Science, Service, Stewardship

AMAPPS project

(Atlantic Marine Assessment Program for Protected Species)

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- **Interagency agreement between:**
  - **NMFS (NEFSC & SEFSC), USFWS, BOEM, Navy**
- **Information needs:**
  - **Assessment of the potential environmental impacts to resources from various actions;**
  - **Evaluate stock assessments**

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Objectives – Collect new data

Collect broad-scale data over multiple years on the seasonal distribution and abundance of marine mammals (cetaceans and pinnipeds), marine turtles, and sea birds using direct aerial and shipboard surveys of coastal U.S. Atlantic Ocean waters

Collect similar data at finer scales at several (~3) sites of particular interest to NOAA partners using visual and acoustic survey techniques

Conduct tag telemetry studies within surveyed regions of marine turtles, pinnipeds and seabirds to develop corrections for availability bias in the abundance survey data and collect additional data on habitat use and life-history, residence time, and frequency of use

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Objectives - Analyses

Assess the population size of surveyed species at regional scales

Develop models and associated tools to translate these survey data into seasonal, spatially-explicit density estimates incorporating habitat characteristics

Explore alternative platforms and technologies to improve population assessment studies

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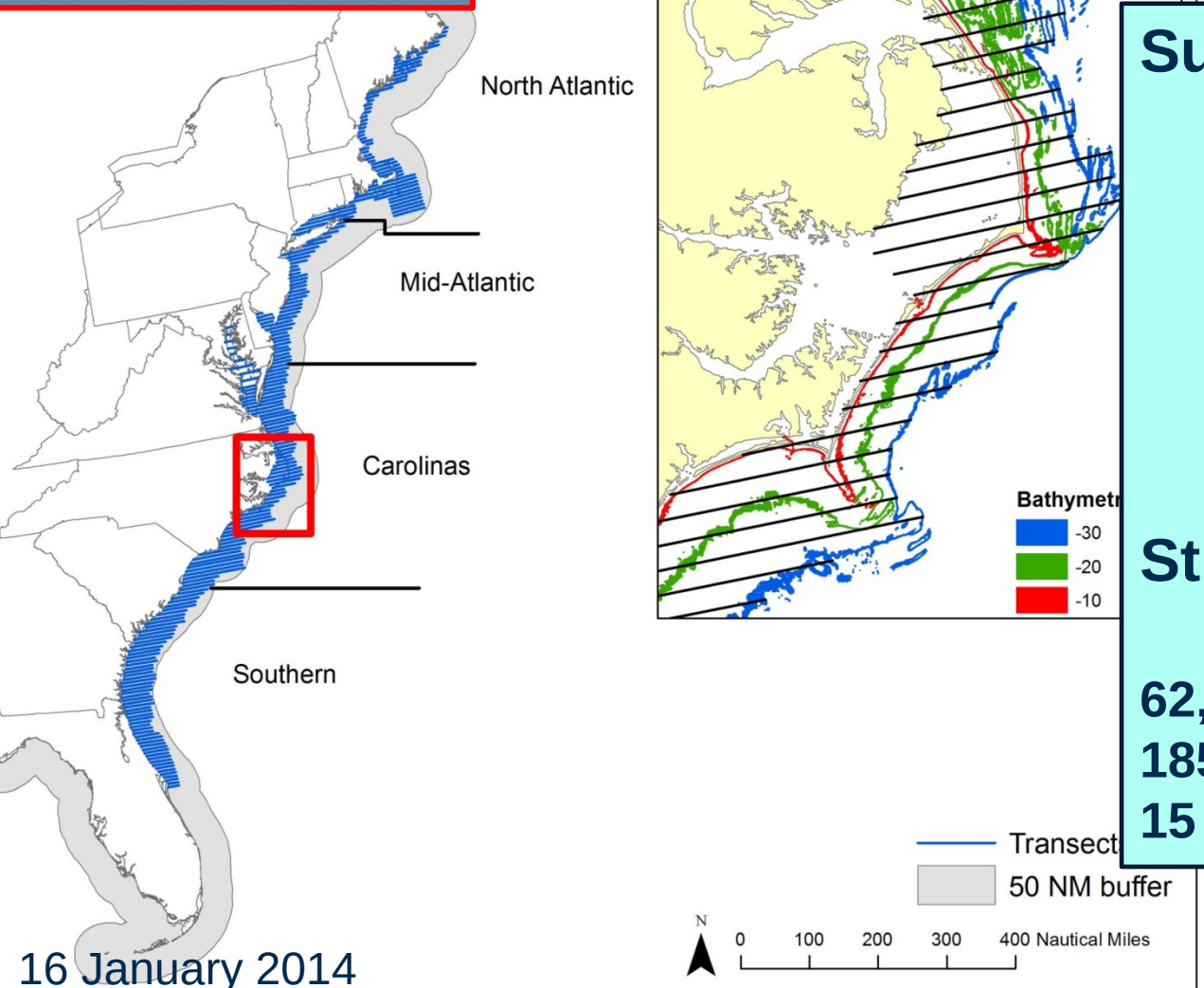
OBJECTIVE:
COLLECT NEW DATA

