North Atlantic Right Whale Consortium Annual Meeting

New Bedford Whaling Museum
New Bedford, MA USA
25-26 October 2022

www.narwc.org

NARWC
THE NORTH ATLANTIC RIGHT WHALE CONSORTIUM

North Atlantic Right Whale Consortium

Annual Meeting
25-26 October 2022
New Bedford Whaling Museum

MEETING FORMAT AND AGENDA

Pre-Meeting:
Prior to the meeting, all registered participants will receive a unique meeting site login code that will allow them to view all pre-recorded presentations in advance of the meeting. All underlined presentations should be view **in advance of the meeting** as they will not be shared live. Those presentations that are not underlined will be shared **live** during the meeting. The six-digit number preceding the presentation title corresponds to the video number on the meeting site. Please note that presentations that are to be viewed live will be uploaded to the meeting site **post meeting**, and therefore have six-digit codes as well.

Participants (both onsite and remote) may submit questions/comments for presenters using the meeting site chat function in advance of the meeting.

Live Meeting:
Remote participants will be able to view the meeting, including live presentations and discussions, using their unique login code on the meeting site.

Following any live presentations within a session, a discussion panel will take place with all presenters within that session. Presenters who are onsite will gather at the front of the auditorium and presenters who are remote will be pulled in to the auditorium by projection feed. The panel will take questions/comments from both onsite and remote meeting participants. Remote participants should use the chat function on the meeting site to submit questions and comments.

All meeting materials (both static and live) are intended for registered participants only and may not be shared in any capacity. All participants have agreed to the meeting Code of Conduct. There is no recording (including but not limited to video, audio, screenshots, or photography) or sharing (including social media) of any material (including but not limited to presentations, presentation content, discussions) without explicit consent of the presenter, speaker, moderator, etc.

*A unique email and passcode are required to access meeting materials and remote viewing of live sessions
*Time listed are EDT
*Underlined talks should be view **in advance** of the meeting and will not be shared live

25 October 2022

0800-0830 Check in

0830 Opening / Keynote
Scott Kraus, NARWC Chair

0900 Session 1: Species Status Update
Moderated by Scott Kraus

01.01.01 **North Atlantic Right Whale Catalog update and whale naming results**
- *Philip Hamilton, Anderson Cabot Center for Ocean Life at the New England Aquarium*

01.01.02 **Update on the North Atlantic Right Whale Unusual Mortality Event: 2017-present**
- *Deborah Fauquier, National Marine Fisheries Service*

01.01.03 **2022 North Atlantic right whale entanglement update**
- *Moira Brown, Canadian Whale Institute/Campobello Whale Rescue Team*

01.01.04 **Serious injury and human impact monitoring and determinations**
- *Heather Pettis, Anderson Cabot Center for Ocean Life at the New England Aquarium*
- *Allison Henry, Northeast Fisheries Science Center*

1030 Break

1100 Session 2: Distribution and Habitat Use
Moderated by Tim Frasier

01.02.01 **Redefining North Atlantic right whale habitat-use patterns under climate change**
- *Erin Meyer-Gutbrod, University of South Carolina*

01.02.02 **Decadal-scale phenology and seasonal climate drivers of North Atlantic right and other baleen whales in a rapidly warming marine ecosystem**
- *Daniel Pendleton, Anderson Cabot Center for Ocean Life at the New England Aquarium*

01.02.03 **Forecasting near-term movements and density of North Atlantic right whales**
- *Nathan Crum, Florida Fish and Wildlife Conservation Commission*

01.02.04 **Abundance and distribution of North Atlantic right whales in eastern Canada estimated from aerial line-transect surveys from 2017 to 2021**
- *Caroline Sauvé, Department of Fisheries and Oceans Canada*

01.02.05 **Vulnerability of North Atlantic right whales to entanglement and collision in the Gulf of St. Lawrence: insights from their movement patterns and diving behavior**
- *Valérie Harvey, Department of Fisheries and Oceans Canada*

01.02.06 **From top to bottom: Predominantly near-surface and near-bottom distribution of North Atlantic right whales in the Gulf of St Lawrence**
- *Andrew Wright, Department of Fisheries and Oceans Canada*

01.02.07 **Didn't we just see you over there? What can vessel-based mark-recapture tell us of right whale movement in the southern GSL in 2022**
- *Delphine Durette-Morin, Canadian Whale Institute*
- *Amy Warren, Anderson Cabot Center for Ocean Life at the New England Aquarium*

01.02.08 **North Atlantic right whale density model for U.S. waters**
- *Jason Roberts, Marine Geospatial Ecology Laboratory, Duke University*

*A unique email and passcode are required to access meeting materials and remote viewing of live sessions
*Time listed are EDT
*Underlined talks should be view **in advance** of the meeting and will not be shared live

01.02.09 **Incorporating prey information into the Duke Right Whale Density Surface Model**
- *Camille Ross, Bigelow Laboratory for Ocean Sciences*

1300 Lunch

1415 Session 3: Health, Physiology, and Genetics
Moderated by Bill McLellan

01.03.01 **Photogrammetric analysis of North Atlantic right whale growth and body condition trends could encourage reduction of sub-lethal trauma, a prerequisite for species survival**
- *Michael Moore, Woods Hole Oceanographic Institution*

01.03.02 **Including serious injury and morbidity cases in the ongoing Unusual Mortality Event of North Atlantic right whales (*Eubalaena glacialis*): 2017-present**
- *Sarah Sharp, International Fund for Animal Welfare*

01.03.03 **Genomic estimates of diversity and population history of North Atlantic and southern right whales**
- *Carla Crossman, Department of Biology, St. Mary's University*

01.03.04 **Skin transcriptome analysis as a potential tool for assessing health in the North Atlantic right whale**
- *Ebru Unal, Mystic Aquarium*

01.03.05 **Drone-based measurements of blowhole temperatures of North Atlantic right whales (*Eubalaena glacialis*) and humpback whales (*Megaptera novaeangliae*)**
- *Gina Lonati, University of New Brunswick St John*

01.03.06 **Using North Atlantic right whale family lineages as a conservation tool**
- *Kara Shervanick, NMFS Southeast Regional Office*

1530 Break/Extended for small meeting/strategic planning opportunities

Informational Tables (outside of Harborview Gallery):

The following groups will have tables set up in the Harbor View gallery during the break to provide information/demonstrations:

- **NEIT Table**

The Northeast Implementation Team is a recovery team appointed by NOAA under the ESA to assist with the development and implementation of the North Atlantic Right Whale recovery plan. Members of the NEIT will be available in-person and virtually to provide updates on past and current efforts to support GARFO and NARWs.

Remote participant LINK
Meeting ID: 882 8240 2569; Passcode: 773774

- **Whale and Dolphin Conservation (WDC) On-Demand Fishing Gear demonstration**

On demand fishing gear trials show promise in reducing right whale entanglements and sustaining economically and culturally important fisheries. Whale and Dolphin Conservation will be demonstrating two types of functioning on-demand display units for individuals interested in learning more about how this alternative fishing gear works.

*A unique email and passcode are required to access meeting materials and remote viewing of live sessions
*Time listed are EDT
*Underlined talks should be view **in advance** of the meeting and will not be shared live

1630 Session 4: Acoustics
Moderated by Peter Corkeron

01.04.01 **Near real-time passive acoustic monitoring for right whales on the U.S. east coast – an update**
- *Mark Baumgartner, Woods Hole Oceanographic Institution*

01.04.02 **Adaptable, open-source deep learning NARW vocalization detection tool**
- *Bruno Padovese, Institute for Big Data Analytics, Faculty of Computer Science, Dalhousie University*

01.04.03 **Current NARW PAM Project updates from the NEFSC**
- *Genevieve Davis, NOAA/NMFS Northeast Fisheries Science Center*

1715 Day 1 Wrap
1730 Onsite Reception

*A unique email and passcode are required to access meeting materials and remote viewing of live sessions
*Time listed are EDT
*Underlined talks should be view **in advance** of the meeting and will not be shared live

26 October 2022

0830 Business Meeting
The business meeting is open to **ALL attendees. Please join us!**

0930 Session 1: Management Program Updates
Moderated by Sean Brillant

02.01.01 **Fisheries and Oceans Canada: An update on research and monitoring activities for North Atlantic right whales (*Eubalaena glacialis*)**
- *Angelia Vanderlaan, Fisheries and Oceans Canada*

02.01.02 **NOAA Fisheries' North Atlantic Right Whale Road to Recovery**
- *Niki Lisi, National Marine Fisheries Service Office of Protected Resources*

02.01.03 **Building the road to recovery: Conservation and management of the eastern North Pacific right whale**
- *Jenna Malek, NOAA Fisheries, Alaska Region*

1015 Break

1045 Ropeless Consortium Meeting Summary
- *Mark Baumgartner, Woods Hole Oceanographic Institution*
- *Sean Brillant, Canadian Wildlife Federation*
- *Michael Moore, Woods Hole Oceanographic Institution*

1100 Session 2: Anthropogenic Event Monitoring and Mitigation - Entanglement
Moderated by Michael Moore

02.02.01 **An approach for allocating where right whale entanglement events may have occurred**
- *Amy Knowlton, Anderson Cabot Center for Ocean Life at the New England Aquarium*

02.02.02 **Collaborations with commercial fish harvesters to determine suitability of low-breaking strength gear modifications in Atlantic Canadian fixed-gear fisheries**
- *Rhyl Frith, Canadian Wildlife Federation*

02.02.03 **How effective are fisheries closures? An orthogonal entanglement risk reduction analysis of time-area fisheries closures in the Gulf of St. Lawrence snow crab fishery**
- *Alexandra Cole, Canadian Wildlife Federation*

02.02.04 **Entanglement response for right whale, Snow Cone: A case study**
- *Scott Landry, Center for Coastal Studies*

02.02.05 **Grappling with the disentanglement toolkit**
- *Max Fertik, Rhode Island School of Design*
- *Max Werner, Rhode Island School of Design*

02.02.06 **Whales and fishermen in Gaspésie: 4 years of survey data, towards a coexistence on the maritime territory**
- *Lyne Morissette, M- Expertise Marine Inc.*

02.02.07 **Bycatch Solutions Hub: Connecting the seafood industry to practical solutions to protect Endangered, Threatened, and Protected (ETP) species**
- *Phillip Sanchez, Sustainable Fisheries Partnership*

*A unique email and passcode are required to access meeting materials and remote viewing of live sessions
*Time listed are EDT
*Underlined talks should be view **in advance** of the meeting and will not be shared live

1200 Session 3: Anthropogenic Event Management – Entanglement
Moderated by Moira Brown

02.03.01 **NOAA's Ropeless Roadmap: A strategy to develop on-demand fishing**
- *Michael Asaro, NOAA Northeast Fisheries Science Center*

02.03.02 **Fisheries and Oceans Canada (DFO): Entanglement prevention and mitigation efforts**
- *Brett Gilchrist, Fisheries and Oceans Canada*
- *Melissa Landry, Fisheries and Oceans Canada*

02.03.03 **Atlantic Large Whale Take Reduction Plan update**
- *Marisa Trego, Greater Atlantic Regional Office, US National Marine Fisheries Service*

02.03.04 **Abandoned gear removal efforts in the Massachusetts Restricted Area**
- *Erin Burke, Massachusetts Division of Marine Fisheries*

1300 Lunch
Student/Professional Roundtables – Professional Host Bios
1. **In person: Harbor View Gallery**
2. **Remote participants LINK**
Meeting ID: 856 5553 3437; Passcode: 945210

1415 Session 4: Anthropogenic Event Monitoring and Management – Vessel Strikes
Moderated by Amy Knowlton

02.04.01 **Transport Canada (TC) update on North Atlantic right whale vessel management measures**
- *Michel Charron, Transport Canada*
- *Chantal Bois, Transport Canada*

02.04.02 **Assessing the risk of vessel strike mortality in North Atlantic right whales along the U.S East Coast**
- *Lance Garrison, National Marine Fisheries Service, Marine Mammal and Turtle Division, Southeast Fisheries Science Center*

02.04.03 **Proposed amendments to the North Atlantic right whale vessel speed rule**
- *Caroline Good, Office of Protected Resources, National Marine Fisheries Service*

02.04.04 **U.S. Army Corps of Engineers conservation and protection measure implementation in the South Atlantic region**
- *Kathryn Lebow, U.S. Army Corps of Engineers - Jacksonville District*

1515 Session 5: Wind Energy: Impacts and Management
Moderated by Mark Baumgartner

02.05.01 **Impact of continual turbine operational noise on the migration of the North Atlantic right whale**
- *Robert Stern, Save Long Beach Island, Inc.*

02.05.02 **How is NOAA Fisheries approaching the recovery of North Atlantic right whales with offshore wind development?**
- *Sean Hayes, NOAA Northeast Fisheries Science Center*

02.05.03 **NMFS offshore wind energy protected species management updates**
- *Nick Sisson, NOAA Greater Atlantic Regional Fisheries Office*

02.05.04 **NEFSC research efforts to better understand right whale habitat and distribution in Southern New England offshore wind development areas and nearby waters**

*A unique email and passcode are required to access meeting materials and remote viewing of live sessions
*Time listed are EDT
*Underlined talks should be view **in advance** of the meeting and will not be shared live

- *Christopher Orphanides, NOAA Fisheries*

1615 Open Forum
Moderated by Scott Kraus

1700 Meeting Wrap and Close

*A unique email and passcode are required to access meeting materials and remote viewing of live sessions
*Time listed are EDT
*Underlined talks should be view **in advance** of the meeting and will not be shared live

NOAA's Ropeless Roadmap: A strategy to develop on-demand fishing

Asaro, M. J.[1]

[1]NOAA Fisheries Northeast Fisheries Science Center, 166 Water Street, Woods Hole, Massachusetts, 02543, USA (michael.asaro@noaa.gov)

NOAA's Ropeless Roadmap describes the current state of on-demand, or "ropeless," fishing and outlines a path for increasing adoption of this technology in U.S. East Coast commercial fisheries. We discuss this developing technology and forecast its future path based on the status of gear development, ongoing regulatory changes, and the need to decrease whale entanglements and associated mortality under the Endangered Species Act and Marine Mammal Protection Act. The need for on-demand fishing is driven by the urgent conservation crisis facing the endangered North Atlantic right whale (*Eubalaena glacialis*). As the need for larger and longer seasonal restricted areas increases to protect right whales, on-demand fishing represents the best solution to separate rope and right whales in areas of highest risk. The Ropeless Roadmap explores the potential for on-demand fishing gear to provide substantial reductions in entanglement risk for fixed gear trap/pot fisheries in a rapidly changing Atlantic ecosystem. We recognize that there are many partners who are key to this process and strategy, particularly state fishery managers and fishery management councils and commissions. Our intent is to share this plan for input and move forward in close collaboration with our partners. We welcome continued feedback on the Ropeless Roadmap via https://bit.ly/3GHOIdE to incorporate the perspectives of all stakeholders involved in these processes and to ensure that all voices are heard to help guide our next steps. We intend to revise the Ropeless Roadmap over time and would like it to serve as a living document to provide NOAA's vision for proceeding through this rapidly evolving landscape.

Near real-time passive acoustic monitoring for right whales on the U.S. east coast – an update

Baumgartner, M.F.[1]

[1]Biology Department, Woods Hole Oceanographic Institution, Woods Hole, Massachusetts, 02543, USA (mbaumgartner@whoi.edu)

The Woods Hole Oceanographic Institution (WHOI) and partners from the NOAA Northeast Fisheries Science Center, Stellwagen Bank National Marine Sanctuary, Wildlife Conservation Society, University of Maryland Center For Environmental Science, U.S. Navy's NAVFAC Atlantic, University of South Carolina, University of Maine, and Rutgers University deployed and operated long-endurance gliders and buoys on the U.S. east coast during 2021 and 2022 to conduct near real-time passive acoustic monitoring of baleen whales, including North Atlantic right whales. Each of these systems was equipped with the digital acoustic monitoring (DMON) instrument, and detection data from the DMON was relayed in near real time, reviewed by trained analysts, and displayed on the publicly accessible Robots4Whales.whoi.edu website as well as many other web- and smartphone-based applications (e.g., Whale Alert, Whale Map, Mysticetus). WHOI deployed DMON-equipped gliders during the winter and spring in the Gulf of Maine, Stellwagen Bank National Marine Sanctuary and near Cox Ledge (south of Massachusetts and Rhode Island), Rutgers University deployed a DMON-equipped glider during the fall, winter and spring in the coastal waters off New Jersey, and the University of Maine deployed a DMON-equipped glider off the coast of Maine during summer. WHOI DMON buoys that operate for at least 1 year at a time were deployed or re-deployed in the New York Bight, south of Martha's Vineyard and off the coasts of New Jersey, Maryland, North Carolina, Virginia and Georgia. New glider deployments are being planned for 2022-2023 by the University of Georgia's Skidaway Institute of Oceanography and Stonybrook University. Verified acoustic detections of right whales from gliders and buoys were used to trigger or extend NOAA Slow Zones for Right Whales outside of Seasonal Management Areas 46 times between September 1, 2021 and September 1, 2022. A brief overview of these deployments will be provided.

2022 North Atlantic right whale entanglement update

Brown, M.[1], Greene, M.[1], Fitzsimmons, R.[1], Ferron, S.[2], Landry, S.[3]

[1]Canadian Whale Institute, 16 Herring Cove Rd, Welshpool, New Brunswick, E5E 1S9, Canada (moirabrown@rightwhales.ca)
[2]Équipe de Desempêtrement du Golfe, c/o 278, Avenue Des Pêcheurs, Shippagan, New Brunswick, E8S 1J6, Canada
[3]Center for Coastal Studies, 5 Holway Ave, Provincetown, Massachusetts, 02657, USA

The right whale entanglement records for the year are presented at the annual NARW consortium meeting. During the 2022 season through 30 September, there have been reports of five entangled right whales, one ongoing and four new cases. The first new case was Sundog #3823 (14 yo female) seen during an aerial survey on 19 May east of the Gaspé Peninsula in the southern Gulf of St. Lawrence. There have been no further sightings since then despite extensive vessel and aerial search efforts. The second new case was photographed among an aggregation of right whales on 1 July and determined to be entangled during photo analysis the following day. The whale was # 1403, 38 yo female named Meridian, recorded ~55 nm east of Shippagan NB in the Western Braddelle Valley. Relocation efforts were delayed by bad weather for two days and were not successful. Meridian was seen again during a right whale research survey 7 July in the Shediac Valley ~30nm east of Shippagan, however erratic and evasive behavior and late discovery of trailing line prevented a tagging attempt. On 23 July, during a research survey, we documented Snow Cone (#3560) alone in the Shediac Valley. Further documentation was obtained for health assessment, but there was nothing the team could do for the whale. On 20 August, a third new entangled right whale, 2021calfof3720, was recorded on Western Braddelle Valley. The yearling was not relocated. During the unsuccessful two-day search for the yearling, the fourth newly entangled whale was sighted on Western Braddelle Valley ~53 nm east of Shippagan. Aerial observers photographed an agitated whale with rope across its back. Identified as # 4501, 7 yo male, he was photographed later during the sighting and the rope was not visible on its back. However not all of the animal was seen and it is unclear if the whale has shed the gear. We wish to note that detection of entangled right whales greater than 50 nm from nearest shore is beyond the existing operational response distance for the vessels used by whale rescue team and government response partners. Response protocols and resources will be reviewed among partners later this year to develop a plan to adapt to distant sightings. Of the four entangled right whale cases reported on last year in 2021 Snow Cone #3560 is ongoing, #3466 has shed his gear and #1803, #4615 and #4680 have not been seen again. The CWRT training program has increased response capacity in Quebec and the Maritimes with trained apprentices based in Shippagan NB, Tadoussac QC and Halifax NS who participate in whale rescue events to further develop their skills.

Abandoned gear removal efforts in the Massachusetts Restricted Area

Burke, E.K.[1]

[1]Massachusetts Division of Marine Fisheries, 836 S. Rodney French Blvd, New Bedford, Massachusetts, 02744, USA
(erin.burke@mass.gov)

DMF has initiated a new joint program with the Massachusetts Environmental Police (MEP) to identify and remove all lost and abandoned fixed fishing gear within state waters portions of the Massachusetts Restricted Area seasonal trap closure. Beginning in February 2022, we utilized a combination of aerial surveillance provided by the Center for Coastal Studies and MEP vessel patrols to identify and mark the location of lost/abandoned fixed fishing gear in the closure. DMF then utilized six contracted commercial lobster vessels working with our staff and MEP officers to haul and remove all gear. In total, we conducted 49 sea-days in which we hauled more than 2,000 traps and roughly 500 buoy lines from the closure. This effort not only ensures that our seasonal state waters closure is effective at eliminating entanglement risk, but it also provided an opportunity to monitor compliance with the closure and requirements for weak rope/contrivances, maximum rope diameter, and gear marking. We are also able to evaluate gear locations relative to closure boundaries using aerial surveillance, which provides information on how fishermen respond to the spatial-temporal patterns of the closure.

Transport Canada (TC) update on North Atlantic right whale vessel management measures

Charron, M.[1]

[1] *Transport Canada, 330 Sparks Street, Ottawa, Ontario, K1A 0N8, Canada (michel.charron@tc.gc.ca)*

The Government of Canada's vessel management measures for the 2022 season to reduce the risk of vessel collisions with North Atlantic right whales (NARW) in Canadian waters came into effect on April 20, 2022. The 2022 measures build off the measures from the previous years, and were developed in consultation with industry and scientists, taking into consideration past confirmed NARW detections, the latest science advice, navigational safety, and economic impacts. In addition to the large mandatory slowdown area covering much of the Gulf, new measures introduced in 2020, including a restricted area in and near the Shediac Valley and a trial voluntary slowdown in Cabot Strait, were implemented once again in 2022 with modifications based on lessons learned in 2021. Surveillance technologies incorporated into the dynamic management of vessel measures in 2020, namely a Remotely Piloted Aircraft System (RPAS) and an underwater acoustic glider, were once again deployed, with additional acoustic monitoring in Cabot Strait to build on our understanding of where, when and how NARW travel through the area.

How effective are fisheries closures? An orthogonal entanglement risk reduction analysis of time-area fisheries closures in the Gulf of St. Lawrence snow crab fishery

Cole, A. K.[1], Brillant, S. W.[1,2]

[1] *Canadian Wildlife Federation, 350 Michael Cowpland Drive, Kanata, Ontario, K2M 2W1, Canada (alexandrac@cwf-fcf.org)*
[2] *Department of Oceanography, Dalhousie University, Halifax, Nova Scotia, B3H 4R2, Canada*

Time-area fisheries closures have been implemented in Canada since 2018 as a protective measure for North Atlantic right whales (NARW), but the protocols for establishing these closures have changed in each year. We conducted a quantitative evaluation of the four closure protocols (2018-2021) for reducing entanglement risk to NARW from the Gulf of St. Lawrence (GSL) snow crab fishery to determine: 1) the effectiveness of each annual closure protocol; and 2) the average amount of entanglement risk removed each year. Monthly baseline risk was estimated using commercial fisheries data provided by Fisheries and Oceans Canada and a whale distribution model developed in 2021. Quantifying risk reduction values for each closure protocol took into consideration the rate of gear removal, the amount of gear lost within each closure, and the risk reintroduced due to redistributed fishing effort (i.e., moved to areas outside of the closures). Effectiveness of each protocol was assessed by applying each to the specific annual patterns of whale sighting from 2018 through 2021 and measuring the amount of risk removed. This orthogonal assessment of four independent annual patterns of sightings provided a sound assessment of the effectiveness of each protocol. Protocols from 2018 and 2019 showed larger potential risk reductions than protocols from 2020 and 2021. Actual annual performance of these time-area closures have, however, been relatively consistent. Over these four years, entanglement risk to NARW from the GSL snow crab fishery is estimated to have been reduced by approximately 62% ± 3% SE, relative to pre-closure estimates of risk.

