Digital Aerial Baseline Survey of Marine Wildlife

In Support of New York State Offshore Wind Energy

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Outline

- Normandeau/APEM Experience
- Proposal Framework
- Known Wildlife Distributions in OPA
- Approach
  - Camera Sensor
  - Flight Planning and Survey Design
  - Data Output
  - Adaptive Methods Consideration
  - Survey Timing
- Data Distribution

Technology Evolution

- **Europe 2007:** Aerial digital surveys are used for collecting offshore biological data
- **USA 2011:** On behalf of BOEM, Normandeau completed a comparison of **three offshore survey methodologies**
  - Boat-based visual
  - Low-altitude aerial visual
  - High-altitude aerial digital

Survey Vessels

Boat surveys:
40-ft sport-fishing boat

Aerial surveys:
Cessna 337 Skymaster aircraft

The digital imagery camera plane flew between 450 and 1000 m altitude

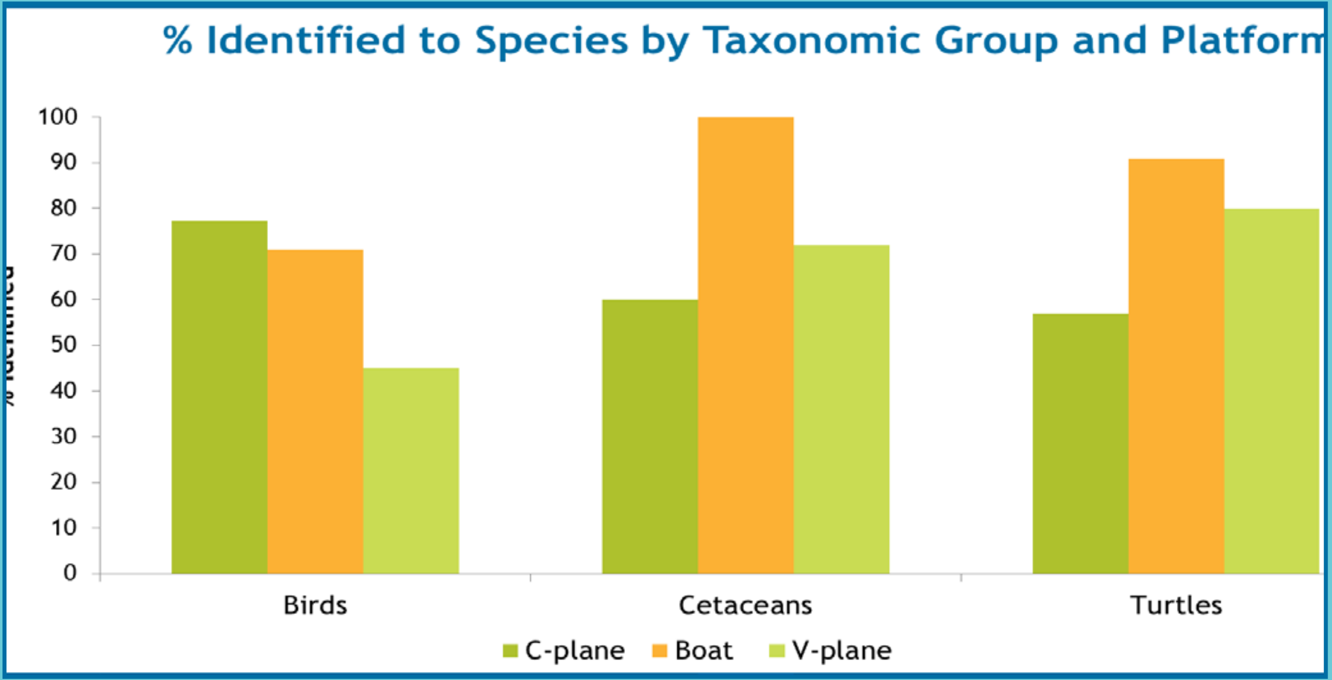
Comparison-Density

- **Turtle Density Estimates**
  - Digital survey estimates 4x higher than visual aerial data
  - Digital survey estimates 10x higher than boat survey data

- **Reasons**
  - Low visibility of turtles from boats at sea-level and from aircraft given the short observation time available
  - Disturbance by both boat and aerial visual survey platforms

Comparison-Identification

- **Birds:** digital aerial surveys and boat-based surveys achieved higher success than visual aerial surveys
- **Turtles and Cetaceans:** boat-based surveys had highest success



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Conclusions

- Digital aerial surveys offer a significant methodological improvement over visual surveys for turtles
- For marine birds and mammals in low-density situations, digital and observer-based survey methods may produce similar density estimates
  - *Caveat:* No marine mammals with long dive times (e.g., whales) were recorded in this study
- Density calculations from digital aerial surveys are more accurate and precise
  - Precise definition of areal coverage
  - Reduced animal repulsion/attraction effects
  - Not affected by observer detectability biases

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APEM Experience

- Provided aerial surveys for 10 years
  - 40 staff in remote sensing team
  - Own aircraft & camera systems
- Extensive experience in nearshore and offshore habitats
- Examples of areas worked in Europe:
  - North Sea
  - German N Sea
  - Irish Sea
  - Baltic Sea
  - Pentland Firth and Orkney Waters
  - Carmarthen Bay

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Innovations & Collaboration

- Innovative approach to survey designs
  - Camera system allows flexible approach
  - E.g., development and application of quasi-random survey to estimate seabird avoidance to operational wind turbines
- APEM-Normandeau ornithology and marine mammal collaborations
  - Baryonyx, Gulf of Mexico
  - Confidential Project (onshore breeding bird census)

Known Wildlife Distributions in OPA

Data Sources: Spatial Data

- Northwest Atlantic Seabird Catalog by USGS, BOEM, available at NOAA
- New England Aquarium using the North Atlantic Right Whale Consortium
- MARCO Mid-Atlantic Ocean Data Portal

USGS science for a changing world

BOEM Bureau of Ocean Energy Management

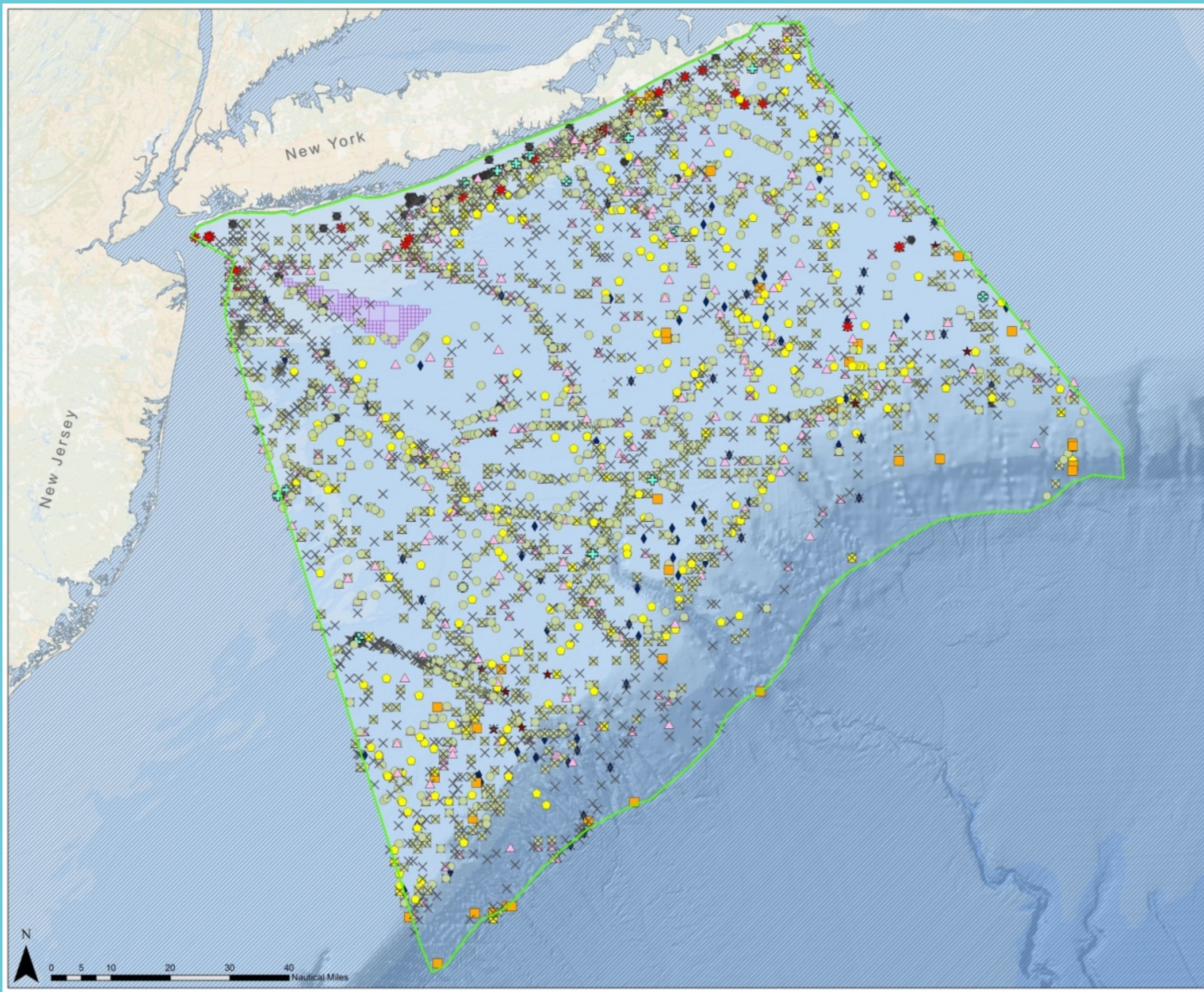
NOAA National Oceanic and Atmospheric Administration U.S. Department of Commerce

NARWC The North Atlantic Right Whale Consortium

New England Aquarium

MARCO Mid-Atlantic Regional Council on the Ocean

Spatial: Birds



- NY Offshore Planning Area
- NY Wind Energy Area

Atlantic Offshore Seabird Dataset Catalog

- Atlantic Puffin
- Razorbill
- Audubon's Shearwater
- Cory's Shearwater
- Red-throated Loon
- Black-legged Kittiwake
- Northern Gannet
- Herring Gull
- Jaegers
- Scoters

