OCS Study
BOEM 2022-001

Improving Monitoring, Data Consistency, Archiving, and Access for Improved Regional Integration of Renewable Energy Science

Workshop Summary on Satellite and GPS Tracking of Avian Species June 29-30, 2021

December 2021

U.S. Department of the Interior
Bureau of Ocean Energy Management
Office of Renewable Energy Programs
Sterling, VA

BOEM
Bureau of Ocean Energy Management

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Workshop Facilitator:

Patrick Field, Consensus Building Institute

Workshop Conveners:

Kyle Baker, David Bigger, and Mary Cody, Bureau of Ocean Energy Management, Office of Renewable Energy Programs

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DISCLAIMER

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REPORT AVAILABILITY

To download a PDF file of this report, go to the U.S. Department of the Interior, Bureau of Ocean Energy Management webpage (https://www.boem.gov/renewable-energy-research-completed-studies). The report is also available at the National Technical Reports Library at https://ntrl.ntis.gov/NTRL/.

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ABOUT THE COVER

The cover shows an endangered rufa red knot (*Calidris canutus rufa*) with a satellite tag attached. The photograph was taken by Larry Niles, Wildlife Restoration Partnerships

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WORKSHOP IN BRIEF

On June 29 and 30, 2021, the Bureau of Ocean Energy Management (BOEM) convened a workshop titled *Improving Monitoring, Data Consistency, Archiving, and Access for Better Regional Understanding across Projects: Satellite and GPS Tracking of Avian Species*. Building on a previous BOEM workshop that focused on tracking and monitoring marine mammals, this workshop focused on improving monitoring, data consistency, archiving, and access for better regional understanding across projects specifically related to tracking avian species off the Atlantic Coast of the United States.

The objectives of the workshop were to:

- Ensure consistency and compatibility of data sets across the various lease and non-lease areas
- Provide for storage in a more centralized location accessible to federal agencies and others

Additional information on the workshop topics and objectives can be found in the Workshop Agenda in Appendix A.

Over 65 practitioners and subject matter experts from federal and state agencies, non-profit organizations, private industry, and research institutes participated in the workshop. At the beginning of the workshop, participants were asked to respond to several demographic questions to see who was "in the room":

- 27 of the 44 poll respondents reported that they represented federal agencies. Other attendees represented state, non-profit, academic, and business sectors.
- Over half of the attendees who responded to the demographic poll reported they were based in the Mid-Atlantic region or in New England. Other attendees were based in Alaska, the Southeast, West Coast, and Midwest of the United States as well as Canada and Europe.
- The areas of expertise most represented among attendees included biology, animal behavior, methods and tools, ecology, avian species regulation, and study design and statistics.

A list of workshop participants can be found in the Attendee List in Appendix B. The 2-day workshop included several presentations by staff representing federal agencies including the BOEM, U.S. Fish and Wildlife Service (USFWS), United States Geological Survey (USGS) and the National Oceanic and Atmospheric Administration (NOAA). The workshop included Mentimeter Polls (Appendix C) of the stakeholder groups in attendance. Workshop Presentations were also given by subject matter experts representing various federal and state agencies, non-profit organizations, and research institutes (Appendix D).

The workshop also featured several breakout and discussion sessions that allowed participants to ask questions, engage in dialogue, share best practices, and brainstorm solutions and next steps. There was general consensus among workshop participants that the need for improved coordination is urgent and should be addressed as soon as possible. While the discussion uncovered the need for new tools and systems, most participants advocated for the use of existing tools and systems to expedite the use of standardized workflows.

The workshop was facilitated by Patrick Field, Senior Mediator at the Consensus Building Institute (CBI), supported by Emily Shumchenia of the Regional Wildlife Science Entity (RWSE).

WORKSHOP PRESENTATIONS

WHY WE ARE HERE

David Bigger, Ph.D., BOEM, Office of Renewable Energy Programs, Environmental Protection Specialist, began the presentations with an overview of the purpose and objectives of the workshop (Appendix D). He highlighted the need for better data consistency and coordination related to tracking avian species along the Atlantic Outer Continental Shelf (OCS) from the Carolinas to Gulf of Maine. He provided an overview of the renewable energy process from leasing to turbine installation, an overview of current and upcoming offshore wind projects off the Atlantic Coast and discussed how Office of Renewable Energy Programs and the Environmental Studies Program have been working together to inform the leasing and permitting decisions for those projects as follows:

- Identifying avian species populations that may be vulnerable to offshore wind development in the Atlantic.
- Understanding where avian species are and where they are not to avoid conflicts.
- Knowing how and under what conditions avian species move through the OCS.
- Understanding how these species will respond during and post-construction and operations of offshore wind turbines.

David shared that BOEM sees an opportunity to use GPS and satellite data to better inform regional analyses and impact assessments of offshore wind infrastructure on the Atlantic and asked workshop participants to consider and share ideas related to:

- Increasing the capacity of using the tracking data to better describe bird use in the region;
- Improving accessibility to the data;
- Standardizing these data for future analyses;
- Leveraging existing tools and resources; and,
- Building partnerships to improve communication and coordination.

GPS AND TELEMETRY TRACKING FOR AVIAN SPECIES

Pam Loring, USFWS, Division of Migratory Birds, Biologist, delivered a presentation that focused on how GPS and telemetry tracking is being deployed on the Atlantic Coast to collect data on the movement of avian species (Appendix D). She discussed how data used in offshore assessments and shared two examples of telemetry projects to explain the key differences between satellite telemetry and radio telemetry. She ended her presentation by highlighting some of the key challenges and information gaps related to tracking birds, especially for small-bodied species tracking where technologies are currently limited.

SECTOR REFLECTIONS

After the first two presentations, representatives from the states, developers, academics, and NGOs were each given an opportunity to discuss opportunities for a more regional approach on data and the challenges and barriers to collaborating at a more regional scale. Representatives included the following individuals.

- Andrew Gill, Ph.D., Centre for Environment, Fisheries and Aquaculture Science
- Matt Robinson, Vineyard Wind
- Don Lyons, Ph.D., National Audubon Society, Seabird Institute
- Peter Paton, Ph.D., University of Rhode Island, Department of Natural Resources Science
- Amanda Dey, Ph.D., New Jersey Fish and Wildlife
- Paul Phifer, Ph.D. Atlantic Shores Offshore Wind LLC

While each sector representative provided unique perspectives, several common themes emerged from their remarks.

- Studies should be coordinated regionally so that highest interest species and populations are identified, sampling and study design is optimized for statistical rigor, and data can address regional needs while also meeting the needs of specific projects.
- There are a lot of data sitting on computers and bookshelves. We need to find it, standardize it, process it, and make it accessible.
- Standardized protocols/best practices, QA/QC, and data protections are needed to make sure that everyone is collecting and using accurate data.
- There should be some standardization and coordination of the types of tracking technologies used, tag programming and options (e.g., duty cycle, additional sensors, calibration), data workflow and management. This could also help streamline the permitting process for tagging efforts.

- Offshore wind development is rapidly expanding, and we need to select a central repository very soon.

DATA MANAGEMENT PROJECT EXAMPLES

After the sector representatives shared their reflections, three projects were presented that showcased different organizations and agencies that have created data repositories and are working to improve how data is gathered, managed, used, and shared.

David Douglas, USGS Alaska Science Center gave a short presentation about the origins and organization of the USGS Alaska Science Center Wildlife Tracking Data Collection (Appendix D). To ensure that future biologists could easily access and use the center's data, the data collection stores data sets in the ASCII format that act as building blocks and will allow for future unified variable naming conventions. David noted that due to government data and security requirements, USGS felt it necessary to create this database under the federal aegis. Key features of the data collection include:

- Metadata
- Data packages with raw Argos data and packaged data
- Suggested citations
- Versioning if data is appended or new data is added
- 'Read Me' files that provide an overview of what each data set is
- Supplementary materials and processed data files
- Data visualizations that pool data and show each bird separately
- Landing pages that look the same for all species
- Tracking maps available for use by the public, teachers, and journalists
- Publicly available datasets after they are published

Sarah Davidson, Movebank, discussed an overview of the Movebank website (https://www.movebank.org/cms/movebank-main), a global database for animal tracking and animal-borne sensor data, hosted by the German Max Planck Institute of Animal Behavior. Movebank is a global project with no user fees and allows different projects to use Movebank at different points in the data life cycle regardless of project or funding source. Sarah also shared information about Movebank's tools and services for working with data throughout its life cycle. Key features of Movebank include the following.

- Users own their data and retain ownership and access when they use Movebank
- Users can set different access levels for managers, collaborators, and the public ranging from a summary of the data to full download capabilities

- Data are harmonized to a shared model and vocabulary during input
- Users can stream their data feeds/real time data directly to Movebank in a way that is standardized and upload files like Argos DIAG and .csv and import tables.
- Movebank has tools to identify and flag outliers in datasets
- Users can download data in a number for formats for analysis
- Movebank has created animal tracking apps for mobile phones
- A new tool called Moveapp is being beta tested and helps users build repeatable workflows out of user-contributed data to help movement ecologists publish data

Arliss Winship, CSS, Inc. under contract to NOAA, discussed the Northwest Atlantic Seabird Catalog NWASC database which was created to provide access to published studies and designed as a repository for survey information. The relational database includes survey and tracking data from a wide variety of data sources with different data points including photos, videos, and aerial- and boat-based data from at-sea surveys and sightings of marine birds. There is no public access point for the database, but NOAA shares it with anyone upon request. Many of the data contributors are also users, such as government agencies, consultants, non-profits, and academics.

EXPLORING THE IDEA IN DEPTH

On the Day 2 of the workshop, Pam Loring, USFWS, Division of Migratory Birds Biologist, synthesized some of the key themes of the workshop and shared some thoughts and ideas to address near- and long-term data needs. She noted that as technology is changing, like the availability of smaller tags, there is an increased interest and an immediate need to coordinate tagging studies for ESA-listed species. She also discussed the longer-term need for a repository to safeguard data into the future and combine data from multiple studies. Her presentation ended with an emphasis on the numerous benefits of collaboration for anyone working in specifies management and scientific research.

KEY DISCUSSION THEMES

During the workshop, key themes emerged related to different types of data needs, current challenges and barriers to data management and collaboration, and the benefits of improving consistency, archiving, and access related to avian species tracking data.

TYPES OF DATA NEEDS

Participants identified and discussed two main types of data needs in the context of tracking avian species.

- Finding, standardizing, and processing existing data and making it accessible
- Creating standard workflows and processes for collecting, storing, and sharing new data

On Day 2 of the workshop, David Douglas created and shared the image below with attendees, noting the relationship between data sources and data repositories and highlighting the need for a common archive or tool that collects and/or hosts data from multiple repositories.

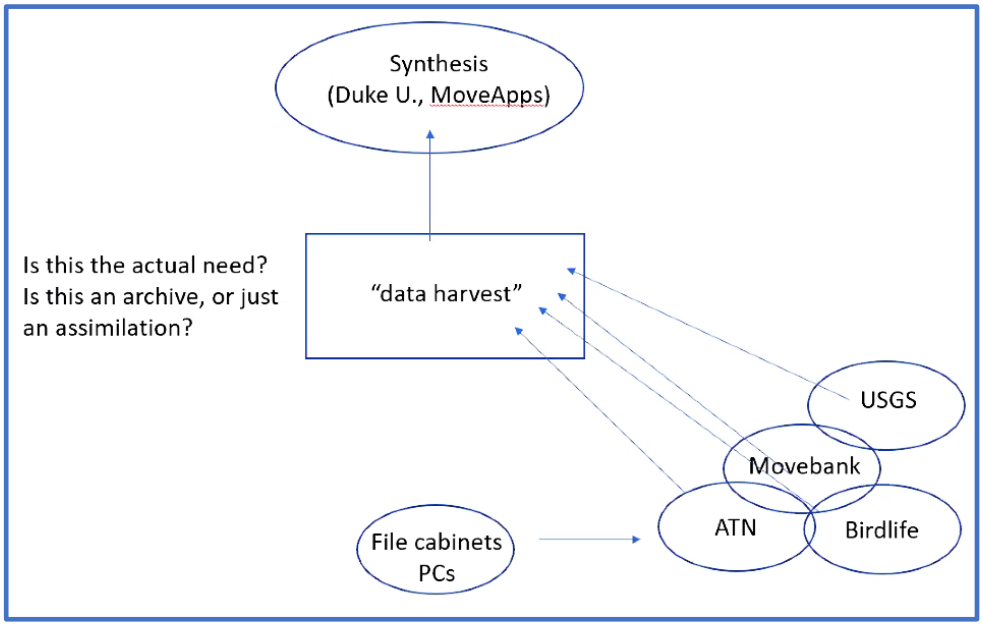

Figure 1. The relationship between data sources and data repositories

Pam Loring shared that improved data coordination is needed in both the short- and long-term.

- Short-term coordination to provide agencies with timely access to information for more informed decision-making. These needs could be met with the following sample workflow:
    - Projects register tags in Movebank with standardized metadata (e.g., species, band #, attachment type, start date & location)
    - Tags set to "live feed"
    - Agency contact on account as collaborator
    - Data can be set to different levels of access depending on the user (i.e., does not have to be public)
    - Use of data in site specific and regional offshore wind assessments

- Long-term coordination to standardize processes and create a widely used repository to archive and safeguard data for the long-term. These needs could be met with a repository like that used by USGS Science Center:
    - Intuitive interface
    - Solid data architecture
    - Includes metadata protocols (e.g., dead/shed)
    - Transportable to other databases
    - Works with various tag types
    - Government-controlled so not subject to various funding and administrative vagaries over time.

VALUE AND BENEFITS OF IMPROVING MONITORING, DATA CONSISTENCY, ARCHIVING, AND ACCESS

Throughout the workshop, panelists and attendees discussed the value of improving monitoring, data consistency, archiving, and access related to satellite and GPS tracking of avian species. The following are some of the key benefits of a collaborative and standardize data tracking approach that were identified:

- There are many potential uses of studies beyond their original purpose.
- Information value is maximized when data are used collectively.
- Gaps in existing data would be easier to identify.
- It would ensure that data is up to date so that the best available science could be used for assessments in the immediate future and over the long term.
- It would save time and money for researchers, industry, agencies, and other stakeholders
- A long-term repository would safeguard data.
- It would provide a standardized, transparent, consistent, and automated workflow.
- It would identify data gaps and facilitate coordination of studies at a regional level which is needed to address migratory species and species who use larger scale habitats for various behaviors and needs.
- It would provide more opportunities for collaboration and complimentary uses of data (species management, scientific papers).

