

Effects of Offshore Wind Energy Developments on Birds

Peter Paton and Scott McWilliams, Univ of Rhode Island
ppaton@uri.edu

- 1) **Collision mortality** – hard to quantify
- 2) **Displacement** – effectively habitat loss
- 3) **Barrier effects** – disrupting local flights (e.g., foraging) and regional migratory flights

Drewitt and Langston. 2006. *Ibis* 148:29-42.

Langston. 2013. *Wildlife Society Bulletin* 37:5-18.

Estimated bird mortalities at land-based turbines:

5.3 mortalities per turbine per year (3.2-7.3)

44,577 turbines = 234,012 mortalities per year

Loss et al. 2013. Biological Conservation 168:201-209

See also Erickson et al. 2014. PLOSone 107491

Thaxter et al. 2017. Proc. Royal Soc. B 284: 20170829



Alameda County / Courtesy to the Chronicle



Alameda County

Estimating collision rates in offshore areas is extremely challenging

Reducing Collision Risk offshore:

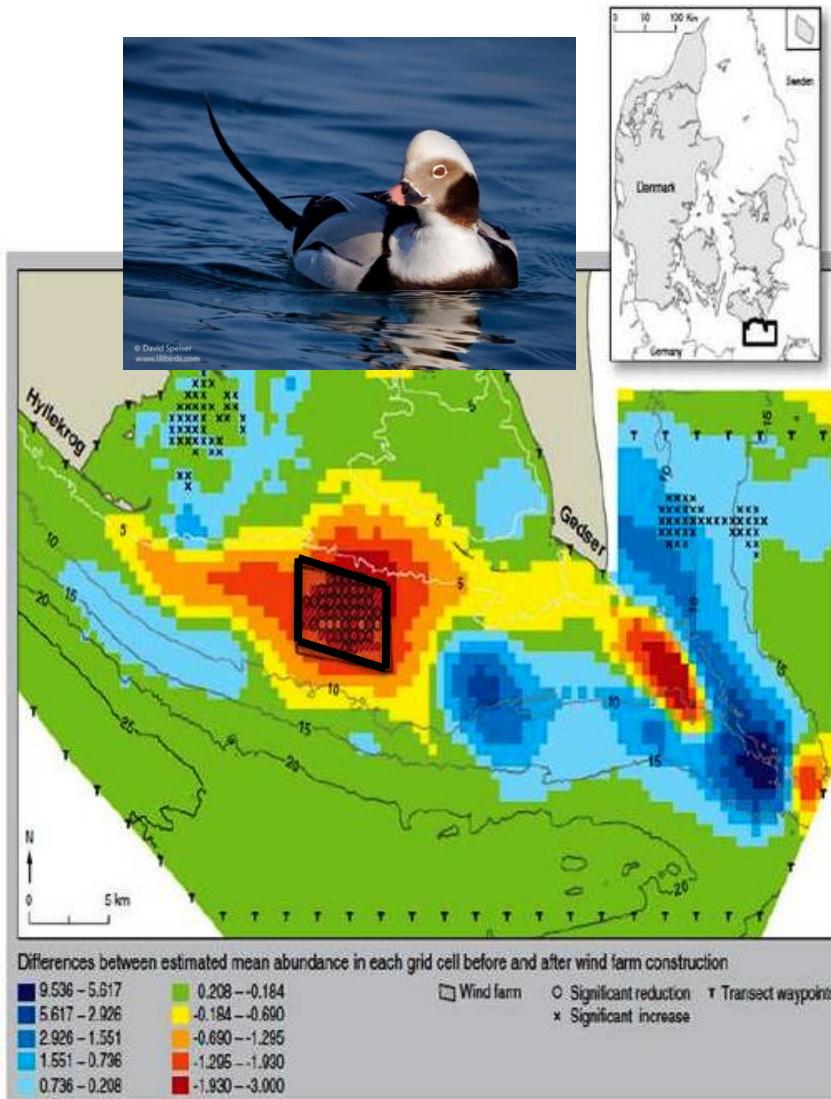
- Steady lights attract birds
- Flashing red lights have lower attraction rates