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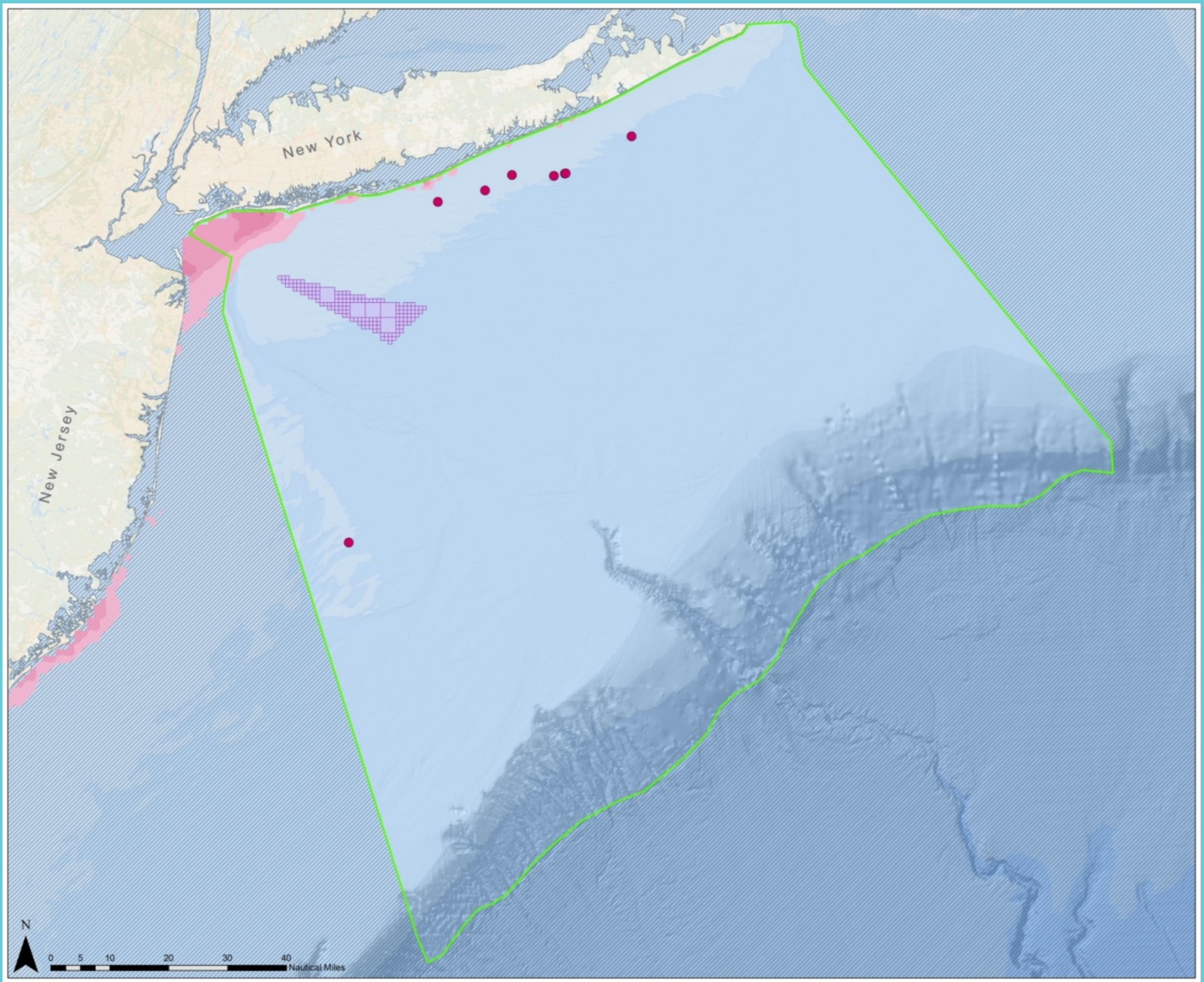
Spatial: Roseate Terns



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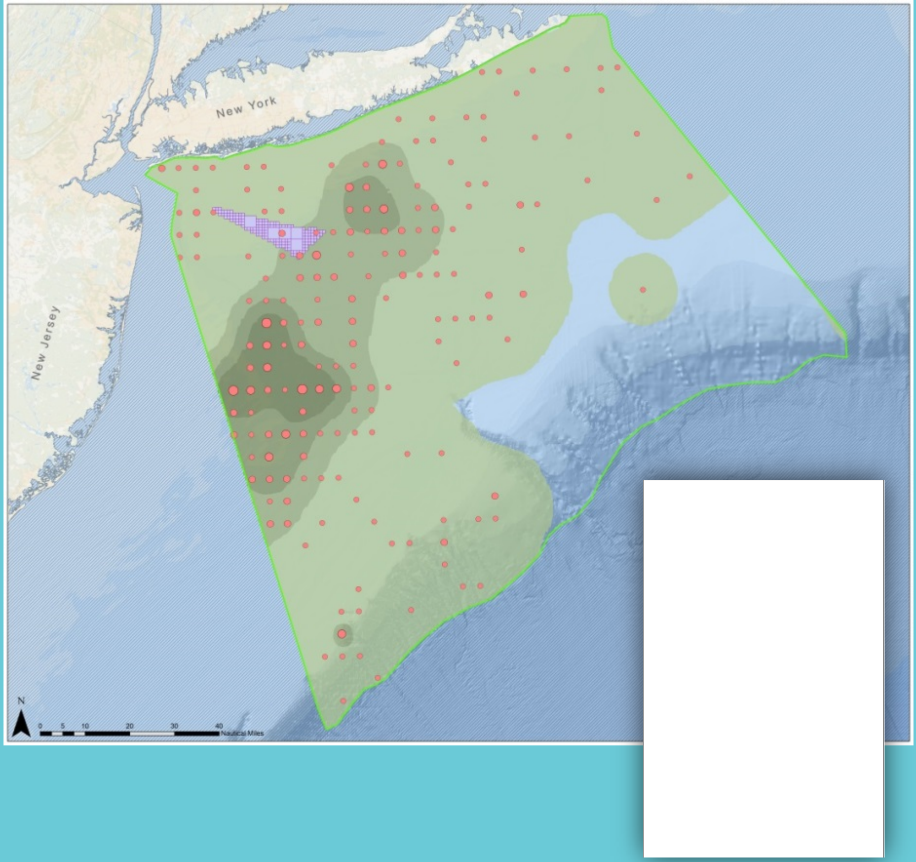
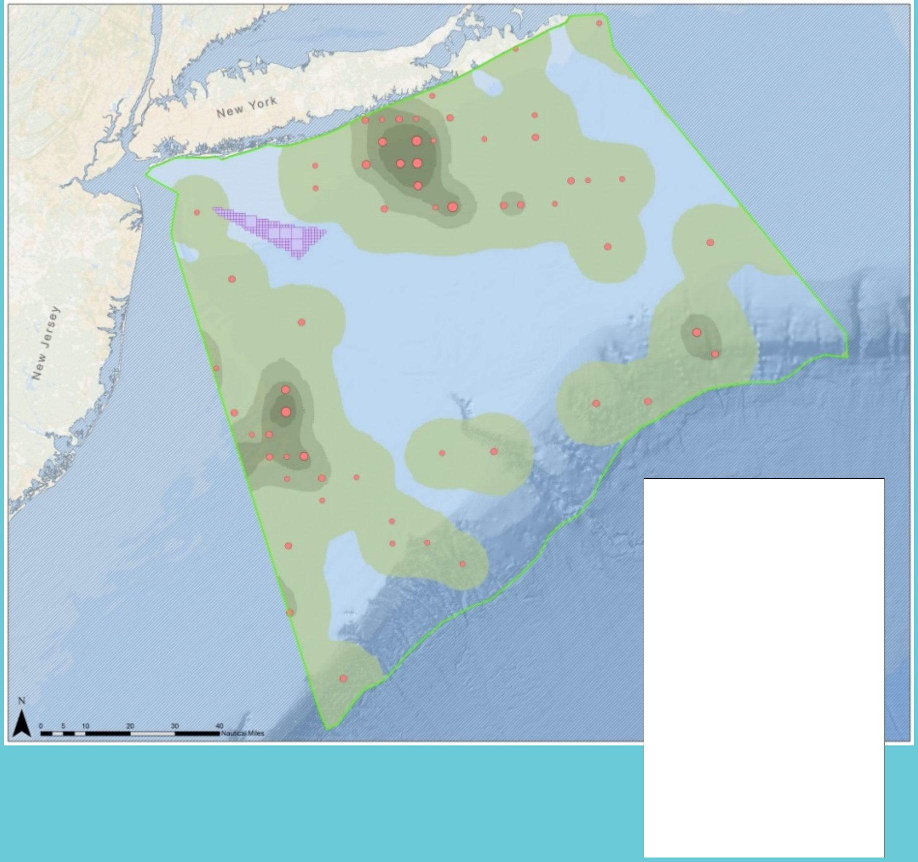
Spatial: Turtles





Approach

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Camera Sensor

- Shearwater III
- 1.5 cm for NYSERDA
- Integrated GPS and IMU

Key Advantages to 1.5 cm Resolution

- 1.5 cm resolution is the same as a nickel at sea-surface
- High quality
- More accurate measurements
  - Head to tail and wingspan
  - Flight height calculation
- Greater confidence in ID
  - Measurements (e.g., flying shearwaters, sitting auks, and gulls)
  - Tern bill colour visible
  - Increased chance of ID'ing individual mammals

Example Bird ID Rates

2 cm v. predicted 1.5 cm

Species Group	Species	% ID (2 cm)	% ID (1.5 cm)
Ducks	Black Scoter	>85%	>98%
	Red-breasted Merganser	>80%	>98%
	Long-tailed Duck	>85%	>95%
Loons	Common & Red-throated Loons	>90%	>98%
Petrels and Shearwaters	Wilson's Storm Petrel	>75%	>85%
	Great & Cory's Shearwater	>80%	>90%
	Manx, Audubon's & Sooty Shearwaters	>60%	>80%
Jeagers and Skuas	Parasitic & Pomarine Jaeger	>85%	>95%
Gulls	Lesser & Great Black-backed Gulls	100%	100%
	Herring Gull	>90%	>99%
	Kittiwake, Laughing & Bonaparte's Gull	>85%	>95%
Terns	Caspian & Royal Terns	>85%	>95%
	Common, Roseate & Forster's Terns	>60%	>75%
Auks	Common Murre & Razorbill	>90% Summer, <50% in Winter	>99% in Summer, <50% in Winter
	Dovekie & Atlantic Puffin	>60%	>90%

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Example High-Res Bird Snags

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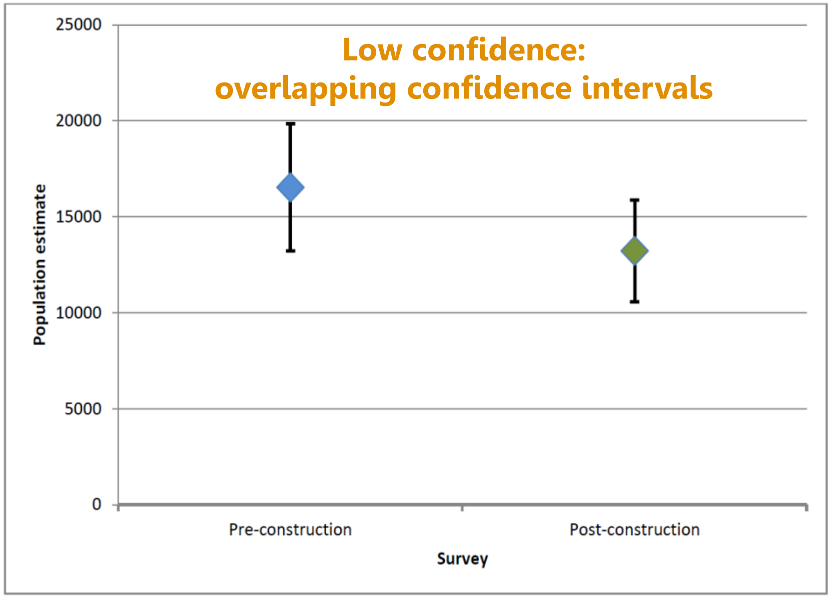
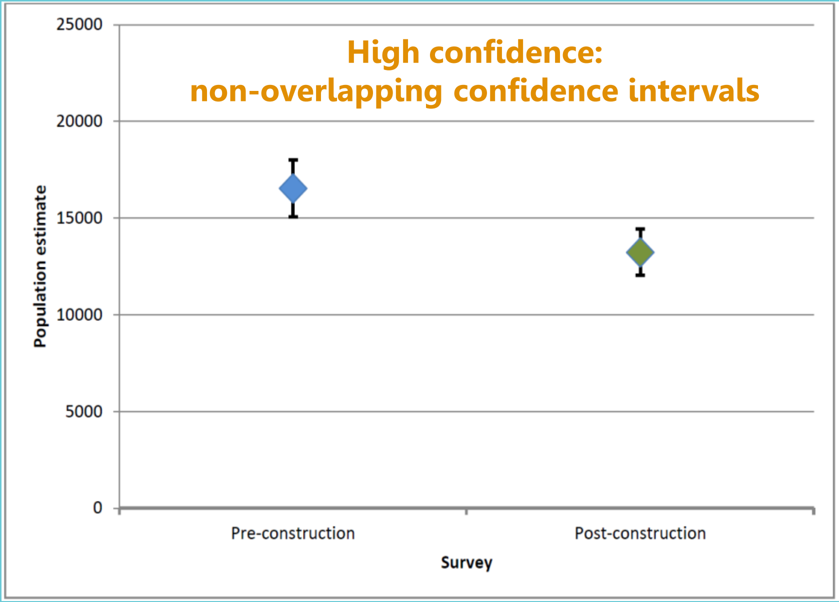
Flight Planning

