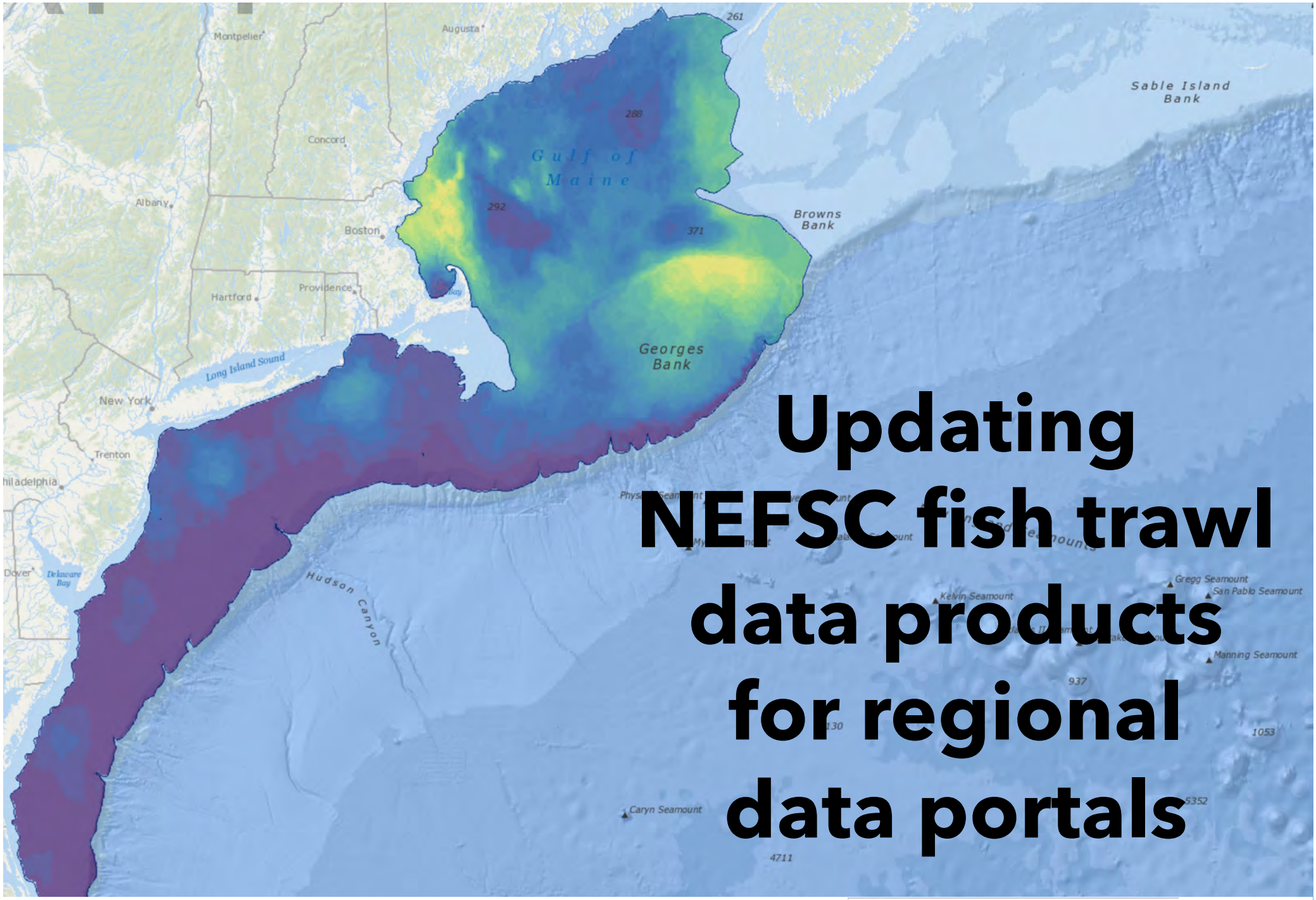


Updating NEFSC fish trawl data products for regional data portals

MARCO Mid-Atlantic Ocean Data Portal

NORTHEAST OCEAN DATA
www.NortheastOceanData.org

Marine Geospatial Ecology Lab, Duke University · NOAA · NCCOS · Loyola University Maryland · The Nature Conservancy

Introductions

Northeast Ocean Data Portal

Emily Shumchenia
(NROC contract staff, Northeast Ocean Data Portal manager)

Marta Ribera
(The Nature Conservancy, Spatial Ecologist)

Marine-life Data & Analysis Team (MDAT)

Pat Halpin, Jesse Cleary, Corrie Curtice
(Marine Geospatial Ecology Lab, Duke University)

Context

- Development of marine life data products accelerated during development of Northeast Ocean Plan and Mid-Atlantic Ocean Action Plan under Obama Admin National Ocean Policy
- New EO has focus on “timely release” of ocean-related data
- Regional ocean partnerships, Northeast Regional Ocean Council (NROC) & Mid-Atlantic Council on the Ocean (MARCO), contract with the Marine-life Data and Analysis Team (MDAT), led by the Duke Marine Geospatial Ecology Lab since 2014
- Individual species data products developed by each MDAT institution (cetaceans, birds, fish)
- Summary data products development guided by expert work groups
- Framework for presentation and description of data products on the Northeast Ocean Data Portal and the Mid-Atlantic Ocean Data Portal, uptake by Marine Cadastre

NORTHEAST OCEAN DATA
www.NortheastOceanData.org

MARCO Mid-Atlantic Ocean Data Portal

MarineCadastre.gov

Purpose of today's meeting

Broadly - obtain feedback on updated fish data products from NEFSC and other experts

- Understand any methodological and/or technical concerns with the implemented approach
- Get feedback on Portal data visualization, presentation, user support, connection to NEFSC and other contextual information
- Discuss ideas for future updates and/or potential additional data products that could be added to the Portal in the future

Foster and maintain relationships between NEFSC and the Portal

https://noaa-edab.github.io/tech-doc/index.html

Technical Documentation, State of the Ecosystem Report

Northeast Fisheries Science Center

22 March 2019

Introduction
1 Data and Code Access
2 Conceptual Models
3 Trend Analysis
4 Ecological Production Units
5 Single Species Status Indicator
6 Aggregate Groups
6.1 Methods
7 Survey Data
8 Recreational Fishing Indicators
9 Commercial Landings Data
10 Bennet Indicator
11 Catch and Fleet Diversity
12 Aquaculture
13 New England Harmful Algal Bloom I...
14 Mid-Atlantic Harmful Algal Bloom In...
15 Fishery Reliance and Social Vulnera...
16 Fishing Community Climate Vulnera...
17 Harbor Porpoise Bycatch
18 Right Whale Abundance
19 Ichthyoplankton Diversity
20 Species Distribution Indicators
21 Species Density Estimates
22 Thermal Habitat Projections
23 Habitat Occupancy Models
24 Verified Records of Southern Kingfish
25 Long-term Sea Surface Temperature
26 Annual SST Cycles
27 Seasonal SST Anomalies
28 Chlorophyll *a* and Primary Production
29 Zooplankton
30 Fish Condition Indicator
31 Fish Productivity Indicator

6.1 Methods

The State of the Ecosystem (SOE) reports are delivered to the New England Fishery Management Council (NEFMC) and Mid-Atlantic Fishery Management Council (MAFMC) to provide ecosystems context. To better understand that broader ecosystem context, many of the indicators are reported at an aggregate level rather than at a single species level. Species were assigned to an aggregate group following the classification scheme of Garrison and Link (2000) and Link et al. (2006). Both works classified species into feeding guilds based on food habits data collected at the Northeast Fisheries Science Center (NEFSC). In 2017, the SOE used seven specific feeding guilds (plus an "other" category; Table 6.1). These seven were the same guilds used in Garrison and Link (2000), which also distinguished ontogentic shifts in species diets.

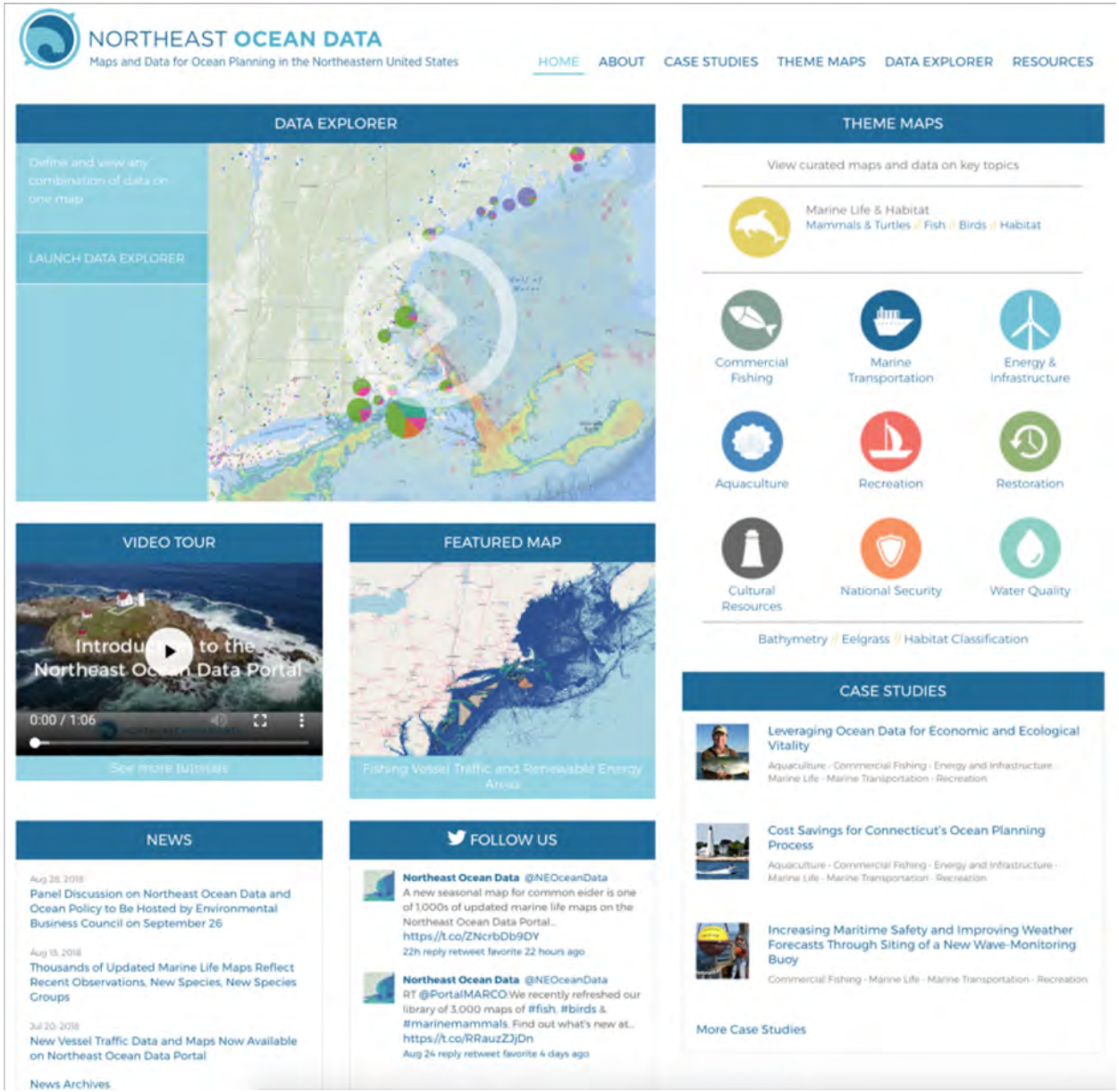
For the purposes of the SOE, species were only assigned to one category based on the most prevalent size available to commercial fisheries. However, several of those categories were confusing to the management councils, so in 2018 those categories were simplified to five (plus "other"; Table 6.2) along the lines of Link et al. (2006). In addition to feeding guilds, species managed by the councils have been identified. This is done to show the breadth of what a given council is responsible for within the broader ecosystem context.

