Marine-life Data & Analysis



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Northeast Regional Ocean Council Public Webinar

August 27, 2014



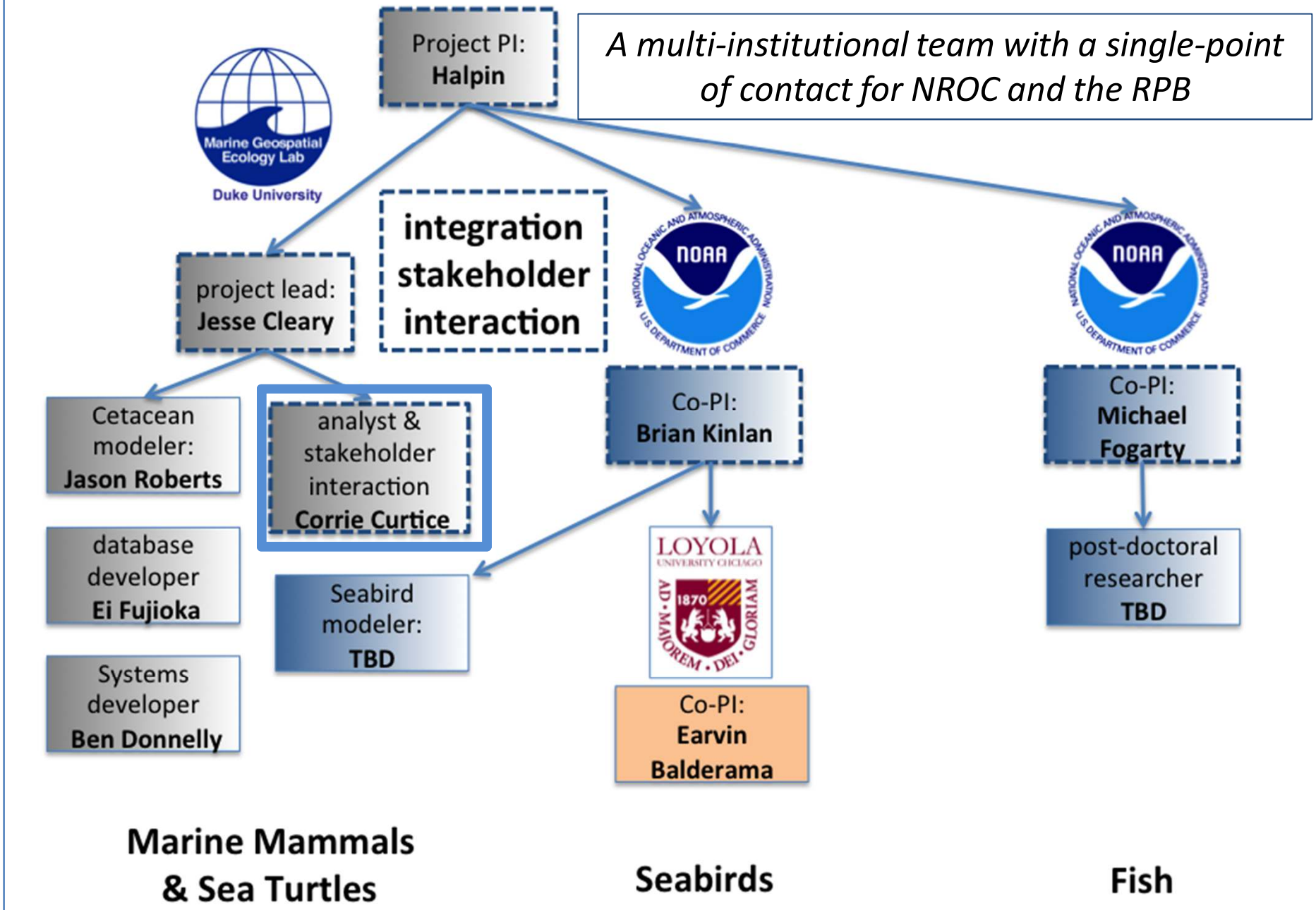
Overview

- Team review
- Timeline review
- Expert working groups
  - Data acquisitions
  - Data product options

Marine-life **D**ata & **A**nalysis **T**eam

- Marine Geospatial Ecology Lab – Duke University
  - Pat Halpin, Jason Roberts, Corrie Curtice, Jesse Cleary
- NOAA – NCCOS
  - Brian Kinlan (Co-I), Arliss Winship
- NOAA – NMFS/NEFSC – EcoAP
  - Mike Fogarty (Co-I), Charles Peretti
- Loyola University
  - Earvin Balderama

Project organization chart



Project timeline

Data Acquisition

Expert input/review

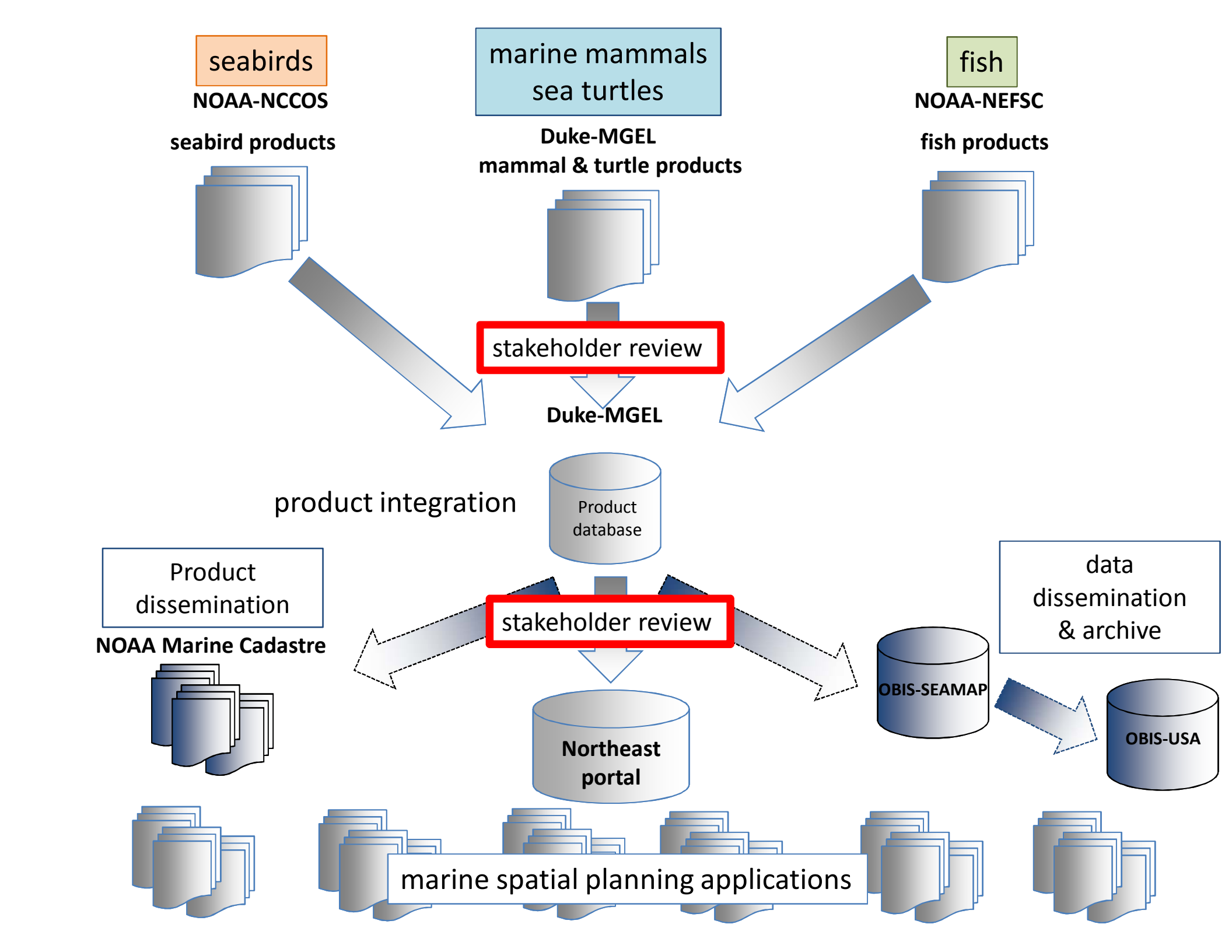
Data Products

Expert input/review

Analysis & Model Products

Expert input/review

Integration


seabirds
NOAA-NCCOS
seabird products
marine mammals
sea turtles
Duke-MGEL
mammal & turtle products
fish
NOAA-NEFSC
fish products
stakeholder review
Duke-MGEL
product integration
Product
database
Product
dissemination
NOAA Marine Cadastre
stakeholder review
data
dissemination
& archive
OBIS-SEAMAP
OBIS-USA
Northeast
portal
marine spatial planning applications

Questions?

Avian Working Group 8-1-2014 discussion topics

- How were season definitions decided?
- How is prioritization of species decided?
  - Species with enough observations will all be modeled
  - Species with too few observations need to be assessed for modeling potential
- How could species be grouped, ie: terns?
- How can models be combined, pre- or post- model
- Nearshore *vs*. at sea species, models
- Post processing options,

  ie: hot spots, diversity spots

At-Sea Avian Survey Effort Summary, as of Aug 1, 2014

Compendium of Avian Occurrence Information in the Atlantic

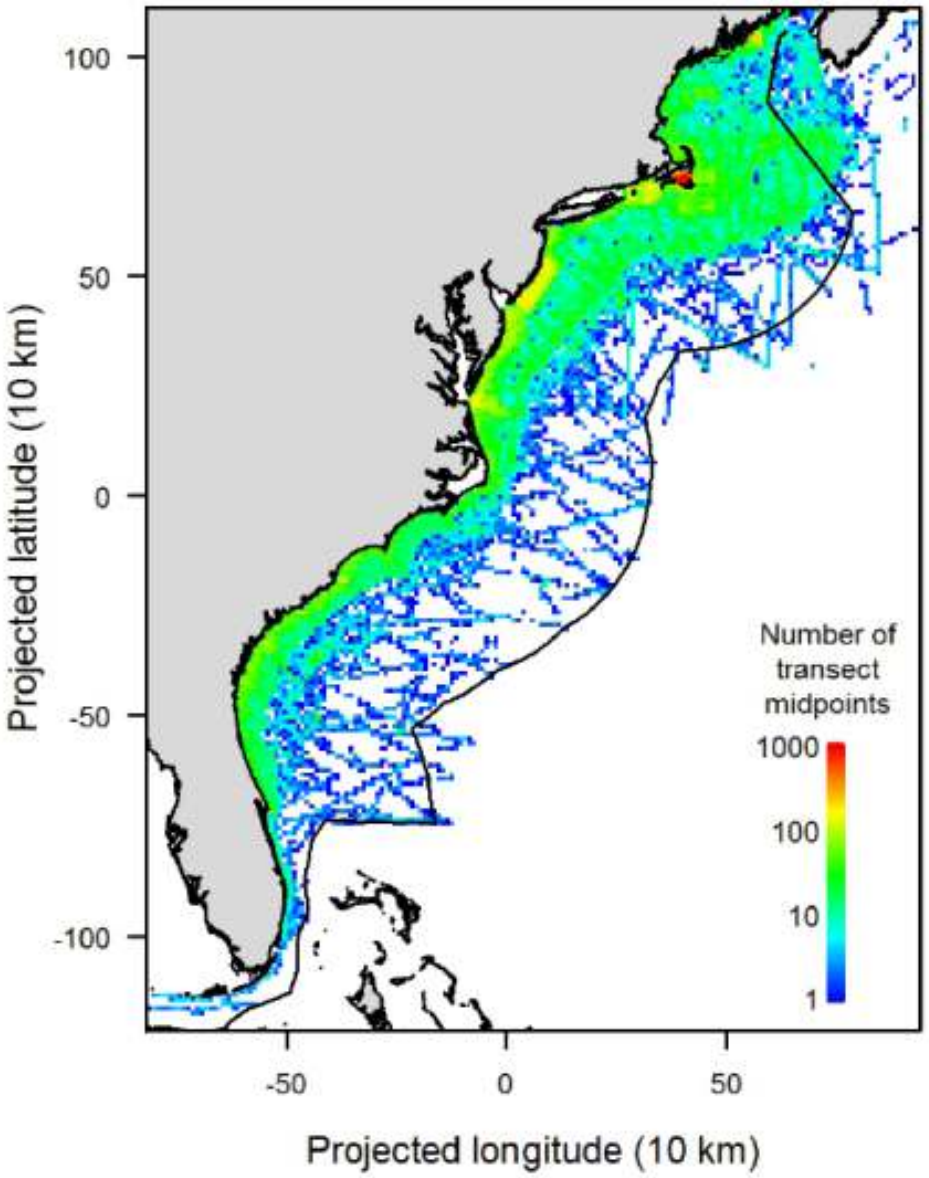


Figure 2. Map of survey effort (number of transect midpoints per 10-km square) across all datasets. The black line indicates the boundary of the Exclusive Economic Zone.

