

Northeast Regional Ocean Council
Marine life Data & Analysis Team (MDAT) Work Plan

Fish Species

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Foreword

Work Plans for the development of products characterizing marine life distribution, abundance and trends were received from the Marine-life Data and Analysis Team (MDAT)¹ by NROC following approximately 12 months of discussion, review, and consideration by three Expert Work Groups, Regional Planning Body members, and many ocean planning stakeholders. These Work Plans contribute to Action 1-1 (i.e., creating new spatial data products of the distribution and abundance of marine life) under the Health Ocean and Coastal Ecosystems Goal in the Framework for Ocean Planning in the Northeast. The spatial data products that will result from these Work Plans will also contribute to NE RPB decisions on incorporating new data products into decision-making, as appropriate. For example, NROC is working with RPB members and agency representatives to understand how distribution/abundance and various types of aggregated or synthesized data products could be used in project siting, planning, permitting and various types of consultations. An option currently under consideration is for these distribution and abundance data products to contribute to the definition of “core areas” for species and species groups that then may be considered in the early phases of project siting and planning. Further synthesis of species and species group core area data products could result in maps of hotspots for single taxa (i.e., Marine Mammals, Sea Turtles, Birds, Fish) and then multi-taxa hotspots.

The MDAT Work Plans contain descriptions of the data sources, methodology, and resulting spatial data products that are being developed for Marine Mammals and Sea Turtles, Avian Species, and Fish Species. Resulting spatial data products include distribution and abundance estimates for various temporal windows derived from models that incorporate environmental/habitat variables, as well as a variety of “summary” data products: species groups, and metrics such as total biomass, species richness, and persistence. MDAT subgroups (Marine Mammals and Sea Turtles, Avian Species, and Fish Species) describe specific data products based on the characteristics of their individual datasets, methodology, and data availability.

NROC envisions that the detailed distribution/abundance map outputs for individual species and species groups could be used by agencies to develop opinions/decisions on specific projects at relatively fine scales. These products would be useful once potentially vulnerable species have already been identified for a particular project/action, and when understanding fine scale distribution/abundance at particular times of year is critical.

Forthcoming aggregate products, such as “core areas” for a species or species group (or eventually whole taxa and multi-taxa), could be used by project proponents, states, federal agencies, and the public to better understand and characterize siting issues early in the planning process for potential projects/actions.

¹MDAT is a partnership between Duke University (PI Pat Halpin), the NOAA Northeast Fisheries Science Center (co-PI Michael Fogarty), the NOAA National Centers for Coastal Ocean Science (co-PI Brian Kinlan), and Loyola University (co-PI Earvin Balderama).

1 Introduction

The Marine-life Data & Analysis Team (MDAT) is working in concert with the Northeast Region Ocean Council (NROC) and the Northeast Regional Planning Body to aggregate data and model products that describe the distribution, abundance and trends of marine life in the Northeast. MDAT will provide well-documented, understandable and comparable products that will support future marine spatial planning needs that emerge from the region. The team is comprised of: the Marine Geospatial Ecology Lab (MGEL) at Duke University; the Center for Coastal Monitoring and Assessment Biogeography Branch at NOAA's National Centers for Coastal Ocean Science (NCCOS); the Ecosystem Assessment Program at the NOAA's Northeast Fisheries Science Center (NEFSC); and the Department of Mathematics and Statistics at Loyola University, Chicago (Loyola). The NEFSC is creating models and products for fish species.

NROC and MDAT have assembled three expert working groups for each group of species (marine mammals and sea turtles, avian species, fish species). Each group has convened twice to review potential data sources, share expertise on specific species, discuss potential products, and review progress. The working groups will continue to meet and be kept apprised of progress throughout the project timeline, with final products being delivered by summer 2015.

This work plan summarizes the progress to date and incorporates work group feedback received on the geographic scope for all products, the specific species to be modeled and mapped, and existing data sources. This plan also presents information about the temporal extent, spatial resolution, data gaps, and methodology that will be used to develop new data products for fish species.

2 Geographic scope: Marine life assessment boundaries for the Northeast

The assessment boundaries for this project were determined by discussions between MDAT team members, the three expert work groups, representatives from the Mid-Atlantic Data Portal team and NROC staff (Figure 1). The resulting area includes Hudson Canyon and Long Island Sound in the southern portion and stretches to the Bay of Fundy in the north. Data product coverage within these bounds will be highly dependent on data availability, and will likely differ among marine life components. The spatial coverage and data limitations specific to each marine life component are described below.