Table 6.1: Aggregate groups use in 2017 SOE. Classifications are based on Garrison and Link 2000.

Feeding.Guild	Description
Apex Predator	Top of the food chain
Piscivore	Fish eaters
Macrozoo-piscivore	Shrimp and small fish eaters
Macroplanktivore	Amphipod and shrimp eaters
Mesoplanktivore	Zooplankton eaters
Benthivore	Bottom eaters
Benthos	Things that live on the bottom
Other	Things not classified above

Table 6.2: Aggregate groups use in 2018 SOE. Classifications are based on Link et al. 2006.

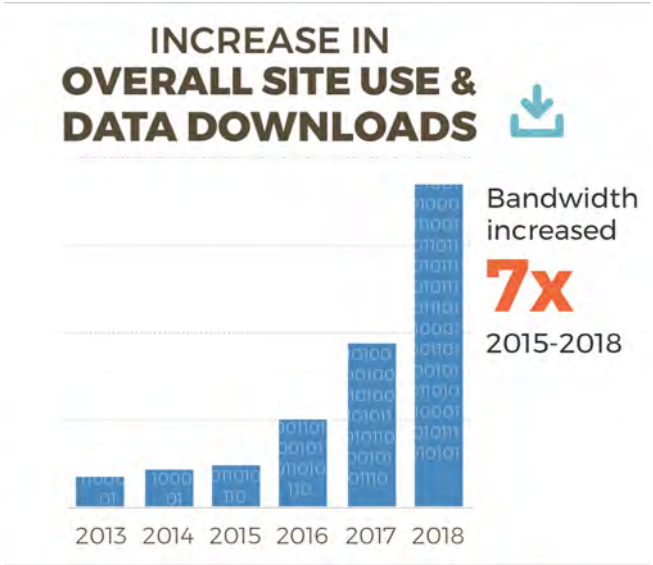
Feeding.Guild	Description
Apex Predator	Top of the food chain
Piscivore	Fish eaters
Planktivore	Zooplankton eaters
Benthivore	Bottom eaters
Benthos	Things that live on the bottom
Other	Things not classified above

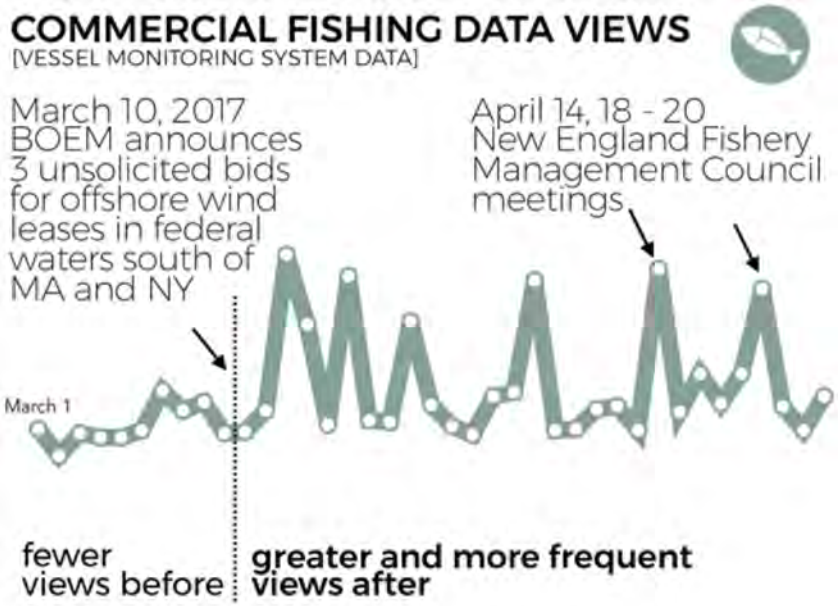


- Source of over 4,000 map products showing the footprint of activities and resources
- Federal, state, and stakeholder provided data
- Customized to address regional stakeholder and agency needs
- Informed and vetted by regional stakeholders and experts

www.NortheastOceanData.org

Portal Use





United States Senate
WASHINGTON, DC 20510

December 14, 2018

Dr. Walter Cruickshank
Acting Director
Bureau of Ocean Energy Management
1849 C Street, NW
Washington, D.C. 20240

Dear Dr. Cruickshank:

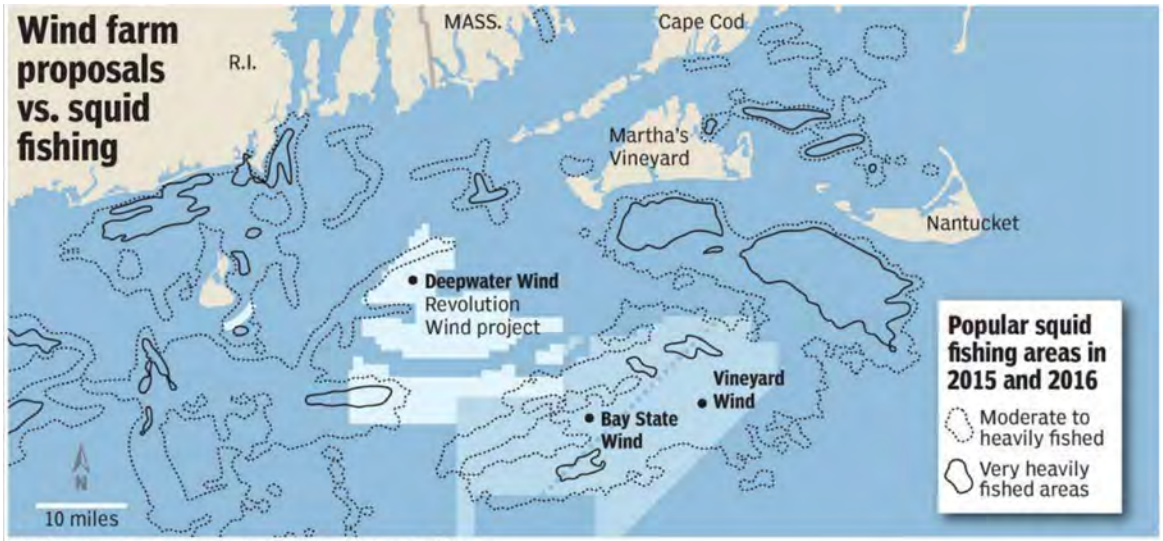
As long-time supporters of both the offshore wind and fishing industries, we write to urge the Bureau of Ocean Energy Management (BOEM) to continue to pursue policies for the offshore wind leasing and permitting process that will help minimize conflicts among developers, the fishing industry, and other stakeholders.

Massachusetts and Rhode Island have championed offshore wind and set ambitious renewable energy goals. Our states understand that smart planning and consultation with stakeholders, particularly the fishing industry, will allow offshore wind to flourish in the United States, protect important ocean resources, and maintain access for existing users. However, we have heard from our constituents who believe that BOEM is not currently taking this balanced approach. This is particularly true with respect to the fishing industry.

The seafood industry is a vital economic engine for our states—supporting 89,868 jobs in Massachusetts and Rhode Island.[1] For example, in 2016, $327 million of seafood was landed in New Bedford, MA and $56 million in Point Judith, RI.[2] These communities, which have suffered federally-declared fishery disasters over the last decade, can ill-afford additional hardship resulting from a faulty development process.

We have seen the offshore wind development process work successfully off the Rhode Island coast, where the nation's first offshore wind project currently provides energy to the residents of Block Island and beyond. With a strong reliance on collaborative and meaningful engagement, Rhode Island's experience proved that offshore wind and other marine industries can operate in harmony. We should apply these lessons to projects off the East Coast.

Though we recognize BOEM utilizes roundtable discussions, liaisons, and initiatives such as "Smart from the Start" to improve communication between the fishing industry and wind developers, many of our constituents consider the existing efforts to be ineffective. These interactions come after a lease is awarded, missing the better opportunity to identify conflicts and mitigate potential harms before awarding a lease. Similarly, we are not confident that BOEM has met the charge set out in the Outer Continental Shelf Lands Act (OCSLA) that BOEM



SOURCE: Energy Management, Deepwater Wind, Bureau of Ocean Energy Management, Northeast Ocean Data

PROVIDENCE JOURNAL GRAPHIC

Select Uses of the Northeast Ocean Data Portal

Planning and Management

- New England Fishery Management Council (NEFMC) Deep Sea Coral Amendment Alternatives
- NEFMC Clam Dredge Exemption Framework Alternatives
- USCG waterways management, including deploying aids to navigation and ice breaking assets
- USCG Port Access Route Study (PARS) – Nantucket Sound
- US Navy identify areas for testing underwater autonomous vessels and potentially affected stakeholders
- NOAA charts
- CT Blue Plan for Long Island Sound
- NY Geographic Information Gateway
- NYSERDA Offshore Wind Master Plan
- Boston Harbor Barrier Feasibility Study
- MA oil and hazardous materials flow study

Regulatory and Siting

- Northeast and NY Wind Energy Area Transit Corridor Development
- Vineyard Wind EIS
- South Fork Wind Farm Construction and Operations Plan
- New York Draft Wind Energy Areas
- NEMAC Mussel Farm sited in Mass Bay – first shellfish farm in federal waters on Atlantic Coast
- NERACOOS wave buoy sited in Cape Cod Bay to inform mariners transiting the canal
- Manna Fish Farm Alternative Siting Analysis
- Proposed Atlantic Link Transmission Cable through the Gulf of Maine – proposed and alternative routes and permitting process details provided via Portal
- States use Portal to inform coastal effects test and federal consistency under CZM
- Consultants supporting permitting and leasing, and developing custom apps for regulated clients

Regulatory and Siting (continued)

