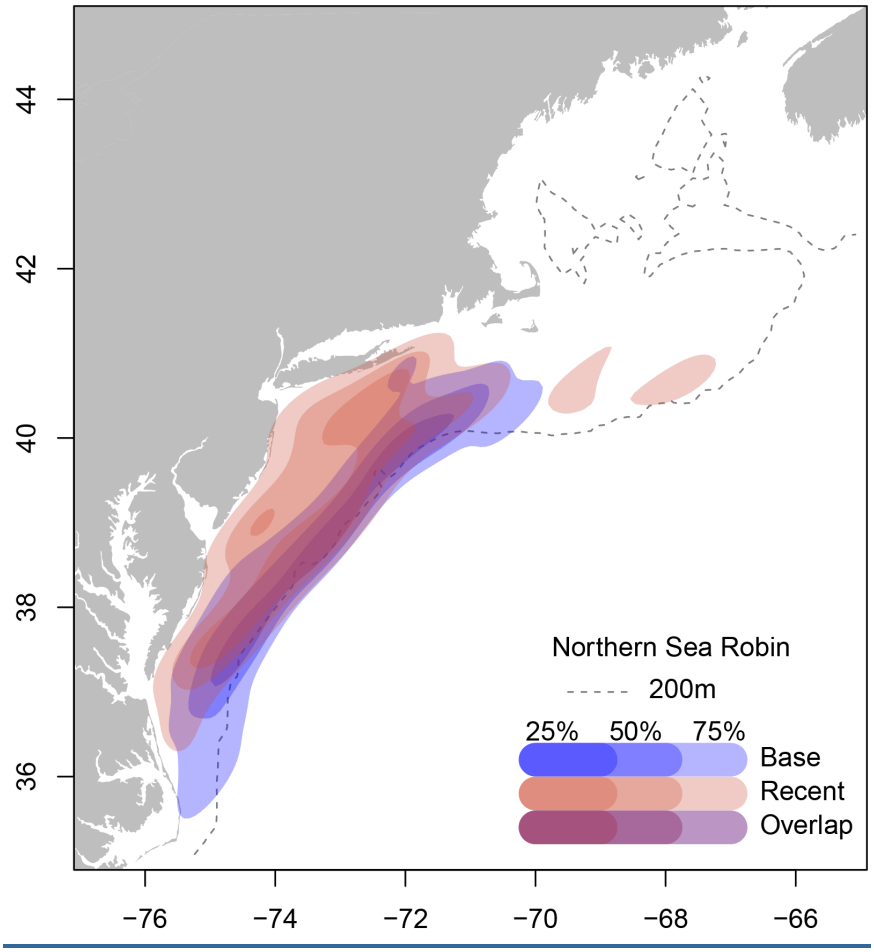
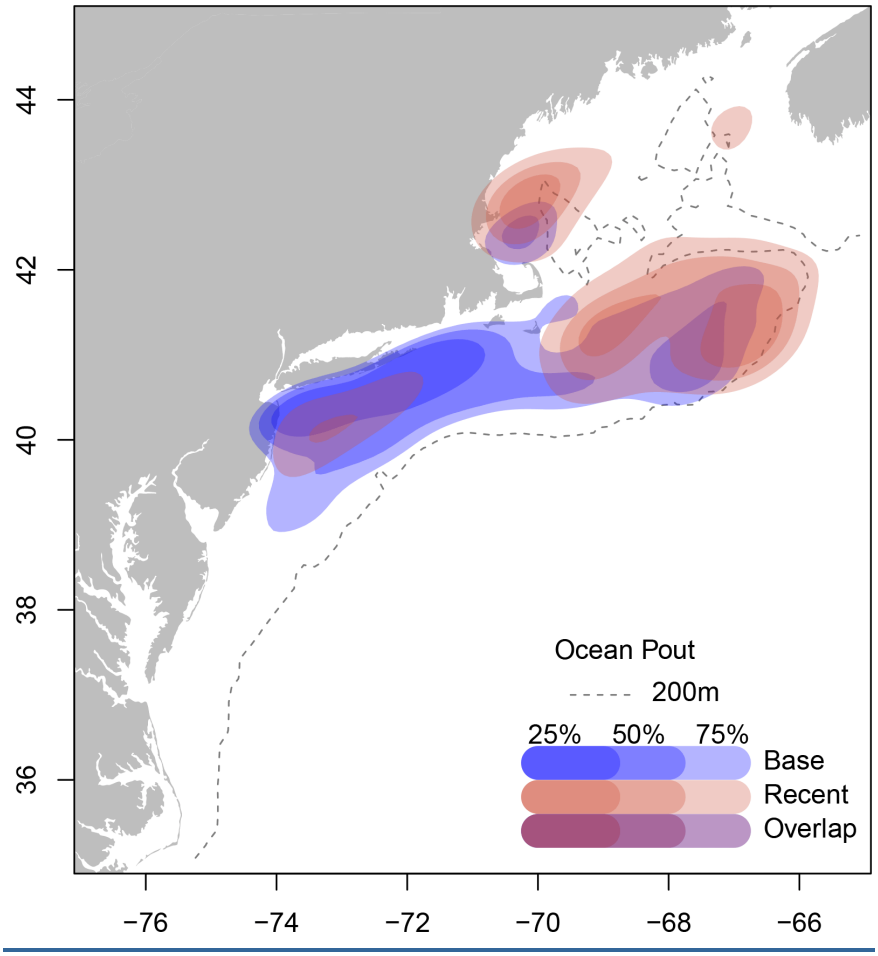
36
−76
−74
−72
−70
−68
−66
Monkfish
200m
25%
50%
75%
Base
Recent
Overlap

Northern sea robin



Ocean pout


44
42
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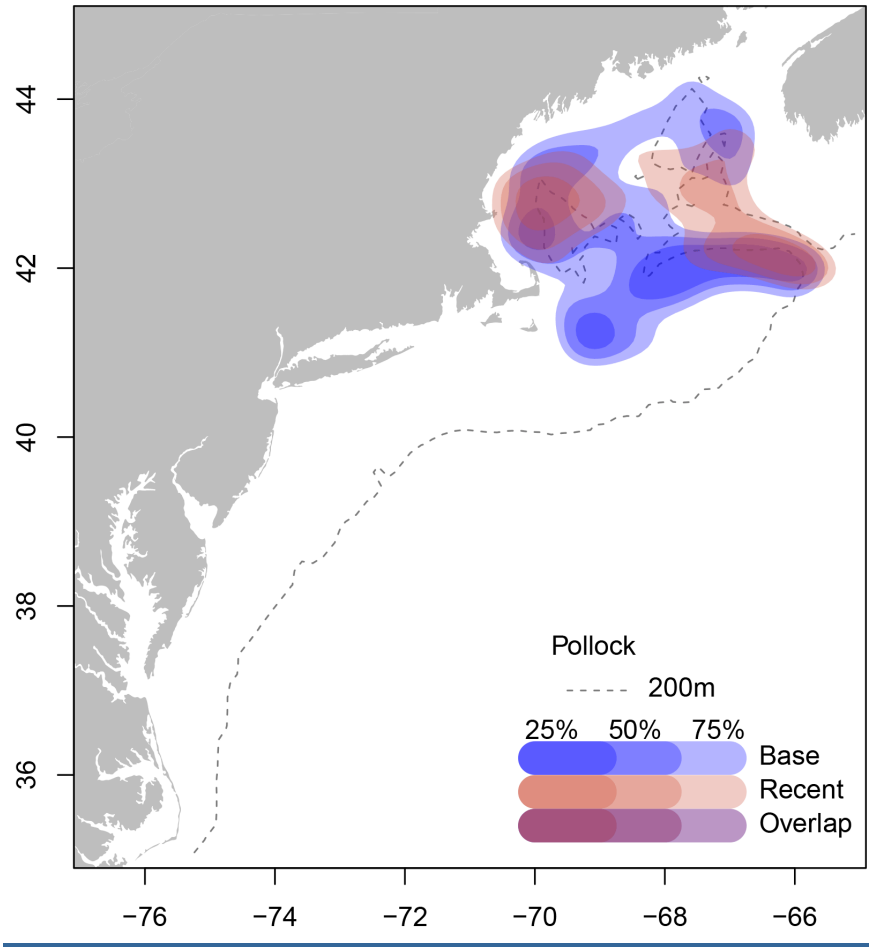
−76
−74
−72
−70
−68
−66
Ocean Pout
200m
25%
50%
75%
Base
Recent
Overlap

Pollock


44
42
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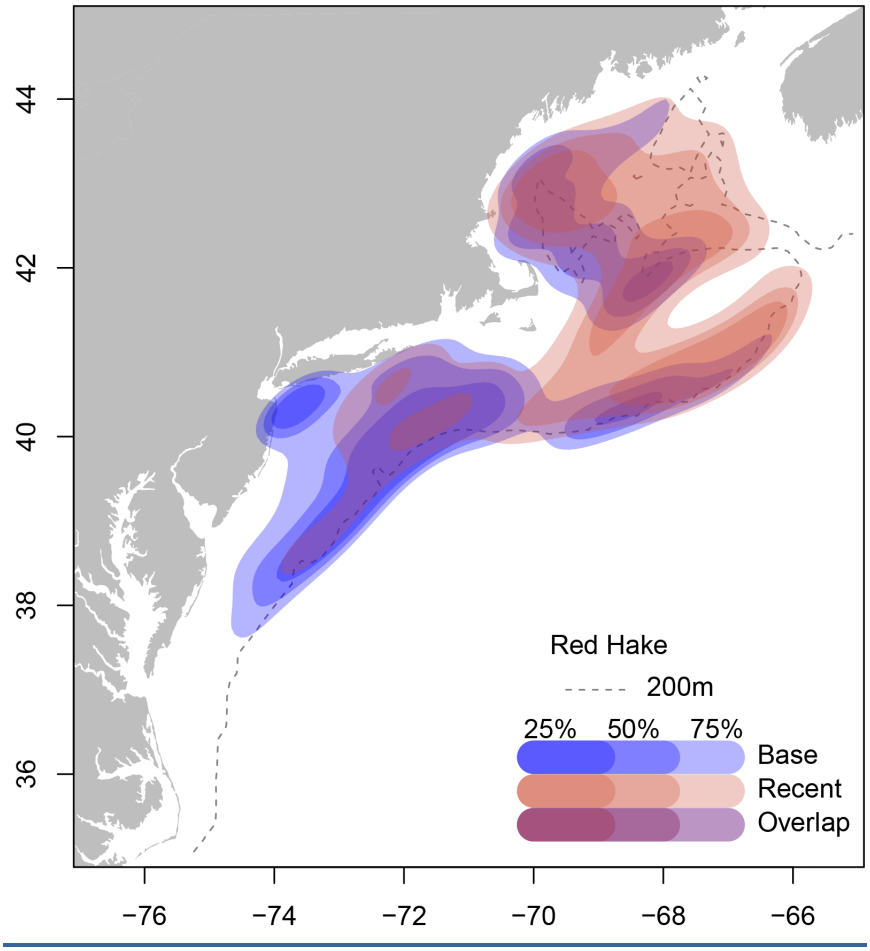
36
−76
−74
−72
−70
−68
−66
Pollock
200m
25%
50%
75%
Base
Recent
Overlap