During the workshop, participants were asked to share their perspectives and priorities via an online polling tool called Mentimeter. Among participants who responded to the poll, the greatest value of a more centralized, shared approach to their organizations were:

- Consistency
- Accessibility
- Efficiency
- Transparency

Participants were asked "*What kinds of hypotheses or questions could a data base with GPS and telemetry help answer regionally?*" Participants submitted responses and were invited to upvote responses from other attendees. The following responses received the most support:

- Migratory movements, timing, and weather of shorebirds in Atlantic OCS region.
- What are cumulative impacts of many individual projects across Atlantic Coast?
- What areas or movement paths are used consistently but perhaps not for long periods of time?
- How do migratory movements change with construction of multiple offshore wind developments?
- Does the current distribution of MOTUS stations (largely to the land-based side of the areas we are most interested in) bias the inferences from movement models?
- What level of variation in habitat use occurs regionally over time?
- Examining trade-offs in space use as a function of food availability, development, and other abiotic conditions.
- Where do seabirds exhibit site fidelity, particularly for foraging behaviors?

DATA PRODUCTION AND STORAGE

Key Barriers and Challenges:

- Data exists in many places (including file cabinets).
- Data exists in in many different formats and in many different databases.
- Managing data is time intensive. Taking existing, cleaning it, storing it, providing access to it, and analyzing it takes a lot of time.
- Managing data is also expensive. It is hard to know how much funding is needed to track down existing data and compile it or develop a new system for storage.
- Upgraded technology gives different kinds of data with columns flipped or small tweaks (e.g., different transmitters give different types of data depending on the manufacture).
- Workflows are not standardized.
- Many federal agencies have strict data storage requirements.

Key Considerations and Areas for Further Exploration:

- Standardize workflows.
- QA/QC rules need to be developed and implemented before data is shared to ensure data is accurate and consistent.
- Long-term storage of raw data is needed and more useful data available across tools to meet people's needs.
- Provide funding to move data from "file cabinets" and into repositories.

DATA COLLATING AND ARCHIVING

Key Barriers and Challenges:

- Metadata standards and maintenance are different across the different tag types.
- There are no standards for how the data is processed.
- Data redundancy is likely when multiple users are using the same or similar data sets.
- Study results may change if data published too early.
- Studies that are supported by graduate students often wait to be published until they have graduated.
- Everyone is at different stages of publishing and willingness to share data. Everyone is working at different time scales.
- Concerns that if data on hunted and endangered species, especially for waterfowl and ducks, is published immediately, the data would be used for hunting and other unintended purposes.
- Some federal agencies require that data be publicly available.

Key Considerations and Areas for Further Exploration:

- Develop consistent workflows and standards for collating and archiving historic, new, and real time data so that they can be usable and accessible when moved from providers to a repository.
- Develop QA/QC rules before data is shared.
- When studies are privately funded, create agreements that no data can be classified, and the data will be made available and accessible to BOEM and other federal agencies and researchers in a reasonable and named timeframe.
- Require manuscripts be included with datasets to make sure people understand the data.
- Expedite and streamline internal review processes that often delay data releases and publishing.
- Provide support and incentives to motivate data providers to share their data such as:
    - Offering co-authorship on manuscripts and reports to the data providers.
    - Appropriate sharing controls and notification of use.
    - Provide analytical tools.

DATA HARVESTING

Key Barriers and Challenges:

- Data owners want to be able to track where their data is going and how it is used.
- If private entities are collecting or funding data, they may be very reluctant to share any kinds of data and proprietary information is very important.

- Raw data can easily be misinterpreted or misconstrued. It is hard to have confidence that data will be used appropriately if it is widely available and accessible.
- Variable speeds of data access across projects.
- Some data is public and other data is protected and needs to be requested from the data owners.

Key Considerations and Areas for Further Exploration:

- Many of the issues and challenges seem to be political and privacy-related rather than technical.
- Data privacy is extremely important. There needs to be data sharing agreements, discussions about permissions, and qualifications of how the data can be used and shared, especially if it is publicly and/or instantly available.
- When data is requested from owners, there is always a well-defined request for what they need and why. BOEM should clearly define their specific need so that data owners understand where their data is going and that this is not just a data grab by big government.
- Incentivize data owners to allow their data to be accessed by telling them that the data will be helping the U.S. government.
- We need well defined, priority questions and hypothesis that can drive data harvesting efforts to specific ends.
- How can we ensure the continuity of a central repository? Movebank standardizes data and helps make it accessible but how can we be assured it will be around for the foreseeable future?

DATA SYNTHESIS

Barriers and Challenges

- We cannot see all the data in one place, so it is hard to know what the data gaps are.
- We do not know if there are new studies that need to be coordinated at a regional level because there is no repository to identify gaps in polygons and geographic areas.
- Different tools vary in usability, longevity, accuracy, and accessibility.
- Movebank has been the go-to for North America avian tracking data for many but not everyone uses it.
- Metadata in Movebank may not be present, updated, and/or accurate.

Considerations and Areas for Further Exploration

- A central place where we can search projects by geography and across databases would be extremely useful.

- Decisionmakers should use the best of what exists vs. developing new systems and prioritize systems as needed.
- Identify which visual and analytical tools are most useful and develop those.
- Provide funding and incentives to create data products that are compatible with user tools.
- Tools for synthesis should make it easy for data owners to transfer data from repositories to analytics.
- Work with Movebank to develop and refine apps, workflows, and data standards.
- Create an OCS-specific synthesis of survey and movement data.

MANAGEMENT DECISIONS

Barriers and Challenges

- There is a cost to analyze data in a timely way to use for offshore wind purposes.
- Several agencies, entities, and groups are having similar conversations and it is hard to make sure everyone is on the same page.

Considerations and Areas for Further Exploration

- Think about what data decisions are needed for planning, siting, mitigation, permitting, and other activities.
- Identify data sharing agreements.
- Develop standards for metadata and QA/QC
- Think about long term study needs, plan for the future, and ensure longevity.
- Convene and coordinate conversations with other experts to make sure everyone is on the same page.
- Explore opportunities to collaborate with and partner with other stakeholder groups and data platforms such as:
    - NYSERDA working groups
    - Regional Wildlife Science Entity
    - National Science Foundation's Office of Advanced Cyberinfrastructure
    - Sciencebase
    - North American Bat Monitoring Program's (NABat) data sharing network
    - Smithsonian Atlas of Migratory Connectivity
    - BirdLife Database – international database for seabirds

CLOSING REMARKS AND NEXT STEPS

At the end of the workshop, participants were asked to indicate their level of interest and anticipate effort in supporting a more centralized approach to data sharing. Overwhelmingly, participants indicated their support and willingness to support a centralized approach to data sharing indicating the value of a collaborative approach was widely understood among participants. Table showing the average responses and distribution of Mentimeter poll responses can be found in Appendix C.

To close the workshop, David Bigger and Pam Loring thanked attendees for their engagement and contributions to the two-day workshop and identified the following next steps for the agency:

- Define BOEM's data needs in writing.
- Develop a framework that would map out a standardized workflow.
- Identify where we could provide incentives and reduce barriers to encourage people to follow standardized workflows.
- Partner with the Regional Wildlife Science Entity to collaborate on defining and prioritizing regional studies, as well as to develop a framework that is coordinated and not ad-hoc.
- Brainstorm with Movebank to demo Moveapp and new tools.

APPENDIX A WORKSHOP AGENDA

Improving Monitoring, Data Consistency, Archiving, and Access for Better Regional Understanding across Projects
Satellite and GPS Tracking of Avian Species

Bureau of Ocean Energy Management (BOEM)
June 29 and 30, 2021

Register in advance for this meeting:
https://cbuilding.zoom.us/meeting/register/tJYrde-hrzkqHtQ-t_WFU2rDiskV7XOBQ4gq
After registering, you will receive a confirmation email containing information about joining the meeting.

Objectives for Workshops:

- Ensure consistency and compatibility of data sets across the various lease and non-lease areas;
- Provide for storage in a more centralized location accessible to federal agencies and others.

Optional Pre-Reads:

- NYSERDA/BRI Bird and Bat Research Meeting Summary (https://a6481a0e-2fbd-460f-b1df-f8ca1504074a.filesusr.com/ugd/78f0c4_201120060f394e9f967cfab207fb1d59.pdf)

Day 1: Agenda

TIME (ET)	PURPOSE	ITEM	PRESENTER
12:45	Tech Check	**Opening of Platform** • Participants may sign-on 5 minutes ahead of the start of the conversation to get adjusted to the web-based technology, sound and video check	CBI
1:00	Introduce	**Welcome** • Welcome, agenda, rules of the road	CBI
1:10	Level Set	**Why We Are Here** • Why BOEM decided to host these workshops • What we are covering and not covering in this workshop (regional from Carolinas to GOM, telemetry and GPS tracking of avian species (not MOTUS), not mitigation • What we'll produce as a product • Overview of OSW specific efforts by multiple actors over the last 10 or so years – geographic focus, intent, sponsor, scale, data produced • Brief overview on methods and emerging technologies, analyses, data, storage, and archiving • Q&A	David Bigger, BOEM

TIME (ET)	PURPOSE	ITEM	PRESENTER
1:40	Learning	**What are GPS and Telemetry tracking, Where and Why it is being deployed on the Atlantic Coast for Avian Species** • Brief description of MOTUS and NYSERDA funded project • Brief intro to satellite/GPS technology • What kind of questions can these tools help answer? • Questions and Answers	Pam Loring, USFWS
2:10	Break	**Break**	
2:20	Sharing	**Sector Reflections** • A representative from sectors given 5 minutes each to discuss: 1) opportunities for a more regional approach on data; 2) challenges and barriers to collaborating at a more regional scale • General Discussion	Panel
2:40	Learning	**Current Management of these and Other Data** • USGS Alaska Science Center Wildlife Tracking (15 minutes, 5 min Q&A) • MoveBank and Max Plank Institute (15 minutes, 5 min Q&A) • Northwest Atlantic Seabird Catalogue (15 minutes, 5 min Q&A) • General Q&A	David Douglas, US Geologic Survey Sarah Davidson, Max Planck Institute Arliss Winship, NOAA (David)
3:40	Closing	**Preview of Day 2** • High level summary of Day 1 • Plan for Day 2	CBI
3:45	Adjourn		

Day 2: Agenda

TIME (ET)	PURPOSE	ITEM	PRESENTER
12:55	Tech Check	**Opening of Platform** • Participants may sign-on 5 minutes ahead of the start of the conversation to get adjusted to the web-based technology, sound and video check	CBI
1:00	Welcome Back	**Welcome** • Welcome, agenda, rules of the road • Summary of Day 1 and key issues raised	CBI
1:15	Discussion	**What is the shared value of a more centralized, shared approach** • Share results for first day Mentimeter response	CBI

TIME (ET)	PURPOSE	ITEM	PRESENTER
		• Discussion	
1:30	Small Group Discussion	**Exploring the Idea in Depth** • A sample approach as food for thought (10 minutes) • Go to breakout groups, mixed groups across sectors • What are the challenges or barriers to have a shared approach to data collection and sharing (i.e. data format and consistency, cost of data management, permitting or regulatory barriers or opportunities, confidentiality and data sharing, etc.)? • What might be the means or method for doing so? • What is needed shorter and longer term?	Pam Loring, USFWS SMEs and Facilitators
2:20	Report Back	**Report Outs** • Each break out group reports ideas and brief questions and discussion on each • Discussion • Facilitator summarizes findings	All
2:45	Break	• During break develop polling on key ideas from each group	CBI + Organizers
3:00	Prioritizing	**Polling and Discussion** • *Group is polled on key ideas and options* • Group discusses polling results and implications	CBI
3:30	Next Steps	**Final Group Comments** • Next steps for BOEM, FWS and the RWSE	Mary Cody and David Bigger, BOEM Pam Loring, USFWS, Emily Shumchenia, RWSE
3:45	Adjourn	**Adjourn**	

APPENDIX B ATTENDEE LIST

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Nate Lash	CBI	nlash@cbi.org
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Nick Napoli	Northeast Regional Ocean Council	nicknapoli01@gmail.com
Pam Loring	USFWS	pamela_loring@fws.gov
Patrick Field	CBI	pfield@cbi.org
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Peter Paton	The University of Rhode Island	ppaton@uri.edu
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Scott Lawton	Dominion Energy	scott.lawton@dominionenergy.com
Shilo Felton	National Audubon Society	shilo.felton@audubon.org
Susanna von Oettingen	USFWS	susi_vonoettingen@fws.gov