Gehring et al. 2009. Ecological Applications 19:505-514



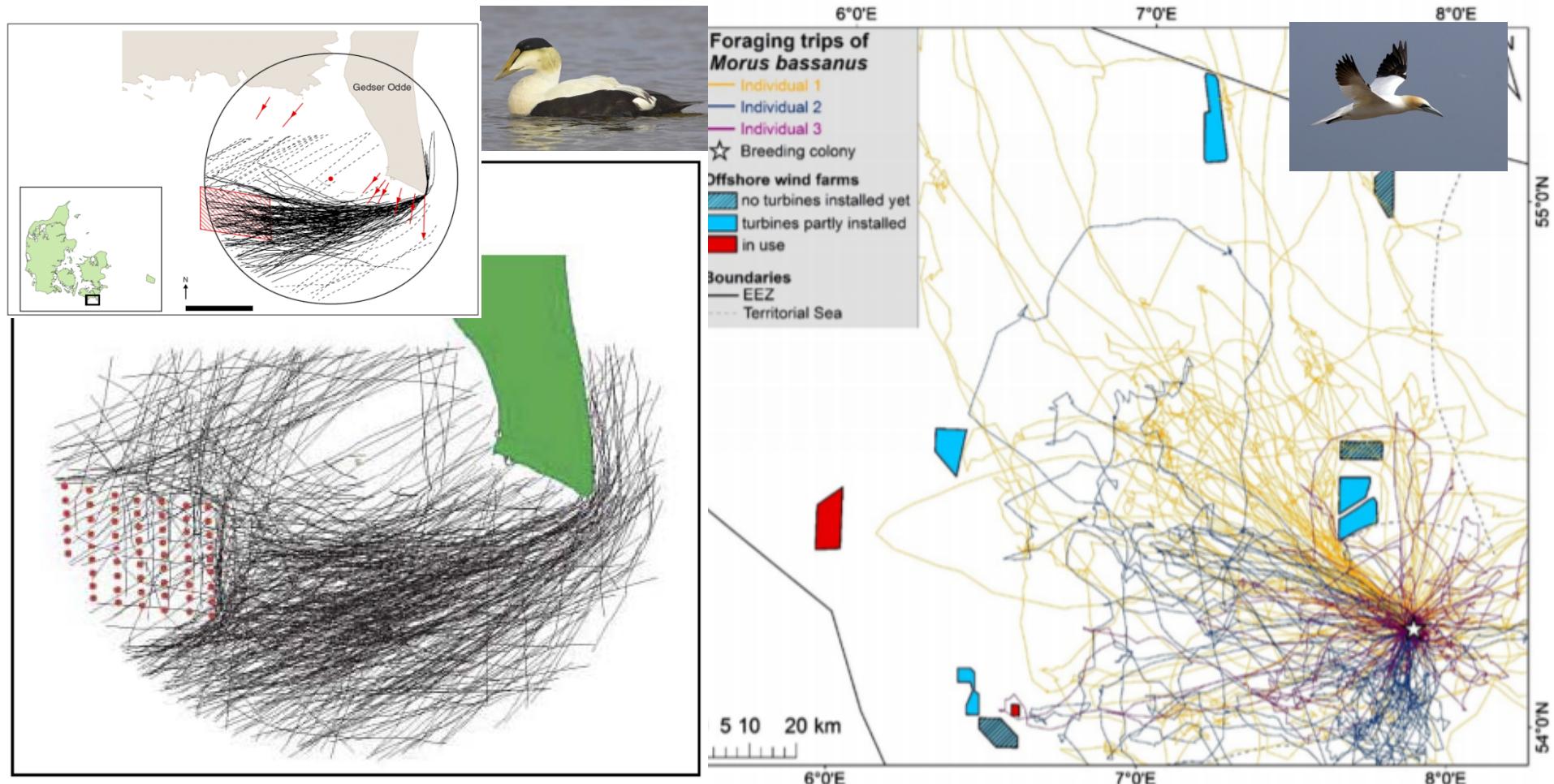
Warbler fallout Machias Seal Island, 24 May 2011: Photo - Ralph Eldridge

Displacement at Offshore Wind Facilities



-Petersen et al. 2011

Barrier Effects at Offshore Wind Facilities



Desholm and Kahlert. 2005.
Biology Letters 1:296-298.

Garthe et al. 2017.
J. Ornithology 158:345-349

Species

	strong avoidance	weak avoidance	no wind farm effect (indifferent behaviour)	weak attraction	strong attraction																						
Strong avoidance	Strong avoidance	Weak avoidance	No effect	Weak attraction	Strong attraction																						
wind farm	mean	Robin Page North Sea Kentish Flats London Array Thetra Gulfleet Sand Scroby-Sands Sheringham Shoal Bligh Thornham Princes Islands Egmond aan Zee BARD Irkens alpha ventura Horns Rev Horns Rev II Tando Nysted Lillgrund Urgundien	UK UK UK UK UK UK UK UK BE BE NL NL DE DE DK DK DK DK DK SE SE	CS CS NS NS NS NS NS NS NS NS NS NS NS NS NS NS NS NS NS BS BS BS BS BS BS	3.0 2.0 2.3 (+) (+) (+) velvet scoter <i>Melanitta fusca</i> red-breasted merganser <i>Mergus serrator</i> great crested grebe <i>Podiceps cristatus</i> red-necked grebe <i>Podiceps grisegena</i> red-throated diver <i>Gavia stellata</i> black-throated diver <i>Gavia arctica</i> red-black-throated diver <i>Gavia stellata/arctica</i> northern fulmar <i>Fulmarus glacialis</i> Manx shearwater <i>Puffinus puffinus</i> northern gannet <i>Morus bassanus</i> great cormorant <i>Phalacrocorax carbo</i> European shag <i>Phalacrocorax aristotelis</i> Arctic skua <i>Stercorarius parasiticus</i> Pomarine skua <i>Stercorarius pomarinus</i> great skua <i>Stercorarius skua</i> Atlantic puffin <i>Fratercula arctica</i> razorbill <i>Alca torda</i> common guillemot <i>Uria aalge</i> razorbill/common guillemot <i>Alca Torda/Uria aalge</i> black-legged kittiwake <i>Rissa tridactyla</i> little gull <i>Hydrocoloeus minutus</i> black-headed gull <i>Larus ridibundus</i> common gull <i>Larus canus</i> great black-backed gull <i>Larus marinus</i>	20 Wind Facilities																					
country	UK	UK	UK	UK	UK	UK	UK	UK	UK	UK	UK	BE	BE	NL	NL	DE	DE	DK	DK	DK	DK	DK	SE	SE			
region	CS	CS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	NS	BS	BS			
common eider <i>Somateria mollissima</i>	3.0													(+)									3.bh	3.bh	3.c	(+)	
long-tailed duck <i>Clangula hyemalis</i>	2.0																						1.ac	2.de	3.b		
common scoter <i>Melanitta nigra</i>	2.3	(+)	(+)	(+)			(-)								(-)				2.d	3.ehj	3.bh	1.cd			(+)		
velvet scoter <i>Melanitta fusca</i>							(-)											2.d	(-)								
red-breasted merganser <i>Mergus serrator</i>																							5.cd	3.bb	(+)		
great crested grebe <i>Podiceps cristatus</i>							(+)											1.d									
red-necked grebe <i>Podiceps grisegena</i>																								2.d			
red-throated diver <i>Gavia stellata</i>																		(+)									
black-throated diver <i>Gavia arctica</i>																											
red-black-throated diver <i>Gavia stellata/arctica</i>																											
northern fulmar <i>Fulmarus glacialis</i>																											
Manx shearwater <i>Puffinus puffinus</i>																											
northern gannet <i>Morus bassanus</i>																											
great cormorant <i>Phalacrocorax carbo</i>	4.1	5.ad	3.be	3.b			(-)											5.de	5.de								
European shag <i>Phalacrocorax aristotelis</i>																											
Arctic skua <i>Stercorarius parasiticus</i>							(-)																				
Pomarine skua <i>Stercorarius pomarinus</i>																											
great skua <i>Stercorarius skua</i>																											
Atlantic puffin <i>Fratercula arctica</i>																											
razorbill <i>Alca torda</i>	2.0	2.b	3.d				2.ad							1.a	2.b	1.d	3.b										
common guillemot <i>Uria aalge</i>	2.0	3.bd	3.a	(+)			3.ad	1.be						1.ad	1.a	1.d	2.ad	2.g	1.d								
razorbill/common guillemot <i>Alca Torda/Uria aalge</i>																											
black-legged kittiwake <i>Rissa tridactyla</i>	2.7	5.b	3.d	(+)			3.a	4.b						3.b	1.b	2.	3.b	a	2.af	1.f	3.b						
little gull <i>Hydrocoloeus minutus</i>	2.1			(-)										3.b	1.a	1.d	3.b		1.ad	3.i	3.j						
black-headed gull <i>Larus ridibundus</i>	3.7		(+)				(+)	5.b									(-)	3.b	3.b		(+)						
common gull <i>Larus canus</i>	3.5		3.b	(+)			3.ad	5.b						5.e	3.b	3.bd	3.bd		3.bf		(+)						
great black-backed gull <i>Larus marinus</i>	3.7	5.b		(+)			3.ad	2.b						5.a	5.a	3.bd	3.bd		5.a	3.d	4.d			3.b			