FWS
Seabird aerial surveys



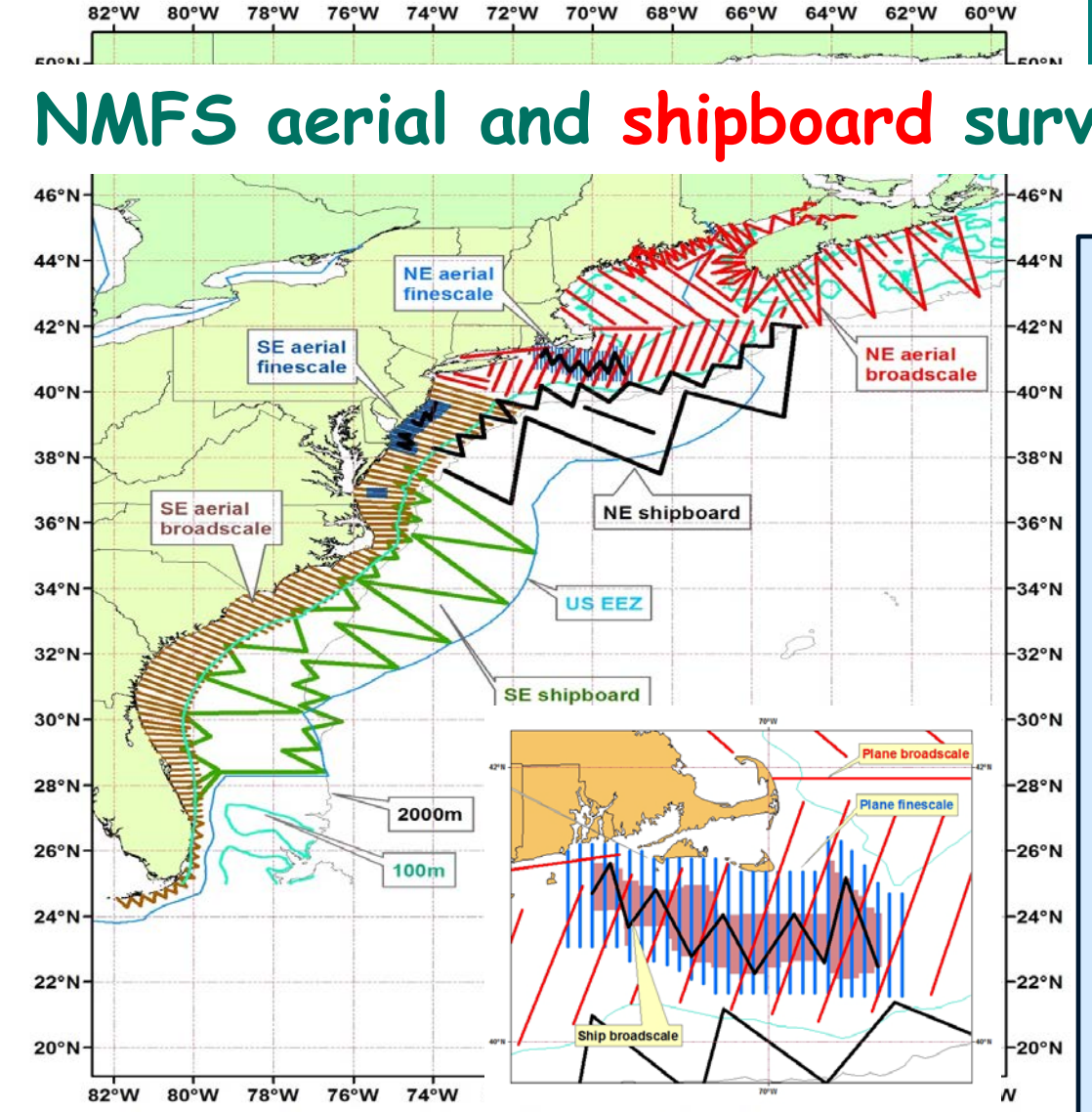
Transect
50 NM buffer
N
0 100 200 300 400 Nautical Miles

