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New England Fishery Management Council
DRAFT Research Priorities and Data Needs for
2017-2021

For consideration at the
April 18-20, 2017
Council meeting

*This document includes the “clean” version and “track changes” version,
showing substantive revisions from the 2010-2014 priorities.*



New England Fishery Management Council

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New England Fishery Management Council
DRAFT Research Priorities and Data Needs for
2017-2021

These research priorities were derived from the Council's 2010-2014 Research Priorities and Data Needs, as reviewed and updated by the Council's Plan Development Teams and species committees. The priorities are not prioritized except where noted.

Several priorities could have been categorized under multiple headings, but were not repeated unless there was a specific need to do so (e.g., where a synthesis of several items is identified in addition to the separate components). Other recommendations could involve an expansion of current data collection efforts and stock monitoring, but also may be addressed through current activities, such as Study Fleet or electronic logbook initiatives.

Some priorities could be addressed through the collaborative efforts of scientists and fishermen. The Council has long recognized the benefits and value of these partnerships, fully supporting the Northeast Fisheries Science Center's initiatives in these areas, and specifically, the Agency's Cooperative Research Program.

With respect to habitat and ecosystem research, the items below address current and perhaps the most obvious information gaps. Studies on broader species relationships, understanding the impacts of land-based activities as well as the range of offshore energy-related development activities, mapping for a baseline understanding of fish habitats, understanding the effects of climate change and a host of other issues will emerge and should be taken into consideration in the future.

Fishery Surveys

1. Efficiency estimation of NMFS trawl survey gear for **monkfish, silver and red hake**, and to estimate efficiency based on gear configuration. Identify any issues regarding the use of a constant catchability coefficient.
2. Supplement existing surveys with the use of fixed gear and/or advanced sampling techniques to facilitate sampling in inaccessible areas (e.g., use of longline or pot/trap gear to sample within complex habitat areas).
3. Continue development of hydroacoustic surveys and other resource surveys of **pelagic species** to provide an independent means of estimating stock sizes and/or defining localized depletion (long-term research).
4. Conduct deep water (>200 m) surveys.¹
5. Develop a conversion factor between the survey results for the *R/V Albatross* and *R/V Bigelow* for **wolffish**.
6. Investigate availability and detectability of **Atlantic herring** in the NEFSC spring and fall trawl survey. Develop fishery acoustic indices for **herring**, and develop a volume-to-weight conversion factor for **herring**.

Population Dynamics

1. Further investigations into stock definition, stock movements, mixing, and migration through tagging studies, DNA markers, morphological characteristics and other means for **groundfish** (Atlantic cod and Atlantic halibut), **Atlantic herring, silver hake, and red hake**.
2. Life history work focusing on: (a) age and growth, (b) longevity, (c) reproduction, and (d) natural mortality of **monkfish**; natural mortality of **scallops**, including all sources of non-harvest mortality such as predation, disease, and incidental mortality.
3. Investigate age, growth, maturity, and fecundity of managed **skate species**.
4. Extensive investigation concerning the biology of **red crab**, including growth rates, molt, reproductive cycles, maturity schedule, fecundity, and particularly the reproductive consequences of depleting large males. Examine red crab sex ratios by depth and year, information on larval supply, transport, settlement and early juvenile distributions and abundance.
5. Calculate and/or improve **river herring and shad** life stage-specific estimates of range-wide natural and human mortality rates, including fishing.
6. Collect information on the marine phases of **river herring and shad** specific to: migrations at sea (e.g., determination of river origin of individual catch in coastal/ocean independent surveys, tagging); determination of river origin of incidental catch in non-targeted ocean fisheries; and marine survival.
7. Investigate fine-scale spawning dynamics and the appropriate size and timing of spawning area closures.

Stock Assessments

1. Continue to explore the sources of uncertainties in **groundfish** and **Atlantic herring** stock assessments, including retrospective patterns, and identify appropriate adjustments (e.g., data or modeling revisions) to resolve those patterns.
2. Develop guidance for rejecting stock assessments, and provide guidance on next steps after an assessment has been rejected.

¹ Staff suggestion - insert "(e.g., red crab)"

3. Evaluate whether the loss of the winter **flatfish** survey impacts the results of the Southern New England and Georges Bank flatfish assessments.
4. Improve and standardize data collection methods for **river herring** and **shad** stocks, and develop biological benchmarks used in assessment modeling and management (e.g., for setting catch caps).
5. Explore use of survey results from the *R/V Bigelow* as a separate index of abundance as the survey time series lengthens.
6. Incorporate other surveys into stock assessments as appropriate (e.g., industry-based surveys, state surveys, North East Area Monitoring and Assessment Program, collaborative surveys between industry and fishery scientists).