Post-construction surveys of 20 Offshore Wind Facilities in Europe

Distance from shore: 2- 101 km

Started operating: 1995-2013

Water depth: 0 – 37 m (most <20 m)

Number of turbines: 7-175



Richard Crossley/VIREO



P. Paton



P. Paton



R. Skarsgard



J. Joseph

Species

Red-throated Loon

Northern Gannet

Northern Fulmar

Long-tailed Duck

Manx Shearwater

Razorbill

Common Murre

Sandwich Tern

Black Scoter

Common/Arctic Tern

Black-legged Kittiwake

Common Eider

Lesser Black-backed Gull

Herring Gull

Black-headed Gull

Great Black-backed Gull

Red-breasted Merganser

European Shag (cormorant)

Great Cormorant

Strong Avoidance

Weak Avoidance

Indifferent Behavior

Weak Attraction

Strong Attraction

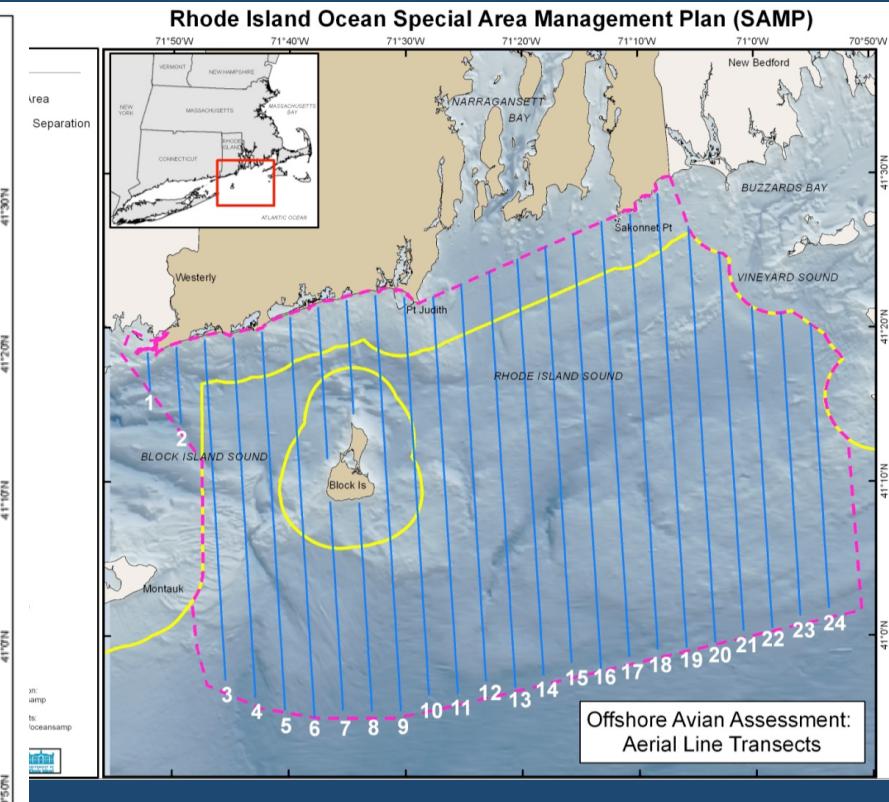
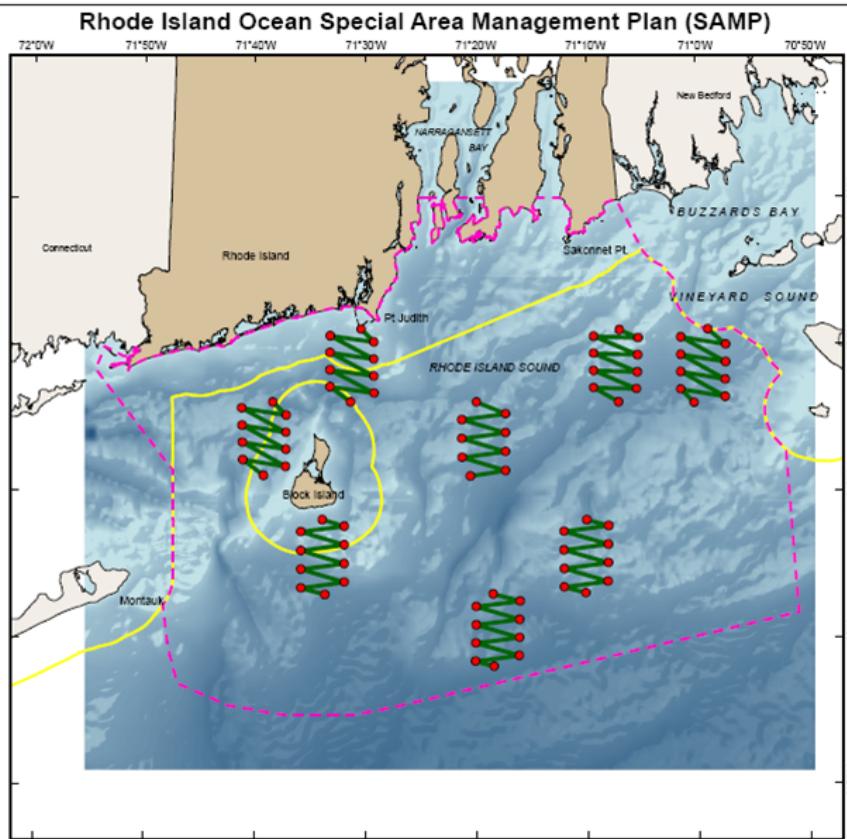
To quantify avian abundance and distribution for Rhode Island Ocean Special Area Management Plan (SAMP):