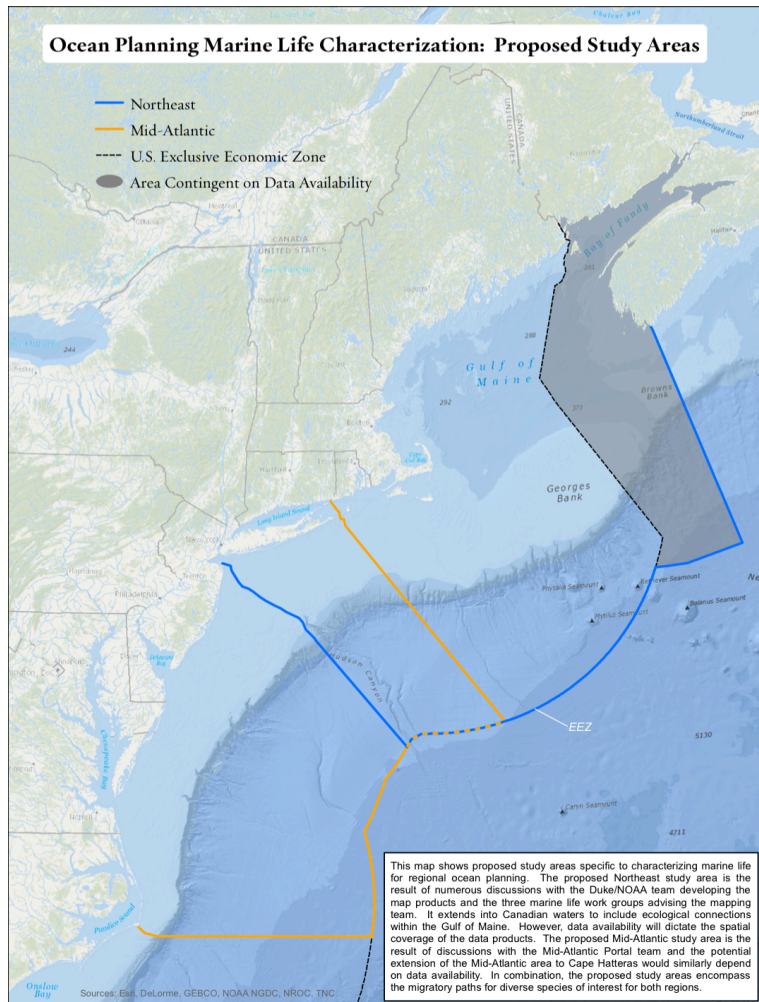


Figure 1. Geographic boundaries for marine life mapping in the Northeast, showing adjacent assessment area in the Mid-Atlantic region.

3 Marine Fish

3.1 Principal Fish trawl datasets and sources, which span from 1970 (NMFS Surveys) to the present and have each used standardized survey designs and data collection methodology but have used different vessels and gears:

- NEFSC
- NEAMAP
- State of Massachusetts
- Maine & New Hampshire

3.2 Fish species and groupings

MDAT will develop and maintain a database of distribution and abundance data and spatial data products for the species in the Principal Trawl Datasets accounting for up to 90% of the relative biomass in the data set. However, in order to reduce the total number of maps managers/planners

would need to use, the work group chose a smaller number of priority (“iconic” ecologically, culturally and/or economically important) species for presentation to NROC. Priority species for presentation to NROC were chosen by tallying feedback from work group members (Table 1).

Table 1. Focal species and groups for the Northeast region.

Species - common name	Federal		State	Primary Data Source	Work Group Comments
	ESA	EFH	E, T, SC		
American lobster				Principal trawl data	
Atlantic cod		X		Principal trawl data	
Atlantic halibut	SC	X			Overfished over a century ago. Recovery and expansion of range should be tracked and used in planning decisions
Atlantic herring		X		Principal trawl data	
Atlantic mackerel		X		Principal trawl data	
Black sea bass		X		Principal trawl data; spring not used	Range is extending north of the Cape into Gulf of Maine. There will be ecological and fishery consequences that should be considered in planning
Blueback herring	SC		NH (SC)	Principal trawl data	
Horseshoe crab		X			
Longfin squid		X		Principal trawl data	
Monkfish (Goosefish)		X		Principal trawl data	
Sand lance				Principal trawl data	
Sea scallop		X		Principal trawl data	
Summer flounder		X		Principal trawl data	
Tautog				Principal trawl data	
Window-pane flounder		X		Principal trawl data	
Atlantic sturgeon		X		Principal trawl data	Rare
Barndoor skate		X		Principal trawl data	
American eel				Principal trawl data	
Jonah crab		X			
Witch flounder		X		Principal trawl data	
Yellowtail flounder		X		Principal trawl data	
Gadoids				Principal trawl data	
Other demersals				Principal trawl data	
Other groundfish				Principal trawl data	
Pelagics				Principal trawl data	
Invertebrates				Principal trawl data	