Fisheries Management

Groundfish

1. Investigate the modern **groundfish** fishery:
 - a. Is the current definition of the directed fishery (landing >1 lb. groundfish per year) is still appropriate?
 - b. How should the inshore and offshore components of the groundfish fishery be identified?
2. Investigate potential means to improve access to healthy **groundfish** stocks while minimizing impacts to stocks in need of conservation
 - a. Feasibility of permit splitting by stocks
 - b. Catch efficiencies by mesh size, when new minimum fish size regulations are implemented.
 - c. Options to broaden the definition of the sector system and increase flexibility in groundfish fishery operations (e.g., expanding the range of participants allowed to join the sector system and the suite of permits and their associated allocations that can be used under the sector system).
 - d. Evaluate the efficacy of existing and potentially new **small-mesh** and **General Category scallop** exemption areas and seasons.
3. Investigate **groundfish** control rules Evaluate the effectiveness of the SSC control rule for setting groundfish catch advice. The SSC's control rule is used in the absence of better information that may allow a more explicit determination of scientific uncertainty for a stock or stocks. Develop guidance on when to use "Option C" and how to estimate ABC under "Option C". Option C states that for stocks that cannot rebuild to B_{MSY} in the specified rebuilding period, even with no fishing, the ABC should be based on incidental bycatch, including a reduction in bycatch rate (i.e., the proportion of the stock caught as bycatch).

Sea Scallops

1. Research to elucidate modes of infection, transmission and distribution of **scallop** diseases and parasites that may adversely impact scallop health, meat quality and reproductive viability. Special attention should be directed to conditions that may result in modifications to the scallop rotational area management strategy to maximize yield.
2. Evaluation of ways to control predation on scallops.
3. Research to address potential implications of spat collection, seeding and relocation of scallops for enhancement purposes in light of unknown impacts of diseases and parasites.

4. Research that investigates the factors affecting fishing power and estimates of how they relate to projections of landings per unit of effort.
5. Research related to identifying the major sources of management uncertainty and measuring their potential effects on future fishery allocations.

Skates

1. Develop effective species identification methods for fishermen, dealers, and port samplers to improve data on species composition of landings and discards. This could include an inexpensive biochemical/genetic assay method, better training and better morphological keys for juvenile skates and skate wings.
2. Evaluate the benefits of species specific management, as recommended by the SSC.
3. Investigate skate discards, including: discard mortality rate estimates for any outstanding species and gear type to move away from the assumed discard rate; alternative methods of estimating dead discards in the specifications process, e.g. forecasting; and examining trends in magnitude of discards.

Monkfish

1. Investigate age validation to resolve the age and growth issues that prevented the stock assessment model from being updated in the 2016 Operational Assessment.
2. Investigate discard mortality rate estimates for monkfish across gear types, as the assumed rate is currently set at 100%.

Fishery Performance and Monitoring

1. Continue to improve reporting compliance, including accurate reporting of species and area fished. This includes proper identification of key species, which are often misreported by fishermen (e.g. **red/white hake**; **silver/offshore hake**).
2. Improve sampling of commercial catch at age data, such as through cooperative NMFS/industry programs to supplement port agent activities for **Atlantic herring** and **groundfish**, with an emphasis on bycatch (including incidental catch).
3. Define localized depletion of spawning components on a spatial and temporal scale for **Atlantic herring**.
4. Investigate fleet behavior and decision-making with respect to their relationship to population dynamics, closed areas, catch rates, etc. in the **Atlantic herring** fishery.
5. Evaluate spatially-explicit changes in **groundfish** fleet behavior in response to restricted fishing in closed areas.
6. Conduct research on the extent and composition of discards and bycatch in the **monkfish**, **groundfish** (including small-mesh) and **skate** fisheries.
7. Investigate discard mortality rates by gear for **monkfish** and **groundfish**, and by gear type, area, season, depth and bottom type for **all seven skate species** with an emphasis on overfished species (thorny and smooth skates).

Bycatch

1. Improve estimates of **red and silver hake** discards from the **northern shrimp** fishery (if re-opened).
2. Identify gears and/or methods that would reduce bycatch and/or improve discard survival of unwanted catch:
 - a. **Red hake** discards in the small mesh fishery; and

- b. **Silver hake** discards in the large mesh fishery.
 - c. Research fishing practices or gear modifications that may change the ratio of component catch species or improve size and species selectivity of gear for **groundfish, monkfish, herring and skates**.
3. Investigate portside sampling and electronic monitoring as tools to monitor the **Atlantic herring** fishery.
4. Collect data on discards of other clupeids in the sea herring and other fisheries, and develop improvements to river herring/shad catch estimation methods in the **Atlantic herring** fishery.
5. Continue River Herring Bycatch Avoidance Program in the **Atlantic herring** fishery, and develop or evaluate innovative approaches for avoidance or monitoring **river herring/shad** catch in small mesh fisheries (e.g., environmental cues and bycatch avoidance, electronic monitoring and portside sampling).
6. Policy evaluation of bycatch management, including possible implementation of a 100% retention policy to minimize discarding and ecosystem effects.
7. Conduct research on the extent and composition of discards and bycatch in the **groundfish** fishery, including research to estimate discard mortality rates by gear for groundfish.