Ship-based Line Transects

8 grids – 2 surveyed per week
Feb 2009-May 2010

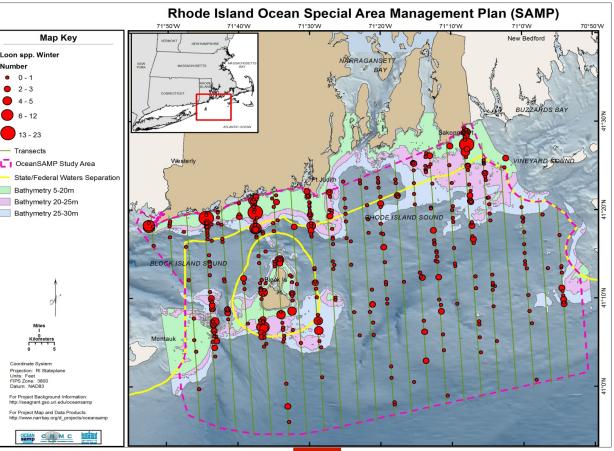
Aerial Line Transects

41 flights 3X month
Oct 2010- July 2012
24 transects – 2.5 km apart

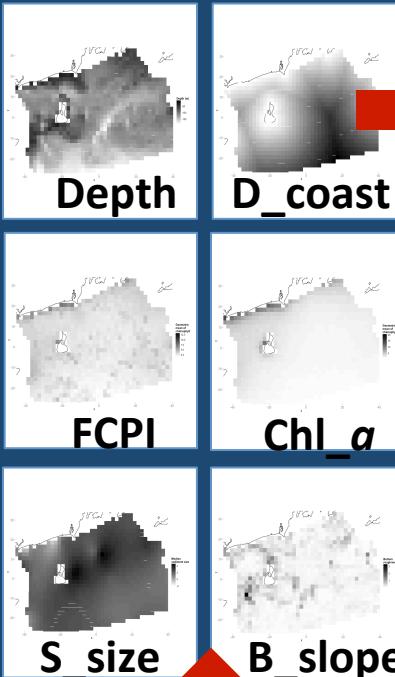


Density Surface Modeling

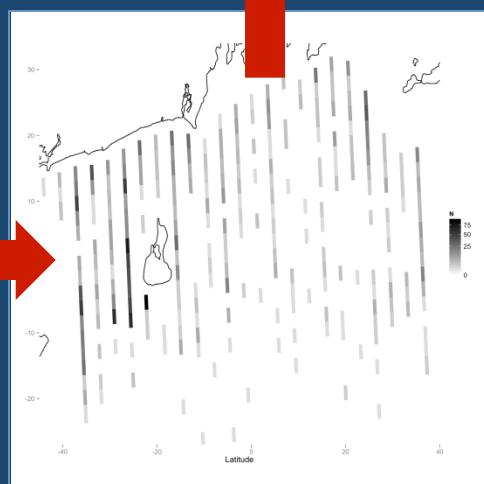
