Sea duck telemetry analyses

Juliet Lamb, Scott McWilliams, Peter Paton, Jay Osenkowski, Clara Cooper-Mullin

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The focus of our project was to synthesize and summarize multi-species sea duck telemetry data from the Atlantic and Great Lakes Sea Duck Migration Study, supplemented by tracking data from Pacific sea duck populations. Our main goals were to identify and quantify use of key habitat areas and migration routes, identify population units, and provide recommendations for monitoring and management.

The expected outcomes of this project included a total of five manuscripts. Two of these – a network analysis of annual-cycle sea duck movements and migration (Lamb et al. 2019, Ecological Applications) and a comparison of multi-species habitat use and partitioning (Lamb et al. 2020, Ecography) – were part of the initial phase of the project (2017-2019) that was a collaboration between Rhode Island Dept Environmental Management, Division of Fish & Wildlife, University of Rhode Island, and many biologists associated with the SDJV. Three additional manuscripts were added in our 2019 project extension with SDJV. The first of these examined the duration and nature of behavioral changes after capture and transmitter implantation (Lamb et al. 2020, Condor). The second of these manuscripts focuses on Black Scoter annual-cycle movements and is near completion - just waiting for final editorial suggestions from co-authors before being submitted by 1 Feb 2021 to the Journal of Wildlife Management. The third paper expands on our published network analysis of movements of sea ducks in eastern North America by incorporating data collected by biologists in western North America of scoter populations. We have slowly been accumulating data from collaborators on the west coast and this report is in the analysis phase and will be submitted within the next few months to Frontiers in Ecology and Environment.

In addition to preparing the manuscripts described above, during this reporting period we have presented our work and methods at several conferences, including at the 2019 Annual Meeting of the Pacific Seabird Group (February 2019, Kauai, Hawaii; network analysis); the North American Duck Symposium (August 2019, Winnipeg, Manitoba; network analysis and habitat selection); the 2019 Annual Meeting of the Waterbird Society (November 2019, Princess Anne, Maryland; habitat selection and partitioning); and the 2020 Annual Meeting of the Pacific Seabird Group (February 2020, Portland, Oregon; habitat selection and partitioning). We have also presented our work at local meetings of the Rhode Island Department of Environmental Management, and at academic seminars.

Manuscripts from this project have so far received at least six citations in published literature and are being used by the U.S. Geological Survey and other agencies to identify hot spots and refine sea duck habitat management strategies. We have also participated in several training sessions

directly aimed at introducing managers to our methods and findings. In December 2020, we participated in the Road to Recovery symposium, organized by the Smithsonian Migratory Bird Center and attended by over 600 wildlife practitioners, where we presented the network analysis project as a case study for multi-species management and participated in a panel discussion on management of declining migratory birds. We have also given webinars on this project to the U.S. Fish and Wildlife Service and the Canadian Wildlife Service.

Abstracts for completed and in-progress manuscripts and download links for completed manuscripts can be found on the following pages. A summary of the recent Road to Recovery workshop and a video recording of our presentation is available at http://marralab.com/r2rpart2/. Copies of the published and draft articles are also available from juliet.lamb@cefe.cnrs.fr.

Abstracts from completed manuscripts

Lamb, J. S., P.W. C. Paton, J. E.Osenkowski, S. S. Badzinski, A. M. Berlin, T. Bowman, C. Dwyer, L. J. Fara, S. G. Gilliland, K. Kenow, C. Lepage,M. L.Mallory, G. H. Olsen, M. C. Perry, S. A. Petrie, J.-P. L. Savard, L. Savoy, M. Schummer, C. S. Spiegel, and S. R. McWilliams. 2019. Spatially explicit network analysis reveals multi-species annual cycle movement patterns of sea ducks. Ecological Applications 29:e01919. DOI: 10.1002/eap.1919. https://esajournals.onlinelibrary.wiley.com/doi/full/10.1002/eap.1919