Species Table with Transect Segment Counts from all Atlantic At-Sea Data

Table. List of species and number of sightings in each season. For each season, only species with >= 100 sightings would normally be modelled. Number of sightings includes incomplete records (missing predictor data) that would be excluded from the analysis.

Species code	Common name	Scientific name	Family	Number of sightings				
				Total	Spring	Summer	Fall	Winter
razo	Razorbill	*Alca torda*	Alcidae	3597	856	358	479	1904
dove	Dovekie	*Alle alle*	Alcidae	1776	283	53	418	1022
blgu	Black guillemot	*Cepphus grylle*	Alcidae	203	17	111	15	60
atpu	Atlantic puffin	*Fratercula arctica*	Alcidae	855	220	273	95	267
comu	Common murre	*Uria aalge*	Alcidae	279	87	41	12	139
lesc	Lesser scaup	*Aythya affinis*	Anatidae	103	0	0	0	103
ltdu	Long-tailed duck	*Clangula hyemalis*	Anatidae	7634	1581	782	1317	3954
blsc	Black scoter	*Melanitta americana*	Anatidae	2772	581	155	449	1587
wwsc	White-winged scoter	*Melanitta fusca*	Anatidae	3438	698	313	751	1676
susc	Surf scoter	*Melanitta perspicillata*	Anatidae	5094	1192	621	1141	2140
rbme	Red-breasted merganser	*Mergus serrator*	Anatidae	297	131	0	28	138
coei	Common eider	*Somateria mollissima*	Anatidae	5688	1210	710	1084	2684
colo	Common loon	*Gavia immer*	Gaviidae	8299	2445	621	1327	3906
rtlo	Red-throated loon	*Gavia stellata*	Gaviidae	5696	2237	173	503	2783
wisp	Wilson's storm-petrel	*Oceanites oceanicus*	Hydrobatidae	10886	1722	7743	1331	90
brsp	Band-rumped storm-petrel	*Oceanodroma castro*	Hydrobatidae	275	14	251	10	0
lesp	Leach's storm-petrel	*Oceanodroma leucorhoa*	Hydrobatidae	2654	227	1969	457	1
bogu	Bonaparte's gull	*Chroicocephalus philadelphia*	Laridae	2311	551	113	383	1264
herg	Herring gull	*Larus argentatus*	Laridae	22300	5845	3291	7663	5501
rbgu	Ring-billed gull	*Larus delawarensis*	Laridae	1777	263	80	294	1140
gbbg	Great black-backed gull	*Larus marinus*	Laridae	16053	3411	3347	5449	3846
lagu	Laughing gull	*Leucophaeus atricilla*	Laridae	3726	696	1428	1399	203
blki	Black-legged kittiwake	*Rissa tridactyla*	Laridae	7035	748	127	2237	3923
brpe	Brown pelican	*Pelecanus occidentalis*	Pelecanidae	513	104	167	100	142
dcco	Double-crested cormorant	*Phalacrocorax auritus*	Phalacrocoracidae	906	131	230	237	308
hogr	Horned grebe	*Podiceps auritus*	Podicipedidae	186	33	16	31	106
cosh	Cory's shearwater	*Calonectris diomedea*	Procellariidae	4368	135	2658	1549	26
nofu	Northern fulmar	*Fulmarus glacialis*	Procellariidae	6678	2253	742	1828	1855
bcpe	Black-capped petrel	*Pterodroma hasitata*	Procellariidae	600	158	339	93	10
grsh	Great shearwater	*Puffinus gravis*	Procellariidae	12765	614	5817	6190	144
sosh	Sooty shearwater	*Puffinus griseus*	Procellariidae	2447	784	1548	111	4
aush	Audubon's shearwater	*Puffinus lherminieri*	Procellariidae	1205	130	753	278	44
mash	Manx shearwater	*Puffinus puffinus*	Procellariidae	687	101	306	265	15
reph	Red phalarope	*Phalaropus fulicarius*	Scolopacidae	1030	462	220	286	62
rnph	Red-necked phalarope	*Phalaropus lobatus*	Scolopacidae	471	130	172	155	14
spsk	South polar skua	*Stercorarius maccormicki*	Stercorariidae	216	21	72	123	0
pasa	Parasitic jaeger	*Stercorarius parasiticus*	Stercorariidae	298	48	75	160	15
posa	Pomarine jaeger	*Stercorarius pomarinus*	Stercorariidae	983	111	146	714	12
grsk	Great skua	*Stercorarius skua*	Stercorariidae	242	16	26	174	26
lete	Least tern	*Sterna antillarum*	Sternidae	303	28	183	86	6
rost	Roseate tern	*Sterna dougallii*	Sternidae	621	87	265	208	61
cote	Common tern	*Sterna hirundo*	Sternidae	3089	543	1448	908	190
royt	Royal tern	*Sterna maxima*	Sternidae	968	391	271	287	19
arte	Arctic tern	*Sterna paradisaea*	Sternidae	263	44	176	43	0
noga	Northern gannet	*Morus bassanus*	Sulidae	19687	5868	1538	4192	8089

1. Prioritization and species selection for analysis

	Federal					State		Other				
Species - common name	ESA	MMPA	EFH	FWS BCR30 Priority	MBTA	E, T, SC	Ocean Plans	Managed fishery	Keystone	Likely to interact with priority human uses	Range info, migratory, etc.	MDAT no. of observations
American avocet				Moderate	X							
American black duck				Highest	X							
American golden plover				High	X							
American oystercatcher				Highest	X	ME, RI, CT (SC)						
Arctic tern					X	ME (E); NH, MA (SC)	MA SSU					263
Atlantic brant				Highest	X							
Atlantic puffin					X	ME (E)						855
Audubon's shearwater				High	X							
Black guillemot					X							203
Black rail				Highest	X	CT, NY (E)						
Black scoter				High	X		MA SSU; RI ADP					2772
Black skimmer					X		MA SSU					

2. At-sea focused analyses vs shore/estuarine/marsh/land-based analyses

3. Grouping of species

Product Examples

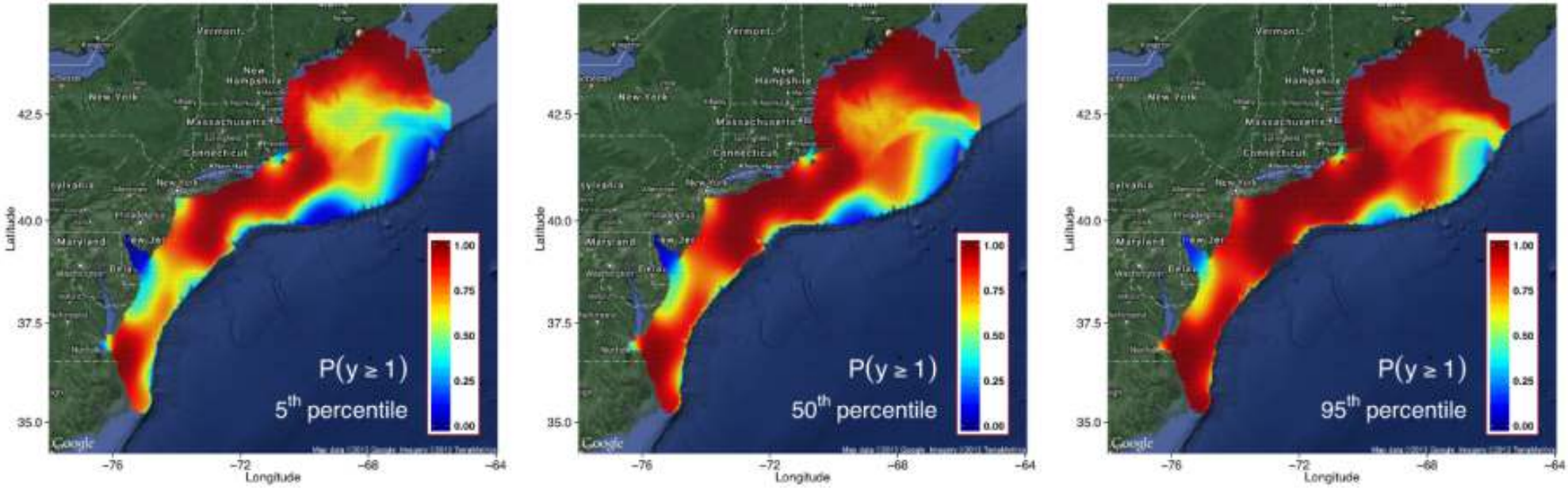
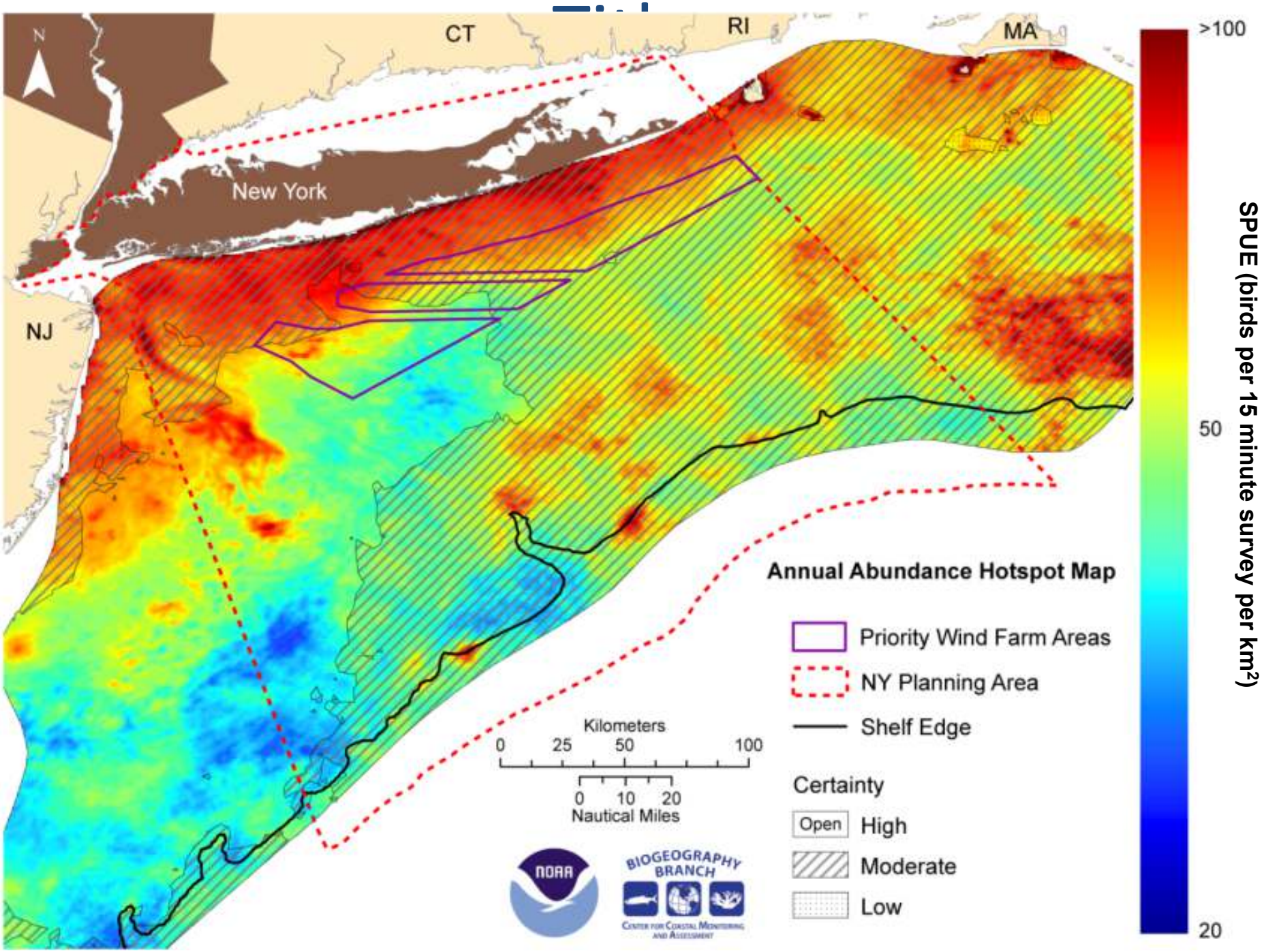