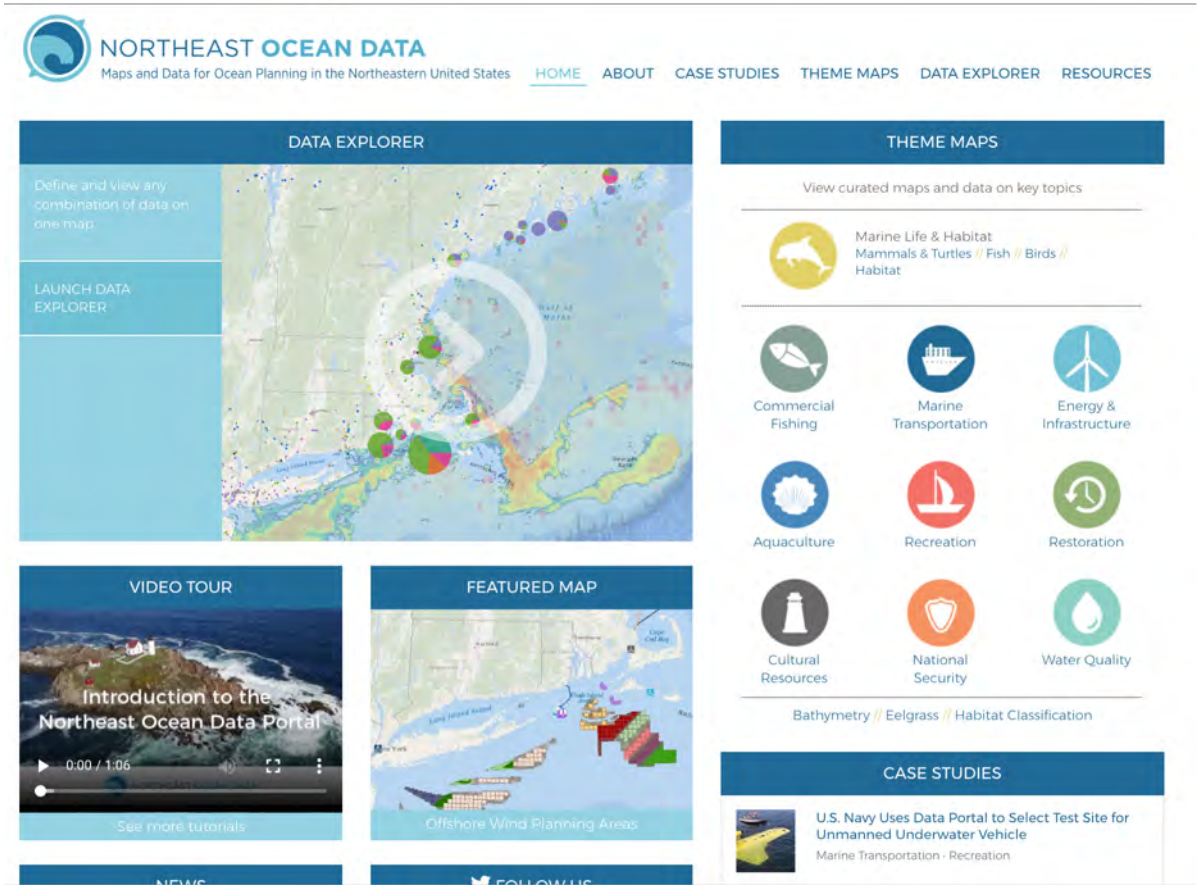
- EPA to review other agency EA and EIS and comment on other agency actions
- USACE regulatory division permitting
- NOAA Office of Habitat Protection and Protected Resources Division consultations
- BOEM Guidelines for Renewable Energy Activities
- Massachusetts Aquaculture Siting Tool – MA-ShellfAST

Education and Research

- UMass Dartmouth; UMass Boston
- UMaine
- Brown
- Boston University
- URI
- Island Institute
- Pew
- Old Dominion University

Context – basic framework

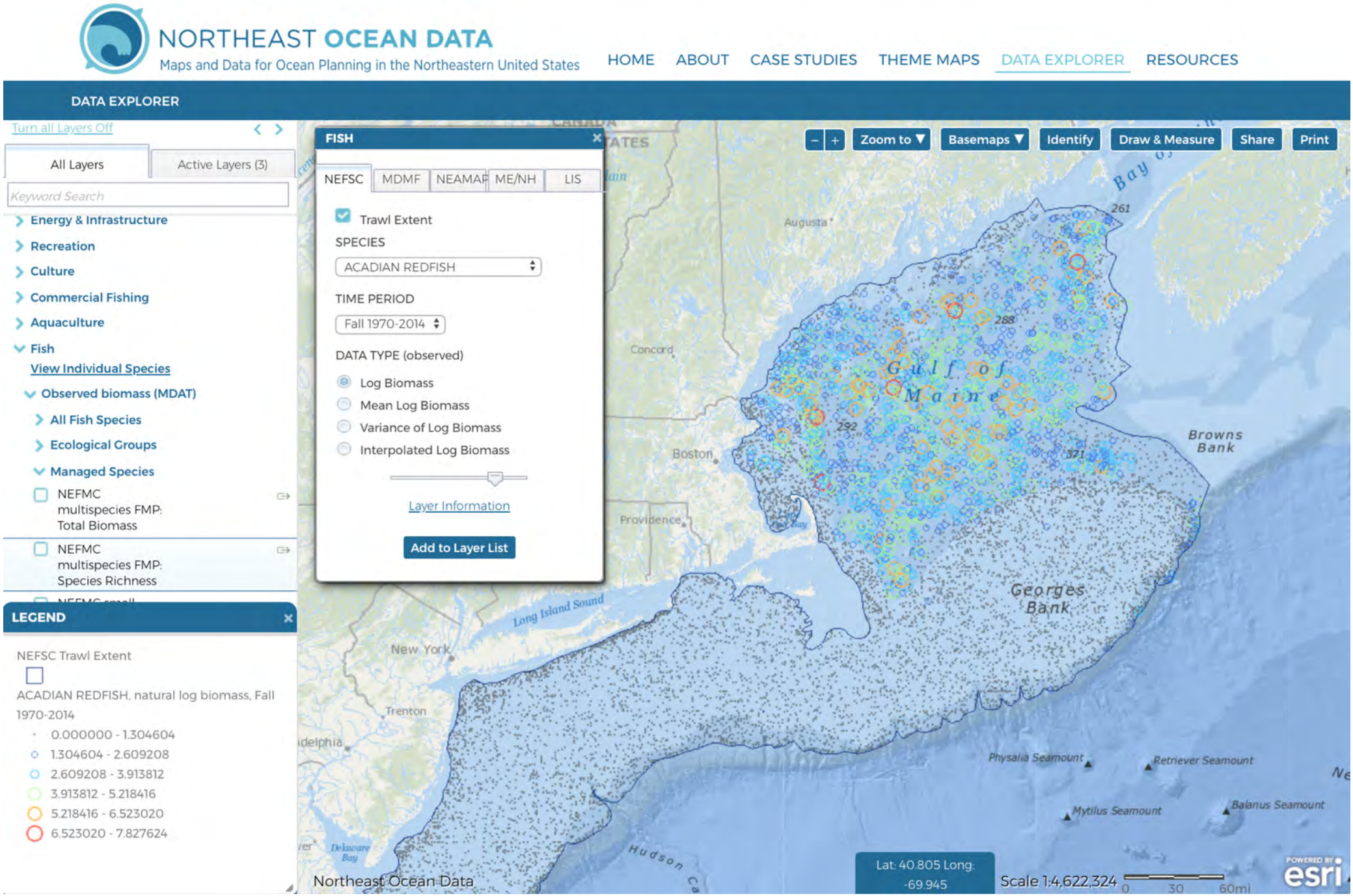
(Similar presentation on each Portal)

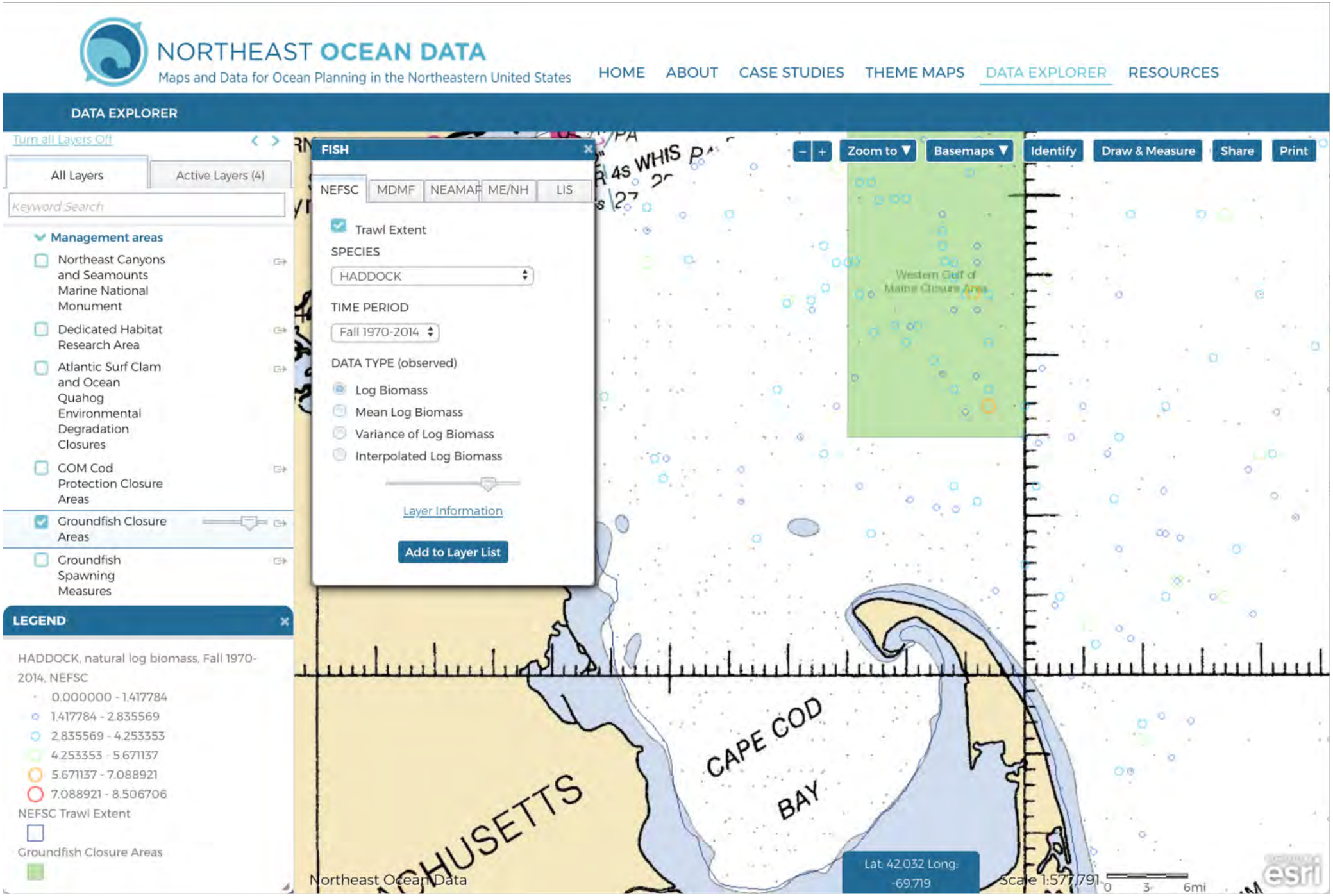


Theme maps: simple map viewers (view one layer at a time)

Data Explorer: overlay multiple layers, basic "GIS" functions

Data download: obtain the data, metadata, and technical report in a package for use in desktop GIS