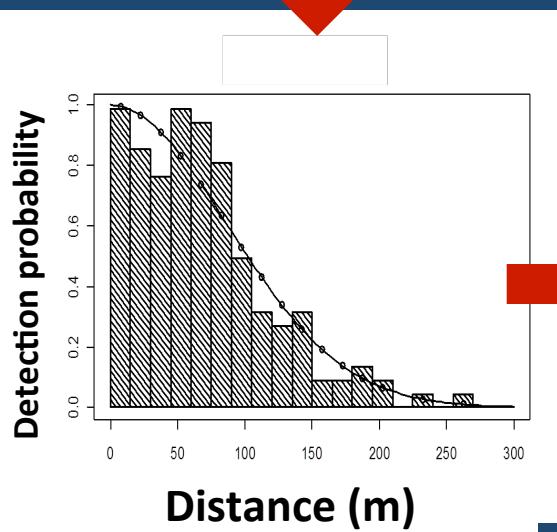
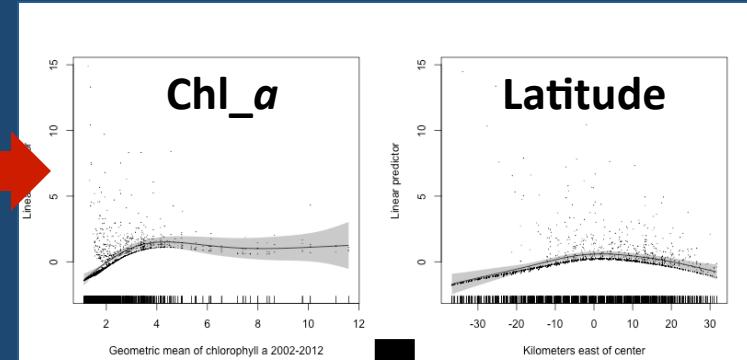
Raw Observations



Environmental Covariates

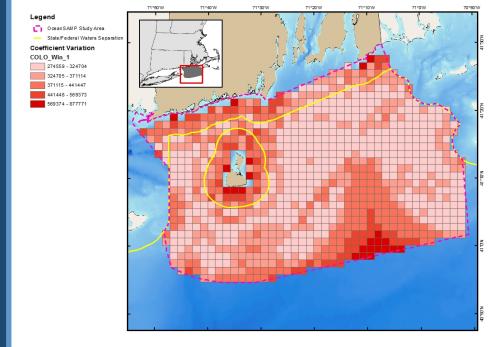


Generalized Additive Model

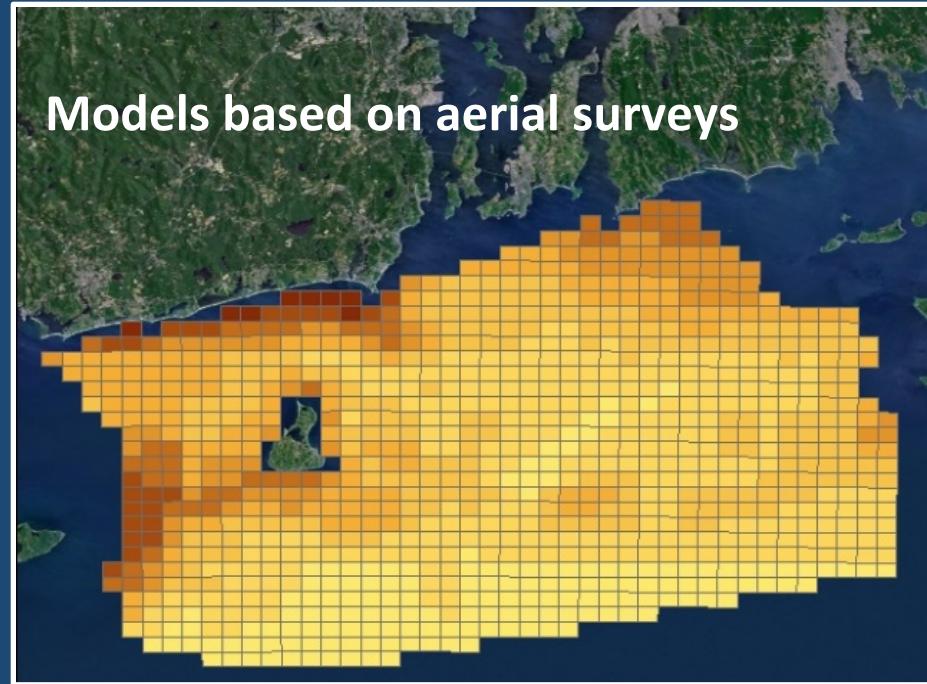
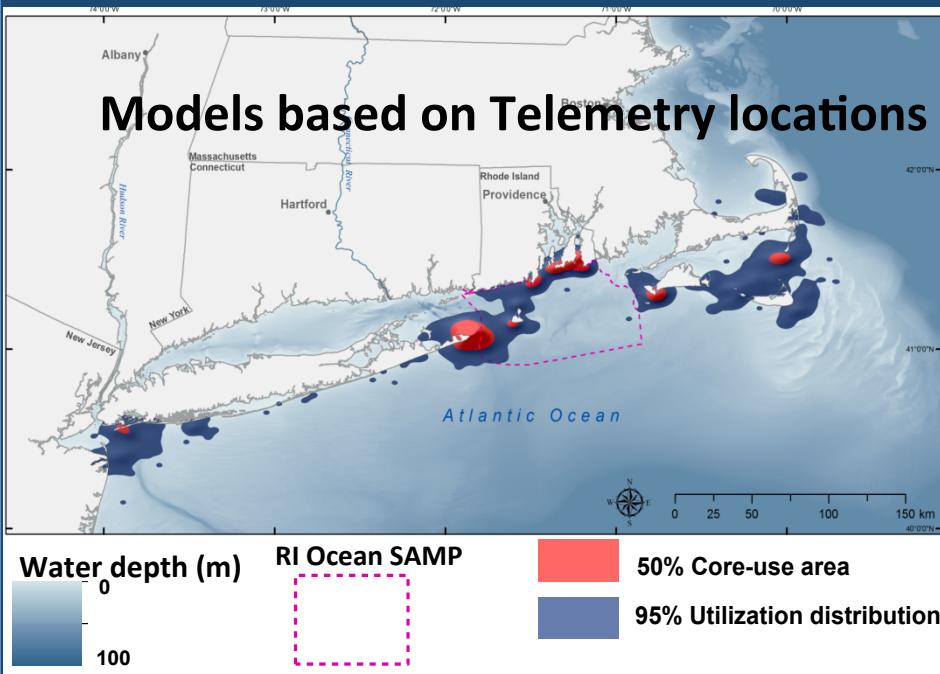


