

Ph.D. Candidate

Lauren Scopel

Graduate Academic Unit

Biology

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**March 28, 2022**

**2:00 p.m. (Atlantic)**

**Virtual Defence**  
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Examining Board:

Dr. Brian Hayden (Biology)

Dr. Jeff Houlahan (Biological Sciences)

Dr. Loïc D'Orangeville (Forestry and Environmental Management)

Dr. Tony Diamond (Biology)

Supervisor

Dr. Graham Forbes (Forestry and Environmental Management)

Supervisor

External Examiner: Dr. Morten Frederiksen

Department of Ecoscience

Aarhus University

The Oral Examination will be chaired by:

Dr. Kevin Englehart, Acting Dean of Graduate Studies

BIOGRAPHY

Universities attended (with dates & degrees obtained):

2012 – present

Ph.D. candidate, University of New Brunswick

2008

BSc, Zoology, Michigan State University

2008

BSc, Fisheries and Wildlife, Michigan State University

Publications:

Depot, K.M., **L.C. Scopel**, S.W. Kress, P. Shannon, A.W. Diamond, and K.H. Elliott. “Atlantic puffin diet reflects haddock and redfish abundance in the Gulf of Maine.” *Marine Ecology Progress Series* 656: 75-87.

Scopel, L.C., A.W. Diamond, S.W. Kress, and P. Shannon. 2019. “Varied breeding responses of seabirds to a regime shift in prey base in the Gulf of Maine.” *Marine Ecology Progress Series* 626: 177-196.

Scopel, L.C., A.W. Diamond, S.W. Kress, A.R. Hards, and P. Shannon. 2018. “Seabird diets as bioindicators of Atlantic herring recruitment and stock size: a new tool for ecosystem-based fisheries management.” *Canadian Journal of Fisheries and Aquatic Sciences*: 75(8): 1215-1229.

Scopel, L.C. and A.W. Diamond. 2018. “Predation and food-weather interactions drive colony collapse in a managed metapopulation of Arctic Terns (*Sterna paradisaea*).” *Canadian Journal of Zoology* 96: 13-22.

Scopel, L.C. and A.W. Diamond. 2017. “The case for lethal control of gulls on seabird colonies.” *Journal of Wildlife Management* 81(4): 572-580.

Cox, J.A., **L.C. Scopel** and M.R. Klostermann. 2012. “Brown-headed nuthatch occupancy in Central Florida and its relationship to forest type, forest structure, and presence of red-cockaded woodpeckers.” *The Condor* 114(3): 622-628.

Selected Conference Presentations:

World Seabird Conference – October 6, 2021 – “Dynamics of prey and predator movements in linked metapopulations”

International Ornithological Congress/Waterbirds Society Meeting – August 19, 2018 – “How can seabird diets be used to inform fisheries management?”

Fishermen and Scientists Research Society – March 7, 2018 – “How can seabird diets be used to inform fisheries management?”

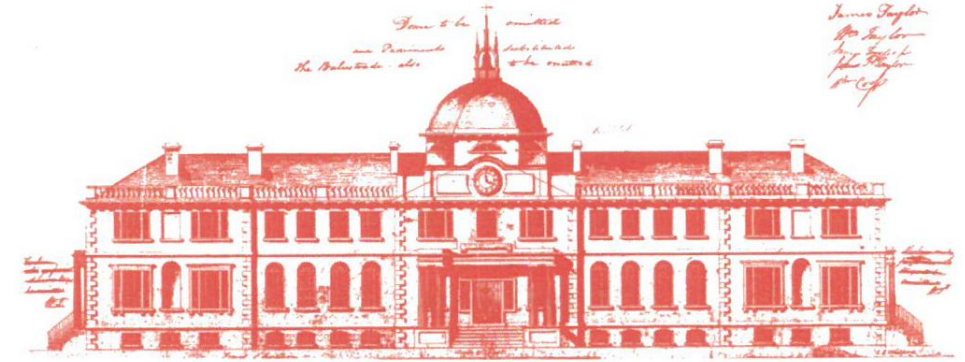
Waterbirds Society Meeting – August 9, 2017 – “How do environmental stressors affect different colonies in a seabird metapopulation?”

World Seabird Conference – October 27, 2015 – “When gulls eat terns: quantifying impacts of management decisions for a seabird colony”

Developing seabird bioindicators for the Gulf of Maine: a demographic study of an Arctic Tern (*Sterna paradisaea*) metapopulation

Abstract

As climate change proceeds, ecosystems are changing rapidly. Marine ecosystems are complex and difficult to monitor, making the prediction of future changes a daunting task. Seabirds are often suggested as potential bioindicators, yet the development of their data for general predictive use is rare. I, using the data of many collaborators, examined the potential use of Arctic Tern (*Sterna paradisaea*) diet and demographic data as bioindicators in the rapidly warming Gulf of Maine (GOM) ecosystem. The collapse of the breeding colony at Machias Seal Island, formerly the largest in North America, was primarily driven by unmitigated egg predation by large *Larus* gulls, not a decline in Atlantic herring (*Clupea harengus*). At the metapopulation scale, reproductive success of Arctic Terns was subject to multiple environmental interactions. The proximity of a colony to shore was associated with higher diet quality, but also greater predator pressures. Interactions between diet quality, weather, and predator behaviour strongly influenced the reproductive success of terns. At the ecosystem scale, the diets of Arctic and Common Terns (*S. hirundo*) could be combined with environmental data to describe and track ecosystem states. Arctic Terns were more likely to consume white hake (*Urophycis tenuis*) and small marine invertebrates, but their dietary trends also tracked measures of the herring stock and fishery. Common Terns were more likely to target high-lipid fish, but they showed stronger spatial trends that limited regional inferences. Finally, I estimated rates of survival, dispersal, and return rates. Arctic Terns have strong dispersal behaviour and regularly leave the major colonies of the GOM, but adult survival has not changed, despite major warming. Multiple types of tern data indicated that the weakest period of the past 30 years was between 2004-2012, when salinity was reduced and small copepods like *Centropages typicus* were less abundant. Arctic Terns were able to react to major declines in habitat quality, and have adjusted well to recent warming. Although Arctic Terns are affected by both top-down and bottom-up forcing, their diet and demographic data are useful as indicators. Terns could function well as ecosystem, guild-, or site-specific indicators, depending on the desired use.



Home of the School of Graduate Studies, Sir Howard Douglas Hall was designed by J.E. Woolford in 1825 and is the oldest university building in Canada still in use.

The University of New Brunswick recognizes that the university sits on traditional Wolastoqey territory. The river that runs right by our university – the St. John River – is also known as Wolastoq, along which live the Wolastoqiyik -- the people of the beautiful and bountiful river.

UNIVERSITY OF NEW BRUNSWICK SCHOOL OF GRADUATE STUDIES

ORAL EXAMINATION

Lauren Scopel

IN PARTIAL FULFILMENT OF THE REQUIREMENTS FOR THE DEGREE OF

DOCTOR OF PHILOSOPHY