NORTHEAST OCEAN DATA
Maps and Data for Ocean Planning in the Northeastern United States
HOME
ABOUT
CASE STUDIES
THEME MAPS
DATA EXPLORER
RESOURCES
DATA EXPLORER
Turn all Layers Off
All Layers
Active Layers (3)
Keyword Search
Energy & Infrastructure
Recreation
Culture
Commercial Fishing
Aquaculture
Fish
View Individual Species
Observed biomass (MDAT)
All Fish Species
Ecological Groups
Managed Species
NEFMC multispecies FMP: Total Biomass
NEFMC multispecies FMP: Species Richness
LEGEND
NEFSC Trawl Extent
ACADIAN REDFISH, natural log biomass, Fall 1970-2014
0.000000 - 1.304604
1.304604 - 2.609208
2.609208 - 3.913812
3.913812 - 5.218416
5.218416 - 6.523020
6.523020 - 7.827624
FISH
NEFSC
MDMF
NEAMAP
ME/NH
LIS
Trawl Extent
SPECIES
ACADIAN REDFISH
TIME PERIOD
Fall 1970-2014
DATA TYPE (observed)
Log Biomass
Mean Log Biomass
Variance of Log Biomass
Interpolated Log Biomass
Layer Information
Add to Layer List
Zoom to
Basemaps
Identify
Draw & Measure
Share
Print
Augusta
Concord
Boston
Providence
New York
Trenton
Gulf of Maine
Browns Bank
Georges Bank
Long Island Sound
Physalia Seamount
Retriever Seamount
Mytilus Seamount
Balanus Seamount
261
288
292
371
Lat: 40.805 Long: -69.945
Scale 1:4,622,324
0 30 60mi
Northeast Ocean Data
esri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HOME
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DATA EXPLORER
RESOURCES
DATA EXPLORER
Turn all Layers Off
All Layers
Active Layers (4)
Keyword Search
Management areas
Northeast Canyons and Seamounts Marine National Monument
Dedicated Habitat Research Area
Atlantic Surf Clam and Ocean Quahog Environmental Degradation Closures
GOM Cod Protection Closure Areas
Groundfish Closure Areas
Groundfish Spawning Measures
FISH
NEFSC
MDMF
NEAMAP
ME/NH
LIS
Trawl Extent
SPECIES
HADDOCK
TIME PERIOD
Fall 1970-2014
DATA TYPE (observed)
Log Biomass
Mean Log Biomass
Variance of Log Biomass
Interpolated Log Biomass
Layer Information
Add to Layer List
LEGEND
HADDOCK, natural log biomass, Fall 1970-2014, NEFSC
0.000000 - 1.417784
1.417784 - 2.835569
2.835569 - 4.253353
4.253353 - 5.671137
5.671137 - 7.088921
7.088921 - 8.506706
NEFSC Trawl Extent
Groundfish Closure Areas
Zoom to
Basemaps
Identify
Draw & Measure
Share
Print
Western Gulf of Maine Closure Area
CAPE COD
BAY
Lat 42.032 Long: -69.719
Scale 1:577,791
0
3
6mi
Northeast Ocean Data
esri

Suite of products

INDIVIDUAL SPECIES PRODUCTS

Biomass (fish)

Abundance (cetaceans, birds)

SUMMARY PRODUCTS

Groups of species:

- Ecological (e.g., demersal fish)
- Managed species (e.g., NEFMC Multispecies FMP)
- Stressor groups (e.g., NEFSC climate vulnerability study)

Total biomass/abundance

Species richness

Displayed on the Portal

"Legacy" products

Shannon diversity

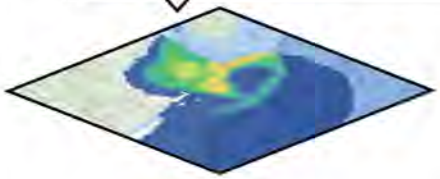
Simpson diversity

Core biomass/abundance area

THOUSANDS

INDIVIDUAL SPECIES & HABITAT LAYERS

How many North Atlantic right whales are predicted in the Gulf of Maine in July?



29 marine mammal species/guilds
40 avian species
82 fish species
3 sea turtle species
physical & biological habitat

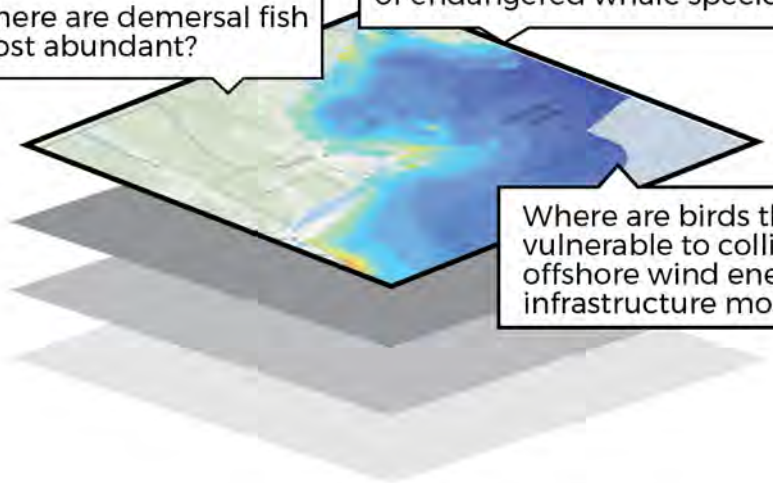
HUNDREDS

SPECIES GROUP LAYERS

Total abundance & species richness for ecological, regulatory, and stressor-sensitivity groups

Where do the highest number of endangered whale species overlap?

Where are demersal fish most abundant?

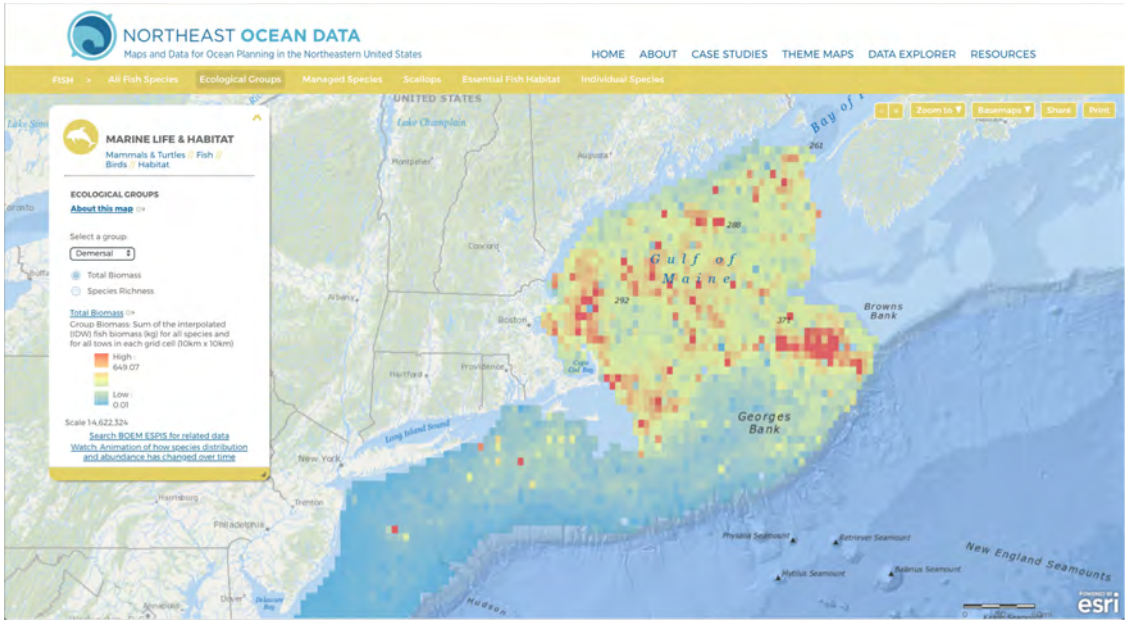


Where are birds that are vulnerable to collision with offshore wind energy infrastructure most abundant?

Version history

Version 1 (2016-2018)

- NEFSC trawl data
  - Fall only
  - 1970-2014 AND 2005-2014
  - Individual species log biomass – point data
  - Interpolated (IDW) log biomass – 10km grid
  - Mean and variance log biomass - hexagons
- Same products for NEAMAP and state trawls (beginning of time series – 2014)



Version history

Version 2 (August 2018)

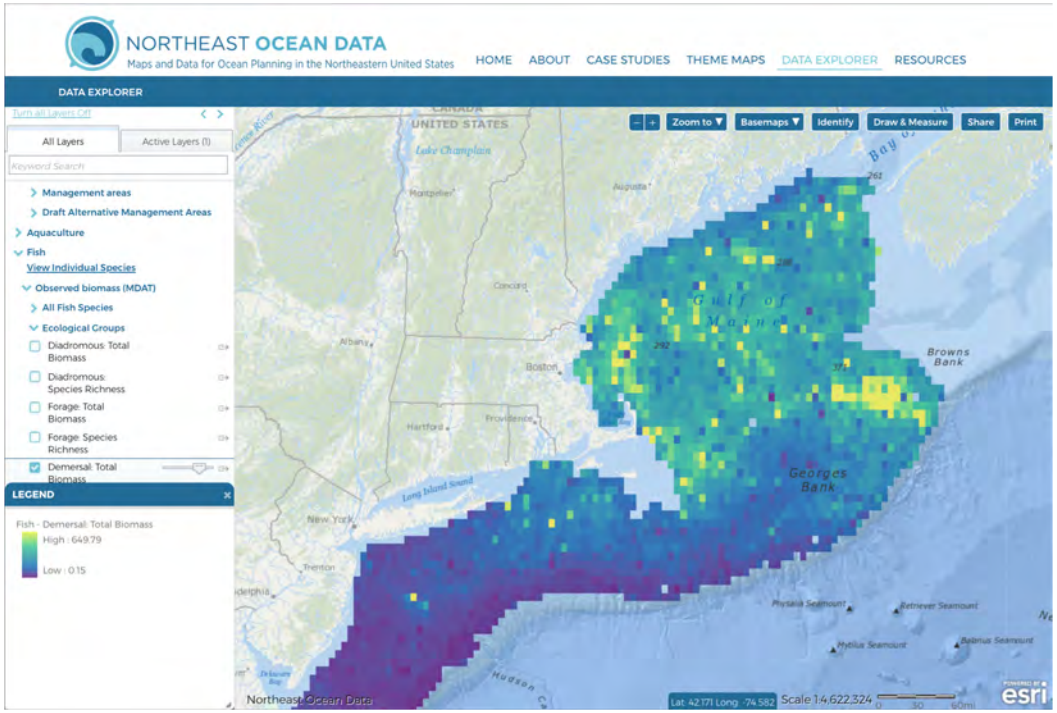
All the same individual species products for fish

Pre-filtered inputs to diversity products (95% species biomass)