- Twin engine capable of flying less than 140 knots
- Proposed to fly at around 1,500 ft
  - Safety
  - Weather
  - Resolution
  - Coverage

Survey Design
Confidence in Estimates

- Without small confidence intervals, it is impossible to assess if environmental change has had a significant impact on a population
  - High confidence = small confidence intervals
  - Low confidence = large confidence intervals





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Survey Design

- OPA = 43,650 km^2
- 7% Transect of OPA (3,073 km^2)

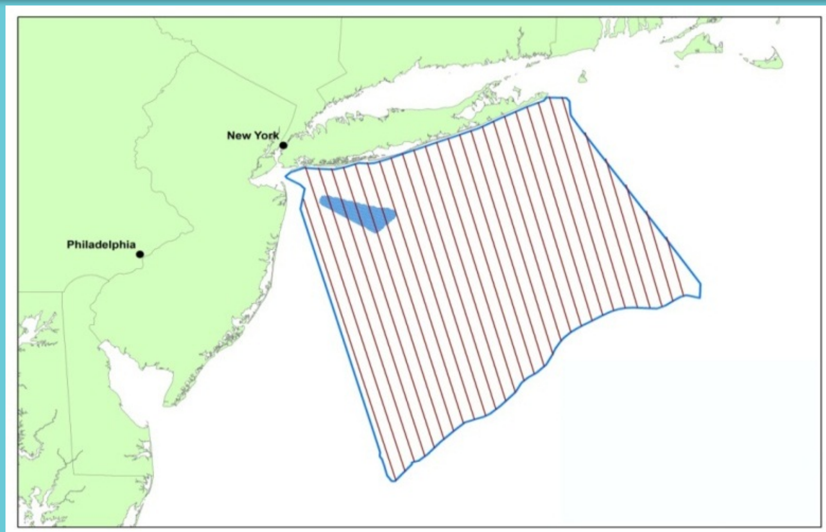
  584 m x 110 m ground sampling per image

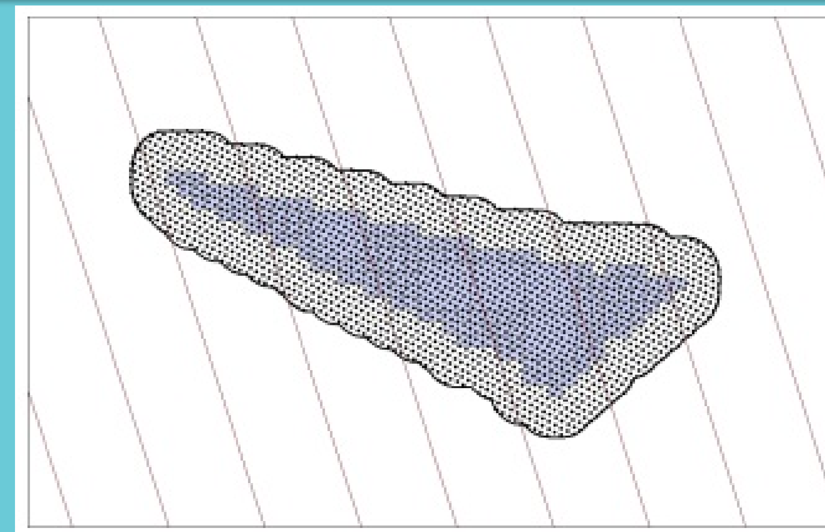
- 10% Grid of WEA + 4 km buffer (128 km^2)

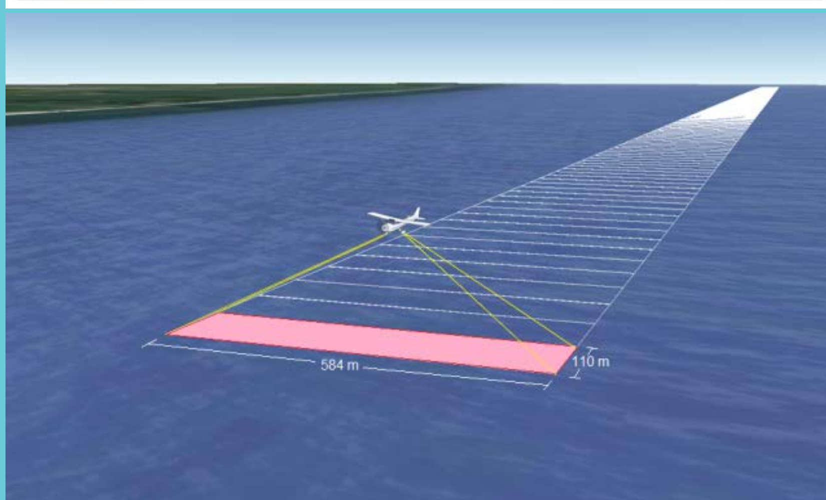
  330 m x 219 m ground sampling per image

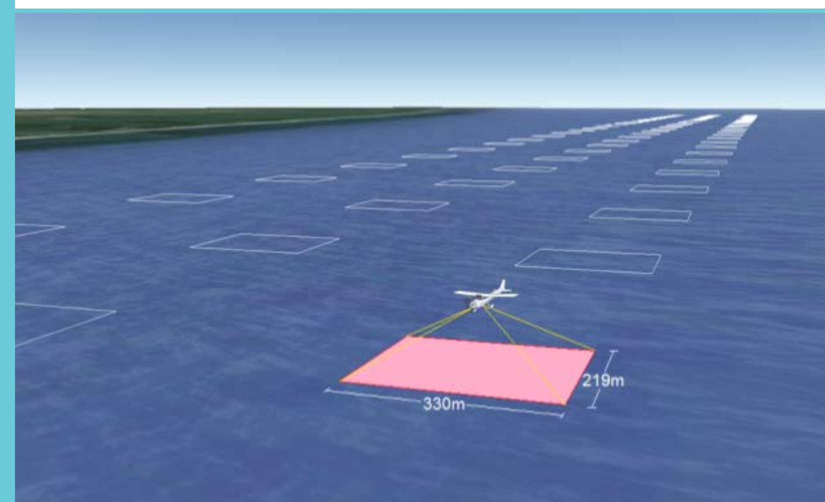
- Rationale for Transect and Grid Design

Survey Design

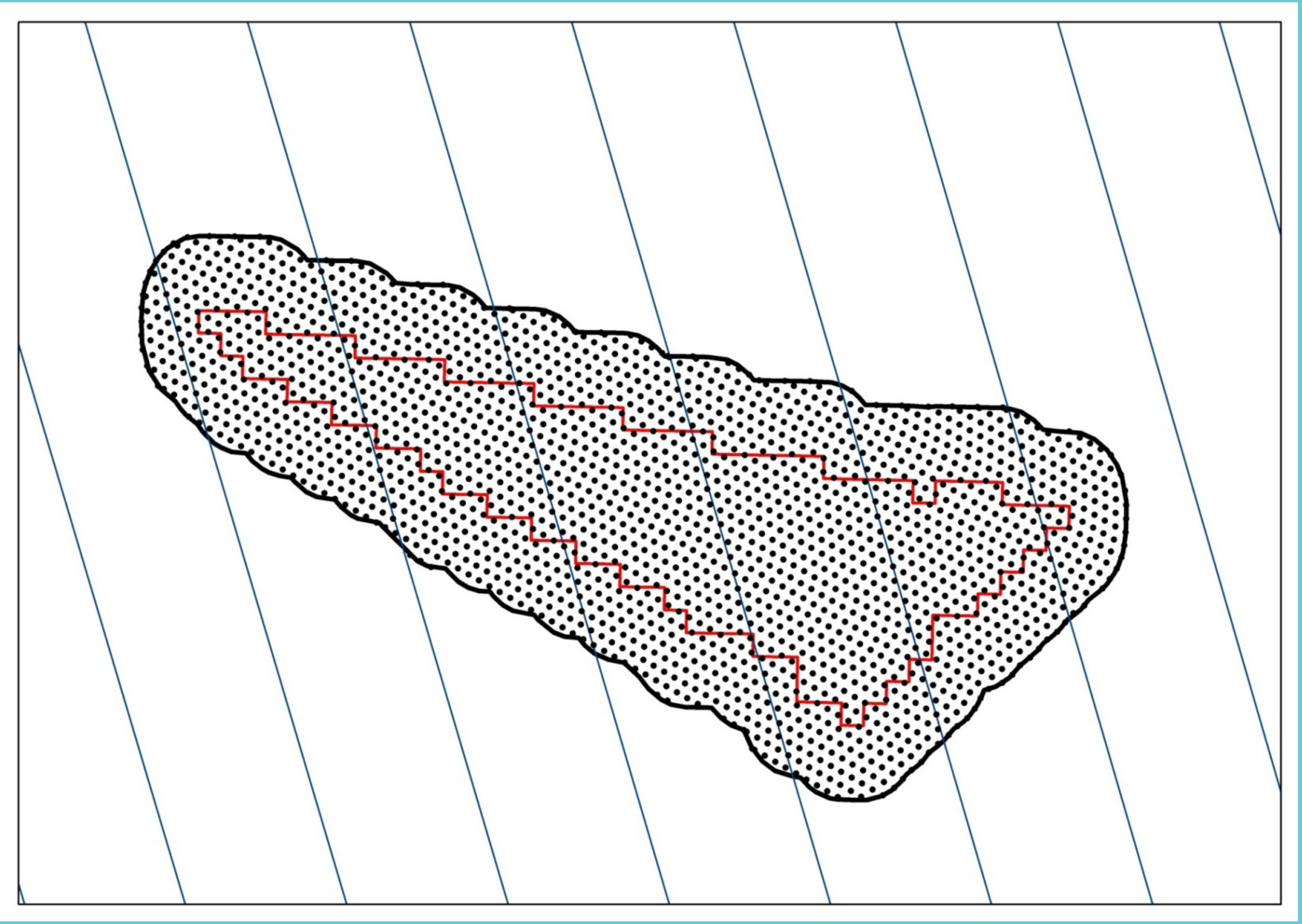








Survey Design



Survey Design
Grid versus Transect

- Both designs have benefits and drawbacks
- Key features transect design
  - Suitable for providing a generalisation of habitat and species abundance over large areas
  - Quicker to collect data
- Key features of grid design
  - Power to detect and monitor change in abundance
  - Greater number of replicates
  - Uniform sampling across environmental gradients

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Survey Design
Accommodating Glare

- **Consideration will be given to**
  - Sun angle (time of day / time of year)
  - Sea state (4 or less aiming for 2 or less)
  - Direction of flight in relation to the sun
  - Camera angle
  - Camera technicians continuously monitor the images collected for quality. Image acquisition will be stopped until suitable conditions occur
  - Extra imagery is routinely collected to replace a few expected glint-affected images

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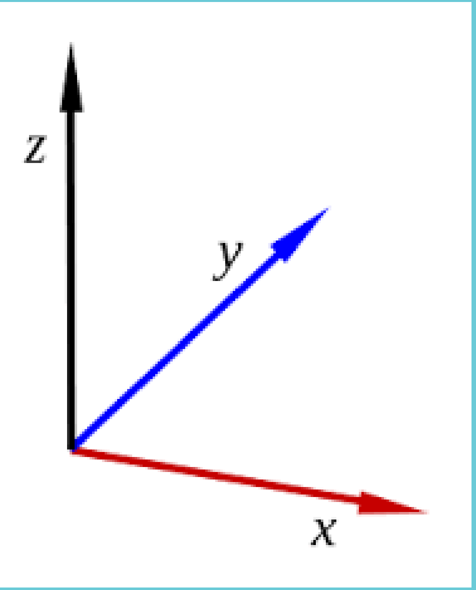
Data Output