Surveys:
- **2010: Feb, Aug, Dec**
- **2011: Feb, Aug**
- **2012: Mar, Sep-Oct**
- **2013: Sep**
- **2014: Feb-Mar**

Strip transect method

62,127 km of track lines
185,093 seabirds detected
15 other species detected

NMFS aerial and shipboard surveys



NOAA's Twin Otter and boat

Surveys:

- 2010: Jul-Aug
- 2011: Jan-Mar, Jun-Aug
- 2012: Mar-May, Sep-Nov
- 2013: Jul-Sep
- 2014: Feb-Apr

103,300 km of track lines

2 team line transect

5400 cetaceans detected
5850 turtles detected
200 seals detected
4100 seabirds detected

Regional abundance estimates available

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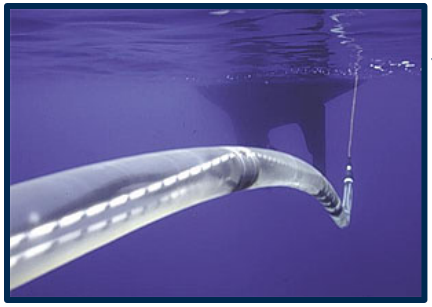
Passive Acoustics



1.Towed array research goals:

- Abundance estimates for highly acoustic species such as sperm, beaked whales & ….
  - NE: 584 hrs of recordings
  - SE: 772 hrs of recordings
  - Identified at least 13 species
- Develop species-specific classifiers

2. Bottom mounted recorders & gliders:

- Baleen whale seasonal distribution and habitat usage especially North Atlantic Right Whales
- Understanding migratory corridors & changes in behavior resulting from changes in climate
- 15 deployed so far

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SEAL PROJECTS

Harbor seals on beach

Harbor seals

- May-Jun 2012 harbor seal abundance estimate (in review):
- 2,700 digital images of haul-out sites over 5 days
- 29 harbor seals radio tagged to adjust for animals not hauled-out during survey

Gray seal with tag

Gray seals

- June 2013 – 9 (7-gps tags; 2-satt tags) non-pup gray seals tagged in Chatham to obtain info on how they utilize their habitat
- Gray seal biological samples collected for health assessment, diet, contaminants, stock ID, age