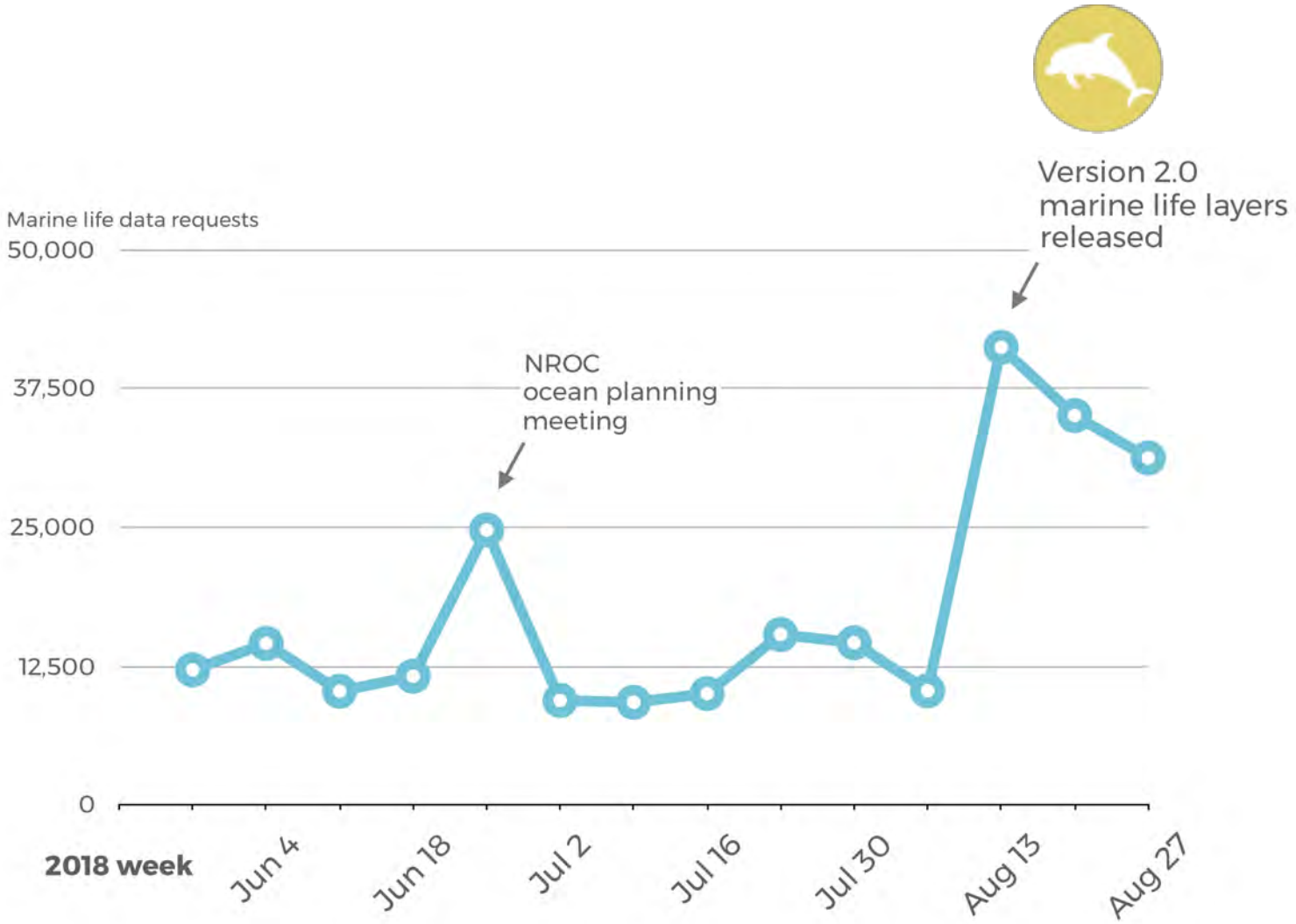
Added species group products for NEAMAP data

Two new species group products based on NEFSC climate vulnerability assessment

Color scheme updated



Marine life data use

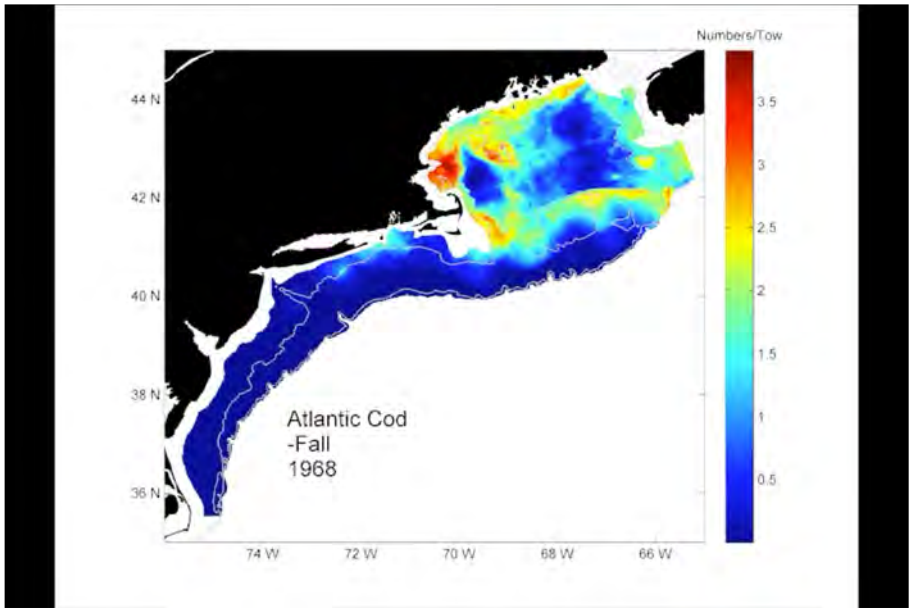


Version 3 goals

1. Update the data – products only included up to 2014 trawl data
2. Address stakeholder feedback
    a) Improve spatial resolution
    b) Add spring trawl data products
    c) Standardize legends so seasons can be compared
3. Opportunity to improve interpolation methodology?

Version 3 goals

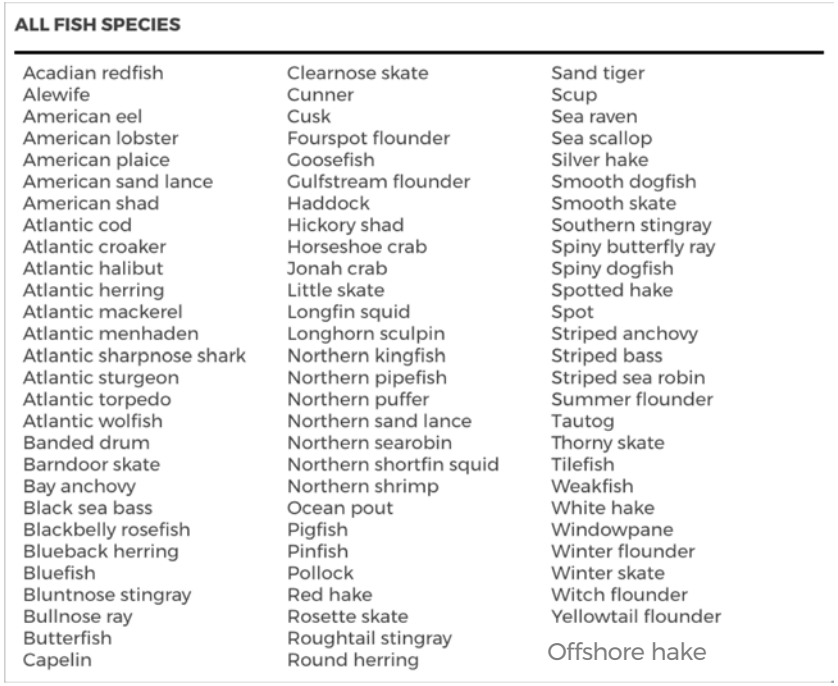
- Our focus was on recreating the animations on the NEFSC website (https://www.nefsc.noaa.gov/ecosys/spatial-analyses/)
- Same species, same interpolation
- However, we updated the code to improve performance, input new data (from OceanAdapt site), and export results as spatial layers (Geotiffs)
- **Outputs**:
  - Shapefiles with stations (2010-2016) with biomass/tow for each species
  - Geotiffs with "transformed" yearly biomass (yearly interpolation, averaged from 2010-2016)



Version 3 goals

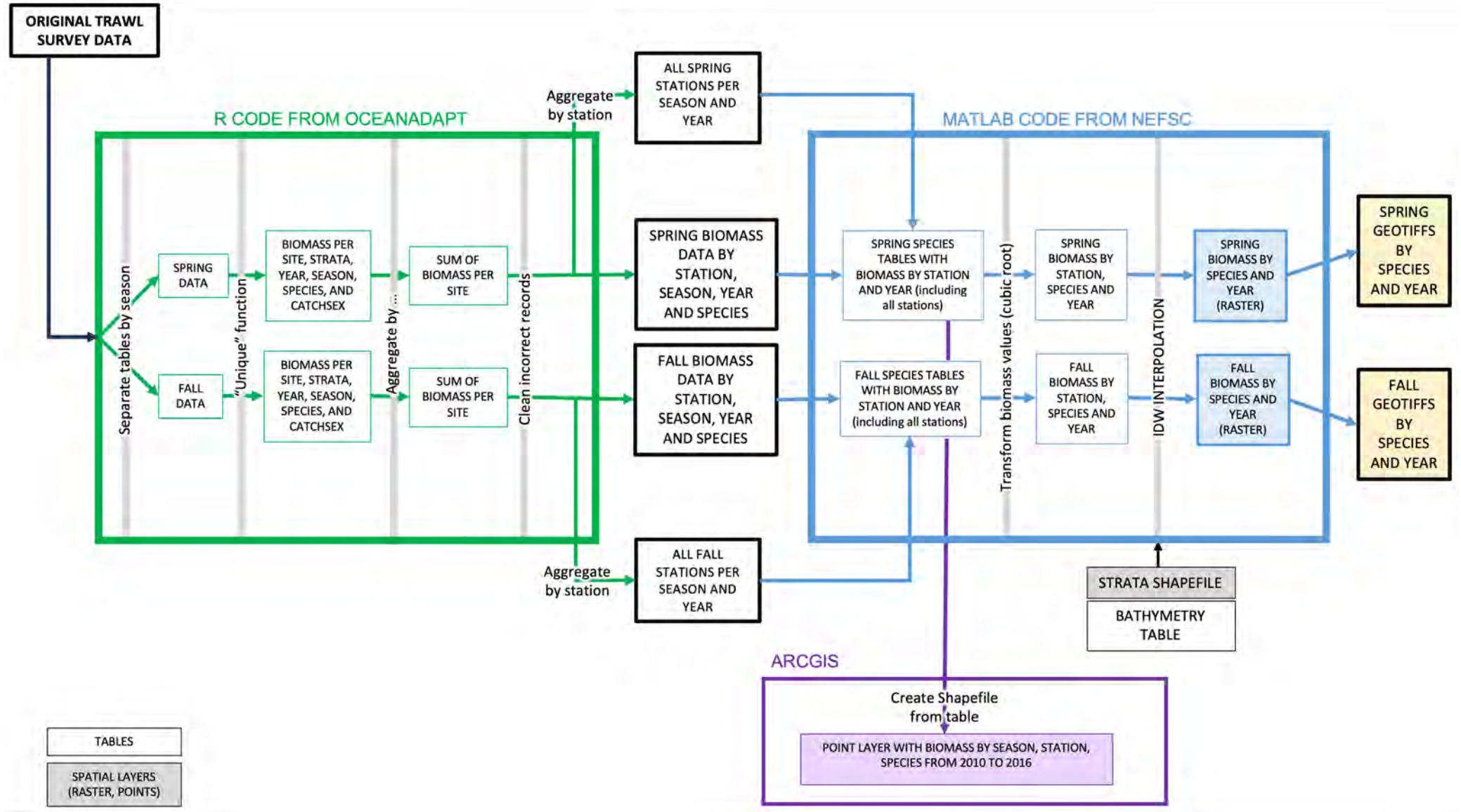
Include products for individual species included in Versions 1 and 2, for which there are not animations on NEFSC website:

- American sand lance
- Atlantic menhaden
- Bay anchovy
- Capelin
- Hickory shad
- Horseshoe crab
- Northern shrimp
- Round herring
- Striped anchovy



