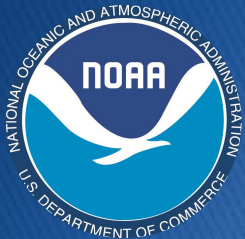


Baleen whale occurrence throughout the western North Atlantic Ocean using Passive Acoustics (2004–2014)

Genevieve Davis¹, Mark Baumgartner², Julianne
Gurnee¹, Danielle Cholewiak¹, Sofie Van Parijs¹,
and many others



¹NOAA Northeast Fisheries Science Center
²Woods Hole Oceanographic Institution

North Atlantic Right Whale

- Endangered, declining population
- Distribution shifts in 2010 highlighted the need for baseline information on seasonal occurrence
- Little is known of fin, sei, and blue whales in the western North Atlantic



North Atlantic Right Whale



Photo: Christin Khan

Fin Whale



Photo: Dani Cholewiak

Sei Whale



Photo: Marjorie Foster

Blue Whale

Passive Acoustic Monitoring

- Movement:
 - Historical and current trends
- Timing
- Distance from Shore



Esri, DeLorme, GEBCO, NOAA NGDC, and other contributors

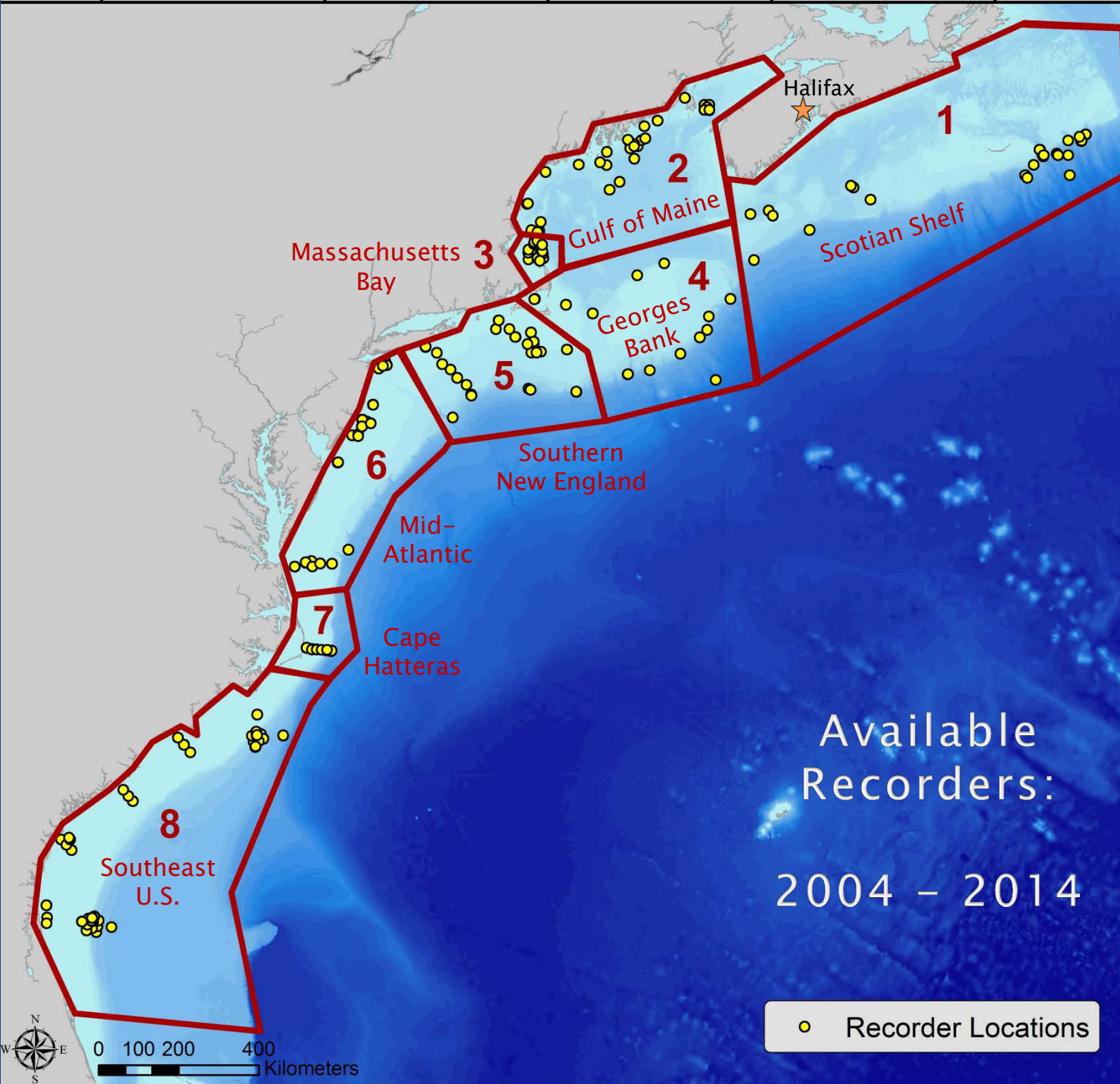


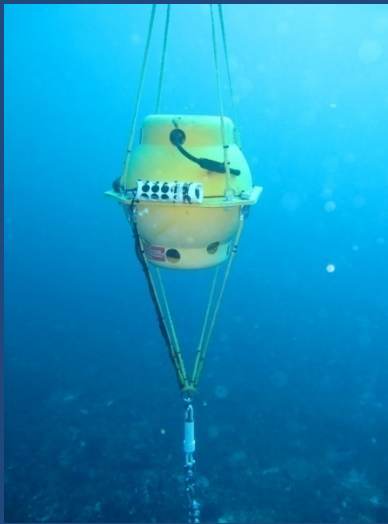
Data Contributors

- Sean Todd; College of the Atlantic
- Chris Clark, Russ Charif, Holger Klinck, Aaron Rice; Cornell University
- Hilary Moors–Murphy; Department of Fisheries and Oceans Canada
- Andy Read, Joy Stanistreet, Lynne Hodge, Doug Nowacek; Duke University
- Kathleen Dudzinski; Dolphin Communication Project
- Julien Delarue, Bruce Martin; JASCO Applied Sciences
- Erin Summers; Maine Department of Marine Resources
- Joel Bell, Jaqueline Bort, Anu Kumar; NAVFAC Naval Facilities Engineering Command
- Scott Kraus; New England Aquarium
- Gary Buchanan; New Jersey Department of Environmental Protection
- Catherine Berchok; NOAA National Marine Mammal Laboratory
- Melissa Soldevilla, Lance Garrison; NOAA Southeast Fisheries Science Center
- Leila Hatch, David Wiley, Mike Thompson; NOS Stellwagen Bank National Marine Sanctuary
- Dave Mellinger, Sharon Nieukirk; Oregon State University
- Kate Stafford; University of Washington
- Denise Risch, Scottish Association for Marine Science
- Ana Sirovic, John Hildebrand; Scripps Institution of Oceanography
- Susan Parks; Syracuse University



Thank You!





MARU

(Marine Autonomous
Recording Unit)

Cornell University



HARP

(High-frequency Acoustic
Recording Package)

Scripps Institution of Oceanography



AMAR

(Autonomous Multichannel
Acoustic Recorder)