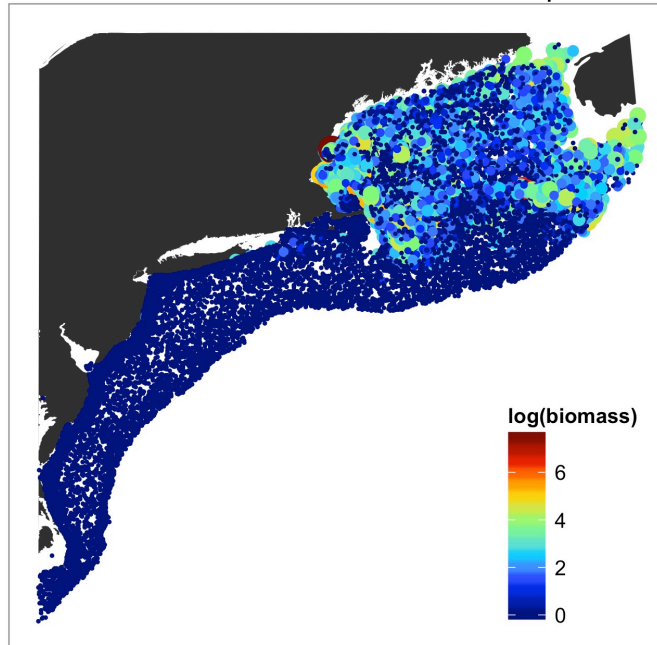
Elasmobranchs				Principal trawl data	
Other fish				Principal trawl data	
Total abundance				Principal trawl data	
Total biomass				Principal trawl data	
Species richness				Principal trawl data	
Species diversity				Principal trawl data	

3.3 Fish model outputs

Three outputs are planned for each species and each summary data product:

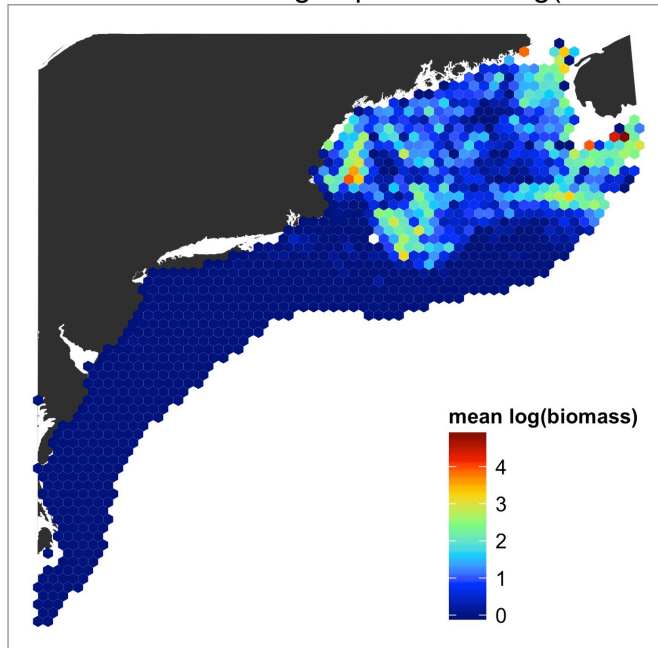
1. Bubble plot: Each raw observation is plotted as a circle, where circle size is proportional to the value of the observation in the tow (e.g., biomass; Atlantic cod example below).