Genomic estimates of diversity and population history of North Atlantic and southern right whales

Crossman, C. A.[1], Fontaine, M. C.[2], Brown, M. W.[3], Hamilton, P. K.[4], Frasier, T. R.[1]

[1]*Dept of Biology, Saint Mary's University, 923 Robie St, Halifax, Nova Scotia, B3H 3C3, Canada (carla.crossman@smu.ca)*
[2] *MIVEGEC, Université de Montpellier, CNRS, IRD, Montpellier, France*
[3]*Canadian Whale Institute, Welshpool, New Brunswick, E5E 1B6, Canada*
[4]*Kraus Marine Mammal Conservation Program, Anderson Cabot Center for Ocean Life, New England Aquarium, Central Wharf, Boston, Massachusetts, 02110, USA*

North Atlantic right whale population growth since the whaling era has been limited compared to the robust population recovery seen in several southern right whale populations. These different trajectories and vastly different sizes (over 10,000 Southern whales and only 336 North Atlantic right whales) have led to questions regarding the historic population size of these species and their contemporary levels of genetic diversity. North

Atlantic right whales are estimated to have one of the lowest levels of genetic diversity based on neutral markers, but ability to sequence entire genomes at relatively small costs has revolutionized the field of conservation genetics: enabling us to better understand the genetic diversity in this species at a genome-wide scale. We sequenced the genomes of 12 North Atlantic and 10 southern right whales and confirmed North Atlantic right whales have extremely low diversity genome-wide, far less than their southern counterparts. We found evidence of more recent inbreeding in North Atlantic than in southern right whales as assessed by runs of homozygosity in the genome and our estimates of historical population sizes suggest that North Atlantic right whales may have lived with much smaller effective population sizes (Ne) compared to southern right whales for millennia. Combined, these data provide insight into the "genetic foundations" of both contemporary populations: the North Atlantic right whale has had a long-term small Ne, which likely eroded genetic diversity and led to recent inbreeding, and therefore puts it at risk for genetic factors to be impacting individual fitness and species recovery; whereas southern right whales have had a much larger long-term Ne, helping to explain the higher contemporary diversity and causing less concern for genetic impacts on recovery.

Forecasting near-term movements and density of North Atlantic right whales

Crum, N.[1], Gowan, T.[1]

[1]Florida Fish and Wildlife Conservation Commission, 100 8th Ave SE, St Petersburg, Florida, 33701, USA (nathan.crum@myfwc.com)

Forecasts of North Atlantic right whale population density and individual movements can provide valuable information for population monitoring and dynamic management activities. For instance, forecasts can inform when and where survey effort should be expended to achieve monitoring objectives, such as maximizing the number of individual right whales detected during a survey. Forecasts can also inform when and where dynamic management and outreach may be most effective. Currently, dynamic management and outreach activities are typically informed by recent sightings, and population monitoring activities in the Southeastern U.S. are informed by a habitat model and recent environmental conditions. However, the use of raw sightings data overlooks observation and sampling error (e.g., the chance that a whale is present in a surveyed area but goes undetected, or the chance that a whale is present in an area that was not surveyed), and predictions from habitat models do not incorporate recent sightings and survey effort data. We improve upon these approaches by placing contemporaneous survey effort, sightings, and photo-ID data in the framework of an integrated spatial capture-recapture movement model. The model estimates the current location of each individual in the population based on when and where each individual has and has not been sighted and when and where survey effort has been expended until that point in time. Then, the model forecasts individuals' future locations using a movement model that is based on past survey effort, sightings, and photo-ID data. We will present a description of the integrated spatial capture-recapture movement model and an example forecast of the movements and population density of right whales in the Southeastern U.S.

Current NARW PAM project updates from the NEFSC

Davis, G. E.[1], Baumgartner, M.[2], Bell, J.[3], Cholewiak, D.[1], Martin, M.[4] Murray, A.[5], Pegg, N.[6], Summers, E.[5], Tennant, S.[4], Tremblay, C.[7], Wilder, J.[4], Van Parijs, S.[1]

[1]NOAA Fisheries Northeast Fisheries Science Center, 166 Water Street, Woods Hole, Massachusetts, 02543, USA (genevieve.davis@noaa.gov)
[2]Woods Hole Oceanographic Institution, Woods Hole, Massachusetts, 02543, USA
[3]Naval Facilities Engineering Systems Command, USA
[4]Under contract with NOAA Fisheries Northeast Fisheries Science Center, 166 Water Street, Woods Hole, Massachusetts, 02543, USA
[5]Maine Department of Marine Resources, West Boothbay Harbor, Maine, 04575, USA
[6]FAU Harbor Branch Oceanic Institute, 5600 US Highway 1 North, Fort Pierce, Florida, 34946, USA
[7]University of Maine School of Marine Sciences, Orono, Maine, 04469, USA

The passive acoustic research group at the Northeast Fisheries Science Center continues to expand its passive acoustic monitoring (PAM) program and develop new approaches for using PAM data to address science and management needs. In collaboration with partners, PAM recorders are deployed in US waters along the Northwestern Atlantic, focused on areas including the Gulf of Maine, the Massachusetts/Rhode Island wind energy lease areas, National Marine Sanctuaries, and the Mid-Atlantic. In 2022, 37 recorders have been

deployed (expanding the 15 continuous archival bottom-mounted recording sites starting in 2020), in addition to numerous real-time gliders and surface-buoys. Results on NARW detections will be presented. Additionally, we released a public online web application that displays PAM detections (Passive Acoustic Cetacean Map; https://apps-nefsc.fisheries.noaa.gov/pacm) from our data and that of a wide number of collaborators. A template is available to submit detection data for all species to be displayed on PACM, for a complete look at PAM work in the western North Atlantic. We are working on establishing an acoustic database, where data can be requested and accessed similarly to current North Atlantic Right Whale Consortium datasets. We have also worked with partners to facilitate a proposed PAM grid network (from Van Parijs et al. 2021) to collaborate on where acoustic effort occurs, avoiding duplicate effort and conducting wider PAM coverage as a whole. We will introduce all of these innovative, collaborative ways that we use to display, process, and serve up passive acoustic data, allowing for improved data exploration and understanding.

Didn't we just see you over there? What can vessel-based mark-recapture tell us of right whale movement in the southern GSL in 2022

Durette-Morin, D.[1], Warren, A.[2], Brown, M.[1], Ramp, C.[3], Thompson, E.[4], Dufour, M.[4], Ratelle, S.[3], Lesage, V.[4]

[1]Canadian Whale Institute, 16 Herring Cove Road, Welshpool, New Brunswick, Canada, E5E 1B6 (delphine@canadianwhaleinstitute.ca)
[2]Kraus Marine Mammal Conservation Program, Anderson Cabot Center for Ocean Life, New England Aquarium, Central Wharf, Boston, Massachusetts, 02110, USA
[3]Institut Maurice-Lamontagne, Department of Fisheries and Oceans Canada, Mont-Joli, Quebec, Canada
[4]Gulf Fisheries Center, Department of Fisheries and Oceans Canada, Moncton, New Brunswick, Canada

The Gulf of St. Lawrence (GSL) has provided a habitat for about 40% of the North Atlantic right whale (*Eubalaena glacialis;* NARW) population since 2015. Observations of NARWs collected during aerial surveys throughout the GSL have found the NARW distribution has been largely concentrated in the Shediac Valley. Due to its proximity to shore and abundance of NARWs, much of the vessel-based NARW survey and oceanographic efforts have been conducted in this Valley since 2016. During July and August 2022, three research platforms conducted vessel-based NARW surveys: the *Jean-Denis Martin* surveys conducted by University of New Brunswick, Canadian Whale Institute (CWI), and New England Aquarium (NEAq); the RHIB-Charlie surveys conducted by CWI, NEAq, and the Fédération régionale acadienne des pêcheurs professionnels; the RHIB-DFO survey efforts conducted by the Fisheries and Oceans Canada. In 2022, the NARW abundance appeared to be low in the Shediac Valley prior to the vessel surveys. The team on the *Jean-Denis Martin* surveyed the Shediac and then further offshore, into Western Bradelle Valley to find whales, while the RHIB surveys focused efforts on the Shediac Valley. Throughout the season, NARW distribution appeared to be scattered and variable between the Shediac Valley and Western Bradelle Valley with some individuals being seen in both areas. Using the photographically captured individual identifications of NARWs across these survey efforts, we will perform a mark-recapture study to characterize the small-scale movements of the whales, between and among Shediac and Western Bradelle valleys. Preliminary analyses are underway.

Update on the North Atlantic right whale Unusual Mortality Event: 2017-present

Fauquier, D.[1], Moore, M.[2], McLellan, W.[3], Costidis, A.[4], Durham, K.[5], Sharp, S.[6], Landry, S.[7], Stolen, M.[8], Pitchford, T.[9], Jackson, K.[9], George, C.[10], Wimmer, T.[11], Bourque, L.[12], Daoust, P.Y.[12], Jones, M.[12], Lair, S.[13], Jalenques, M.[13], Rotstein, D.[14], Henry, A.[15], Hayes, S.[15], Garron, M.[16], Smith, A.[16], Fougeres, E.[17], Mase-Guthrie, B.[18], Hardy, M.[19], Ratelle, S.[19], Moors-Murphy, H.[20], Vanderlaan, A.[20], Landry, M. [21], Rowles, T.[1], Spradlin, T.[1], Wilkin, S.[1]

[1]National Marine Fisheries Service, Office of Protected Resources, Silver Spring, Maryland, 20910, USA (deborah.fauquier@noaa.gov)
[2]Woods Hole Oceanographic Institution, Woods Hole, Massachusetts, 02543, USA
[3]University of North Carolina, Wilmington, Wilmington, North Carolina, 28403, USA
[4]Virginia Aquarium and Marine Science Center, Virginia Beach, Virginia, 23451, USA
[5]Atlantic Marine Conservation Society, Westhampton Beach, New York, 11977, USA
[6]International Fund for Animal Welfare, Yarmouth Port, Massachusetts, 02675, USA
[7]Center for Coastal Studies, Provincetown, Massachusetts, 02657, USA
[8]Hubbs-SeaWorld Research Institute, Melbourne Beach, Florida, 32951, USA

[9]*Florida Fish and Wildlife Conservation Commission, St. Petersburg, Florida, 33701, USA*
[10]*Georgia Department of Natural Resources, Brunswick, Georgia, 31520, USA*
[11]*Marine Animal Response Society, Halifax, Nova Scotia, B3H 3A6, Canada*
[12]*Canadian Wildlife Health Cooperative, Atlantic Veterinary College, University of Prince Edward Island, Charlottetown, Prince Edward Island, C1A 4P3, Canada*
[13] *Canadian Wildlife Health Cooperative, Université de Montréal, St. Hyacinthe, Québec, J2S 2M2, Canada*
[14]*Marine Mammal Pathology Services, Olney, Maryland, 20830, USA*
[15]*National Marine Fisheries Service, Northeast Fisheries Science Center, Woods Hole, Massachusetts, 02543, USA*
[16]*National Marine Fisheries Service, Greater Atlantic Fisheries Office, Gloucester, Massachusetts, 01930, USA*
[17]*National Marine Fisheries Service, Southeast Regional Fisheries Office, St Petersburg, Florida, 33701, USA*
[18]*National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, Florida, 33419, USA*
[19]*Fisheries and Oceans Canada, Science Branch, Gulf Region, Moncton, New Brunswick, E1C 5K4, Canada*
[20]*Fisheries and Oceans Canada, Bedford Institute of Oceanography, Dartmouth, Nova Scotia, B2Y 4A2, Canada*
[21]*Fisheries and Oceans Canada, Ottawa, Ontario, K1A 0E6, Canada*

An Unusual Mortality Event (UME), which is defined under the U.S. Marine Mammal Protection Act as "a stranding that is unexpected, involves a significant die-off of any marine mammal population, and demands immediate response" was declared by the National Marine Fisheries Service for North Atlantic right whales (*Eubalaena glacialis)* starting in 2017, due to elevated numbers of dead or seriously injured whales along the Northwest Atlantic Ocean coast. This is a transboundary event and the investigation includes whales stranding in both Canada and the United States. The UME is ongoing with 53 known cases, including 34 dead and 19 seriously injured individuals to date. Of the 34 confirmed dead whales, 21 were first documented in Canada and 13 were first documented in the United States. The breakdown of known mortalities by year includes: 17 whales in 2017, 3 in 2018, 10 in 2019, 2 in 2020, and 2 in 2021. There have been no mortalities reported in 2022 as of 18 August. Of the 24 whales that were necropsied, 20 (83%) were confirmed, probable, or suspect deaths as a direct result of human activities: entanglements (9) or vessel strikes (11). Of the 19 serious injury cases, which involve live free-swimming non-stranded whales, 17 had serious injuries from entanglements and 2 from vessel strikes. Additionally, a Morbidity Protocol has been developed to identify free-swimming sub-lethally injured or ill whales and these whales will be added to the UME in late summer 2022. Therefore, of the 43 cases examined (both live and dead), ~91% (39/43) were impacted by entanglements (26) or vessel strikes (13). Given there are fewer than 350 individual North Atlantic right whales remaining, these 53 individuals in the UME represent at minimum 15% of the population, which is an extremely significant impact on such a critically endangered species.
More information can be found at the National Marine Fisheries Service UME website: (https://www.fisheries.noaa.gov/national/marine-life-distress/2017-2022-north-atlantic-right-whale-unusual-mortality-event).

Collaborations with commercial fish harvesters to determine suitability of low-breaking strength gear modifications in Atlantic Canadian fixed-gear fisheries

Frith, R.[1], Vézina, E. [1], Urbancic, K.[1], Brillant, S.[1]

[1]*Canadian Wildlife Federation, 110 Chain Lake Drive Unit 3J, Halifax, Nova Scotia, B3S 1A9, Canada (rhylf@cwf-fcf.org)*

In 2023, Fisheries and Oceans Canada (DFO) will implement mandatory use of low breaking strength rope or links in Atlantic Canada's fixed-gear fisheries as a component of Canada's 2023 fishery management measures intended to prevent entanglements of North Atlantic right whales (NARW). The suitability of these low-breaking strength gear modifications for commercial fisheries in Atlantic Canada is largely unknown, but critically important as gear modifications that cannot withstand typical fishing conditions will produce more lost fishing gear, increase costs to fish harvesters, and increase entanglement risk for NARW. To contribute to this knowledge, we collaborated with the Area 19 Snow Crab Fishermen's Association in 2021 to collect data on hauling loads and to trial gear modifications. Load cells installed during the Area 19 crab fishing season showed 94% of hauls measured greater than 1700 lbf (7.5 kN), with a maximum of 2700 lbf (12 kN). Gear modifications were trialled

out of season, but in typical environmental conditions and equipment for this fishery with simulated trap-loads (i.e., 40-95 fm depths, 120 fm 5/8" buoy lines, 1340 lb traps). Of the weak rope and weak sleeve configurations trialled, 53% of buoy lines were no longer functional after 3 hauls. Time tension line cutters and spring-releases remained functional throughout trials. Trials with Area 19 members continued in 2022 and the work was expanded to 115 lobster harvesters from five fisheries associations. These partners were surveyed and provided with gear modifications to test during their commercial season. Data were reported from 39 harvesters so far and are being analyzed. Preliminary findings suggest some gear modification options will be suitable for inshore lobster fisheries for some regions. The final analysis will be presented and will ultimately be provided to DFO to inform the implementation of their policy in different fisheries.

Assessing the risk of vessel strike mortality in North Atlantic right whales along the U.S East Coast

Garrison, L. P.[1], Adams, J.[2], Patterson, E. M.[2], Good, C. P.[2]

[1]Marine Mammal and Turtle Division, Southeast Fisheries Science Center, National Marine Fisheries Service, 75 Virginia Beach Drive, Miami, Florida, 33149, USA (Lance.Garrison@noaa.gov)
[2]Marine Mammal and Sea Turtle Conservation Division, Office of Protected Resources, National Marine Fisheries Service, Silver Spring, Maryland, 20910, USA

Vessel strikes continue to be an important source of mortality and serious injury for North Atlantic Right Whales along the U.S. east coast. In 2008, the National Marine Fisheries Service implemented efforts to reduce vessel strike mortality by establishing seasonal management areas (SMAs) where large (> 65 feet length) vessels were restricted to traveling at 10 knots or less, establishing recommended and mandatory large vessel routes, and implementing voluntary dynamic management areas. Despite these efforts, vessel strike mortalities continue to occur, particularly outside of established SMAs and with smaller vessels. To help evaluate potential management actions to reduce vessel strike mortality and serious injury in right whales, we developed an encounter risk model for the U.S. east coast to 1) evaluate the overall risk of vessel strike mortality, 2) identify areas of greatest risk, and 3) quantify the potential benefits of expanded vessel speed restrictions. The encounter risk model accounts for the probability of an encounter between whales and vessels, the probability that a whale will be near the surface, the probability of avoidance of the vessel by the whale, and the probability of mortality given a vessel strike. We account for uncertainty in each of these processes, discuss potential biases, and identify important data gaps. The model shows that the greatest risk of vessel strikes occurred throughout waters of the mid-Atlantic and southern New England, particularly during colder months of the year. Based upon a potential expansion of vessel speed restrictions to cover the region of highest risk, the model suggests that an average reduction in vessel strike mortality of 27.5% could be achieved by reducing vessel speeds in this region to less than 10 knots.

Fisheries and Oceans Canada (DFO): Entanglement prevention and mitigation efforts

Gilchrist. B.[1], Landry, M. S.[1]

[1]Fisheries and Oceans Canada, 200 Kent Street, Ottawa, Ontario, Canada, K1A 0E6 (Brett.Gilchrist@dfo-mpo.gc.ca)

Canada has the most comprehensive fisheries management measures for the protection and recovery of North Atlantic right whales (NARW), in the world. Since 2017, Canada has implemented and adapted strong measures for the protection of the NARW which is listed as Endangered under the Canadian *Species At Risk Act*. Specifically, the Department of Fisheries and Oceans Canada (DFO) implements fisheries management measures with the primary objective of entanglement prevention for NARW throughout its Canadian range. Approximately 40% of the known population of right whales frequent Canadian waters during times when there is the potential for overlap with active non-tended fixed gear fisheries. The Department achieves its objective by minimizing fishing gear and right whale co-occurrence through changes to fishing seasons and adaptive, near real-time fishing area closure protocols. In addition, Canada has a robust right whale monitoring and detection regime, which includes flights, vessels, and acoustic devices covering their known range and areas beyond. In addition to targeted measures for right whales, since 2018, DFO has put in place a series of regulatory measures in support of marine mammal conservation and protection. For example, the Department has implemented a comprehensive lost gear retrieval program and is bringing in requirements for gear modifications meant to reduce serious injury should

marine mammal entanglements occur. Further, DFO continues to support and collaborate with marine mammal incident response networks in all regions under the umbrella of the Marine Mammal Response Program.

Proposed amendments to the North Atlantic right whale vessel speed rule

Good, C.P.[1], Zou, C.[2], Adams, J.[1], Lisi, N. E.[1], Gahm, M.[1], Bettridge, S.[1], Patterson, E.M.[1], Borggaard, D.[2], Zoodsma, B.[3], Ingulsrud, L.[4]

[1]Office of Protected Resources, National Marine Fisheries Service, Silver Spring, Maryland, 20910, USA (caroline.good@noaa.gov)
[2]Greater Atlantic Regional Fisheries Office, National Marine Fisheries Service, Gloucester, Massachusetts, 01930, USA
[3]Southeast Regional Office, National Marine Fisheries Service, St. Petersburg, Florida, 33701, USA
[4]West Coast Regional Office, Office of National Marine Sanctuaries, National Ocean Service, National Oceanic and Atmospheric Administration, Monterey, California, 93940, USA

NOAA Fisheries has proposed changes to amend the current North Atlantic right whale (*Eubalaena glacialis*) vessel speed rule to further reduce the likelihood of mortalities and serious injuries to endangered right whales. Vessel collisions are a leading cause of the species' decline and a primary factor in their ongoing Unusual Mortality Event (UME). Regulations requiring seasonal 10-knot speed limits for most vessels ≥65 ft in length were first implemented in 2008 within designated areas along the U.S. East Coast. Since then, right whales have continued to experience elevated levels of lethal strike risk due in part to collisions involving smaller unregulated vessels (<65 ft in length) and changes in right whale distribution and habitat use, which have rendered the current seasonal boundaries and timing inadequate to provide sufficient protection. The proposed changes to the rule would: (1) modify the spatial and temporal boundaries of current speed restriction areas and rename them Seasonal Speed Zones (SSZs), (2) add most vessels 35 ft to 65 ft in length to the vessel size class subject to speed restriction, (3) create a Dynamic Speed Zone framework to implement mandatory speed restrictions when right whales are detected and likely to remain present outside active SSZs, and (4) update the speed rule's safety deviation provision. Changes to the speed rule are proposed to reduce lethal vessel strike risk based on a coast-wide collision mortality risk assessment and updated information on right whale distribution, vessel traffic patterns, and vessel strike mortality and serious injury events. These proposed amendments to the existing vessel speed rule are essential to help mitigate the ongoing right whale population decline, UME, and prevent the species' extinction.

North Atlantic right whale Catalog update and whale naming results

Hamilton, P. K.[1], Howe, K. R.[1], Knowlton, A. R.[1], Marx, M. K.[1], McPherson, K. D.[1], Pettis, H. M.[1], Robinson, K. M.[1], Vance, S.[1], Warren, A. M.[1], Zani, M. A.[1]
[1]Kraus Marine Mammal Conservation Program, Anderson Cabot Center for Ocean Life, New England Aquarium, Central Wharf, Boston, Massachusetts, 02110, USA (phamiltn@neaq.org)

Each year the New England Aquarium provides an update of the status of the photo-identification Catalog which they manage for the Consortium. This update will include: the number of animals currently in the Catalog, their age and sex and whether they are presumed alive or dead; the number of sightings and images contributed in the last year; new animals added to the Catalog; the matching status of the data by year; and an overview of recent births, mortalities and entanglements (although details of the latter two will likely be provided by other presenters). Also, comparisons of data submission and number of whales alive historically will be presented. To ensure that the most up-to-date data are provided, these numbers will be calculated in mid-October and therefore the results are not provided in this abstract. Given the large number of researchers that utilize the Catalog data, it is important to provide annual summaries of the status of available data so that these researchers can determine appropriate research objectives. Lastly, the final results of the Consortium whale naming effort will be presented.

Vulnerability of North Atlantic right whales to entanglement and collision in the Gulf of St. Lawrence: Insights from their movement patterns and diving behaviour

Harvey, V.[1], Ramp, C.[1], Andrews, R. D.[2], Johnson, C. L.[3], Sorochan, K.[3], Plourde, S.[1], Gosselin, J. F.[1], Mosnier, A.[1], Lesage, V.[1]

[1]Maurice Lamontagne Institute, Fisheries and Oceans Canada, Mont-Joli, Quebec, Canada (valerie.harvey@dfo-mpo.gc.ca)

[2]Marine Ecology and Telemetry Research, Seabeck, Washington, USA
[3]Bedford Institute of Oceanography, Fisheries and Oceans Canada, Dartmouth, Nova Scotia, Canada

In recent years, about 40% of the North Atlantic right whale (*Eubalaena glacialis*, NARW) population has summered in the Gulf of St. Lawrence (GSL), Canada, where high anthropogenic mortalities were reported in 2017 and 2019. We used satellite-linked time-depth/fastlocGPS Argos transmitters to assess vessel strike and entanglement risks in the GSL by documenting NARW movement and diving behavior in relation to *Calanus* spp. distribution and biomass sampled using plankton nets and Video Plankton Recorder. Twenty-one tags deployed in August 2019 and May—July 2022 lasted for 0.1—29 days. NARWs expectedly moved little during the short deployments in 2019 (median=0.4 d); 9 of the 12 whales showed similar movement patterns during longer deployments in 2022 (median=9.7 d), either remaining in, or moving between Shediac Valley and Western Bradelle Valley. Another three individuals visited the Laurentian Channel, northern GSL or northeast Prince-Edward-Island. Diving behaviour differed considerably between years, especially at night. During daytime and in both years, NARW shared their time approximately evenly between the surface (< 12 m) and seabed (> 70 m). However, during nighttime, NARW from 2019 spent only 7% of their time near the seabed (with 85% spent near surface), while NARW from 2022 spent, on average, a similar proportion of their time near the seabed (37%) and surface (44%). In August 2019, aggregations of *Calanus* spp. occurred near the seabed and were most concentrated during daytime; analyses for zooplankton sampling conducted in 2022 are underway. While additional prey distribution and quantitative risk models are needed to interpret our results, we highlight two important findings: NARW feeding ecology can vary over time; NARW are particularly at risk of entanglement by their tendency to forage near the seabed, and can be at higher risk of collision at night in some years/seasons.

How is NOAA Fisheries approaching the recovery of North Atlantic right whales with offshore wind development?