Jasco Applied Sciences

Recorder Types



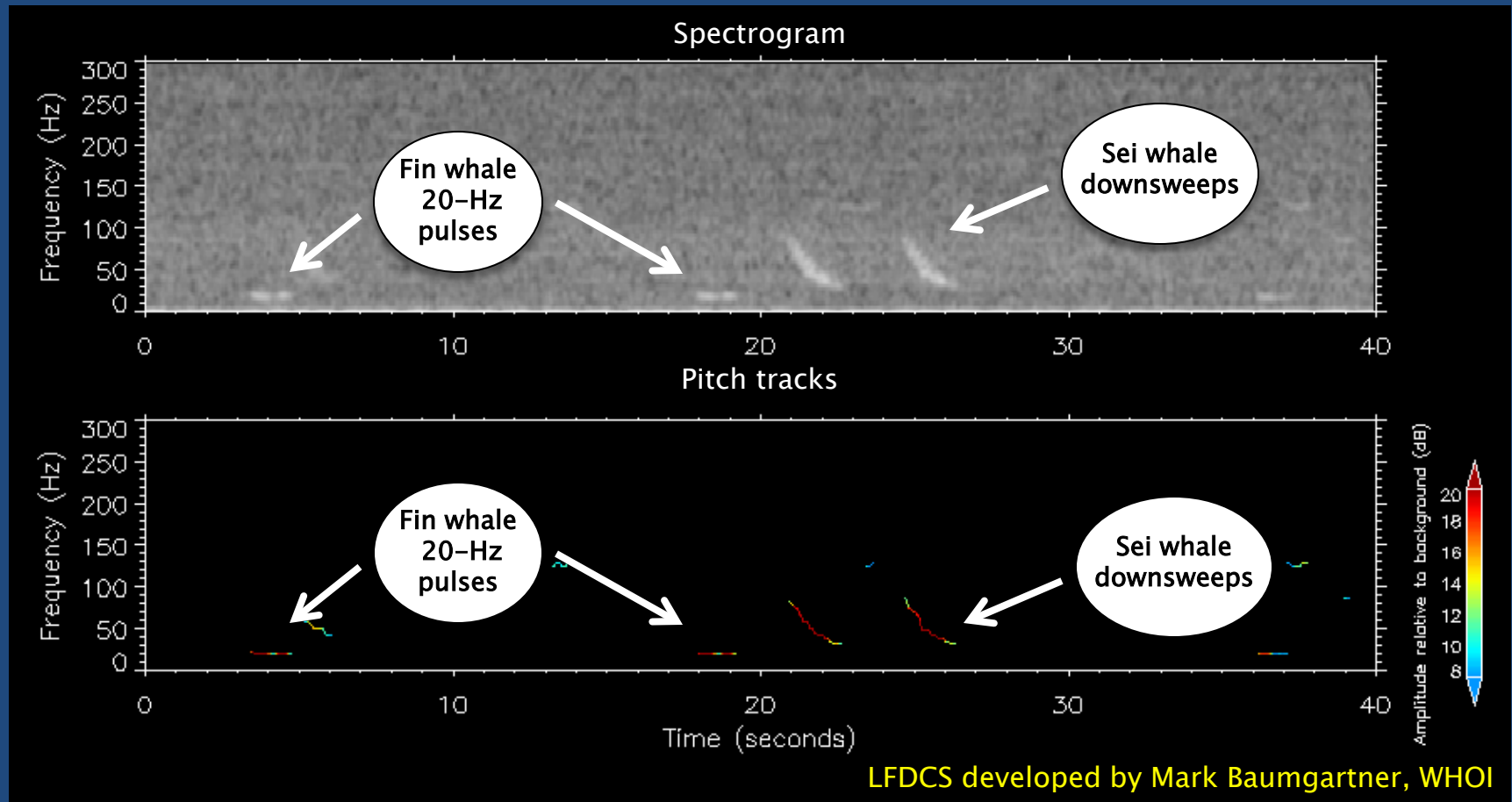
HARU

(Haruphone)

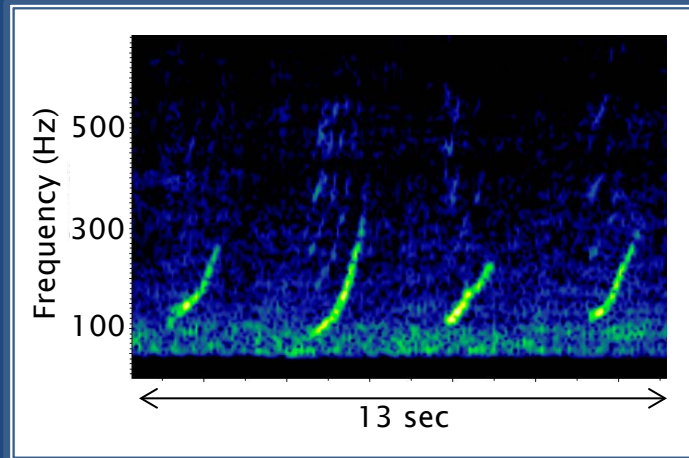
NOAA PMEL &
Oregon State University

LFDCS: Low-frequency detection and classification system

- Creates a conditioned spectrogram
- Detects sounds and pitch tracks
- Classifies pitch tracks based on call library
- Right, fin, sei, and blue whales