Habitat

1. Research resulting in greater understanding of the relationships between managed species and the geological, biological, and physical features of the habitats they occupy. Research that produces information to assess spatial variation in habitat use and fisheries productivity is the highest priority (i.e., research results with demonstrable utility to analyze spatial management alternatives for habitat). Ideally, these results will contain spatially explicit data including species abundances at different life-history stages, measures of species condition (or survivorship, growth rate, or similar metric linked to variation in productivity across the landscape) and the characteristics of concurrently sampled habitat features, substrates and associated prey. The resulting research and data products should contain explicit statements regarding the limitations of the data for defining essential fish habitat, given the original sampling design and spatial and temporal scales of sampling. Particular areas of interest include:
 - a. Geological and biological sampling of the Gulf of Maine region to improve spatial resolution and characterize temporal variability.
 - b. Targeted sampling of benthic community structure (infauna and epifauna) in representative substrate types (e.g., mud, sand, gravel, cobble, and boulder in high and low energy environments) across multiple environmental settings.
 - c. Concurrent spatial data on recruitment, growth and reproduction across habitats and environmental settings.
 - d. Studies that groundtruth, via physical sampling, benthic fauna observed in video and still imagery-based datasets.
 - e. Links between habitat characteristics and primary prey species.
 - f. Acoustic surveys (e.g., multibeam, side-scan sonar) to add to the growing number of seafloor habitat maps in the region, particularly in the Gulf of Maine.

2. Evaluate and quantify linkages between habitat types (e.g., space/time variation of shelter and prey) and the productivity of managed species. This could help refine EFH designations to understand the relative benefits of EFH impact minimization alternatives, and possibly to inform reference point definitions.
3. Experimental examination of gear impacts on seabed habitats in Northeast US waters that take effort, season, sedimentary character and biological community into account. Sampling should follow an appropriate experimental design, such as before-after control impact (BACI). Particular attention should be paid to studies that replicate the broad scale impacts of commercial levels of fishing activity rather than single impact studies, and to studies that monitor long-term recovery of affected habitat features. Particular areas of interest include:
 - a. Studies that would inform assessments of the effects of fixed gears on seabed habitat components. In particular, the extent of fixed gear movement along the seabed during setting, soaking, and hauling is not known.
 - b. Comparative studies of the effects of various trawl gear configurations on seabed habitat components. These studies would inform estimates of the possible benefits of gear restrictions/modifications.
 - c. Studies that quantify the degree of seabed contact for particular gears and their component parts, within a variety of habitat types.
4. Studies that refine estimates of benthic boundary shear stress at the seabed/water column interface and groundtruth critical shear stress thresholds across seasons and depths (i.e., are seabed sediments stable/unstable at various levels of flow, as predicted by models, what are effects of variation in biological attributes that influence disturbance via shear stress). Where possible, use data from sensors deployed on the seabed to groundtruth modeled estimates.
5. Targeted studies following the 2013-2015 Northeast region deep-sea coral research work in the Gulf of Maine and in the offshore canyons and seamounts that focus on defining areas/habitat conditions that support coral and sponge “garden” habitats. Studies of growth, reproduction, population connectivity and functional role as fish habitat are of particular interest. Develop more sophisticated, higher-resolution models that predict coral presence/absence or relative abundance, not just likelihood of occurrence.
6. Studies of invasive organisms to understand their distribution and spread, and to evaluate impacts on habitats, ecosystems, and target species.

FMP-Specific Habitat Research

Groundfish

1. Perform comparative studies of the impacts of varying gear configurations on habitat (e.g., differential impacts of chain vs. roller sweeps; catchability and concurrent habitat effects of shortened or modified ground cables, or semi-pelagic doors, etc.).

Sea Scallops

1. Characterize habitats within scallop fishing grounds, including:
2. Video and/or photo transects of the seafloor before and after scallop fishing commences.
3. Identification of nursery and over-wintering habitats of species vulnerable to habitat alteration by scallop fishing.

4. Studies that evaluate habitat recovery following impact with scallop dredges or trawls.
5. Studies that examine fine scale fishing effort distributions in relation to fine scale habitat distribution.
6. Studies that directly support evaluation of present and candidate habitat management areas and Habitat Areas of Particular Concern to assess whether these areas are accomplishing their stated purposes and to assist in better defining the complex ecosystem processes that occur in these areas.
7. Evaluate long-term or chronic effects of scallop fishing on marine resource productivity.
8. Identify and evaluate methods to reduce the habitat impacts of scallop fishing, including studies that evaluate variability in scallop dredge efficiency across habitats, times, areas.

