Development of a relational database and predictive modeling of seabird occurrence for the western Atlantic Ocean between Maine and Florida

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Introduction:

Offshore wind-generated electricity promises to be an important source of renewable energy in the future, but negative interactions between birds and wind turbines have been documented at operating sites in Europe. Unfortunately, seabird distribution in the western Atlantic between Maine and Florida is not well known, historical data collection has been haphazard, and these data exist in a variety of formats, limiting the ability of U.S. regulatory agencies to make informed decisions that will minimize the potential effects of turbines and related development on seabirds in this region. To date, this work has compiled nearly all the existing seabird occurrence data and a variety of biophysical characteristics for the region into a relational database that can now be manipulated in a geographic information system (GIS). The information is being used to develop spatially-explicit, hierarchical models of select seabird species that will help guide future placement of wind turbines and other offshore development activities.

Objectives

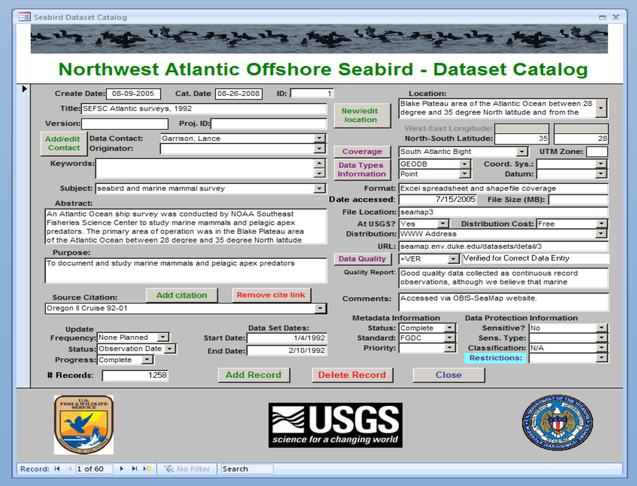
(1) Retrieve, compile, and organize seabird data for the Atlantic Outer Continental Shelf (OCS) region.

(2) Make available seabird data in an electronic database and useable in a GIS.

(3) Model seabird distribution and evaluate importance of various bio-physical factors on select species.

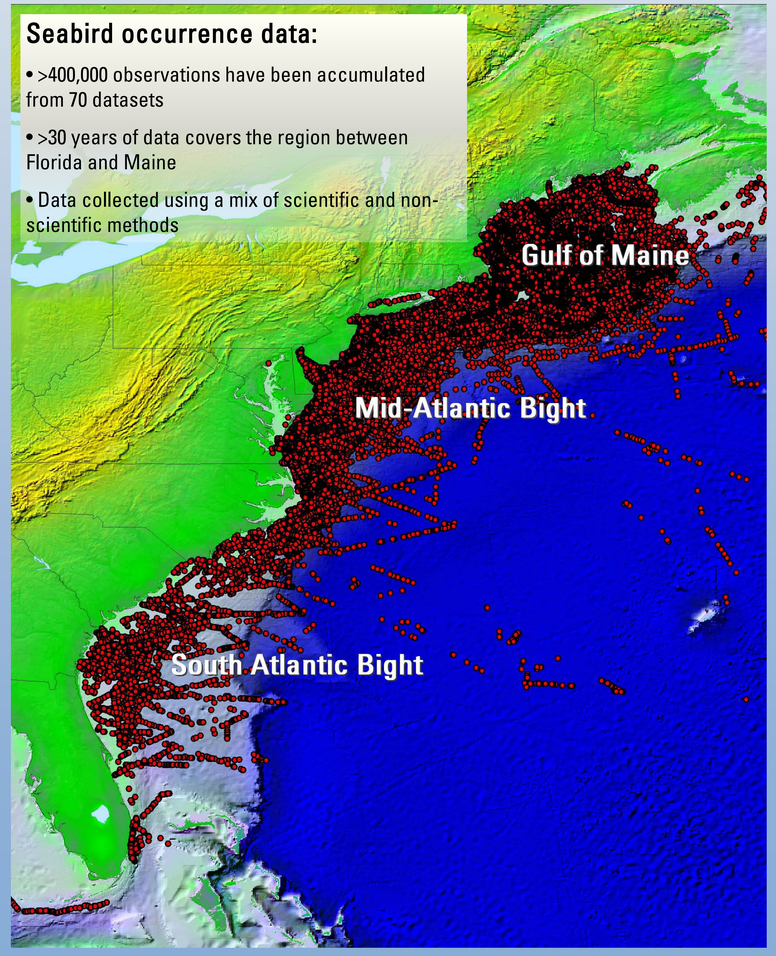
Methods:

- Developed a catalog of seabird occurrence datasets for U.S. Atlantic waters in Microsoft Access (see interface below).
  - Geographic information: coverage area, coordinate system, datum
  - General information: title, abstract, purpose, keywords, dates, contact information
  - Data: type, availability, quality
- Gathered existing electronic and paper records of historical and recent seabird data, standardizing data where necessary.
- Gathered relevant bio-physical data (e.g., bathymetry, temperature, bottom type) from a number of sources including the National Climatic Data Center, National Oceanographic and Atmospheric Administration (NOAA), and others.
- Combine seabird and biophysical data for hierarchical modeling.