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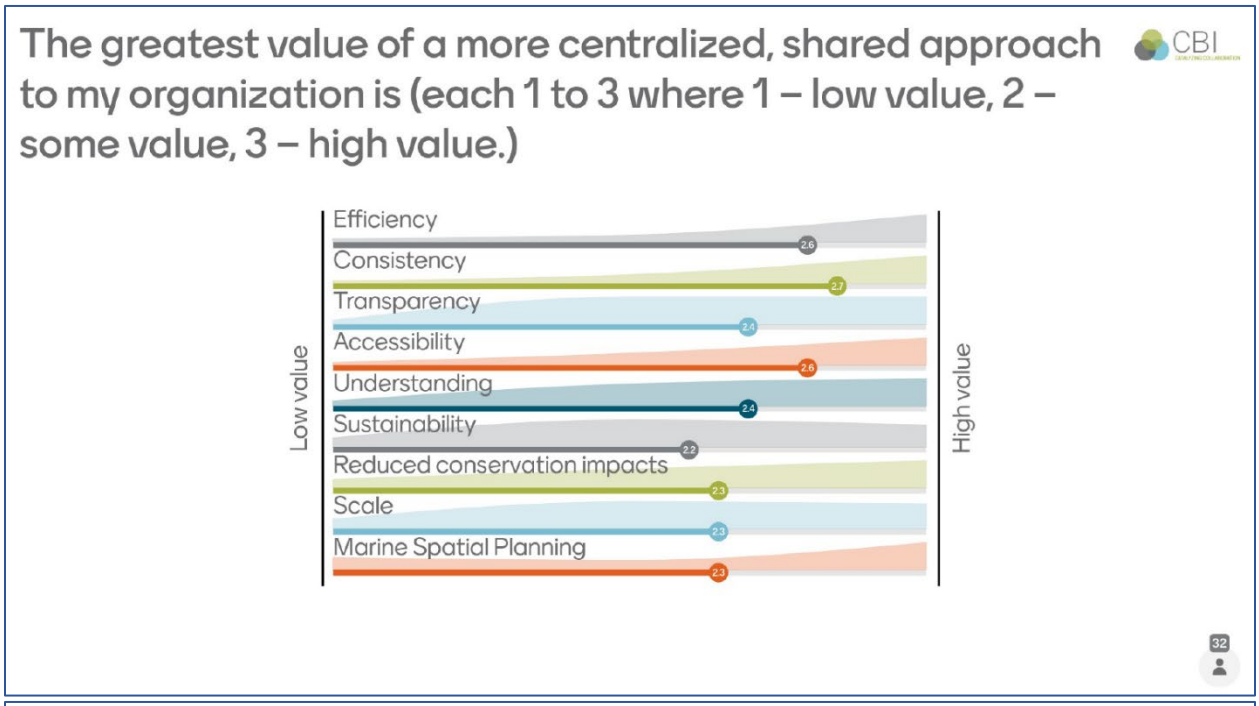
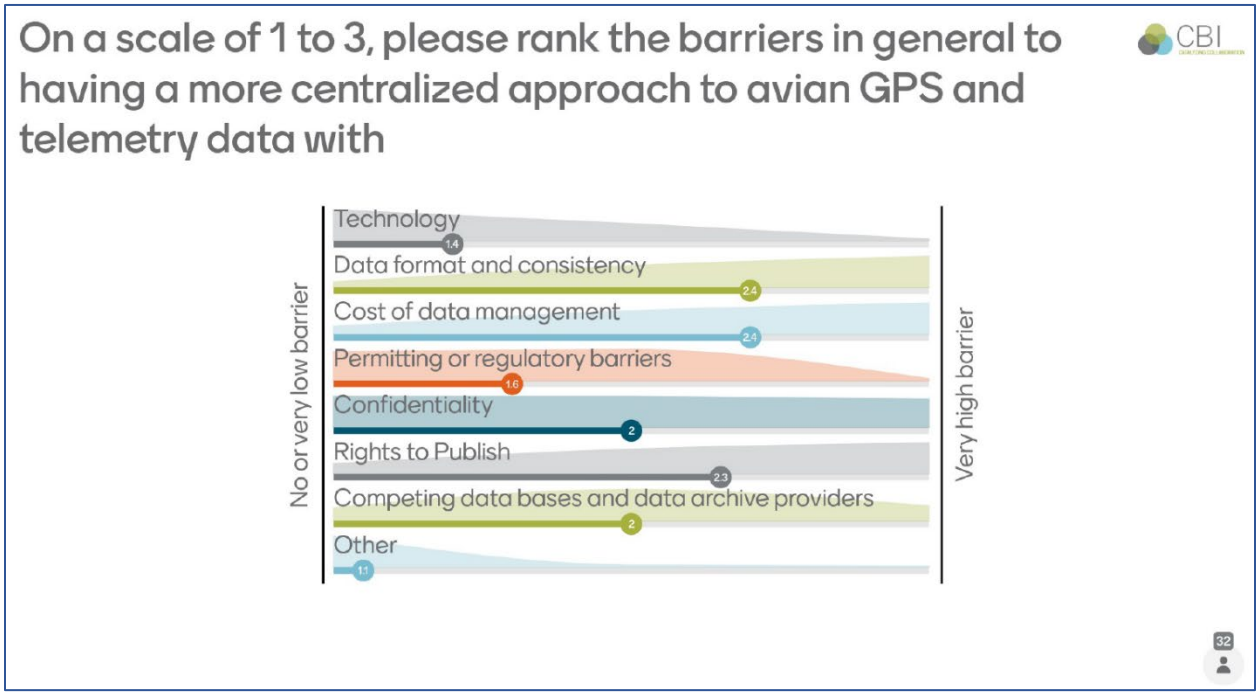
Todd Callaghan	Massachusetts Office of Coastal Zone Management	todd.callaghan@mass.gov
Tori Mezebish	The University of Rhode Island	tmezebish@uri.edu
Véronique Drolet-Gratton	Environment and Climate Change Canada	veronique.drolet-gratton2@canada.ca

APPENDIX C MENTIMETER RESULTS

During the workshop, participants were asked to share their perspectives and priorities via an online polling tool called Mentimeter. The questions and results of those polls are below.

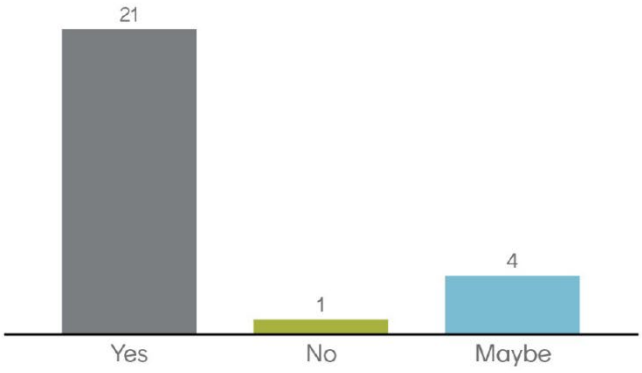




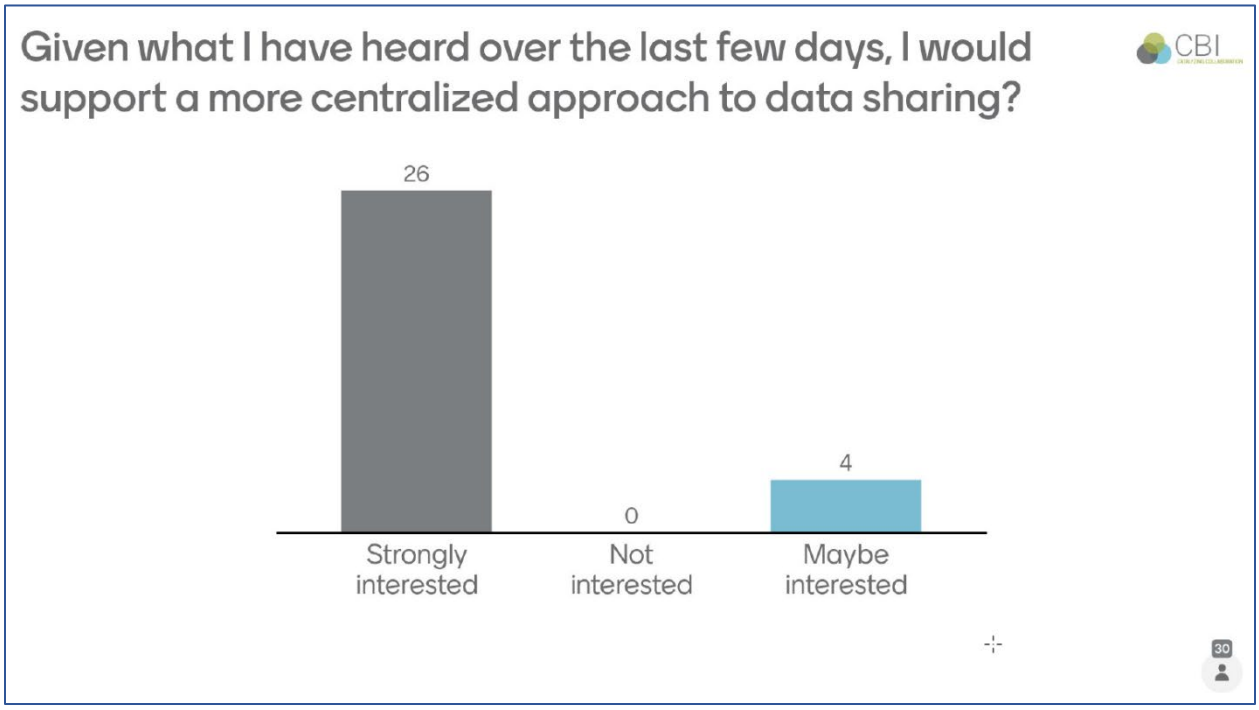
On a scale of 1 to 3, please rank the incentives for data providers to provide data to a centralized repository or archive with

29

Given what I have heard over the last few days, I would actively collaborate with others to advance a more centralized approach to data sharing?



26


Given what I have heard over the last few days, I would support a more centralized approach to data sharing?
CBI
26
0
4
Strongly interested
Not interested
Maybe interested

APPENDIX D WORKSHOP PRESENTATIONS

Avian Tracking Data for Offshore Wind Assessments in US Atlantic

Pam Loring
U.S. Fish and Wildlife Service
Division of Migratory Birds, North-Atlantic Appalachian Region

Main Types of Data Used in Offshore Assessments

Survey data

- Site-specific distribution and abundance
- Data bounded in space and time (snapshot)

Tracking data

- Individual flight paths and altitude
- Data collected across space & time (within limits of technology)

Main Types of Tracking Data

Satellite Telemetry

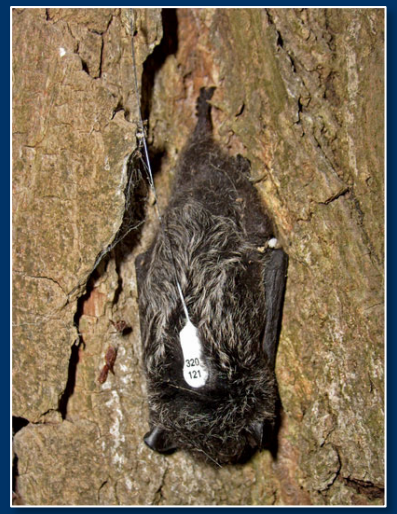
- Transmitters communicate with satellites
- Satellites estimate locations
- Tracking coverage is global

Radio Telemetry

- Transmitters emit radio signals
- Signals received by antennas
- Tracking coverage is limited to locations and range of antennas

Motus: Collaborative Automated Radio Telemetry

- Small radio tags: 0.25 – 2 g
- High temporal resolution (~5-10 s)
- Tracked by receiving stations (antenna towers, range <20 km)
- Data coordination via Motus Network



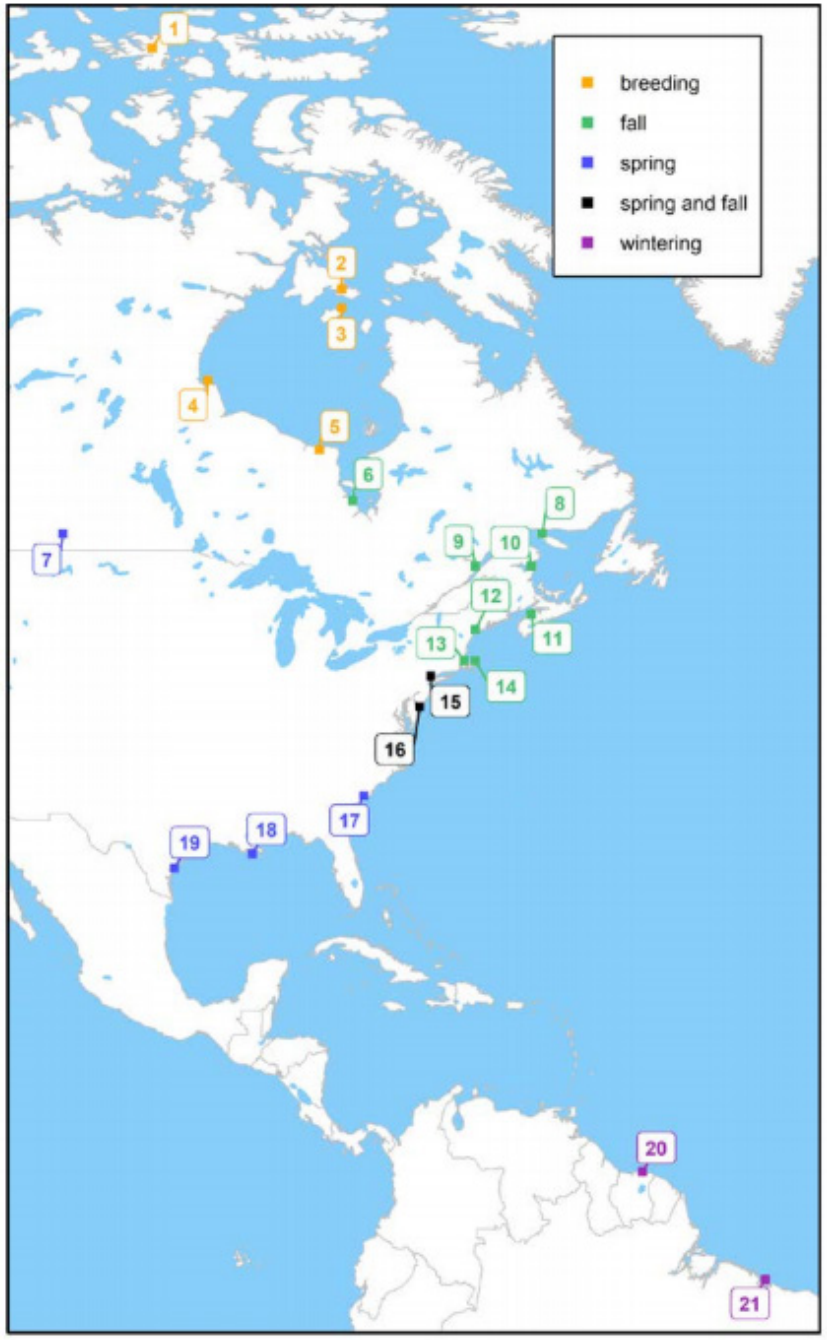
Tracking Movements of Migratory Shorebirds in the U.S. Atlantic Outer Continental Shelf Region