Geospatial Accuracy

- Custom flight planning software pre-programs the survey transects and grids
- System-specific, aircraft mounted GPS/GNSS systems ensure that surveys are flown as accurately as possible
- Automatic image acquisition over specified locations
- As data capture occurs, GPS data are automatically logged with each exposure including the xyz coordinate and heading of the camera at the point of capture



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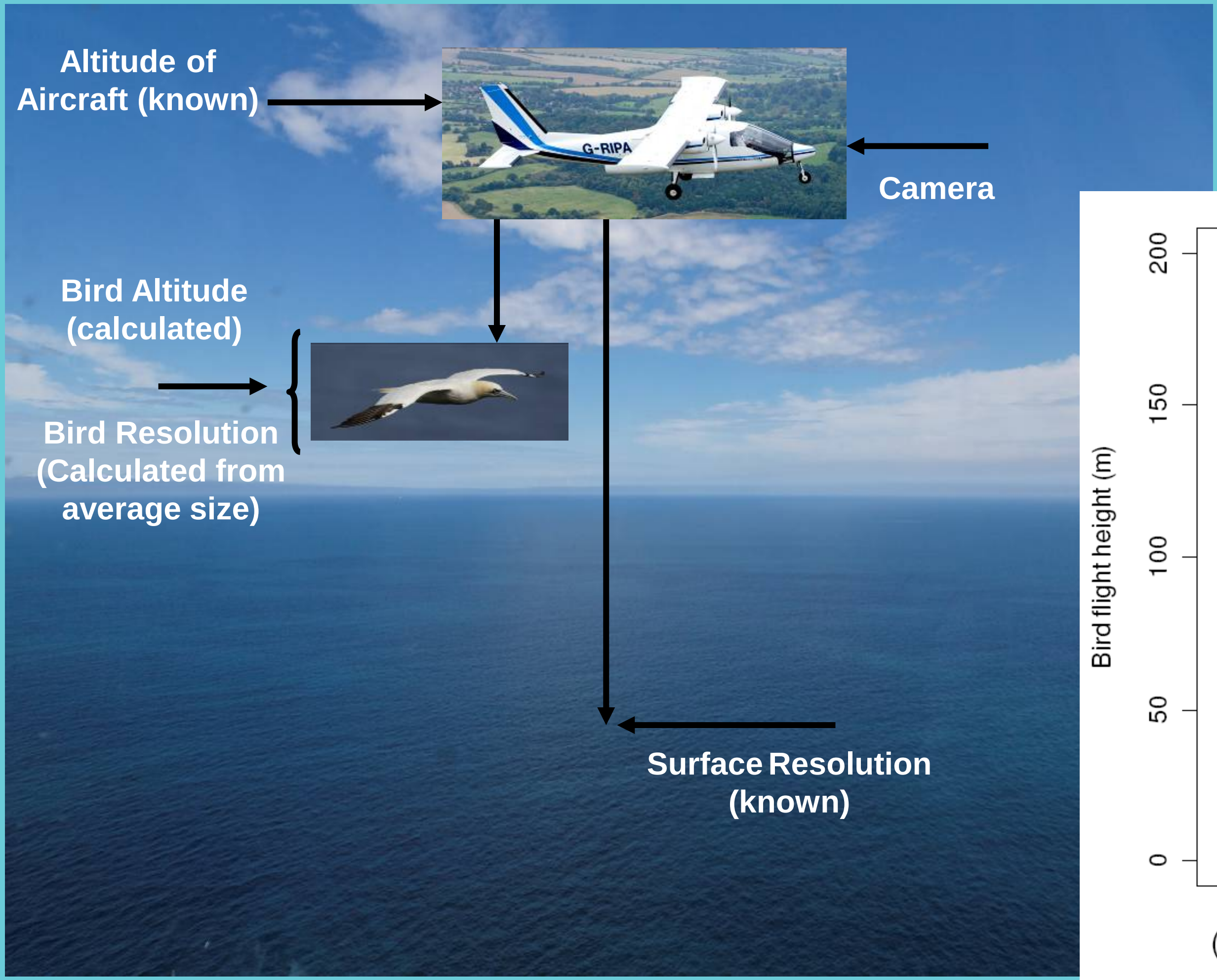
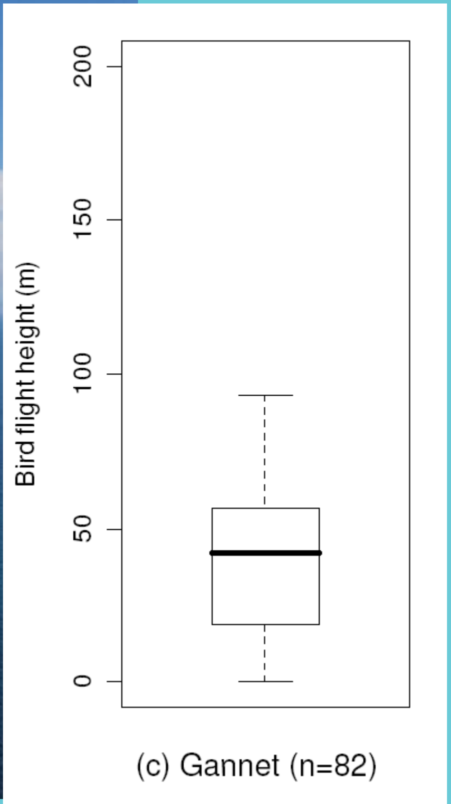
Data Output

- Identify wildlife to lowest possible taxonomic group
  - Birds
  - Marine mammals
  - Turtles
  - Sharks
  - Rays
  - Fish
- Geo-rectified image snags with associated metadata including height and direction
- Other Anthropogenic Data
  - Boats, met masts, etc.

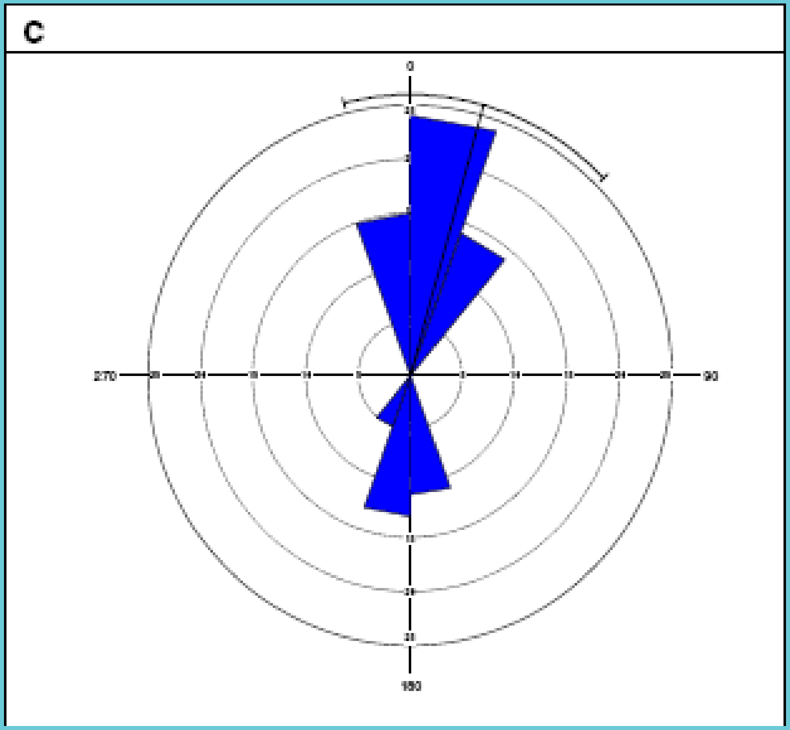
Data Output
Flight Height





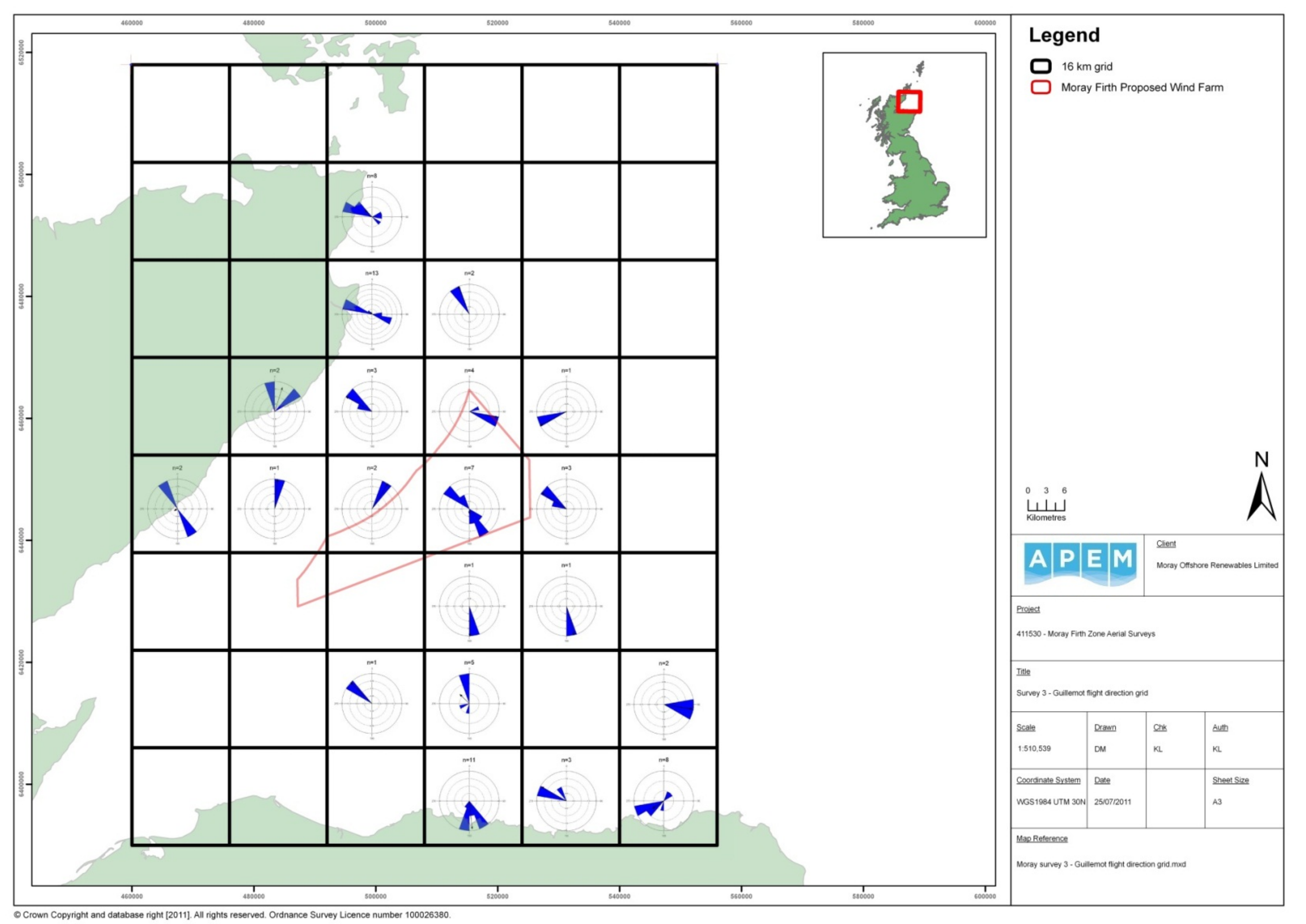
Data Output
Flight/Path Direction

- Individual wildlife are geo-referenced
- Bearing is automatically determined from head-tail axis
- Extraction to GIS
- Rose diagrams produced for defined areas



- Predominant flight/path direction is detectable

Data Output
Flight/Path Direction



Adaptive Methods Consideration

- Goal→ Create best value for 3 year data set
- Do Year 1 and/or 2 data confirm historical hot spot and cold spots?
- Stratified by area and/or by target species
- More detailed data–sampling emphasis and/or resolution