Long-distance migration presents complex conservation challenges, and migratory species often experience shortfalls in conservation due to the difficulty of identifying important locations and resources throughout the annual cycle. In order to prioritize habitats for conservation of migratory wildlife, it is necessary to understand how habitat needs change throughout the annual cycle, as well as to identify key habitat sites and features that concentrate large numbers of individuals and species. Among long-distance migrants, sea ducks have particularly complex migratory patterns, which often include distinct post-breeding molt sites as well as breeding, staging and wintering locations. Using a large set of individual tracking data (n = 476 individuals) from five species of sea ducks in eastern North America, we evaluated multi-species habitat suitability and partitioning across the breeding, post-breeding migration and molt, wintering and pre-breeding migration seasons. During breeding, species generally occupied distinct habitat areas, with the highest levels of multi-species overlap occurring in the Barrenlands west of Hudson Bay. Species generally preferred flatter areas closer to lakes with lower maximum temperatures relative to average conditions, but varied in distance to shore, elevation and precipitation. During non-breeding, species overlapped extensively during winter but diverged during migration. All species preferred shallow-water, nearshore habitats with high productivity, but varied in their relationships to salinity, temperature and bottom slope. Sea ducks selected most strongly for preferred habitats during post-breeding migration, with high partitioning among species; however, both selection and partitioning were weaker during pre-breeding migration. The addition of tidal current velocity, aquatic vegetation presence and bottom substrate improved non-breeding habitat models where available. Our results highlight

the utility of multi-species, annual-cycle habitat assessments in identifying key habitat features and periods of vulnerability in order to optimize conservation strategies for migratory wildlife.

Lamb, J. S., P.W. C. Paton, J. E.Osenkowski, S. S. Badzinski, A. M. Berlin, T. Bowman, C. Dwyer, L. J. Fara, S. G. Gilliland, K. Kenow, C. Lepage, M.L.Mallory, G. H. Olsen, M. C. Perry, S. A. Petrie, J.-P. L. Savard, L. Savoy, M. Schummer, C. S. Spiegel, and S. R. McWilliams. 2020. Assessing year-round habitat use by migratory sea ducks in a multi-species context reveals seasonal variation in habitat selection and partitioning. Ecography 43: 1842-1858. DOI: 10.1111/ecog.05003 https://onlinelibrary.wiley.com/doi/full/10.1111/ecog.05003

Long-distance migration presents complex conservation challenges, and migratory species often experience shortfalls in conservation due to the difficulty of identifying important locations and resources throughout the annual cycle. In order to prioritize habitats for conservation of migratory wildlife, it is necessary to understand how habitat needs change throughout the annual cycle, as well as to identify key habitat sites and features that concentrate large numbers of individuals and species. Among long-distance migrants, sea ducks have particularly complex migratory patterns, which often include distinct post-breeding molt sites as well as breeding, staging, and wintering locations. Using a large set of individual tracking data (N = 476 individuals) from five species of sea ducks in eastern North America, we evaluated multi-species habitat suitability and partitioning across the breeding, post-breeding migration and molt, wintering, and pre-breeding migration seasons. Species selected for common habitat features throughout the annual cycle; however, habitat selectivity and inter-species partitioning varied by season. Sea ducks partitioned shared breeding habitat according to climate conditions, landcover, and distance to water bodies. Wintering sea ducks displayed strong selectivity but weak habitat partitioning, and all species occupied shallow-water aquatic habitats with relatively high productivity, salinity, and temperatures. Selection intensity and partitioning were both strong during post-breeding migration and molt, but weak during pre-breeding migration, suggesting that availability of preferred habitat features is particularly important during the post-breeding period. Our results highlight the utility of multi-species, annual-cycle habitat assessments in informing conservation strategies for migratory wildlife.