Hayes, S. A.[1], Borggaard, D.[2], Cholewiak, D.M.[1], Daly-Fuchs, J.[3], Lipsky, A.[4], Orphanides, C.[4], Sisson, N.[2], Van Parijs, S.[1]

[1]NOAA Fisheries Northeast Fisheries Science Center, 166 Water Street, Woods Hole, Massachusetts, 02543, USA (sean.hayes@noaa.gov)
[2]NOAA Fisheries Greater Atlantic Regional Fisheries Office, 55 Great Republic Dr, Gloucester, Massachusetts, 01930, USA
[3]NOAA Fisheries Office of Protected Resources, 1315 East-West Hwy, Silver Spring, Maryland, 21042, USA
[4]Northeast Fisheries Science Center, 28 Tarzwell Dr, Narragansett, Rhode Island, 02882, USA

Whale oil provided the lighting and machine lubrication needed for 19th century factories, contributing to the industrial revolution and what became a global petroleum based economy. As we seek to mitigate the resulting impacts of climate change through renewable energy technologies like offshore wind (OSW), how will we co-manage the continued existence of marine resources like the North Atlantic right whale (NARW) with our needs for energy? Indeed, other renewable energy sources like hydropower have a long history of unintended consequences including the listing of 22 stocks of salmon and sturgeon populations under the ESA in the Atlantic and Pacific regions. Some issues with hydropower like fish passage were anticipated, but many cascading habitat and ecosystem consequences were not. OSW may not directly restrict access to key habitats, but it may alter habitat, and cause avoidance and exacerbate other threats. Applying lessons learned from the interactions of protected species and ecosystems with hydropower, NOAA Fisheries scientists and managers can help advance the coexistence of new renewable energy sources and NOAA trust resources.

In the case of NARW's, we are evaluating a range of known and emerging threats from different phases of offshore wind development. This includes increased risk of vessel strike, noise, changes in fishing practices and other entanglement risks, and habitat changes that might impact plankton production, attract predators and trigger avoidance to key foraging and calving areas. NOAA Fisheries is working with partners to identify the potential impacts to NARWs from offshore wind including determining uncertainty and risk surrounding those potential impacts, by building modeling and decision-support tools, advancing use of monitoring technologies, and developing research study plans to inform policy planning, multi-agency strategies and evaluate long term ecological impacts from offshore wind.

An approach for allocating where right whale entanglement events may have occurred

Knowlton, A.R.[1], Marx, M.K.[1], Hamilton, P.K.[1], Pendleton, D.E.[2], Pettis, H.M.[1]

[1]Kraus Marine Mammal Conservation Program, Anderson Cabot Center for Ocean Life, New England Aquarium, Central Wharf, Boston, Massachusetts, 02110, USA (aknowlton@neaq.org)
[2]Anderson Cabot Center for Ocean Life, New England Aquarium, Central Wharf, Boston, Massachusetts, 02110, USA

Entanglements of North Atlantic right whales are a frequent annual occurrence resulting in wrapping scars of varying severity and, for a subset of cases, attached fishing gear. Information on geographic origin of entanglements could inform important nuances of mitigation measures. Origin of attached gear has been traced back to region for only a small number of cases. Here we present an approach for allocating entanglement events to region. Our approach is based upon the whale's last sighting location before a given detected entanglement event and the first sighting location after that event, evidenced by scars or attached gear. We assessed the subset of entanglements that occurred within a 180-day window (n = 449 of 1,707 total cases from 1980-2019) and made a variety of assumptions based on movement patterns within the population. The eastern seaboard was divided into four regions in US waters – southeast U.S., Mid-Atlantic Bight, southern New England, and Gulf of Maine/Georges Bank. Canadian waters represented a fifth region. Each entanglement event was manually reviewed to assess which regions the whale may have moved through before it was detected with entanglement injuries. Each of these regions was given an equal probability of being the origin of the entanglement event. These probabilities were summed by region, across all cases. Initial findings indicate the Gulf of Maine/Canadian waters represented the highest tally of summed probabilities. For the subset of cases where sightings before and after entanglement events were in the same region, the Gulf of Maine and Canada had the highest tallies (n = 55 for each) and the southeast US was third (n = 31). Further analyses on the breakdown by decade and injury severity will be presented. This provides an important tool for monitoring where entanglements may be occurring.

Entanglement response for right whale, Snow Cone: A case study

Landry, S.[1], Brown, M.[2], Durazo, P.[1], Fitzsimmons, R.[2], George, C.[3], Green, M.[2], Harvey, M.[1], Jackson, K.[4], Jakush, J.[4], Kelly, E.[1], Kolkmeyer, T.[3], Lynch, B.[1], Pitchford, T.[4], Sandilands, D.[1], Tackaberry, J.[1]

[1]Center for Coastal Studies, 5 Holway Ave, Provincetown, Massachusetts, 02657, USA (sclandry@coastalstudies.org)
[2]Campobello Whale Rescue Team, Welshpool, New Brunswick, E5E 1B6, Canada
[3]Georgia Department of Natural Resources, Brunswick, Georgia, 31520, USA
[4]Florida Fish and Wildlife Conservation Commission, Fish and Wildlife Research Institute, Ocala, Florida, 34471, USA

North Atlantic right whale #3560 (Snow Cone) was first reported entangled in March of 2021 off Massachusetts and despite several entanglement responses, remains entangled as of last sighting in July of 2022 off New Brunswick. While many of the challenges responders have faced during her entanglement have been consistent with prior right whale entanglement cases, other aspects have been unique. Typical of ongoing right whale entanglements, insights into her case increased with each new sighting, from highly ambiguous at first report to a more solid understanding at last sighting. During 35 sightings and six on-water responses, teams within the Atlantic Large Whale Disentanglement Network eventually assessed her as having a deeply embedded wrap of rope around her rostrum and woven through her baleen, a configuration that has killed multiple right whales in the past. In December of 2021, Snow Cone was sighted on the calving grounds with a calf, presenting the network with an unprecedented challenge for this species. The presence of the calf necessitated modifying or abandoning certain disentanglement techniques and heightened safety concerns for responders. During the six on-water responses, about 400 feet of rope was removed from her entanglement, however the life-threatening wrap embedded in her rostrum and the weave of rope in her baleen remain. This case will explore the real-life context of entanglement response and illustrates the challenges that responders face in balancing animal welfare, human safety, and wildlife management priorities; the value of coordinated disentanglement response across the species' range; and the need for improved tools and techniques. It also underscores the fundamental limitations of disentanglement response,

and as such, the focus that must be placed on entanglement prevention.

U.S. Army Corps of Engineers conservation and protection measure implementation in the South Atlantic region

Lebow, K. E.[1], Bonine, N. M.[2], Shirey, A.D.[3], Shajahan, N.[1], Nolet, V.[2], Davies, K.[3]

[1]U.S. Army Corps of Engineers - Jacksonville District, 701 San Marco Blvd, Jacksonville, Florida, 32207, USA (kathryn.e.lebow@usace.army.mil)
[2]U.S. Army Corps of Engineers, South Atlantic Division, Atlanta, Georgia, 30303, USA
[3]U.S. Army Corps of Engineers, Charleston District, Charleston, South Carolina, 29403, USA

Throughout the South Atlantic region, the U.S. Army Corps of Engineers' (Corps) oversees maintenance dredging for navigation supporting America's economically vital ports, military readiness, recreation, and performs beach nourishment for coastal storm protection. These missions co-occur with areas where North Atlantic Right Whales (NARW) migrate – through North and South Carolina – and calve each winter – in Georgia south through Northeast Florida and were evaluated by the National Marine Fisheries Service (NMFS) in the South Atlantic Regional Biological Opinion (SARBO) to assure compliance with the Endangered Species Act (ESA). The SARBO was updated in 2020 and expanded the activities and area covered, as well as added coverage for 25 ESA species and critical habitats, requiring a risk-based decision process to balance the needs of these species while meeting Corps Mission requirements.

The 2020 SARBO incorporated the Corps' NARW Conservation Plan which significantly expanded protective measures, including aerial surveys. These surveys are coordinated with NMFS to send alerts to mariners to reduce the likelihood of vessel strikes. Aerial surveys also provide valuable data to NARW researchers, demonstrating migration patterns and changing trends in calving grounds. A commitment to minimize dredging work when NARW are present to further reduce the vessel strike risk and adhere to additional speed restrictions when work occurs during the NARW season has also been made. In conjunction with these efforts, the Corps coordinates with NMFS and other partners to improve education and outreach for the NARW.

With upcoming Infrastructure and Jobs Act funded projects, the Corps is positioned to continue collaboration with federal and non-federal sponsors to aid in the NARW's protection and conservation. In this presentation the Corps will present details on the NARW Conservation Plan, the 2020 SARBO's impact on the preservation of whales, aerial survey data and efforts, and our commitment to protection of the species.

NOAA Fisheries' North Atlantic Right Whale Road to Recovery

Lisi, N. E.[1], Borggaard, D.[2], Cholewiak, D.[3], Gahm, M.[4], Garrison, L.[5], Grewal, C.[2], Patterson, E. M.[4], Zoodsma, B.[6]

[1]National Marine Fisheries Service, 1315 East-West Hwy, Silver Spring, Maryland, 20910, USA (niki.lisi@noaa.gov)
[2]Greater Atlantic Regional Fisheries Office, National Marine Fisheries Service, Gloucester, Massachusetts 01930, USA
[3]NOAA Fisheries Northeast Fisheries Science Center, 166 Water Street, Woods Hole, Massachusetts, 02543, USA
[4]NOAA Fisheries Office of Protected Resources, 1315 East-West Hwy, Silver Spring, Maryland, 21042, USA
[5]Southeast Fisheries Science Center, National Marine Fisheries Service, Miami, Florida, 33149, USA
[6]Southeast Regional Office, National Marine Fisheries Service, St. Petersburg, Florida, 33701, USA

In July 2022, NOAA Fisheries announced the release of the *North Atlantic Right Whale Road to Recovery*. This framework describes NOAA Fisheries' efforts to halt the North Atlantic right whale (*Eubalaena glacialis)* decline, as it encapsulates all of our ongoing work across the agency and in collaboration with our partners and stakeholders to conserve and rebuild the population. This strategy is built on the foundation of the statutory requirements that NOAA Fisheries is charged with implementing under the Endangered Species Act and the Marine Mammal Protection Act. The *Road to Recovery* complements the *North Atlantic Right Whale 2021-2025 Priority Action Plan* by identifying two related, overarching goals: (1) Address Threats to the Species and (2) Monitor Recovery Progress. Each goal has three associated objectives. Goal 1 aims to (1.1) Address Vessel Strikes; (1.2) Address Fishing Gear Entanglements; and (1.3) Address Potential and Emerging Threats, including impacts from climate

change, new and expanded ocean uses, and ocean noise. Goal 2 aims to (2.1) Monitor Population and Health, (2.2) Monitor Threats, and (2.3) Monitor Effectiveness of Conservation. By identifying our goals and objectives, NOAA Fisheries is able to demonstrate and communicate progress on major activities and associated milestones, which will help to protect, rebuild and conserve the North Atlantic right whale population. The *Road to Recovery* is a living resource and it will be updated regularly to include new activities and milestones.

Drone-based measurements of blowhole temperatures of North Atlantic right whales (Eubalaena glacialis) and humpback whales (Megaptera novaeangliae)

Lonati, G. L.[1], Moore, M.[2], Zitterbart, D.[2], Richter, S.[2], Klymentieva, H.[1], Hynes, N.[1], Robbins, J.[3], Davies, K.[1]

[1]University of New Brunswick Saint John, 100 Tucker Park Road, Saint John, New Brunswick, E2L 4L5, Canada (gina.lonati@unb.ca)
[2]Woods Hole Oceanographic Institution, Woods Hole, Massachuetts, 02543, USA
[3]Center for Coastal Studies, 5 Holway Ave, Provincetown, Massachusetts, 02657, USA

The North Atlantic right whale (NARW, *Eubalaena glacialis*) continues to face extinction despite management efforts targeted at reducing mortalities. Consequently, we must increase management focus on the *health* of these whales; in other words, ensuring individuals are healthy enough to forage, grow, and reproduce, thereby ensuring the perpetuation of the species. This will require better biometrics for gauging the health of individual whales. Internal body temperature is a common biometric for mammals; it is relatively stable in healthy individuals, but deviations can signify disease or injury. Preliminary work has shown that drone-based infrared thermography (IRT) can quantify internal body temperatures of whales by collecting thermal videos of the blowholes during respirations. At the 2020 Consortium Meeting, we proposed a protocol to obtain accurate, absolute temperatures of whale blowholes with drone-based IRT. Since then, we have validated these methods via a whale simulation experiment and found that drone-based IRT measurements are within 6ºC of true temperatures. We then collected data with this protocol from NARWs in the Gulf of St. Lawrence (2021 & 2022) and humpback whales (HWs, *Megaptera novaeangliae*) in the Bay of Fundy (2020-2022). Thus far, we have analyzed blowhole temperatures from 10 NARWs and 8 HWs. Maximum temperatures per individual ranged from 21.1-28.2ºC and 20.9-33.2ºC, respectively. When we account for the precision of our current methods and drone altitude, these measurements approach subdermal temperatures measured previously in freshly harvested baleen whales (30-36ºC). Next steps include accounting for environmental variables and IRT sensor dynamics, which should further improve the accuracy and precision of our methods, and comparing blowhole temperatures to body condition, which will demonstrate whether blowhole temperatures are a reliable biometric for assessing individual whale health. Ultimately, drones have the potential to conduct comprehensive, minimally invasive health assessments on individual whales to aid with management and conservation. .

Building the road to recovery: Conservation and management of the eastern North Pacific right whale

Malek, J. C.[1], Berchock, C. L.[2], Crance, J. L.[2]

[1]NOAA Fisheries, Alaska Regional Office, 222 West 7th Avenue Box 43, Anchorage, Alaska, 99513, USA (jenna.malek@noaa.gov)
[2]NOAA Fisheries, Alaska Fisheries Science Center, Marine Mammal Laboratory, Seattle WA, 98115

The North Pacific right whale (*Eubalaena japonica*, NPRW) is one of the most critically endangered large whales in the world. Though other whale populations have rebounded since the cessation of whaling, the eastern population of NPRW has not recovered. With only ~30 individuals and a large historical range, many basic life history details such as calving areas, migratory routes, and population demographics remain unknown. NOAA Fisheries has used passive acoustic data and surveys to learn about this elusive species that lives in a region with significant technical and logistical research obstacles. Acoustics have provided valuable information about NPRW spatio-temporal distribution year-round in Alaska while surveys and other sightings have led to the addition of at least 9 new individuals to the NPRW catalog since 2017. Sightings reported by fishers have increased in 2022 and we are conducting targeted outreach with Alaska Native communities, fishers, and the general public to help increase awareness about the species. Additionally, we are reviewing designated critical habitat to determine if a

petitioned revision is warranted. We recognize that the lack of eastern NPRW recovery is not just an Alaskan problem – this is a broader issue that will require strong partnerships with a diversity of stakeholders along the US west coast and Pacific Islands. As we begin building a recovery and research program for NPRW, we hope to learn from the experience of the North Atlantic right whale community to help us better conserve and manage this critically endangered population.

Redefining North Atlantic right whale habitat-use patterns under climate change

Meyer-Gutbrod, E. L.[1], Davies, K. T. A.[2], Johnson, C. L.[3], Plourde, S.[3], Kenney, R. D.[5], Ramp, C.[6], Gosselin, J. F.[4], Lawson, J. W.[7], Greene, C. H.[8]

[1]University of South Carolina, 701 Sumter Street, EWS 617, Columbia, South Carolina, 29208, USA (emgutbrod@seoe.sc.edu)
[2]Department of Biological Sciences, University of New Brunswick, Saint John, New Brunswick, E2L 4L5, Canada
[3]Fisheries and Oceans Canada, Bedford Institute of Oceanography, PO Box 1006, Dartmouth, Nova Scotia, B2Y 4A2, Canada
[4]Fisheries and Oceans Canada, Maurice Lamontagne Institute, 850 Route de la Mer, Mont-Joli, Quebec, G5H 3Z4, Canada
[5]University of Rhode Island, Graduate School of Oceanography, Narragansett, Rhode Island, 02882, USA
[6]Sea Mammal Research Unit, Scottish Oceans Institute, University of St Andrews, St Andrews, United Kingdom
[7]Fisheries and Oceans Canada, Northwest Atlantic Fisheries Centre, 80 E. White Hills Rd., P.O. Box 5667, St. John's, Newfoundland and Labrador, A1C 5X1, Canada
[8]Ocean Resources and Ecosystems Program, Cornell University, Ithaca, New York, 14853, USA

Changes in the physical oceanography of the Northwest Atlantic stemming from both natural and anthropogenic climate change impact the foraging ecology and distribution of endangered North Atlantic right whales. In this study, right whale sightings from 1990–2018 were analyzed to examine decadal patterns in monthly habitat use in 12 high-use areas. Depth-integrated abundances of late-stage *Calanus finmarchicus* and *C. hyperboreus* were also analyzed for decadal variations in the right whale foraging habitats. There were significant differences in the occurrence, seasonal timing, and persistence of foraging habitats across these three decades. In the decades of the 1990s and the 2010s, prey was less abundant than in the 2000s, corresponding to reduced use of the Southeast US calving grounds in the winter, increased use of Cape Cod Bay in winter and spring, and reduced use of Roseway Basin in the fall. In the 2010s, right whale sightings increased in Southern New England and the Gulf of St. Lawrence in the spring and summer, respectively. Summertime declines in the 2010s in late-stage copepod abundances in the Gulf of Maine and surrounding regions, as well as in the Gulf of St. Lawrence, indicate that recent increased use of the Gulf of St. Lawrence is driven by a decline in prey in traditional foraging habitats rather than by an increase in prey in the new foraging habitat. This analysis of decadal-scale differences in right whale sightings and prey abundance is critical for redefining right whale distribution patterns for the most recent (post-2010) decade.

Photogrammetric analysis of North Atlantic right whale growth and body condition trends could encourage reduction of sub-lethal trauma, a prerequisite for species survival

Moore, M. J.[1], Miller, C. M.[1], Durban, J.[2], Fearnbach, H.[3], Leander, S.[2], Knowlton, A.[4]

[1]Woods Hole Oceanographic Institution, 266 Woods Hole Rd, Woods Hole, Massachusetts, 02738, USA (mmoore@whoi.edu)
[2]Southall Environmental Associates, Inc., Aptos, California, USA
[3]SR3, SeaLife Response, Rehabilitation and Research, Des Moines, Washington, USA
[4]Kraus Marine Mammal Conservation Program, Anderson Cabot Center for Ocean Life, New England Aquarium, Central Wharf, Boston, Massachusetts, 02110, USA

North Atlantic right whales (*Eubalaena glacialis)* risk extinction unless conservation measures are substantially enhanced. Variably-enforced regulations focus on reducing mortality from vessel strikes and fishing gear entanglement off the eastern shores of the United States and Canada. However, sub-lethal stressors, especially entanglement, along with climate driven changes to the food supply, also have a major impact on reproductive success, which is required for recovery. Analysis of long-term aerial photogrammetry data of known individuals has revealed a significant reduction in individual growth

and calving rates, and longitudinal drone-photogrammetry studies are now tracking shorter term changes in body condition and reproductive success. Continued monitoring of these parameters are generating essential data to both inform the efficacy of mitigation efforts and educate the general public on the status of the remaining live North Atlantic right whales. Until consumers and voters successfully demand that their ship-borne goods and trap-caught seafood be procured without serious welfare and health concerns, recovery is very unlikely.

Whales and fishermen in Gaspésie: 4 years of survey data, towards a coexistence on the maritime territory

Morissette, L.[1], Côté, J.[2], Maltais, D.[3], de Montgolfier, B.[4], Deroche, V.[5]

[1]M - Expertise Marine Inc., 10 rue Luce-Drapeau, Sainte-Luce, Quebec, G0K 1P0, Canada (lyne@m-expertisemarine.com)
[2]Regroupement des pêcheurs professionnels du sud de la Gaspésie, Chandler, Québec, G0C 1K0, Canada
[3]Université du Québec à Chicoutimi, Chicoutimi, Québec, G7H 2B1, Canada
[4]Aquasearch, 15 lot. Les Coteaux Ouest, 97228 Sainte-Luce, Martinique
[5]Centre d'initiation à la recherche et d'aide au développement durable (CIRADD), Carleton-sur-Mer, Québec, G0C 1J0, Canada

Since 2019, a team of interdisciplinary experts is exploring the situation of lobster fishermen of Gaspésie in the context of the North Atlantic Right Whale "crisis", from different angles (ecological, social, economic and sustainable development of coastal communities). Beyond the stakes related to the spatio-temporal distribution of this endangered species in a Gulf, there are some specific, finer scale concerns relative to the zones that overlap fishing areas and the challenges of coexistence that this entails. This is especially true for coastal areas (less than 20 fathoms), where an important lobster fishery takes place, and for which almost no information was available to implement the NARW protection measures. This project, FOR and WITH fishers who are adapting to a changing and challenging future, allowed us to meet fishermen to collect their opinion on the NARW crisis, to produce a social analysis on the history and social context of this fishery in Gaspésie and its evolution in recent years, and to propose a series of recommendations to fishermen, scientists, and the governments regarding this fishery. These results will be presented, along with the main legacy of this project, an ongoing vessel-based survey of the coastal zone during the lobster fishing season. This survey covered more than 1000 km^2 each year and allowed to assess the biodiversity of an area that is important for both fishers and marine mammals. We are presenting the fourth year of data collection of this survey effort. Two other products are launched in 2022 and will be shared with the NARWC participants: a book covering the ecological, social, economic and sustainable development aspects of the situation for lobster fishermen in Gaspésie, and a children's novel highlighting the life and innovations of lobster fishermen wanting to coexist with whales in eastern Canada.

NEFSC research efforts to better understand right whale habitat and distribution in southern New England offshore wind development areas and nearby waters

Orphanides, C.[1], Walsh, H.[1], Cholewiak, D.[2], Conger, L.[2], Foley, H.[2], Van Parijs, S.[2], Zitterbart, D.[3], Wiley, D.[4], Hayes, S.[2], Lipsky, A.[1], Sisson, N.[5]

[1]NOAA Northeast Fisheries Science Center, 28 Tarzwell Drive, Narragansett, Rhode Island, 02891, USA (chris.orphanides@noaa.gov)
[2]Northeast Fisheries Science Center, 166 Water Street, Woods Hole, Massachusetts, 02543, USA
[3]Woods Hole Oceanographic Institution, 86 Water St, Falmouth, Massachusetts, 02543, USA
[4]Stellwagen Bank National Marine Sanctuary, 175 Edward Foster Road, Scituate, Massachusetts, 02066, USA
[5]Greater Atlantic Regional Fisheries Office, 55 Great Republic Drive, Gloucester, Massachusetts, 01930, USA

Recent aerial and passive acoustic data have shown an increasing right whale presence in and adjacent to the Massachusetts/Rhode Island Wind Energy Areas (WEAs) in southern New England. This area is known to attract aggregations of foraging right whales during the winter, and is occupied throughout the year. Right whale conservation concerns related to offshore wind development in this area include vessel strikes, noise, fishery interactions due to changes in fishing practices, and potential habitat modifications including oceanographic changes that may influence prey distribution. We have undertaken

collaborative research efforts to better understand right whale habitat use in this region and potential impacts to abundance, foraging, distribution, health, and reproduction. These efforts include baseline plankton and oceanographic sampling in the WEAs and adjacent to foraging right whales, Dimethylsulfide (DMS) sampling, tagging of right whales coordinated with prey sampling and demographics, photo identification, passive acoustic monitoring, aerial surveys, and efforts to discern diet through DNA analysis of scat samples. In addition, we are coordinating on research priorities with the Regional Wildlife Science Collaborative and are working closely with the Greater Atlantic Regional Fisheries Office to coordinate research to inform management and conservation needs.