Red hake


44
42
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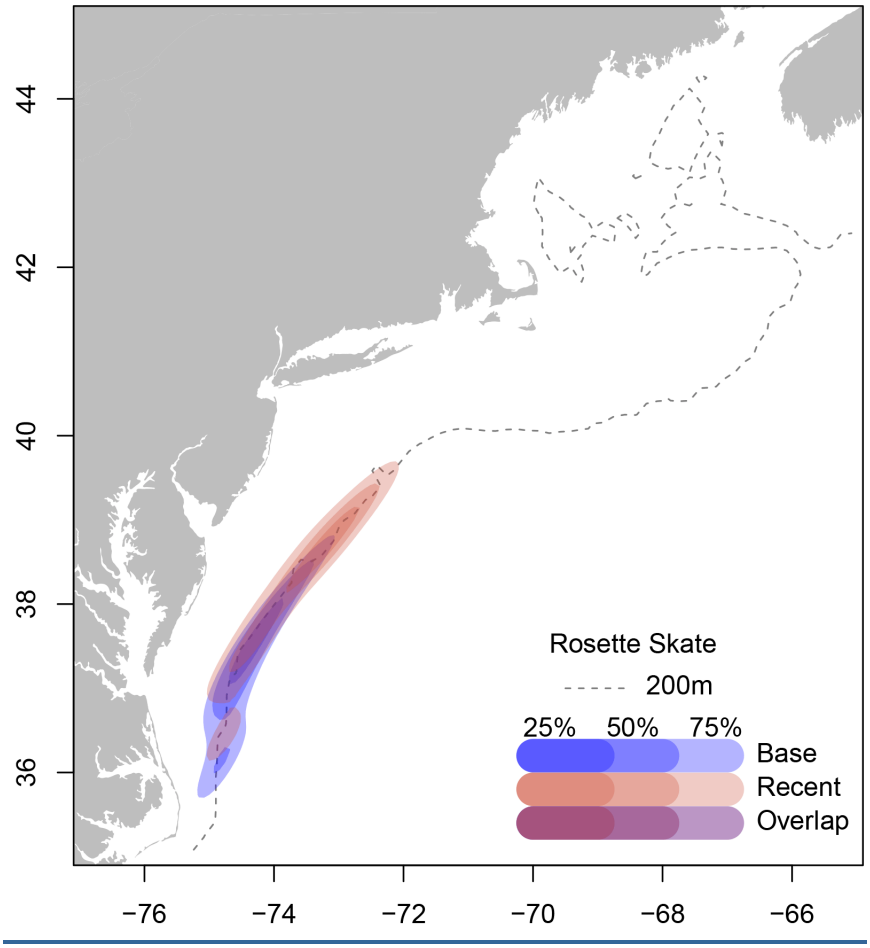
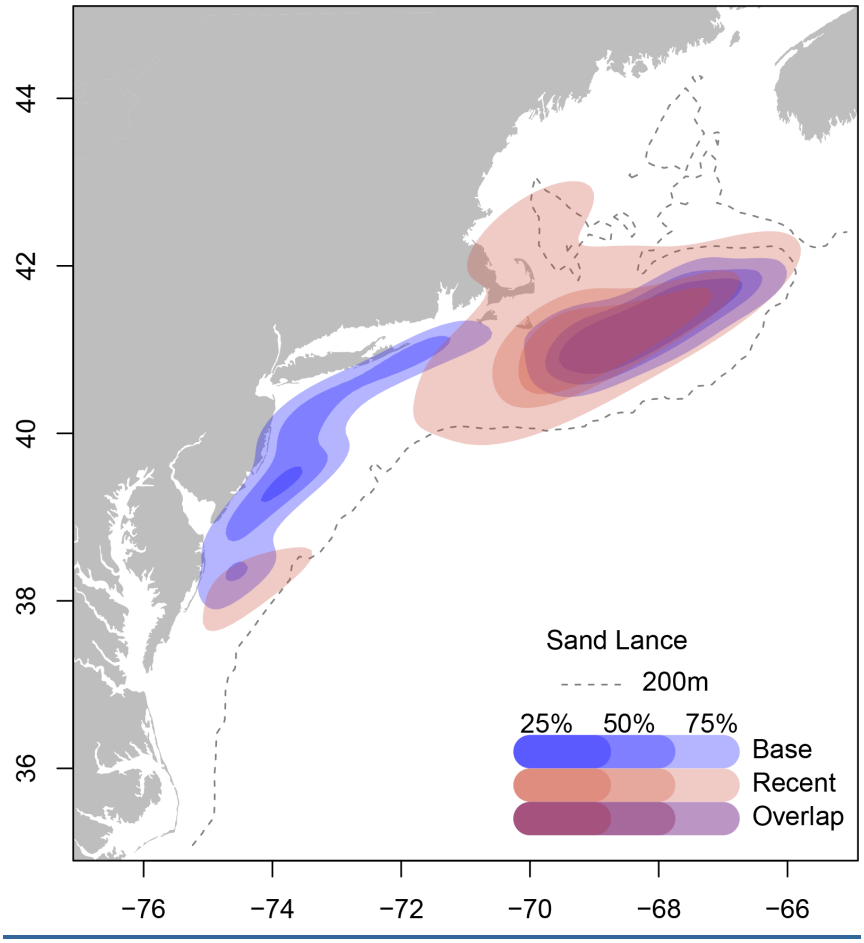
36
−76
−74
−72
−70
−68
−66
Red Hake
200m
25%
50%
75%
Base
Recent
Overlap

Rosette skate



Sand lance


44
42
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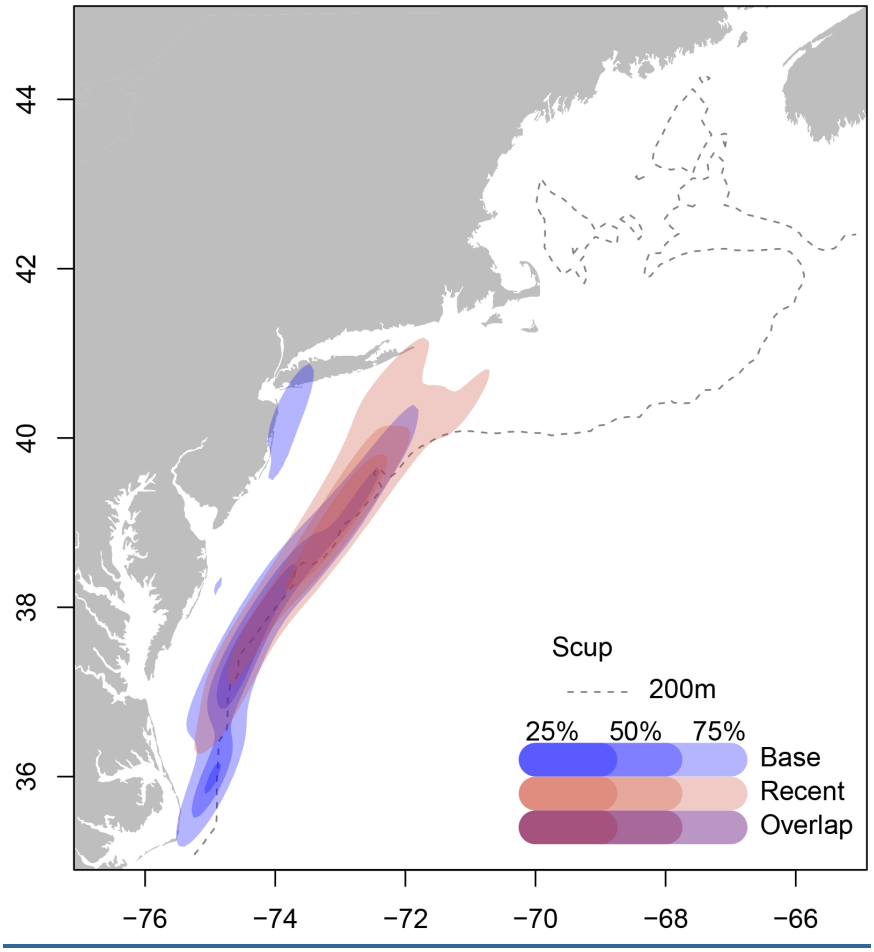
−76
−74
−72
−70
−68
−66
Sand Lance
200m
25%
50%
75%
Base
Recent
Overlap