ALL FISH SPECIES

Acadian redfish	Clearnose skate	Sand tiger
Alewife	Cunner	Scup
American eel	Cusk	Sea raven
American lobster	Fourspot flounder	Sea scallop
American plaice	Goosefish	Silver hake
American sand lance	Gulfstream flounder	Smooth dogfish
American shad	Haddock	Smooth skate
Atlantic cod	Hickory shad	Southern stingray
Atlantic croaker	Horseshoe crab	Spiny butterfly ray
Atlantic halibut	Jonah crab	Spiny dogfish
Atlantic herring	Little skate	Spotted hake
Atlantic mackerel	Longfin squid	Spot
Atlantic menhaden	Longhorn sculpin	Striped anchovy
Atlantic sharpnose shark	Northern kingfish	Striped bass
Atlantic sturgeon	Northern pipefish	Striped sea robin
Atlantic torpedo	Northern puffer	Summer flounder
Atlantic wolfish	Northern sand lance	Tautog
Banded drum	Northern searobin	Thorny skate
Barndoor skate	Northern shortfin squid	Tilefish
Bay anchovy	Northern shrimp	Weakfish
Black sea bass	Ocean pout	White hake
Blackbelly rosefish	Pigfish	Windowpane
Blueback herring	Pinfish	Winter flounder
Bluefish	Pollock	Winter skate
Bluntnose stingray	Red hake	Witch flounder
Bullnose ray	Rosette skate	Yellowtail flounder
Butterfish	Roughtail stingray	
Capelin	Round herring	Offshore hake


ORIGINAL TRAWL SURVEY DATA
R CODE FROM OCEANADAPT
Separate tables by season
SPRING DATA
FALL DATA
"Unique" function
BIOMASS PER SITE, STRATA, YEAR, SEASON, SPECIES, AND CATCHSEX
BIOMASS PER SITE, STRATA, YEAR, SEASON, SPECIES, AND CATCHSEX
Aggregate by ...
SUM OF BIOMASS PER SITE
SUM OF BIOMASS PER SITE
Clean incorrect records
Aggregate by station
ALL SPRING STATIONS PER SEASON AND YEAR
Aggregate by station
ALL FALL STATIONS PER SEASON AND YEAR
SPRING BIOMASS DATA BY STATION, SEASON, YEAR AND SPECIES
FALL BIOMASS DATA BY STATION, SEASON, YEAR AND SPECIES
MATLAB CODE FROM NEFSC
SPRING SPECIES TABLES WITH BIOMASS BY STATION AND YEAR (including all stations)
FALL SPECIES TABLES WITH BIOMASS BY STATION AND YEAR (including all stations)
Transform biomass values (cubic root)
SPRING BIOMASS BY STATION, SPECIES AND YEAR
FALL BIOMASS BY STATION, SPECIES AND YEAR
IDW INTERPOLATION
SPRING BIOMASS BY SPECIES AND YEAR (RASTER)
FALL BIOMASS BY SPECIES AND YEAR (RASTER)
SPRING GEOTIFFS BY SPECIES AND YEAR
FALL GEOTIFFS BY SPECIES AND YEAR
STRATA SHAPEFILE
BATHYMETRY TABLE
ARCGIS
Create Shapefile from table
POINT LAYER WITH BIOMASS BY SEASON, STATION, SPECIES FROM 2010 TO 2016
TABLES
SPATIAL LAYERS (RASTER, POINTS)

Edits to the Matlab code

- **New data**: Up to 2017 for Spring and 2016 for Fall
- **Outputs** exported as GeoTiff layers (instead of animations)
- Taking **one year at a time**

```
% Picking Data
%k=find((YEAR>=Yr-2) & (YEAR<=Yr+2)  & (strcmp(SEASON,seasonlist{x}))==1);
k=find((YEAR==Yr) & (strcmp(SEASON,seasonlist{x}))==1);
```

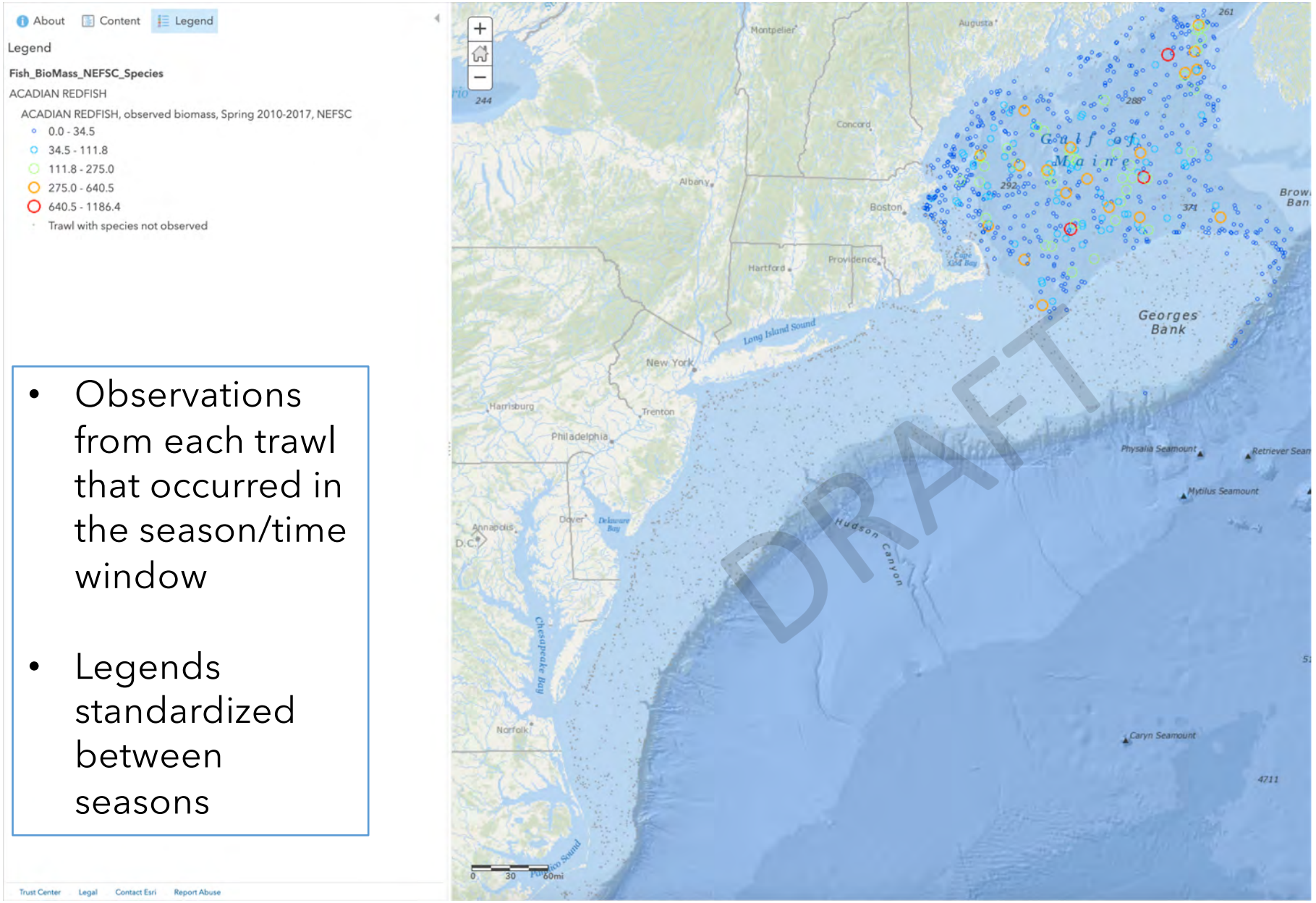
ORIGINAL
NEW

- Fixing bugs and improving performance

```
AdjLon=xi(q,m)+(LONDD2-xi(q,m)).*((AdjDist./Dist));
AdjLat=yi(q,m)+(LATDD2-yi(q,m)).*((AdjDist./Dist));
k=find(Dist==0); AdjLon(k)=xi(q,m)+AdjDist(k)+.02;AdjLon(k)=zi(q,m)+AdjDist(k)+.02;
k=find(LONDD2-xi(q,m)<0); AdjLon(k)=AdjLon(k)-.01;
k=find(LONDD2-xi(q,m)>=0); AdjLon(k)=AdjLon(k)+.01;
%k=find(LATDD2-xi(q,m)<0); AdjLat(k)=AdjLat(k)-.01;
%k=find(LATDD2-xi(q,m)>=0); AdjLat(k)=AdjLat(k)+.01;
k=find(LATDD2-yi(q,m)<0); AdjLat(k)=AdjLat(k)-.01;
k=find(LATDD2-yi(q,m)>=0); AdjLat(k)=AdjLat(k)+.01;
```