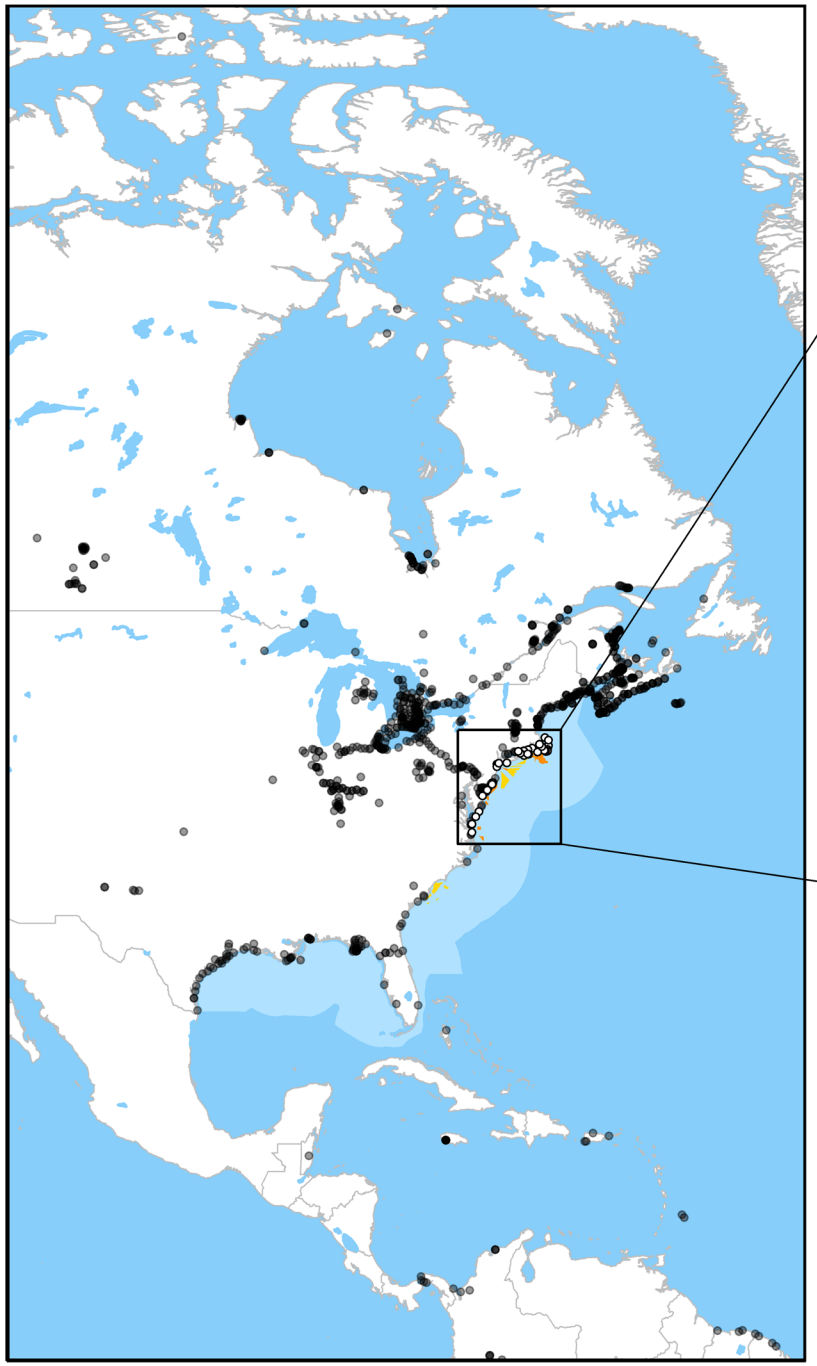
- Collaborative shorebird study – data from Arctic Canada to South America
- Included 12 species of shorebirds (n=1,363) tagged across 21 sites
- Regional movements & flight altitudes within US Atlantic study area (MA to VA)
- Timing & weather of offshore flights

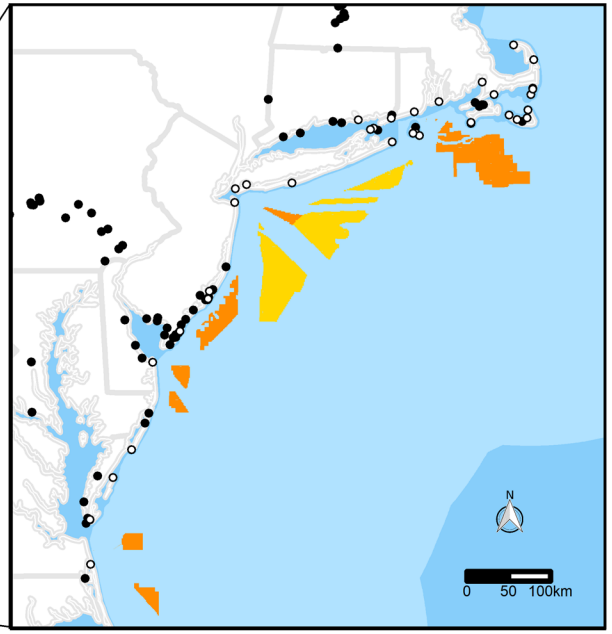
BOEM
Bureau of Ocean Energy Management

U.S. Fish & Wildlife Service
Department of the Interior

Environment and Climate Change Canada
Environnement et Changement climatique Canada

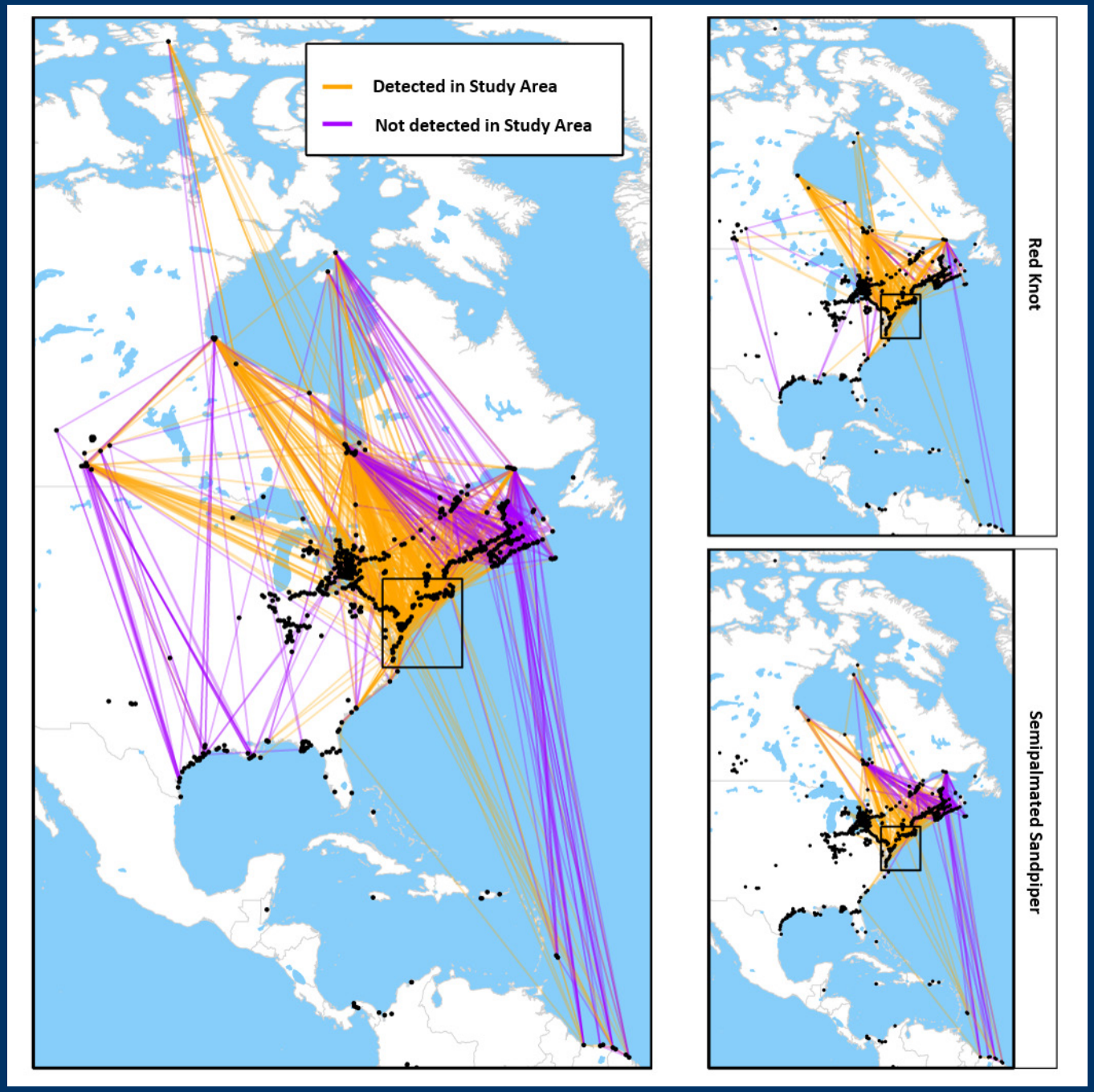






- Motus Network partner station
- BOEM station
- Federal Waters
- Lease Areas
- Planning Areas

- 65% of tagged birds detected within Study Area (n=594)
- Spring offshore flights from mid May to early June, when winds blowing to the north-northeast
- Fall offshore flights from July (peak) to Nov when winds blowing to the south-southeast
- Offshore data limited by range of land-based Motus stations (<20 km) and coarse interpolations
- Offshore stations would improve coverage and resolution



Developing a Framework for Offshore Automated Radio Telemetry (Motus)

- Funding: New York State Energy Research and Development Authority (NYSERDA)
- Co-leads: USFWS Migratory Birds, Biodiversity Research Institute, University of Rhode Island, Birds Canada
- Timeframe: 2020-2022

NEW YORK STATE OF OPPORTUNITY. NYSERDA

U.S. FISH & WILDLIFE SERVICE DEPARTMENT OF THE INTERIOR

bri BIODIVERSITY RESEARCH INSTITUTE innovative wildlife science

UNIVERSITY OF RHODE ISLAND HOPE 1892

Motus Wildlife Tracking System

Objectives of Offshore Motus Network

- Motus stations on buoys and offshore wind turbines
- Online study design tool
- Framework for coordinating tagging studies
- Offshore Motus Data Portal
- Stakeholder advisory group and workshops

Piloting Offshore Tracking Stations on Wind Turbine and Buoys

Ørsted

US Wind
Fueling our future, naturally.

equinor

Information Gaps – Avian Movements & Offshore Wind

- Movements throughout entire Atlantic region (Motus data limited to detection range of stations, <20 km)
- High accuracy estimates of flight paths and altitudes
- Altitude variation with winds aloft, weather conditions
- Multi-scale avoidance rates (e.g. wind farm, individual turbines)
- Variation in avoidance rates with weather conditions

Satellite Telemetry Technologies

- Location estimation: Argos (doppler shift), GPS
- Spatial resolution:
  - Argos (2-D): 250 to >1,500 m
  - GPS (3-D): ± 10 m (lat/lon), ± 20 m (altitude)
- Temporal resolution (varies):
  - Battery size/weight & type (e.g. solar)
  - Data transfer method (= power consumption)
- Data transfer: loggers (need recapture), base stations (need bird to fly in range), cellular/GSM, satellite uplink

Satellite Telemetry Pilot Study – Common Terns (2017)

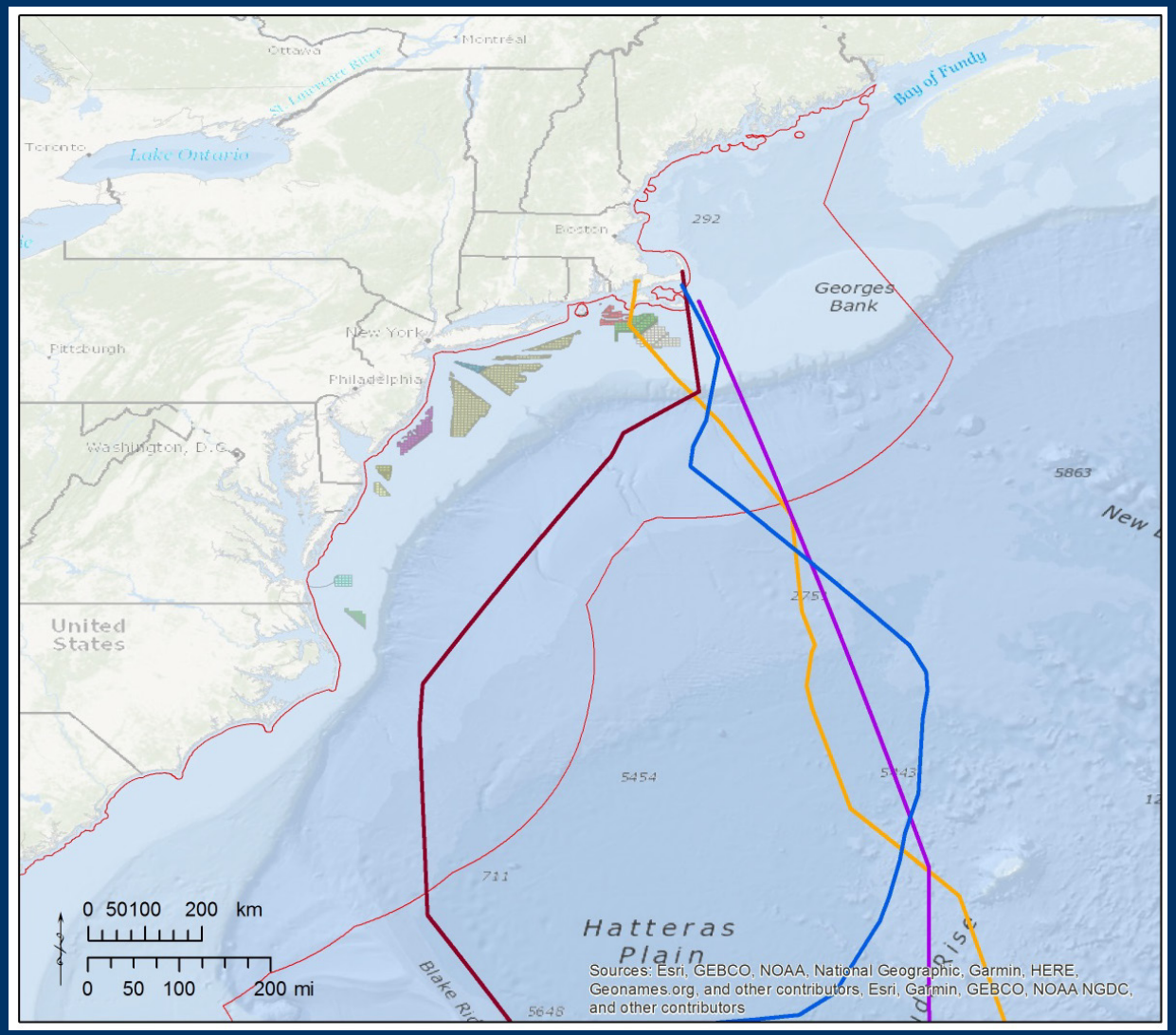
- 2-g solar PTTs (Argos)
- N = 5 Common Terns tagged on Petit Manan Island in Maine, USA during incubation
- Attached with backpack harness, no adverse effects to behavior or productivity observed
- Average 11 pts/day, tracked 102 – 652 days
- Spatial resolution: 250 – 1,500 m accuracy

Tracks of Common Terns (fall migration 2017)