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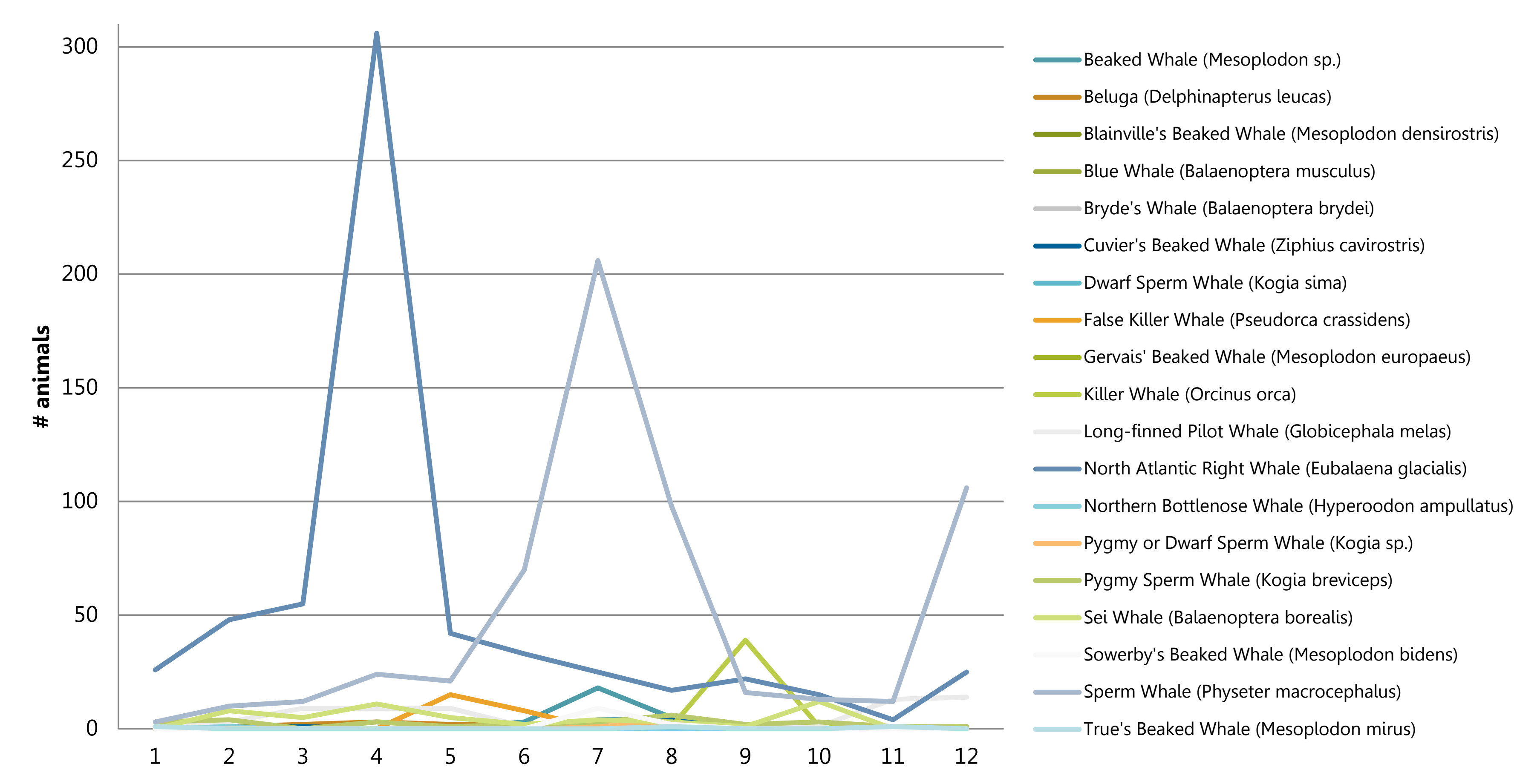
Data Sources: Temporal Data

- Northwest Atlantic Seabird Catalog by USGS, BOEM, available at NOAA
- New England Aquarium using the North Atlantic Right Whale Consortium
- MARCO Mid-Atlantic Ocean Data Portal
- eBird

Temporal: Marine Mammals



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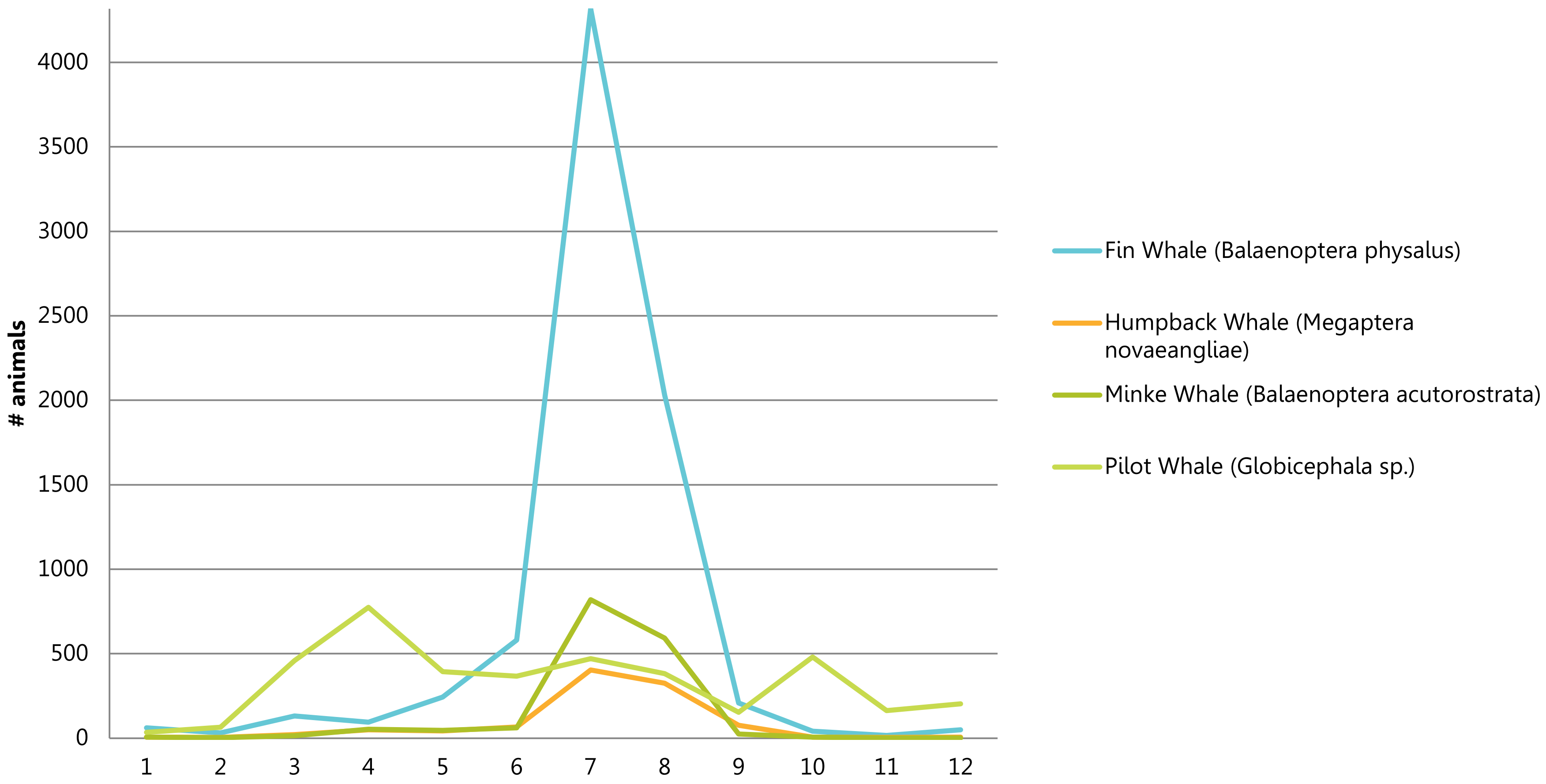
Temporal: Marine Mammals



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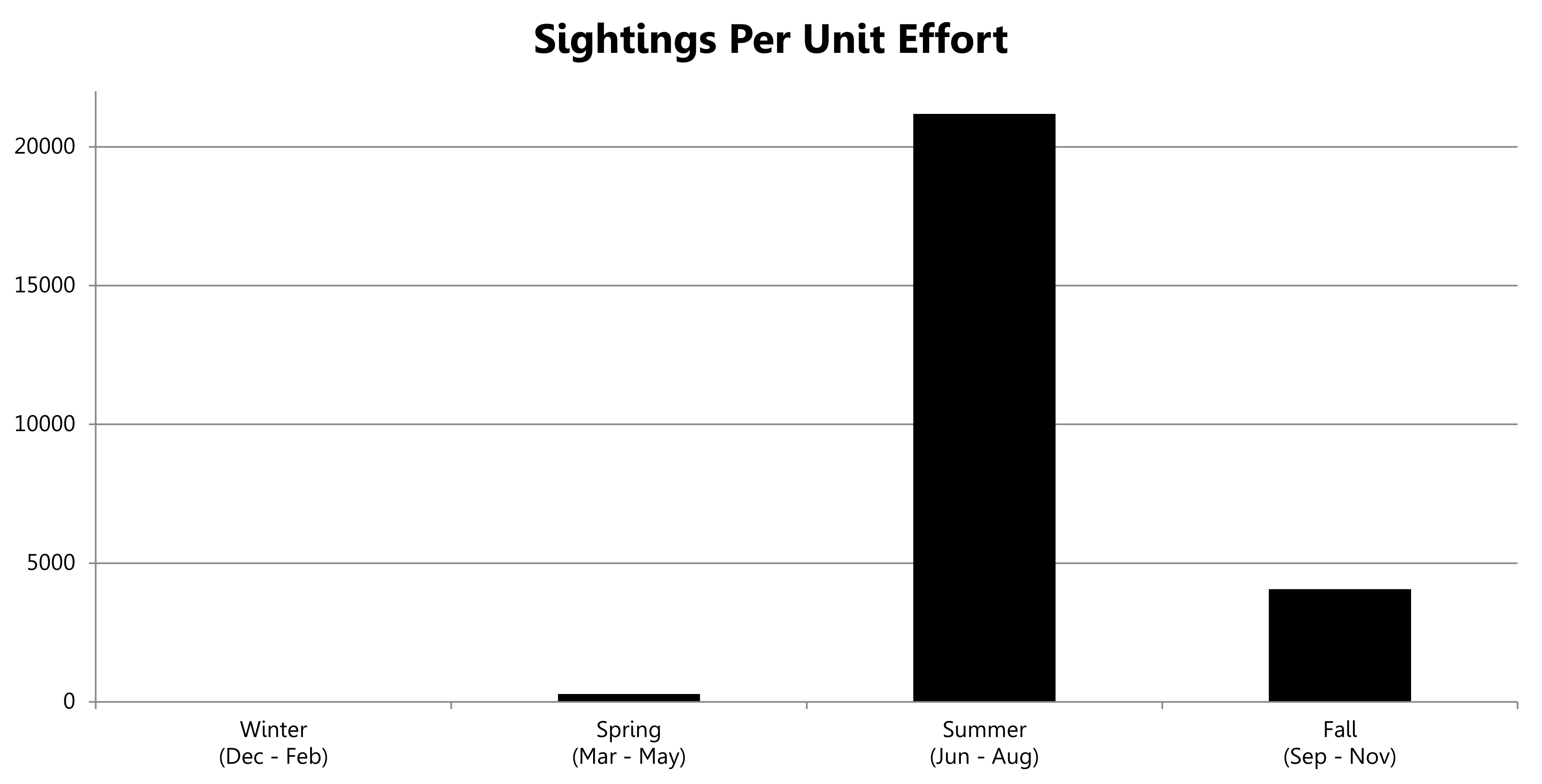
Temporal: Turtles