Segments

Point Estimates



Black Scoter Distribution



RI Ocean SAMP:

No offshore wind turbines in waters < 20 m deep to minimize displacement of seaducks, loons and other species from foraging sites

Loring et al. 2014. JWM 78:645-656

Flanders et al. 2015. MEPS 533: 277-290.

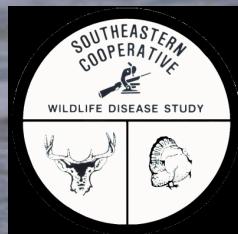
Important take home messages

- Fine- scale Pre-construction avian surveys and planning to minimize impacts are vital for a successful projects
- Surveys over multiple years are needed due to annual variation in distributions
- Post-construction assessments are needed for vulnerable species – such as current efforts we will hear about in later talks

URI Avian Publications

- Beuth et al. 2016. Validating the deuterium dilution method to measure body composition of common eider. *Wildl. Soc. Bull.* 40:456-463
- Beuth et al. 2016. Body composition dynamics of common eider during winter: An application of the deuterium dilution method. *Wildl. Soc. Bull.* 40:464-469
- Beuth et al. 2017. Habitat use and movements of common eiders wintering in southern New England. *J. of Wildl. Management* 8: 1276-1286.
- Flanders et al. 2015. Using a community occupancy model to identify key seabird areas in southern New England. *Mar Ecol Prog Ser.* 533:277-290.
- Loring et al. 2013. Densities of wintering scoters in relations to benthic prey assemblages in a North Atlantic Estuary. *Waterbirds*: 36: 36:144-155.
- Loring et al. 2014. Habitat use and selection of black scoters in southern New England and siting of offshore wind energy facilities. *J Wildl. Management* 78: 645-656.
- Shumchenia et al. 2012. An adaptive framework for selecting environmental monitoring protocols to support ocean renewable energy development. *Sci. World J.* 2012:450685.
- Smith et al. 2015. Using land-based surveys to assess sea duck abundance and behavior in nearshore waters of southern New England. *Waterbirds* 38:252-259.
- Winiarski et al. 2013. Spatially explicit model of wintering common loons: conservation implications. *Mar Ecol Prog Ser* 492:273-283
- Winiarski et al. 2014. A spatial conservation prioritization approach for protecting marine birds given proposed offshore wind energy development. *Biol Con* 169:79-88
- Winiarski et al. 2014. Integrating aerial and ship surveys of marine birds. *Condor* 116:149-161.