Adaptable, open-source deep learning NARW vocalization detection tool

Padovese, B.[1], Frazao, F.[1], Gehrmann, R.[1], Kirsebom, O. M.[2], Beslin, W. A. M.[3], Evers, C. H. M.[3], Theriault, J.[4], Matwin, S.[1]

[1]Institute for Big Data Analytics, Faculty of Computer Science, Dalhousie University, 6050 University Ave, Halifax, Nova Scotia, B3H 1W5, Canada (bpadovese@dal.ca)
[2]Open Ocean Robotics, Victoria, British Columbia, V8Z 7X8, Canada
[3]Fisheries and Oceans Canada, Bedford Institute of Oceanography, 1 Challenger Drive, Dartmouth, Nova Scotia, B2Y 4A2, Canada
[4]Ocean Environmental Consulting, 9 Ravine Park, Cres., Halifax, Nova Scotia, B3M 4S6, Canada

Passive Acoustic Monitoring (PAM) has been widely employed for monitoring North Atlantic right whales (NARW). Extensive efforts to protect the species has led to an increasing number of underwater listening devices and accumulation of large acoustic datasets. Analyzing these datasets becomes impractical without automated detection and classification software. Detectors and classifiers based on deep neural networks and deep learning techniques have shown great potential, but their performance is limited by the availability of large quantities of annotated training samples. While many studies have explored deep neural networks for the detection and classification of marine mammal vocalizations in particular underwater acoustic environments, few have provided the software tools necessary to reproduce and apply the deep learning models to different acoustic environments and datasets. We developed an open-source tool to facilitate the creation of deep learning-based acoustic detectors and classifiers for NARW vocalizations. This tool offers a series of options that encompass building, evaluating, and running deep learning models. It includes functions to 1) create training and test datasets from raw acoustic data using different audio representations (i.e., spectrograms, cepstrogram, etc); 2) train a deep learning model to detect and classify NARW vocalizations; 3) evaluate the model on fully-annotated test datasets and report standard performance metrics; and 4) run the model on a directory of audio files. Notably, this tool enables adapting an existing model to a new environment through transfer learning using considerably less annotated training samples from the new dataset. We demonstrate this tool using a model trained on and applied to several PAM datasets collected along the east coast of Canada and the United States.

Decadal-scale phenology and seasonal climate drivers of North Atlantic right and other baleen whales in a rapidly warming marine ecosystem

Pendleton, D. E.[1], Tingley, M. W.[2], Ganley, L. M.[1], Friedland, K. M.[3], Mayo, C.[4], Brown, M. W.[5], McKenna, B. E.[4], Jordaan, A.[6], Staudinger, M. D.[7]

[1]New England Aquarium, 1 Central Wharf, Boston, Massachusetts, 04915, USA (dpendleton@neaq.org)
[2]Ecology and Evolutionary Biology, University of California – Los Angeles, Los Angeles, California, USA
[3]National Marine Fisheries Service, 28 Tarzwell Drive, Narragansett, Rhode Island, USA
[4]Center for Coastal Studies, Provincetown, Massachusetts, USA
[5]Canadian Whale Institute, Welshpool, New Brunswick, Canada
[6]Department of Environmental Conservation, University of Massachusetts Amherst, Amherst, Massachusetts, USA
[7]U.S. Geological Survey, Department of the Interior Northeast Climate Adaptation Science Center, Amherst, Massachusetts, USA

Species' response to rapid climate change can be measured through shifts in timing of recurring biological events, known as phenology. The Gulf of Maine is one of the most rapidly warming regions of the ocean, and thus an ideal system to study phenological and biological responses to climate change. A better understanding of climate-induced

changes in phenology is needed to effectively and adaptively manage human-wildlife conflicts. Using data from a 20+ year marine mammal observation program, we tested the hypothesis that the phenology of large whale habitat use in Cape Cod Bay has changed and is related to regional-scale shifts in the thermal onset of spring. We used a multi-season occupancy model to measure phenological shifts and evaluate trends in the date of peak habitat use for North Atlantic right (*Eubalaena glacialis*), humpback (*Megaptera novaeangliae*), and fin (*Balaenoptera physalus*) whales. The date of peak habitat use shifted by +18.1 days (0.90 d/yr) for right whales and +19.1 days (0.96 d/yr) for humpback whales. We then evaluated interannual variability in peak habitat use relative to thermal spring transition dates (STD), and hypothesized that right whales, as planktivorous specialist feeders, would exhibit a stronger response to thermal phenology than fin and humpback whales, which are more generalist piscivorous feeders. There was a significant negative effect of western region STD on right whale habitat use, and a significant positive effect of eastern region STD on fin whale habitat use indicating differential responses to spatial seasonal conditions. Protections for threatened and endangered whales have been designed to align with expected phenology of habitat use. Our results show that whales are becoming mismatched with static seasonal management measures through shifts in their timing of habitat use, and they suggest that effective management strategies may need to alter protections as species adapt to climate change.

North Atlantic right whale anthropogenic events monitoring and serious injury update

Pettis, H.[1], Henry, A.[2]

[1]Anderson Cabot Center for Ocean Life at the New England Aquarium, Boston, Massachusetts, 02110, USA (hpettis@neaq.org)
[2]NOAA Northeast Fisheries Science Center, 166 Water Street, Woods Hole, Massachusetts, 02543, USA (allison.henry@noaa.gov)

In 2022, eleven new injured whales were added to the Right Whale Injury Monitoring list. Additions included five whales carrying gear (#1403, #3560, #3823, #4501, and the 2021 calf of #3720), five whales with entanglement wounds but not carrying gear (#3191, #3401, #4042, #4650, and the 2021 calf of #3020), and one whale with a vessel strike (the 2020 calf of #1612). Of these whales, one was determined to be in declining condition coinciding with its injuries (#3560) and the impact of injury on whale health was inconclusive for the remaining 10 whales, primarily because the injuries were new. Relatively short injury detection timeframes for several whales allow for an assessment of where these injuries were acquired. An updated report on all injured whales currently on the monitoring list (including new and previously detected injuries) will be released in January 2023. We continue to integrate injury data into the Anthropogenic Events web portal that was developed in 2021 and have engaged with various stakeholders to explore useful extraction routines and visual output options to better support management and conservation efforts. We expect to develop the framework and user interface for a web-based visualization site in 2023 that will feature structured user authentication for leveled access to data and reporting outputs.

Preliminary serious injury determinations were made for the 11 new injured whales. #3560 and the 2021 calf of #3720 are both determined to have serious injuries. Following National Serious Injury protocols, the 2022 dependent calf of seriously injured #3560 will also be assigned a serious injury determination. #1403, #3823, and #4501 have prorated injuries. #3191, #3401, #4042, #4650, the 2020 calf of #1612 and the 2021 calf of #3020 have non-serious injuries. When assigning numerical values to these injuries to compare to PBR (0.7), the total is 5.25 seriously injured whales to date. These determinations are subject to change. Official determinations will be published in annual Stock Assessment and Serious Injury reports.

North Atlantic right whale density model for U.S. waters

Roberts, J. J.[1], Yack, T. M.[1], Schick, R. S.[1] , Halpin, P. N.[1]

[1]Marine Geospatial Ecology Laboratory, Duke University, A324 Lev Sci Res Ctr, Durham, North Carolina, 27708, USA (jason.roberts@duke.edu)

The North Atlantic right whale density model integrates line transect surveys conducted since 2003 by 11 collaborating organizations into a statistical model that estimates the absolute number of whales per square kilometer at 5 km, monthly resolution for the U.S. and parts of the Canadian Maritimes from bathymetric, oceanographic, and biological covariates. The model is used by U.S. agencies for

rulemaking, planning, and permitting, including most recently for regulations intended to reduce risk of incidental harm to right whales from fishing and shipping industries, and to evaluate potential impacts from offshore energy operations and military training and testing exercises. In this talk, we will present density predictions from the latest model, version 12, which extends through October 2020 and utilizes 6.0% more aerial effort and 4.3% more shipboard effort than the version 10 model we presented at the 2020 NARWC meeting. To help visualize the new model results in context, we present them with NOAA's new fishing and proposed shipping regulatory zones overlaid and also include a comparison with passive acoustic detections from NOAA and its collaborators.
The region between Cape Hatteras and Nantucket Shoals experienced the largest changes in estimated densities, resulting from additional sightings in southern New England in 2019-2020 and an improvement in the model's structure designed to better differentiate that area from the Virginia-New York region. Sightings, density model predictions, and passive acoustic monitoring indicate right whales have been present south of Nantucket year-round in recent years, with highest densities in December-May. South of Cape Hatteras, a moderate rebound at the calving grounds in the 2019/20 season boosted long-term densities slightly. North of Nantucket Shoals, the changes were spatially complex but generally modest in magnitude, with the most intense change being a reduction in density in the Great South Channel in May and June.

Incorporating prey information into the Duke right whale density surface model

Ross, C. H.[1], Roberts, J. J.[2], Runge, J. A.[3], Brady, D. C.[3], Pendleton, D. E.[4], Record, N. R.[1]

[1]Bigelow Laboratory for Ocean Sciences, 60 Bigelow Drive, East Boothbay, Maine, 04544, USA (cross@bigelow.org)
[2]Marine Geospatial Ecology Laboratory, Duke University, A324 Lev Sci Res Ctr, Durham, North Carolina, 27708, USA
[3]Darling Marine Center, School of Marine Sciences, University of Maine, Walpole, Maine, 04573, USA
[4]Anderson Cabot Center for Ocean Life, New England Aquarium, Central Wharf, Boston MA USA 02110

Predictions of North Atlantic right whale distributions form an increasingly important tool used in policy and management decisions for this endangered species. Incorporating plausible prey fields into right whale models has the potential to improve predicted whale distributions, and, by implication, the decisions based upon them. We statistically modeled distributions of *Calanus finmarchicus*, *Centropages typicus*, and *Pseudocalanus* spp. using a Random Forest model with the goal of incorporating these prey fields into a right whale density surface model that is part of the National Oceanic and Atmospheric Administration's (NOAA's) North Atlantic right whale decision support tool. Initial runs indicated that the right whale model's skill metrics (e.g., REML score, AIC) were improved by incorporating the modeled prey distributions. Differences between the right whale models with and without zooplankton layers highlighted ecologically important regions for this critically endangered species (e.g., Bay of Fundy, Nantucket Shoals).

Bycatch Solutions Hub: Connecting the seafood industry to practical solutions to protect endangered, threatened, and protected (ETP) species

Sanchez, P.[1], Morgan, A.[1], Novak, K.[1], Mihalik, K.[1]

[1]Sustainable Fisheries Partnership, 4348 Waialae Avenue #692, Honolulu, Hawaii, 96816, USA (phillip.sanchez@sustainablefish.org)

In 2021, Sustainable Fisheries Partnership (SFP) presented to the Ropeless Consortium alongside our retail partner, Publix Super Markets, and researcher Hannah Myers, with the University of Alaska, Fairbanks, on efforts to engage the seafood industry to support ropeless gear in Canadian snow crab and U.S. lobster fisheries. The presentation was in tandem with a new SFP initiative ,"Protecting Ocean Wildlife", to help the seafood industry address ETP bycatch more broadly across their supply chains. The initiative has grown since last year's Consortium, with much interest from retailers to take steps to protect ETP species, including the North Atlantic Right Whale. One challenge we have identified while building this program is the lack of practical, actionable information available to the seafood industry to be able to easily implement or support solutions to mitigate bycatch.

There are already many great programs being delivered by NGOs, international organizations, and others to reduce bycatch in fisheries. However, these

are largely focused on certain high-profile species, specific geographies, or individual fisheries. And they do not include the seafood industry at scale, in an engaging way.

SFP plans to remove this barrier through the launch of a Bycatch Solutions Hub that will bring practical information about bycatch into a single place while forming a network of companies that are actively engaged in tackling the problem. The Bycatch Solutions Hub will provide tools, resources and options for companies interested in implementing bycatch mitigation efforts in their supply chains, and will be a place to share experiences with new gear and to collaborate with others in the industry to solve particular bycatch problems.The Bycatch Solutions Hub will be the first of its kind in the seafood industry, highlighting voluntary, industry-led adoption of best practices to protect ocean wildlife. SFP plans to launch the Hub with a focus on ropeless gear solutions in crab and lobster fisheries.In this presentation, we will share some examples of experiences connecting interested industry stakeholders to opportunities to learn more about ropeless technology that is available, where and how they can access gear to try it out, connecting them with others who have tried the gear to hear their feedback and suggestions, and identifying funding opportunities to make more gear available.

Abundance and distribution of North Atlantic right whales in eastern Canada estimated from aerial line-transect surveys from 2017 to 2021

Sauvé, C. C.[1], Gosselin, J. F.[1], Harvey, V.[1], Ollier, A.[1], Lawson, J. W.[2], Goulet, P. J.[2]

[1]Department of Fisheries and Oceans Canada, Maurice Lamontagne Institute, 850 route de la Mer, Mont-Joli, Quebec, G5H 3Z4, Canada (caroline.sauve@dfo-mpo.gc.ca)
[2]Northwest Atlantic Fisheries Centre, Department of Fisheries and Oceans Canada, St. John's, Newfoundland, A1C 5X1, Canada

Between 29 August 2017 and 12 November 2021, the Department of Fisheries and Oceans (DFO) Canada conducted aerial systematic line transect surveys covering the Gulf of St. Lawrence (GSL), the Bay of Fundy, the Scotian shelf, and the Grand Banks of Newfoundland. A total of 437,614 km were surveyed using up to three aircraft simultaneously, and 369 NARW groups were detected. Average group size detected on track lines was 1.21 ± 0.04 (range: 1-6). Closing mode procedure for a minimum of 20 minutes was implemented when NARW were detected, and average group size including animals detected during closings was 3.91 ± 0.28 (range 1-25). Strata-specific NARW abundance estimates were derived from distance sampling models. Most of the NARW were detected in the western half of the southern GSL, where the highest abundance indices estimated using passing mode, uncorrected for availability and perception biases, were 48 (95%CI: 24-94) in late July 2020 and 45 (95%CI: 17-120) in early August 2019. The highest abundance using closing mode count as cluster size, which may be positively biased, was 91 (95%CI: 42-192) in June 2020. NARW were present in the GSL as early as 25 April, and were still present as late as 14 November. NARW abundance increased in the western half of the southern gulf in May, plateaued between late May and early August, and then declined. NARW were also detected in lower numbers in the northwest and southeast GSL, and in the Roseway Basin; no NARW were detected on the Grand Banks. These results provide a measure abundance of NARW in Canadian waters and of their seasonal use of the GSL from 2017 to 2021. They will support the development of habitat models and risk assessments.

Including serious injury and morbidity cases in the ongoing Unusual Mortality Event of North Atlantic right whales (Eubalaena glacialis): 2017-present

Sharp, S. M.[1], Costidis, A.[2], Henry, A.[3], Fauquier, D.[4], McClellan, W.[5], Moore, M.[6], Knowlton, A.[7], Pettis, H.[7], Landry, S.[8], Wimmer, T.[9], Bourque, L.[10], Raverty, S.[11], Jackson, K.[12], Jakush, J.[12], Gulland, F.[13, 14], Patterson, E.[4], Good, C.[4], Long, K.[4], Taylor, J.[4], Bettridge, S.[4], Brill, K.[4], Rowles, T.[4], Wilkin, S.[4], Spradlin, T.[4]

[1]International Fund for Animal Welfare, 290 Summer Street, Yarmouthport, Massachusetts, 02675, USA (ssharp@ifaw.org)
[2]Stranding Response and Biomedical Research, Virginia Aquarium & Marine Science Center, Virginia Beach, Virginia, USA
[3]Protected Species Branch, Resource Evaluation and Assessment Division, Northeast Fisheries Science Center, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, Woods Hole, Massachusetts, USA
[4]Marine Mammal and Sea Turtle Conservation Division, Office of Protected Resources, National Marine Fisheries Service, National Oceanic and

Atmospheric Administration, Silver Spring, Maryland, USA
[5]University of North Carolina Wilmington, Wilmington, North Carolina, USA
[6]Biology Department, Woods Hole Oceanographic Institution, Woods Hole, Massachusetts, USA
[7]Kraus Marine Mammal Center, Anderson Cabot Center for Ocean Life, New England Aquarium, Central Wharf, Boston MA USA 02110
[8]Marine Animal Entanglement Response, Center for Coastal Studies, Provincetown, Massachusetts, USA
[9]Marine Animal Response Society, Halifax, Nova Scotia, Canada
[10]Canadian Wildlife Health Cooperative, Atlantic Veterinary College, University of Prince Edward Island, Charlottetown, Prince Edward Island, Canada
[11]Animal Health Center, Ministry of Agriculture, Abbotsford, British Columbia, Canada
[12]Florida Fish and Wildlife Conservation Commission, St. Petersburg, Florida, USA
[13]Karen C. Drayer Wildlife Health Center and One Health Institute, University of California, Davis, School of Veterinary Medicine, Davis, California, USA
[14]Marine Mammal Commission, Bethesda, Maryland, USA

The U.S. Marine Mammal Protection Act (MMPA) mandates effective responses to unusual mortality events (UMEs), defined as *"a stranding that is unexpected; involves a significant die-off of any marine mammal population; and demands immediate response."* In 2017, the National Marine Fisheries Service (NMFS) declared an UME for North Atlantic right whales (*Eubalaena glacialis*) after several mortalities in the U.S. and Canada, which is ongoing. The species is critically endangered with fewer than 350 individuals, and to date there have been 53 whales documented in the UME: 34 dead and 19 seriously injured. Entanglements in fishing gear and vessel strikes are the primary causes of this UME. The UME was initiated based on elevated mortalities; however, during the investigation, detection of live right whales suffering from vessel strike or entanglement injuries warranted including serious injury cases following the NMFS Process that defines serious injuries as those that are "more likely than not" to result in the death of the animal. Retrospective and prospective cases meeting the serious injury classification were added to the UME in 2020. Given elevated morbidity is also a component of UMEs, a complementary Morbidity Protocol has been recently developed to account for live whales known to be sublethally injured or ill, but not considered seriously injured. Morbidity is an injury or illness that may not lead to death, but can reduce or impair well-being including growth and reproduction (*i.e.*, sublethal effects). These sublethally injured or ill whales will be added to the UME in late summer 2022 after reviewing available data. By including mortalities, serious injuries, and sublethal injuries and illness in the investigation, we can better document the full population impacts that have occurred during the UME time-period. We thank the field survey and photo-identification teams documenting right whales, which informs the injury review process, and the Stranding and Entanglement Response Network members who respond to and document stranded or entangled animals.

More information can be found at the National Marine Fisheries Service UME website: (https://www.fisheries.noaa.gov/national/marine-life-distress/2017-2022-north-atlantic-right-whale-unusual-mortality-event).

Using North Atlantic right whale family lineages as a conservation tool

Shervanick, K.[1], Coogan, C.[2], Engleby, L.[1], Rowles, T.[3]

[1]NMFS Southeast Regional Office, 263 13th Ave S, St Petersburg, Florida, 33702, USA (kara.shervanick@noaa.gov)
[2]NMFS Greater Atlantic Regional Fisheries Office, Gloucester, Massachusetts, 01930, USA
[3]NMFS Office of Protected Resources, Silver Spring, Maryland, 20910, USA

There are many terrestrial species for which family lineages have been used as conservation tools. While it is common for researchers to use names and numbers to identify individuals, there are few populations of marine mammals that are studied for long enough or intensely enough to develop family lineages. The North Atlantic Right Whale Consortium Catalog integrates a variety of long-term data sets that are essential for informing family lineages and tracking individual life histories. As a result, many endangered North Atlantic right whales (NARW) are known as individuals. However, individual family lineages are not always fully known due to gaps in information (e.g. lack of sightings or genetics) which limits the ability to use these as conservation tools compared to other species.

When NARW family lineages – especially maternal lineages – are known, they are often used *ad hoc* to celebrate births or mourn a well-known whale.

However, a systematic approach describing lineages can be used to investigate impacts to the population from vessel strikes and entanglements, provide insight into potential links between matrilineal lines and habitat use/exposure to threats, or can be used as proactive conservation messaging tools to help connect the public to these animals or highlight the threats they face through story-telling. For instance, nearly half of Pediddle's (#1012) lineage has been impacted by entanglements or vessel strikes, and four are within the UME for NARWs. Understanding family lineages provides numerous conservation benefits for a species whose population has plummeted. We need to use every tool in the tool box and family lineages are informative and powerful tools for conservation.

NMFS offshore wind energy protected species management updates

Sisson, N. B.[1], Daly-Fuchs, J.[2]

[1]NOAA Greater Atlantic Regional Fisheries Office, 55 Great Republic Drive, Gloucester, Massachusetts, 01930, USA (nick.sisson@noaa.gov)
[2]NOAA Office of Protected Resources, 1315 East-West Hwy, Silver Spring, Maryland, 21042, USA

Offshore wind energy development along the U.S. East Coast is progressing rapidly with more than 25 active leases on the Outer Continental Shelf of the U.S. East Coast and new potential lease areas identified in the Gulf of Maine, Central Atlantic, the Gulf of Mexico, and along the Pacific coast. NOAA's National Marine Fisheries Service (NMFS) is actively engaged in the offshore wind development process by fulfilling multiple roles, primarily providing input and review as a cooperating agency to the Bureau of Ocean Energy Management through the National Environmental Policy Act process as well as fulfilling our mandates under the Endangered Species Act (ESA) and the Marine Mammal Protection Act (MMPA). Understanding how offshore wind energy infrastructure and operations will interact with marine ecosystems, including resources managed by NMFS, is critical to meeting the Administration's goal to deploy 30 gigawatts of offshore wind in the United States by 2030, while protecting biodiversity and promoting ocean co-use.

The rapid development of the industry requires NMFS to quickly consider how these projects can avoid and minimize impacts to protected species from offshore wind energy development including vessel strike, noise, changes in fishing practices and other entanglement risks, and habitat/ecosystem changes. NMFS is taking a number of approaches to ensure the protection of our trust resources. These include programmatic efforts as part of the environmental review process, active coordination with partners to evaluate impacts, and development of resources to assist developers and other stakeholders in their evaluation of project impacts on protected species and their habitat. This presentation will provide an update on how NMFS has been engaged in offshore wind development under the ESA and MMPA and resources and efforts that have been developed to evaluate impacts.

Grappling with the disentanglement toolkit

Smith, A. F.[1], Fertik, M.[2], Werner, M.[2] , Morin, D.[1], Smith, A.[3]

[1]Protected Resources Division, NOAA Fisheries Greater Atlantic Regional Fisheries Office, 55 Great Republic Drive, Gloucester, Massachusetts, 01930, USA (Ainsley.Smith@noaa.gov)
[2]Masters in Industrial Design Program, Rhode Island School of Design, Providence, Rhode Island, 02903, USA
[3]Associate Professor of Industrial Design, Rhode Island School of Design, Providence, Rhode Island, 02903, USA

North Atlantic Right whales are critically endangered, and the population and its subsequent generations are directly impacted by entanglements. Thus, it is essential for entanglement response teams to have all the tools they need available, so they are best prepared during the response window of opportunity. This project combined the expertise of Rhode Island School of Design (RISD) Masters students, NOAA Fisheries Large Whale Entanglement Response Program staff, and members of the Atlantic Large Whale Disentanglement Network to evaluate disentanglement tools from a unique materials-focused perspective. CAD drawings of the current cache of tools were produced in Fusion 360 software to address production needs. The standard grapple was given stress tests in the Fusion 360 program to identify weak spots in design and where the tool could be strengthened. 3D-Printed elastic, semi-flexible resin, and cast urethane were then used to make templates of the grapple to identify if novel techniques could be used to produce these tools more quickly or more affordably. We concluded that by using digital fabrication and experimental manufacturing techniques, a more adjustable set of

tools could be produced depending on regional disentanglement needs. The next steps include developing a digital library of tool files that can be adapted, easily reproduced, and shared with teams and local manufacturers. This will aid in efficient, cost-effective tool production. Additionally, we aim to apply the stress test results to future tool designs, to create a safer environment for animals and disentanglers alike. This work will be presented to RISD students as a case study for *Critical Artifact*, a college-level course approved for Wintersession 2023, to inspire current students to continue work on this project and ecological systems design.

Impact of continual turbine operational noise on the migration of the North Atlantic right whale

Stern, R. J.[1]

[1]*Save Long Beach Island, Inc, 344 North 13th Street, Surf City, New Jersey, 08008, USA* (*drbob232@gmail.com*)

The underwater noise from the operation of today's larger offshore wind turbines is estimated to be much greater than that previously measured for smaller and moderate size turbines. At the same time the primary migration corridor of the North Atlantic right whale along the eastern seaboard runs adjacent to or even intersects with some of the selected wind energy areas. This creates the potential for significant noise disturbance to the whale as it attempts to migrate. Using the New Jersey wind energy area as a case study, the potential impact on the migration from turbine operational noise will be presented. Estimates of noise source level for today's larger turbines are determined by extrapolation of the trend results of noise versus turbine power from two studies of measured noise levels for smaller and moderate size turbines. The proximity of the primary migration corridor to the turbines is determined from other studies. Appropriate noise propagation loss factors are used to estimate the distance for the noise source level to decrease to 120 decibels (dB) so as not to disturb the whale's behavior. The results show that the entire corridor will be permeated by levels above 120 dB, which would disturb or potentially even block the whale's migration.