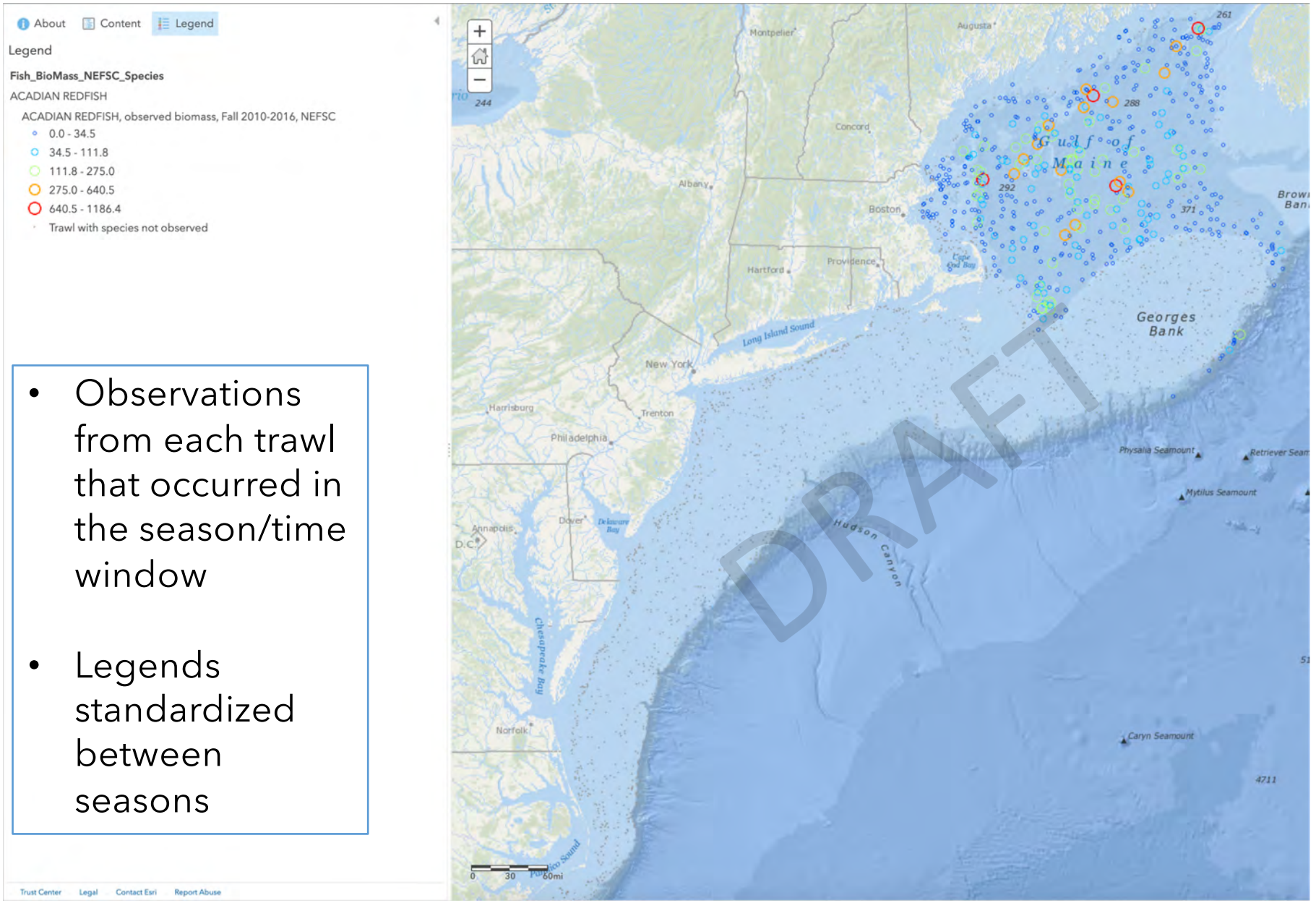
ORIGINAL
NEW

Example output



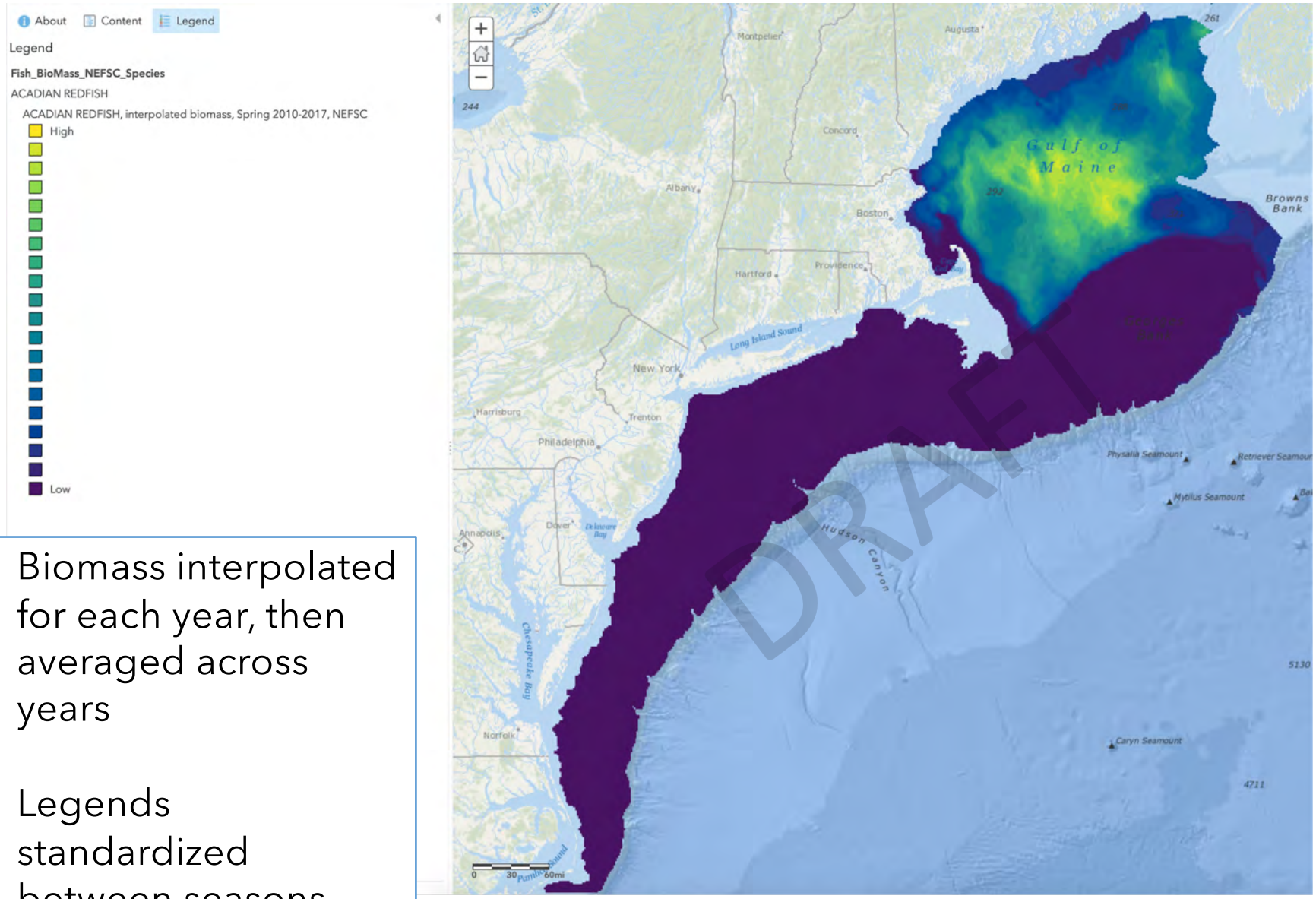
- Observations from each trawl that occurred in the season/time window
- Legends standardized between seasons

Example output



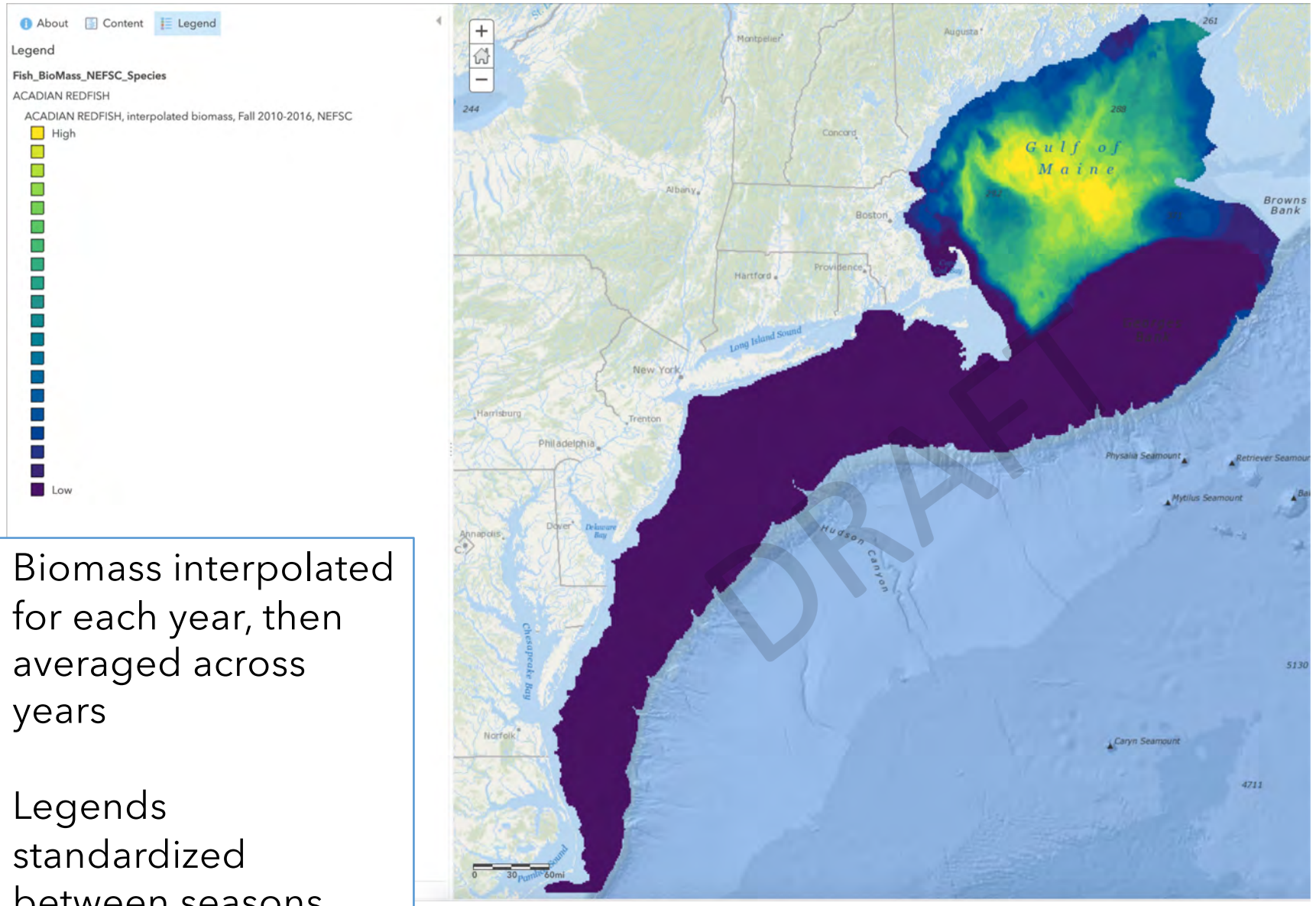
- Observations from each trawl that occurred in the season/time window
- Legends standardized between seasons

Example output



- Biomass interpolated for each year, then averaged across years
- Legends standardized between seasons

Example output

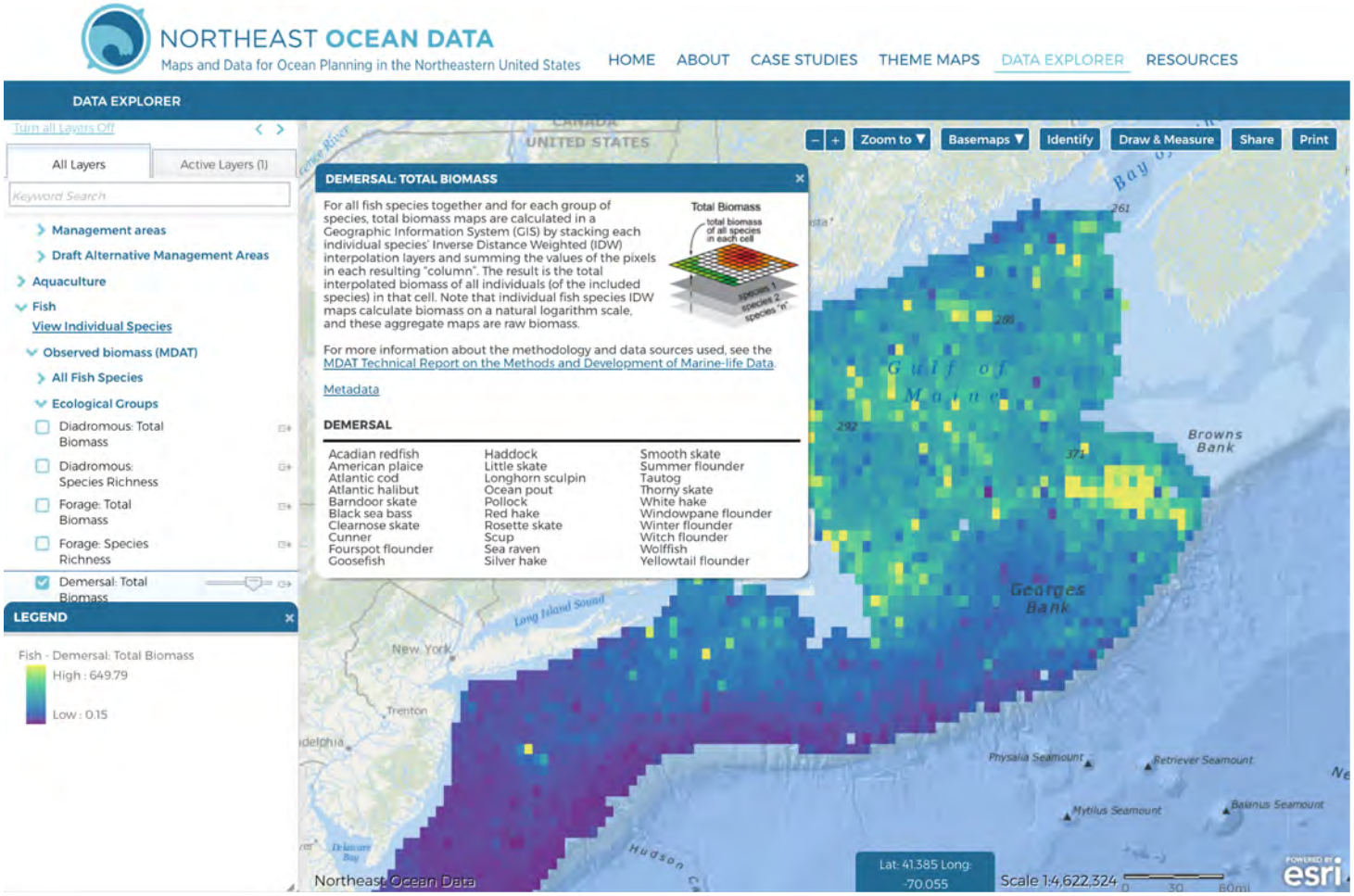


- Biomass interpolated for each year, then averaged across years
- Legends standardized between seasons

Questions

- Any issues with the code edits?
- Is this the best way to visualize these layers?