Scup


44
42
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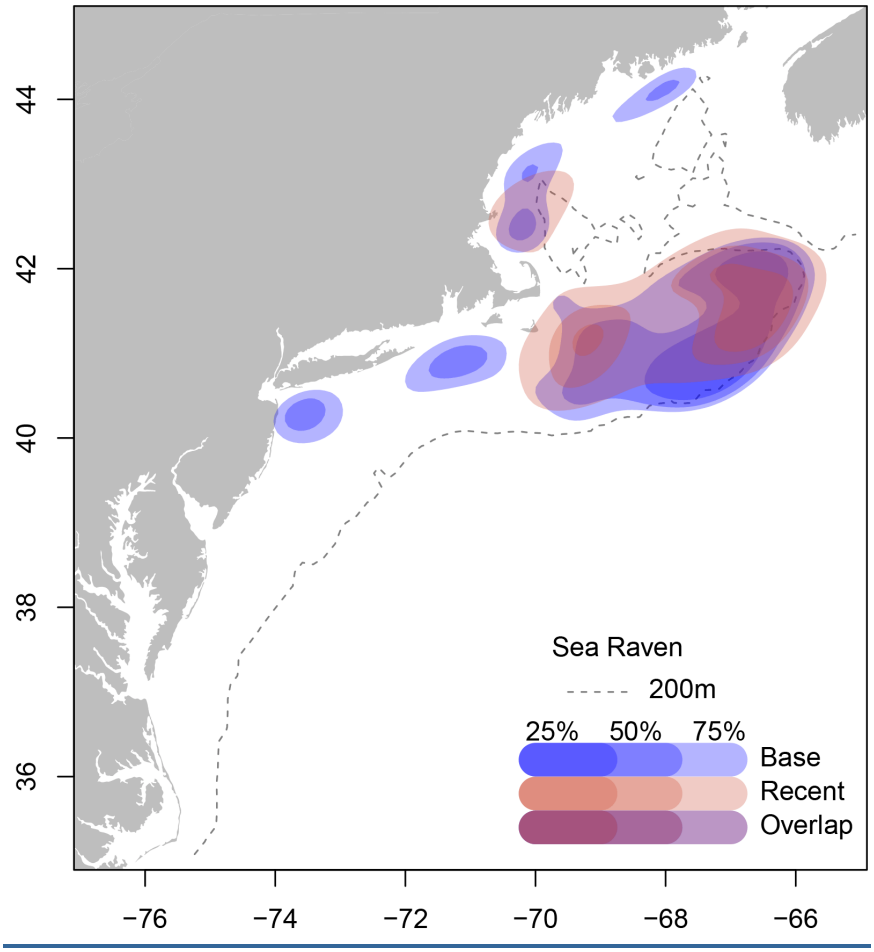
36
−76
−74
−72
−70
−68
−66
Scup
200m
25%
50%
75%
Base
Recent
Overlap

Sea raven


44
42
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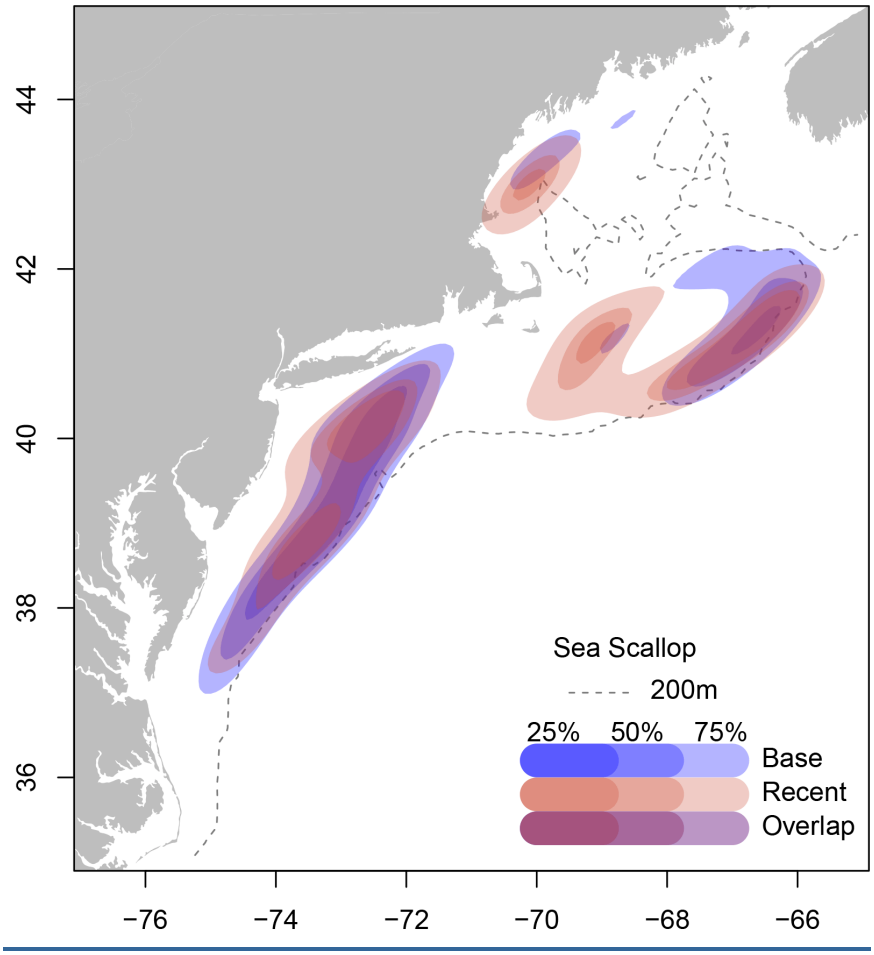
36
−76
−74
−72
−70
−68
−66
Sea Raven
200m
25%
50%
75%
Base
Recent
Overlap

Sea scallop


44
42
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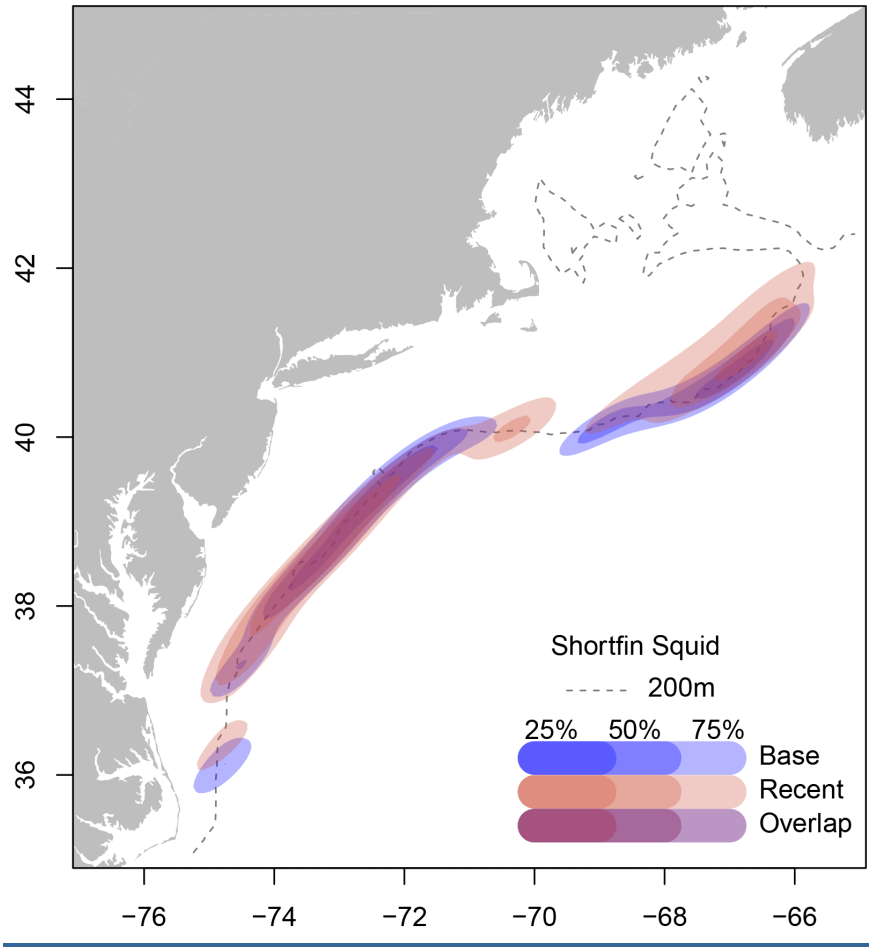
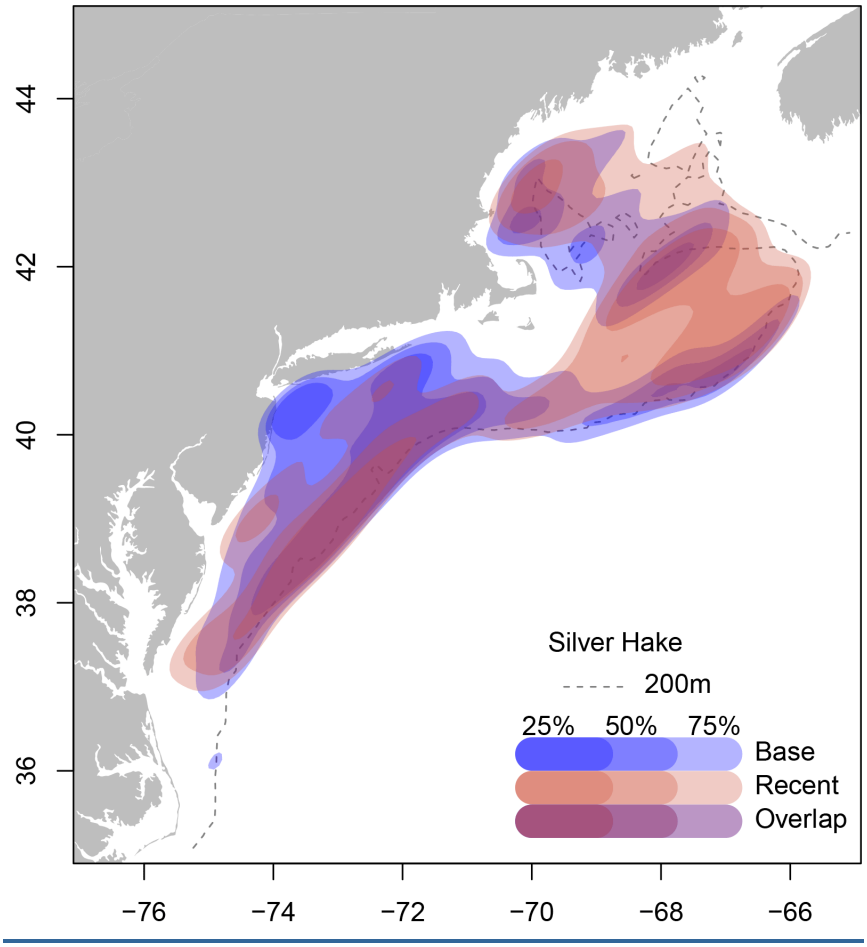
−76
−74
−72
−70
−68
−66
Sea Scallop
200m
25%
50%
75%
Base
Recent
Overlap