Monkfish

3. Conduct tagging and telemetry studies that focus on basic life history and habitat use.

Ecosystems

1. Research ecosystem operational advice, emphasizing synthesis of existing data, modelling, and meta-data analysis, including environmental variability and climate change; relationship between habitat and fishery resource productivity (including the impact of fishing on functional value of habitat); trophic interactions and their implications; managing mix species fisheries; function and effectiveness of closed area management.
2. Synthesize predator/prey information on **Atlantic herring** and other forage fish and fill data gaps; investigate the role of forage fish in the Northwest Atlantic ecosystem and their importance for other managed species; assess the relative importance of herring vs. other forage species as both prey and predator in the ecosystem (e.g., competition with right whales and juvenile cod for *C. finmarchicus*).
3. Evaluate potential resilience of managed species to ecosystem change through preservation of forage diversity.
4. Provide information for use in marine spatial planning.²
5. Investigate relationships between stocks, including predator/prey relationships and evaluate whether stock status of some species is increasing the rebuilding timeline of **groundfish** stocks.
6. Conduct research concerning trophic interactions of **monkfish** and monkfish cannibalism on other species; recognize the need to incorporate monkfish into prey assessments.
7. Investigate the influence of physical factors (including environmental changes) on shifts in the range and distribution of species within the **skate** complex.
8. Examine trophic interactions between **skate** species and other bottom species that occupy the same habitats.
9. Investigate effectiveness of seasonal and year-round spatial management areas to achieve desired goals, including improved yield, mortality reduction, spawning protection, bycatch avoidance/reduction, and ecosystem protection and improvement.

² Staff suggestion – Delete as it's too vague.

10. Monitor trends in non-target, ecosystem components.
11. Develop and enhance industry-based oceanographic data collection (e.g., physical, primary productivity, habitat metrics).

Endangered, Threatened and Protected Species

1. Identify "hot spots" within the **scallop** fishery using data on observed take of sea turtles and other suitable information (e.g., data on observed turtle interactions for other fisheries or fishery surveys in the area where the scallop fishery operates).
2. Develop gear modifications or fishing techniques that may be used to reduce or eliminate the threat of sea turtle interactions without unacceptable reductions in target retention in **all fisheries**.
3. Investigate protected species bycatch/discards in the **Atlantic herring** fishery.

Socioeconomics

1. Continue to support data collection efforts for improved social and economic impact analyses, as well as cost-benefit analysis, for all species, but particularly **groundfish** and **Atlantic herring**.
2. For the **Atlantic herring** fishery: (1) Characterize the individuals, families, firms, organizations, and communities involved in the Atlantic herring fishery; (2) Identify capacity use and fixed costs of Atlantic herring vessels; (3) Characterize Atlantic herring stakeholders besides those of the commercial herring fishery (e.g., whale watching, tuna, groundfish, lobster fisheries); (4) Characterize Atlantic herring dealers and processors (e.g., dependence on herring, location, costs, earnings, employment); and (5) Characterize market dynamics (e.g., relationships between fishermen, buyers, and processors; and end users in bait and fresh markets).
3. Improve the ability to quantify economic impacts from restricted fishing in closed areas (e.g., develop spatially-explicit fleet behavior model).
4. Evaluate the social and economic impacts and consequences of the area rotation program of the **scallop** fishery, including evaluation of potential distributional effects as well as impacts on other fisheries.
5. Evaluate barriers to marketing **whiting** and **red hake**, which could lower fishery discards and improve profitability.



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[Substantive revisions from 2010-2014 priorities in “track changes”]

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Fishery Surveys

1. Efficiency estimation of NMFS trawl survey gear for **monkfish**, **silver and red hake**, and to estimate efficiency based on gear configuration. Identify any issues regarding the use of a constant catchability coefficient.
2. Supplement existing surveys with the use of fixed gear and/or advanced sampling techniques to facilitate sampling in inaccessible areas (e.g., use of longline or pot/trap gear to sample within complex habitat areas).
3. Continue development of hydroacoustic surveys and other resource surveys of **pelagic species** to provide an independent means of estimating stock sizes and/or defining localized depletion (long-term research).
4. Conduct deep water (>200 m) surveys.¹
5. Develop a conversion factor between the survey results for the *R/V Albatross* and *R/V Bigelow* for **wolffish**.
6. Investigate availability and detectability of **Atlantic herring** in the NEFSC spring and fall trawl survey. Develop fishery acoustic indices for **herring**, and develop a volume-to-weight conversion factor for **herring**.
7. Conduct intensive industry-based surveys of each of the five **sea scallop** access areas (Closed Area I, Closed Area II, Nantucket Lightship, Elephant Trunk and Delmarva areas) and beyond (Northern Gulf of Maine management area and Southern New England).
8. Research new advanced **scallop** and multipurpose survey technologies (video, sonar, towed, AUV, etc.) and protocols that should be compatible with and complement the existing scallop resource surveys.
9. Conduct peer review and inter-survey calibrations of new and existing **scallop** surveys.