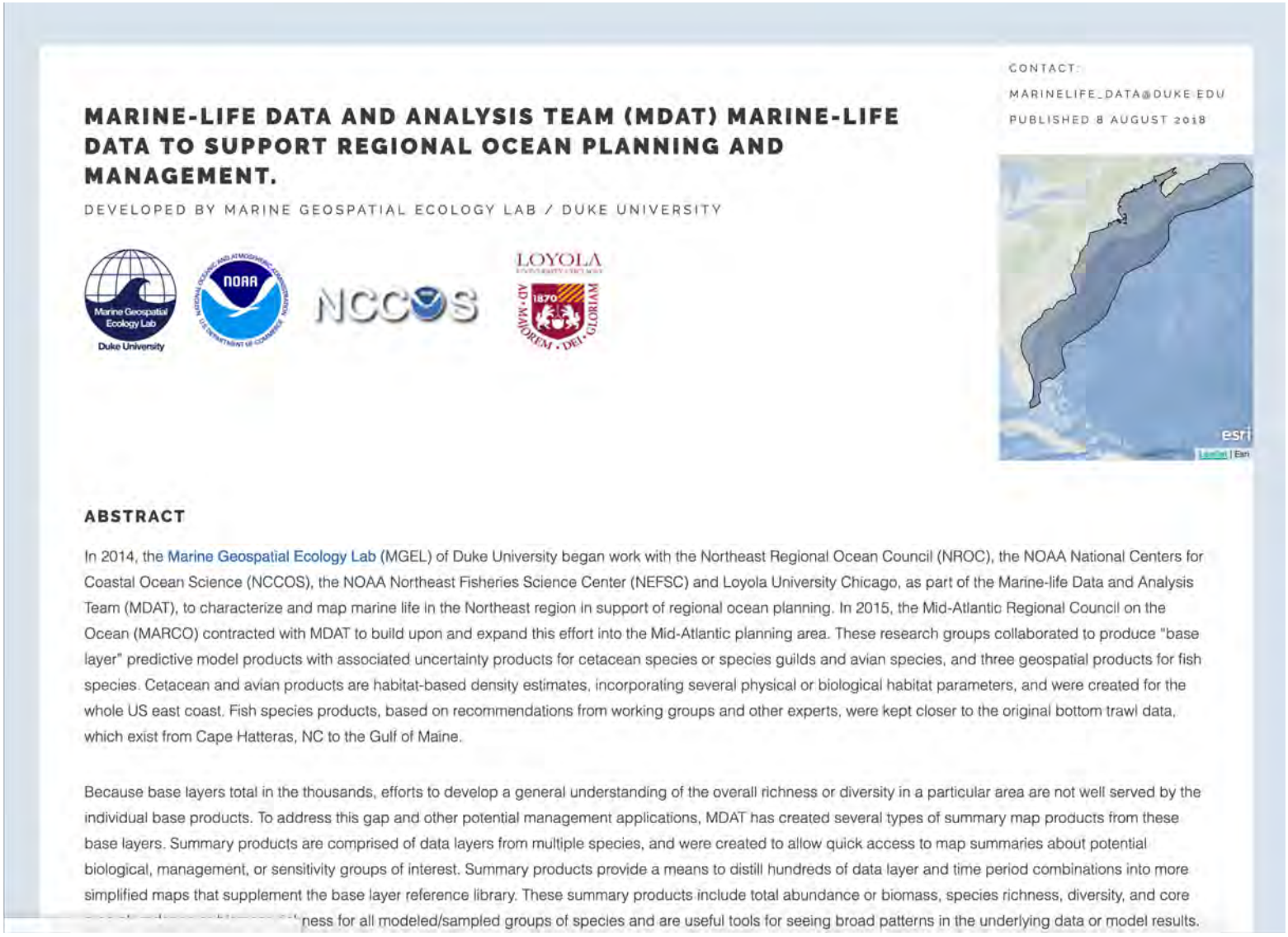
Documentation and user support



- Metadata
- Technical report
- Interactive tools - popups

Documentation and user support

http://seamap.env.duke.edu/models/mdat/



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PUBLISHED 8 AUGUST 2018

MARINE-LIFE DATA AND ANALYSIS TEAM (MDAT) MARINE-LIFE DATA TO SUPPORT REGIONAL OCEAN PLANNING AND MANAGEMENT.

DEVELOPED BY MARINE GEOSPATIAL ECOLOGY LAB / DUKE UNIVERSITY

ABSTRACT

In 2014, the Marine Geospatial Ecology Lab (MGEL) of Duke University began work with the Northeast Regional Ocean Council (NROC), the NOAA National Centers for Coastal Ocean Science (NCCOS), the NOAA Northeast Fisheries Science Center (NEFSC) and Loyola University Chicago, as part of the Marine-life Data and Analysis Team (MDAT), to characterize and map marine life in the Northeast region in support of regional ocean planning. In 2015, the Mid-Atlantic Regional Council on the Ocean (MARCO) contracted with MDAT to build upon and expand this effort into the Mid-Atlantic planning area. These research groups collaborated to produce "base layer" predictive model products with associated uncertainty products for cetacean species or species guilds and avian species, and three geospatial products for fish species. Cetacean and avian products are habitat-based density estimates, incorporating several physical or biological habitat parameters, and were created for the whole US east coast. Fish species products, based on recommendations from working groups and other experts, were kept closer to the original bottom trawl data, which exist from Cape Hatteras, NC to the Gulf of Maine.

Because base layers total in the thousands, efforts to develop a general understanding of the overall richness or diversity in a particular area are not well served by the individual base products. To address this gap and other potential management applications, MDAT has created several types of summary map products from these base layers. Summary products are comprised of data layers from multiple species, and were created to allow quick access to map summaries about potential biological, management, or sensitivity groups of interest. Summary products provide a means to distill hundreds of data layer and time period combinations into more simplified maps that supplement the base layer reference library. These summary products include total abundance or biomass, species richness, diversity, and core

ness for all modeled/sampled groups of species and are useful tools for seeing broad patterns in the underlying data or model results.

Documentation and user support

MARINE-LIFE DATA AND ANALYSIS TEAM (MDAT) TECHNICAL REPORT ON THE METHODS AND DEVELOPMENT OF MARINE-LIFE DATA TO SUPPORT REGIONAL OCEAN PLANNING AND MANAGEMENT

Authors: Corrie Curtice, Jesse Cleary, Emily Shumchenia, Patrick Halpin

Prepared on behalf of The Marine-life Data and Analysis Team (MDAT):
Patrick Halpin (Principal Investigator, Duke University), Earvin Balderama (Co-I, Loyola University Chicago), Jesse Cleary (Duke University), Corrie Curtice (Duke University), Michael Fogarty (Co-I, NOAA/NEFSC), Brian Kinlan† (NOAA/NCCOS), Charles Perretti (NOAA/NEFSC), Jason Roberts (Duke University), Emily Shumchenia (NROC), Arliss Winship (Co-I, NOAA/NCCOS)

Date published: 08 August 2018

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Accessible from: http://seamap.env.duke.edu/models/MDAT/MDAT-Technical-Report.pdf

† Deceased January 27, 2017

NCCOS · Marine Geospatial Ecology Lab, Duke University · NOAA · LOYOLA 1870 AD MAJOREM DEI GLORIAM

Documentation and user support

In prep:
Cleary J, Curtice C, Shumchenia E, Roberts J, Winship A, Ribera M, Kinlan B, Napoli N, Perretti C, Fogarty M, Halpin P.
Summary data products for characterizing marine life distribution in the US Northeast and Mid-Atlantic regions for ocean planning purposes.
Target journal: PLOS ONE

Documentation and user support

Marine-life Data and Analysis Team (MDAT) Fish Product Updates
Summary of Changes for v3.0 Update (January 2019)

Overview

Fish individual species products were updated by MDAT, in partnership with The Nature Conservancy, and OceanAdapt (a collaboration between the Pinsky Lab at Rutgers University and the National Marine Fisheries Service) in early 2019. These products were reviewed by species experts and other stakeholders, as well as the MDAT fish expert working group at that time, and are documented in detail in Curtice et al. (2019). This document contains a brief summary of the changes to the base-layer products and the MDAT group summary products. Additional details on the base-layer products and summary products can be found in the MDAT Technical Report (Curtice et al., 2019).

Individual species base-layer updates

1. Additional season. Spring individual species biomass is now represented in addition to fall individual species biomass.

2. Additional survey data. Individual species products now include data at each surveyed trawl site from 2010-2017 for fall and 2010-2016 for spring (records for fall 2017 were removed due to problem with survey gear, as recommended by the NOAA Northeast Fisheries Science Center (NEFSC)).

3. New mapping methodology. In addition to maps of observed biomass for each individual species, MDAT and partners developed maps of interpolated biomass using code initially developed by NEFSC to create animations of species biomass change over time. The interpolation considers the depth of each observation and the sampling strata of which it is a member. The results are 2km x 2km grid-cell interpolations of fish biomass informed by certain habitat variables. Interpolated biomass products represent the average biomass for each species during each season for the examined years (2010-2017 for fall and 2010-2016 for spring).

4. New species. All 82 species mapped in v2.0 are mapped in v3.0, with the addition of offshore hake, for 83 total v3.0 species.

Next steps

- Ensure technical/data partners have opportunity to review and comment (this meeting, Pinsky lab)
- Ensure NEFMC and MAFMC GIS staff have opportunity to review and comment
- Input/feedback from other ocean planning stakeholders, including original fish work group
- Thorough testing of data on Portal development site
- Public release coordinated among NE and MARCO Portals

Other ongoing work and in development

- Integrating ESA Section 7 Consultation Areas, GARFO Protected Resources Division
- Representing opportunistic sightings for cetaceans, various entities
- Bird tracking data products, BOEM, BRI, USFWS