Shortfin squid



Silver hake


44
42
40
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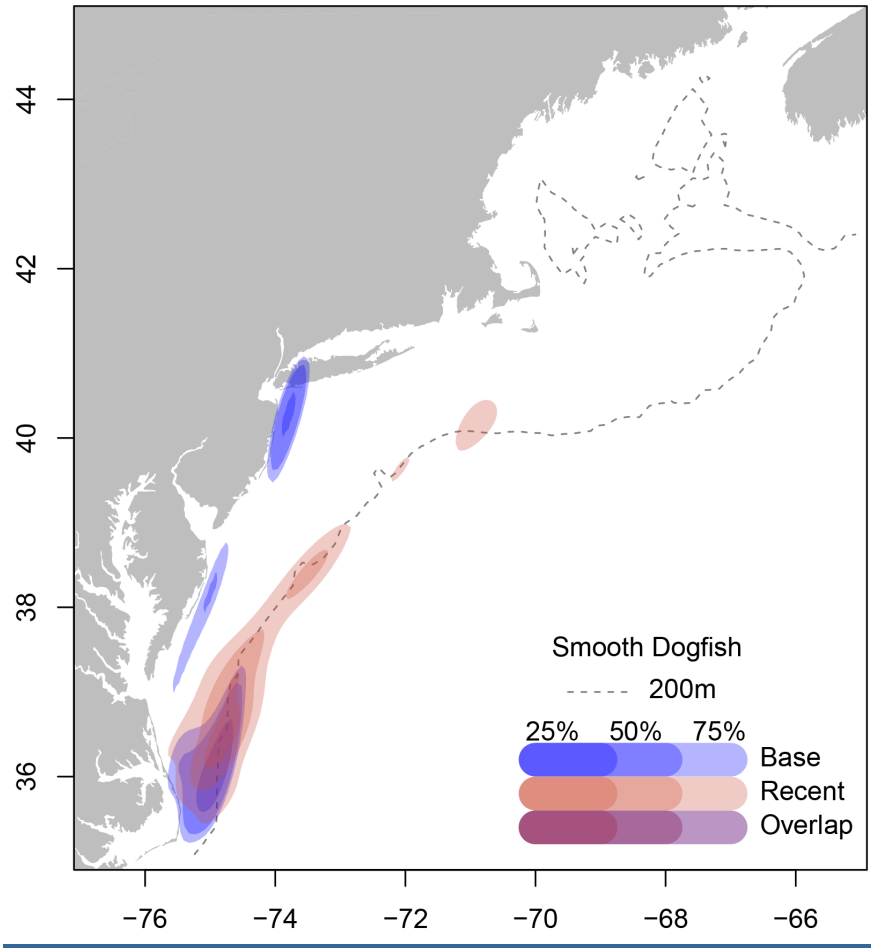
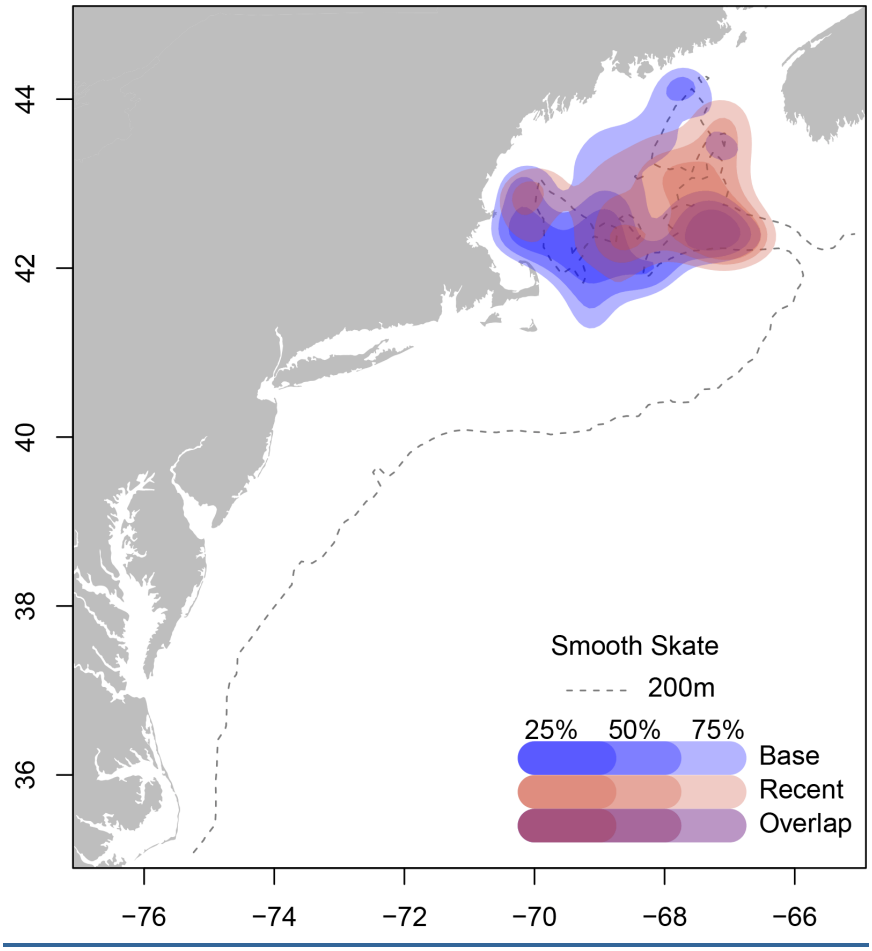
36
−76
−74
−72
−70
−68
−66
Silver Hake
200m
25%
50%
75%
Base
Recent
Overlap

