Digital Aerial Baseline Survey of Marine Wildlife
In Support of New York State Offshore Wind Energy

Greg Lampman  NYSERDA
Greg Forcey  Normandeau Associates, Inc.
Steph McGovern  APEM
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

![Graph showing % identified to species by taxonomic group and platform]
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.
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
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
Spatial: Birds

**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

NY Offshore Planning Area
NY Wind Energy Area
Spatial: Roseate Terns
Spatial: Turtles
Approach
Innovations & Collaboration

- Innovative approach to survey designs
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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

<table>
<thead>
<tr>
<th>Species Group</th>
<th>Species</th>
<th>% ID (2 cm)</th>
<th>% ID (1.5 cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ducks</td>
<td>Black Scoter</td>
<td>&gt;85%</td>
<td>&gt;98%</td>
</tr>
<tr>
<td></td>
<td>Red-breasted Merganser</td>
<td>&gt;80%</td>
<td>&gt;98%</td>
</tr>
<tr>
<td></td>
<td>Long-tailed Duck</td>
<td>&gt;85%</td>
<td>&gt;95%</td>
</tr>
<tr>
<td>Loons</td>
<td>Common &amp; Red-throated Loons</td>
<td>&gt;90%</td>
<td>&gt;98%</td>
</tr>
<tr>
<td>Petrels and Shearwaters</td>
<td>Wilson’s Storm Petrel</td>
<td>&gt;75%</td>
<td>&gt;85%</td>
</tr>
<tr>
<td></td>
<td>Great &amp; Cory’s Shearwater</td>
<td>&gt;80%</td>
<td>&gt;90%</td>
</tr>
<tr>
<td></td>
<td>Manx, Audubon’s &amp; Sooty Shearwaters</td>
<td>&gt;60%</td>
<td>&gt;80%</td>
</tr>
<tr>
<td>Jeagers and Skuas</td>
<td>Parasitic &amp; Pomarine Jaeger</td>
<td>&gt;85%</td>
<td>&gt;95%</td>
</tr>
<tr>
<td>Gulls</td>
<td>Lesser &amp; Great Black-backed Gulls</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td></td>
<td>Herring Gull</td>
<td>&gt;90%</td>
<td>&gt;99%</td>
</tr>
<tr>
<td></td>
<td>Kittiwake, Laughing &amp; Bonaparte’s Gull</td>
<td>&gt;85%</td>
<td>&gt;95%</td>
</tr>
<tr>
<td>Terns</td>
<td>Caspian &amp; Royal Terns</td>
<td>&gt;85%</td>
<td>&gt;95%</td>
</tr>
<tr>
<td></td>
<td>Common, Roseate &amp; Forster’s Terns</td>
<td>&gt;60%</td>
<td>&gt;75%</td>
</tr>
<tr>
<td>Auks</td>
<td>Common Murre &amp; Razorbill</td>
<td>&gt;90%</td>
<td>&gt;99% in Summer, &lt;50% in Winter</td>
</tr>
<tr>
<td></td>
<td>Dovekie &amp; Atlantic Puffin</td>
<td>&gt;60%</td>
<td>&gt;90%</td>
</tr>
</tbody>
</table>
Example High-Res Bird Snags
Flight Planning

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

- Altitude of Aircraft (known)
- Bird Altitude (calculated)
- Bird Resolution (Calculated from average size)
- Surface Resolution (known)
- Camera

(c) Gannet (n=82)
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
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
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

- Fin Whale (Balaenoptera physalus)
- Humpback Whale (Megaptera novaeangliae)
- Minke Whale (Balaenoptera acutorostrata)
- Pilot Whale (Globicephala sp.)

MAR_APR  JUL  OCT_NOV
Temporal: Turtles

Sightings Per Unit Effort

- Winter (Dec - Feb)
- Spring (Mar - May)
- Summer (Jun - Aug)
- Fall (Sep - Nov)
Temporal: eBird

#birds by month, type

# birds

Month

MAR MAY NOV

Jaeger-Skua
Plover/etc
Duck/etc
Loon_Grebe
Cormorant
Fulmar
Puffin/etc
### 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

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Survey Timings: Winter
February-March

Atlantic Puffin

Herring Gull

Razorbill
Survey Timings: Spring
April-May

Roseate Tern

N.B. Also one LETE record in May
Survey Timings: Summer
July-August

Cory’s Shearwater

Audubon’s Shearwater
Survey Timings: Summer
July-August

Barn Swallow
Arctic Tern
Common Tern
Roseate Tern
Bridled Tern
Sooty Tern
Great Black-backed Gull
Herring Gull
Ring-billed Gull
Laughing Gull
Parasitic Jaeger
Pomarine Jaeger
South Polar Skua
Red Phalarope
Red-necked Phalarope
Sanderling
Semipalmated Plover
American Golden Plover
Double-crested Cormorant
Northern Gannet
Band-rumped Storm-petrel
Leach’s Storm-petrel
Wilson’s Storm-petrel
Audubon’s Shearwater
Manx Shearwater
Sooty Shearwater
Great Shearwater
Cory’s Shearwater
Northern Fulmar
Common Loon
Survey Timings: Fall October-November

- **Black-legged Kittiwake**
- **Red-throated Loon**
- **Jaegers and Skuas**
- **Northern Gannet**
## Survey Timing

**Proposed**

<table>
<thead>
<tr>
<th>Seasonal Survey</th>
<th>Months</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winter</td>
<td>February/March</td>
</tr>
<tr>
<td>Spring</td>
<td>End of April–May</td>
</tr>
<tr>
<td>Summer</td>
<td>End of July–August</td>
</tr>
<tr>
<td>Fall</td>
<td>October/November</td>
</tr>
</tbody>
</table>
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:

Gregory.lampman@nyserda.ny.gov

http://remote.normandeau.com/NYSERDA
WREN Webinars Held to Date

• This is WREN’s 8th webinar.
• Each offers perspectives from multiple nations on research, monitoring, methodologies, and results of wind energy and wildlife interactions.
• If you are not on the webinar mailing list, simply send a blank email to join-wind-webinars@lyris.pnnl.gov

All webinars and associated presentations are archived on the WREN Hub at: http://tethys.pnnl.gov.
Thank You!

For questions or to provide ideas for future webinars, please contact one of the members of the WREN Operating Agent team:

- Karin Sinclair karin.sinclair@nrel.gov
- Andrea Copping andrea.copping@pnnl.gov
- Jocelyn Brown-Saracino jocelyn.brown-saracino@ee.doe.gov