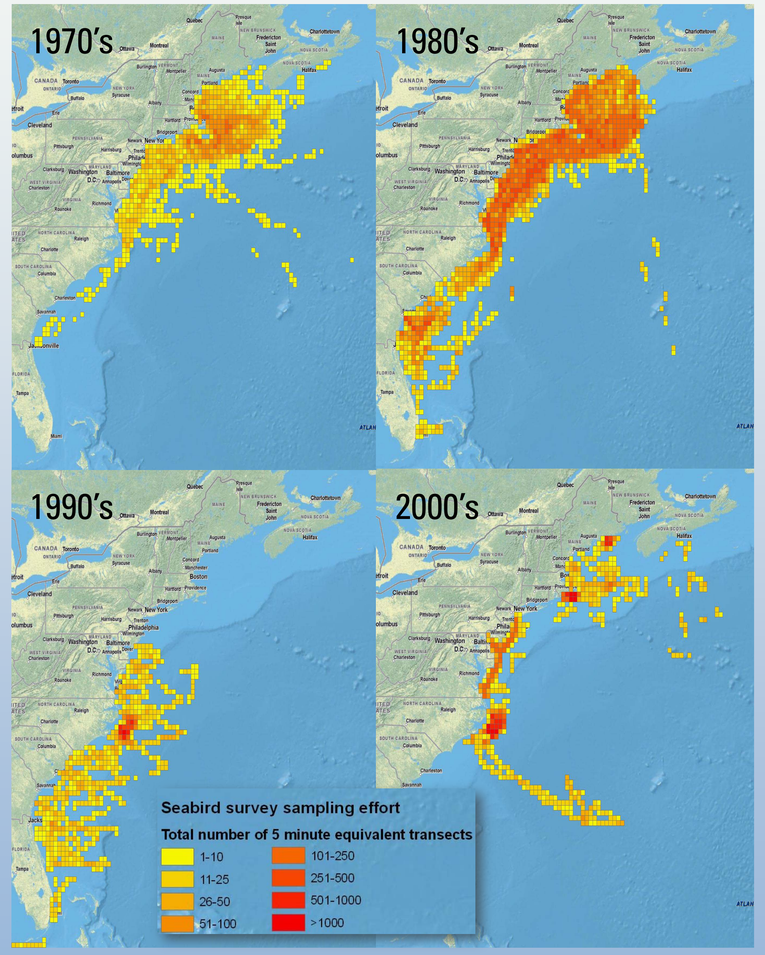
Selected seabird survey datasets for the northwest Atlantic

Dataset	Dates	Geographic coverage
Manomet Center for Conservation Sciences	1978-1980	Gulf of Maine, Mid-Atlantic Bight
Cetacean and Seabird Assessment Program	1980-1988	Gulf of Maine, Mid-Atlantic Bight
Georgia pelagic surveys	1982-1985	South Atlantic Bight
Southeast Fisheries Science Center surveys	1992,1998,1999	South Atlantic Bight
Winter Survey of the Mid-Atlantic	2001-2003	Mid-Atlantic Bight
Cape Wind, Mass Audubon	2002-2006	Nantucket Sound
North Carolina shelf—trophic predators	2004-2005	Offshore North Carolina
Bar Harbor whale watch	2005-2006	Offshore Mount Desert Island, ME
NOAA Ecosystem Monitoring Survey	2007-2009	Gulf of Maine, Mid-Atlantic Bight
NOAA Herring Acoustic Survey	2006-2009	Gulf of Maine, Mid-Atlantic Bight



Seabird survey effort

- In order to better document the spatial and temporal variability of seabirds surveys in the Atlantic OCS, we standardized survey effort to account for both discrete-time and continuous-strip surveys.
- Color schemes represent a standardized range of the number of surveys conducted in each grid cell in 5 minute equivalents.
  - Discrete time transects: 5 minute equivalents = # of 5 minute periods of survey
  - Continuous time transects: 5 minute equivalents = 0.8333 nautical mile survey segments (the distance traveled by a ship traveling 10 knots for 5 minutes)



Future Work:

- Use a hierarchical modeling approach to analyze data from a cross-section of seabird species, selected based on life-history information such as foraging attributes and conservation status.
- In the model we will:
  - Evaluate spatial variability (local, regional)
  - Evaluate temporal variability (seasons, years, decades)
  - Incorporate environmental covariates (SST, depth, proximity to seasurface fronts, chlorophyll).
  - Use estimates of effort as an offset term to account for differences in counts due to differences in survey effort.
- Develop a predictive model with confidence intervals and overlay these results on maps of wind energy potential to map potential areas of risk for seabirds.