This problem needs much more attention than it has been receiving, it is hoped that this presentation can spark that additional effort.

2022 Atlantic Large Whale Take Reduction Plan updates

Trego, M. L.[1], Zou, C.[2], Franco, C.[2], Goebel, J.[1], Asaro, M. J.[3], Henry, A.[2], Morin, D.[1], Shank, B[3], Miller, A.[2], Huamani, A.[2], Solinger, L.[2], Duffing Romero, M.[2], Shervanick, K.[4], Coogan, C.[1]

[1]*Greater Atlantic Regional Office, U.S. National Marine Fisheries Service, Gloucester, Massachusetts, 01930, USA (marisa.trego@noaa.gov)*
[2]*Integrated Statistics, 16 Sumner St, Woods Hole, Massachusetts, 02543, USA*
[3]*Northeast Fisheries Science Center, U.S. National Marine Fisheries Service, Woods Hole, Massachusetts, 02543, USA*
[4]*Southeast Regional Office, U.S. National Marine Fisheries Service, St. Petersburg, Florida, 33701, USA*

In 2021, NOAA's National Marine Fisheries Service (NMFS) published a Final Rule on to modify the Atlantic Large Whale Take Reduction Plan (Plan) to reduce the risk of entanglements of right whales in Northeast lobster and Jonah crab trap/pot gear by at least 60 percent. We implemented two new seasonal restricted areas and modifications to the Massachusetts Restricted Area in addition to gear modifications requiring weak rope or weak insertions, minimum trap/trawl modifications, and gear marking changes (as required on May 1, 2022). However, updated population information suggests annual human-caused mortality and serious injury of the North Atlantic right whale is still unsustainable and requires a greater risk reduction than previously estimated during the last rulemaking to get below the Potential Biological Removal level (PBR). NMFS has expanded a Decision Support Tool that was used during the previous rulemaking to assess relative entanglement risk to large whales from all fisheries coastwide. NMFS is using the model to inform the Atlantic Large Whale Take Reduction Team (Team) on the combinations of measures that are necessary to reduce mortality and serious injury of North Atlantic right whales to a level below PBR. We anticipate recommendations from the Team by the end of 2022 that will form the basis of a proposed rule in 2023 and a final rule to be implemented by the end of 2024.

Skin transcriptome analysis as a potential tool for assessing health in the North Atlantic right whale

Unal, E.[1], Singh, V.[2], Romano, T.[1]

[1]Mystic Aquarium, 55 Coogan Blvd, Mystic, Connecticut, 06355, USA (eunal@mysticaquarium.org)
[2]Computational Biology Core, University of Connecticut, 67 North Eagleville Road, Storrs, Connecticut, 06269, USA

Transcriptome reflects the amount of momentary gene activity in a cell and can be utilized to quantify changes in gene expression in response to a stressor event such as entanglement, vessel strikes or disease. Transcriptomes also provide extensive genomic resources to explore the links between genes and health including stress levels, infection and inflammation, nutrition status, and other immune system imbalances. Skin tissue, which is easily accessible in wild cetaceans, is a rich source of gene expression with diverse biological functions that are also represented in other tissue types. This study proposes to use skin transcriptomics as a potential tool to contribute health information for the North Atlantic Right Whale (NARW), using subsamples of epidermal skin collected by remote biopsy (0.5cm^3 frozen at -80°C or in RNAlater™) by other scientists studying the NARW. We propose to generate skin transcriptomes from archived samples and those collected from about 12 individuals per year in collaboration with NARW scientists over the course of 2-4 years using RNA sequencing. Comparison of skin transcriptomes in NARW over time will enable monitoring of temporal changes in biological processes and metabolic pathways within the population across years and around stressor events. Moreover, by comparing health-compromised (i.e., underweight, entangled, those with large skin lesions and/or injuries) and healthy whales, it is possible to identify specific compromises in health and immune system and stress-related changes. In the short-term, data obtained from targeted immune gene expression can be utilized to examine associations between health-related data collected by other NARW scientists (i.e., body and skin condition, hormone measurements), along with life history data (i.e., body size, age, sex) for potential biomarker identification. In the long term, the data obtained can potentially be utilized as an additional health monitoring tool and contribute health status information for conservation and recovery of the species.

Fisheries and Oceans Canada: An update on research and monitoring activities for North Atlantic right whales (Eubalaena glacialis)

Vanderlaan, A. S. M.[1], Allain, R.[2], Aulanier, F.[3], Bennour, L.[2], Beslin, W.[1], Boehner, L.[1], Brennan, C. E.[1], Buffet, K.[1], Comeau, S.[4], Dufour, M.[2], Duquette, K.[3], Elliott, M.[3], Emery, P.[1], Furey, G.[4], Gosselin, J. F.[3], Goulet, P.[4], Hardy, M.[2], Harvey, V.[3], Heaslip, S. G.[1], Holub, R.[4], Johnson, C. L.[1], Juif, C.[3], Labbé, A.[5], Lacroix-Lepage, C.[2], Lang, S. L. C.[1], Lesage, V.[3], Lawson, J. W.[4], Leblanc, C.[2], McDermid, J.[2], Moors-Murphy, H. B.[1], Mosnier, A.[3], Murphy, A.[4], Plourde, I.[3], Ramp, C. S.[3], Ratelle, S.[2], Robichaud, M. F.[2], Rousseau, M.[3], Roy, N.[3], Royer, P.[3], Sanchez, M.[1], Sauvé, C.[3], Sheppard, L.[4], Simard, Y.[3], Sorochan, K. A.[1], Thompson, E.[2], Walker, R.[1], Wright, A. J.[1], Xu, J.[1]

[1]Fisheries and Oceans Canada, Bedford Institute of Oceanography, 1 Challenger Drive, Dartmouth, Nova Scotia, B2Y 4A2, Canada (angelia.vanderlaan@dfo-mpo.gc.ca)
[2]Fisheries and Oceans Canada, Gulf Fisheries Centre, 343 Université Avenue, Moncton, New Brunswick, Canada
[3]Fisheries and Oceans Canada, Institut Maurice-Lamontagne, 850 Rte de la Mer, Mont-Joli, Québec, Canada
[4]Fisheries and Oceans Canada, North Atlantic Fisheries Centre, 80 E White Hills Road, St Johns, Newfoundland and Labrador, Canada
[5]Fisheries and Oceans Canada, National Headquarters, 200 Kent Street, Ottawa, Ontario, Canada

Fisheries and Oceans Canada (DFO) continues to conduct research on the critically endangered North Atlantic right whale (NARW) with initiatives including monitoring through systemic aerial surveys and passive acoustics; habitat and prey studies; noise modelling; and other studies. Systematic aerial surveys to document the spatiotemporal distribution of NARWs in Canadian waters started in mid-April, with multiple passes of the southern Gulf of St. Lawrence (GSL) supporting the development of species distribution models. Additional surveys were undertaken in the northern GSL, Cabot Strait, Bay of Fundy, and on the Scotian Shelf. DFO continues to catalogue photographs and videos of NARWs from a variety of platforms for identification and documentation of injuries. Passive acoustic monitoring continues at a number of sites across Atlantic Canada, with monitoring extended to include sites off eastern and northern Newfoundland. The deployment of an array of acoustic recorders in Cabot

Strait this autumn will improve monitoring of NARW migrations. Near real-time detection efforts continue with seven detection systems in the GSL and the initiation of the Whale Acoustic Slocum Program. DFO developed and launched Whale Insight, a visualization platform displaying NARW sightings, detections, and associated effort data. Sound propagation studies and soundscape modelling that characterizes vessel noise are ongoing. Satellite tracking of 12 NARWs over multiple weeks in 2022, and concomitant sampling of their foraging habitat and prey in the southern GSL will allow for a comprehensive assessment of collision and entanglement risks. Foraging habitat and prey studies have continued through field observations coupled with bio-physical Calanus model simulations, and will provide insights into processes driving Calanus availability. There are ongoing efforts to develop a comprehensive and accurate representation of the baseline seasonal fixed-gear fisheries landscape throughout the GSL to quantify fisheries threats for NARWs. This presentation summarizes the NARW research undertaken by DFO and its collaborators.

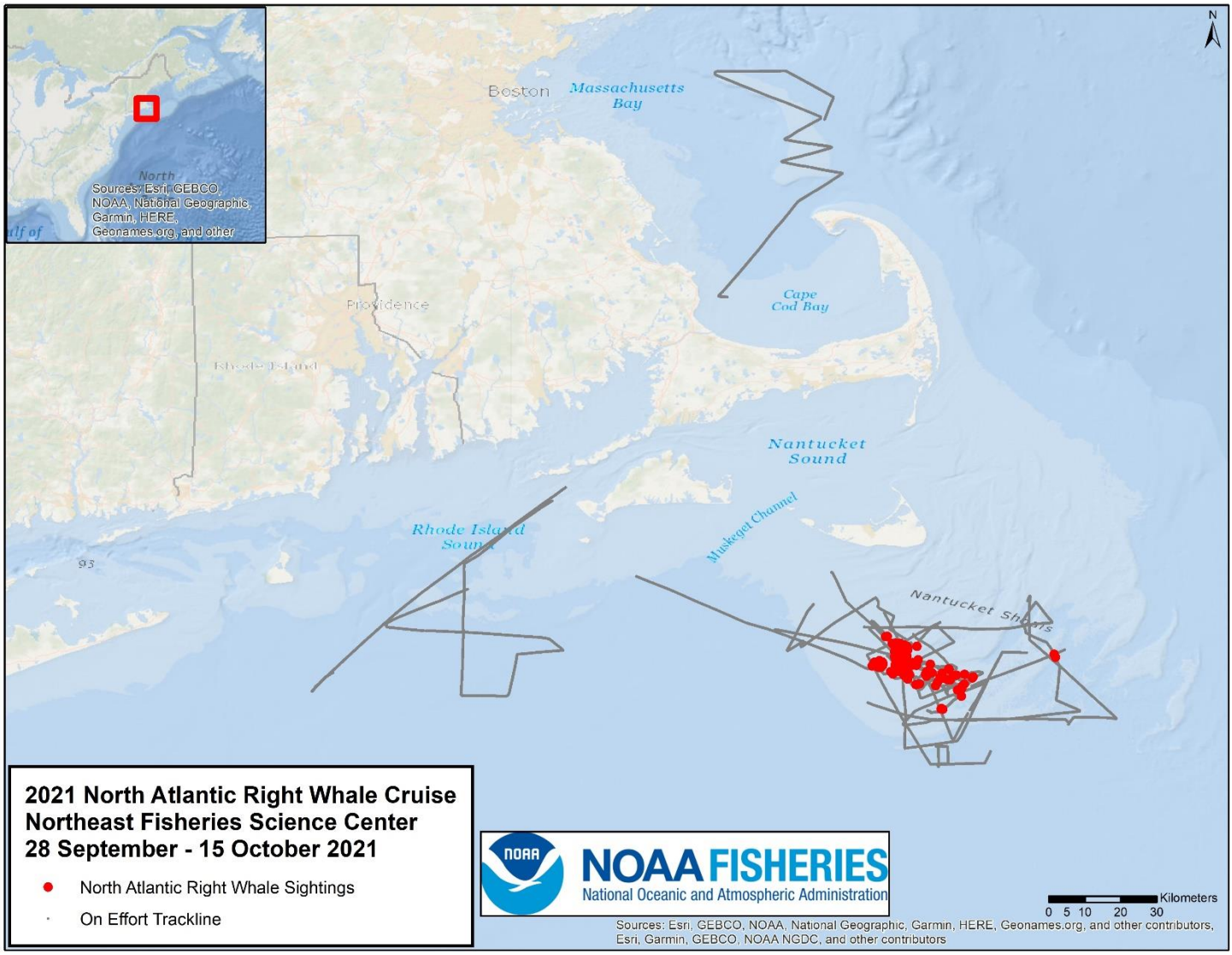
From top to bottom: Predominantly near-surface and near-bottom distribution of North Atlantic right whales in the Gulf of St Lawrence

Wright, A. J.[1], Gabaldon, J.[2], Zhang, D.[2]

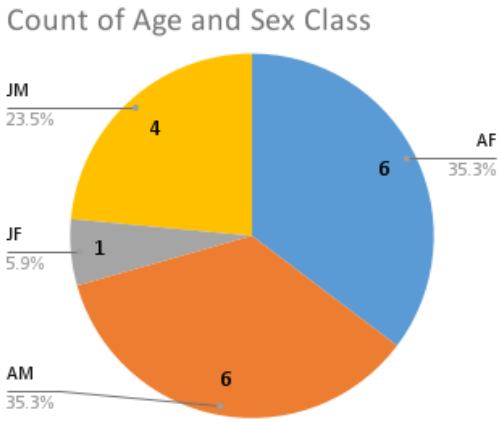
[1]*Fisheries and Oceans Canada, 1 Challenger Drive, Dartmouth, Nova Scotia, B2Y 4A2, Canada (andrew.wright@dfo-mpo.gc.ca)*
[2]*University of Michigan, Ann Arbor, Michigan, USA*

Over the last decade, critically endangered North Atlantic right whales have shifted their summer distribution, declining in presence in the lower Bay of Fundy and on the southwestern Scotian Shelf and increasing in the Western Gulf of St Lawrence. In the Gulf they face the same lethal threats as are present elsewhere, primarily entanglement in fishing gear and ship strikes. Feeding behaviour in the lower Bay of Fundy and southwestern Scotian Shelf involves stereotyped deep 'flat-bottom' dives, where right whales target deeper aggregations of their *Calinus* prey. However, studies of feeding behaviour in Cape Cod Bay found that the whales fed by skimming sub-surface *Calinus* aggregations. As the different foraging strategies influence the extent of the risks presented by shipping and fishing, it is important to determine how the whales are feeding in their new habitat. To explore this, acoustic and biologging suction-cup attached DTAGs were deployed on five individuals in the Gulf in 2019 and 2020. Diving behaviour in the was largely split between surface periods (50%) and the flat-bottom dives observed previously in the Bay of Fundy (32%). These were found to be at, or very close to, the sea floor, where most of the Calinus has been found to aggregate in the Gulf. Surface periods included logging, short respiratory dives and, in one case, a couple of parabolic, low-activity dives similar to those thought to be sleeping at depth in harbor porpoises. This biphasic vertical distribution not only places the whales at risk of being hit by ships, but it may also put them at risk of coming into contact with groundlines used in various fishing industries in the Gulf. Additional research is needed as these limited number of datasets were also restricted to hours of daylight.

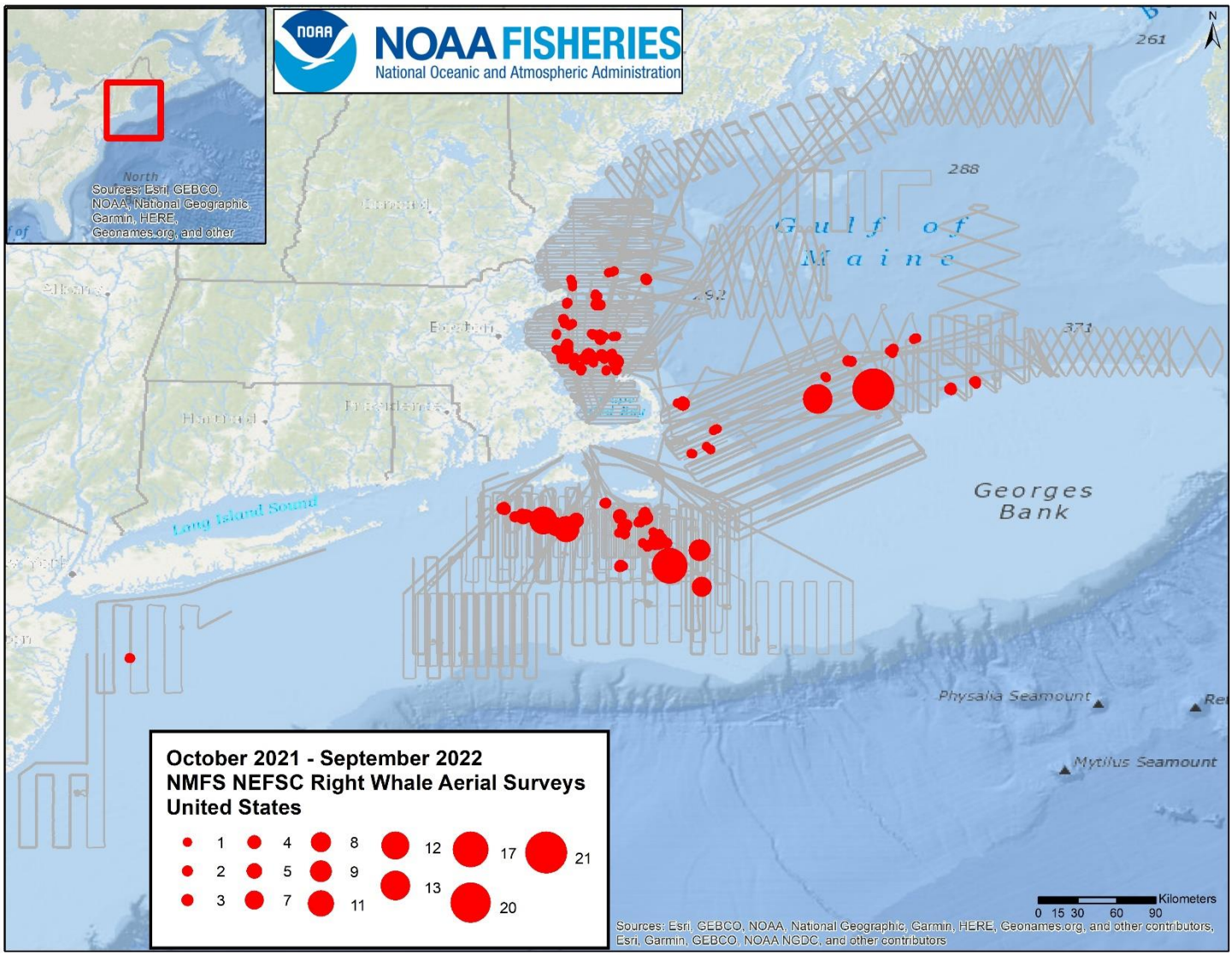
NMFS Northeast Right Whale Cruise
28 September – 15 October 2021
Southern New England



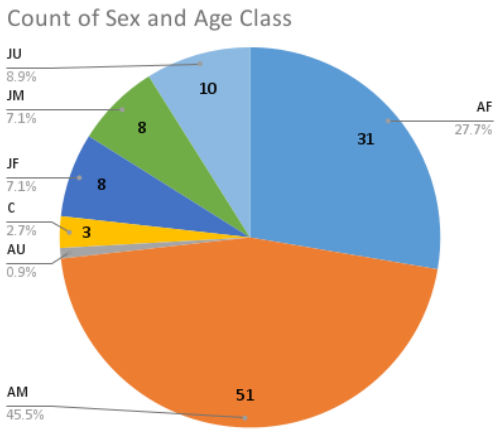
- M/V Warren Jr. surveyed in southern New England from 28 September 2021 – 15 October 2021
- Sighted 17 unique right whales
- Deployed 11 digital acoustic archival tags, durations up to 13:47



NMFS Northeast Right Whale Aerial Surveys
October 2021 – September 2022
United States

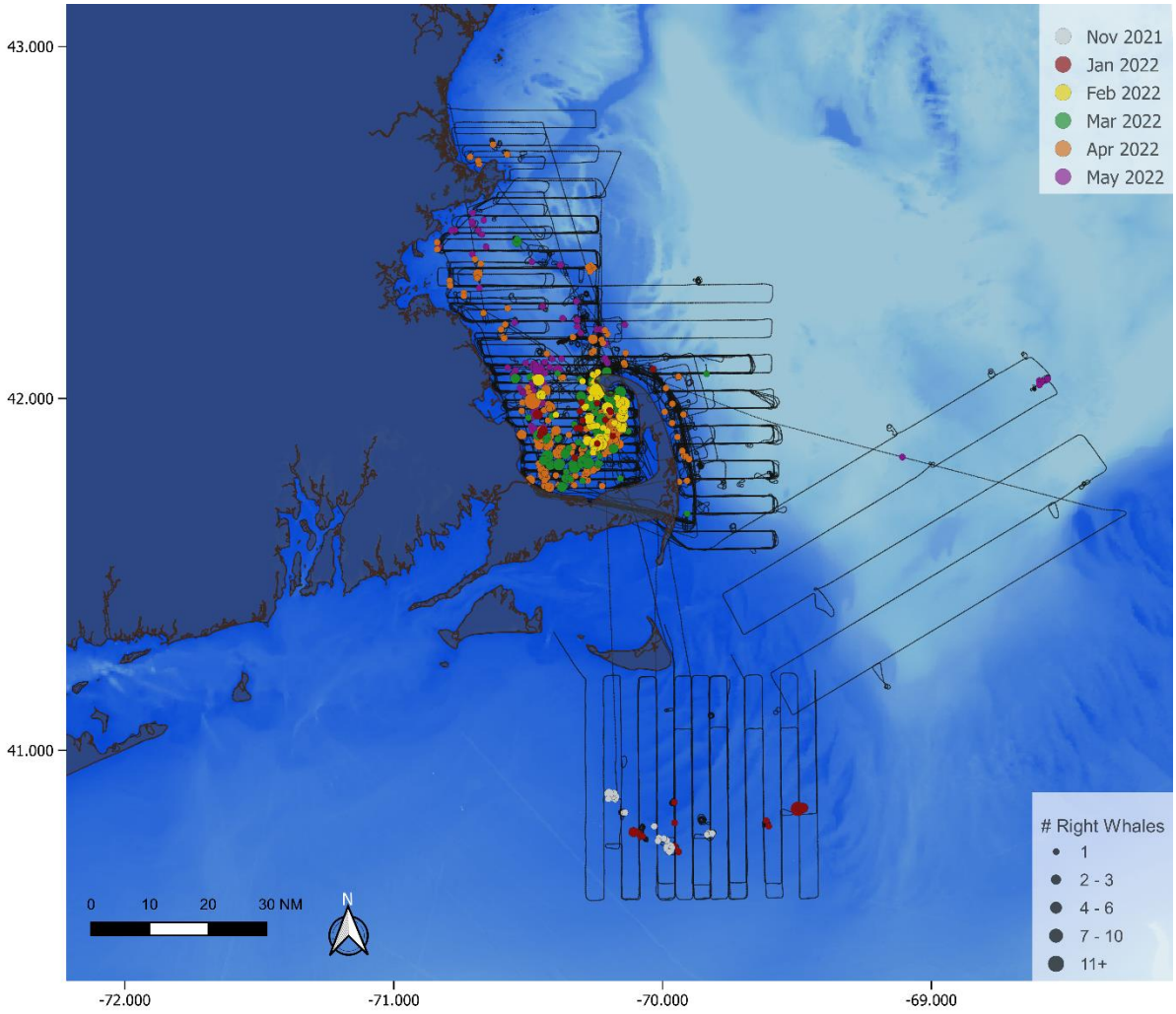


- NOAA Twin Otter conducted 62 surveys in the US from October 10, 2021 – August 5, 2022
- Total flight time (including transits) was 341.3 hours
- Sighted 112 unique right whales



Aerial right whale surveys in Cape Cod Bay and adjacent waters by the Center for Coastal Studies Right Whale Ecology Program

November 2021 to May 2022



Month	No. of aerial survey days	Trackline miles (nm)	No. unique right whales identified per month	No. of new individuals for season
November	4	1123	30	9
December	0	0	0	0
January	5	1187	48	17
February	6	1282	131	79
March	8	2212	146	71
April	10	3146	95	67
May	7	1845	80	26
	40	**10,795**	-	**269**