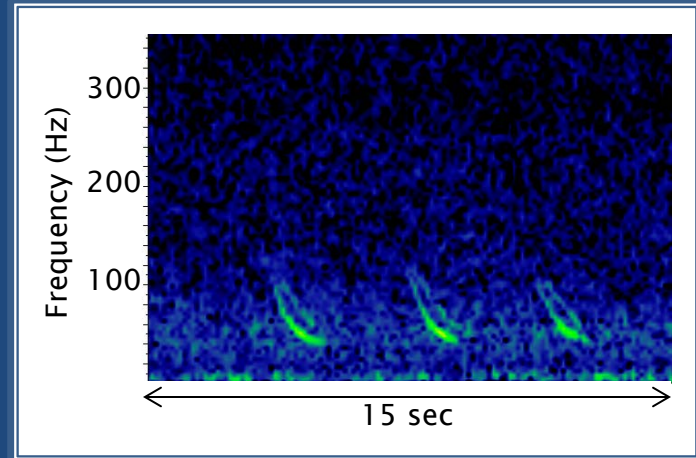


Call Types & Detection Ranges



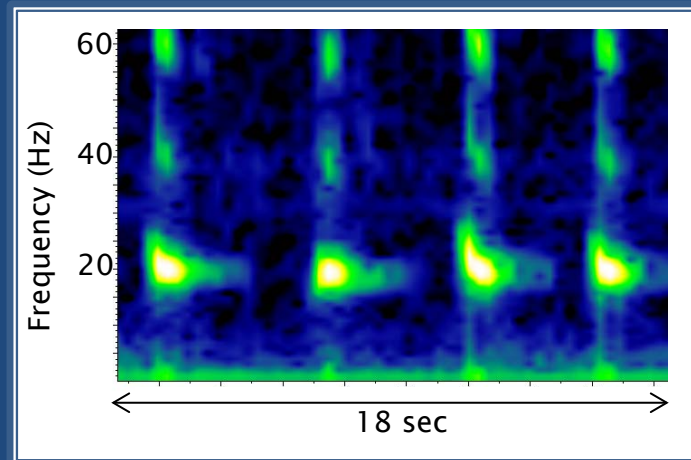
Right Whale: upcall

100–300 Hz, ~8–16 KM



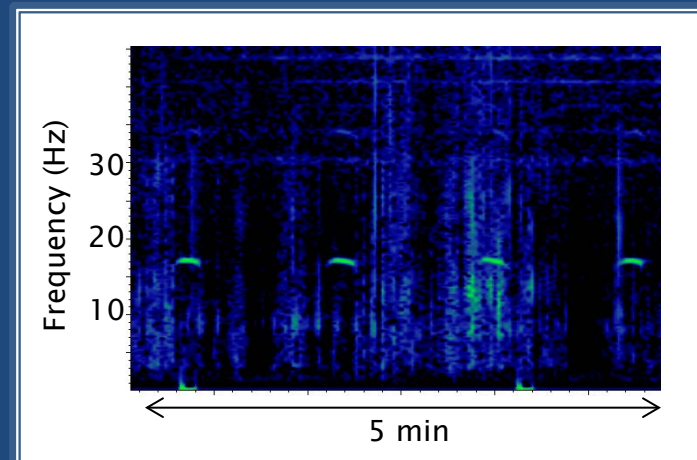
Sei Whale: downsweep

30–130 Hz, ~10–20 KM



Fin Whale: 20-Hz pulse

20 Hz, ~50–60 KM

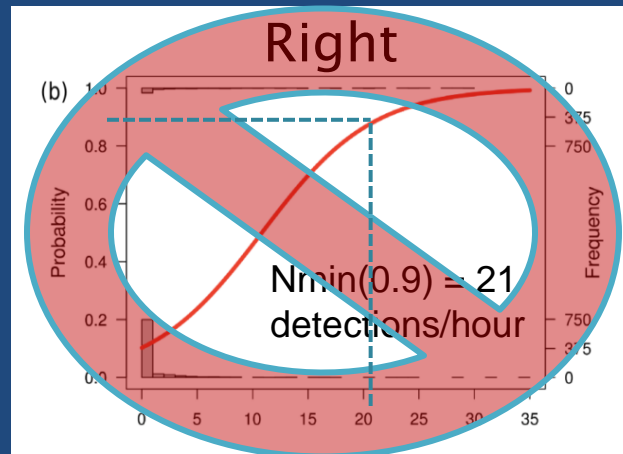
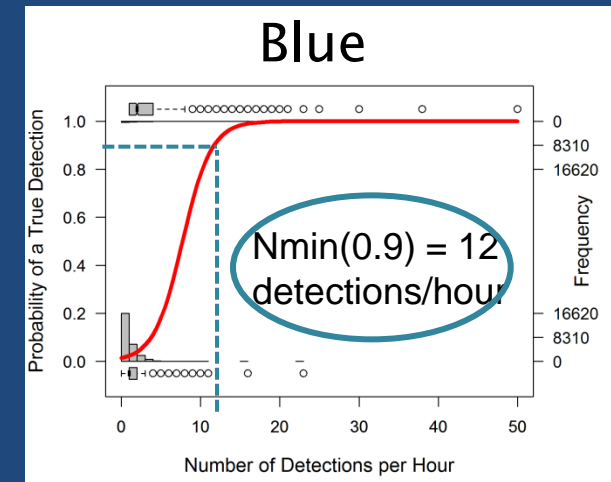
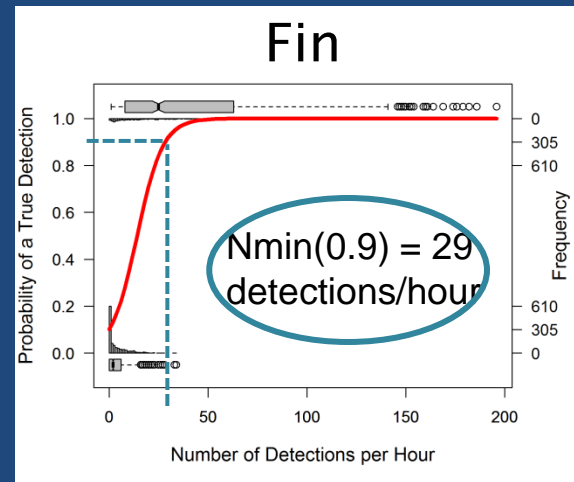
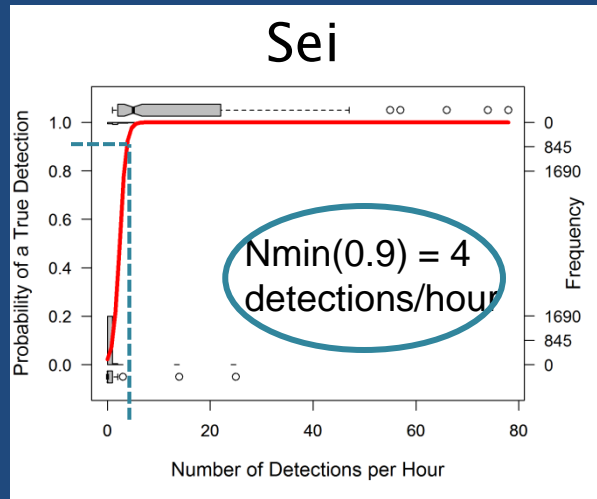


Blue Whale: A, B, AB calls

18 Hz, ~200 KM

Detector Manual Analysis

- Sub-sampled detections throughout years and across regions to verify true presence
- Fitted observations with logistic regressions to determine minimum number of detections needed per hour for species presence



Manually verify all detections

Davis et al. 2017. *Scientific Reports*. 7: 13460

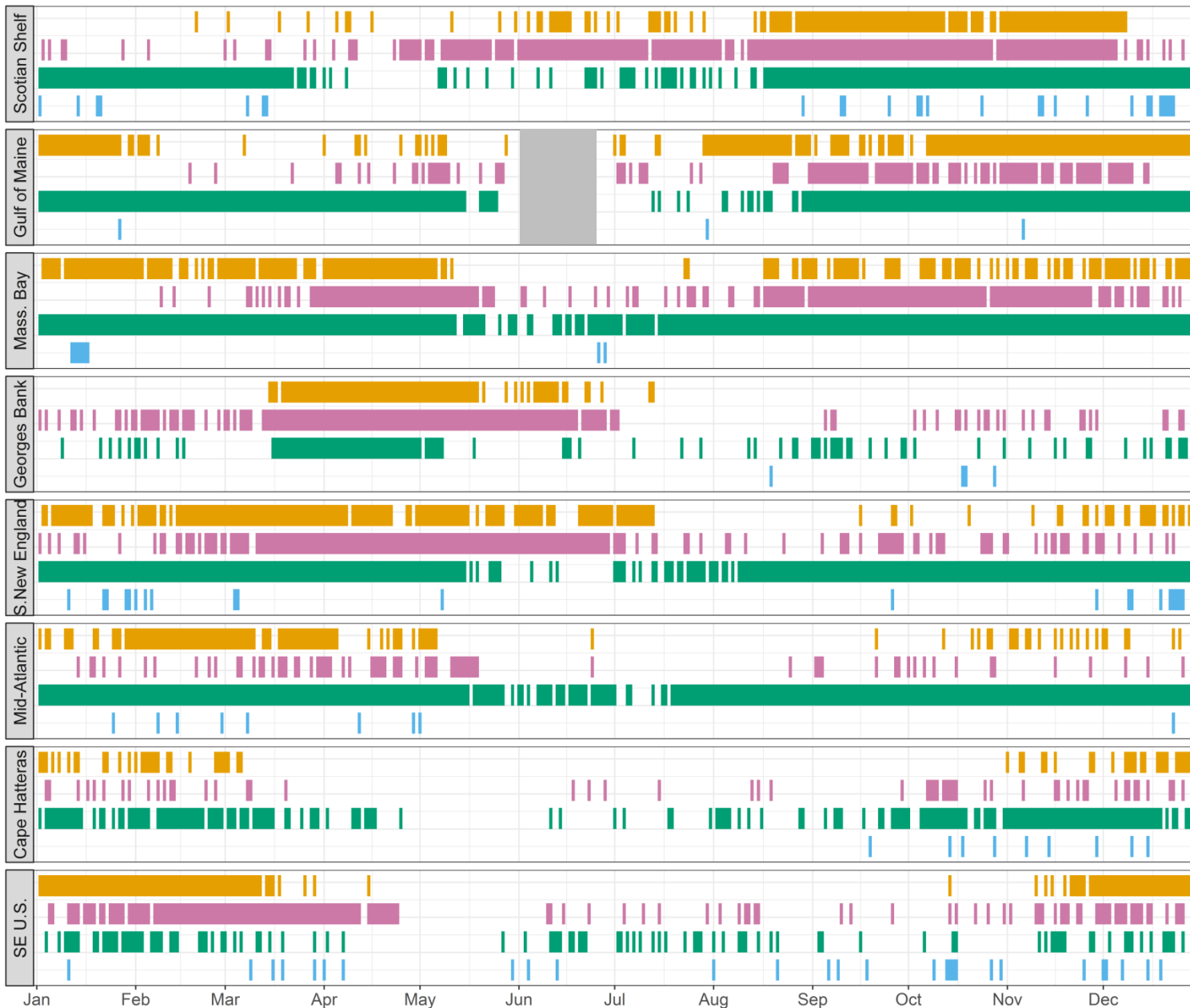
Initial Results

- 305 recorders
- 32,041 days of recordings
- Of these,
 - 2,504 days have verified right whale presence
 - 3,402 days have sei whale detections
 - 5,041 days have fin whale detections
 - 102 days have blue whale detections