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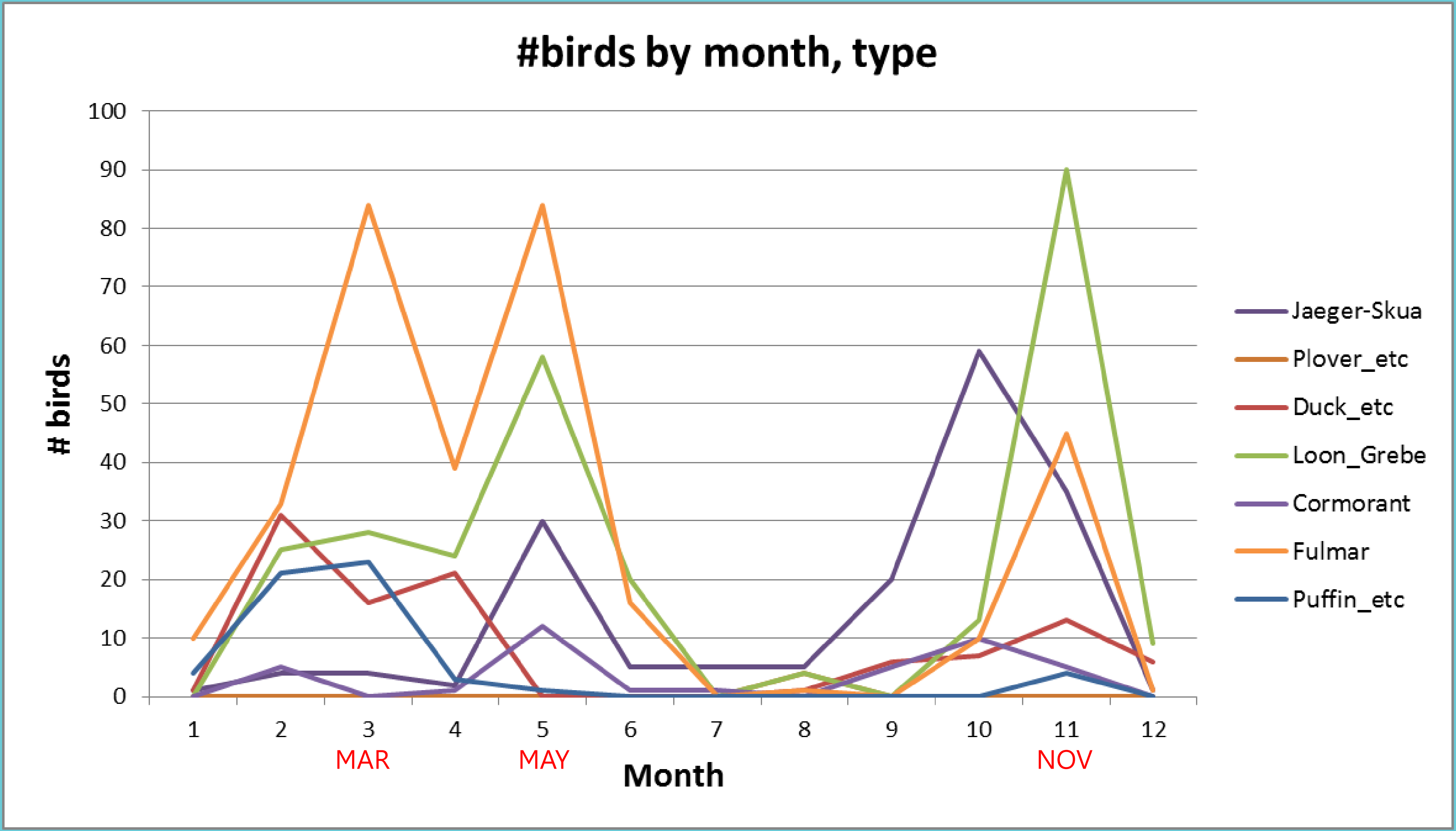
Temporal: eBird



Sensitive Species

- **Population Sensitivity**
  - Roseate Tern
  - Cory's Shearwater
  - Audubon's Shearwater
- **Displacement Sensitivity**
  - Roseate Tern
  - Atlantic Puffin
  - Razorbill
  - Red-throated Loon
  - Northern Gannet
- **Collision Sensitivity**
  - Roseate Tern
  - Herring Gull
  - Jaegers
  - Black-legged Kittiwake

Robinson Willmott, J. C., G. Forcey, and A. Kent. 2013. *The relative vulnerability of migratory bird species to offshore wind energy projects on the Atlantic Outer Continental Shelf*. OCS Study BOEM 2013-207.

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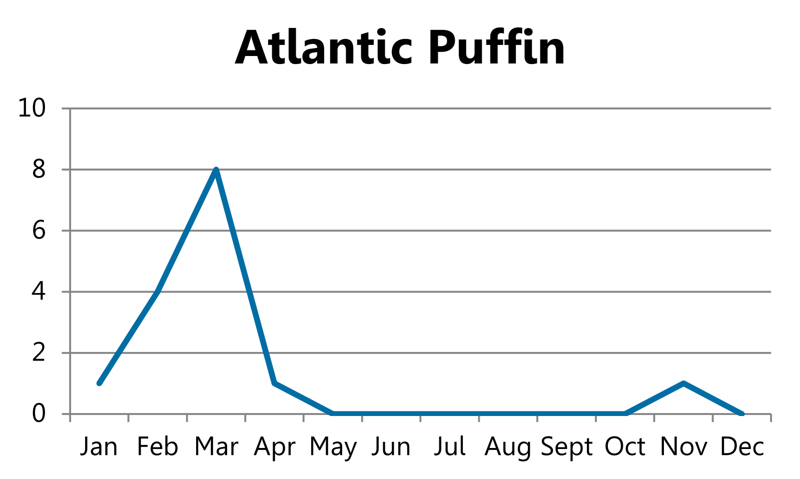
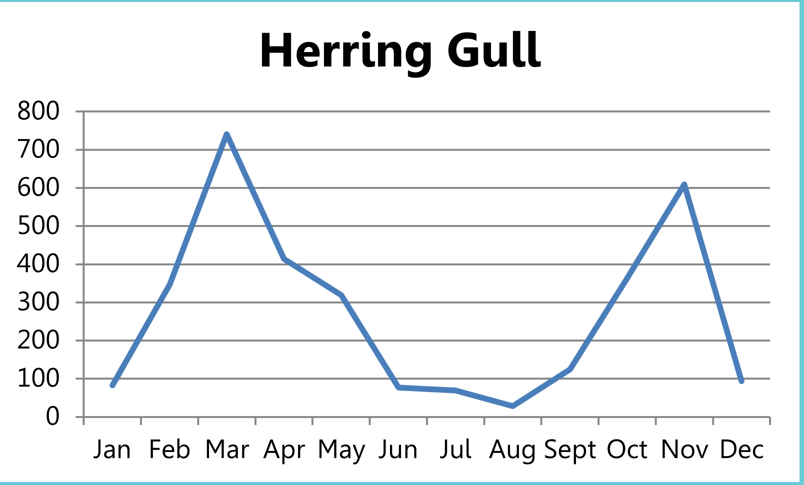
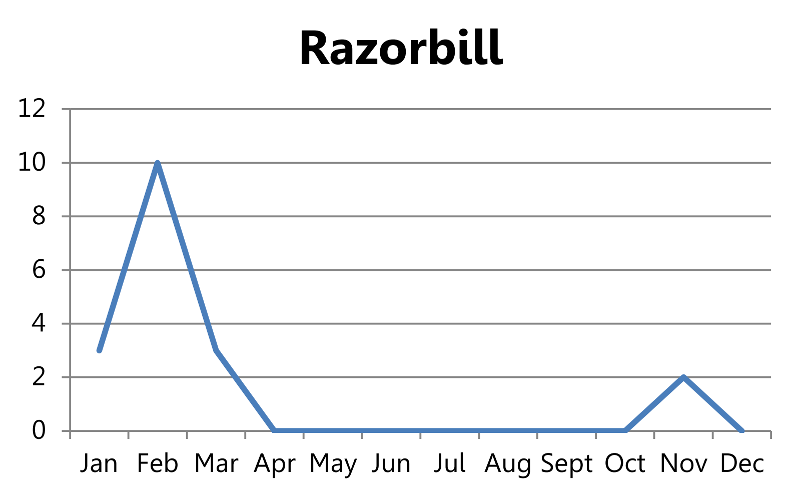
Survey Timings: Winter

February-March







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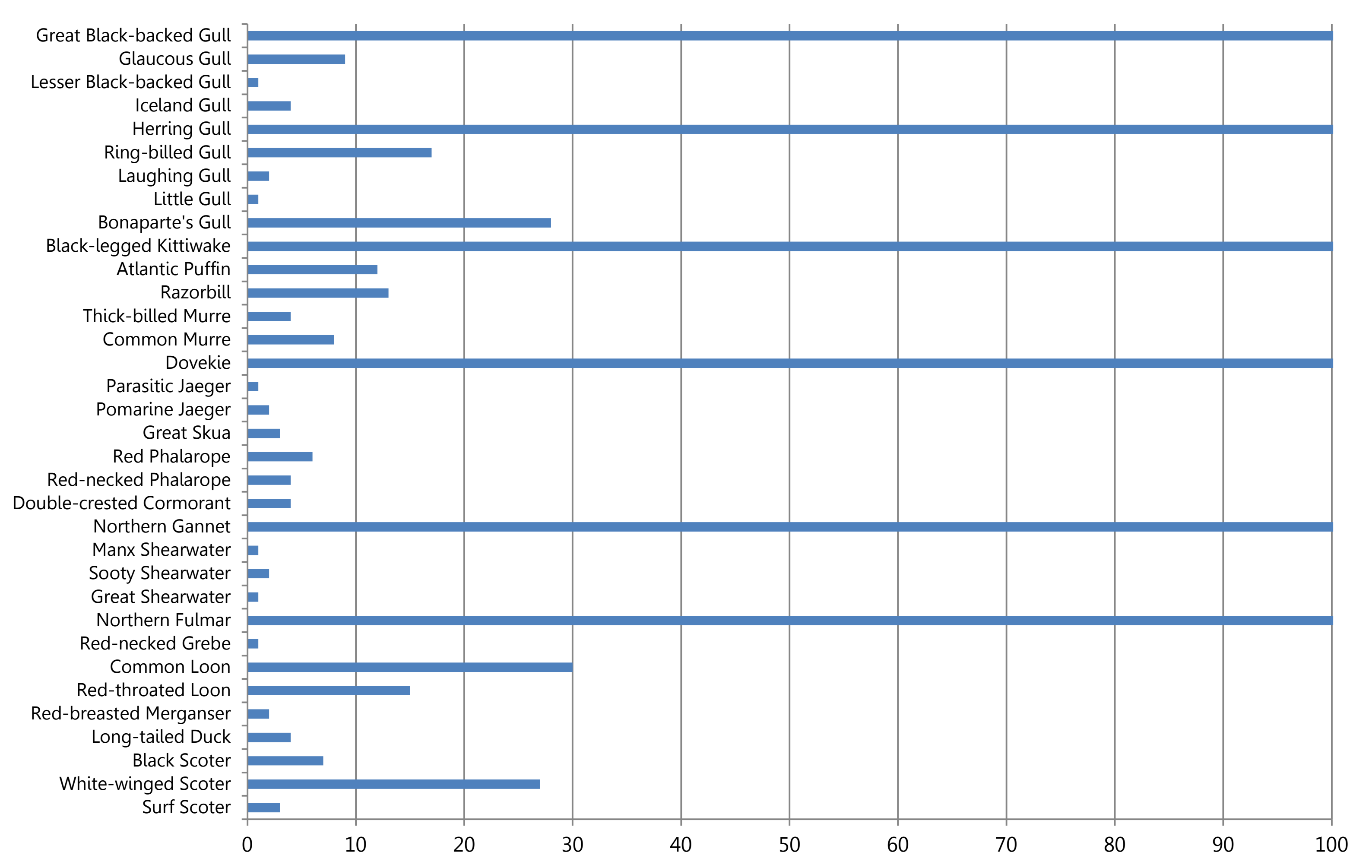