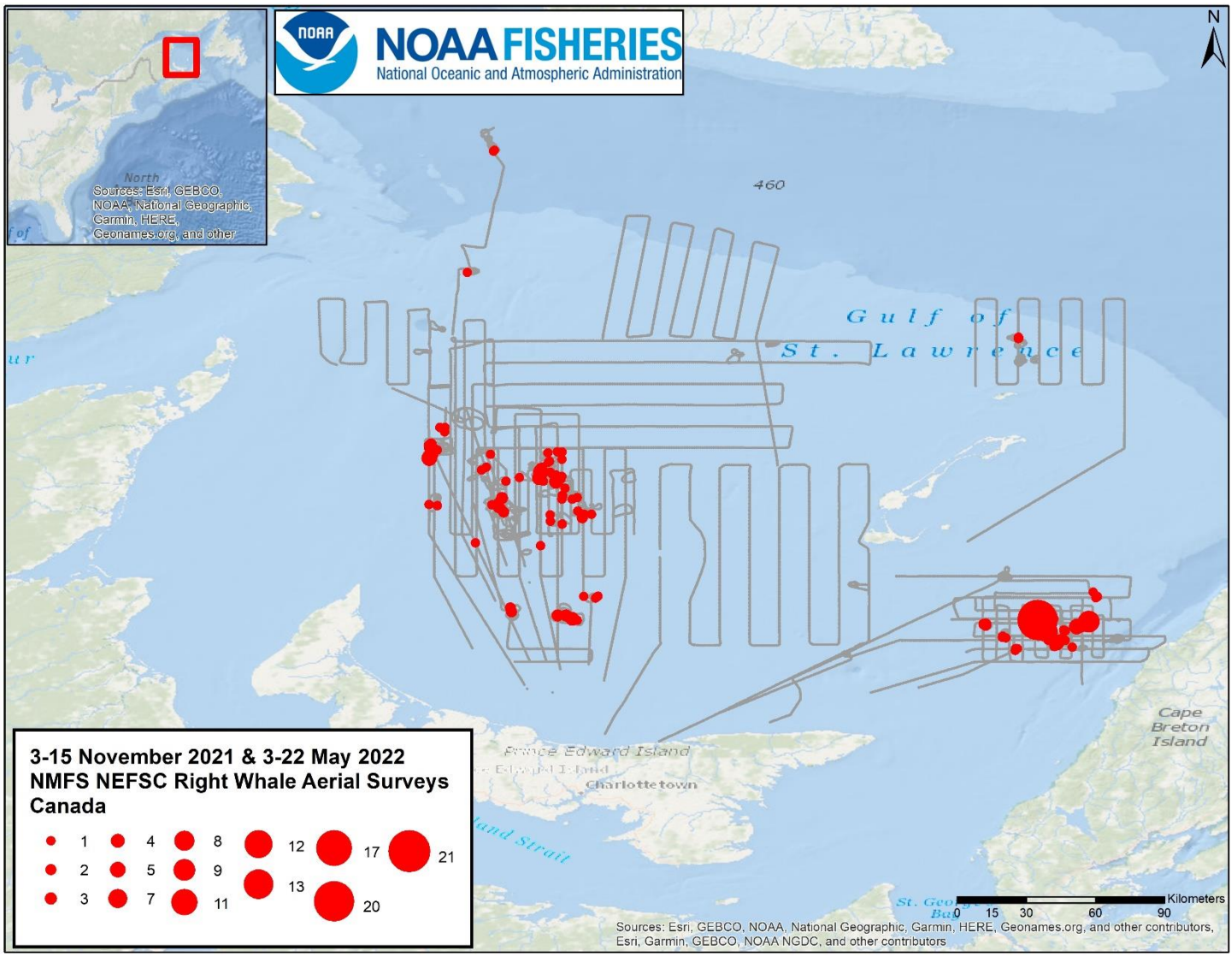
- CCS conducted 40 aerial surveys aboard Cessna 337 & O-2 Skymaster from 4 November 2021 to 25 May 2022
- Right whales were observed on 34 of 40 aerial survey days
- Habitat team collected 425 zooplankton samples on 22 research cruises in Cape Cod Bay
- Across all platforms, CCS documented at least 273 individual right whales, including:

Age Class	**Female**	**Male**	**Unknown Sex**
Adult	80	132	7
Juvenile	12	13	19
Calf	0	1	9

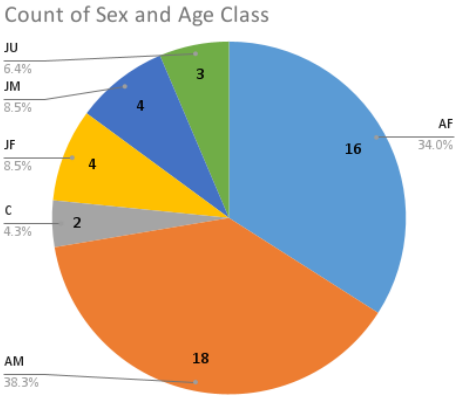
RWEP team: Stormy Mayo, Christy Hudak, Amy James, Brigid McKenna, Carolyn O'Connor, Emily Patrick, Sarah Pokelwaldt, Corry Psutka, Ryan Schosberg

Research conducted under NMFS Permit #25740(-01)

NMFS Northeast Right Whale Aerial Surveys
3-15 November 2021 and 3-22 May 2022
Canada

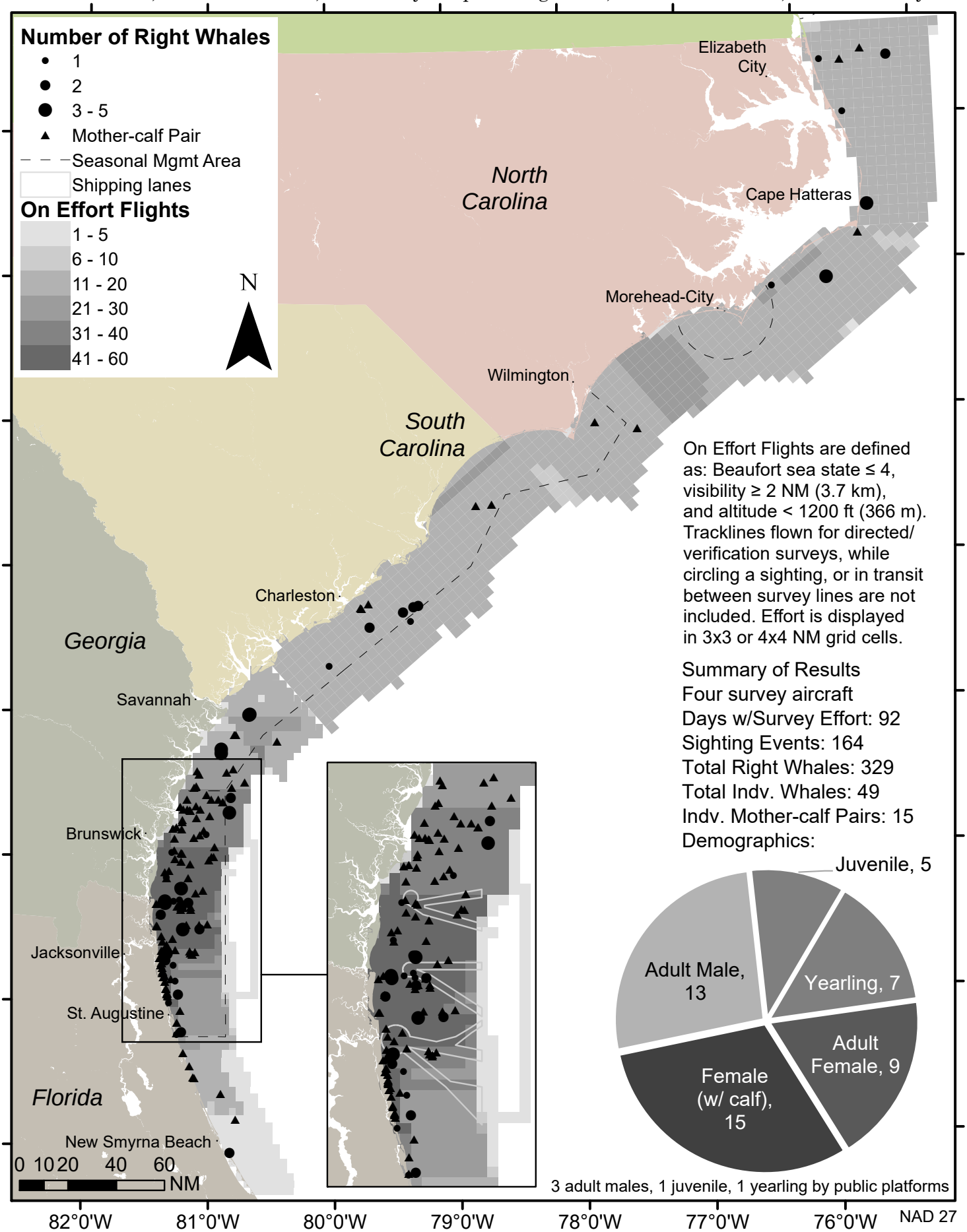


- NOAA Twin Otter conducted 17 surveys in Canada from 3-15 November 2021 and 3-22 May 2022
- Total flight time (including transits) was 79.8 hours
- Sighted 47 unique right whales



Southeast U.S. Aerial Surveys
November 15, 2021 – April 15, 2022

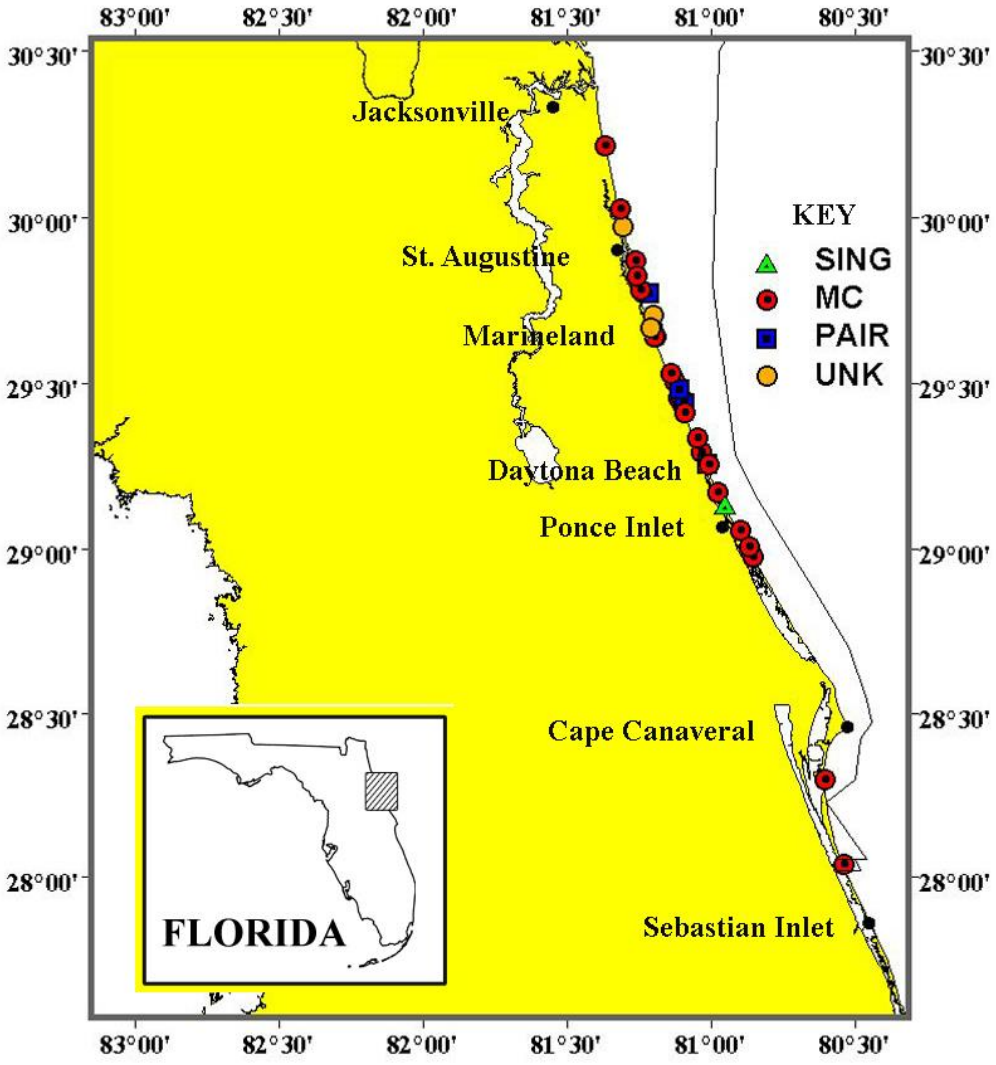
Clearwater Marine Aquarium Research Institute
Florida Fish and Wildlife Conservation Commission
Funding provided by: FWC, Georgia Department of Natural Resources, NOAA Fisheries, U.S. Army Corps of Engineers, U.S. Coast Guard, and U.S. Navy



On Effort Flights are defined as: Beaufort sea state ≤ 4, visibility ≥ 2 NM (3.7 km), and altitude < 1200 ft (366 m). Tracklines flown for directed/ verification surveys, while circling a sighting, or in transit between survey lines are not included. Effort is displayed in 3x3 or 4x4 NM grid cells.

Summary of Results
Four survey aircraft
Days w/Survey Effort: 92
Sighting Events: 164
Total Right Whales: 329
Total Indv. Whales: 49
Indv. Mother-calf Pairs: 15
Demographics:

3 adult males, 1 juvenile, 1 yearling by public platforms

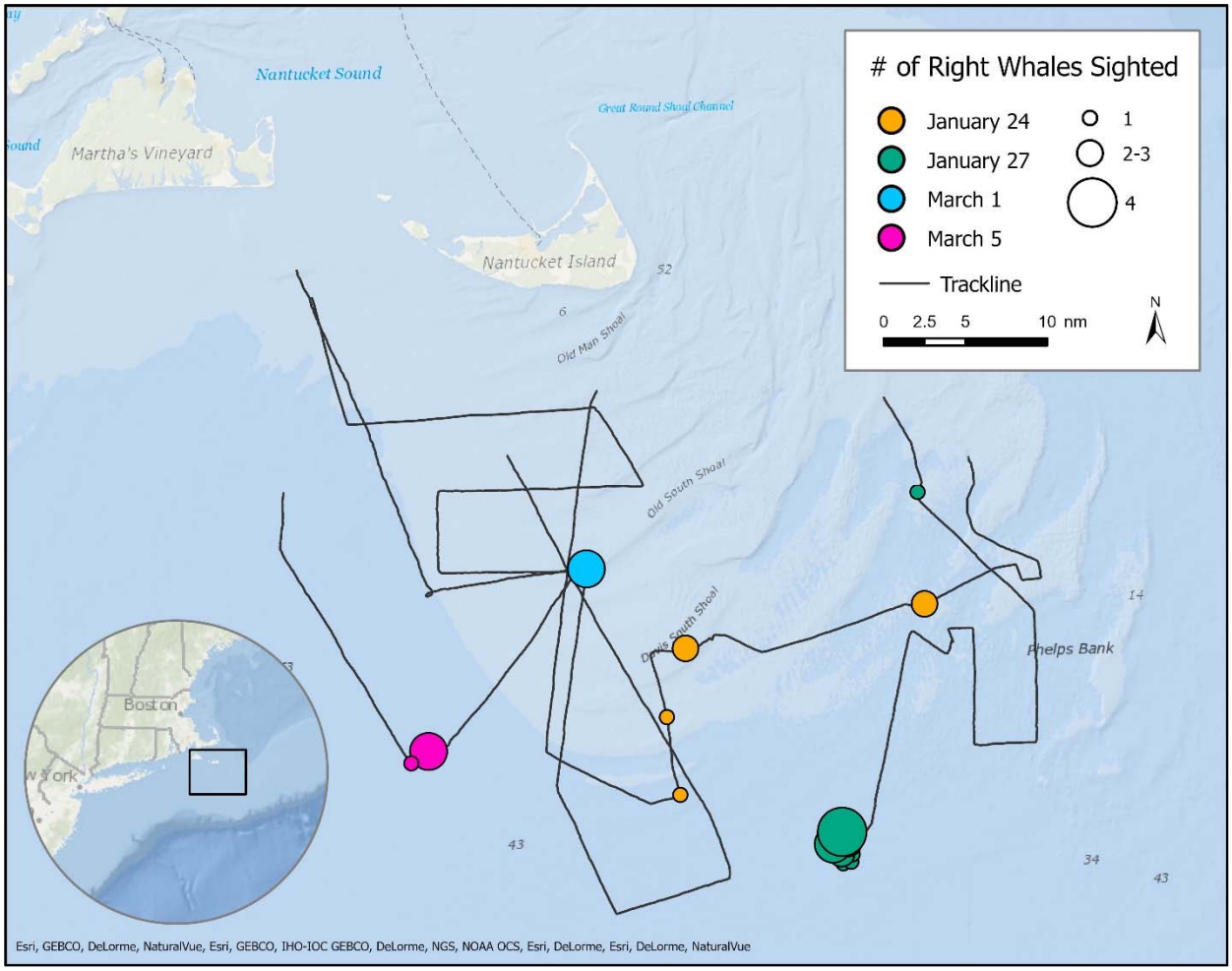


Verified right whale sightings by the Volunteer Sighting Network (VSN) during the 2021–22 southeastern U.S. (SEUS) season. Sightings resulted from a collaborative effort between the Marineland Right Whale Project and the Marine Resources Council, and included assistance from the Florida Fish and Wildlife team. The total n = 33. Most sightings were mother-calf pairs. There were no groups of ≥ 3 in this area in this season.The use of shore-launched drones considerably enhanced the efficacy of the shore-based sighting network. The black line off the coast is the boundary of the right whale critical habitat.

Anderson Cabot Center for Ocean Life
at the New England Aquarium

Vessel-based right whale surveys in Southern New England in 2022

Anderson Cabot Center for Ocean Life at the New England Aquarium



	January 24	January 27	March 1	March 5	Total
Track line Miles (NM)	78	60	92	92	**322**
No. of photo-documented sightings	2	7	1	2	**12**
No. of Unique Individuals	3	7	3	4	**17**

Survey Team: Katie Graham, Philip Hamilton, Kelsey Howe, Sharon Hsu, Amy Knowlton, Marilyn Marx, Katherine McKenna, Kate McPherson, Orla O'Brien, Amy Warren, Monica Zani

Funding by: Irving Oil and Island Foundation

Research conducted under NMFS permit #25739. Map by Kelsey Howe.

New England Aquarium
Protecting the blue planet

Anderson Cabot Center for Ocean Life
at the New England Aquarium

Aerial surveys of the RIMA/MA Wind Energy Areas: 2022 Field Season

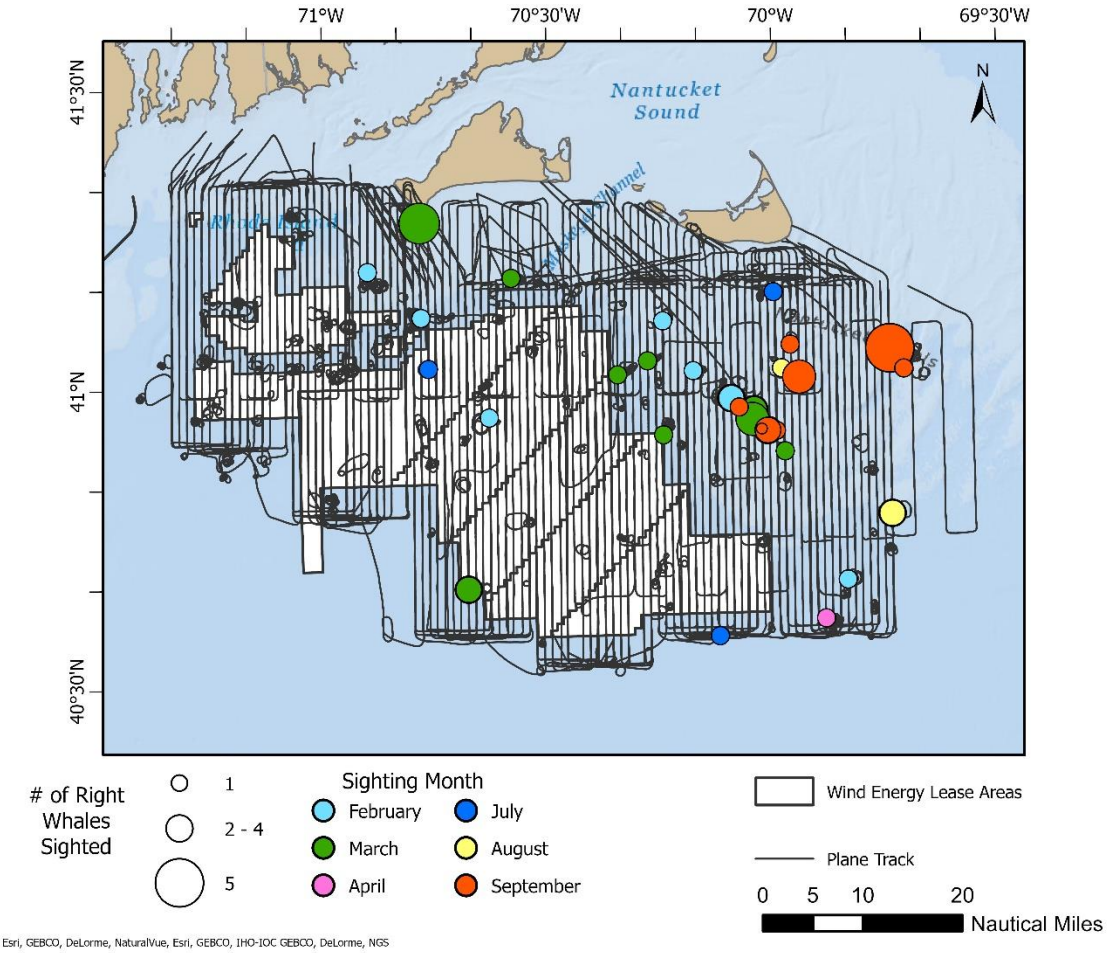


Table 1. Survey Summaries

Month	# survey days	Survey Mileage (nm)	# right whales sighted	# unique whales ID'd
February	5	2084	8	3
March	4	2059	16	11
April	3	1623	1	1
May	3	1052	0	0
June	3	1619	0	0
July	3	1872	3	2
August	3	1618	3	3
September	3	1536	15	13

Table 2. Demographic Information

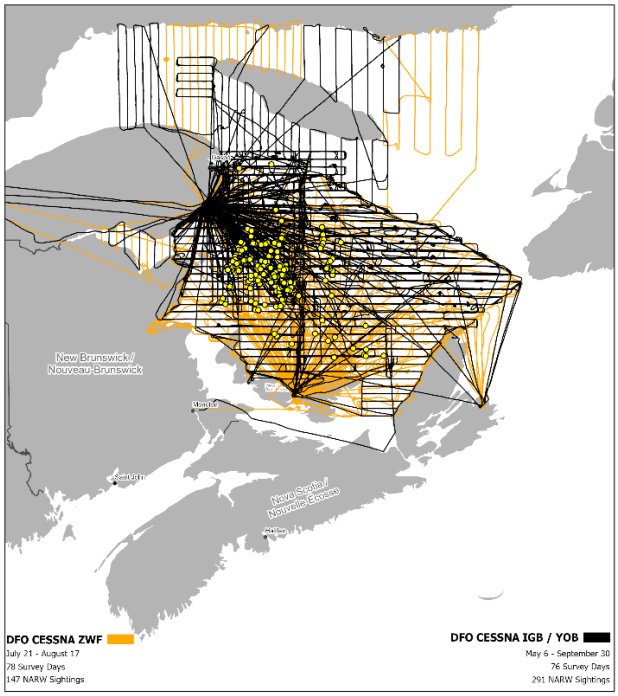
	Adult	Juvenile
Male	13	4
Female	8	2
Unknown sex	-	1

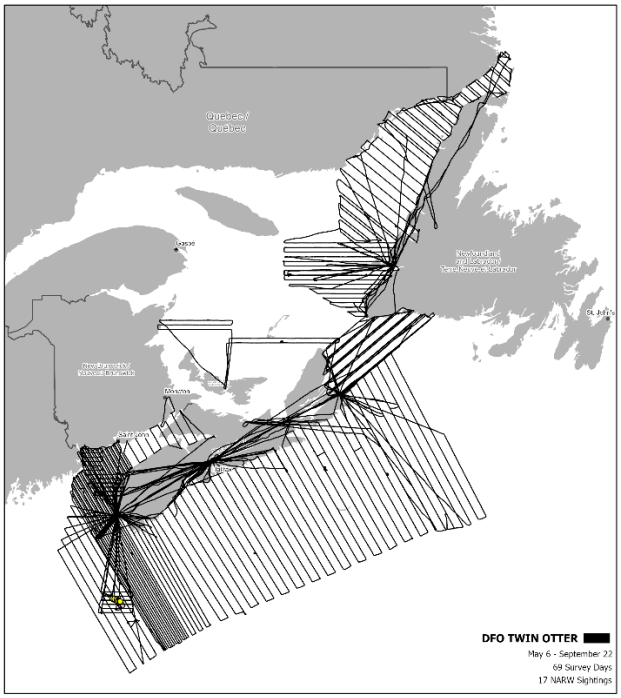
Survey team: Orla O'Brien, Katherine McKenna, Sharon Hsu – EcoMap Group, Anderson Cabot Center for Ocean Life at the New England Aquarium

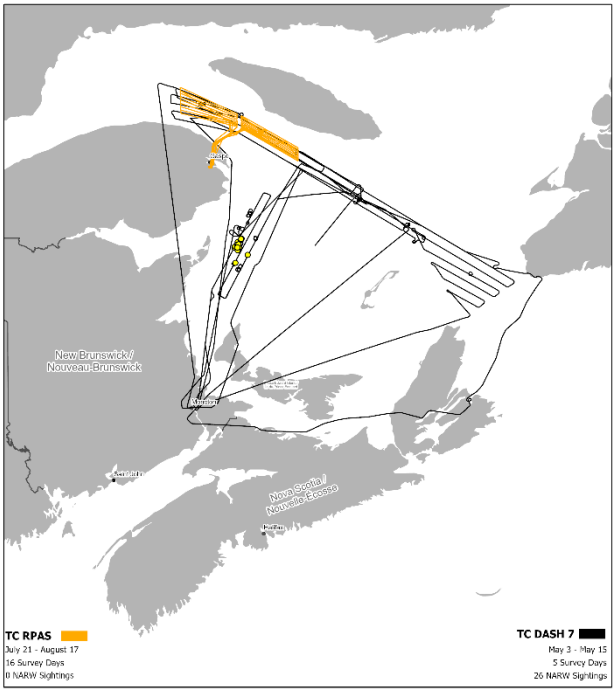
Surveys funded by Massachusetts Clean Energy Center, NOAA, and a private foundation; surveys conducted under NMFS research permit 25739.