Initial Results: Daily Presence

North

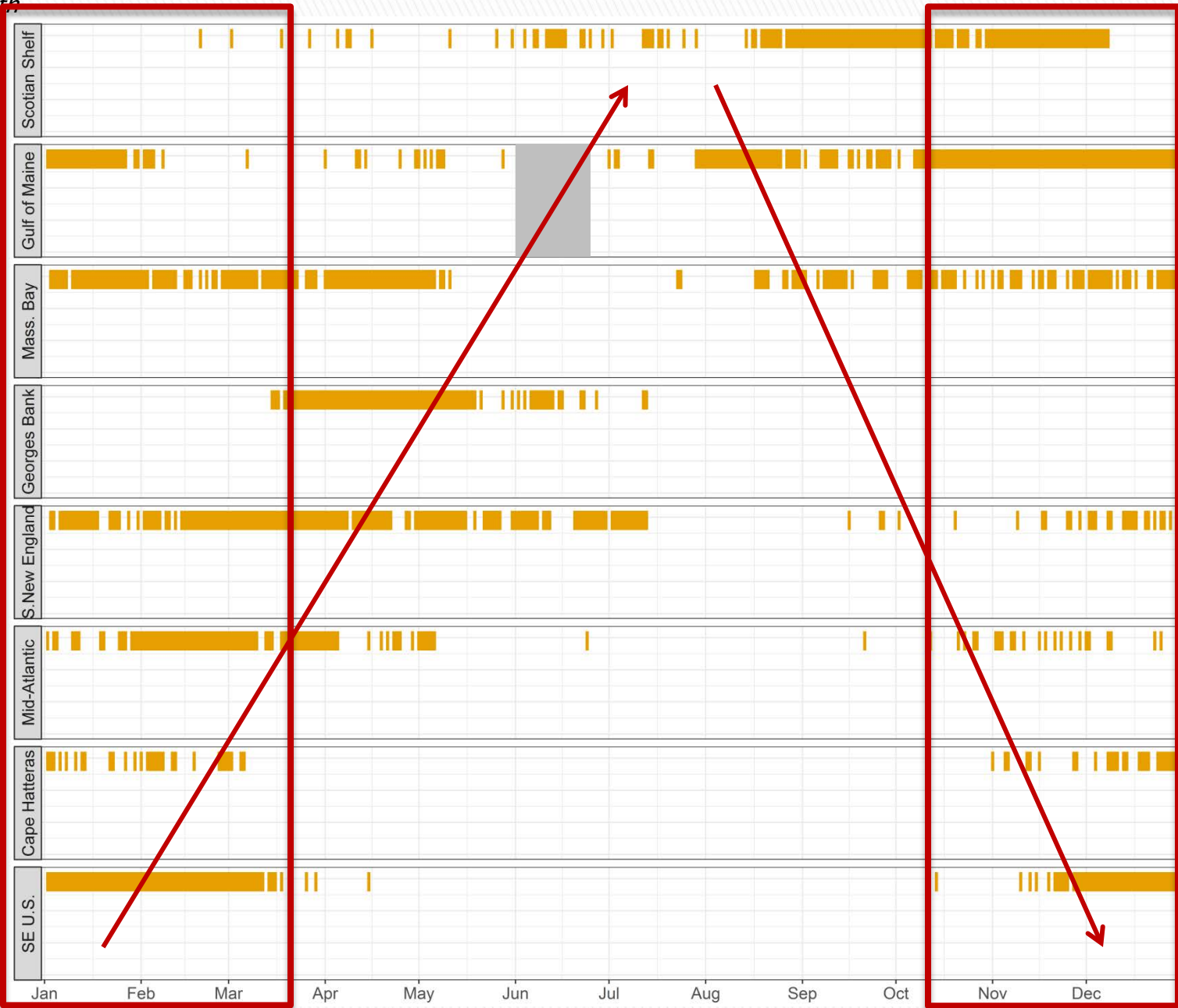


South

Results: Right Whale Daily Presence

North

Region



South

Initial Results: Sei Whale Daily Presence

North



RAW
DETECTOR
OUTPUT!