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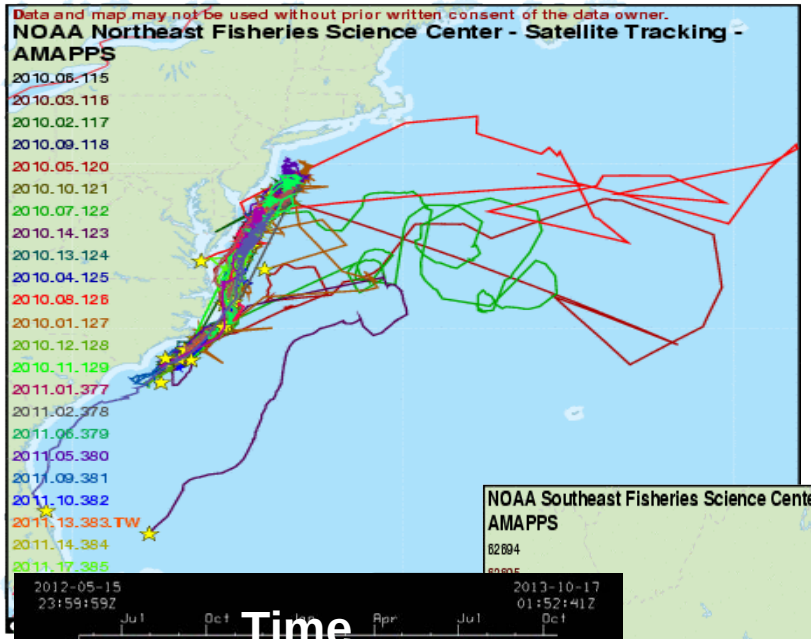
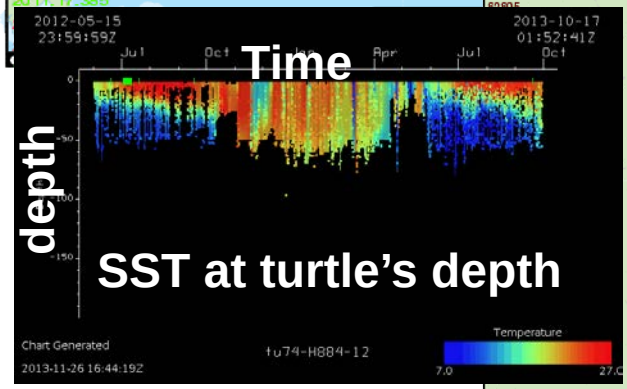
Loggerhead turtle tagging project

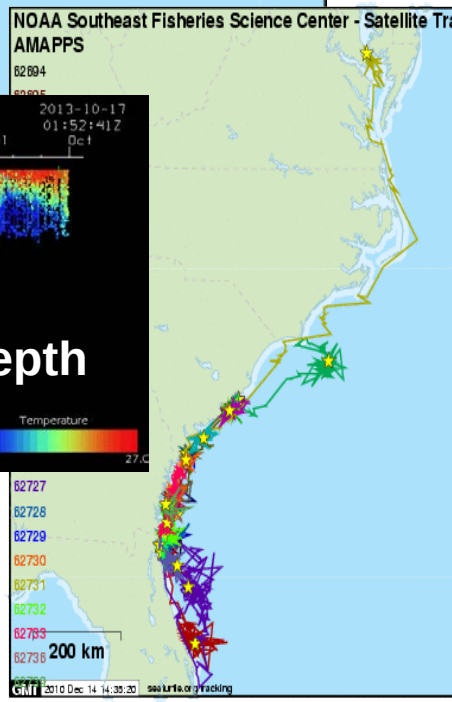
Loggerhead turtle tags

- —2010: 30 in SE, 15 in NE
- —2011: 15 in NE
- —2012: 7 in NE
- —2013: 30 in SE, 6 in NE

2010 tag and aerial survey data used to estimate 800,000+ loggerhead turtles (NEFSC + SEFSC 2011)