- 169741 (m)
- 169743 (f)
- 169744 (f)
- 169745 (m)

Error polygon of locations over WEAs

- 169744 (mean 2,317 m)

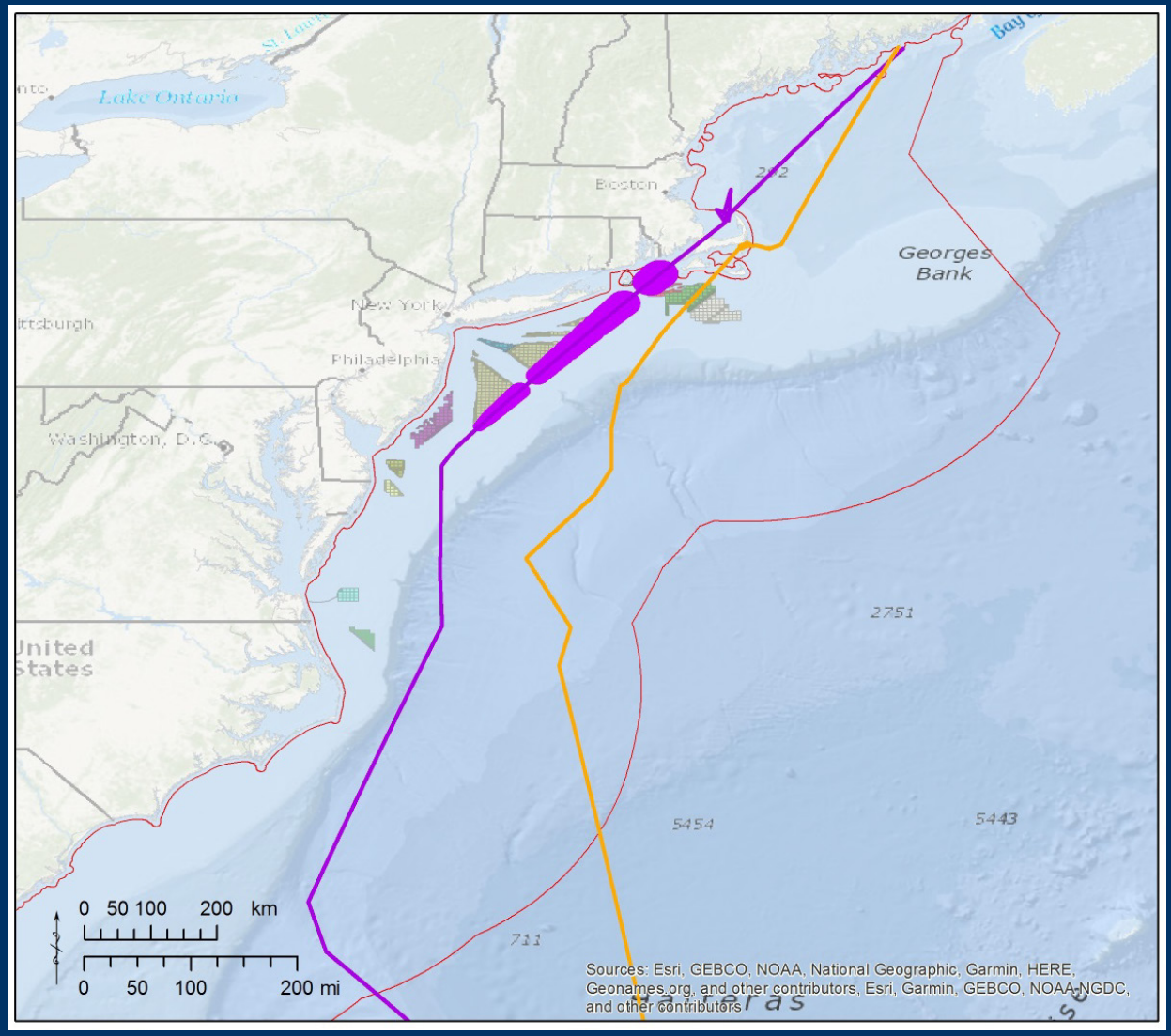


Tracks of Common Terns (spring migration 2018)

- 169743 (f)
- 169744 (f)

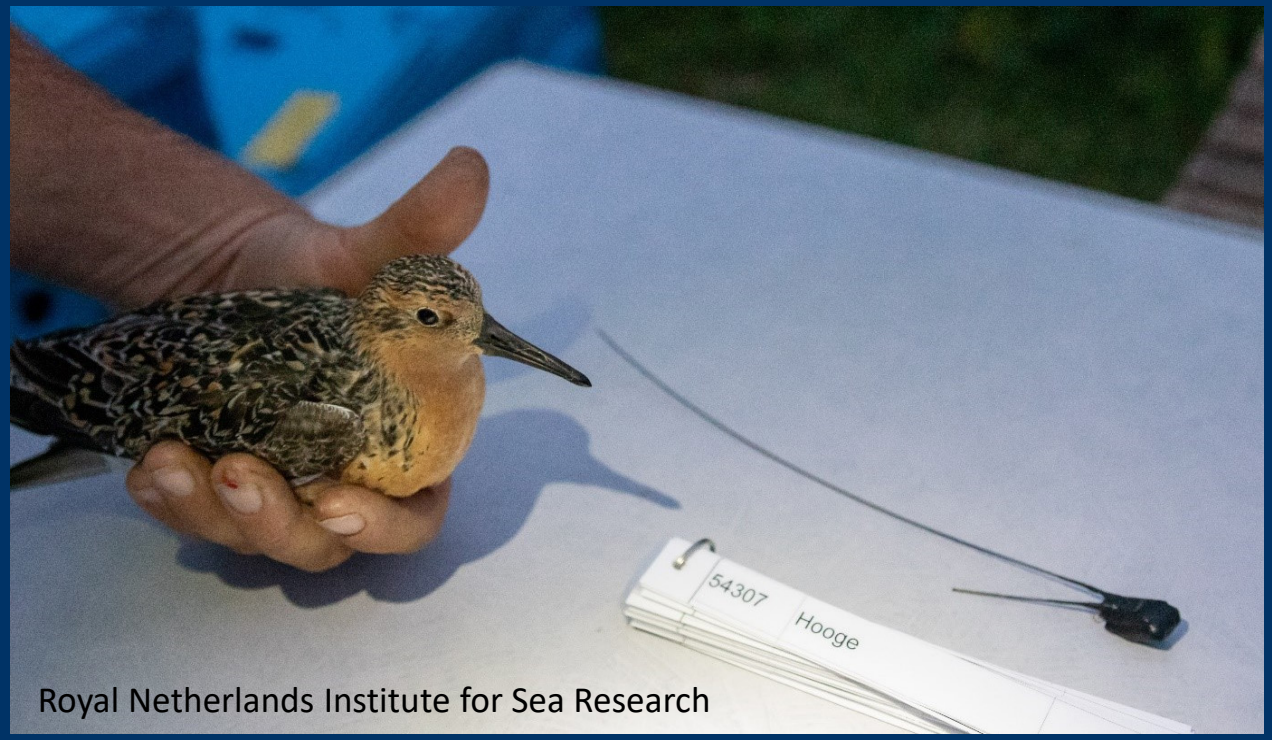
Error polygon of locations over WEAs

- 169743 (mean 14,552 m)
- 169744 (mean 1,636 m)



Piloting Lightweight GPS tags on Red Knots in Coastal NJ

- 2.6 g GPS-Argos tags
- 60 locations + altitude, relay to satellites
- Accuracy: ± 20 m
- Fall departure flights (NJ) and spring northbound routes (from Brazil)



Royal Netherlands Institute for Sea Research

ATLANTIC SHORES offshore wind

NEW JERSEY AUDUBON www.njaudubon.org

WILDLIFE RESTORATION PARTNERSHIPS WWW.WILDRESTORE.COM

U.S. FISH & WILDLIFE SERVICE DEPARTMENT OF THE INTERIOR

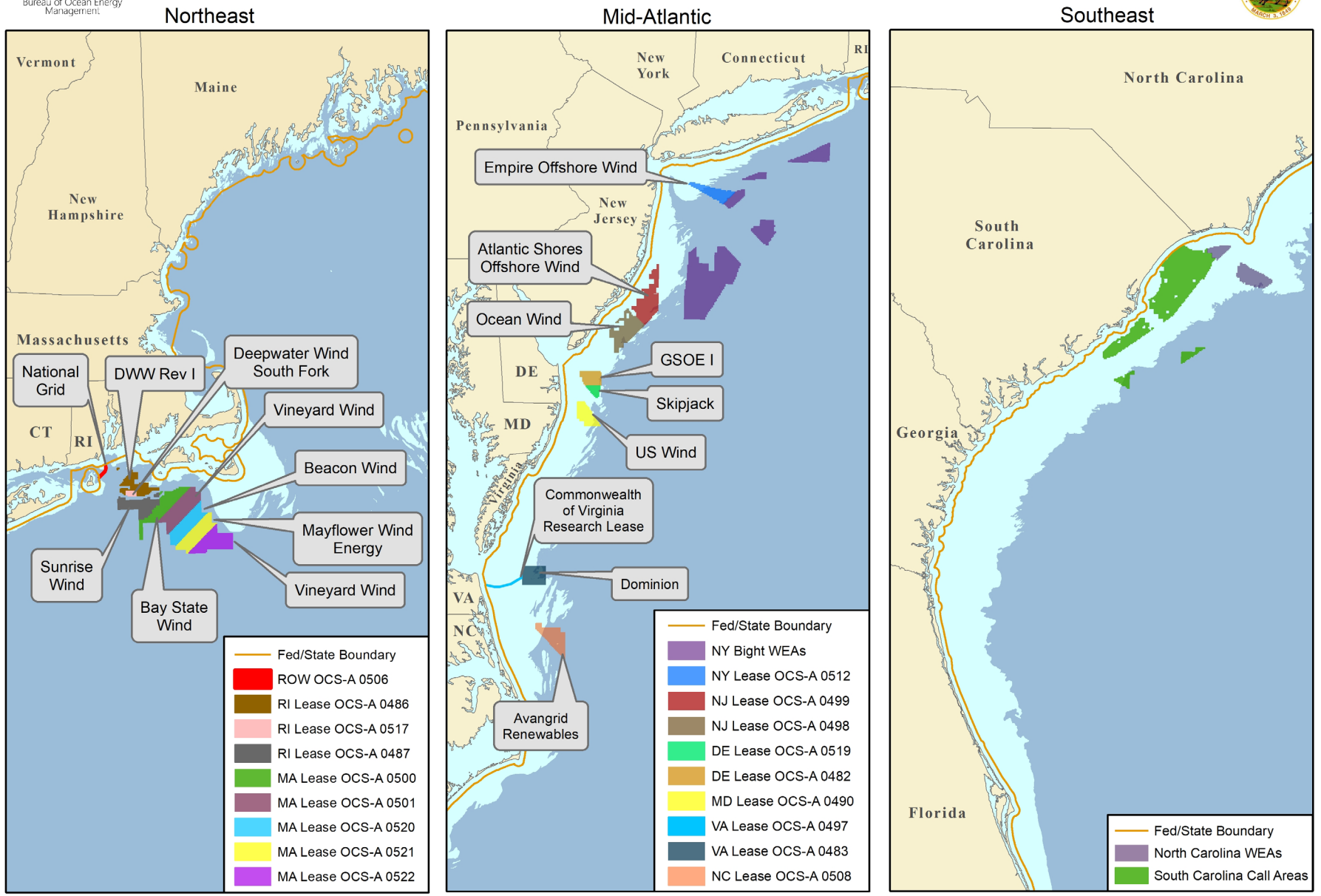
Technology Trade-offs

- Radio telemetry/Motus
  - Requires detection by stations
  - Resolution of data varies with station coverage
  - Collaborative Motus network maximizes sample size & information obtained

- Satellite:
  - Global tracking coverage
  - High resolution data including altitude
  - Small sample sizes – could be leveraged by more coordinated approach

Atlantic OCS Renewable Energy - Massachusetts to South Carolina

BOEM Bureau of Ocean Energy Management



Bathymetry

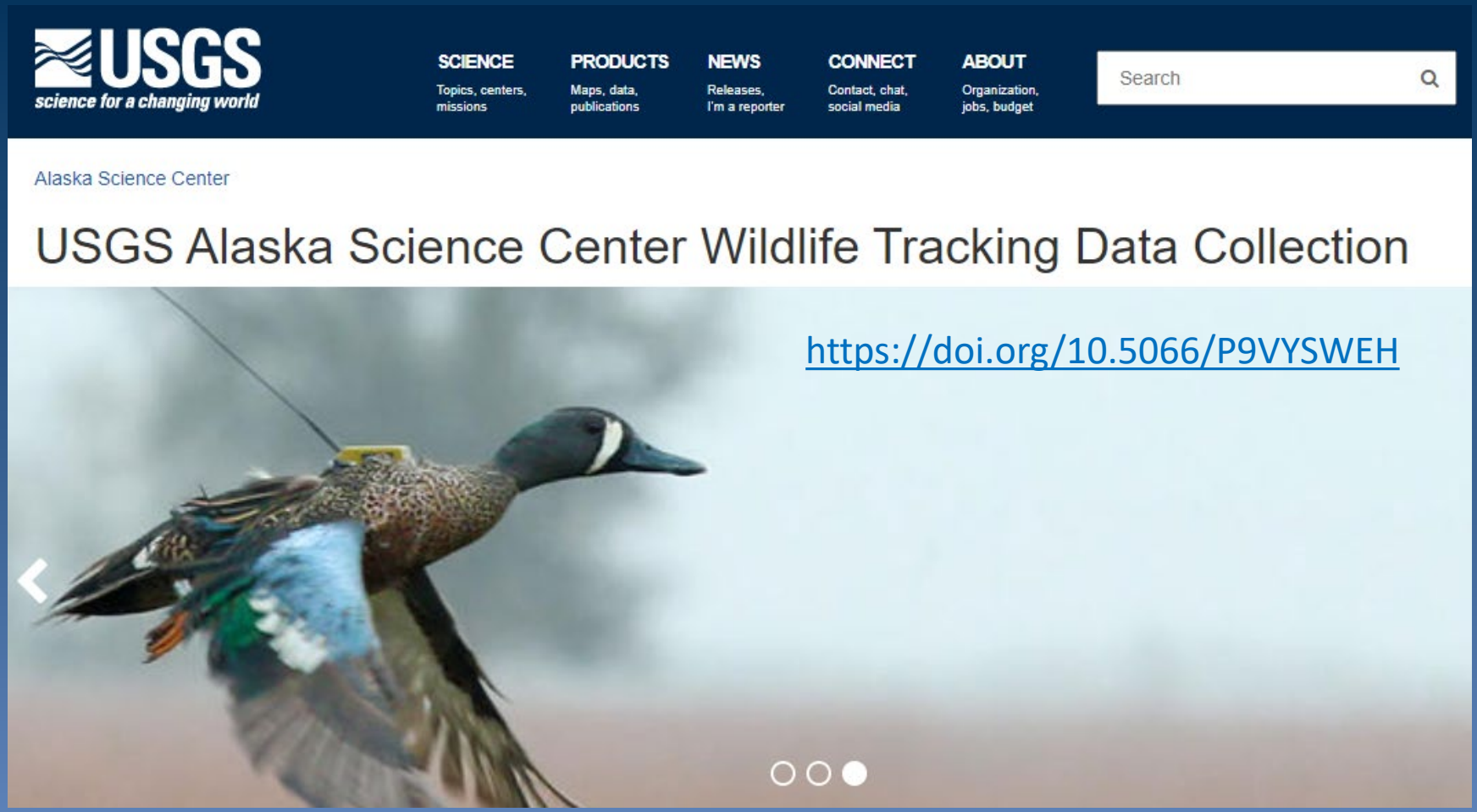
- Up to 30 meters
- More than 30 meters

0 50 100 150 200 250

Nautical Miles

Map Date: 3/29/2021

Map ID: ERB-2017-1004



David Douglas
U.S. Geological Survey
Alaska Science Center
ddouglas@usgs.gov

Use of trade names does not imply endorsement by the U.S. Government

What will biologists want 100+ years from now?