South

Initial Results: Fin Whale Daily Presence

North



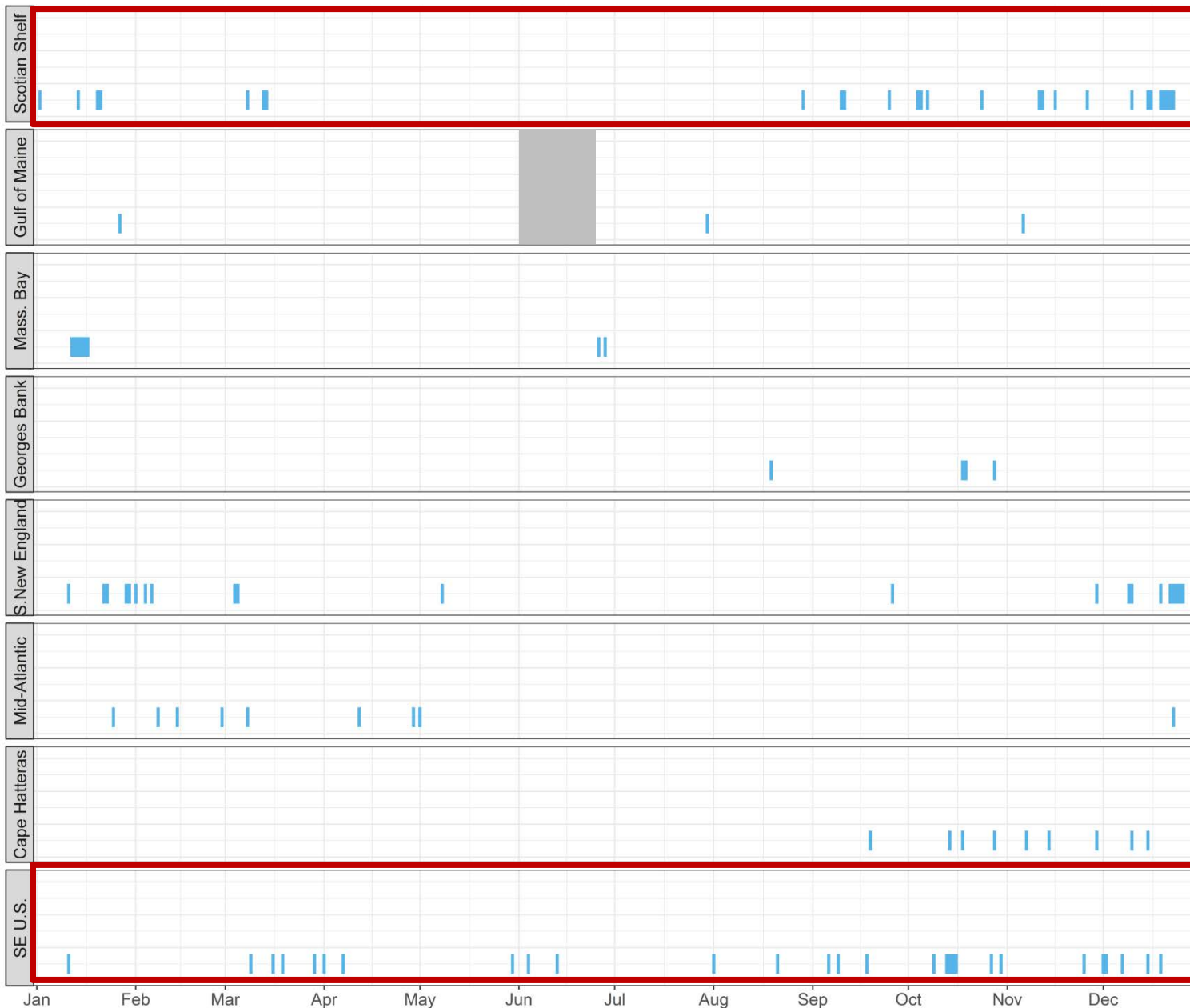
RAW
DETECTOR
OUTPUT



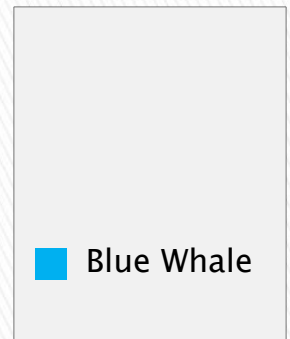
South

Initial Results: Blue Whale Daily Presence

North

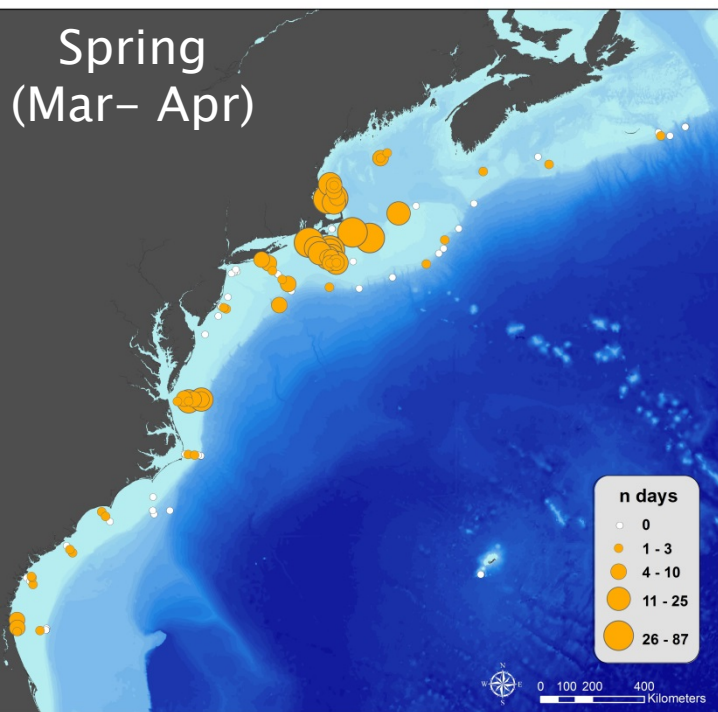


RAW
DETECTOR
OUTPUT

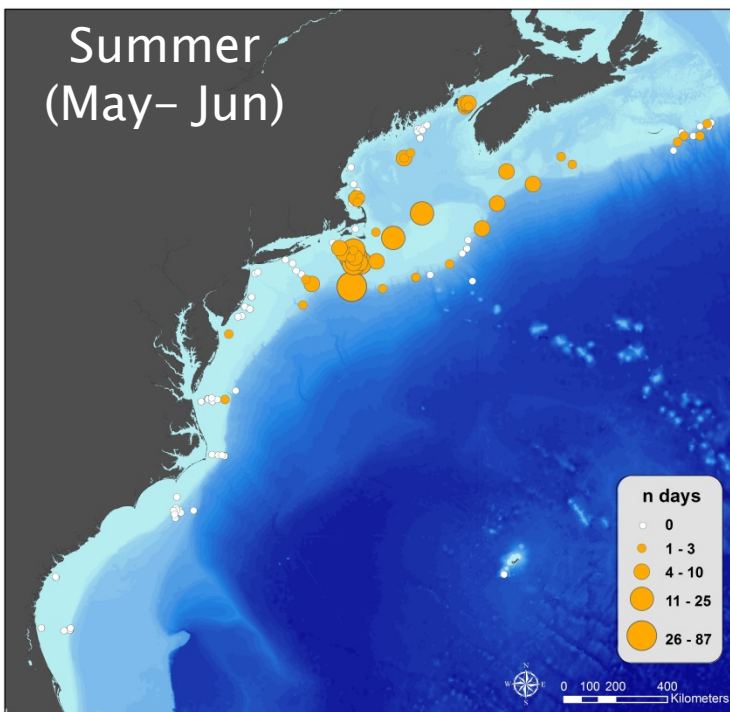


South

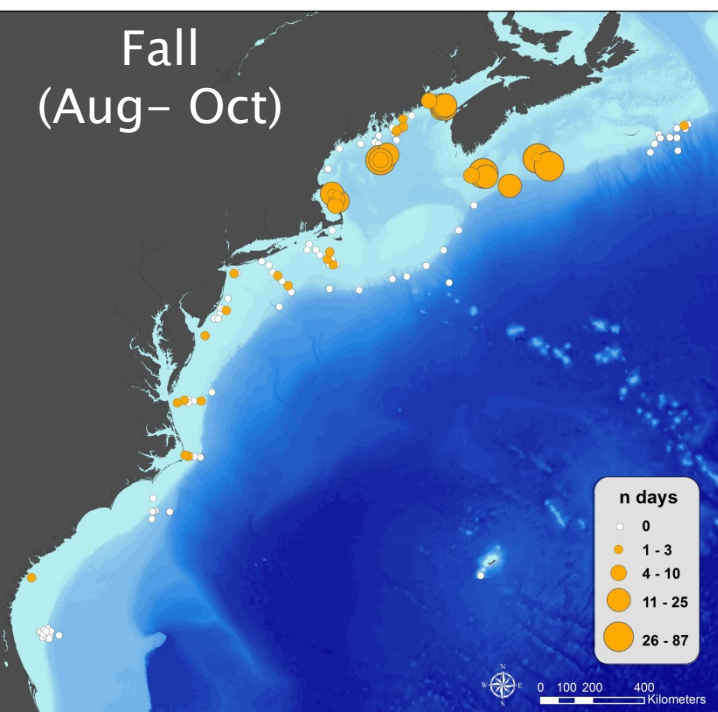
Spring
(Mar– Apr)



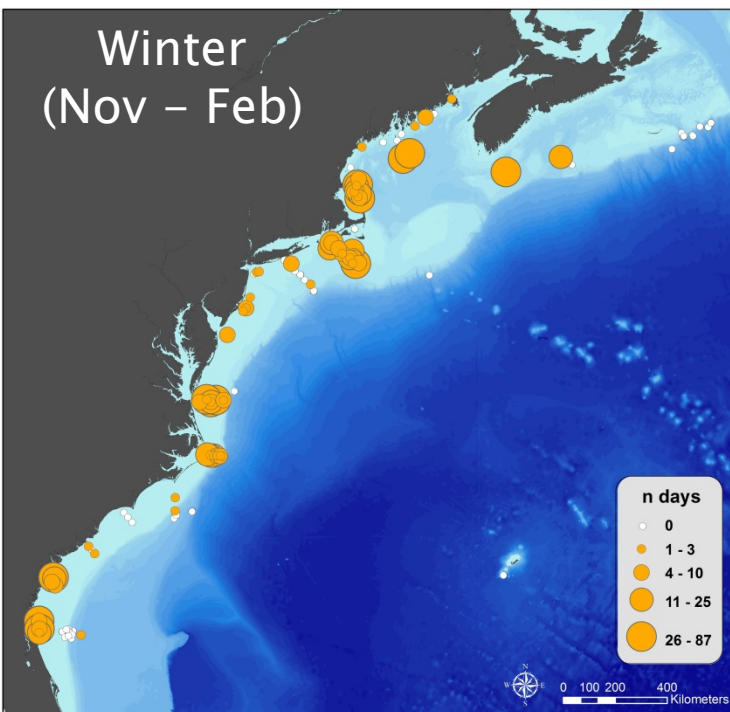
Summer
(May– Jun)



Fall
(Aug– Oct)



Winter
(Nov – Feb)