Population Dynamics

1. Further investigations into stock definition, stock movements, mixing, and migration through tagging studies, DNA markers, morphological characteristics and other means for **groundfish** (**Atlantic cod and Atlantic halibut**), **Atlantic herring**, **silver hake**, and **red hake**.
2. Life history work focusing on: (a) age and growth, (b) longevity, (c) reproduction, and (d) natural mortality of **monkfish**; recruitment processes (reproduction, larval and early post-settlement stages), growth natural mortality of **scallops**, including all sources of non-harvest mortality such as predation, disease, and incidental mortality.
3. Investigate age, growth, maturity, and fecundity of managed **skate species**.
4. Extensive investigation concerning the biology of **red crab**, including growth rates, molt, reproductive cycles, maturity schedule, fecundity, and particularly the reproductive consequences of depleting large males. Examine red crab sex ratios by depth and year, information on larval supply, transport, settlement and early juvenile distributions and abundance.
5. Calculate and/or improve **river herring and shad** life stage-specific estimates of range-wide natural and human mortality rates, including fishing.
6. Collect information on the marine phases of **river herring and shad** specific to: migrations at sea (e.g., determination of river origin of individual catch in

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coastal/ocean independent surveys, tagging); determination of river origin of incidental catch in non-targeted ocean fisheries; and marine survival.

- ~~7. Investigate bathymetric demography of population of **silver hake**, including changes in seasonal distribution caused by environmental forcing to help with stock identification.~~
7. Investigate fine-scale spawning dynamics and the appropriate size and timing of spawning area closures.

Stock Assessments

1. Continue to explore the sources of uncertainties in **groundfish** and **Atlantic herring** stock assessments, including retrospective patterns, and identify appropriate adjustments (e.g., data or modeling revisions) to resolve those patterns.
2. Develop guidance for rejecting stock assessments, and provide guidance on next steps after an assessment has been rejected.
3. Evaluate whether the loss of the winter **flatfish** survey impacts the results of the Southern New England and Georges Bank flatfish assessments.
4. Improve and standardize data collection methods for **river herring** and **shad** stocks, and develop biological benchmarks used in assessment modeling and management (e.g., for setting catch caps).
5. Explore use of survey results from the *R/V Bigelow* as a separate index of abundance as the survey time series lengthens.
6. Incorporate other surveys into stock assessments as appropriate (e.g., industry-based surveys, state surveys, North East Area Monitoring and Assessment Program, collaborative surveys between industry and fishery scientists).

Fisheries Management

Groundfish

1. Investigate the modern groundfish fishery:
 - a. Is the current definition of the directed fishery (landing >1 lb. groundfish per year) is still appropriate?
 - b. How should the inshore and offshore components of the groundfish fishery be identified?
2. Investigate potential means to improve access to healthy stocks while minimizing impacts to stock in need of conservation
 - a. Feasibility of permit splitting by stocks
 - b. Catch efficiencies by mesh size, when new minimum fish size regulations are implemented.
 - c. Options to broaden the definition of the sector system and increase flexibility in groundfish fishery operations (e.g., expanding the range of participants allowed to join the sector system and the suite of permits and their associated allocations that can be used under the sector system).
 - d. Evaluate the efficacy of existing and potentially new **small-mesh** and **General Category scallop** exemption areas and seasons.
3. Investigate groundfish control rules Evaluate the effectiveness of the SSC control rule for setting **groundfish** catch advice. The SSC's control rule is used in the absence of better information that may allow a more explicit determination of scientific uncertainty for a stock or stocks. Develop guidance on when to use

- “Option C” and how to estimate ABC under “Option C”. Option C states that for stocks that cannot rebuild to B_{MSY} in the specified rebuilding period, even with no fishing, the ABC should be based on incidental bycatch, including a reduction in bycatch rate (i.e., the proportion of the stock caught as bycatch).
4. ~~Develop a management strategy evaluation program (a specific approach to address scientific and management uncertainty, organizational and/or institutional programs and bodies, and sources and levels of funding).~~
 5. ~~Develop industry-based information collection systems to improve information used for groundfish management.~~
 6. ~~Quantify the impacts of closed areas, and evaluate the effectiveness of timing closures to coincide with spawning activity (e.g. Gulf of Maine rolling closures).~~
 7. ~~Investigate the effect of various management instruments (specifically user rights and ocean zoning) on management performance (biological, social and habitat) and enforcement.~~
 8. ~~Investigate the feasibility of public leasing of vessels to reduce fishing mortality for fisheries that have long-term potential to sustain the existing fleet capacity.~~
 9. ~~Consider management options for minimizing impacts on vulnerable marine ecosystems.~~
 10. ~~Evaluate effects and effectiveness of permanent closed areas.~~