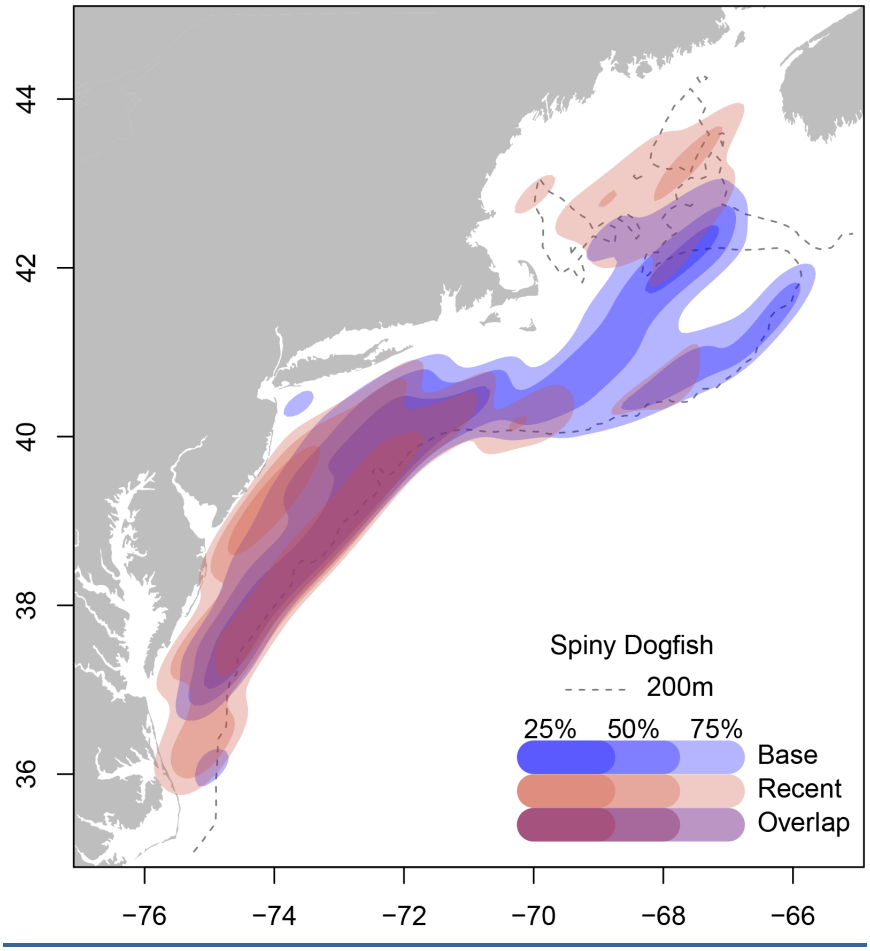
Smooth dogfish



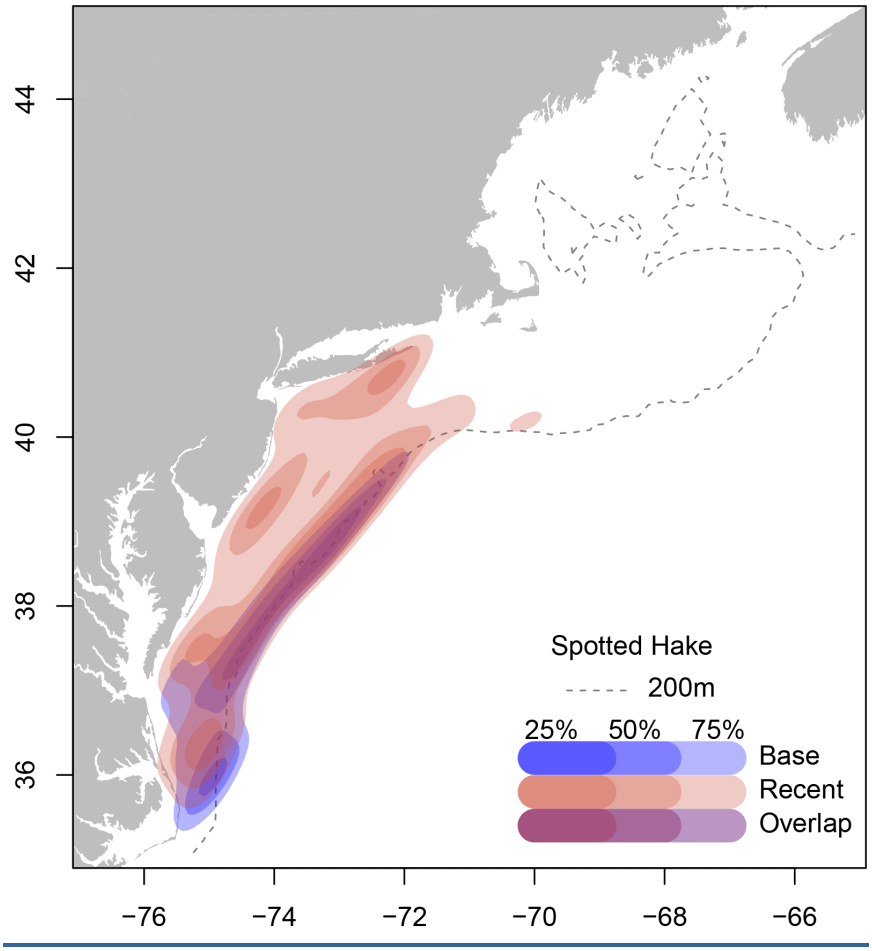
Smooth skate



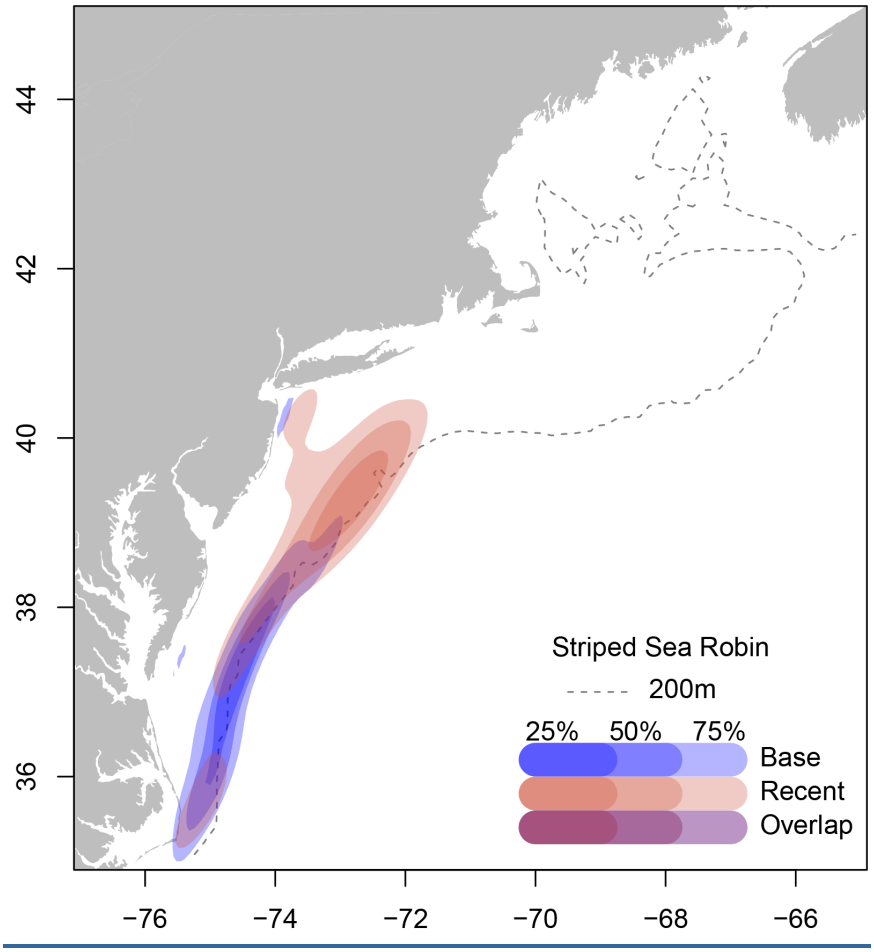
Spiny dogfish



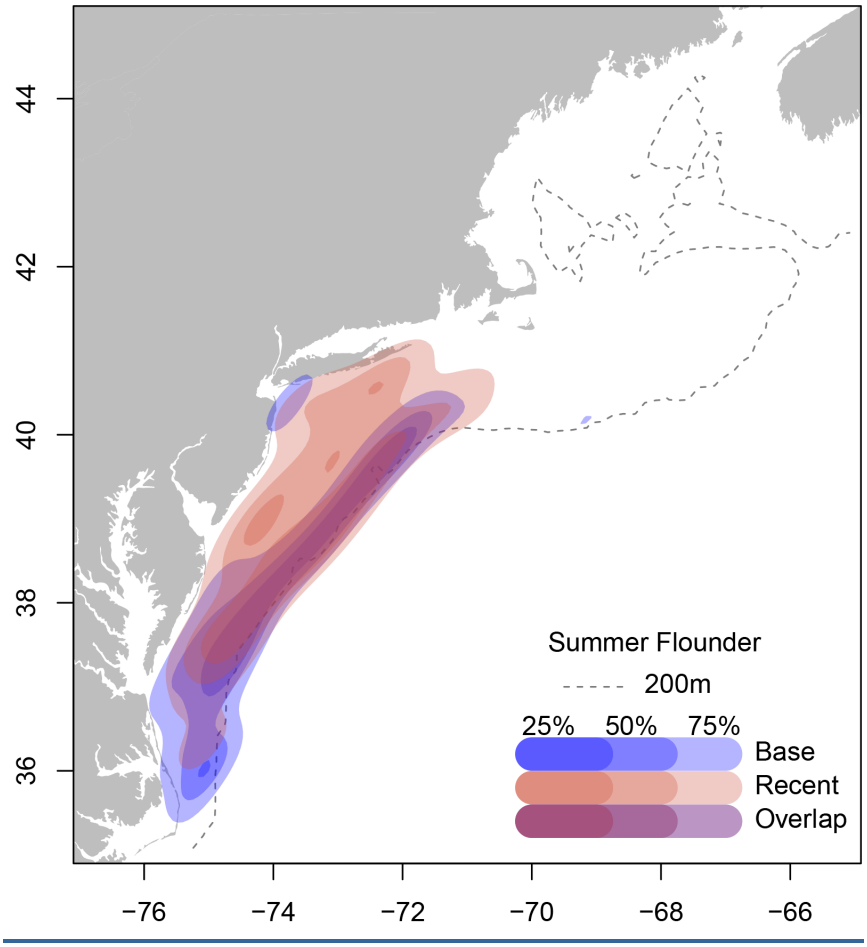
Spotted hake



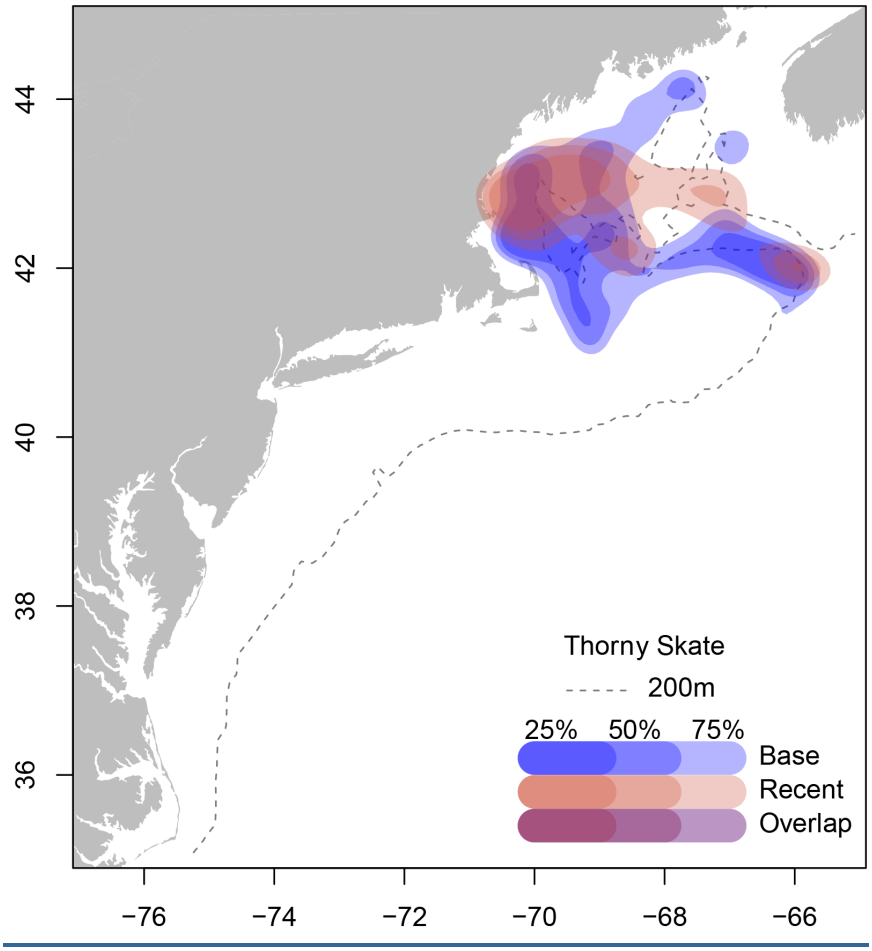