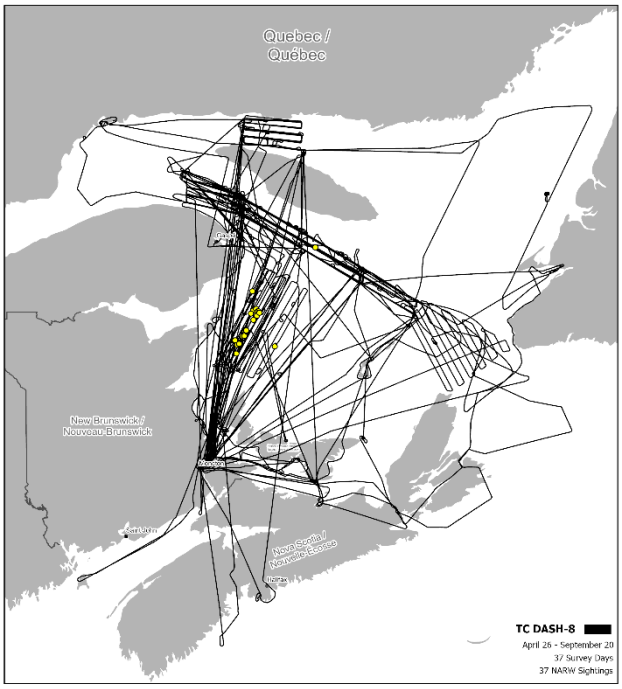
2022 Marine mammal aerial surveys in eastern Canadian waters

Conducted by: DFO and TC





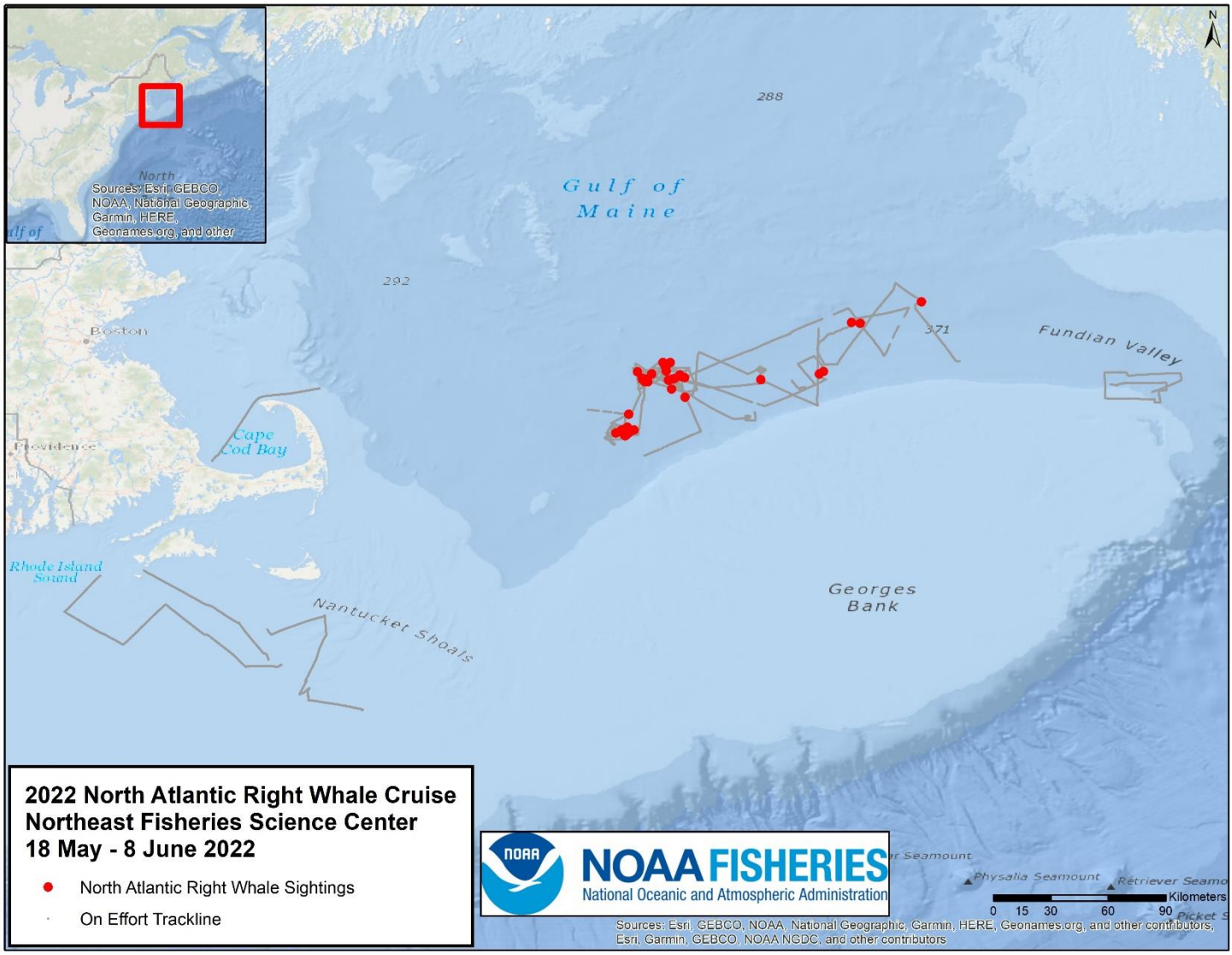




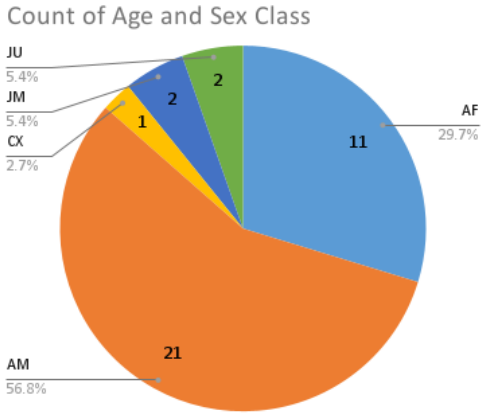
- Survey data collected up to and including Sept 30.
- All surveys except DFO-Twin Otter (Sept 26) and TC-RPAS (Aug 17) extend beyond Sept 30.
- Fisheries surveillance flights conducted by DFO- Conservation and Protection not included and efforts extends beyond Sept. 30.
- Sightings in map (yellow circles) represent either single or multiple individuals.
- Imagery continues to be collected from multiple sources (e.g., air, vessel, land) and submitted to the Right Whale Consortium (new: mid-season GoC catalogue submitted Oct 1).

*Fisheries and Oceans Canada (DFO) Science Program- Twin Otter, Cessna 1 (ZWF) and Cessna 2 (YOB **or** IGB)*
TC National Aerial Surveillance Program- Atlantic (Dash-8) and Central (Dash-7)
TC Aircraft Services Directorate - Remotely Piloted Aircraft System (RPAS) *Project*

NMFS Northeast Right Whale Cruise
18 May – 8 June 2022

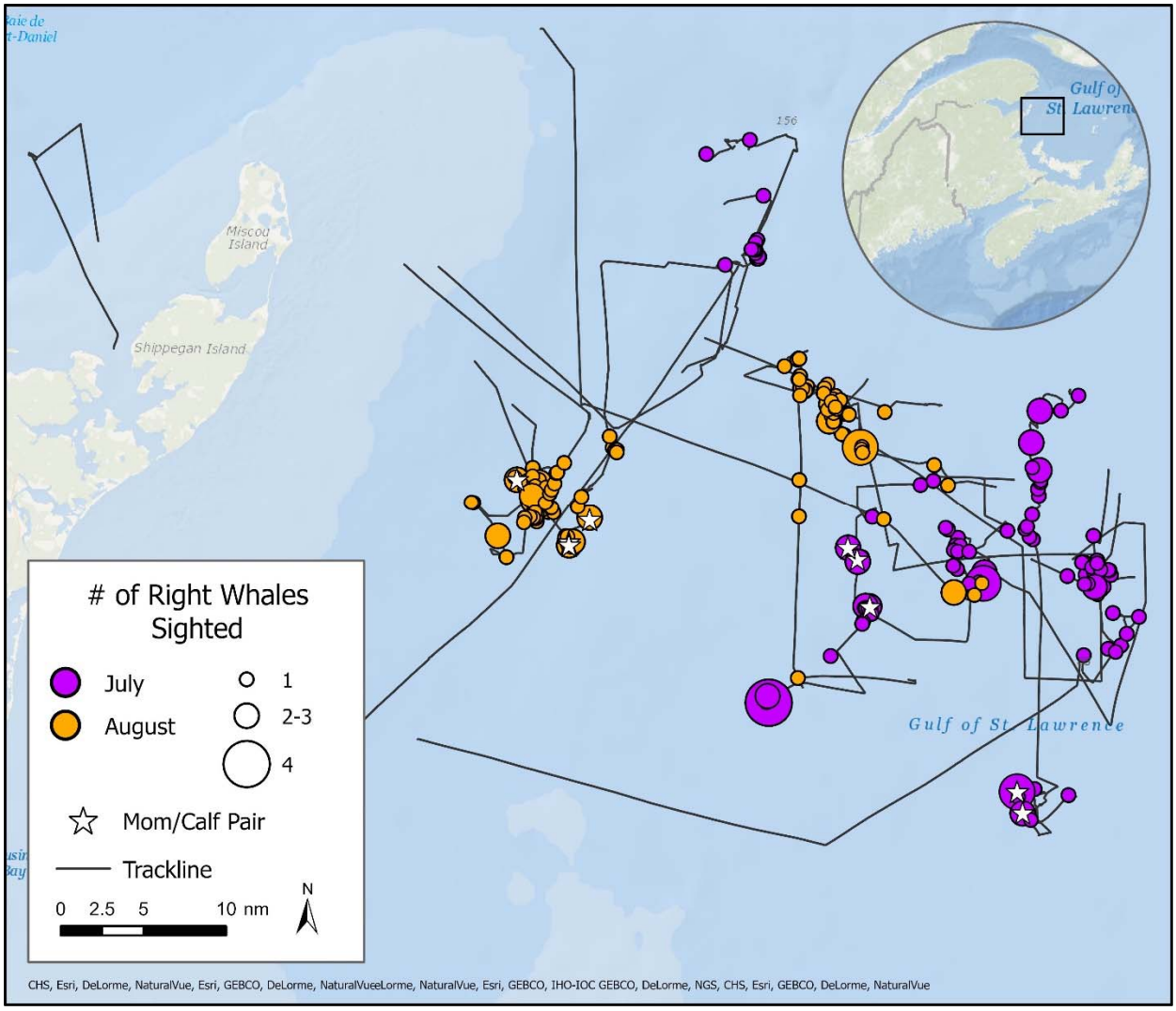


- M/V Warren Jr. surveyed from 18 May – 8 June 2022
- Sighted 37 unique right whales
- Deployed 2 digital acoustic archival tags, durations up to 22:00



Vessel-based right whale surveys in the Gulf of St. Lawrence in 2022

Anderson Cabot Center for Ocean Life at the New England Aquarium, Canadian Whale Institute,
and the University of New Brunswick



	Cruise 1	Cruise 2	Total
Cruise Dates	07 July – 18 July	06 August – 16 August	
No. of survey days	8	8	**16**
Track line Miles (NM)	372	413	**785**
No. of photo-documented sightings	121	113	**234**
No. of Unique Individuals	67	44	**81**
No. of Mom/calf pairs	3	2	**4***

*Moms: #1245, 1817, 2753, 4180

Survey Team:

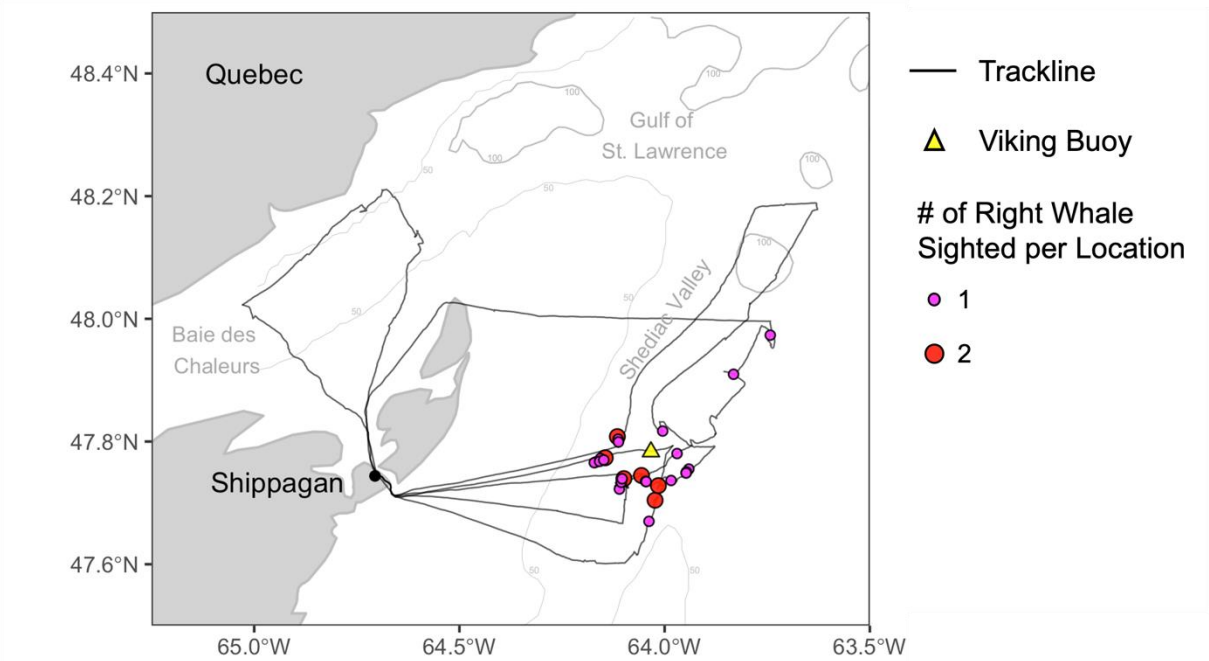
New England Aquarium: Philip Hamilton, Kelsey Howe, Kate McPherson, Amy Warren, Monica Zani
Canadian Whale Institute: Moira Brown, Delphine Durette-Morin
University of New Brunswick: Kim Davies, Cody Carlyle, Natasha Hynes, Kate Indeck, Gina Lonati, Andréa Mesquita

Funding by: Canada Space Agency, Canada Steamship Lines, Canadian Foundation for Innovation, Fisheries and Oceans Canada, Habitat Stewardship Program for Aquatic Species at Risk, Irving Oil, Island Foundation, Marine Environmental Observation Prediction and Response Network of Centres of Excellence, and NSERC.

Research conducted under section 73 SARA permit issued by Department of Fisheries and Oceans to the NEAq (permit no. DFO-GLF-QUE-2022-02) and UNB (permit no. DFO-GLF-QUE-MAR-2022-03). Map by Kelsey Howe.

Vessel-based right whale survey in the Gulf of St. Lawrence 2022

Canadian Whale Institute (CWI), Anderson Cabot Center for Ocean Life at the New England Aquarium (NEAq) and Fédération régionale acadienne des pêcheurs professionnels (FRAPP)



Vessel survey tracks are shown as black lines with circles indicating locations of right whale sighting events, and colour and size reflecting number of individual whales sighted per location.

Survey period	23 July - 03 August
No. of survey days	4
Trackline nautical miles (NM)	423.5
No. of photographed whales	30
No. of unique individuals	17

Survey Team:

Canadian Whale Institute: Moira Brown Delphine Durette-Morin
New England Aquarium: Kelsey Howe, Amy Warren
FRAPP: Stephane Ferron, Aldo Ferron

Funding by: Habitat Stewardship Program for Species at Risk, and Canada Steamship Lines and in-kind support from FRAPP.

Research conducted under section 73 SARA permit issued by Department of Fisheries and Oceans to the NEAq (permit no. DFO-GLF-QUE-2022-02).

Report from Education Committee
October 2022
Submitted by Robert Rocha, Chair

Regional

ASRI, NBWN and WDC held monthly meetings to discuss issues related to NARWs. Much of the focus was the updating and finalizing of an infographic (at right) and preparation for a jointly led webinar via Mystic Seaport Museum. The three organizations co-led an online webinar titled, "Warning – Whale Crossing. Know Before You Go" on May 24, hosted by Mystic Seaport Museum.

Anne DiMonti and Monica Pepe submitted a proposal to the Sailing Leadership Forum to present at their conference in FL in February.

Building on our work with *Sharing the Seas*, ASRI and NBWM have signed on as partners, with WDC and NOAA-GARFO, in promoting *See A Spout* and *Whale SENSE*.

NOAA-GARFO (information below is taken from a PDF submitted by Allison Rosner)
Right Whale Slow Zones –
From March 2021 through March 2022 the Northeast relayed 84 Slow Zone notifications to mariners (46 new zones and 38 extensions of previously established zones). Notably, acoustic detections triggered 48 of these Slow Zones. Overall, adding acoustic information to our notification to mariners has nearly doubled the number of notifications from any of the previous 5 years (2016-2020).

As of 4/12/22 there are 4,125 subscribers for Right Whale Slow Zone email alerts (compared to 1,795 reported on 3/17/2021) and approximately an additional 647 email addresses on the original right whale ship strike notification email listserv

Safe Boating Courses
In partnership with the USCG Auxiliary, a new 12-minute video on marine mammal laws, whale watching guidelines, and right whale protections is being added to Safe Boating classes throughout New England and the Mid-Atlantic. The video was marketed specifically to USCG Auxiliary Safe Boating courses and may be viewed here. This video was developed through the *See A Spout, Watch Out!* program, a partnership between GARFO, Whale and Dolphin Conservation, and Stellwagen Bank National Marine Sanctuary. From April 2021-April 2022, the video has been viewed 286 times

Whale SENSE Atlantic
Nineteen companies from Maine through Virginia now participate in our Whale Sense program for responsible whale watching, including several new companies from New York, New Jersey, and Delaware. Each company participates in annual training that includes specific modules on right whale regulations, protection, and reporting.

Recreational Fishing
We added new messaging to the *FishRules* app to warn recreational fishermen to slow down in Massachusetts waters when peak right whale abundance coincides with the recreational cod and haddock season. This messaging was also carried in NOAA and USCG social media posts and distributed through our government delivery emails.

Atlantic Large Whale Take Reduction Plan Outreach

In 2021, GARFO held 15 virtual scoping meetings, informational meetings, and public hearings. Fishermen have received numerous informational and reminder emails from the GARFO office regarding the new regulations and restricted areas, including information regarding an Emergency Closure implemented in April 2022.

In addition to implementing Phase 1 of the amendments, we began outreach regarding Phase 2 amendments in September 2021. We held 7 public hearings on scoping for Phase 2, as well as 3 call-in days to receive input, which reached about 200 people. We held several informational webinars between January and March 2022, which reached about 300 people. We also gave presentations to the Mid Atlantic Fisheries Management Council, Atlantic States Marine Fisheries Commission, and New England Fisheries Management Council regarding Phase 2.

Massachusetts

Boston Harbor City Cruises (submitted by Laura Howes)

Boston Harbor City Cruises (we added 'City' last year) has put into to place a Right Whale Reporting and Operation Procedure Policy, due to the increased sightings of Right Whales in Massachusetts Bay and outside Boston Harbor. This policy was first created in 2018. We are a Whale SENSE whale watch, and shared our policy with the NOAA and WDC sponsors that organize the program. The Whale SENSE sponsors were proud of this initiative and used it as a template in their training for other whale watch companies that are part of the Whale SENSE program. All BHCC Right Whale Sightings are reported to the NOAA hotline, and photos are shared with the NAWRC. Several of our Right Whale Reports to NOAA have triggered Dynamic Management Areas in Massachusetts Bay.

New Bedford Whaling Museum (submitted by Bob Rocha)

The Museum is serving as temporary host of all NARWC paper files and CDs.

Hosted a demonstration of On Demand Fishing methods, led by WDC, on October 20.

Participated in several activities with regional partners, as reported above.

Whale and Dolphin Conservation – Plymouth (submitted by Monica Pepe)

WDC maintained the *Face-ing Extinction* Facebook page, which has a current following of 3,274. Posted content covered a broad range of right whale related topics but focused on updates to the latest conservation measures and NOAA Fisheries Slow Zone alerts for mariners.

WDC's Monica Pepe worked with the NEAQ team on the annual right whale naming series that was shared as a blog, as well as a post series on the *Face-ing Extinction* Facebook page. Stay tuned for this year's series!

WDC's Regina Asmutis-Silvia served as an expert panelist at two *Last of the Right Whales* film screenings: Cape Cod National Seashore Visitor Center and Audubon Society of Rhode Island.

WDC was busy throughout 2022 at outreach events with our life-size inflatable right whale, Delilah. Highlights include a road trip to Bethany Beach, Delaware, the Green River Music Festival in Massachusetts, and a whole suite of local libraries and grade schools.

WDC created a short video that shows how difficult it is to see right whales from a vessel. This video has been used to bolster support for slower vessel speeds in an effort to prevent dangerous accidental collisions. Additionally, a short video demonstrating how on-demand fishing gear works is being finalized for public distribution.

We are currently running a campaign to obtain public support for the proposed vessel strike rule issued by NMFS. At the time of this writing, we've collected 1,205 petition signatures in support of the proposed rule.

WDC continues to be a leading partner on collaborative boater outreach programs, *Whale SENSE* and *See A Spout, Watch Out!*. Through these programs we educate commercial whale watching companies and recreational boaters about safe operations around whales, with a particular focus on right whales. Highlights this year include launching a free, self-guided training course for recreational boaters, a Podcast interview for *PartsVu Xchange Talks Boating & Fishing*, and a meeting with the 11th Hour Racing sailing team in advance of the Newport to Bermuda sailing race. We also had the opportunity to share resources with boaters and the media in response to persistent humpback whale presence near our coastal town of Plymouth, MA this summer.