Study Partners and Collaborators

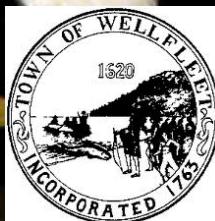


COASTAL RESOURCES CENTER

University of Rhode Island



Department of Conservation and Recreation
Commonwealth of Massachusetts



www.briloon.org



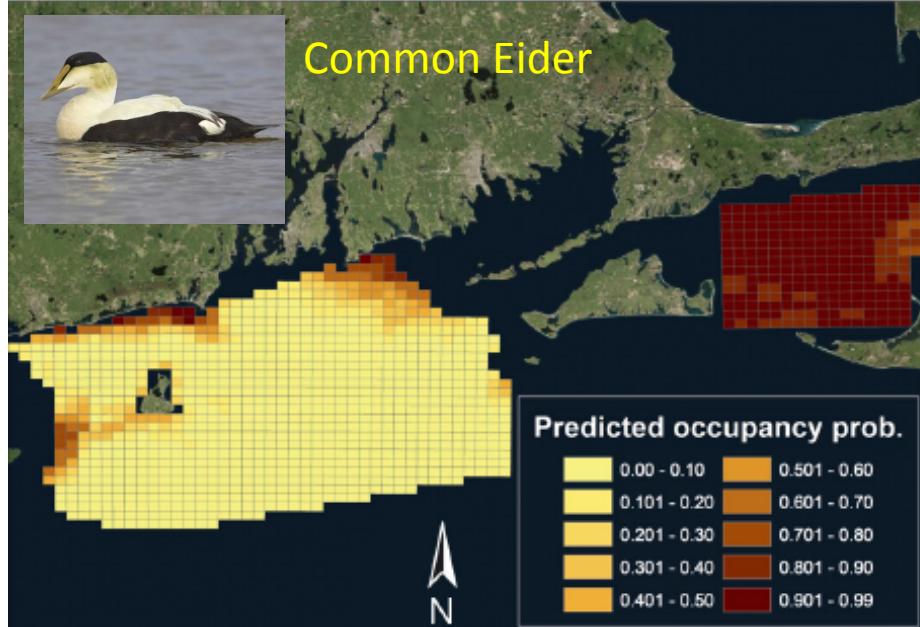
Northeast Wildlife Disease Cooperative



Photo Courtesy Andreas Trepte, www.photo-natur.de

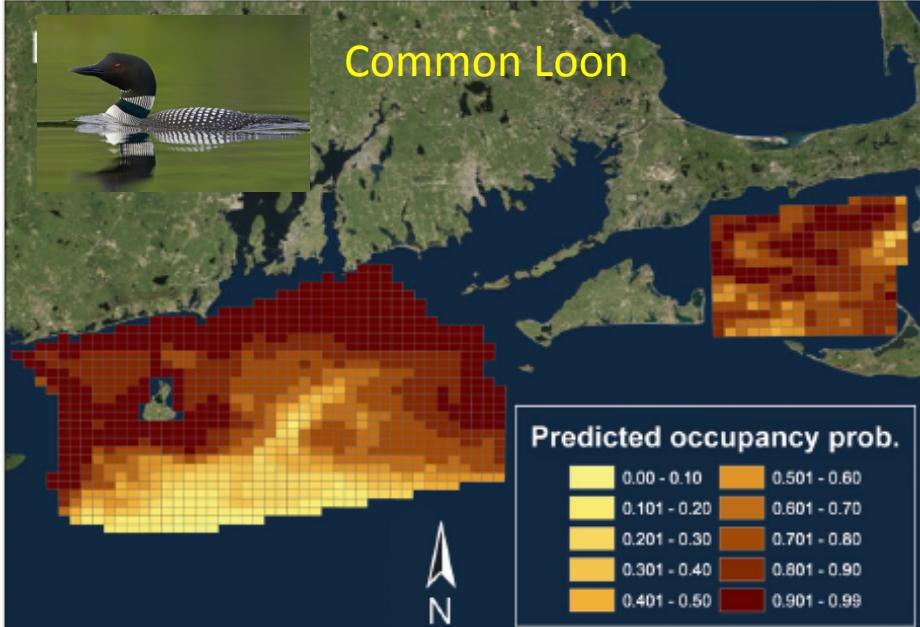


Common Eider



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

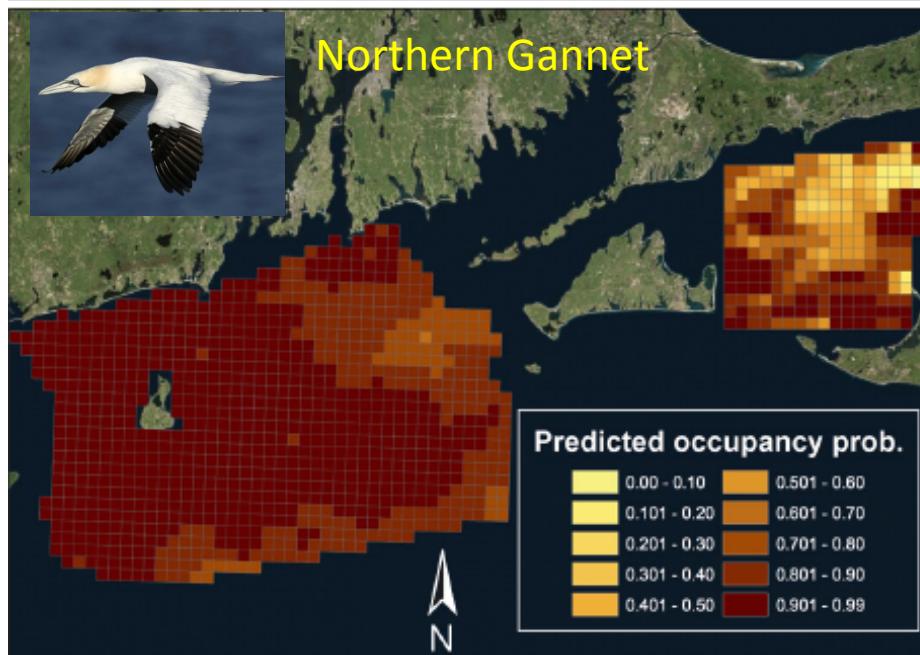
Common Loon



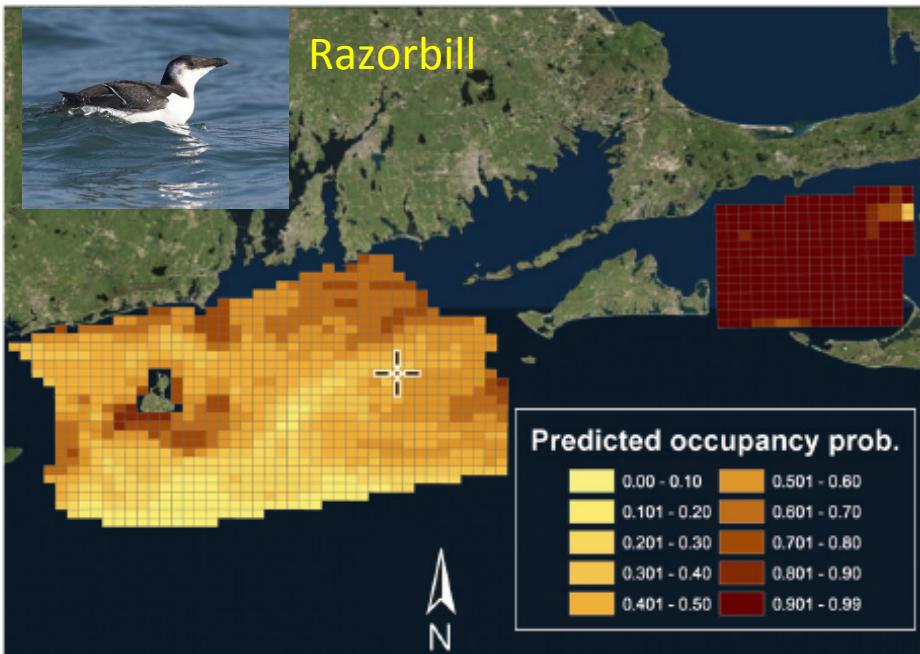
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