Development Team:
Lee Tibbitts, John Reed, John Pearce, Dennis Walworth, and David Douglas

Answer:

- Everything
- in ASCII format
- with metadata

Data releases are by species, each with a unique DOI

Species	
Emperor Goose (*Anser canagicus*)	Common Murre (*Uria aalge*)
Greater White-fronted Goose (*Anser albifrons*)	Thick-billed Murre (*Uria lomvia*)
Tundra Swan (*Cygnus columbianus*)	Kittlitz's Murrelet (*Brachyramphus brevirostris*)
Whooper Swan (*Cygnus cygnus*)	Tufted Puffin (*Fratercula cirrhata*)
Blue-winged Teal (*Anas discors*)	Gull Species and Hybrids (*Larus* spp.)
Northern Pintail (*Anas acuta*)	Red-throated Loon (*Gavia stellata*)
Spectacled Eider (*Somateria fischeri*)	Pacific Loon (*Gavia pacifica*)
Surf Scoter (*Melanitta perspicillata*)	Yellow-billed Loon (*Gavia adamsii*)
Black Scoter (*Melanitta americana*)	Northern Fulmar (*Fulmarus glacialis*)
Whimbrel (Numenius phaeopus)	Red-faced Cormorant (*Phalacrocorax urile*)
Marbled Godwit (*Limosa fedoa*)	Pelagic Cormorant (*Phalacrocorax pelagicus*)

For example, Tundra Swan

Data visualizations →

Data packages →

Raw & Processed data

Citation w/DOI and versioning →

Return to Ecosystems >> Wildlife Tracking Data Collection

USGS Alaska Science Center scientists collect data from wildlife tracking devices to: determine locations of animals throughout their annual cycles, understand patterns of habitat use, quantify time spent on various behaviors, and identify geographic areas repeatedly used by wildlife that may indicate sites of importance to species and populations. Tracking data from other wildlife species can be found at: https://doi.org/10.5066/P9VYSWEH

Tracking Maps

Tundra Swan Tracking Maps

These webpages contain four different types of browse maps and other visualizations of the tracking data.

- Maps (Animated, Static, Interactive, and Google Earth)
- Summary graphs of the data: where, when, duration
- **Note:** These maps serve only as a depiction of the geographic content of the specific data provided and may be inappropriate for inferences and interpretation outside the intent of the original study. For example, maps may portray only certain ages, sexes, limited numbers of animals or variable tracking duration and start times that may limit inference for other questions. Users are advised to read the publication(s) and data set metadata associated with these maps to understand appropriate use and data limitations.

Argos Wildlife Tracking of Tundra Swans.
(Credit: David Douglas, USGS. Public domain.)

Data Packages

Argos Satellite Telemetry Data

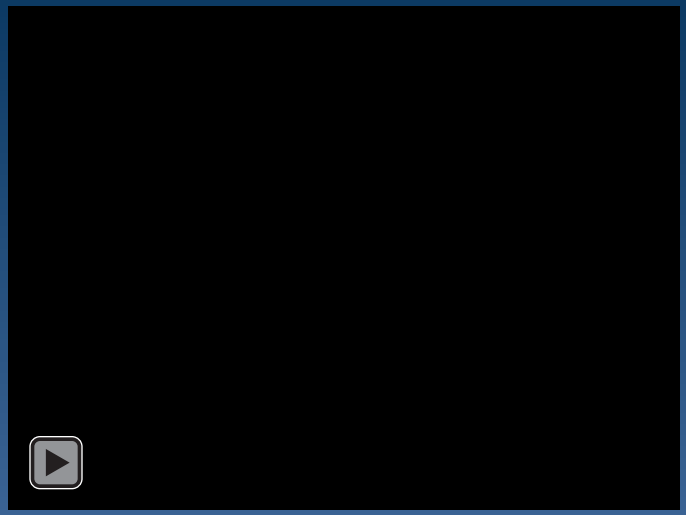
These data packages contain the data collected from satellite transmitters attached to free-ranging animals. The packages include both *raw* and *processed* location and sensor data. The *raw data* includes data as originally retrieved from the Argos System. The *processed data* have been filtered for location plausibility, and sensor data have been decoded into standard measurement units. For most users, the *processed data* will be preferred.

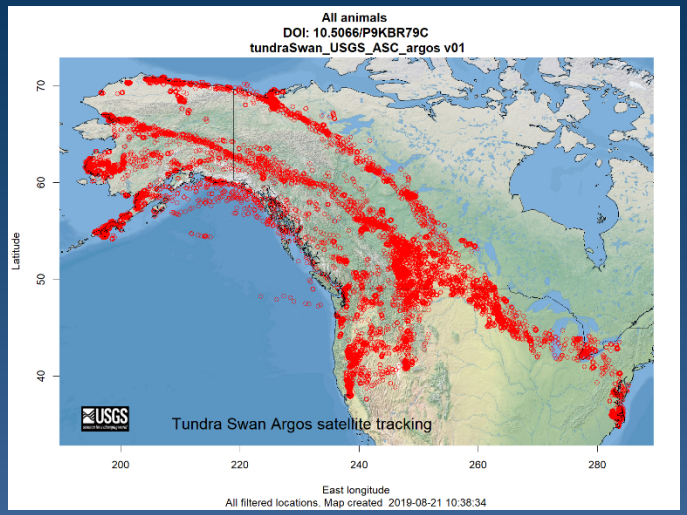
- Raw Data [Metadata] [Data Download]
- Processed Data [Metadata] [Data Download]
- Read Me [PDF]

Suggested Citation

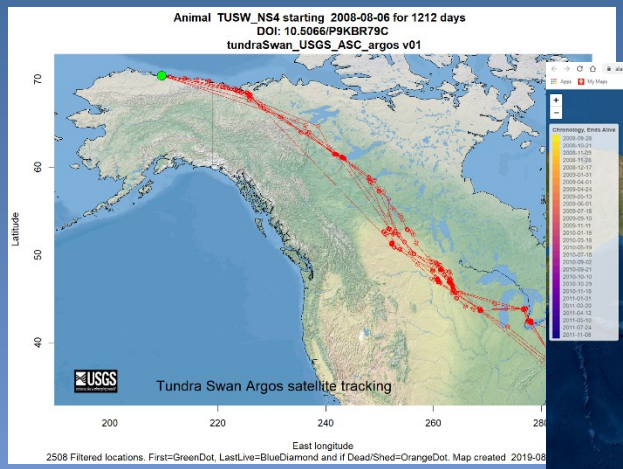
Ely, C.R., Terenzi, J., Tibbitts, T.L., Douglas, D.C., 2020, Tracking data for Tundra Swans (*Cygnus columbianus*) (ver 1.0, January 2020): U.S. Geological Survey data release, https://doi.org/10.5066/P9KBR79C

Data visualizations (pooled data)

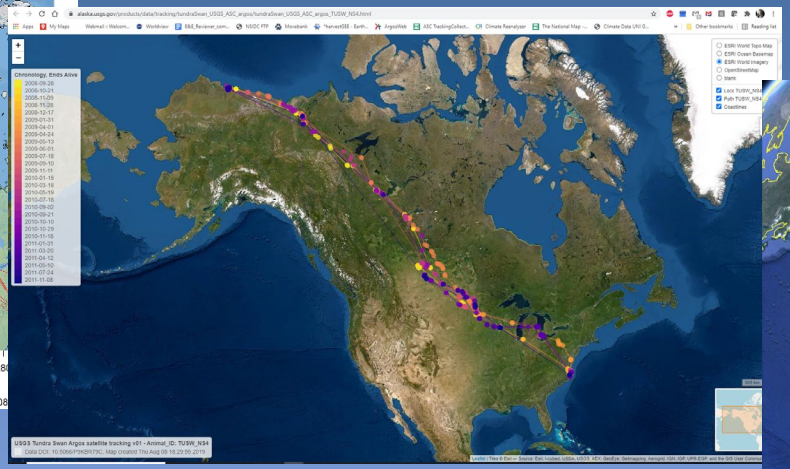




Data visualizations (each animal)



Static (jpg)



Interactive (Leaflet html)

Google Earth (kml)

Data packages – Raw data & Processed data

Data Packages

Argos Satellite Telemetry Data

These data packages contain the data collected from satellite transmitters attached to free-ranging animals. The packages include both *raw* and *processed* location and sensor data. The *raw data* includes data as originally retrieved from the Argos System. The *processed data* have been filtered for location plausibility, and sensor data have been decoded into standard measurement units. For most users, the *processed data* will be preferred.

- Raw Data [Metadata] [Data Download]
- Processed Data [Metadata] [Data Download]
- Read Me [PDF]

Raw data package: contains ASCII and PDF files only

Name	Date modified	Type	Size
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Name	Date modified	Type	Size
rawData	2020-01-22 10:44 AM	File folder	
supplementaryMaterial	2020-01-22 10:43 AM	File folder	
tundraSwan_USGS_ASC_argos_rawData_metadata.html	2020-01-22 10:07 AM	Microsoft Edge H...	210 KB
tundraSwan_USGS_ASC_argos_rawData_metadata.xml	2020-01-22 10:02 AM	XML Document	96 KB
tundraSwan_USGS_ASC_argos_README.pdf	2020-01-22 09:48 AM	Adobe Acrobat D...	347 KB
versionHistory.txt	2020-01-21 04:24 PM	TXT File	1 KB

Name	Date modified	Type	Size
Argos Users Manual 2008.pdf	2017-08-31 01:44 PM	Adobe Acrobat D...	1,476 KB
MTI Field Manual_PTT-100_Battery.pdf	2018-10-01 02:42 PM	Adobe Acrobat D...	2,609 KB

Name	Date modified	Type	Size
tundraSwan_USGS_ASC_argos_deploymentAttributes.csv	2019-12-03 01:01 PM	Microsoft Excel C...	17 KB
tundraSwan_USGS_ASC_argos_diagLegacy.txt	2019-08-08 04:43 PM	TXT File	57,906 KB
tundraSwan_USGS_ASC_argos_diagTabular.csv	2019-08-08 05:01 PM	Microsoft Excel C...	26,407 KB
tundraSwan_USGS_ASC_argos_dsLegacy.txt	2019-08-08 04:44 PM	TXT File	42,709 KB
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Processed data package: contains ASCII and PDF files only

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supplementaryMaterial	2020-01-22 10:46 AM	File folder	
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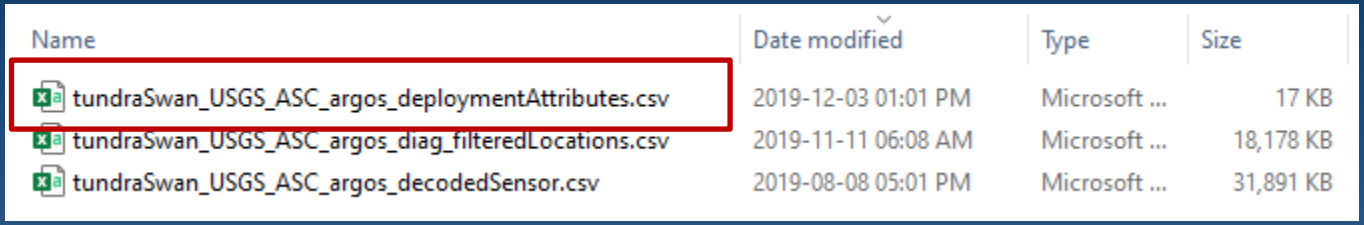
tundraSwan_USGS_ASC_argos_processedData_metadata.xml	2020-01-22 10:02 AM	XML Document	99 KB
tundraSwan_USGS_ASC_argos_README.pdf	2020-01-22 09:48 AM	Adobe Acrobat Document	347 KB
versionHistory.txt	2020-01-21 04:24 PM	TXT File	1 KB

Name	Date modified	Type	Size
Argos Users Manual 2008.pdf	2017-08-31 01:44 PM	Adobe Acrobat D...	1,476 KB
MTI Field Manual_PTT-100_Battery.pdf	2018-10-01 02:42 PM	Adobe Acrobat D...	2,609 KB

Name	Date modified	Type	Size
tundraSwan_USGS_ASC_argos_deploymentAttributes.csv	2019-12-03 01:01 PM	Microsoft ...	17 KB
tundraSwan_USGS_ASC_argos_diag_filteredLocations.csv	2019-11-11 06:08 AM	Microsoft ...	18,178 KB
tundraSwan_USGS_ASC_argos_decodedSensor.csv	2019-08-08 05:01 PM	Microsoft ...	31,891 KB

Processed data package: Deployment attributes file



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tundraSwan_USGS_ASC_argos_diag_filteredLocations.csv	2019-11-11 06:08 AM	Microsoft ...	18,178 KB
tundraSwan_USGS_ASC_argos_decodedSensor.csv	2019-08-08 05:01 PM	Microsoft ...	31,891 KB

Important

Data_Release_DOI
Data_Release_Version

Animal_ID
Animal_Species
PTT_ID

Deployment_Start_Timestamp_UTC
Deployment_End_Timestamp_UTC
Deployment_Fate
Deployment_End_Type

Deployment_Start_Latitude
Deployment_Start_Longitude
Deployment_Start_Locale

Animal_BandID
Animal_Sex
Animal_LifeStage
Animal_ReproCondition
Animal_Mass
Animal_MortalityType
PTT_Manufacturer
PTT_Model
PTT_Mass
PTT_Attachment
PTT_PowerOutput
PTT_PowerSource
PTT_RepetitionPeriod
PTT_DutyCycle
PTT_ReadoutMethod
PTT_LocationAlgorithm

Processed data package: Deployment fate

Attribute:Attribute_Label: **Deployment_Fate**

Attribute_Definition: Deduced final status of the animal and satellite transmitter (PTT) at the time tracking of the live free-ranging animal ended (i.e., animal died, transmitter failed/detached, or tracking of a live animal was otherwise terminated). Determined by assessment of sensor and movement data. For example, activity sensor values that remain constant, temperature sensor values that emulate ambient conditions, and/or lack of expected movement.