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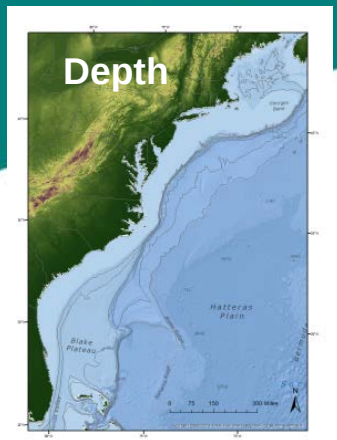
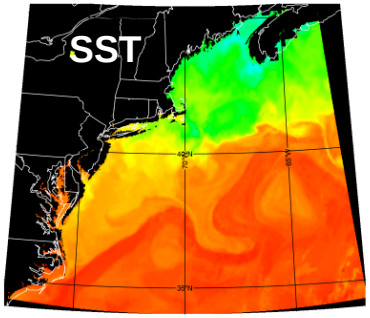
Habitat and trophic data

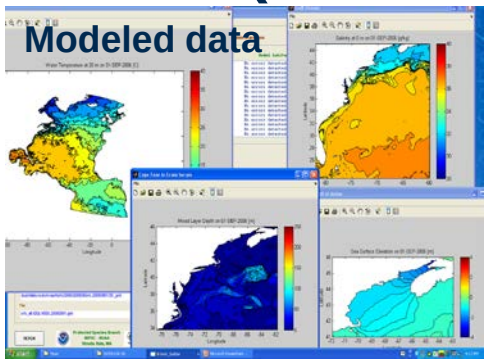


Static habitat data (depth, bottom slope)

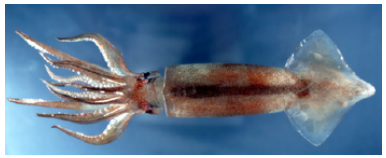
Dynamic satellite-based data (sst, chlorophyll)

Dynamic model-based data (thermocline depth)





Other parts of the ecosystem /sources



- **Fish and benthic densities from NMFS**
- **Bycatch data from NMFS**
- **From other projects (BOEM, Navy, states, NGO, etc)**

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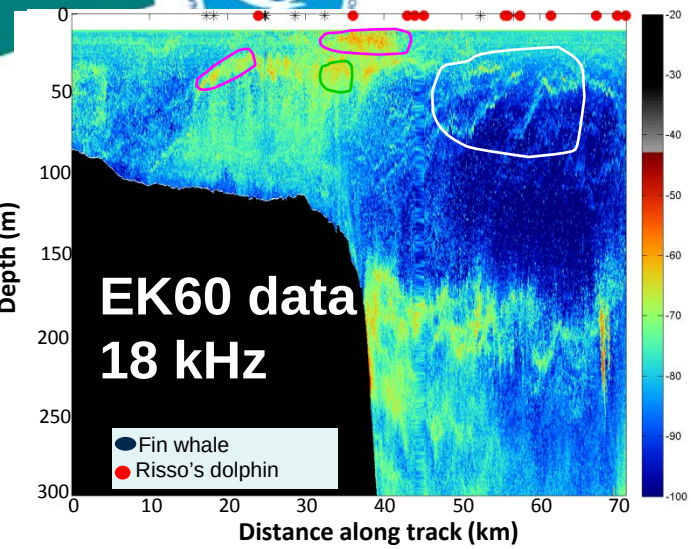
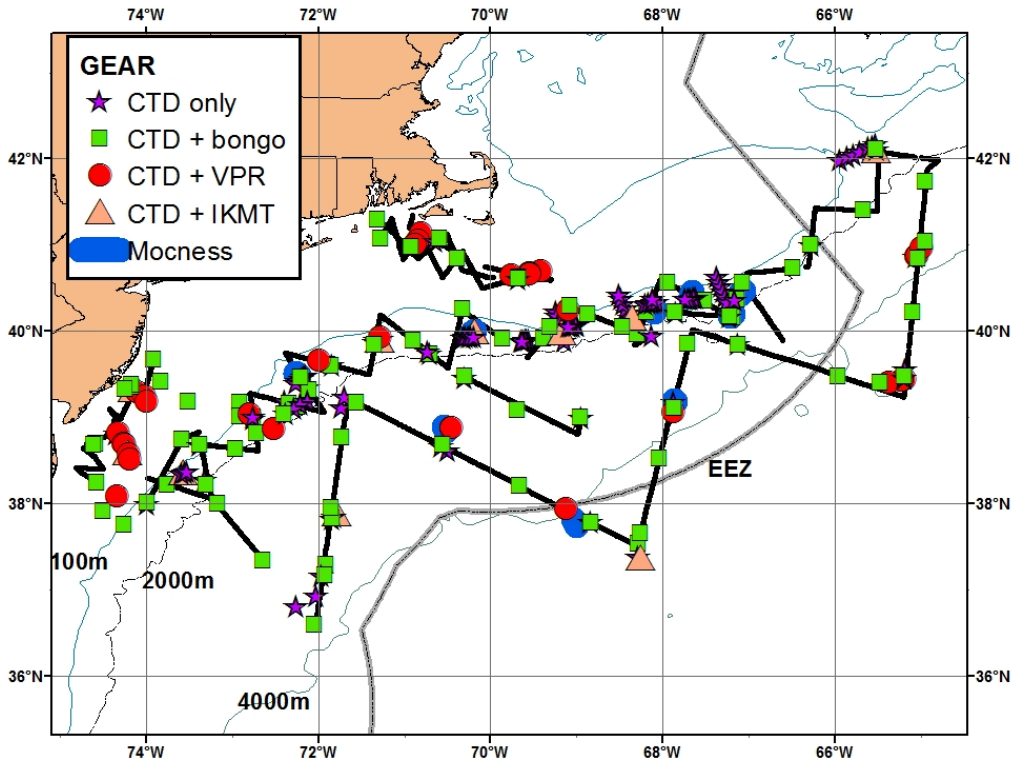
Habitat and trophic data