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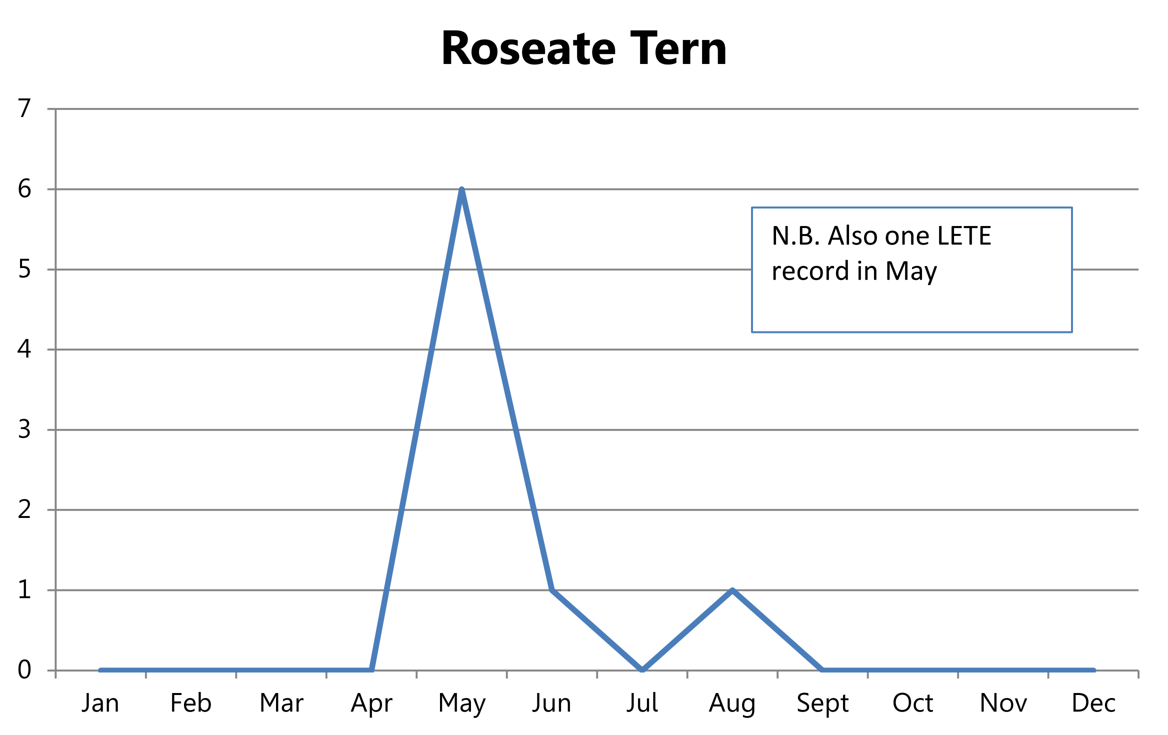
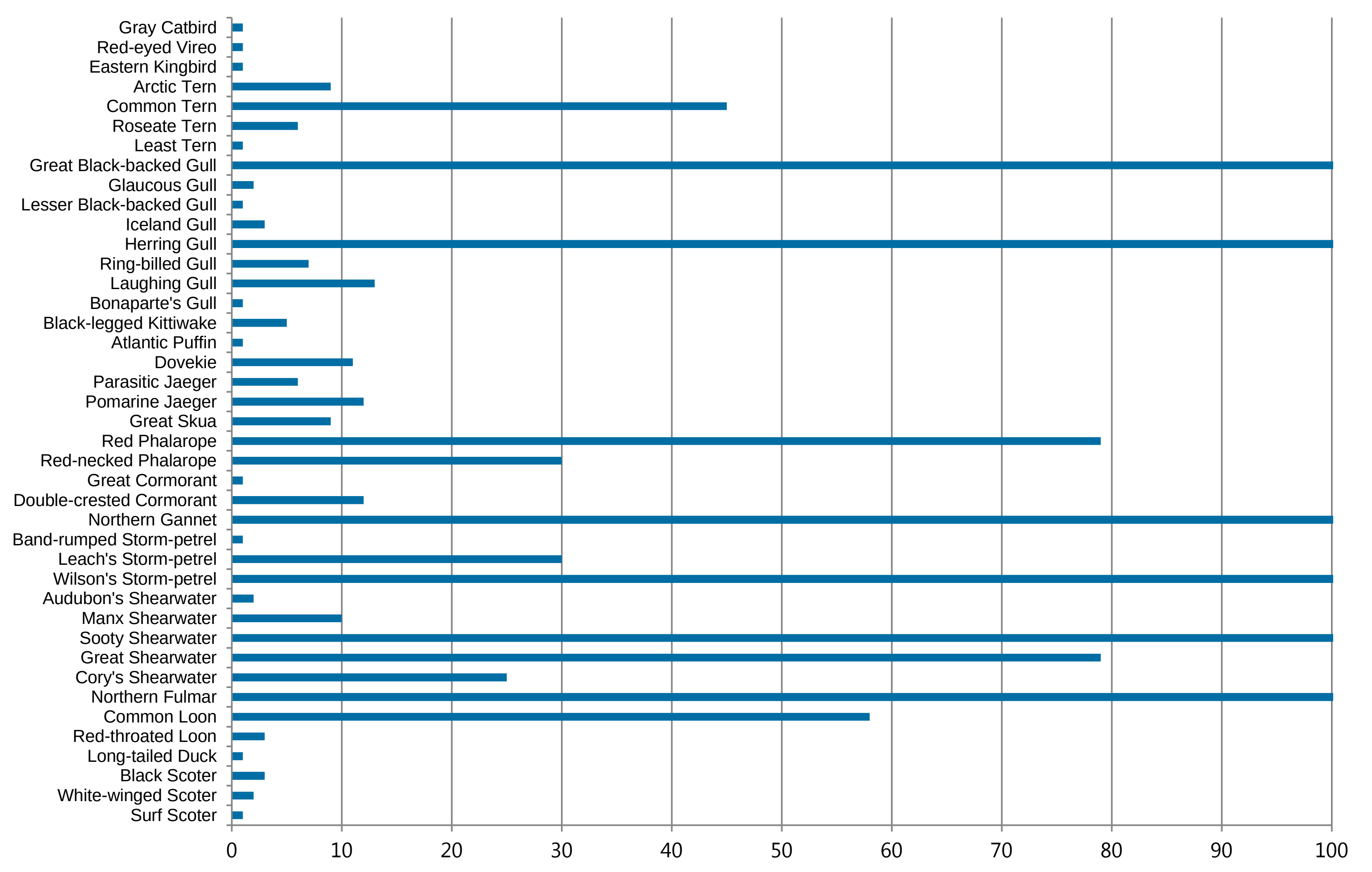
Survey Timings: Spring
April-May



Survey Timings: Spring

April-May



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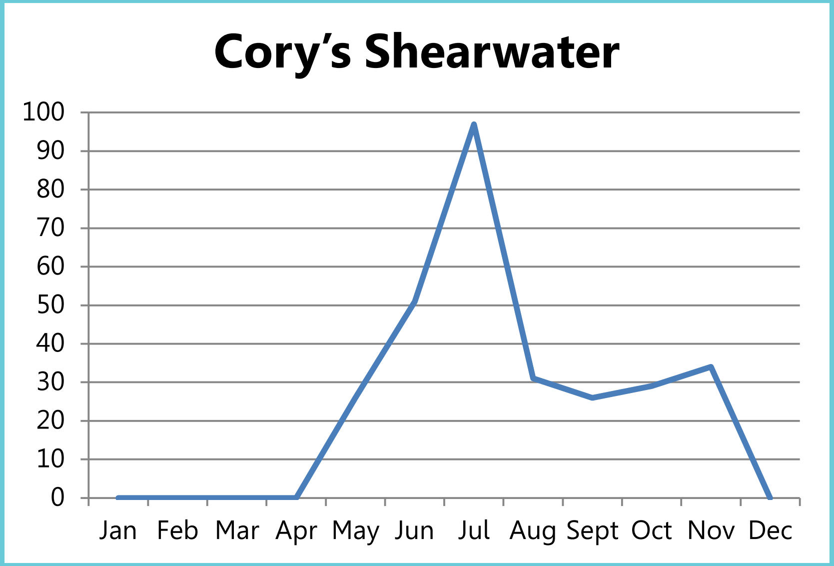
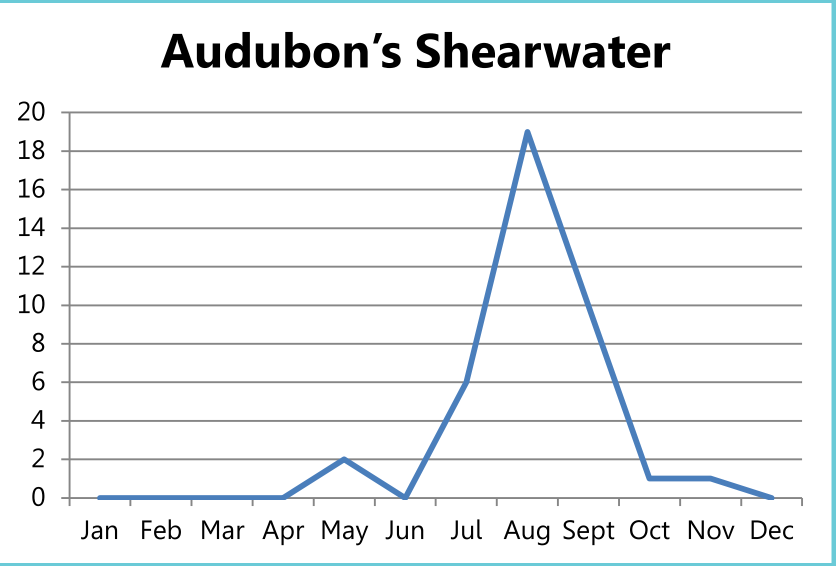
Survey Timings: Summer
July-August