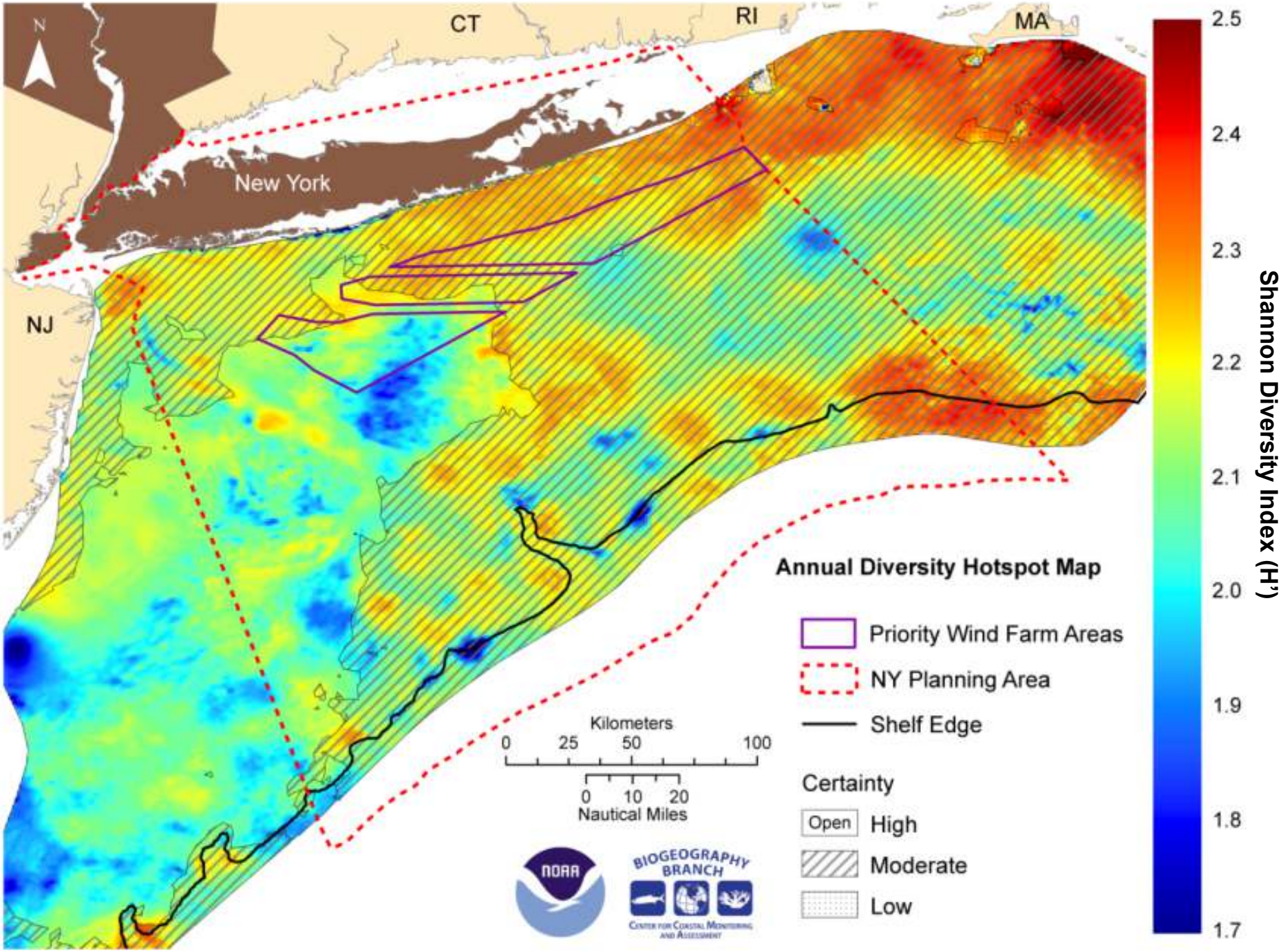
Figure 2: Northern Gannet: Risk maps of the probability of observing at least one individual during the year. The median estimate is presented along with the 5^{th} and 95^{th} percentiles to show uncertainty in parameter estimates.

From Balderama, Gardner and Reich, in prep.

Synthetic map products: abundance hotspots



Synthetic map products: diversity hotspots



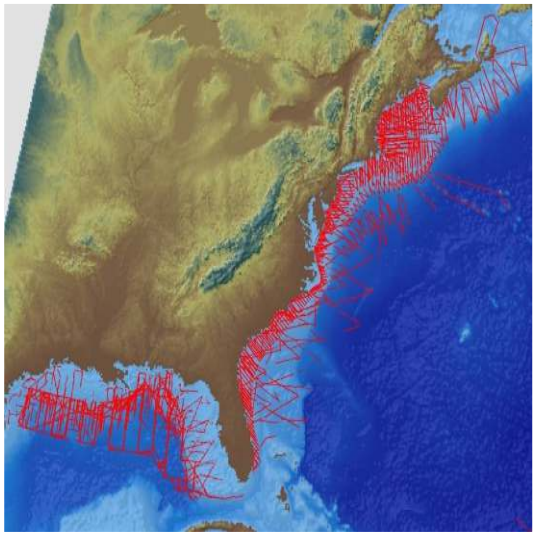
Questions?

Marine Mammal & Sea Turtle Working Group 8-7-2014 discussion topics

- What additional line transect surveys we should incorporate?
- What spatial extent does NROC want?
- Should we summarize models into multi-species summaries (e.g. all baleen whales)?
- How to handle situations where density modeling is not possible?
  - Rare species
  - Near-shore / estuarine areas
- How to best present model uncertainty?
- Do members of the working group have expertise in particular species, and would they be interested in reviewing models in detail offline?
- Should we produce alternative products, other than density models?

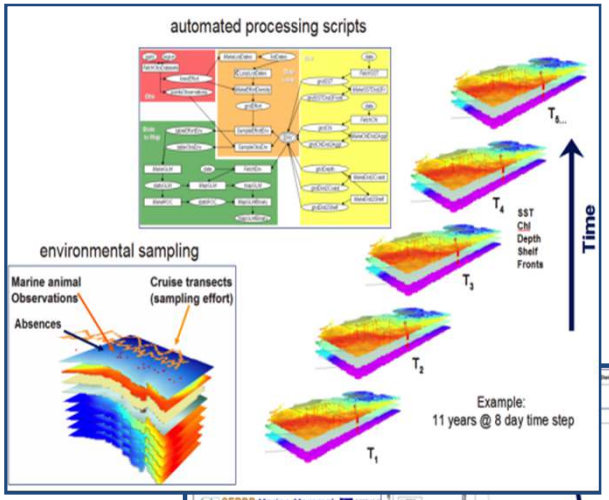
Density modeling process in a nutshell

(1) Conduct line transect surveys

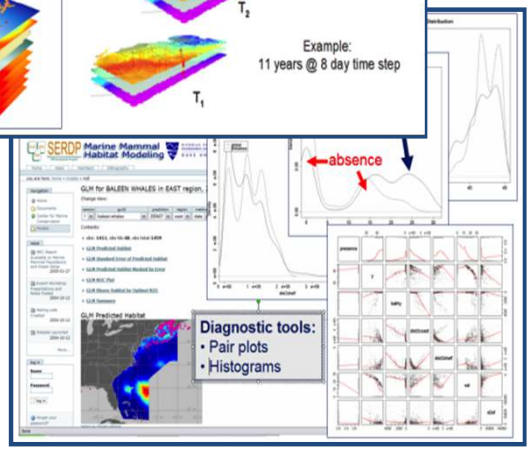


NOAA and other partners

(2) Link survey tracklines and animal sightings to oceanographic observations

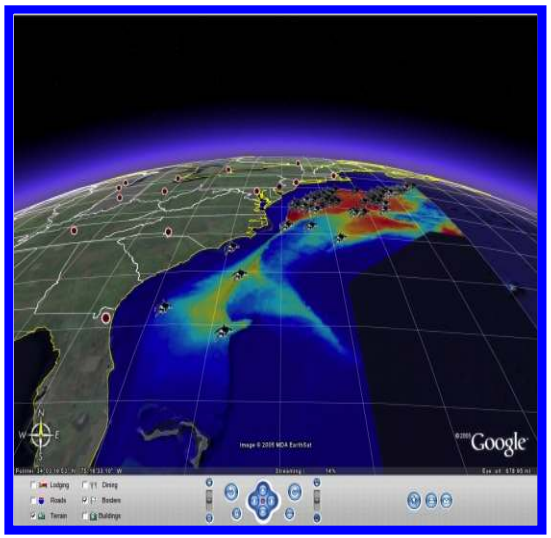


Duke



(3) Predict animal density (animals/km^2) from oceanographic conditions using multivariate statistics