New Hampshire
YOTRW / Blue Ocean Society / Whale Mobile (submitted by Cynde McInnis)
The Year of the Right Whale has *Booths in a Box* available for loan. The *Booth in a Box* is an innovative outreach display that contains everything to set up a table at a festival, school event, or environmental fair. It's a great way to introduce people to right whales and the threats they face. Visit www.yearoftherightwhale for more information.

Our activities/curricula which are based on the North Atlantic Right Whale Catalog, are available for middle or high school teachers.

Rhode Island
Audubon Society of Rhode Island (submitted by Anne DiMonti)
Anne did a talk for Bay County Florida Audubon titled *A Marine Biologist Journey on a Whale Ship: Reflections in Marine Conservation*. This was followed by a talk at the local High School the next day. Both involved discussions on conservation efforts for the North Atlantic Right Whale.

Whale and Dolphin Conservation demonstrated methods for On Demand Fishing at the Audubon Society of Rhode Island Raptor Weekend event.

We hosted a screening of the *Last of the Right Whales* on September 22nd, followed by a panel discussion, which was moderated by Anne DiMonti. Panel experts were Dr. Bob Kenney (Professor Emeritus, URI), Captain Thomas Fetherston (US Navy retired), and Regina Asmutis-Silva (Executive Director, WDC).

Canada (submitted by Joanne Jackson, HitPlay Productions)
It's been a year since *Last of the Right Whales* had its World Premiere at the Calgary International Film Festival and was then viewed virtually by many members of the Consortium. The producers wanted me to pass on their thanks and appreciation to everyone in the Consortium who has participated in screening events and/or helped spread the word about the film.

Last of the Right Whales has had over 140 screenings in the US and Canada and proven to be a great tool for building general public awareness of the current situation that North Atlantic right whales face. There is an impact campaign report being prepared that the producers will share with the media and this community in the new year.

The film was the number one Canadian film at the box office opening weekend and was followed by an often-sold-out Coastal Tour along the whales' migration route. These events generated over 230 media articles or stories about NARW and the film while the social media channels had a reach of over 710,000 impressions. Numerous community screenings and a campus tour of 10 campuses have been on-going this

fall. The power of watching the film with a general audience or a fishing community and being able to discuss the issues with marine mammal experts or a panel afterwards seems significant.

Broadcast Premieres & Educational Opportunities

In Canada, the film will be featured on CBC's *The Nature of Things* in early 2023, and a French dubbed version on *Explora* in French Canada. In the US, PBS Nova will broadcast a customized American version that will broadcast in 2023. Both the CBC and PBS versions will be available for streaming. There are not yet airdates for the European version, which will air on ARTE in France and Germany. *Last of the Right Whales* can be screened in four languages. English, French dubbed or subtitled, Spanish dubbed, and Mi'kmaw.

Community screening opportunities for organizations/individuals will be available until the end of 2022. After broadcast in early 2023 the film will be available for educational screenings in the US and Canada. Hosting inquiries as well as 'downloadable' educational tools including a film hosting guide, film discussion guide, and curriculum guides (available early 2023) for high school and post-secondary educators, can be accessed HERE.

2022 NARWC Annual Meeting Participants

First Name	Last Name	Affiliation
Jeff	Adams	NMFS OPR
Alex	Aines	Oceana
Julie	Albert	Marine Resources Council
Elaine	Alberts	Georgia Aquarium
Dee	Allen	Marine Mammal Commission
Johanna	Anderson	Anderson Cabot Center for Ocean Life at the New England Aquarium
Perry	Andrea	Broad Reach Fund
Alexi	Archer	Whale and Dolphin Conservation
Reese	Armstrong	College of the Atlantic
Michael	Asaro	NOAA Fisheries
Jessica	Aschettino	HDR
Regina	Asmutis-Silvia	Whale and Dolphin Conservation
Deborah	Austin	Fisheries and Oceans Canada
William	Barnhill	NOAA Fisheries
Lisa	Barrett	Captain John boats
Mark	Baumgartner	Woods Hole Oceanographic Institution
Leah	Baumwell	The Pew Charitable Trusts
Pierre	Bélanger	Fisheries and Oceans
Joel	Bell	NAVFAC Atlantic
Leila	Bennour	DFO
Ryan	Bernstein	GARFO
Wilfried	Beslin	Fisheries and Oceans Canada
Shannon	Bettridge	NOAA Fisheries
Stacey	Bieren	Fisheries and Oceans Canada, Maritimes
Ana	Bishop	Marine Geospatial Ecology Lab/Duke
Richard	Blome	Smithsonian Ocean Hall
Andrea	Bogomolni	Island Foundation
Chantal	Bois	Transport Canada
Oliver	Boisseau	Marine Conservation Research Int'l
Diane	Borggaard	NMFS
Jacqueline	Bort	NAVFAC LANT (US Navy)
Laura	Bourque	Canadian Wildlife Health Cooperative
Sabrina	Braunlich	Whale and Dolphin Conservation
Sean	Brillant	Canadian Wildlife Federation
Melissa	Brochu	Fisheries and Oceans Canada
Gilbert	Brogan	Oceana
Moira	Brown	Canadian Whale Institute
Jamie	Brusa	NOAA Affiliate
Lisa	Bujold	Fisheries and Oceans
Liz	Burgess	Anderson Cabot Center for Ocean Life at the New England Aquarium
Erin	Burke	MA DMF
Steve	Burton	FAU HBOI
Melanie	Burton (Giffin)	PEI Fishermen's Association
Saya	Butani	Whale and Dolphin Conservation

First Name	Last Name	Affiliation
Kristina	Cammen	University of Maine
William	Carome	LobsterLift LLC
Lori	Caron	Pioneers for a Thoughtful Co Existence
Alexandra	Carroll	NAVAL UNDERSEA WARFARE CENTER
Virginia	Carter	Environment America
Beth	Casoni	Massachusetts Lobstermen's Association
Kate	Chadwick	Saint Mary's University
Michel	Charron	Transport Canada
Steinauer-Scudder	Chelsea	
Michelle	Cho	Anderson Cabot Center for Ocean Life at the New England Aquarium
Danielle	Cholewiak	NOAA/NMFS/NEFSC
David	Chosid	Massachusetts Division of Marine Fisheri
Chris	Clark	Vineyard Offshore
Marie-Eve	Clark	Merinov
Joel	Cohen	Joel LIkes To Photo LLC
Alexandra	Cole	Canadian Wildlife Federation
Tim	Cole	NOAA/NMFS
Kathleen	Collins	International Fund for Animal Welfare
Karen	Compton	Fisheries and Oceans Canada, Maritimes
Lisa	Conger	noaa/nefsc
Colleen	Coogan	NMFS
Lauren	Cooley	IFAW
Peter	Corkeron	Anderson Cabot Center for Ocean Life at the New England Aquarium
Julien	Cormier	Fisheries and Oceans Canada
Vicki	Cornish	Marine Mammals Commission
Alexander	Costidis	Virginia Aquarium
Jean	Côté	RPPSG
Cheryl	Cross	GARFO
Carla	Crossman	Saint Mary's University
Leah	Crowe	Integrated Statistics/NEFSC
Nathan	Crum	Florida FWC
Jose	Cruz	Whale and Dolphin Conservation
Soren	Dahl	NMFS OPR
Jaclyn	Daly-Fuchs	NOAA Fisheries
Kimberly	Damon-Randell	NOAA
Pierre-Yves	Daoust	Canadian Wildlife Health Cooperative
Jane	Davenport	Defenders of Wildlife
Nancy	Daves	Tybee Island Marine Science Center
Genevieve	Davis	NOAA NMFS NEFSC
Nick	Dean	Spindrift Images
Monica	Deangelis	NAVAL UNDERSEA WARFARE CENTER
Suzanne	Delesdernier	Lowell Public Schools
Katharine	Deuel	The Pew Charitable Trusts
Anne	Dimonti	Audubon Society of Rhode Island

First Name	Last Name	Affiliation
Danielle	Dion	Quoddy Link Marine
Karin	Dolan	NAVAL UNDERSEA WAFARE CENTER
Paul	Donlan	Mysticetus LLC
Nicole	Downing	The Blue Ocean Society for Marine Conser
Lysiane	Drewitt	Transport Canada
Mareike	Duffing Romero	NOAA NEFSC & Integrated Statistics
Mylene	Dufour	DFO
Pete	Duley	NOAA NEFSC
Delphine	Durette-Morin	Canadian Whale Institute / CWRT
Kimberly	Durham	Atlantic Marine Conservation Society
Sarah	E Callan	Mystic Aquarium
Melissa	Edmonds	Southern Environmental Law Center
Isabelle	Elliott	Fisheries and Oceans
Michael	Elliott	DFO
Sara	Ellis	Associated Scientists at Woods Hole
Dan	Engelhaupt	HDR
Carter	Esch	DOC/NOAA/NMFS
Taylor	Evans	Stony Brook University
Jeffry	Fasick	University of Tampa
Deborah	Fauquier	National Marine Fisheries Service
Stephane	Ferron	Équipe de désempêtrement du Golfe
Maxwell	Fertik	Rhode Island School of Design (RISD)
Thomas	Fetherston	RI Saltwater Anglers Association
Sheryl	Fink	IFAW
Robert	Fitzsimmons	Campobello Whale Rescue
Peter	Flood	Green Seal Environmental
Heather	Foley	NOAA Fisheries NEFSC/Int. Statistics
Sue	Forsey	Fisheries and Oceans Canada
Crystal	Franco	NOAA Fisheries
Brenna	Frasier	Saint Mary's University
Tim	Frasier	Saint Mary's University
Rhyl	Frith	Canadian Wildlife Federation
Erica	Fuller	Conservation Law Foundation
Ellie	Gabrielson	College of the Atlantic
Meghan	Gahm	NMFS Office of Protected Resources
Laura	Ganley	Anderson Cabot Center for Ocean Life at the New England Aquarium
Lance	Garrison	NMFS, Southeast Fisheries Science Center
Mendy	Garron	NOAA / NMFS
Clay	George	Georgia DNR
Pat	Gerrior	NOAA Fisheries Retired
Brett	Gilchrist	Fisheries and Oceans Canada
Roxanne	Gillett	DFO
Laurent	Giugni	Canadian Space Agency
Robert	Glenn	MADMF

First Name	Last Name	Affiliation
Jennifer	Goebel	NMFS GARFO
Linnea	Goh	College of the Atlantic
Howard	Goldstein	NMFS OPR
Caroline	Good	NMFS, Office of Protected Resources
Laura	Gray	NMFS
Mackie	Greene	Campobello Whale Rescue
Corie	Grewal	NMFS GARFO
Olivia	Guerra	International Fund for Animal Welfare
Frances	Gulland	Marine Mammal Commission
Robert	Hache	STF Consulting Inc.
Rachel	Hager	NOAA
James	Hain	Associated Scientists at Woods Hole
Toby	Hall	Offspring Films Ltd
Patricia	Halpin	University of New Hampshire
Philip	Hamilton	Anderson Cabot Center for Ocean Life at the New England Aquarium
Amy	Hapeman	NMFS OPR
Amalia	Harrington	Maine Sea Grant
Randle	Hart	Saint Mary's University
Valerie	Harvey	Fisheries and Oceans Canada
Marin	Hawk	Marine Stewardship Council
Kelsey	Hayden	Fisheries and Oceans Canada, Maritimes
Sean	Hayes	NOAA Fisheries
Susan	Heaslip	Fisheries and Oceans Canada
Dennis	Heinemann	Marine Mammal Commission
Heidi	Henninger	Atlantic Offshore Lobstermen's Assn.
Allison	Henry	NMFS/NEFSC
Jean	Higgins	GARFO
Jane	Hoppe	International Fund for Animal Welfare
Eliot	Horowitz	Viam, INC
Kelsey	Howe	Anderson Cabot Center for Ocean Life at the New England Aquarium
Laura	Howes	UMass Boston/BHCC
Sharon	Hsu	New England Aquarium
Alessandra	Huamani	Integrated Statistics--NOAA NFSC
Carrie	Hubard	NMFS OPR
Christy	Hudak	Center for Coastal Studies
Nicole	Hunter	IFAW
Kate	Indeck	University of New Brunswick
Katie	Jackson	Florida Fish & Wildlife (FWC)
Jen	Jakush	Florida Fish & Wildlife (FWC)
Amy	James	Center for Coastal Studies
Shiva	Javdan	Canadian Wildlife Federation
Meghan	Jeans	Binnacle Fund
Catherine	Johnson	Fisheries and Oceans Canada
Chris	Johnson	WWF

First Name	Last Name	Affiliation
Kirklen	Johnson	Canadian Wildlife Federation
Lindsey	Jones	Allied Whale, College of the Atlantic
Whitney	Kapp	IFAW MMRR
Kira	Kasper	International Fund for Animal Welfare
Mckercher	Katherine	Fisheries and Oceans Canada
Ellen	Keane	GARFO
Emily	Kelly	Center for Coastal Studies
Adam	Kenney	LFA 34 Fisherman
Robert	Kenney	URI Graduate School of Oceanography
Francine	Kershaw	Natural Resources Defense Council
Christin	Khan	NOAA/NEFSC
Joelle	Kilchenmann	University of Maine
Emma	Kindley	IFAW
Jay	Kirkham	Dalhousie University
Cara	Kirkpatrick	Genome Atlantic
Olga	Kiseliova	Fisheries and Oceans Canada
Richard Zack	Klyver	Blue Planet Strategies
Victoria	Knorr	Washington Department of Fish & Wildlife
Amy	Knowlton	Anderson Cabot Center for Ocean Life at the New England Aquarium
Trip	Kolkmeyer	GDNR
Heather	Koopman	UNCW/GMWSRS
Artie	Kopelman	CRESLI
Scott	Kraus	NARWC
Abigail	Kreuser	University of South Carolina
Adèle	Labbé	Fisheries and Oceans Canada
Erin	Labrecque	Marine Mammal Commission
Élise	Lacaille	Transport Canada
Marianne	Lacroix	Maine Lobster Marketing Collaborative
Claudie	Lacroix-Lepage	DFO
Melissa	Landry	Landry
Samuel	Landry	DEPARTMENT OF FISHERIES AND OCEANS
Scott	Landry	Center for Coastal Studies
Cameron	Lane	Canadian Wildlife Federation
Jon	Lang	Maritime Whale
Jean	Lanteigne	FRAPP
Lauri	Leach	Marine Mammal Commission
Kathryn	Lebow	US Army Corps of Engineers
Laurence	Lecavalier	Transport Canada
Josée	Lessard	Transports Canada
Jacob	Levenson	Bureau of Ocean Energy Management
Naomi	Lewandowski	DOE Wind Energy Technologies Office
Daniel	Linden	NOAA Fisheries
Niki	Lisi	NMFS
Keith	Lohnes	Clearwater Seafoods LP

First Name	Last Name	Affiliation
Gina	Lonati	University of New Brunswick Saint John
Kristen	Long	NMFS Office of Protected Resources
Veronique	Loubier Chiasson	Corbo Inc
Charles	Lucas	Broad Reach Fund
Allison	Ludtke	Animal Welfare Institute
Bob	Lynch	Center for Coastal Studies
Nadine	Lysiak	Suffolk University
Ryan	Mahoney	Clearwater Seafoods LP
Kara	Mahoney Robinson	Anderson Cabot Center for Ocean Life at the New England Aquarium
Jenna	Malek	NOAA Fisheries
Steve	Manley	NMFS OPR
Hannah	Mark	Fisheries and Oceans Canada
Dan	Marrone	GARFO
Rob	Martin	NOAA
Marilyn	Marx	Anderson Cabot Center for Ocean Life at the New England Aquarium
Kendall	Mashburn	New England Aquarium
Charles	Mayo	Center for Coastal Studies
Patrice	Mccarron	MLA
Shasta	Mcclenahan	NMFS OPR
Jess	Mccoppin	Bar Harbor Whale Watch Company
Sarah	Mccormack	Whale and Dolphin Conservation
Christina	Mccosker	University of Maine
Brigid	Mckenna	Center for Coastal Studies
Katherine	Mckenna	New England Aquarium
William	Mclellan	UNC Wilmington
Kate	Mcpherson	Anderson Cabot Center for Ocean Life at the New England Aquarium
Bill	Mcweeny	The Calvin Project
Tom	Melone	Allco Renewable Energy Limited
Catherine	Merriman	Fisheries and Oceans Canada
Marianne	Messina	Mongabay
Erin	Meyer-Gutbrod	University of South Carolina
Alicia	Miller	NOAA Fisheries
Carolyn	Miller	Woods Hole Oceanographic Institution
Christina	Miller	Author
Meredith	Moise	NMFS GARFO
Kristen	Monsell	Center for Biological Diversity
Michael	Moore	Woods Hole Oceanographic Institution
Hilary	Moors-Murphy	Fisheries and Oceans Canada
David	Morin	GARFO
Lyne	Morissette	M - Expertise Marine
Anna	Moscrop	Marine Conservation Research Int'l
Kate	Mueller	IFAW
Anita	Murray	Department of Marine Resources
Piper	Myers-Poppay	College of the Atlantic

First Name	Last Name	Affiliation
Lisa	Neyman	Florida FWC
Misty	Niemeyer	IFAW
Martin	Noel	APPCA
Véronique	Nolet	Transport Canada
Orla	O'Brien	Anderson Cabot Center for Ocean Life at the New England Aquarium
Kate	Oconnell	Animal Welfare Institute
Meghan	O'Connor	Florida FWC
Alison	Ogilvie	Northeast Fisheries Science Center
Phinn	Onens	NMFS OPR
Chris	Orphanides	Orphanides
Richard	Orton	Saint Mary's University
Sierra	Osborne	Whale and Dolphin Conservation
Maggie	O'Shea	Marine Geospatial Ecology Lab/Duke Univ
Ann	Pabst	UNC Wilmington
Richard	Pace	Grizzlywhaler Enterprises
Bruno	Padovese	MERIDIAN, Dalhousie University
Danielle	Palmer	GARFO
Fern	Paltrow	College of the Atlantic
Shannie	Parent	Ministère Pêches et Océans Canada
Eric	Patterson	NMFS OPR
Genevieve	Peck	Fisheries and Marine Institute - MUN
Suzanne	Pelisson	Woods Hole Oceanographic Institution
Mathieu	Pellerin	Ministère Pêches et Océans
Dan	Pendleton	Anderson Cabot Center for Ocean Life at the New England Aquarium
Alicia	Pensarosa	Ocean Alliance
Monica	Pepe	Whale and Dolphin Conservation
Heather	Pettis	Anderson Cabot Center for Ocean Life at the New England Aquarium
Catherine	Pigeon-Dubeau	Marine Stewardship Council
Tom	Pitchford	Florida Fish & Wildlife (FWC)
Kelsey	Potlock	NMFS OPR
Suparnamaaya	Prasad	MIT
Jessica	Provenzano	Florida Institute of Technology
Alexis	Rabon	Rudee Tours
Sonya	Radvan	Saint Mary's University
Aicha	Rakhdoune	Offspring Films Ltd
Hope	Rankin	College of the Atlantic
Stephanie	Ratelle	DFO
Jessica	Redfern	Anderson Cabot Center for Ocean Life at the New England Aquarium
Desray	Reeb	BOEM
Molly	Reeve	JASCO Applied Sciences
Craig	Reiser	Smultea Sciences
Sarah	Reiter	Anderson Cabot Center for Ocean Life at the New England Aquarium
Jake	Rice	N/A
Meghan	Rickard	NY Natural Heritage Program/NYSDEC

First Name	Last Name	Affiliation
Jason	Roberts	Duke Univ. Marine Geospatial Ecology Lab
Marie-France	Robichaud	DFO
Paul	Robichaud	FRAPP
Bob	Rocha	New Bedford Whaling Museum
Emily	Rochon	Vineyard Offshore
Rosalind	Rolland	New England Aquarium
Tracy	Romano	Mystic Aquarium
Kathryn	Rose	IFAW
Howard	Rosenbaum	Wildlife Conservation Society
Camille	Ross	Bigelow Laboratory for Ocean Sciences
William	Rossiter	NY4WHALES
Teri	Rowles	NOAA OPR
Audrey	Salinger	Saint Mary's University
Helen	Sampson	Offspring Films Ltd
Phillip	Sanchez	Sustainable Fisheries Partnership
Doug	Sandilands	Center for Coastal Studies
Caroline	Sauvé	Fisheries and Oceans Canada (DFO)
Rob	Schick	Duke University
Ryan	Schosberg	Center for Coastal Studies
Alicia	Schuler	NOAA Fisheries
Dianna	Schulte	Blue Ocean Society for Marine Cons.
Sarah	Seaberg	IFAW
Amadi Afua	Sefah-Twerefour	University of South Carolina
Burton	Shank	NOAA / NEFSC
Brian	Sharp	IFAW
Rhod	Sharp	BBC
Sarah	Sharp	IFAW
Russell	Shomberg	Marine Acoustics Inc.
Liese	Siemann	Coonamessett Farm Foundation
Kirsten	Silva	University of Maryland CBL
Julia	Singer	Oceana
Nick	Sisson	NOAA Fisheries/GARFO
Sahra	Skripsky	Canadian Wildlife Federation
Amy	Sloan	NMFS OPR
Ainsley	Smith	NOAA Fisheries
Dan	Smith	WHOI/NOAA
Pam	Snyder	New England Aquarium
Steven	Solari	NOAA OMAO
Laura	Solinger	NOAA NEFSC
Brenna	Sowder	MCNARW
Andrea	Spence	IFAW
Trevor	Spradlin	NMFS OPR
Kevin	Staples	Maine Department of Marine Resources
Dave	Steckler	Mysticetus LLC

First Name	Last Name	Affiliation
Julia	Stepanuk	Biodiversity Research Institute
Robert	Stern	Save Long Beach Island, Inc.
Ashley	Stokes	Seacoast Science Center
Megan	Stolen	Blue World Research Institute
Taylor	Stoni	MA Division of Marine Fisheries
Emily Rose	Stringer	College of the Atlantic
Allyn	Sullivan	Attentive Energy / TotalEnergies
Erin	Summers	Maine Department of Marine Resources
Willow	Surran	College of the Atlantic
Parks	Susan	Biology Department, Syracuse University
Wendy	Szaniszlo	Canadian Wildlife Federation
Jenn	Tackaberry	Center for Coastal Studies
Jessica	Taylor	NMFS/OPR
Sara	Tennant	Northeast Fisheries Science Center
Jamie	Testa	Chesapeake Biological Laboratory
Isabelle	Theriault	Fisheries and Oceans Canada
Elizabeth	Thompson	DFO
Kim	Tilas	MET
Sean	Todd	Allied Whale, College of the Atlantic
Kathryn	Townsend	Maritime Aboriginal Peoples Council
Marisa	Trego	NOAA Fisheries
Max	Tritt	GARFO
Molly	Tucker	Allied Whale/ BHWW
Ebru	Unal	Mystic Aquarium
Krystyna	Urbancic	Canadian Wildlife Federation
Alexis	Van Bemmel	Fisheries and Oceans Canada
Shelby	Vance	Anderson Cabot Center for Ocean Life at the New England Aquarium
Angelia	Vanderlaaan	Fisheries and Oceans Canada
Hanna	Vatcher	Canadian Wildlife Federation
Kaitlyn	Veenstra	Canadian Wildlife Federation
Elizabeth	Vézina	Canadian Wildlife Federation
Connie	Vincent	Fisheries and Oceans Canada
Kristy	Volker	IFAW
Lou	Volpe	College of the Atlantic
Robyn	Walker	Fisheries and Oceans Canada
Leslie	Ward	FWC
Amy	Warren	Anderson Cabot Center for Ocean Life at the New England Aquarium
Corey	Webster	DEPARTMENT OF FISHERIES AND OCEANS
Amy	Weeks-Dunham	College of the Atlantic
Mason	Weinrich	CCS
Hannah	Wellman	Marine Mammal Commission
Maximilian	Werner	Rhode Island School of Design (RISD)
Julianne	Wilder	NOAA / WHOI
Sam	Wilding	Monterey Bay Aquarium

First Name	Last Name	Affiliation
Alyssa	Wile	IFAW
Sarah	Wilkin	NMFS OPR
Jamie	Williams	College of the Atlantic
Todd	Williams	Fisheries and Oceans Canada
Tonya	Wimmer	Marine Animal Response Society
Andrew	Wright	DFO
Debbie	Wright	Volusia County, Environmental Management
Tina	Yack	Duke University
Monica	Zani	Anderson Cabot Center for Ocean Life at the New England Aquarium
Chao	Zou	NMFS/GARFO