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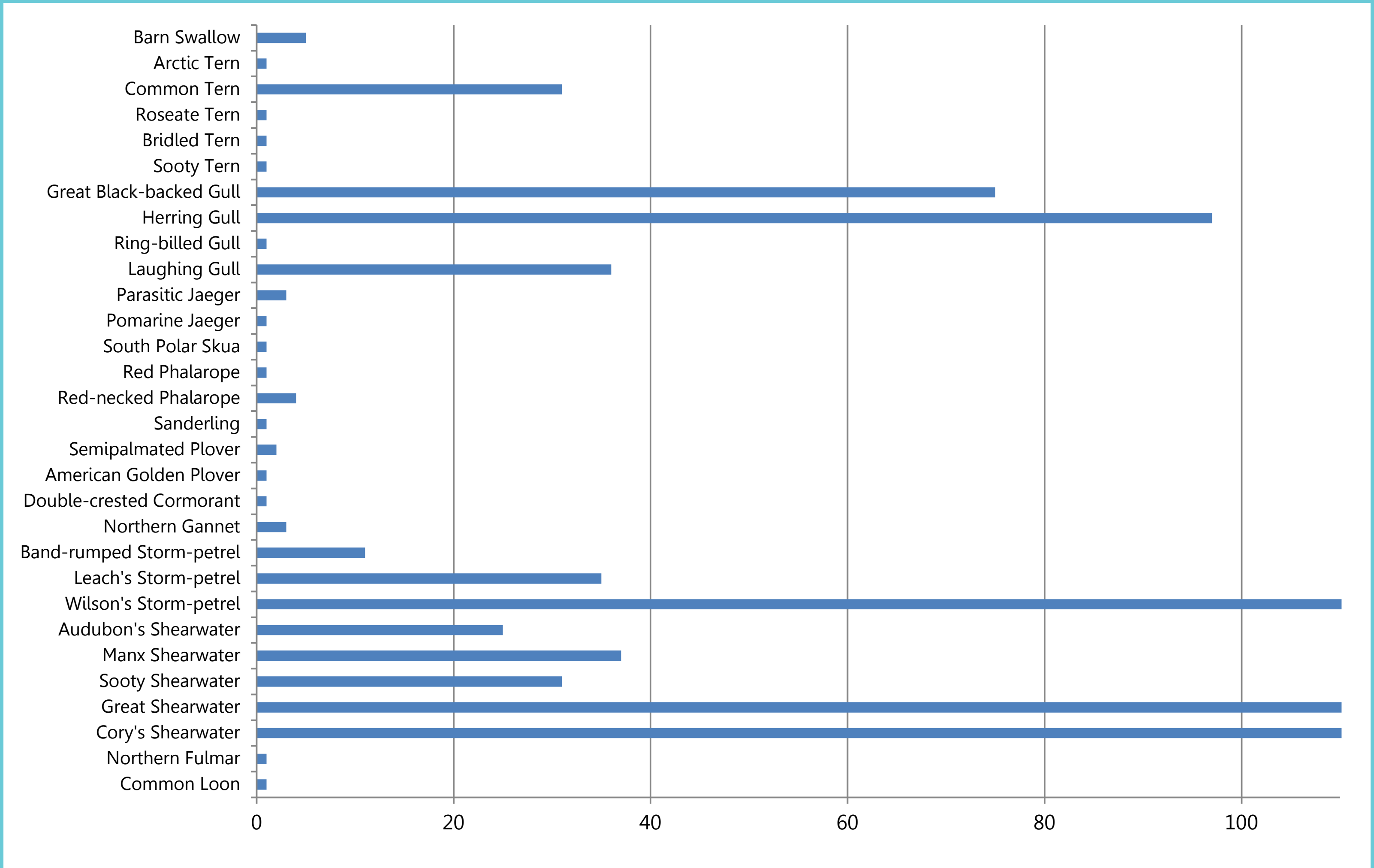
Survey Timings: Summer

July-August



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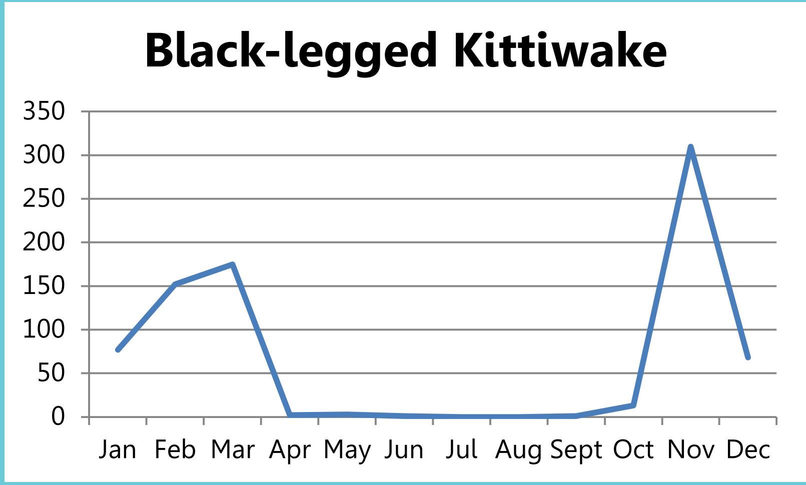
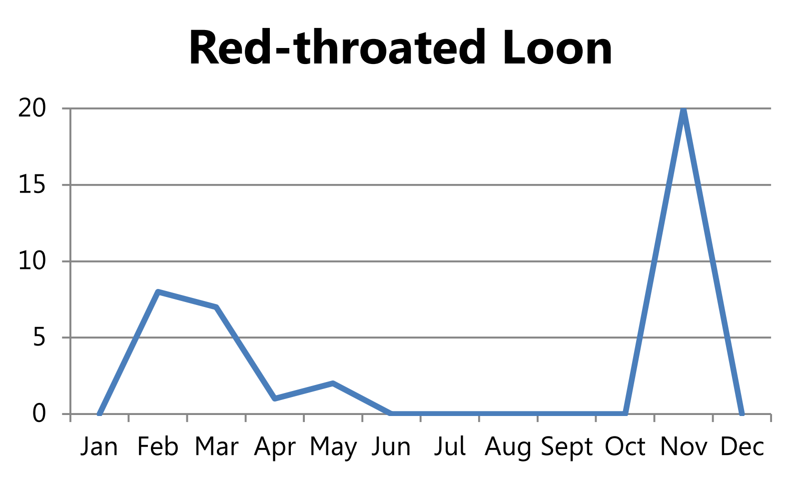
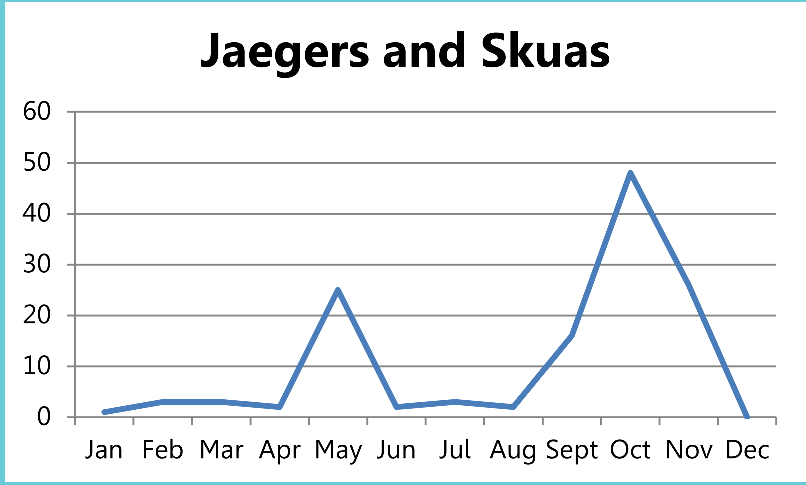
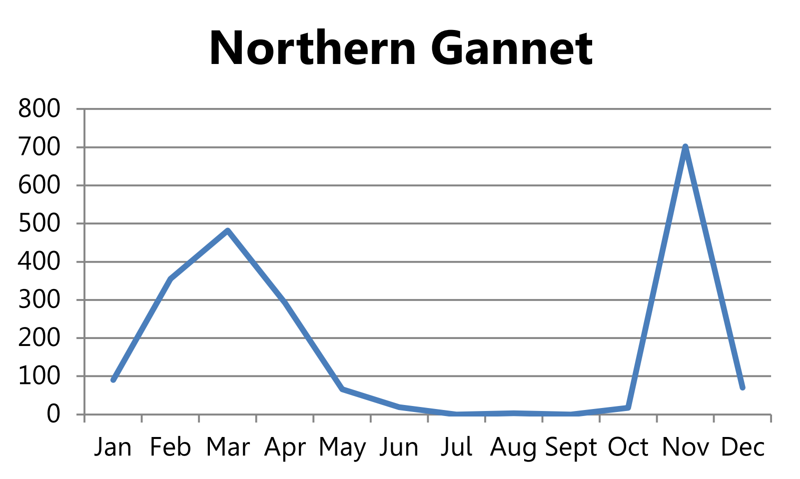
Survey Timings: Fall

October-November









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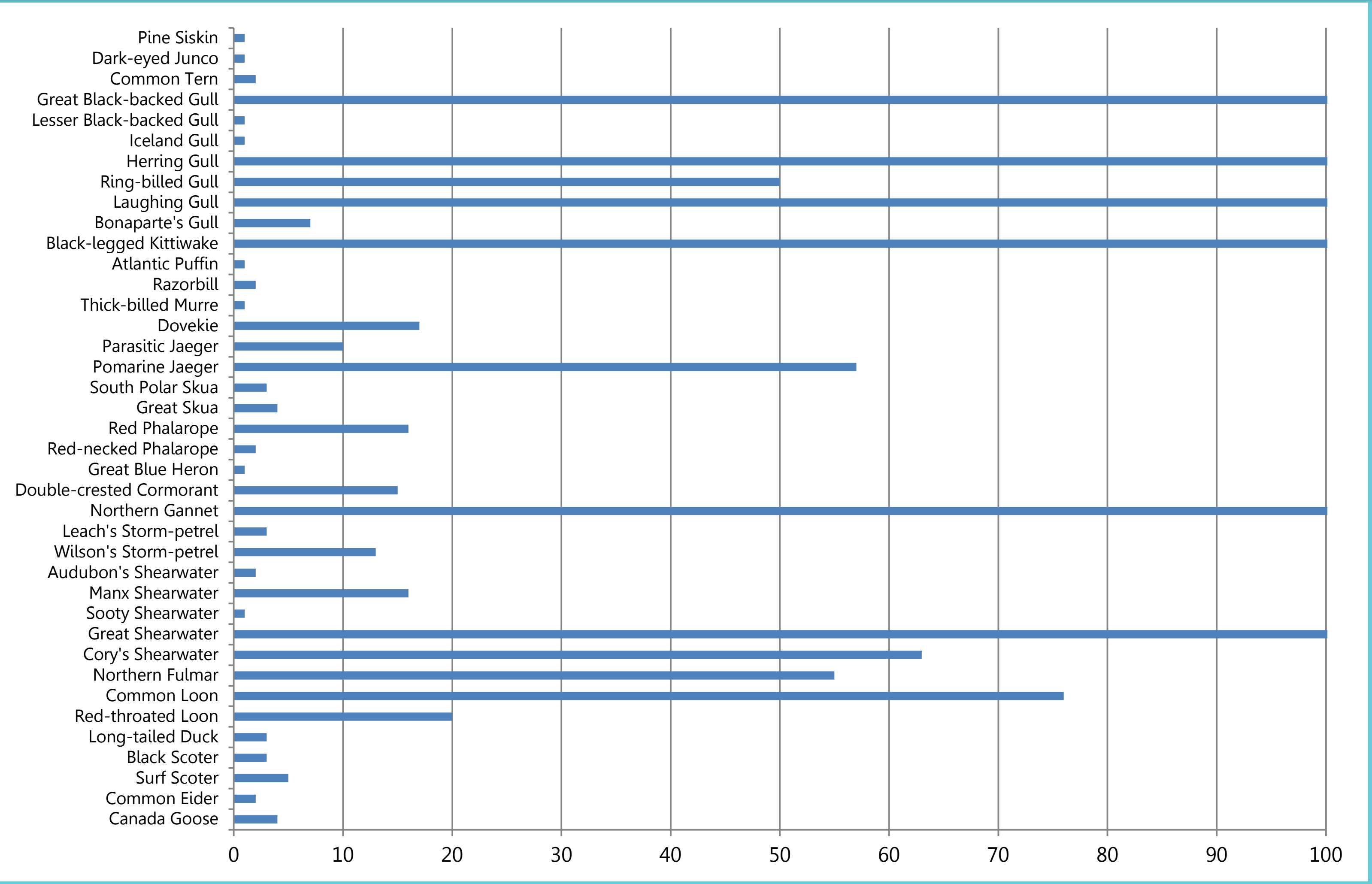
October-November



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Survey Timing
Proposed

Seasonal Survey	Months
Winter	February/March
Spring	End of April–May
Summer	End of July–August
Fall	October/November

Data Distribution

AMAPPS program NOAA and USFWS

Northwest Atlantic Seabird Catalog
by USGS, BOEM, available at NOAA

North Atlantic Right Whale Consortium

MARCO Mid-Atlantic Data Portal

MA Marine Fisheries

NY DOS Geographic Information Gateway

Large Pelagics Research Center at UMass

Feedback and Suggestions

Feedback and suggestions should be sent to:

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http://remote.normandeau.com/NYSERDA

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