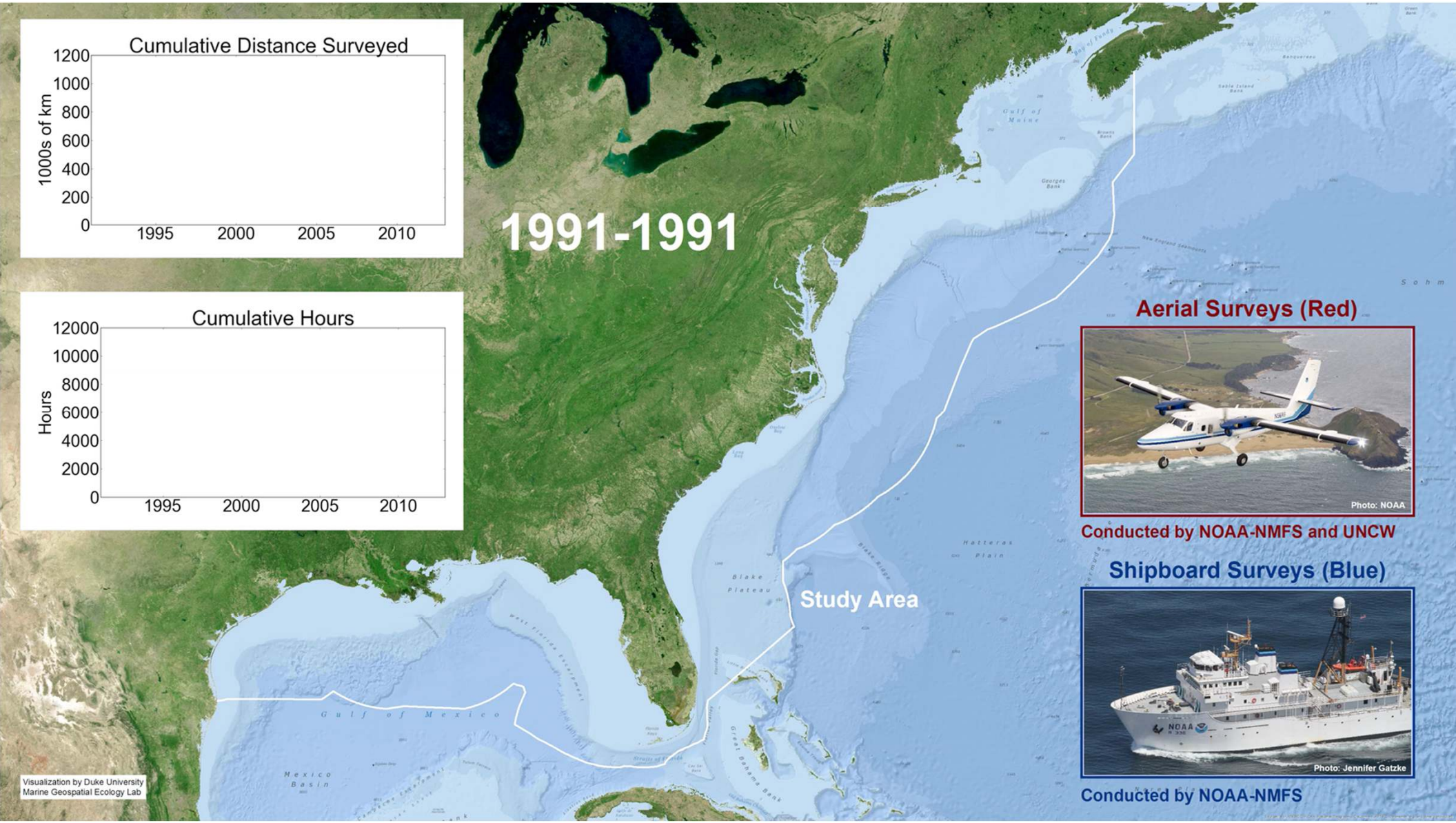
(4) Produce density maps for use in marine spatial planning processes



Approach, philosophy, and key assumptions

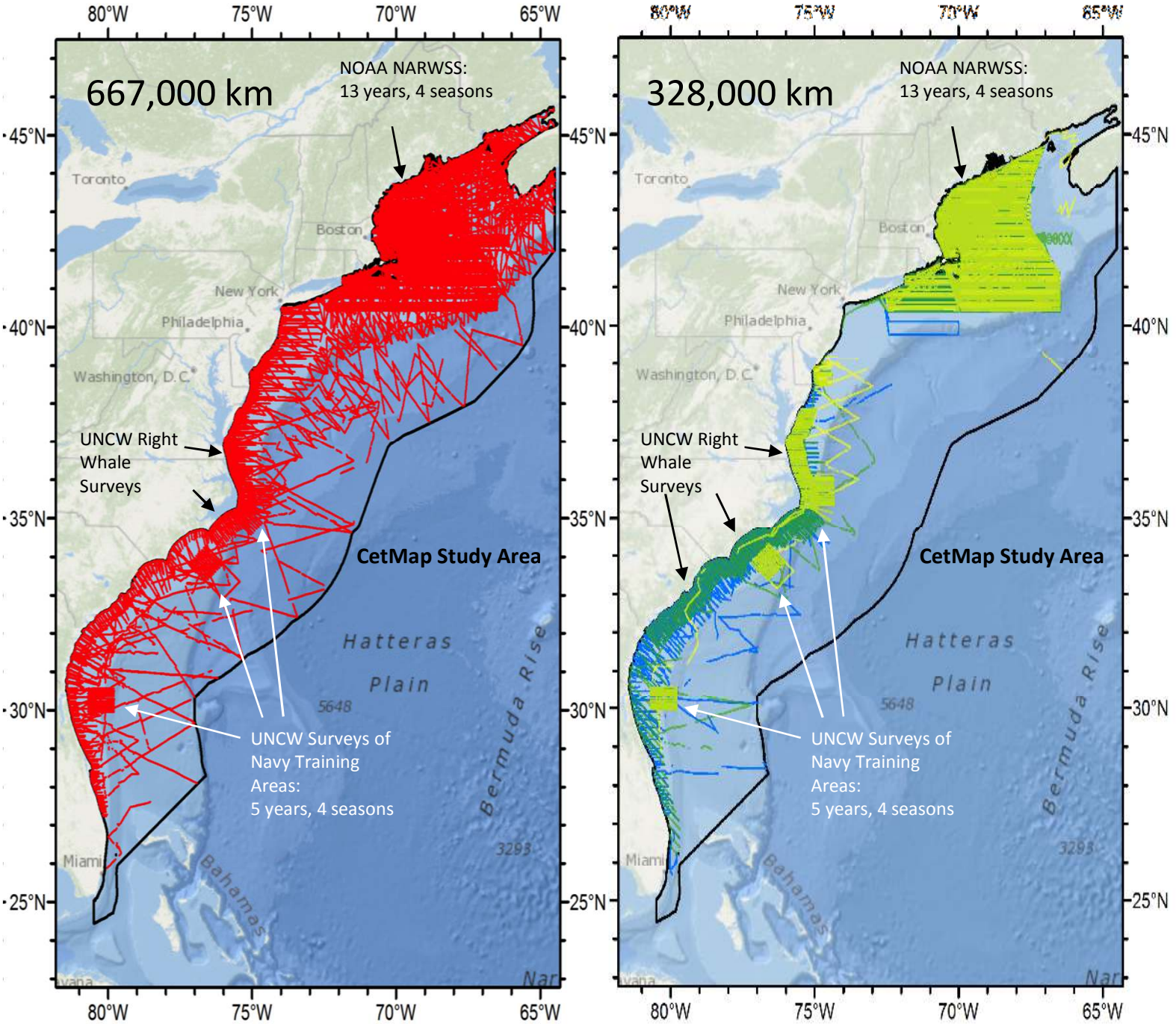
- Use a habitat-based approach, with generalized additive models (GAMs)
- When sufficient sightings are available, fit different models where different behaviors or relationships are expected (e.g. breeding vs. feeding seasons)
  - When few sightings are available, fit one model to available sightings
  - When sightings are very sparse, distribute density uniformly
- Define species-specific seasons based on patterns in the sightings and reports in the literature
- For rare species that may be ecologically similar (e.g. beaked whales), group their sightings and model the group
- For ambiguous sightings in which the definitive sightings appear to show distinct habitats (e.g. “fin/sei whale”), we are experimenting with a habitat-based classification model prior to density modeling
- For ambiguous sightings in which the definitive sightings do not show distinct habitats (e.g. “pilot whale”), model the group

Marine mammal aggregation data overview



Atlantic Surveys

Summer (Red), Fall (Yellow),
Winter (Blue), Spring (Green)