Striped sea robin



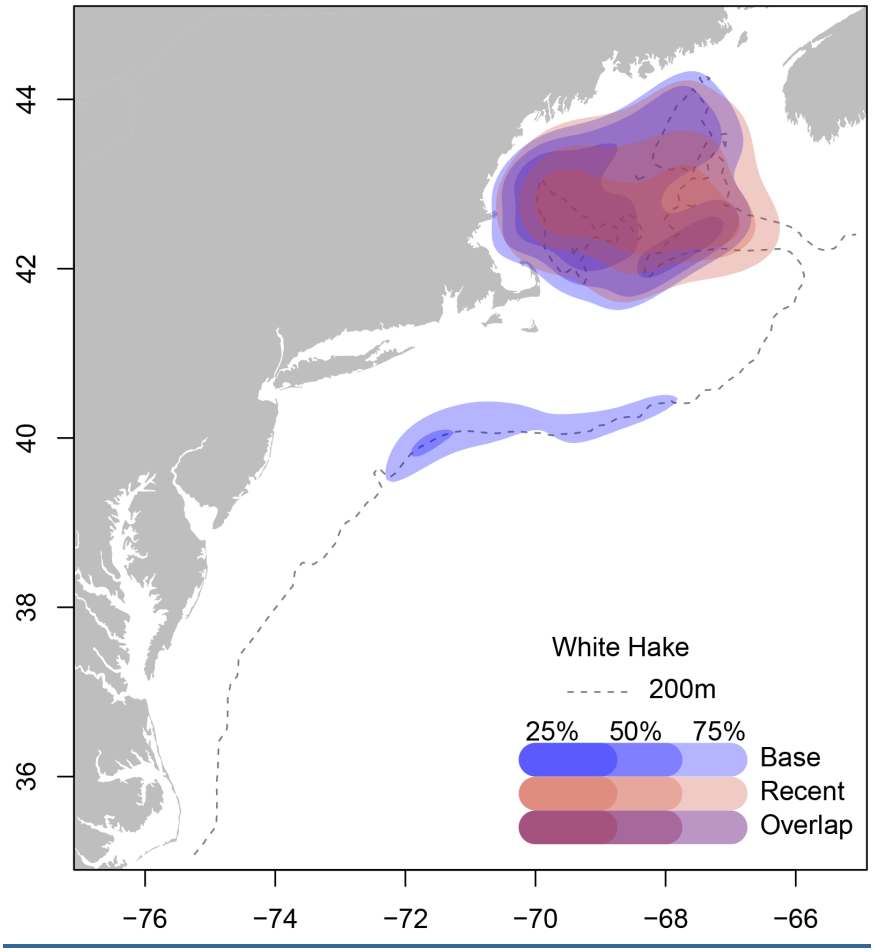
Summer flounder



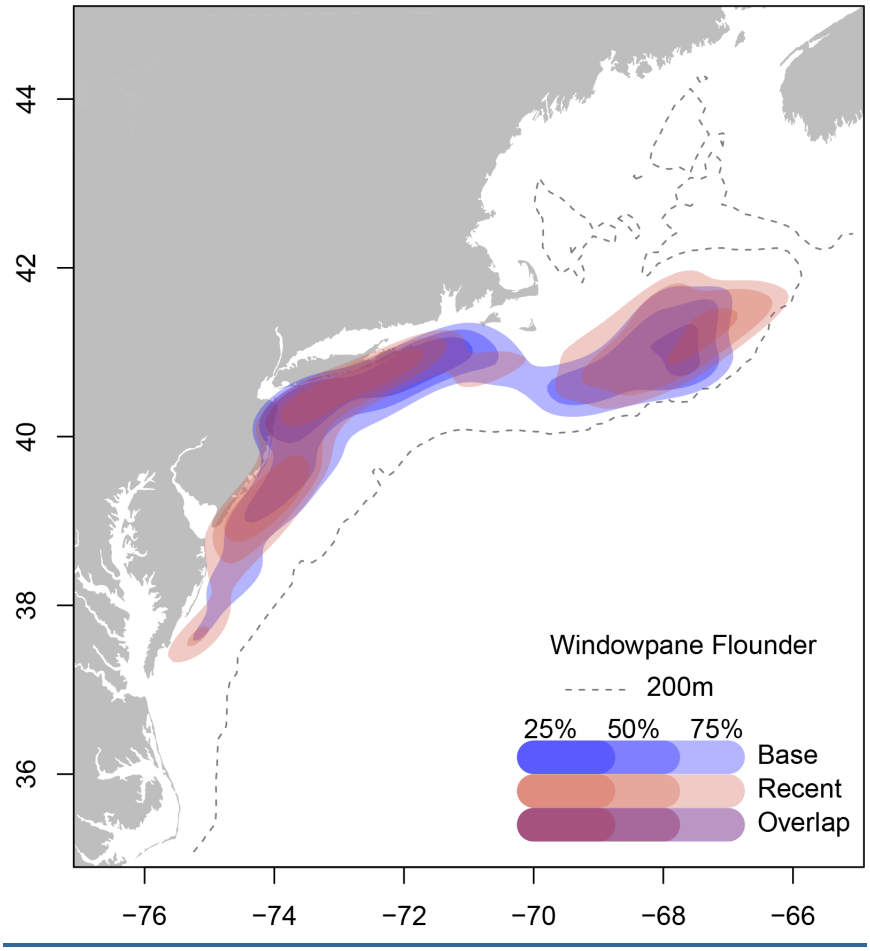
Thorny skate



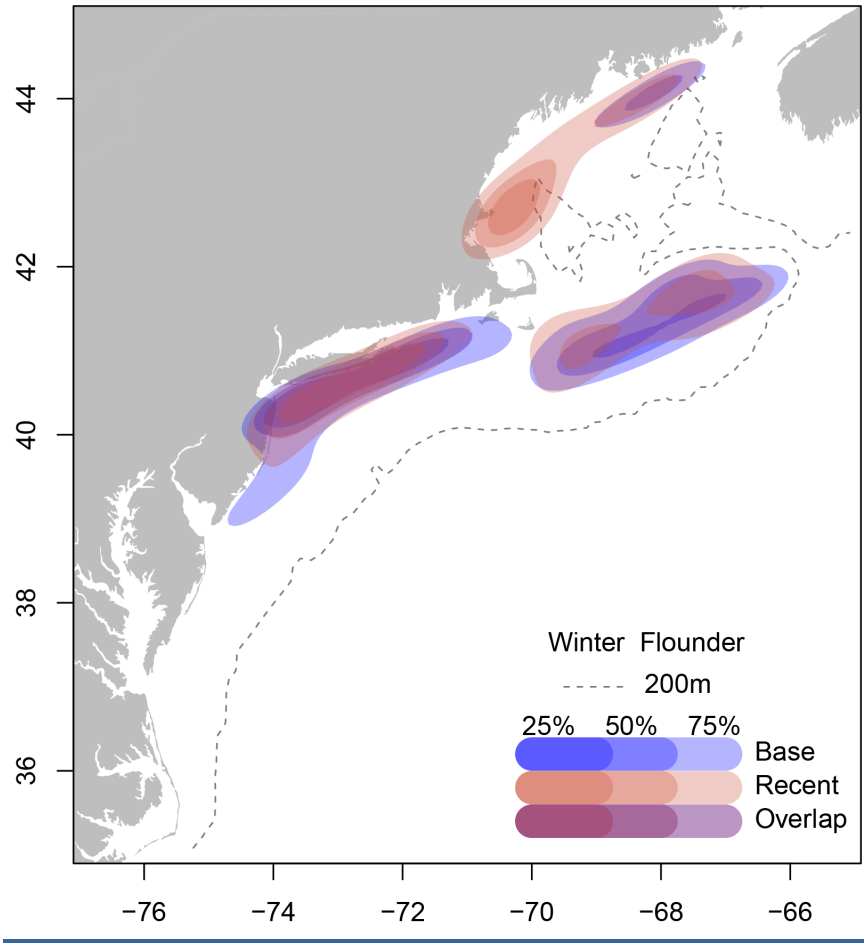
White hake


44
42
40
38
36
−76
−74
−72
−70
−68
−66
White Hake
200m
25%
50%
75%
Base
Recent
Overlap