- Shipboard data collected simultaneously
  - EK60 backscatter data for plankton & fish
  - Plankton and macronekton samples from bongo nets, VPR, MOCNESS, Isaac kid trawl





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Data bases

1) NMFS Oracle database contains:
   a) NE aerial 2010-12; SE aerial 2012 spring; NE & SE shipboard 2011 abundance data
      - Trackline data - over 5000 records (date, time, position, speed)
      - Effort data - over 4000 records (date, time, effort status, observers, weather observations, transect, etc.)
      - Sighting data – over 4000 records (date, time, species, group size, behavior, cue, distance, bearing, etc.)
   b) Turtle satellite tag data
      - ~122,300 location records of which about 30,400 are Class 3, 2, or 1
   c) Seal satellite tag data
      - ~ 2000 records, including over 1300 dive records so far
   d) Environmental data associated with abundance data
2) Tethys database for acoustic data
3) Marine bird compendium database

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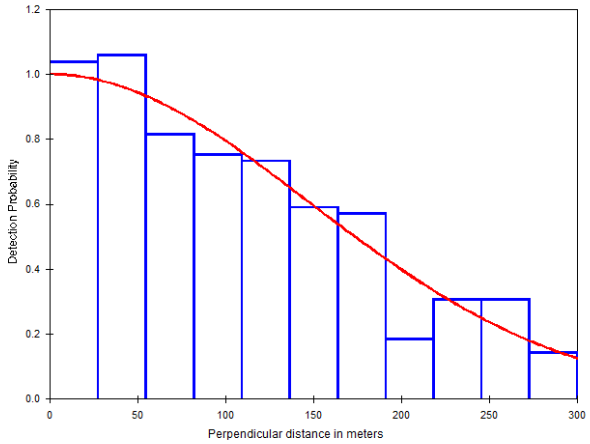
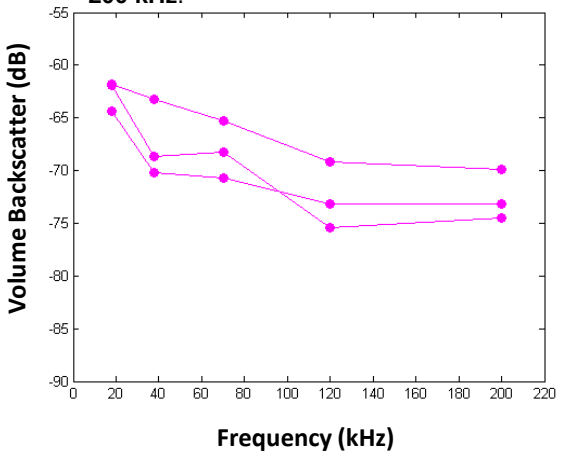
OBJECTIVE:
ANALYZE DATA