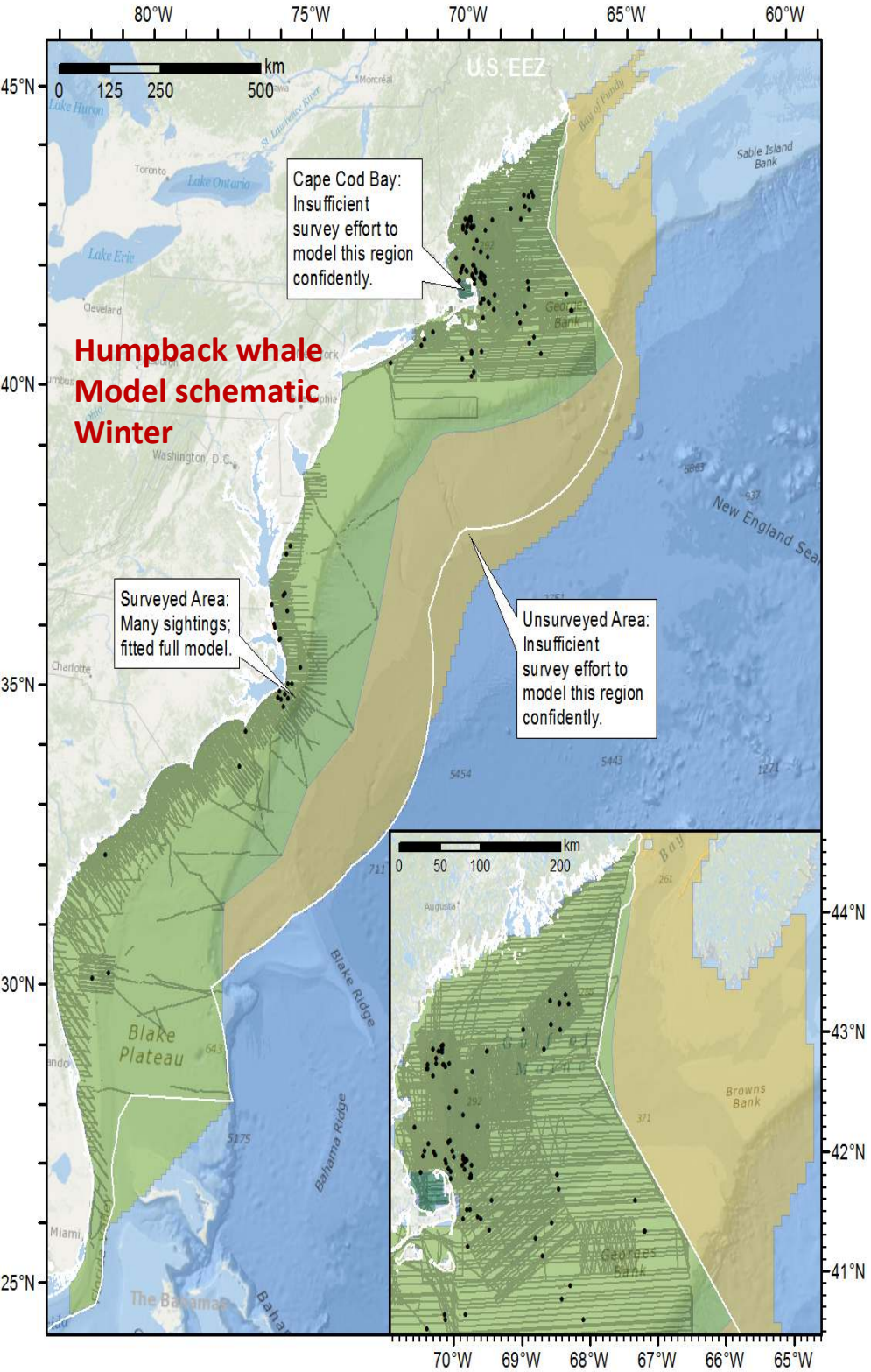
Marine mammal survey data

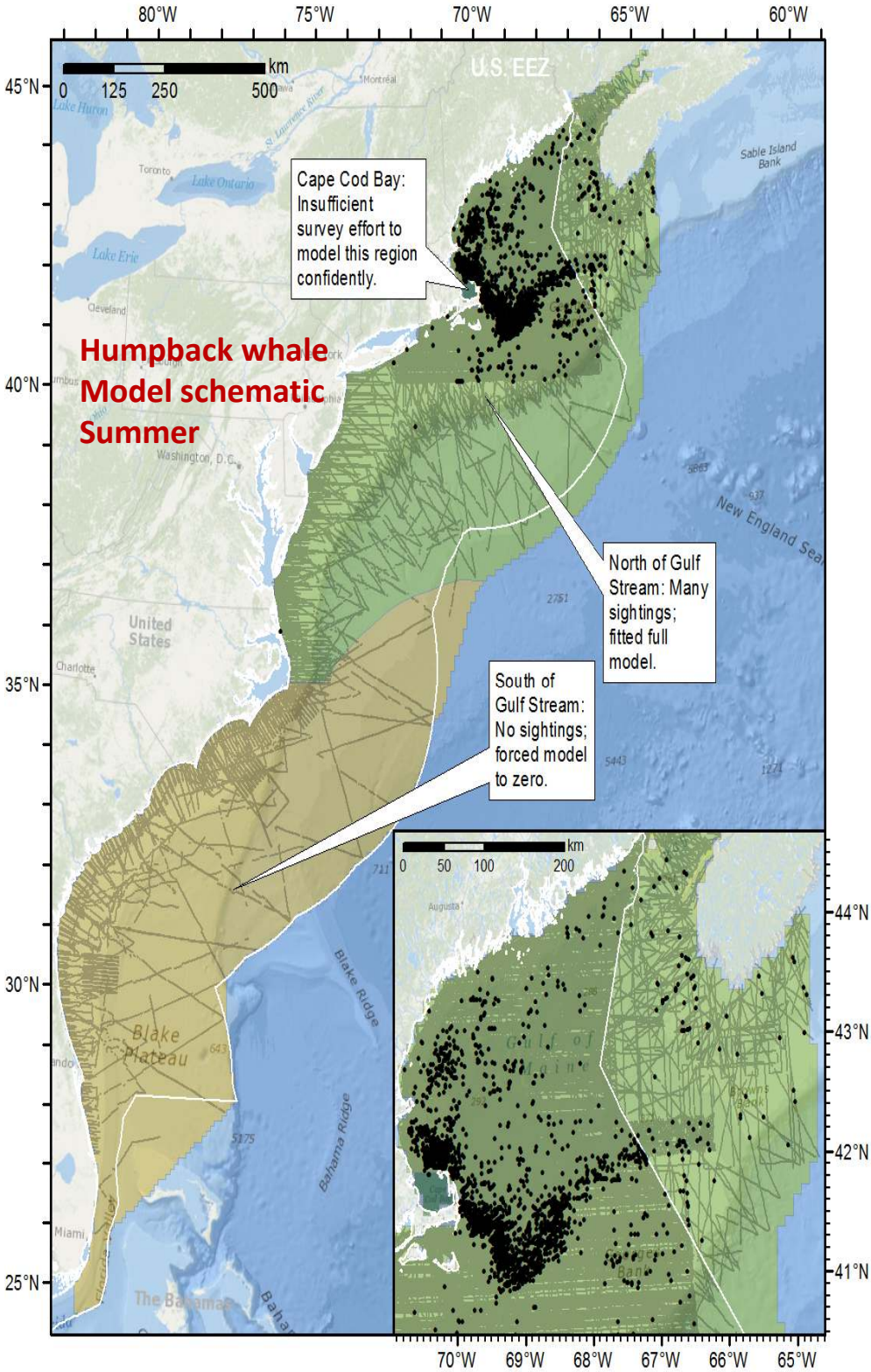
Surveys	Started	Ended	On Effort Length (1000s km)	Effort Hours	Survey Count
NEFSC Aerial Surveys	1995	2008	70	412	8
NEFSC North Atlantic Right Whale Sighting Survey	1999	2013	438	2366	24
NEFSC Shipboard Surveys	1995	2004	16	1145	6
NJDEP Aerial Surveys	2008	2009	11	60	2
NJDEP Shipboard Surveys	2008	2009	14	836	2
SEFSC Atlantic Shipboard Surveys	1992	2005	29	1764	6
SEFSC Mid Atlantic Tursiops Aerial Surveys	1995	2005	35	196	7
SEFSC Southeast Cetacean Aerial Surveys	1992	1995	8	42	2
UNCW Cape Hatteras Aerial Surveys (Navy)	2011	2013	38	250	4
UNCW Early Marine Mammal Aerial Surveys	2002	2002	18	98	1
UNCW Jacksonville Aerial Surveys (Navy)	2009	2013	132	805	10
UNCW Onslow Bay Aerial Surveys (Navy)	2007	2011	98	563	6
UNCW Right Whale Aerial Surveys	2005	2008	114	586	3
Virginia Aquarium Aerial Surveys (in progress)	2012	2014			1

Table 1: Northwest Atlantic line transect surveys used in Duke marine mammal and sea turtle density models for the east coast of the United States and southern Canada.

Marine mammal and sea turtle sightings

Family	Scientific Name	Common Name	Sightings	Modeled as group
Cetaceans	Balaenoptera acutorostrata	Minke whale	1010	
	Balaenoptera borealis	Sei whale	589	
	Balaenoptera musculus	Blue whale	7	
	Balaenoptera physalus	Fin whale	1730	
	Delphinus delphis	Common dolphin	803	
	Eubalaena glacialis	North Atlantic right whale	1595	
	Globicephala	Unidentified pilot whale	670	Pilot whales
	Grampus griseus	Risso's dolphin	514	
	Hyperoodon ampullatus	Northern bottlenose whale	3	Beaked whales
	Kogia	Unidentified small sperm whale	3	
	Kogia sima	Dwarf sperm whale	1	
	Lagenorhynchus acutus	Atlantic white-sided dolphin	1677	
	Lagenorhynchus albirostris	White-beaked dolphin	12	
	Megaptera novaeangliae	Humpback whale	2700	
	Mesoplodon	Unidentified beaked whale	82	Beaked whales
	Mesoplodon bidens	Sowerby's beaked whale	8	Beaked whales
	Mesoplodon densirostris	Blainville's beaked whale	2	Beaked whales
	Mesoplodon mirus	True's beaked whale	2	Beaked whales
	Orcinus orca	Killer whale	4	
	Phocoena	Harbor porpoise	2781	
	Physeter macrocephalus	Sperm whale	247	
	Stenella attenuata	Pantropical spotted dolphin	4	
	Stenella coeruleoalba	Striped dolphin	84	
	Stenella frontalis	Atlantic spotted dolphin	7	
	Stenella longirostris	Spinner dolphin	1	
	Tursiops truncatus	Bottlenose dolphin	477	
	Ziphiidae	Unidentified beaked whale	2	Beaked whales
	Ziphius cavirostris	Cuvier's beaked whale	21	Beaked whales
Pinnipeds	Caniformia	Unidentified seal	909	Seals
	Halichoerus grypus	Gray seal	24	Seals
	Phoca vitulina	Harbor seal	250	Seals
Turtles	Caretta	Loggerhead turtle	470	
	Chelonia mydas	Green turtle	3	
	Dermochelys coriacea	Leatherback turtle	232	
	Lepidochelys kempii	Kemp's ridley turtle	59	


Humpback whale
Model schematic
Winter
Cape Cod Bay: Insufficient survey effort to model this region confidently.
Surveyed Area: Many sightings; fitted full model.
Unsurveyed Area: Insufficient survey effort to model this region confidently.
U.S. EEZ
km
0 125 250 500
0 50 100 200
80°W
75°W
70°W
65°W
60°W
45°N
40°N
35°N
30°N
25°N
44°N
43°N
42°N
41°N
70°W
69°W
68°W
67°W
66°W
65°W
Blake Plateau
Blake Ridge
Bahama Ridge
Georges Bank
Browns Bank
New England Seamounts
Sable Island Bank
Lake Huron
Lake Ontario
Lake Erie
Toronto
Cleveland
Washington, D.C.
Charlotte
Miami
The Bahamas
Montréal
Augusta