Right Whale

Seasonal
Occurrence

2004–2014



Davis et al. 2017.
Scientific Reports

Right Whale Monthly Presence

2004 – 2014

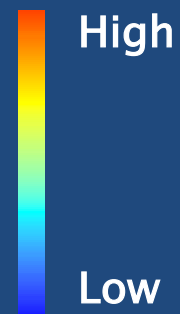
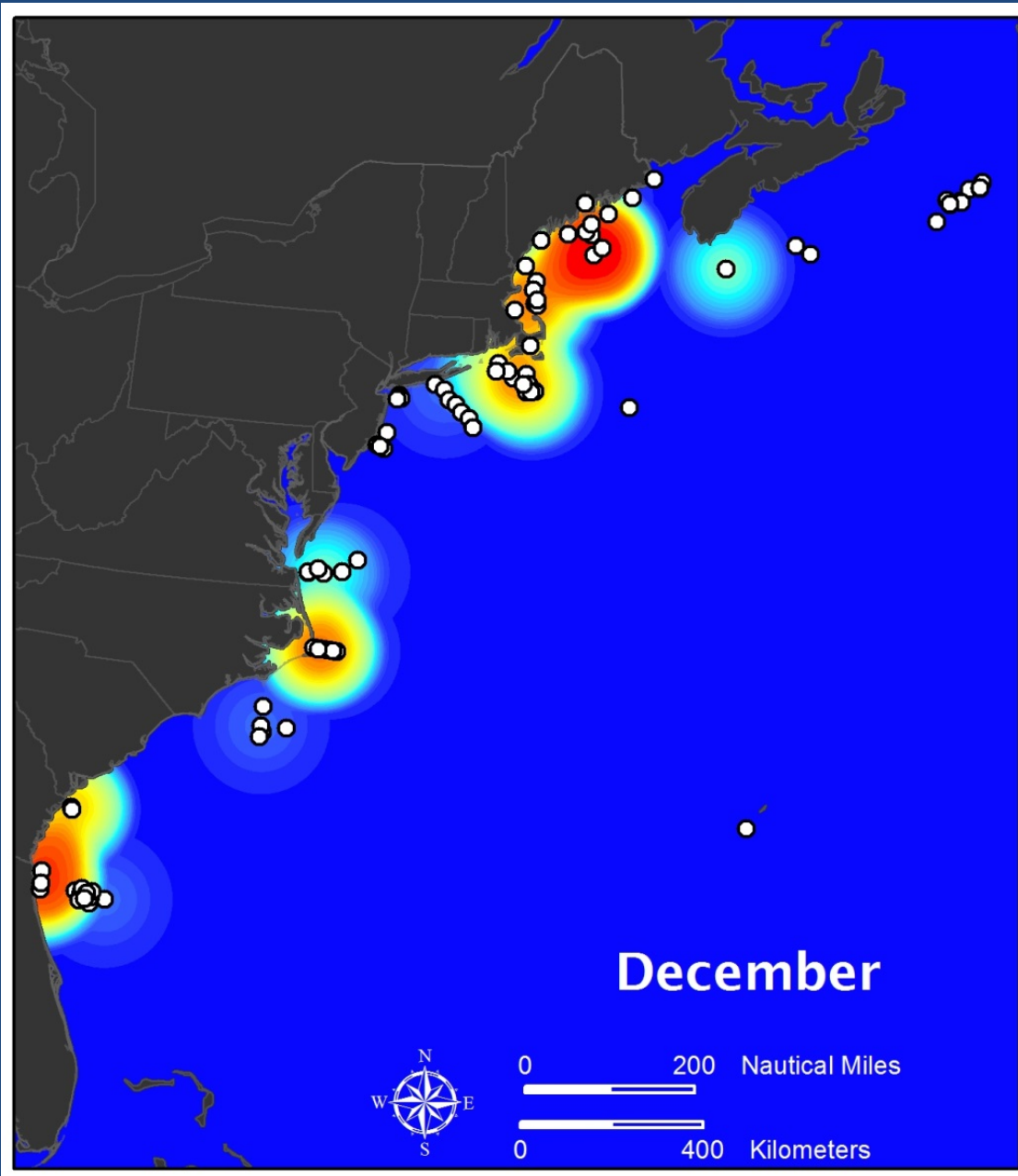
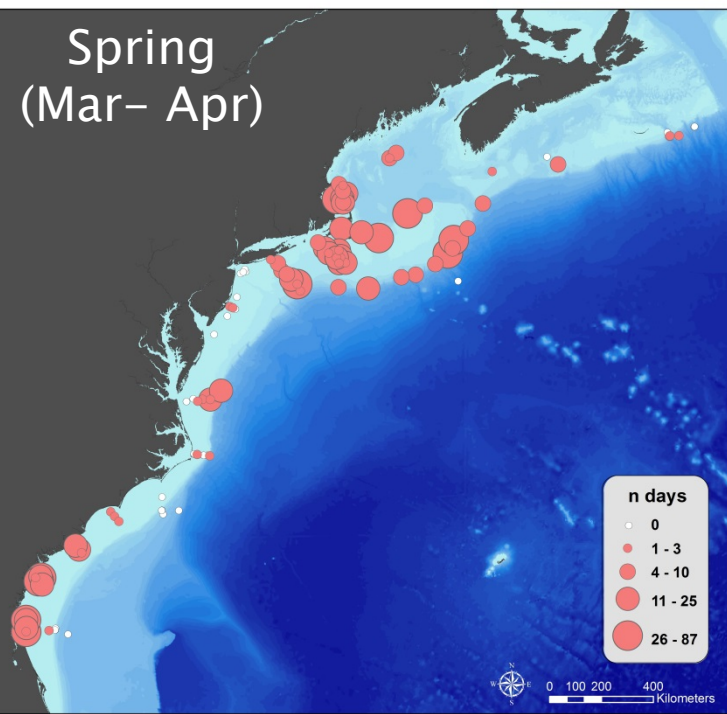
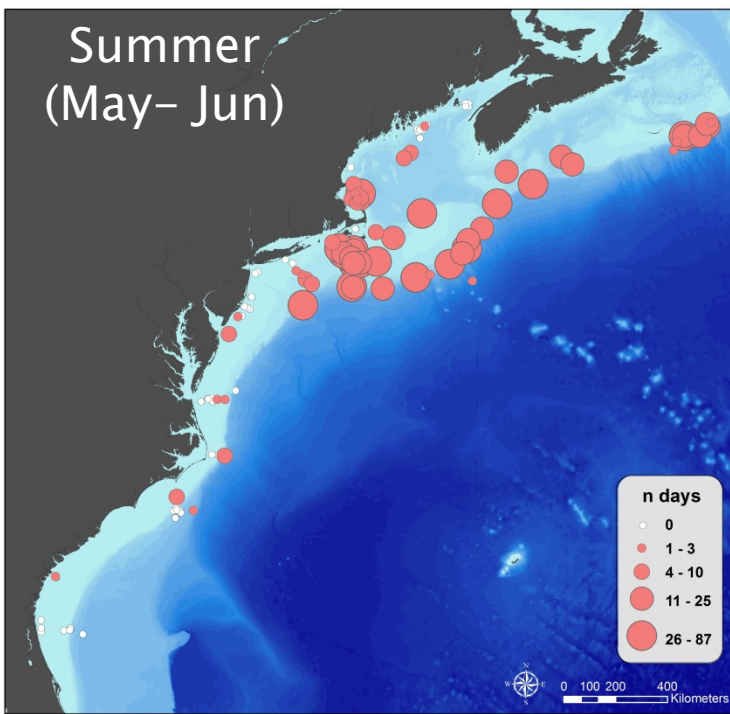


Figure adapted from Mike Thompson, NOAA/SBNMS

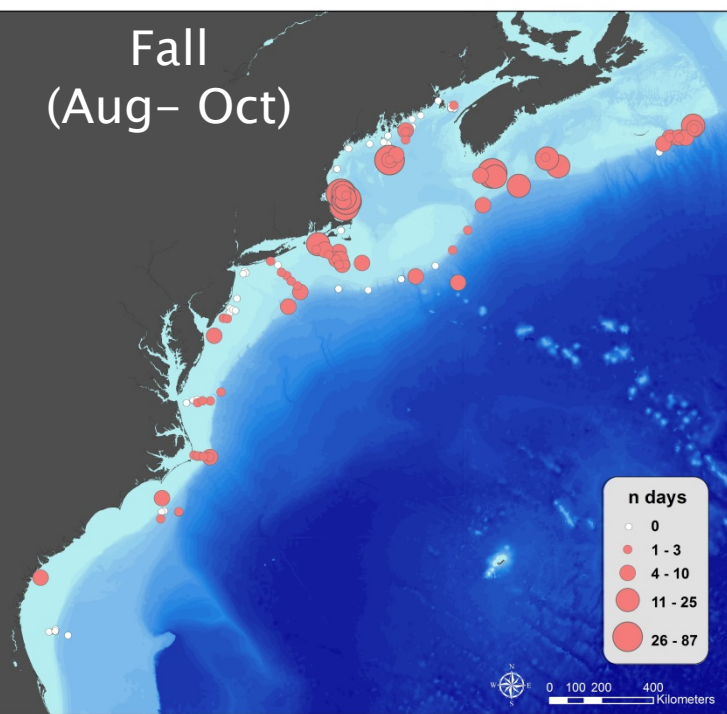
Spring
(Mar– Apr)



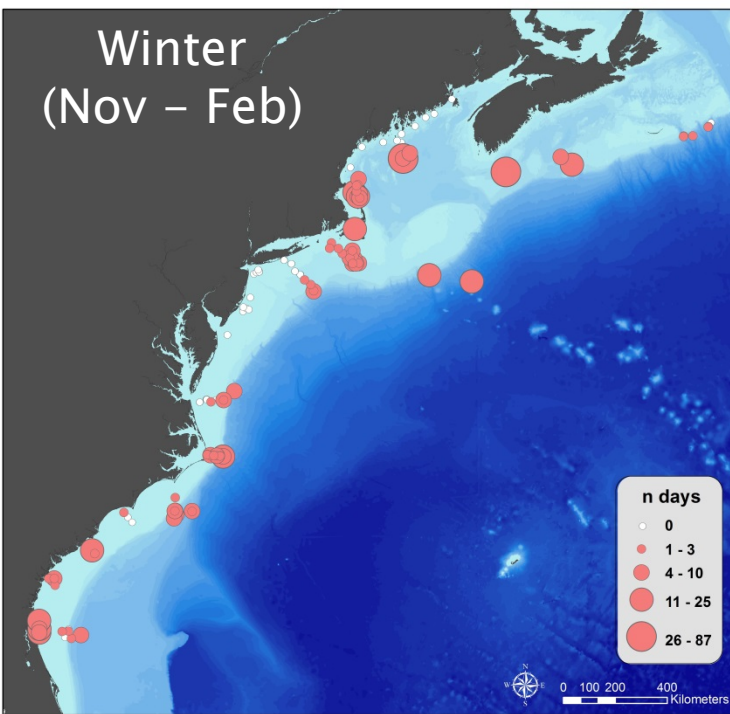
Summer
(May– Jun)