Sea Scallops

1. Research to elucidate modes of infection, transmission and distribution of scallop diseases and parasites that may adversely impact scallop health, meat quality and reproductive viability. Special attention should be directed to conditions that may result in modifications to the scallop rotational area management strategy to maximize yield.
2. Evaluation of ways to control predation on scallops.
3. Research to address potential implications of spat collection, seeding and relocation of scallops for enhancement purposes in light of unknown impacts of diseases and parasites.
4. Research that investigates the factors affecting fishing power ~~for each limited access vessel~~ and estimates of how they relate to projections of landings per unit of effort.
5. Research related to identifying the major sources of management uncertainty and measuring their potential effects on future fishery allocations.

Skates

1. Develop effective species identification methods for fishermen, dealers, and port samplers to improve data on species composition of landings and discards. This could include an inexpensive biochemical/genetic assay method, better training and better morphological keys for juvenile skates and skate wings.
2. Evaluate the benefits of species specific management, as recommended by the SSC.
- 1.3. Investigate skate discards, including: discard mortality rate estimates for any outstanding species and gear type to move away from the assumed discard rate; alternative methods of estimating dead discards in the specifications process, e.g. forecasting; and examining trends in magnitude of discards.

Monkfish

1. Investigate age validation to resolve the age and growth issues that prevented the stock assessment model from being updated in the 2016 Operational Assessment.
2. Investigate discard mortality rate estimates for monkfish across gear types, as the assumed rate is currently set at 100%.

Fishery Performance and Monitoring

1. Continue to improve reporting compliance, including accurate reporting of species and area fished. This includes proper identification of key species, which are often misreported by fishermen (e.g. **red/white hake**; **silver/offshore hake**). ~~Improve procedures to reduce aggregate trip reporting by coastal states, so that more catches are reported by an identified vessel at an identified dealer, whether or not they have a federal permit, when they land a federally regulated species (reportedly) captured in state waters~~
2. Improve sampling of commercial catch at age data, such as through cooperative NMFS/industry programs to supplement port agent activities for **Atlantic herring** and **groundfish**, with an emphasis on bycatch (including incidental catch).
3. Define localized depletion of spawning components on a spatial and temporal scale for **Atlantic herring**.
4. Investigate fleet behavior and decision-making with respect to their relationship to population dynamics, closed areas, catch rates, etc. in the Atlantic herring fishery.
5. Evaluate spatially-explicit changes in groundfish fleet behavior in response to restricted fishing in closed areas.
6. Conduct research on the extent and composition of discards and bycatch in the **monkfish**, **groundfish** (including small-mesh) and **skate** fisheries.
7. Investigate discard mortality rates by gear for **monkfish** and **groundfish**, and by gear type, area, season, depth and bottom type for **all seven skate species** with an emphasis on overfished species (thorny and smooth skates).

Bycatch

1. Improve estimates of red and silver hake discards from the northern shrimp fishery (if re-opened).
2. Identify gears and/or methods that would reduce bycatch and/or improve discard survival of unwanted catch:
 - a. Red hake discards in the small mesh fishery; and
 - b. Silver hake discards in the large mesh fishery.
 - c. Research fishing practices or gear modifications that may change the ratio of component catch species or improve size and species selectivity of gear for **groundfish**, **scallop**, **monkfish**, **herring** and **skates**.
3. Investigate portside sampling and electronic monitoring as tools to monitor the Atlantic herring fishery.
4. Collect data on discards of other clupeids in the sea herring and other fisheries, and develop improvements to river herring/shad catch estimation methods in the Atlantic herring fishery.
5. Continue River Herring Bycatch Avoidance Program in the Atlantic herring fishery, and develop or evaluate innovative approaches for avoidance or monitoring

- river herring/shad catch in small mesh fisheries (e.g., environmental cues and bycatch avoidance, electronic monitoring and portside sampling).
- 6. Policy evaluation of bycatch management, including possible implementation of a 100% retention policy to minimize discarding and ecosystem effects.
- 7. Conduct research on the extent and composition of discards and bycatch in the **groundfish** fishery, including research to estimate discard mortality rates by gear for groundfish.