Humpback whale
Model schematic
Summer
Cape Cod Bay: Insufficient survey effort to model this region confidently.
North of Gulf Stream: Many sightings; fitted full model.
South of Gulf Stream: No sightings; forced model to zero.
U.S. EEZ
km
0 125 250 500
0 50 100 200
80°W
75°W
70°W
65°W
60°W
45°N
40°N
35°N
30°N
25°N
44°N
43°N
42°N
41°N
70°W
69°W
68°W
67°W
66°W
65°W
Blake Plateau
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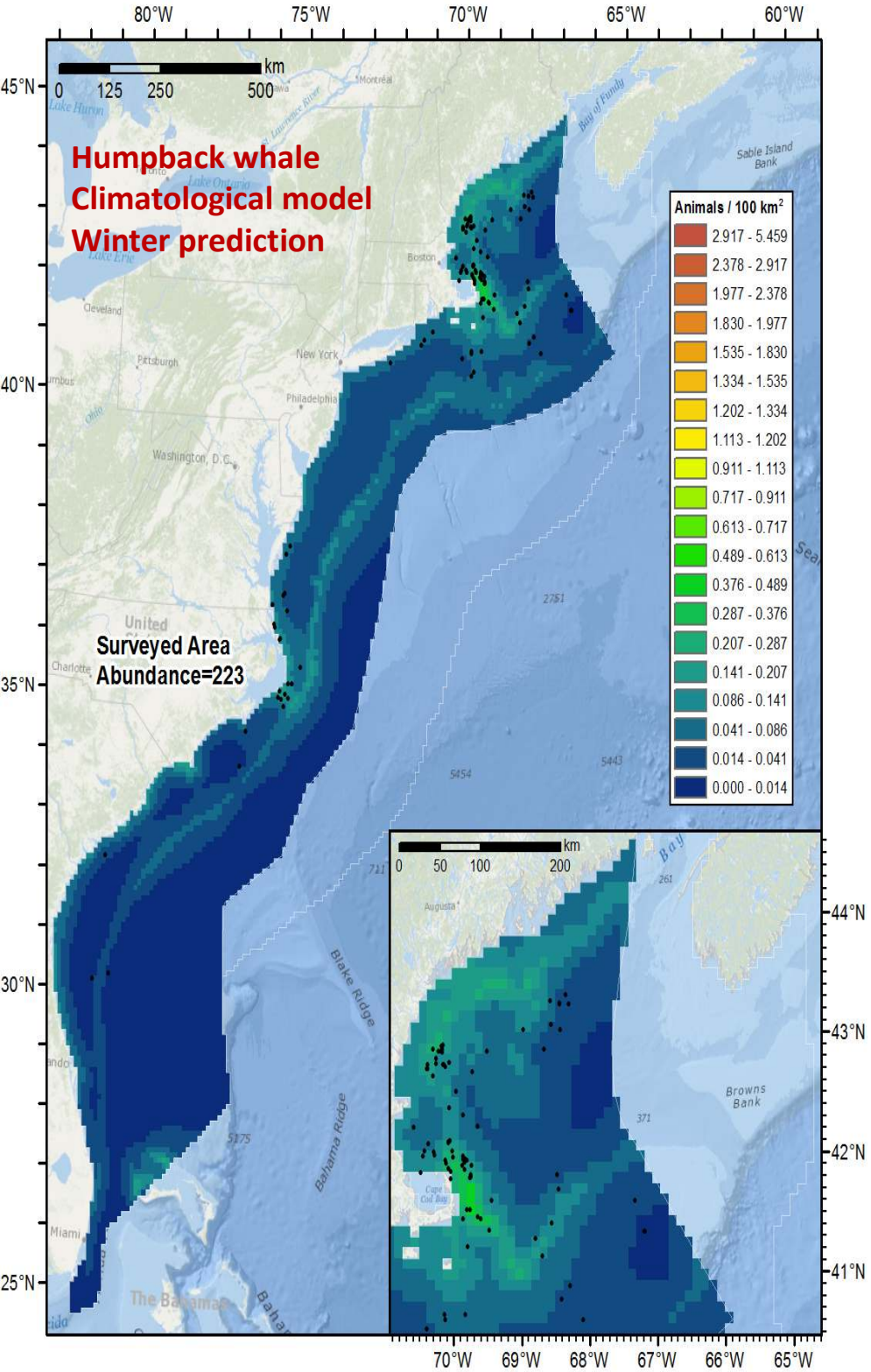
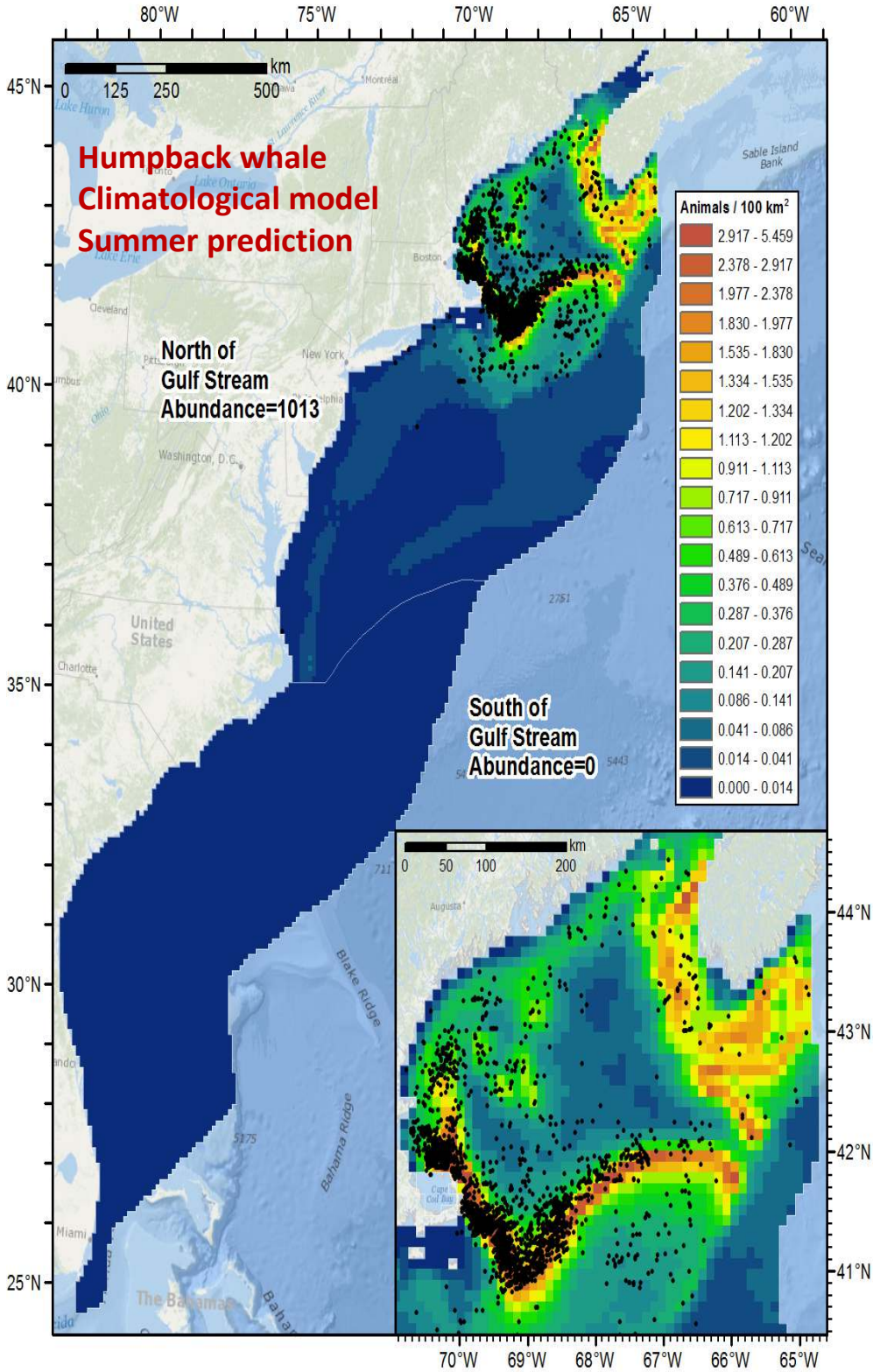
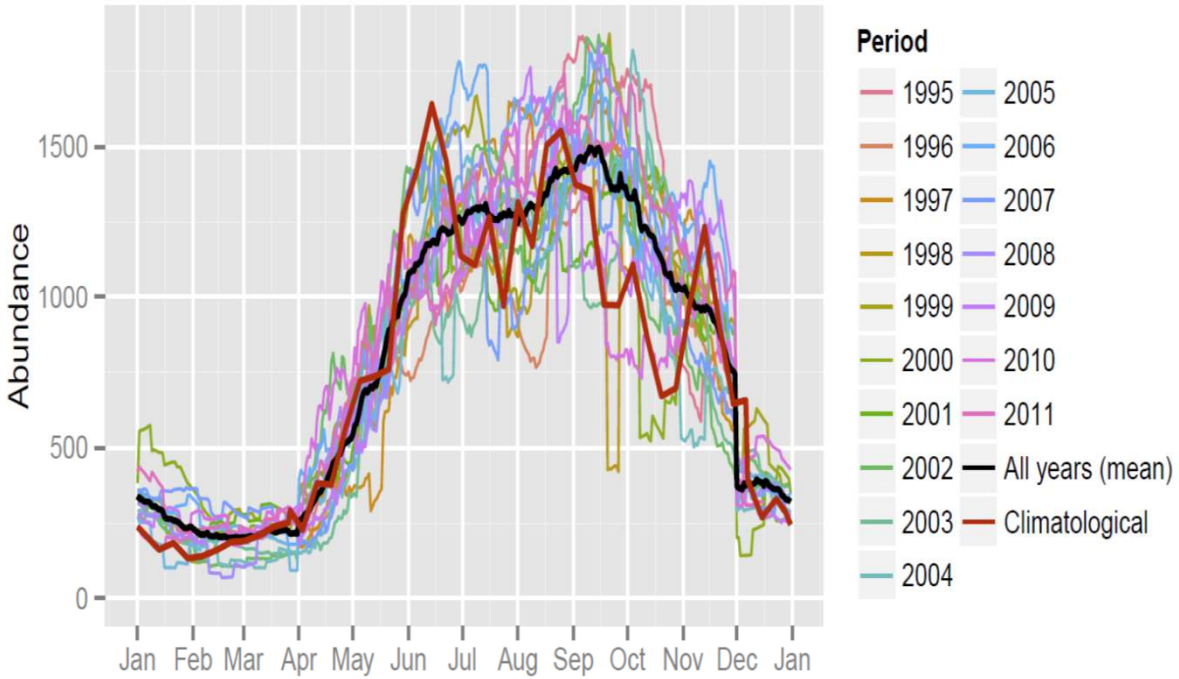
Lake Erie
Toronto
Cleveland
Washington, D.C.
Charlotte
Miami
The Bahamas
Montréal
Augusta
United States


Humpback whale
Climatological model
Winter prediction
Surveyed Area
Abundance=223
Animals / 100 km²
2.917 - 5.459
2.378 - 2.917
1.977 - 2.378
1.830 - 1.977
1.535 - 1.830
1.334 - 1.535
1.202 - 1.334
1.113 - 1.202
0.911 - 1.113
0.717 - 0.911
0.613 - 0.717
0.489 - 0.613
0.376 - 0.489
0.287 - 0.376
0.207 - 0.287
0.141 - 0.207
0.086 - 0.141
0.041 - 0.086
0.014 - 0.041
0.000 - 0.014
km
0 125 250 500
0 50 100 200
80°W
75°W
70°W
65°W
60°W
45°N
40°N
35°N
30°N
25°N
44°N
43°N
42°N
41°N
Blake Ridge
Bahama Ridge
Browns Bank
Sable Island Bank
Bay of Fundy
Montréal
Boston
New York
Philadelphia
Washington, D.C.
Cleveland
Pittsburgh
Miami
Charlotte
Augusta
United States

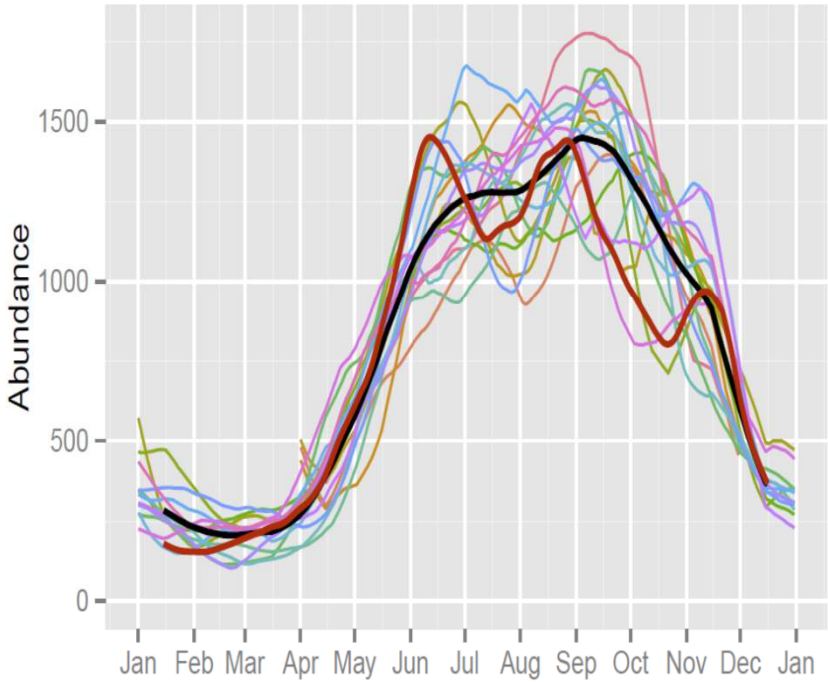

Humpback whale
Climatological model
Summer prediction
North of
Gulf Stream
Abundance=1013
South of
Gulf Stream
Abundance=0
Animals / 100 km²
2.917 - 5.459
2.378 - 2.917
1.977 - 2.378
1.830 - 1.977
1.535 - 1.830
1.334 - 1.535
1.202 - 1.334
1.113 - 1.202
0.911 - 1.113
0.717 - 0.911
0.613 - 0.717
0.489 - 0.613
0.376 - 0.489
0.287 - 0.376
0.207 - 0.287
0.141 - 0.207
0.086 - 0.141
0.041 - 0.086
0.014 - 0.041
0.000 - 0.014
km
0 125 250 500
0 50 100 200
80°W
75°W
70°W
65°W
60°W
45°N
40°N
35°N
30°N
25°N
44°N
43°N
42°N
41°N
Blake Ridge
Bahama Ridge
Sable Island Bank
Boston
New York
Washington, D.C.
Cleveland
Miami
Charlotte
Augusta
United States