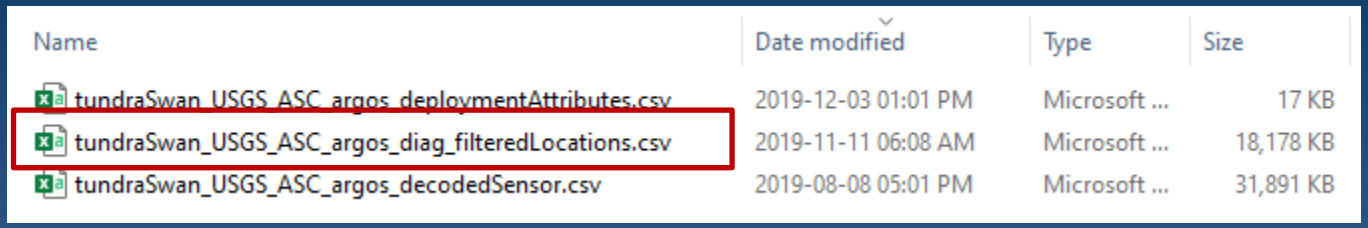
Enumerated_Domain_Value: **alive**
Coded if there was no evidence or knowledge that the animal died or the satellite transmitter was shed. The 'Deployment_End_Timestamp_UTC' was set to the date/time of the last obtained transmission from the PTT or shortly thereafter.

Enumerated_Domain_Value: **shed**
Enumerated_Domain_Value: **dead**
Enumerated_Domain_Value: **shed/dead**
Enumerated_Domain_Value: ~~undetermined~~

The 'Deployment_End_Timestamp_UTC' was set to the date/time of the most recently obtained transmitter data indicative of **attachment to the live free-ranging animal**.

(+6 months of shed/dead data collections are added to the data release)

Processed data package: Location data file



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tundraSwan_USGS_ASC_argos_diag_filteredLocations.csv	2019-11-11 06:08 AM	Microsoft ...	18,178 KB
tundraSwan_USGS_ASC_argos_decodedSensor.csv	2019-08-08 05:01 PM	Microsoft ...	31,891 KB

Added variables

Data_Release_DOI
Data_Release_Version

Animal_ID
Animal_Species

Latitude
Longitude

Binary flag → **Location_DAF_Filter**

Alive? → **Tracking_Status**

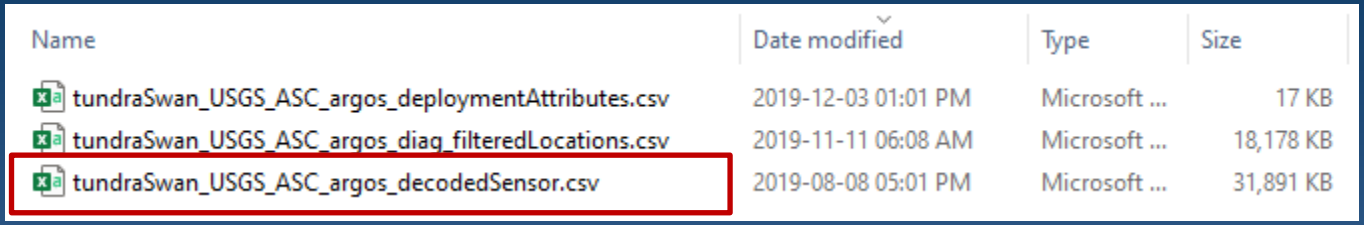
Lat_ShedDead
Lon_ShedDead

<---------- Raw data values ---------->

Location_Timestamp_UTC
Location_Class
Location_NOPC
Location_ErrorRadius
Location_ErrorSemimajor
Location_ErrorSemiminor
Location_ErrorOrientation
Location_ErrorGDOP
Location_IndexQuality
Location_LI_Index
Location_QQ_Index
Location_AssumedAltitude
Location_Lat_Solution_1
Location_Lon_Solution_1
Location_Lat_Solution_2
Location_Lon_Solution_2

PTT_ID
PTT_Program
Pass_Satellite_ID
Pass_Messages_N
Pass_Messages_gt120dB
Pass_Messages_BestLeveldB
Pass_Duration
Pass_EstimatedFrequency

Processed data package: Decoded sensor data file



Name	Date modified	Type	Size
tundraSwan_USGS_ASC_argos_deploymentAttributes.csv	2019-12-03 01:01 PM	Microsoft ...	17 KB
tundraSwan_USGS_ASC_argos_diag_filteredLocations.csv	2019-11-11 06:08 AM	Microsoft ...	18,178 KB
tundraSwan_USGS_ASC_argos_decodedSensor.csv	2019-08-08 05:01 PM	Microsoft ...	31,891 KB

Alive?