Northern Gannet



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community



Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AEX, Getmapping, Aerogrid, IGN, IGP, swisstopo, and the GIS User Community

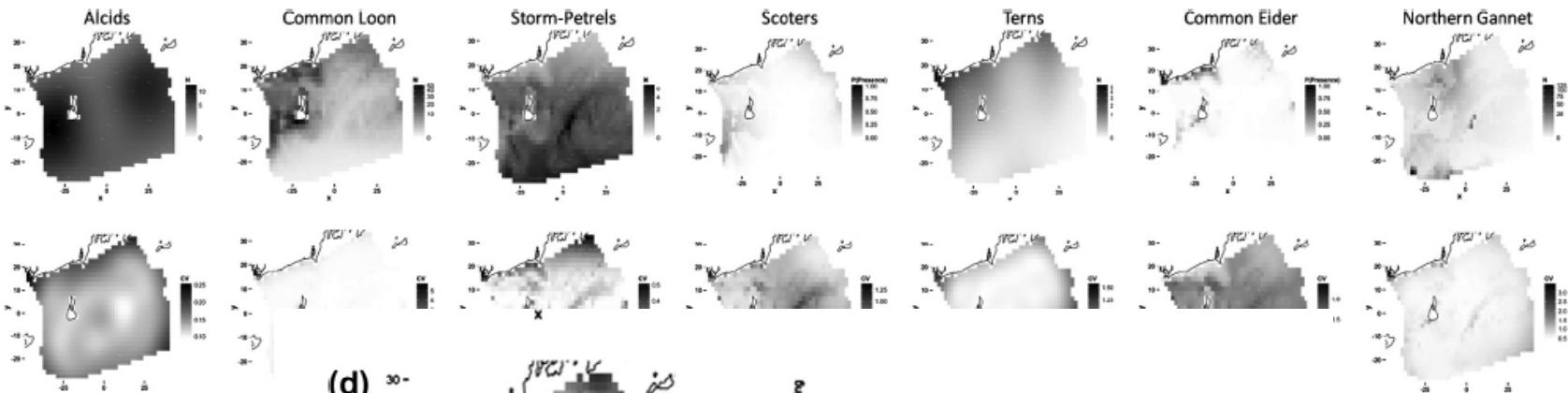
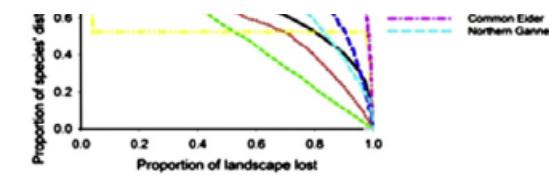
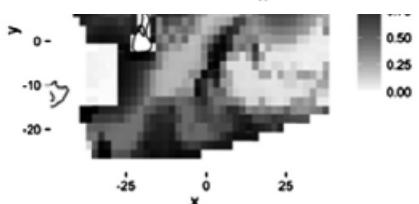
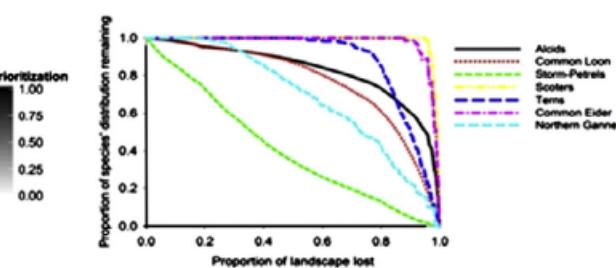
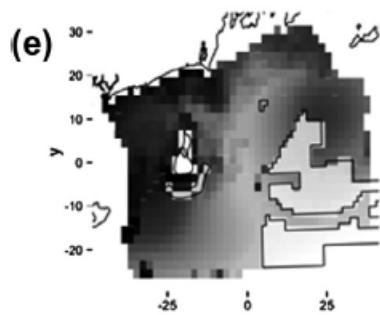
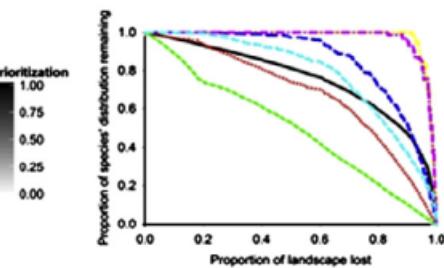
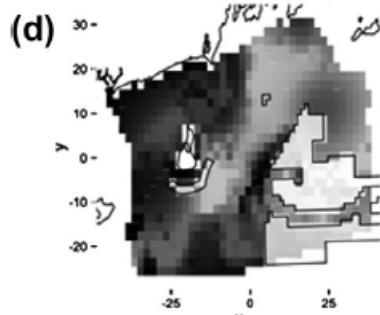


Fig. 2. Density surface models of coast of Rhode Island. Top panel uncertainty (coefficient of variati

ed during aerial surveys off the
ence. Bottom panels are model



Estimated bird mortalities at land-based turbines:
5.3 mortalities per turbine per year (3.2-7.3)
44,577 turbines = 234,012 mortalities per year

Loss et al. 2013. Biological Conservation 168:201-209

See also Erickson et al. 2014. PLOSone 107491

Thaxter et al. 2017. Proc. Royal Soc. B 284: 20170829