Predicted temporal variability

Unsmoothed

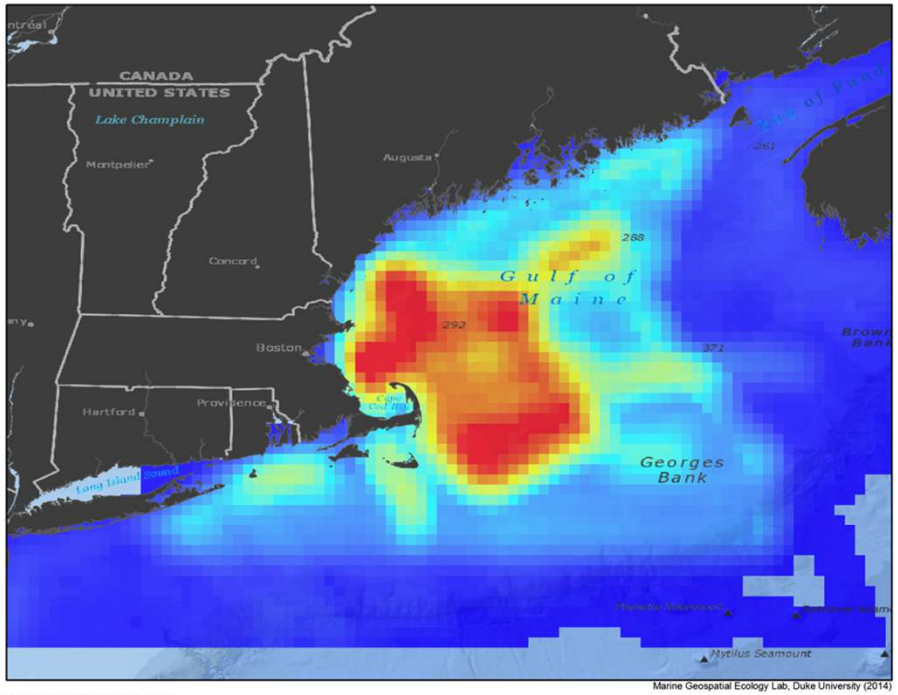


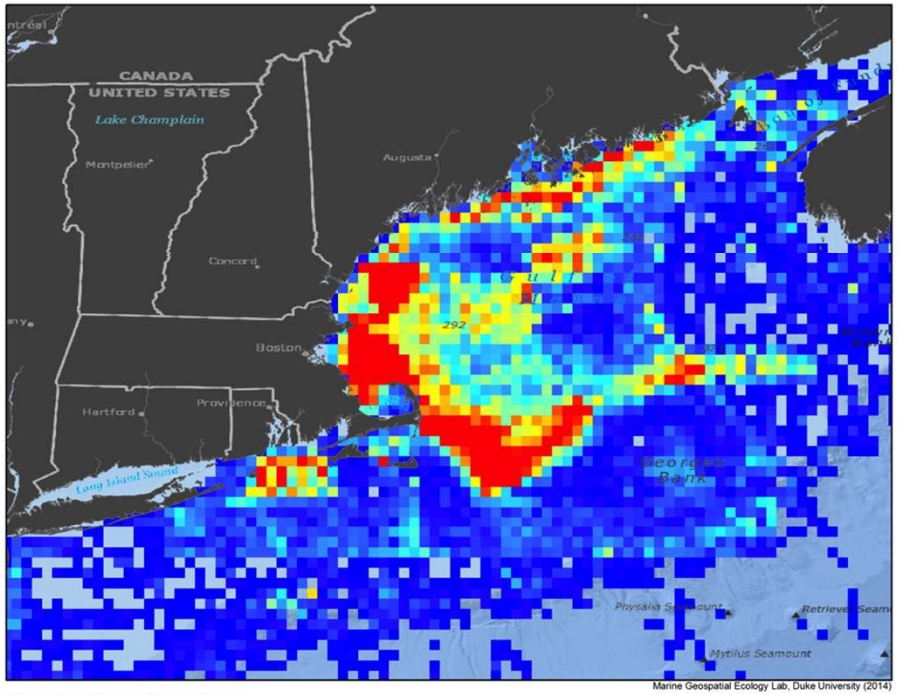
30-day moving average



Comparison of Humpback whale abundance predicted at a daily time step for different time periods. Individual years were predicted using contemporaneous models. “All years (mean)” averages the individual years, giving the mean annual abundance of the contemporaneous model. “Climatological” was predicted using the climatological model.

Example: Survey & observation density





Questions?

Fish Working Group 8-12-2014 discussion topics

- Summary of species covered by data sets in-hand
- Regulatory and other considerations of species
- Data input opportunities
- Under-represented species, from trawl surveys
- Nearshore vs. offshore trawls
- Type of analyses options

- Map and animation data product options

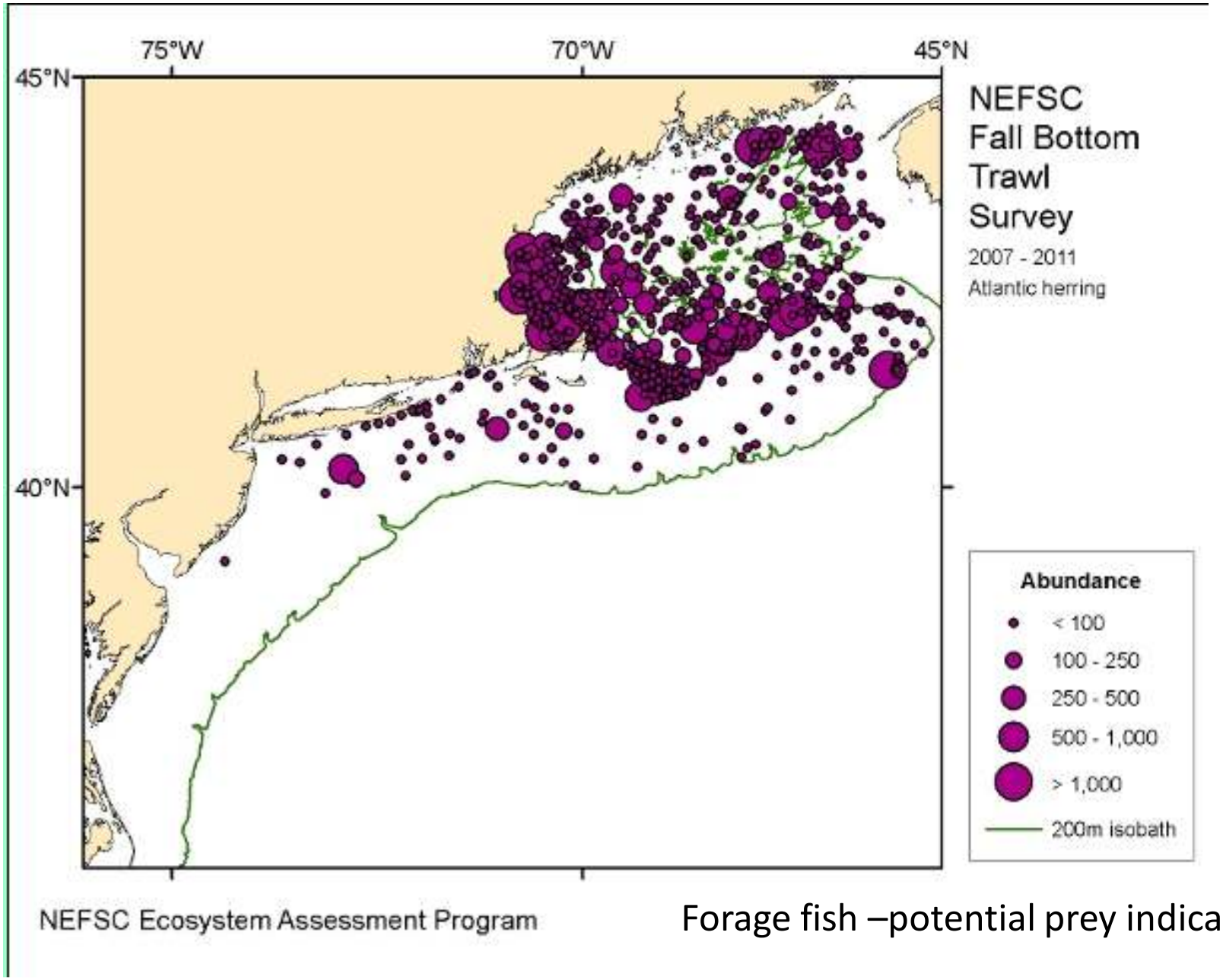
NOAA Fish Species Datasets

Species	Not Used		Species	Not Used
Acadian Redfish			Pollock	
Alewife			Red Drum	Spring
American Lobster			Red Hake	
American Plaice			Rosette Skate	
American Shad			Roughtail Stingray	Spring
Atlantic Cod			Sand Lance	
Atlantic Croaker			Sand Tiger Shark	Spring
Atlantic Herring			Scup	
Atlantic Mackerel			Sea Raven	
Atlantic Stingray	Fall & Spring		Sea Scallop	
Atlantic torpedo			Sharpnose Shark	
Banded Drum	Spring		Shortfin Squid	
Barndoor Skate			Shorthorn Sculpin	Fall
Black Drum	Spring		Silver Hake	
Black Sea Bass			Smooth Butterfly Ray	
Blackbelly Rosefish			Smooth Dogfish	
Blueback Herring			Smooth Skate	
Bluefish			Southern Eagle Stingray	Fall
Bluntnose Stingray	Spring		Southern Stingray	Spring
Bullnose Stingray	Spring		Spiny Butterfly Ray	Spring
Butterfish			Spiny Dogfish	
Clearnose Skate			Spot	
Cownose Ray			Spotted Hake	
Cravelle Jack			Star Drum	Fall & Spring
Cunner			Striped Bass	
Cusk			Striped Burrfish	Spring
Fourspot Flounder			Striped Sea Robin	
Gulf Stream Flounder			Summer Flounder	
Haddock			Tautog	
Little Skate			Thorney Skate	
Longfin Squid			Tilefish	
Longhorn Sculpin			Weakfish	
Monkfish			White Hake	
Northern Kingfish			Windowpane Flounder	
Northern Puffer	Spring		Winter Flounder	
Northern Sea Robin			Winter Skate	
Ocean Pout			Witch Flounder	
Pig Fish	Spring		Wolffish	
Pin Fish			Yellowtail Flounder	
Pipefish				

Prioritization and species selection for analysis (abbreviated…)