Magenta regions: "Fish-like" frequency response curves. Higher intensity at 18 kHz, lower intensity at 200 kHz.



$$P(\theta|Data) \propto P(Data|\theta)*P(\theta)$$

$$p_a(y) = \frac{s}{s+d} + \frac{w(y)}{s+d}$$

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Density estimates corrected for some biases

- **Perception bias – accounted for with 2 teams**
- **Availability bias – accounted for with**
  - **Tag data (turtles, birds, seals),**
  - **Passive acoustics (sperm and beaked whales),**
  - **Data published in previous literature**
- **Species-specific biases – such as:**
  - **Highly aggregated bird flocks**
  - **Incorporating bird observations not identified to species into species-specific abundance models**

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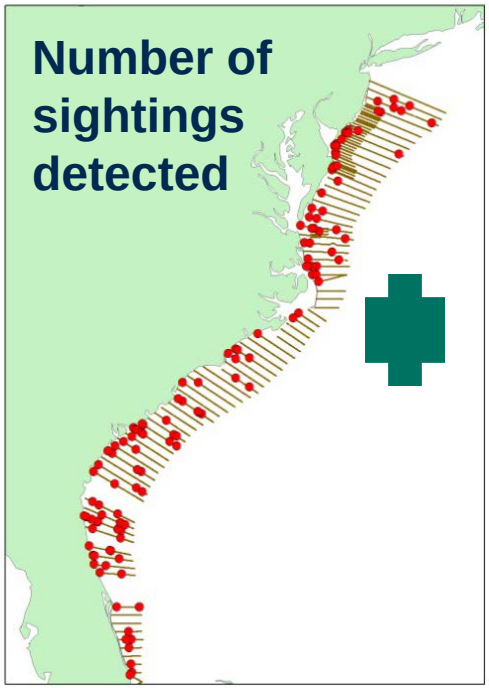
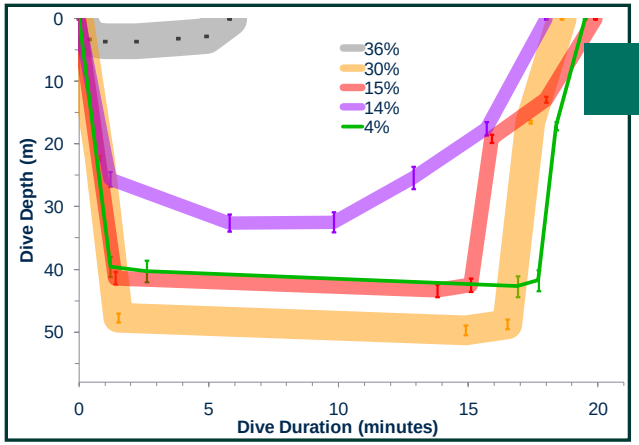
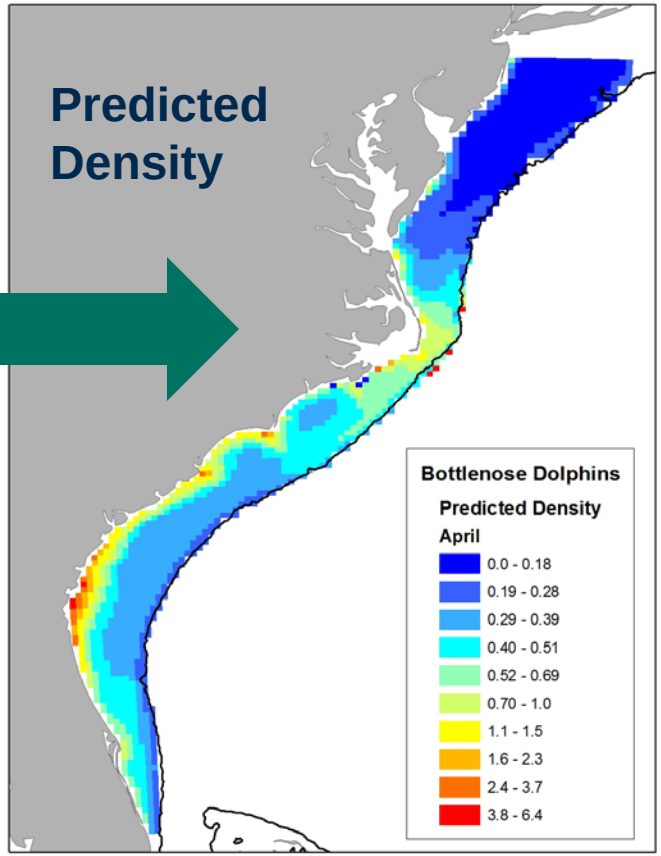
Incorporating habitat into models of:

- Numbers of groups in an area
- Numbers of animals in the group
- Dive time patterns



Dive profiles





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Modeling habitat density estimates

- Bayesian hierarchical models
- Generalized linear and additive models
- Non-parametric multiplicative regression models

Multiple methods allow comparison of methods, development of best method for each species, model averaging since each method has its pros and cons

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Data integration to improve density estimates

- **Integrating detection probabilities and habitat to estimate density of cetaceans and turtles**
- **Integrating loggerhead turtle's tag and visual data**
- **Integrating sperm whale passive and visual data**
- **Integrating seal haul-out photo counts and tag data**

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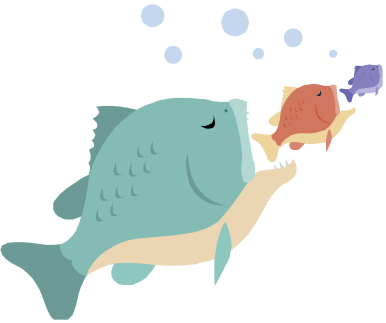
Integrating other types of data to improve density estimate and understand the ecosystem relationships better

Loggerhead turtle spatial and temporal explicit density using abundance survey and satellite track data from us and various other investigators, plus bycatch rates.



Explore ecosystem mechanistic relationships using marine mammal data, static habitat data, dynamic habitat data from satellites and ocean models, EK60 backscatter data, plankton data, fish data, etc.

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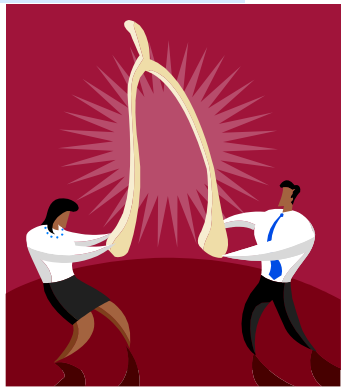
Future - Planning to implement another inter-agency agreement

Wish list:



- **Include other agencies and organizations**
- **Continue work on cetaceans, seabirds, seals, and turtles**
- **Continue quantifying different types of bias corrections**
- **Continue passive acoustic work**
- **Continue non-summer aerial survey of shelf (<2000 m depth)**
- **Continue process survey data collection to include multiple trophic levels and animal behavior**
- **Continue method development to improve density habitat models and integrate different data types**

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QUESTIONS?

AMAPPS = Atlantic Marine Assessment Program for Protected Species

http://www.nefsc.noaa.gov/read/protspp/mainpage/AMAPPS/