Fall
(Aug– Oct)



Winter
(Nov – Feb)



RAW
DETECTOR
OUTPUT

Sei Whale

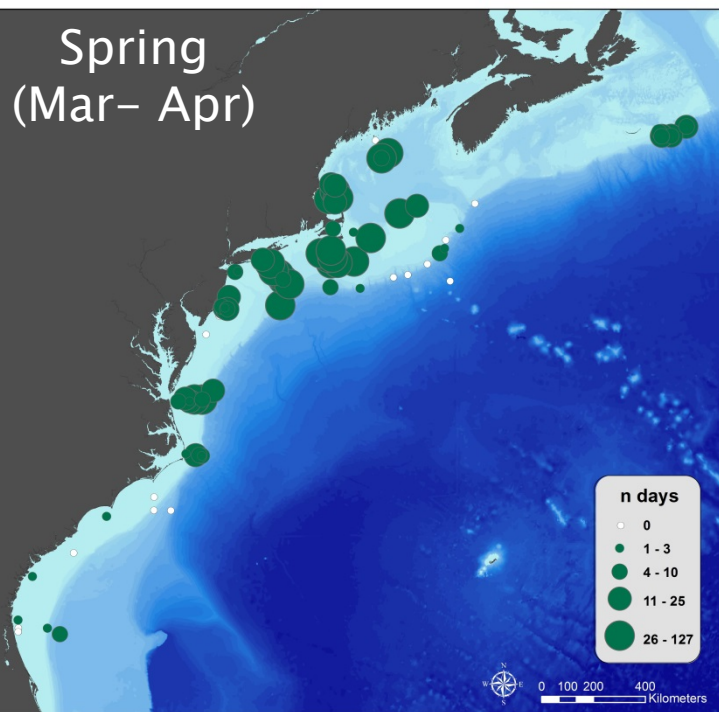
Seasonal
Occurrence

2004–2014

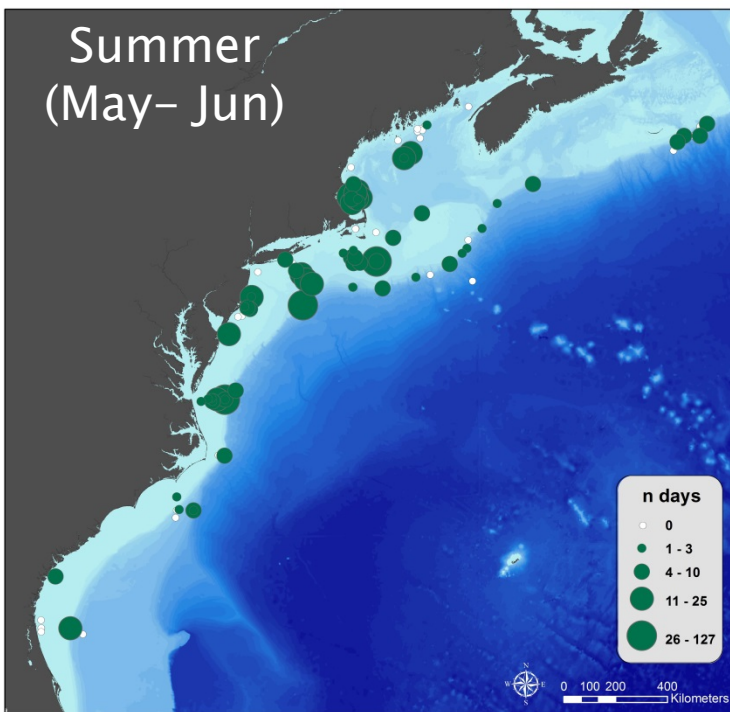


Photo: Dani Cholewiak

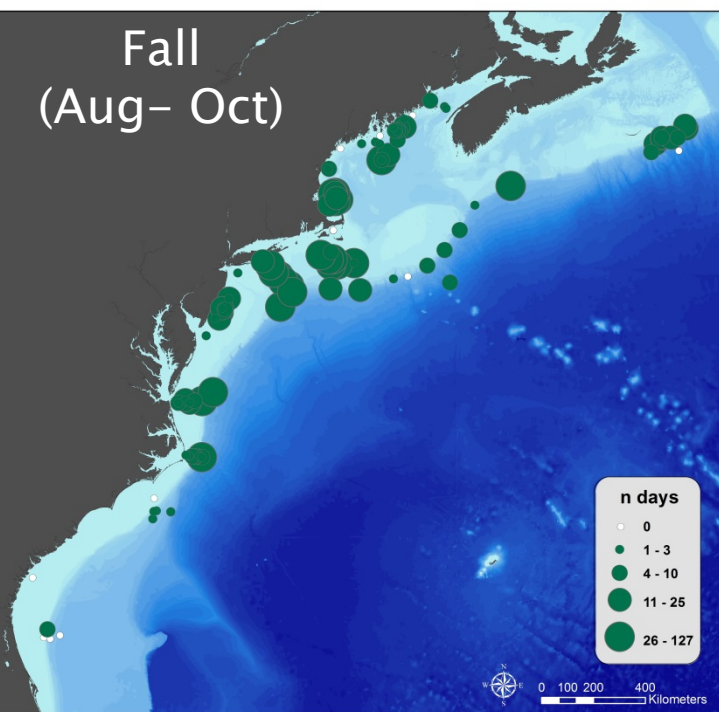
Spring
(Mar– Apr)



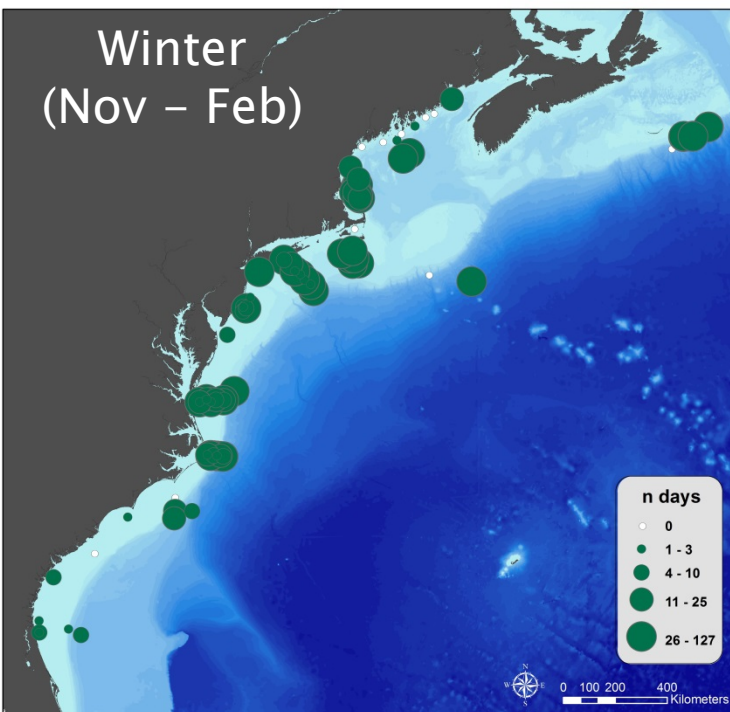
Summer
(May– Jun)



Fall
(Aug– Oct)



Winter
(Nov – Feb)