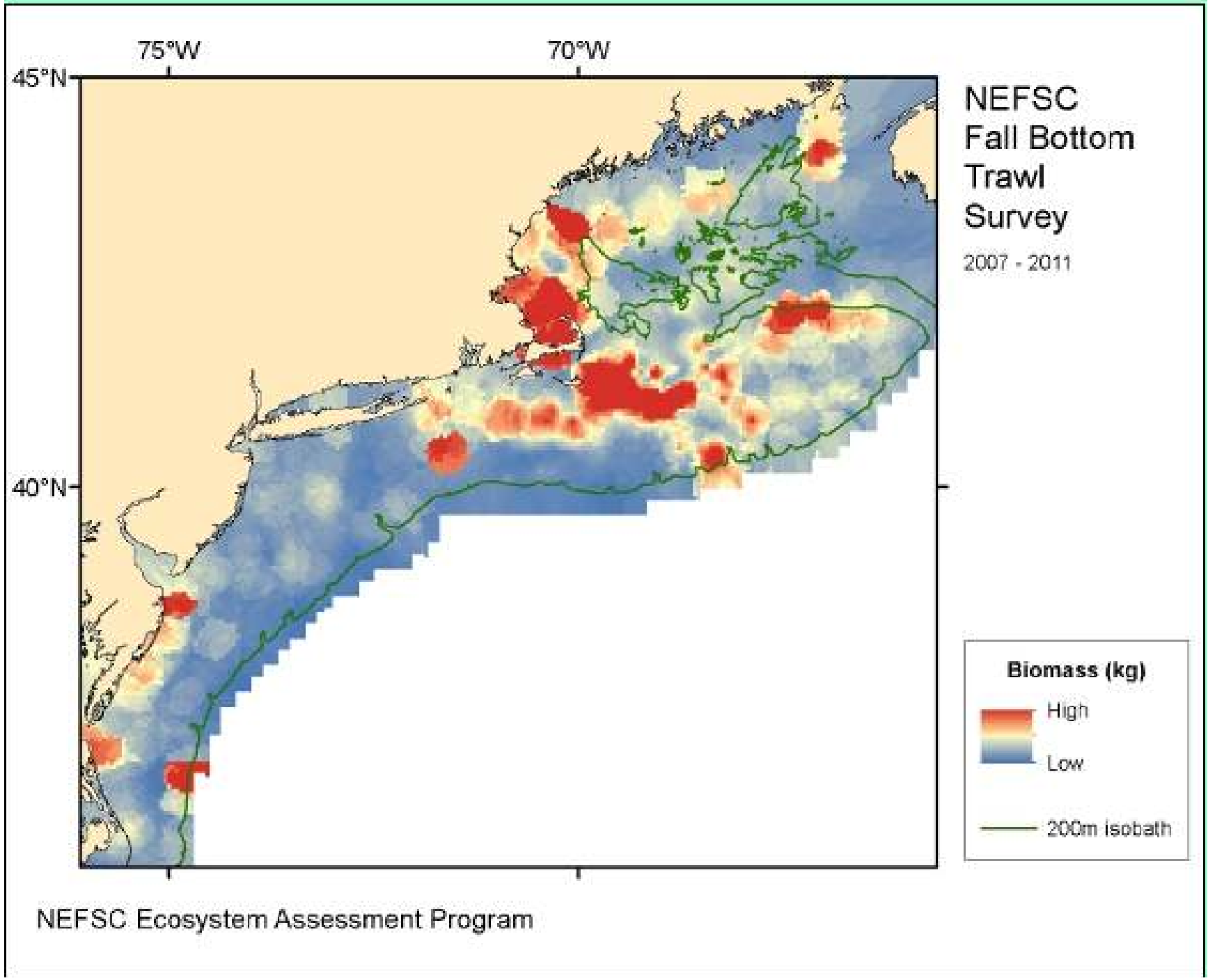
	Federal		State		Other				
Species - common name	ESA	EFH	E, T, SC	Ocean Plans	Managed fishery	Keystone	Likely to interact with priority human uses	Range info, migratory, etc.	Data (quality/quantity)
Alewife	SC		NH (SC)						
American eel			ME, NH (SC)		X				
American lobster					X				
American plaice		X			X				
American shad			NH (SC)		X				
Arctic char			ME (SC)						
Atlantic bluefin tuna	SC								
Atlantic cod		X			X				
Atlantic croaker					X				
Atlantic halibut	SC	X			X				
Atlantic herring		X			X	X			
Atlantic mackeral		X			X				
Atlantic menhaden					X				
Atlantic salmon	E	X	ME (E)		X				
Atlantic sea scallop		X			X				
Atlantic sturgeon	E		MA (E); CT (T)		X				
Atlantic wolffish	SC					X			

Atlantic herring – keystone species

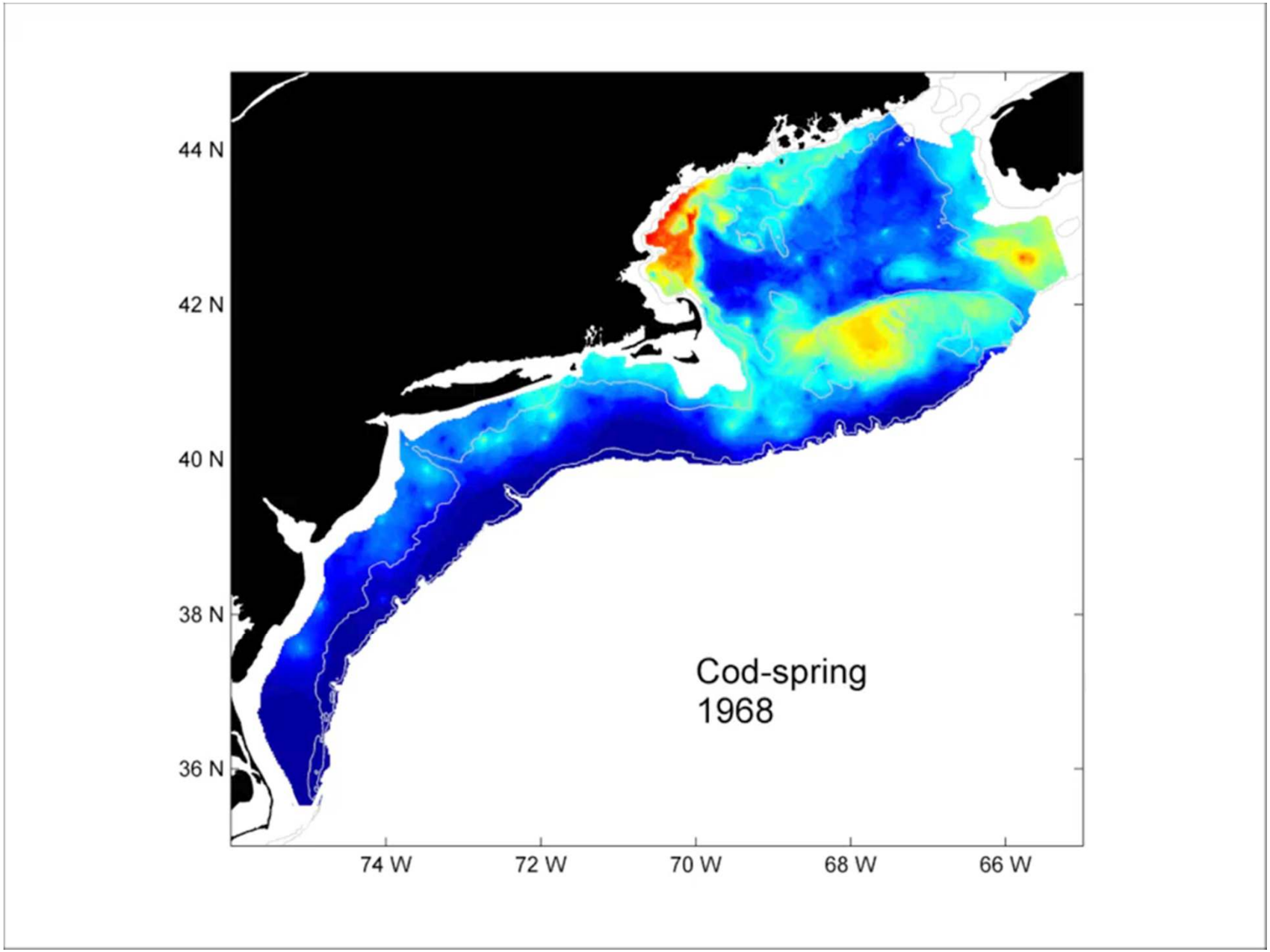


Forage fish –potential prey indicator;

Total biomass



Atlantic Cod distribution over time

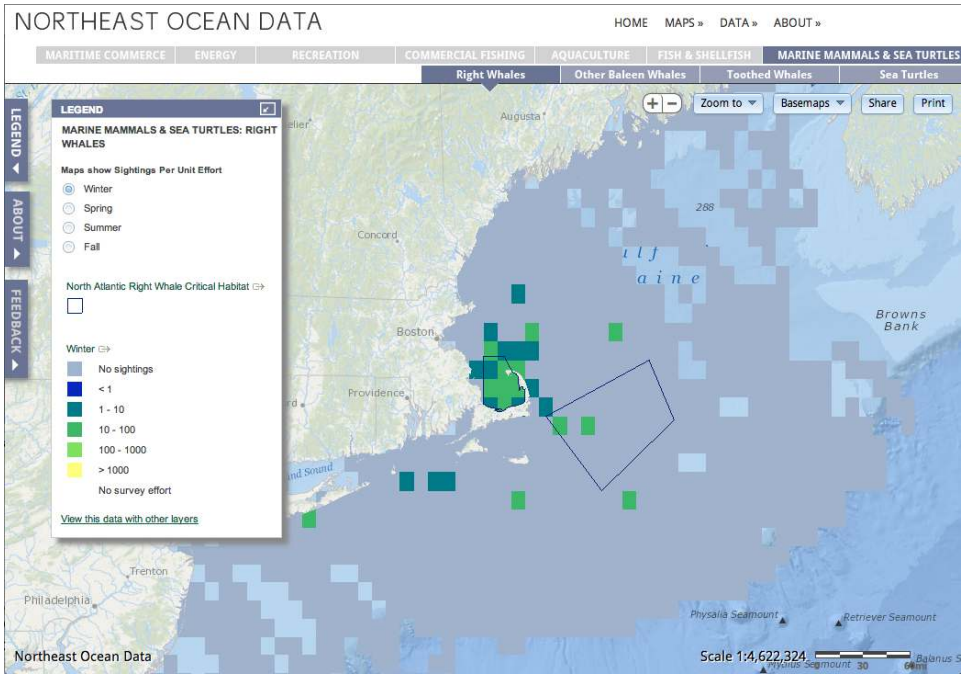


NEFSC Spring Bottom Trawl Survey 1968 – 2008

Stakeholder Input

- Future synthesis products
  - Identify focal species
  - Mapping products and visualization options
  - Visualizing uncertainty
  - Portal integration

Integrated Data & Model Products	Map products
Data richness and density	Seasonal data richness
Areas of expected data gaps (space & time)	Seasonal data gaps
Areas of high species overlap (hot spots)	Seasonal / annual
Areas of management concern and human use	Per activity
Prey species	As available



Questions

- **Species** - Which species are of highest priority?
- **Resolution and Extent** - What spatial resolution of predictions and over what geographic extent would be most useful for marine spatial planning? What time scales are of interest?

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