ATLANTIC COD biomass bubble plot



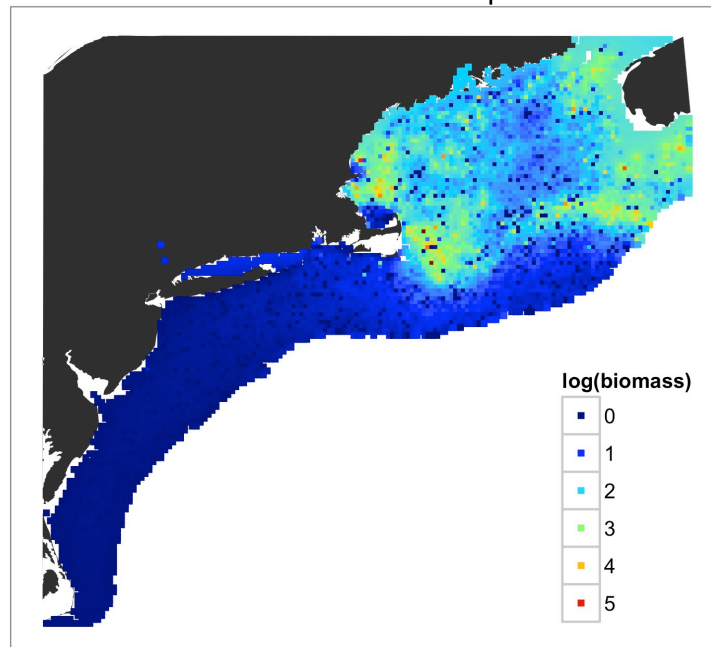
- Hexagon plot: The survey area is divided into a grid of hexagons (10km) and a summary statistic (e.g., median) is applied to observations within each hexagon (Atlantic cod example below).

ATLANTIC COD hexagon plot: mean log(biomass)



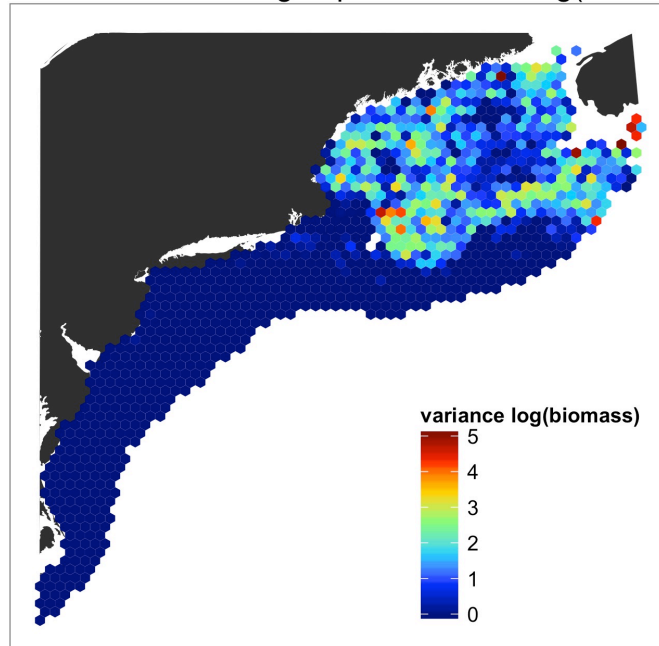
- Inverse-distance weighted (IDW) interpolation plot: An inverse-distance weighting algorithm is applied to all observations to smooth over multiple observations and to interpolate in regions with few observations with a grid size of 5km (Atlantic cod example below).

ATLANTIC COD idw plot



4. Uncertainty will be estimated as the variance within each hexagon.

ATLANTIC COD hexagon plot: variance log(biomass)



All outputs will cover the Northeast and Mid-Atlantic continental shelf region. Each species and summary data product will be produced both for the entire available time period and for the last 10 years. Uncertainty will be estimated using bootstrap resampling.

3.4 Map subsets

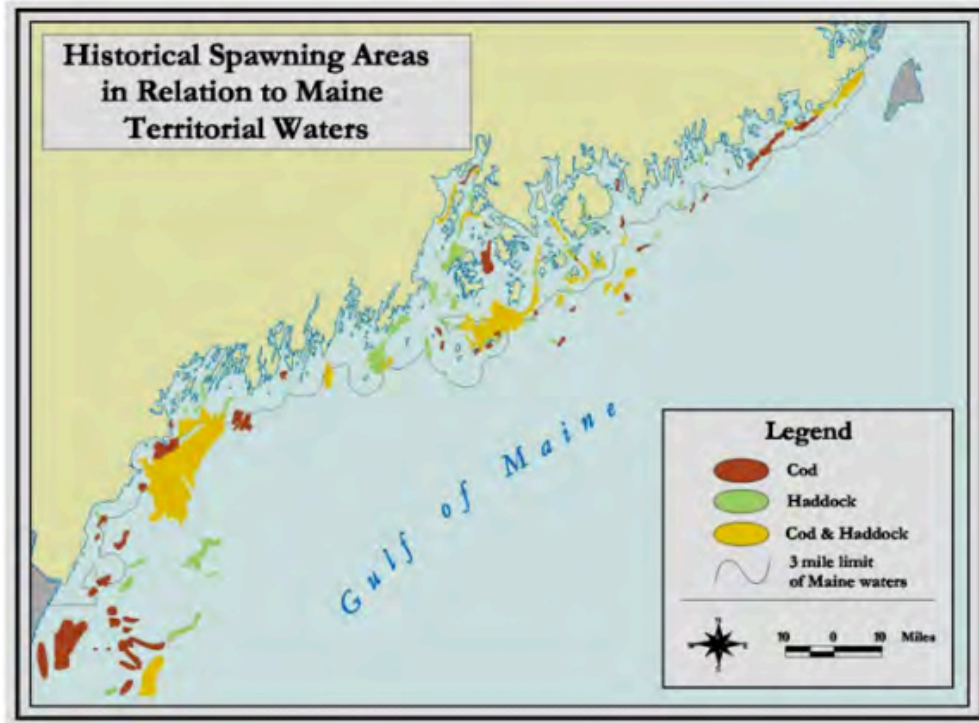
Each model output (section 3.4) will be produced for each of the following five map subsets:

1. Federal survey (1970 - 2014)
2. Federal survey (2005 - 2014)
3. MDMF survey
4. NEAMAP survey
5. Maine & New Hampshire survey

Therefore, for each species and aggregate in Table 1 and Appendix 1, 20 maps will be produced (4 outputs x 5 subsets).

3.5 Other Fish data

- Trawl effort maps of all tows for each data source will be provided.
- Animations of species abundance over time will be provided for all focal species
- Historical locations of spawning grounds for cod and haddock (Ted Ames, personal communication; see image below)



3.6 Summary data products for Fish

Summary data products will be provided to illustrate general patterns across taxa. These include functional groups, total abundance, total biomass, species richness, and species diversity (Table 1).

Appendix 1. List of species for which survey animations have been developed and the functional groups to which they have been assigned.

Species	Functional Group
Blackbelly Rosefish	Other fish
Silver Hake	Gadoid
Spotted Hake	Gadoid
Butterfish	Pelagic
Atlantic Cod	Gadoid
Pollock	Gadoid
Longfin squid	Invertebrate
Shortfin squid	Invertebrate
American lobster	Invertebrate
Jonah Crab	Invertebrate
Longhorn Sculpin	Other demersal
Northern Sea Robin	Other demersal
Sand Lance	Other fish
Sea Raven	Other demersal
Striped Sea Robin	Other demersal
Acadian Redfish	Other fish
Atlantic Croaker	Other fish
Monkfish	Other demersal
Northern PufferPig Fish	Other demersal
Red Hake	Gadoid
Scup	Other fish
Tilefish	Other fish
Banded Drum	Other fish
Haddock	Gadoid
Ocean Pout	Other demersal
Striped Bass	Other fish
Weakfish	Other fish
White Hake	Gadoid
Wolffish	Other fish
Cusk	Other fish
Pin FishSpot	Other fish
American Plaice	Flatfish
Fourspot Flounder	Flatfish
Gulf Stream Flounder	Flatfish
Summer Flounder	Flatfish
Windowpane Flounder	Flatfish

Winter Flounder	Flatfish
Witch Flounder	Flatfish
Yellowtail Flounder	Flatfish
Halibut	Flatfish
Sea Scallop	Invertebrate
Alewife	Pelagic
American Shad	Pelagic
Atlantic Herring	Pelagic
Atlantic Mackerel	Pelagic
Atlantic torpedo	Pelagic
Blueback Herring	Pelagic
Bluefish	Pelagic
Northern Kingfish	Pelagic
Pipefish	Other fish
Black Sea Bass	Other fish
Cunner	Other fish
Tautog	Other fish
Sturgeon	Other fish
American Eel	Other fish
Smooth Dogfish	Elasmobranch
Spiny Dogfish	Elasmobranch
Barndoor Skate	Elasmobranch
Bluntnose Stingray	Elasmobranch
Bullnose Stingray	Elasmobranch
Clearnose Skate	Elasmobranch
Little Skate	Elasmobranch
Rosette Skate	Elasmobranch
Roughtail Stingray	Elasmobranch
Sand Tiger Shark	Elasmobranch
Sharpnose Shark	Elasmobranch
Smooth Skate	Elasmobranch
Southern Stingray	Elasmobranch
Spiny Butterfly Ray	Elasmobranch
Thorney Skate	Elasmobranch
Winter Skate	Elasmobranch