Habitat

1. Research resulting in greater understanding of the relationships between spatial databases designed for analyses of managed species, and the geological, biological, and physical features of the habitats they occupy-relationships. Research that produces information to assess spatial variation in habitat use and fisheries productivity is the highest priority (i.e., research results with demonstrable utility to analyze spatial management alternatives for habitat). Ideally, these ~~data~~ results will contain spatially explicit data including absolute-species abundances at different life-history stages, measures of species condition (or survivorship, growth rate, or similar metric linked to variation in productivity across the landscape) and the characteristics of concurrently sampled habitat features, and substrates and associated prey. The resulting research and data products should contain explicit statements regarding the limitations of the data for defining essential fish habitat/EFH analyses, given the original sampling design and spatial and temporal scales of sampling. Particular areas of interest include:
 - a. Geological and biological sampling of the Gulf of Maine region to improve spatial resolution and characterize temporal variability.
 - b. ~~Targeted~~Broadscale infaunal sampling ~~of~~and benthic community structure (infauna and epifauna) in representative substrate types (e.g., mud, sand, gravel, cobble, and boulder in high and low energy environments) across multiple environmental settings.analyses (i.e. an update to the Theroux and Wigley dataset).
 - c. Concurrent spatial data on recruitment, growth and reproduction across habitats and environmental settings.
 - d. Studies that groundtruth, via physical sampling, benthic fauna observed in video and still imagery-based datasets.
 - e. Links between habitat characteristics and primary prey species.
 - f. Acoustic surveys (e.g., multibeam, side-scan sonar) to add to the growing number of seafloor habitat maps in the region, particularly in the Gulf of Maine.
2. Evaluate and quantify linkages between habitat types (e.g., space/time variation of shelter and prey) and the productivity of managed species. This could help refine EFH designations to understand the relative benefits of EFH impact minimization alternatives, and possibly to inform reference point definitions.
3. Experimental examination of gear impacts on seabed habitats in Northeast US waters that take effort, season, sedimentary character and biological community into account. Sampling should follow an appropriate experimental design, such as before-after control impact (BACI). Particular attention should be paid to studies

that replicate the broad scale impacts of commercial levels of fishing activity rather than single impact studies, and to studies that monitor long-term recovery of affected habitat features. Particular areas of interest include:

- a. Studies that would inform assessments of the effects of fixed gears on seabed habitat components. In particular, the extent of fixed gear movement along the seabed during setting, soaking, and hauling is not known.
 - b. Comparative studies of the effects of various trawl gear configurations on seabed habitat components. These studies would inform estimates of the possible benefits of gear restrictions/modifications. ~~Also, evaluate whether gear restrictions actually result in changes in the distribution of fishing effort by habitat type. In order to model the effects of these changes, data would need to be collected on when, where, and under what conditions particular gear configurations are employed.~~
 - c. Studies that quantify the degree of seabed contact for particular gears and their component parts, within a variety of habitat types.
4. Studies that refine estimates of critical benthic boundary shear stress at the seabed/water column interface and groundtruth critical shear stress thresholds across seasons and depths (i.e., are seabed sediments stable/unstable at various levels of flow, as predicted by models, what are effects of variation in biological attributes that influence disturbance via shear stress). Where possible, use data from sensors deployed on the seabed to groundtruth modeled estimates.
 5. Targeted studies following the 2013-2015 Northeast region deep-sea coral research work in the Gulf of Maine and in the offshore canyons and seamounts that focus on defining areas/habitat conditions that support coral and sponge “garden” habitats. Studies of growth, reproduction, population connectivity and functional role as fish habitat are of particular interest. Develop more sophisticated, higher-resolution models that predict coral presence/absence or relative abundance, not just likelihood of occurrence.
 6. Studies of invasive organisms to understand their distribution and spread, and to evaluate impacts on habitats, ecosystems, and target species.
 - ~~7. Link habitat types and their specific functions with fishery resource productivity. This information could be used to refine EFH designations, to understand the relative benefits of EFH impact minimization alternatives and possibly to inform reference point definitions.~~
 - ~~8. Collect additional data on the locations of deep-sea corals on/adjacent to the Northeast US continental shelf. Broad-scale observations of previously unsurveyed areas would refine understanding of the total area of seabed covered by these species—much of the current data was collected on a fine scale and there are many gaps in coverage.~~
 - ~~9. Explore trade-offs between habitat protection within closed or restricted areas and shifts in effort to open areas; impacts of implicit or explicit outcomes should be groundtruthed.~~

FMP-Specific Habitat Research

Groundfish

Perform comparative studies of the impacts of varying gear configurations on habitat (e.g., differential impacts of chain vs. roller sweeps, ~~and rockhopper gear;~~ catchability and concurrent habitat effects of shortened or modified ground cables, or semi-pelagic doors, etc.).