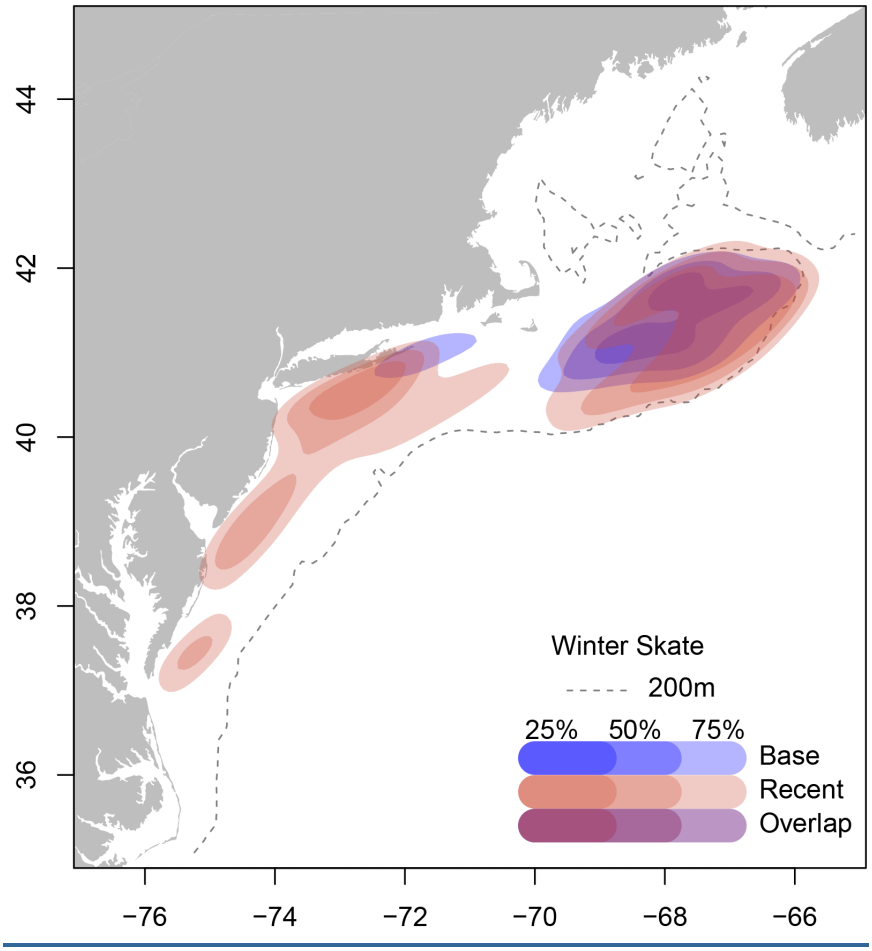
Windowpane flounder



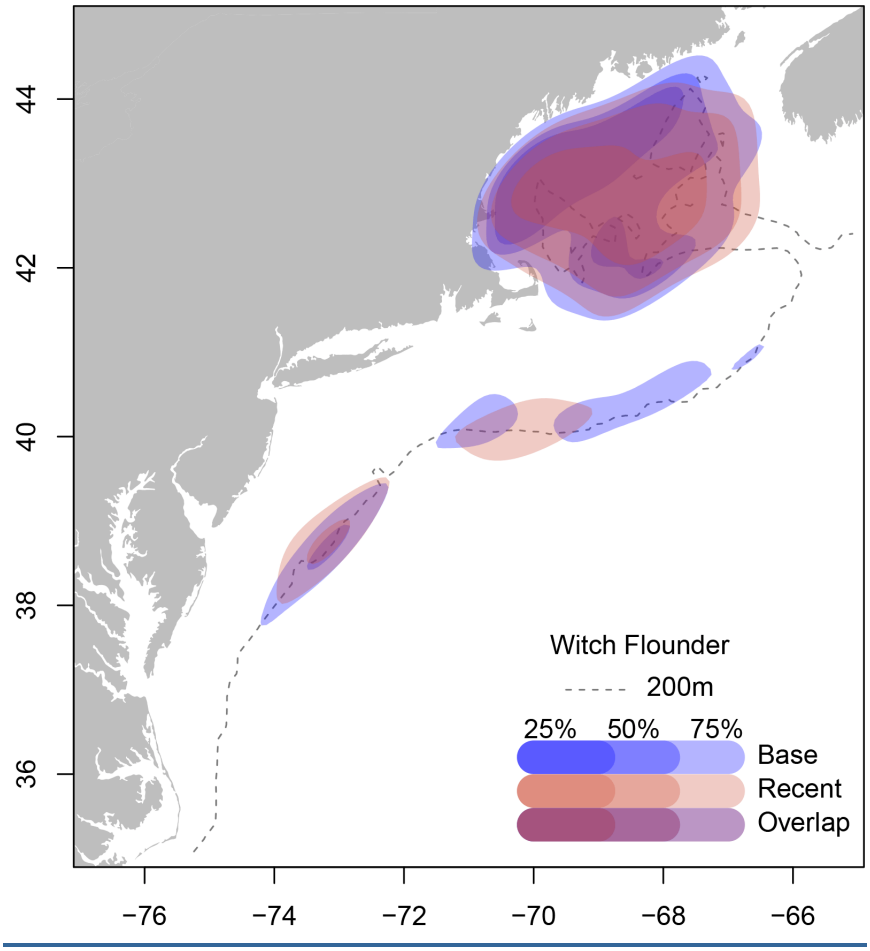
Winter flounder



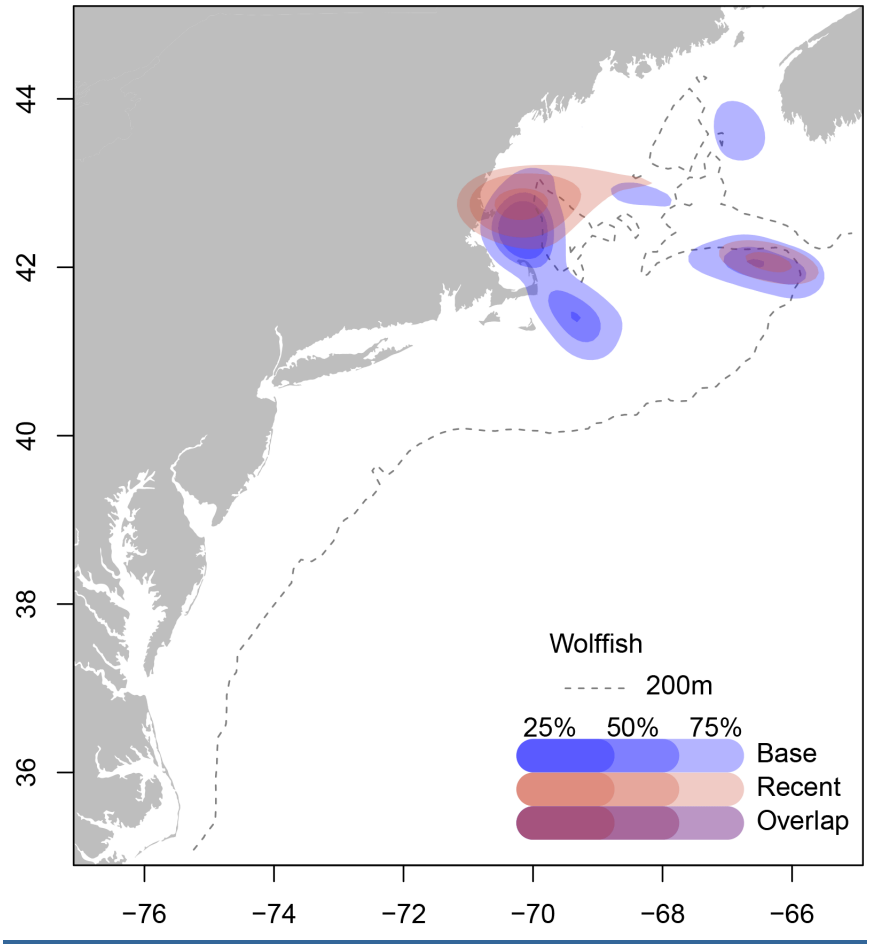
Winter skate



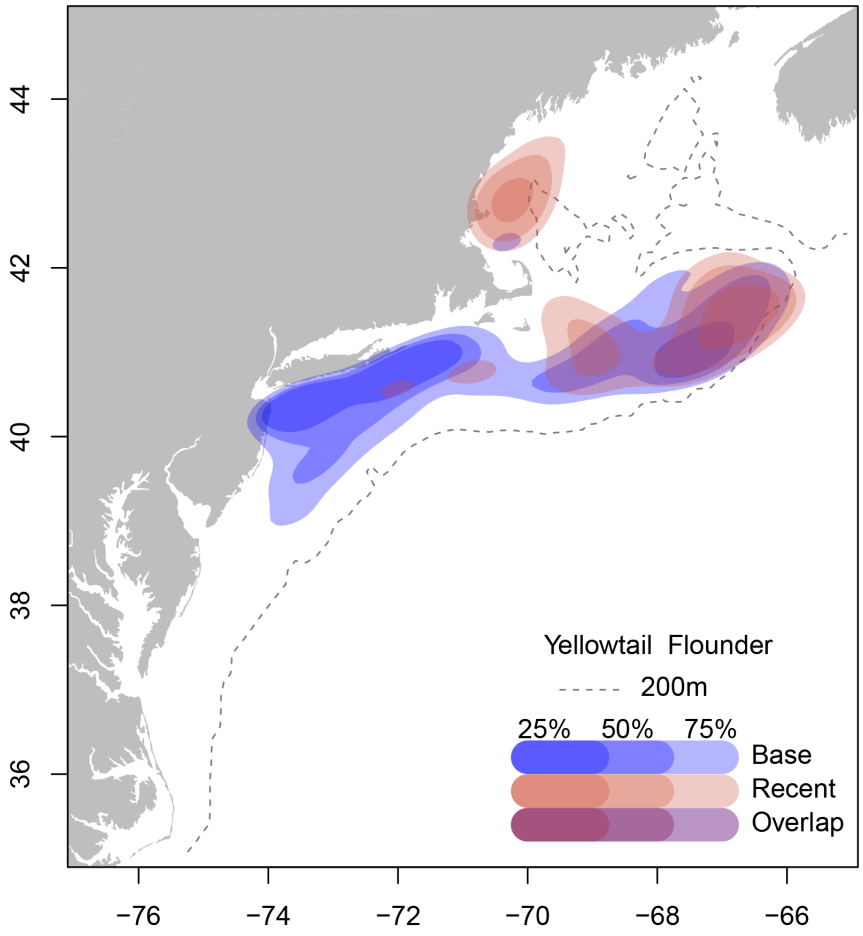
Witch flounder



Wolffish

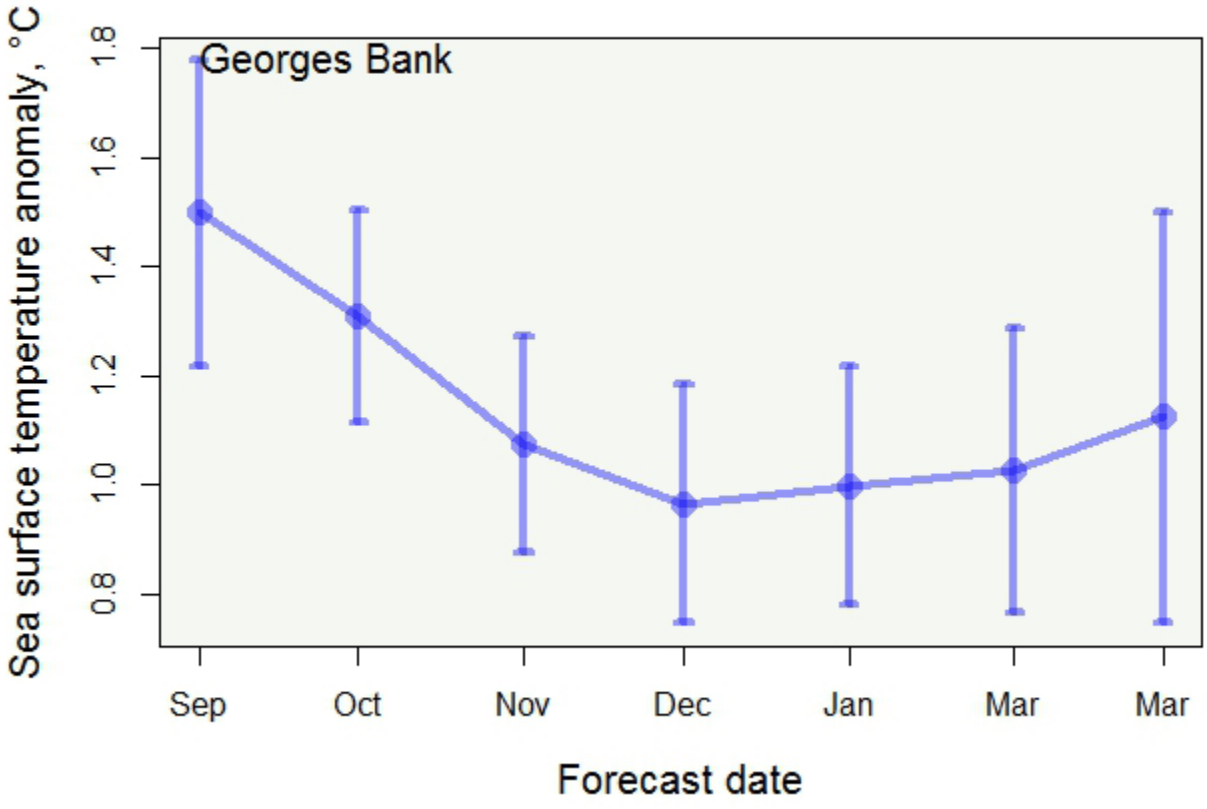

44
42
40
38
36
−76
−74
−72
−70
−68
−66
Wolffish
200m
25%
50%
75%
Base
Recent
Overlap