RAW
DETECTOR
OUTPUT

Fin Whale

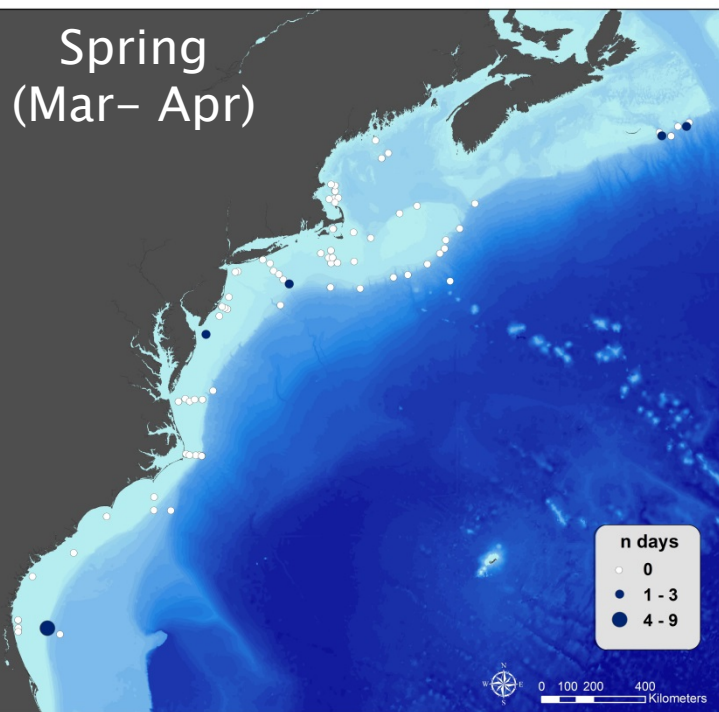
Seasonal
Occurrence

2004–2014

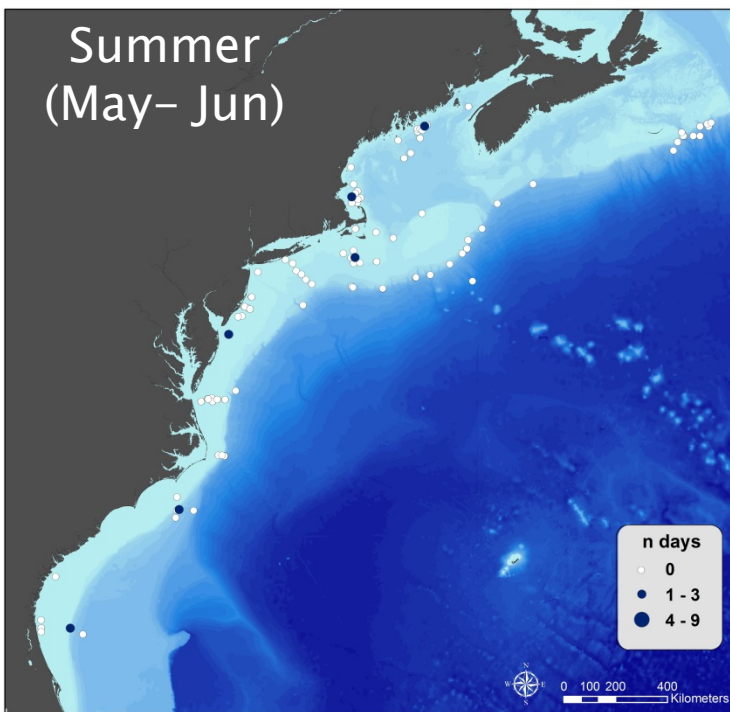


Photo: Christin Khan

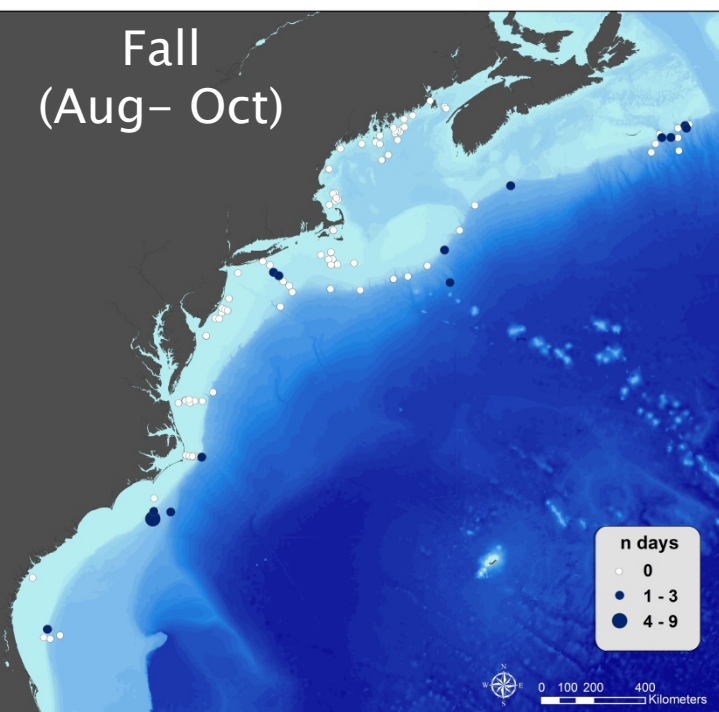
Spring
(Mar– Apr)



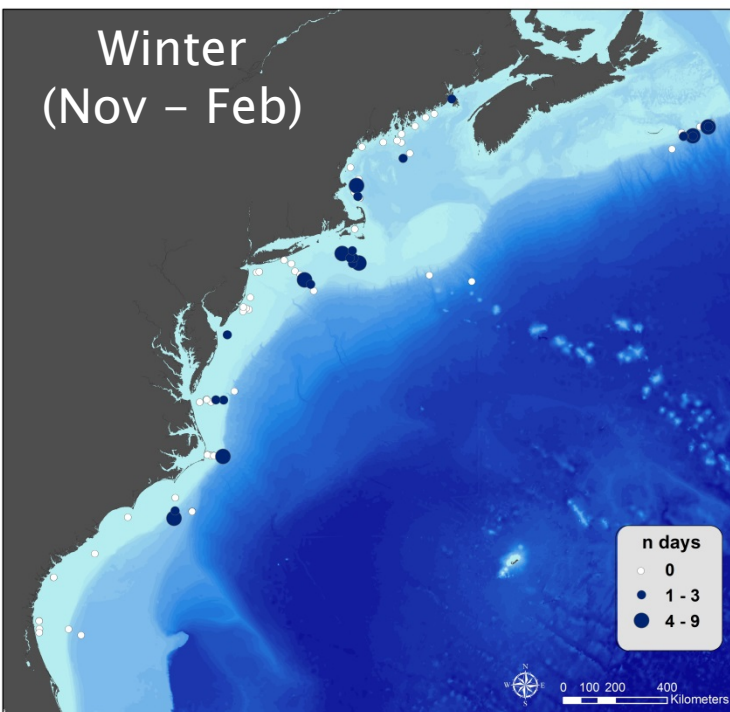
Summer
(May– Jun)



Fall
(Aug– Oct)



Winter
(Nov – Feb)



RAW
DETECTOR
OUTPUT

Blue Whale

Seasonal
Occurrence

2004–2014



Photo: Marjorie Foster

Next steps

Preliminary results: Fin, sei, and blue whale results from raw detector output!

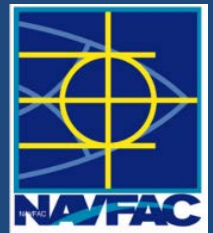
- Except for right whales (published), evaluate detector output for other species
- Changes over time
- Distance from shore/depth
- Humpback whales coming soon

Conclusions

- Decade-long, trans-boundary analysis, brought together from acoustic monitoring projects with varying goals
 - Right, fin, and sei whales are detected along the entire eastern seaboard in winter months
 - Sei whales: follow a similar pattern as right whales; present along entire coast in both winter and spring but more acoustic activity in spring
 - Fin whales: present across all regions and seasons, except for southernmost regions in summer
 - Blue whales: sporadic detections in varying depths along the entire coastline; greatest acoustic presence in winter, except for the Southeast U.S.

Acknowledgements

- T. Cole, P. Corkeron, A. DeAngelis, P. Duley, D. Gerlach, A. Henry, H. Heenehan, C. Khan, E. Matzen, J. Stanley, J. Stanistreet, S. Weiss–NOAA/NEFSC/Protected Species Branch
- Daniel Woodrich – NOAA/AFSC
- Alyssa Scott – University of Washington
- Chris Pelkie, Chris Tessaglia–Hymes, Margaret Daly – Bioacoustics Research Program, Cornell University
- Solange Brault, Jarett Byrnes, Mike Rex – University of Massachusetts Boston
- Chris Sutherland – University of Massachusetts Amherst
- Many field teams and boat crew



Funded by:

- NOAA NMFS
-  Fisheries and Oceans Canada



Thank you!