Sea Scallops

1. Characterize habitats within scallop fishing grounds, including:
 - a. Video and/or photo transects of the seafloor before and after scallop fishing commences.
 - b. Identification of nursery and over-wintering habitats of species vulnerable to habitat alteration by scallop fishing.
 - c. Studies that evaluate habitat recovery following impact with scallop dredges or trawls.
 - d. Studies that examine fine scale fishing effort distributions in relation to fine scale habitat distribution.
 - e. Studies that directly support evaluation of present and candidate habitat management areas and Habitat Areas of Particular Concern to assess whether these areas are accomplishing their stated purposes and to assist in better defining the complex ecosystem processes that occur in these areas.
 - f. ~~Develop high resolution sediment mapping of scallop fishing areas possibly using the Canadian sea scallop industry mapping efforts as a model;~~
2. Evaluate long-term or chronic effects of scallop fishing on marine resource productivity.
3. Identify and evaluate methods to reduce the habitat impacts of scallop fishing, including studies that evaluate variability in scallop dredge efficiency across habitats, times, areas, ~~and gear designs and research on habitat effects from scallop fishing and the development of practicable methods to minimize or mitigate those impacts.~~

Monkfish

- ~~1.3.~~ Conduct tagging and telemetry studies that focus on basic life history and habitat use.

Ecosystems

1. Research ecosystem operational advice, emphasizing synthesis of existing data, modelling, and meta-data analysis, including environmental variability and climate change; relationship between habitat and fishery resource productivity (including the impact of fishing on functional value of habitat); trophic interactions and their implications; managing mix species fisheries; function and effectiveness of closed area management.
2. Synthesize predator/prey information on **Atlantic herring** and other forage fish and fill data gaps; investigate the role of forage fish in the Northwest Atlantic ecosystem and their importance for other managed species; assess the relative importance of herring vs. other forage species as both prey and predator in the ecosystem (e.g., competition with right whales and juvenile cod for *C. finmarchicus*).

3. Evaluate potential resilience of managed species to ecosystem change through preservation of forage diversity.
4. Provide information for use in marine spatial planning.²
5. Investigate relationships between stocks, including predator/prey relationships and evaluate whether stock status of some species is increasing the rebuilding timeline of **groundfish** stocks.
6. Conduct research concerning trophic interactions of **monkfish** and monkfish cannibalism on other species; recognize the need to incorporate monkfish into prey assessments.
7. Investigate the influence of physical factors (including environmental changes) on shifts in the range and distribution of species within the **skate** complex.
8. Examine trophic interactions between **skate** species and other bottom species that occupy the same habitats.
9. Investigate effectiveness of seasonal and year-round spatial management areas to achieve desired goals, including improved yield, mortality reduction, spawning protection, bycatch avoidance/reduction, and ecosystem protection and improvement.
10. Monitor trends in non-target, ecosystem components.
11. Develop and enhance industry-based oceanographic data collection (e.g., physical, primary productivity, habitat metrics).

Endangered, Threatened and Protected Species

1. Identify "hot spots" within the **scallop** fishery using data on observed take of sea turtles and other suitable information (e.g., data on observed turtle interactions for other fisheries or fishery surveys in the area where the scallop fishery operates).
2. Develop gear modifications or fishing techniques that may be used to reduce or eliminate the threat of sea turtle interactions without unacceptable reductions in target retention in **all fisheries**.
3. Investigate protected species bycatch/discards in the **Atlantic herring fishery**.
4. ~~Continue and update studies on turtle behavior with respect to how sea turtle interactions with **scallop** dredge gear are occurring.~~

Socioeconomics

1. Continue to support data collection efforts for improved social and economic impact analyses, as well as cost-benefit analysis, for all species, but particularly **groundfish** and **Atlantic herring**.
2. For the **Atlantic herring** fishery: (1) Characterize the individuals, families, firms, organizations, and communities involved in the Atlantic herring fishery; (2) Identify capacity use and fixed costs of Atlantic herring vessels; (3) Characterize Atlantic herring stakeholders besides those of the commercial herring fishery (e.g., whale watching, tuna, groundfish, lobster fisheries); (4) Characterize Atlantic herring dealers and processors (e.g., dependence on herring, location, costs, earnings, employment); and (5) Characterize market dynamics (e.g., relationships between fishermen, buyers, and processors; and end users in bait and fresh markets).

² Staff comment: This is vague and a hold-over from the 2010-2014 priorities. Suggest deleting.

3. Improve the ability to quantify economic impacts from restricted fishing in closed areas (e.g., develop spatially-explicit fleet behavior model).
4. Evaluate the social and economic impacts and consequences of the area rotation program of the **scallop** fishery, including evaluation of potential distributional effects as well as impacts on other fisheries.
5. Evaluate barriers to marketing **whiting** and **red hake**, which could lower fishery discards and improve profitability.

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