Yellowtail flounder

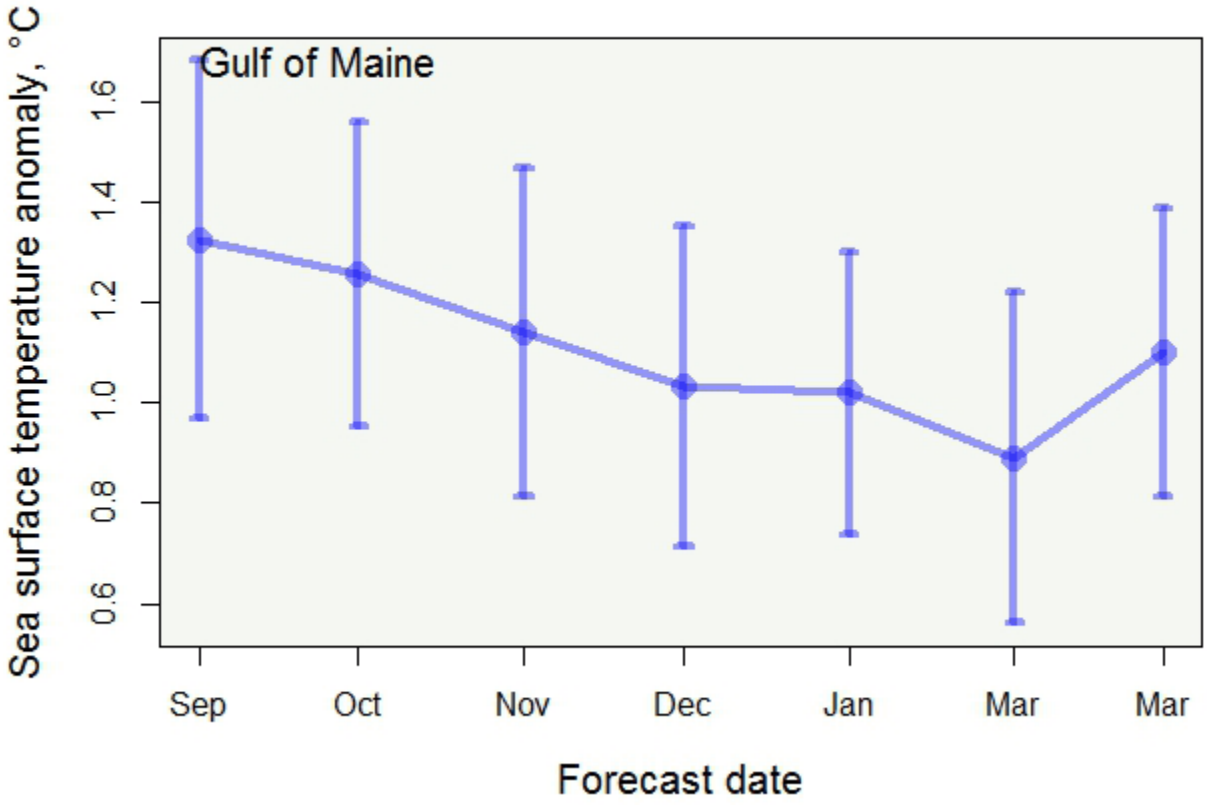


Sea Surface Temperature Forecast

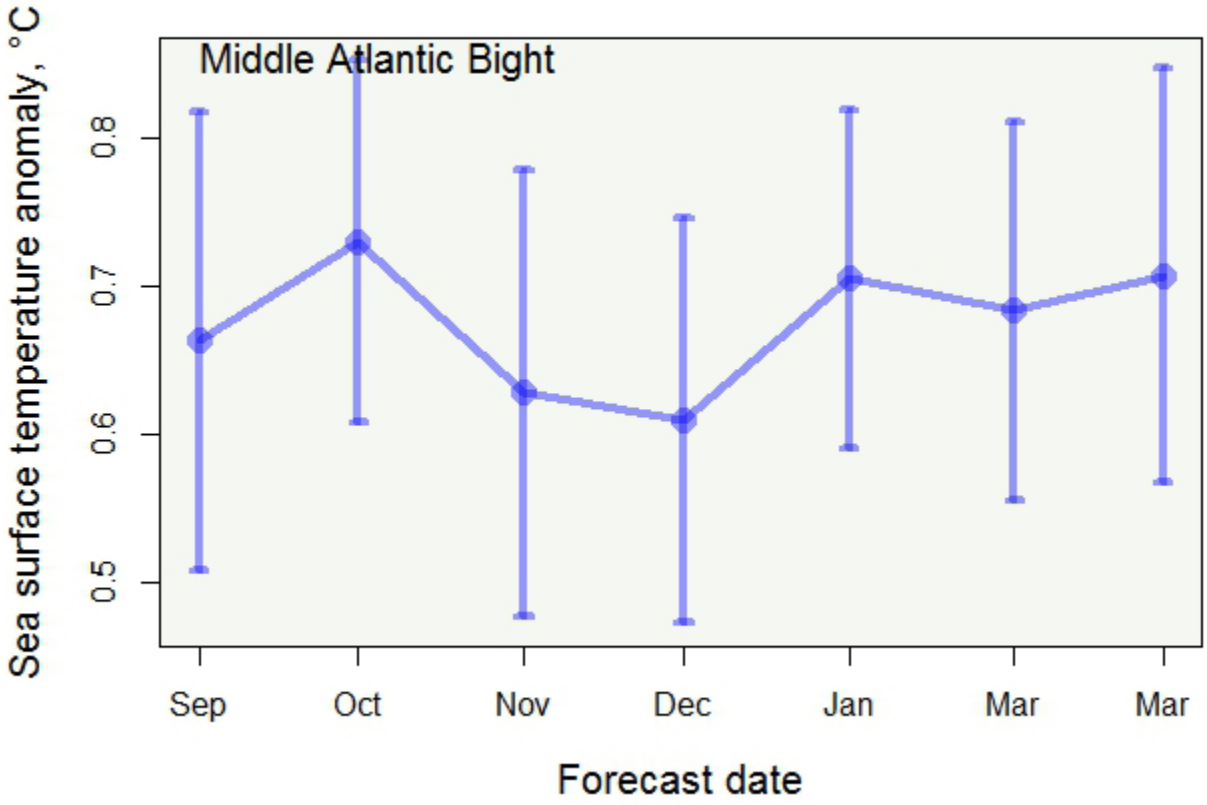
For each of the ecoregions of the Northeast Shelf, an ensemble mean estimate of forecast sea surface temperature from the fall 2017 into winter 2018 is provided with error bar representing the 95% confidence interval around the mean. The ensemble draws from seven climate models recast on similar models grid by the North American Multi-Model Ensemble project. The forecasts suggest that SST will remain above average in all areas through the winter into the spring; however, the SST anomaly levels may decrease by substantial levels in the Gulf of Maine.



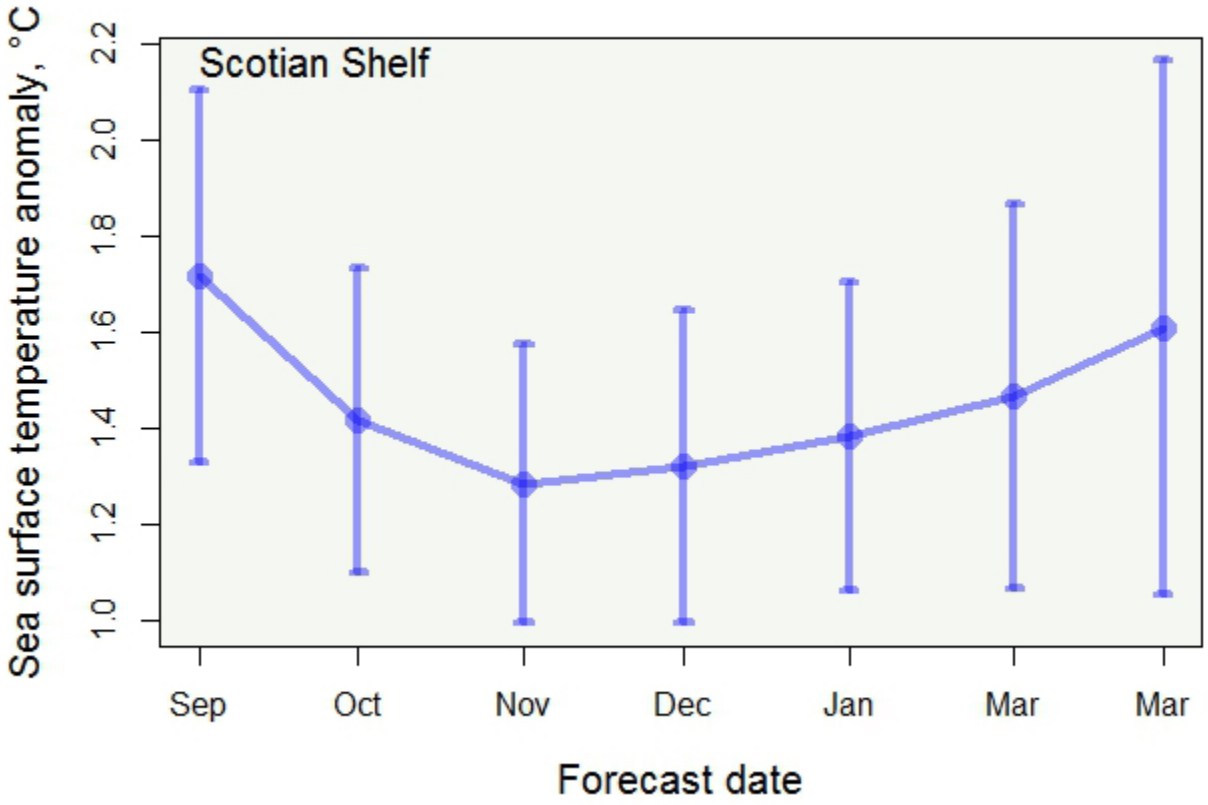
Georges Bank



Gulf of Maine



Middle Atlantic Bight



Scotian Shelf