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Studies of the effects of transmitters on wildlife often focus on survival. However, sublethal behavioral changes resulting from radio-marking have the potential to affect inferences from telemetry data and may vary based on individual and environmental characteristics. We used a long-term, multi-species tracking study of sea ducks to assess behavioral patterns at multiple temporal scales following implantation of intracoelomic satellite transmitters. We applied state-space models to assess short-term behavioral patterns in 476 individuals with implanted satellite transmitters, as well as comparing breeding site attendance and migratory phenology across

multiple years after capture. In the short term, our results suggest an increase in dispersive behavior immediately following capture and transmitter implantation; however, behavior returned to seasonally average patterns within ~5 days after release. Over multiple years, we found that breeding site attendance by both males and females was depressed during the first breeding season after radio-marking relative to subsequent years, with larger relative decreases in breeding site attendance among males than females. We also found that spring and breeding migrations occurred later in the first year after radio-marking than in subsequent years. Across all behavioral effects, the severity of behavioral change often varied by species, sex, age, and capture season. We conclude that, although individuals appear to adjust relatively quickly (i.e. within 1 week) to implanted satellite transmitters, changes in breeding phenology may occur over the longer term and should be considered when analyzing and reporting telemetry data.

Lamb, J. S., S. G. Gilliland, P.W. C. Paton, J. E.Osenkowski, J.-P. L. Savard, T. Bowman, P. H. Loring, G. H. Olsen, M. C. Perry, and S. R. McWilliams. In review. Annual-cycle Movements and Phenology of Black Scoters in Eastern North America. Journal of Wildlife Management.

Sea ducks exhibit complex movement patterns throughout their annual cycle, as most species utilize distinct molt and staging sites during migration, in addition to disjunct breeding and wintering sites. Although research on black scoters (Melanitta americana) has investigated movements and habitat selection during the winter, little is known about their annual cycle movements. We used satellite telemetry to identify individual variation in migratory routes and breeding areas for black scoters wintering along the Atlantic Coast, and to assess migratory connectivity between wintering, staging, breeding, and molting sites. Black scoters occupied wintering areas from the Canadian Maritimes to the South Atlantic Bight with males using on average 2.5 distinct winter areas compared to 1.1 areas for females, with within-winter movements averaging 1256 km per individual. Individuals utilized on average 2.1 staging sites during spring migration, with almost all tagged birds detected in the Gulf of St. Lawrence. Most individuals occupied breeding areas west of Hudson Bay in the Barrenlands, which previously was unknown as a nesting area. Males arrived earlier and departed earlier than females from breeding sites. During fall migration, females took approximately 25 fewer days than males to migrate from breeding sites to molt and staging sites, and then wintering areas. Most birds utilized molt sites in James and Hudson Bays before migrating directly to coastal wintering sites, which took approximately 11 days and covered 1524 km. Males tended to arrive 10 days before females to wintering areas. There was weak connectivity between breeding and wintering sites, however females exhibited higher fidelity (4.5 km) to previously-used breeding sites compared to males (60 km). Our results show that the Atlantic Coast population of the black scoter is more dispersed in the winter, but more concentrated during migration than other species of sea ducks. These results could have implications for future survey efforts designed to assess population trends of black scoters.

The Lamb et al. 2020 article in Ecography was recently featured on the cover of the journal:

A mixed-species flock of sea ducks (Tribe: Mergini) at sunrise off the coast of Rhode Island, USA. This flock was photographed during an early-morning trip to capture sea ducks at sea and fit them with GPS transmitters. Sea ducks often concentrate in large, dense flocks in preferred marine habitat areas during non-breeding. In Lamb et al., we used tracking data from this region, as well as from other locations throughout eastern North America, to examine sea duck habitat use throughout the annual cycle in a multi-species context. We found that sea ducks prefer highly productive nearshore marine habitats, often in areas with seagrasses and strong tidal currents. These findings help to identify important habitats used by high concentrations of non-breeding sea ducks, which may overlap with areas recently proposed for offshore wind energy development along the Atlantic coast of North America. Photo Credit: Peter Paton, University of Rhode Island.