Data_Release_DOI
Data_Release_Version

Animal_ID
Animal_Species

Tracking_Status

PTT_ID
PTT_Program
Pass_Satellite_ID
Sensor_Timestamp_UTC

Sensor_Temperature_C
Sensor_Voltage
Sensor_Activity

All the data releases are available in Movebank

```
> searchMovebankStudies(x="USGS_ASC", login=Login)
 [1] "blackScoter_USGS_ASC_argos"
 [2] "blueWingedTeal_USGS_ASC_argos"
 [5] "commonMurre_USGS_ASC_argos"
 [6] "emperorGoose_USGS_ASC_argos"
 [7] "glaucousWingedGull_USGS_ASC_argos"
 [8] "gullSpecies_USGS_ASC_argosGPS"
 [9] "marbledGodwit_USGS_ASC_argos"
[10] "northernFulmar_USGS_ASC_argos"
[11] "northernPintail_USGS_ASC_argos"
[12] "pelagicCormorant_USGS_ASC_argos"
[13] "redFacedCormorant_USGS_ASC_argos"
[14] "redThroatedLoon_USGS_ASC_argos"
[15] "spectacledEider_USGS_ASC_argos"
[16] "surfScoter_USGS_ASC_argos"
[17] "thickBilledMurre_USGS_ASC_argos"
[18] "tuftedPuffin_USGS_ASC_argos"
[19] "tundraSwan_USGS_ASC_argos"
[20] "whimbrel_USGS_ASC_argos"
[21] "whooperSwan_USGS_ASC_argos"
[22] "yellowBilledLoon_USGS_ASC_argos"
>
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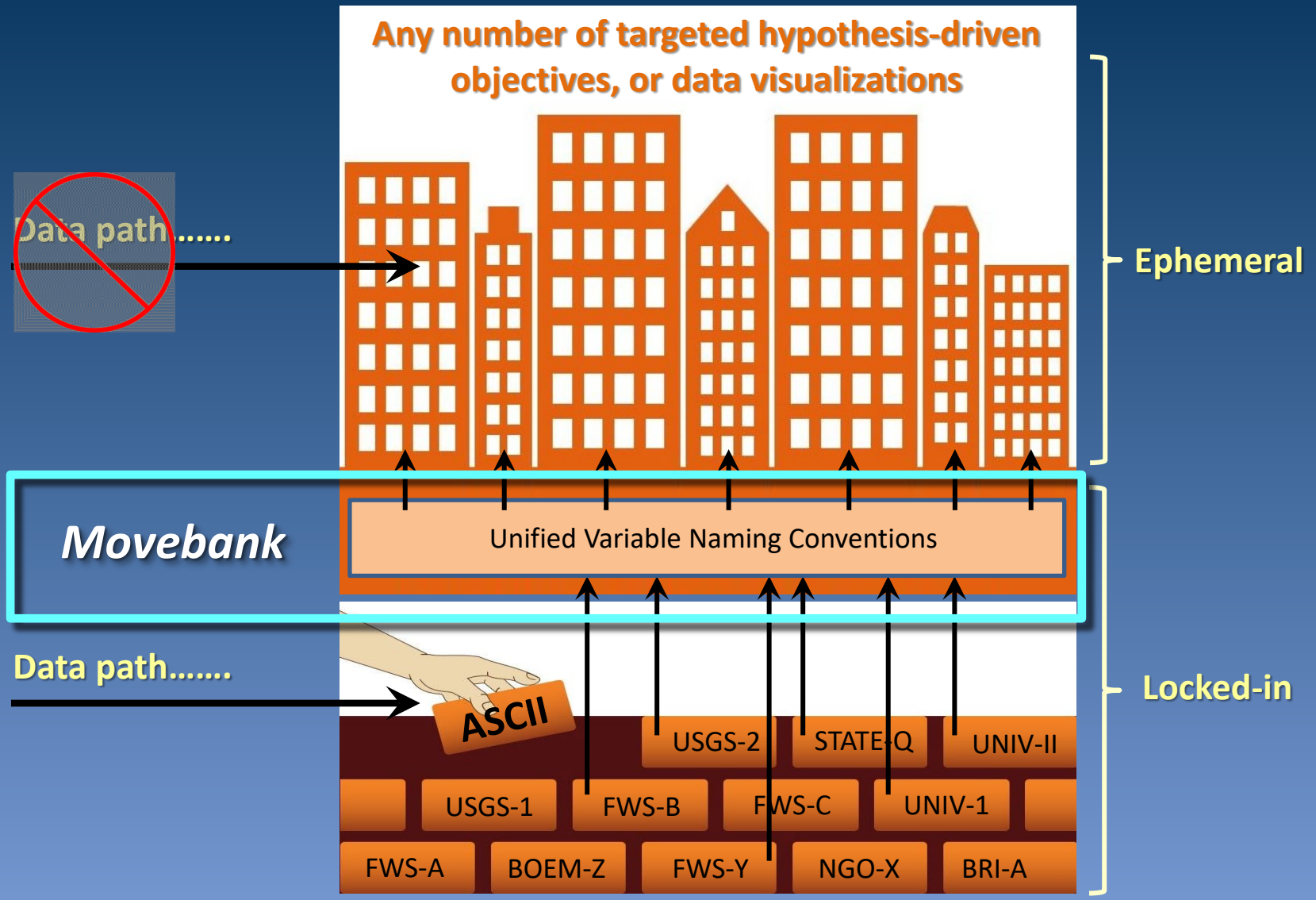
The ASCII Data Foundation

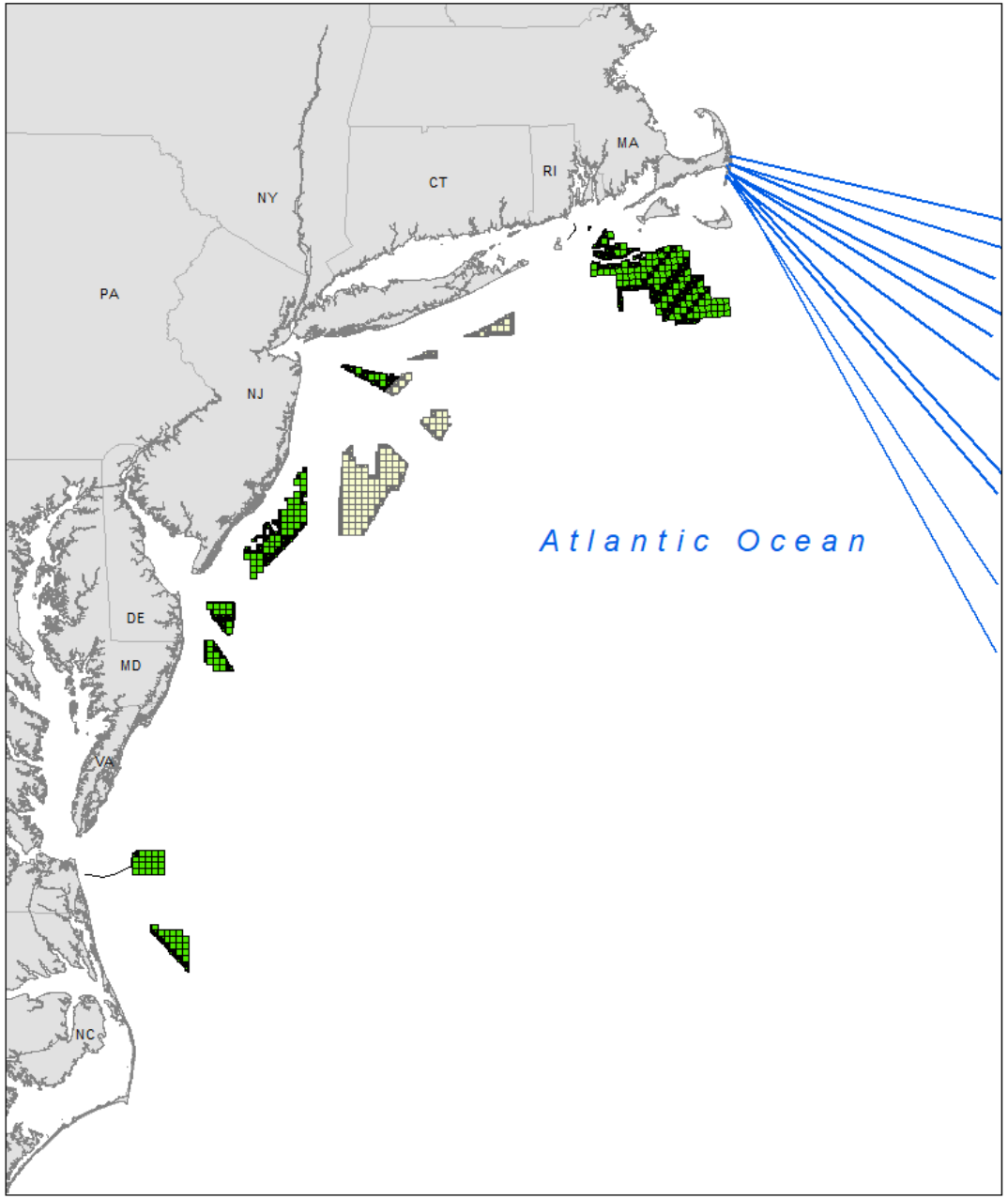


Sample Approach for Data Coordination

Need to Coordinate Tracking Data

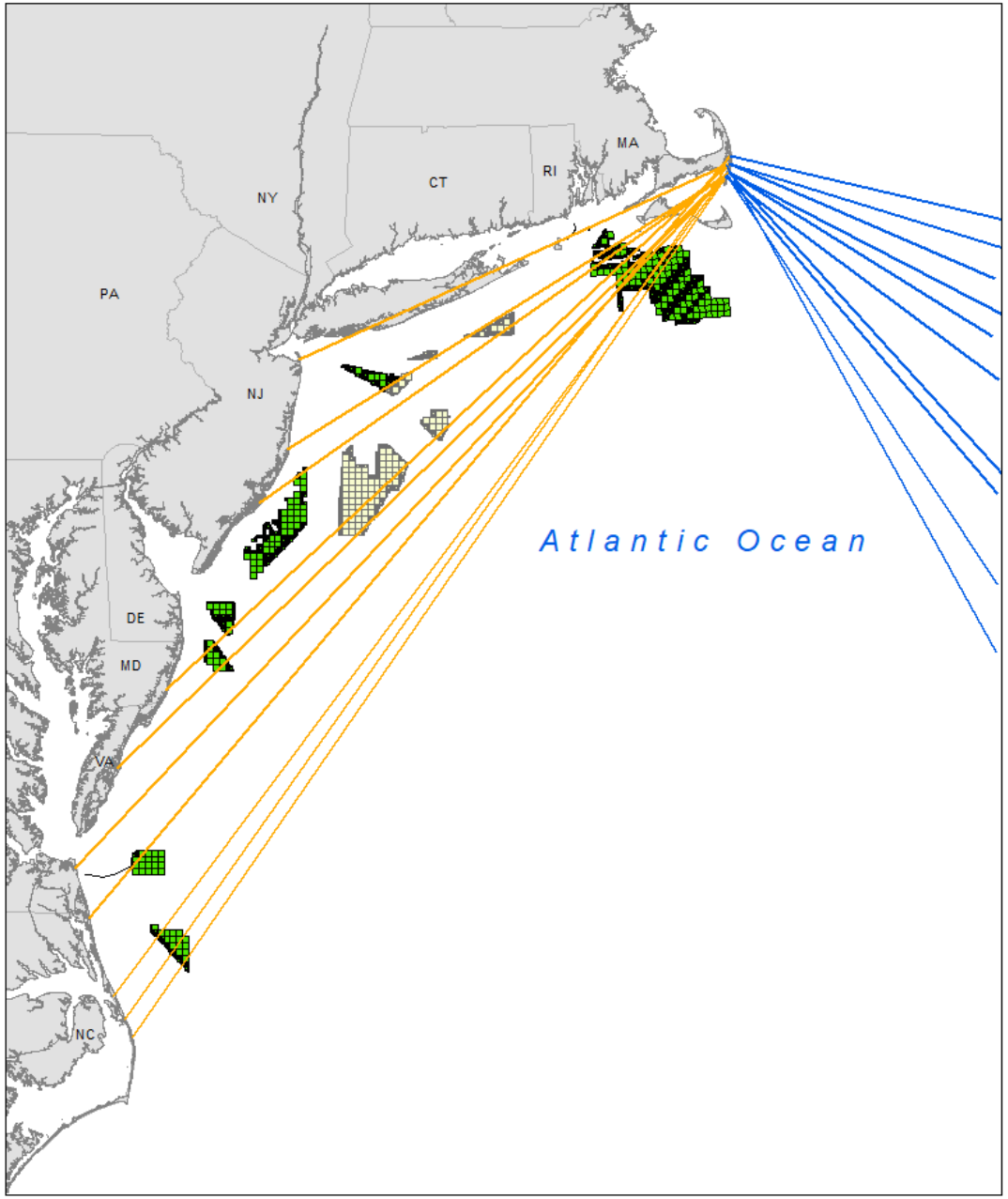
- Smaller tags = increased interest in ESA-listed species
- Risks of tagging animals versus value of information
- Information value maximized when data used collectively
- Immediate need for framework to coordinate
- Long-term need for data safeguard/repository

Importance of Data Coordination Across Studies



Study A: Red Knot Tags (N=10), MA - Early Fall

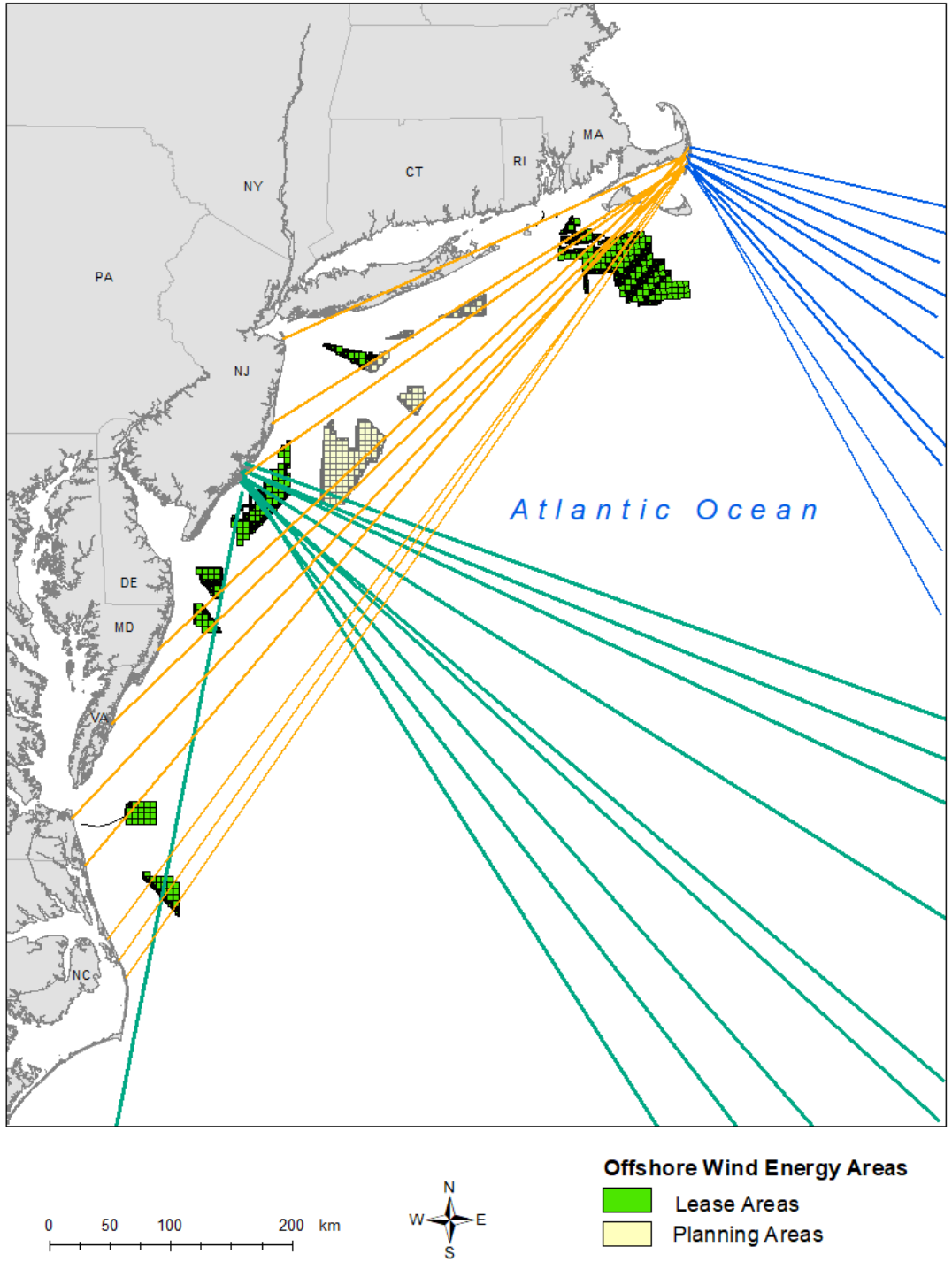
Importance of Data Coordination Across Studies



Study A: Red Knot Tags (N=10), MA - Early Fall

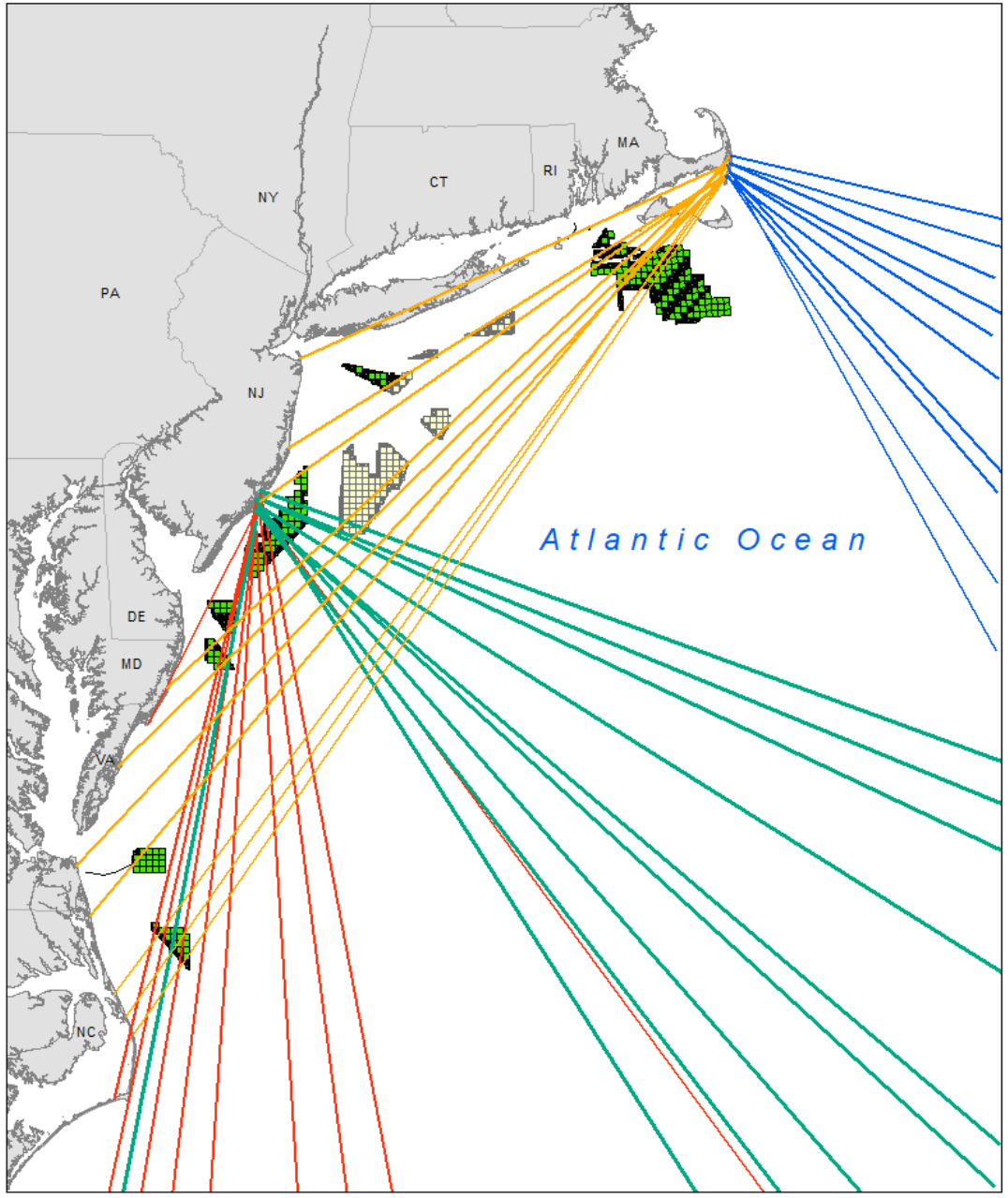
Study B: Red Knot Tags (N=10), MA – Late Fall

Importance of Data Coordination Across Studies



- Study A: Red Knot Tags (N=10), MA - Early Fall
- Study B: Red Knot Tags (N=10), MA – Late Fall
- Study C: Red Knot Tags (N=10), NJ – Early Fall

Importance of Data Coordination Across Studies



- Study A: Red Knot Tags (N=10), MA - Early Fall
- Study B: Red Knot Tags (N=10), MA – Late Fall
- Study C: Red Knot Tags (N=10), NJ – Early Fall
- Study D: Red Knot Tags (N=10), NJ – Late Fall

N = 40 sample size when data combined from multiple studies

Population level variation and inferences

Best available information on site-specific and cumulative exposure estimates

Short-term Coordination Framework

- Aim: agencies timely access to information (e.g. offshore wind)
- Sample Workflow:
  - Projects register tags in Movebank with standardized metadata (e.g. spp, band #, attachment, start date & loc)
  - Tags set to “live feed”
  - Agency contact on account as collaborator
  - Use of data in site specific and regional offshore wind assessments
  - EnvData & MoveApp tools – help to standardize/streamline workflow to increase efficiency, consistency and transparency?

Long-Term Coordination Framework

- Aim: long-term repository to safeguard data (agency-funded & other data used in decision-making)
- Alaska USGS Science Center Approach
  - Intuitive interface
  - Solid data architecture
  - Metadata protocols (e.g. dead/shed)
  - Transportable to other databases
  - Works w/various tag types
- With additional funding, possible to expand or duplicate for Atlantic studies?

Benefits of Tracking Data Framework

- Long-term repository to safeguard data
- Standardized, transparent, consistent & automated workflow
- Save time and money
- Best available science for assessments both in the immediate future and over the long term
- More opportunities for collaboration and complimentary uses of data (species management, scientific papers)

Thank you!

Photo: P. Paton

U.S. Department of the Interior (DOI)

The DOI protects and manages the Nation's natural resources and cultural heritage; provides scientific and other information about those resources; and honors the Nation's trust responsibilities or special commitments to American Indians, Alaska Natives, and affiliated island communities.

Bureau of Ocean Energy Management (BOEM)

BOEM's mission is to manage development of U.S. Outer Continental Shelf energy and mineral resources in an environmentally and economically responsible way.