Sea Duck Joint Venture
Annual Project Summary
FY23 (October 1, 2022 – September 30, 2023)

Project Title: Engaging a transboundary expert network to prioritize coastal and marine habitat management for sea ducks in the Salish Sea (Grant #F22AC01122).

Principal Investigators:

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Partners:

- Dr. Sarah Converse (University of Washington/ USGS Cooperative Research Unit)
- Kyle Spragens (Washington Department of Fish and Wildlife)
- Dr. Trina Bayard (Audubon Washington)
- Megan Ross, Dr. W. Sean Boyd, Kathleen Moore, supported by Andrew Huang (Environment and Climate Change Canada – Canadian Wildlife Service and Science and Technology Branch)
- Bruce Harrison (Ducks Unlimited Canada)
- Monica Iglecia and Laura Farwell (Pacific Birds Habitat Joint Venture, U.S.).

Project Description:

Globally significant numbers of several sea duck species are dependent on the Salish Sea, and the Sea Duck Joint Venture has identified the Salish Sea as a priority region because of its importance for wintering sea ducks including the three scoter species (Surf *Melanitta perspicillata*, White-winged *M. deglandi* and Black *M. americana*), and Long tailed Duck *Clangula hyemalis*). Benthic-feeding birds from a variety of taxa, including sea ducks, are showing long-term declines in the Canadian portion of the Salish Sea. Annual monitoring in Washington State for scoter Melanitta species, a marine bird vital sign indicator, also suggests long-terms declines. These results underscore the urgency behind elevating this key element of the Salish Sea ecosystem into conservation planning processes. Unravelling differential patterns in sea duck abundance trends requires an understanding of their habitat use throughout their winter range in the Salish Sea.

Two parallel efforts have recently been completed to spatially model sea duck habitat-use in both Puget Sound and the Strait of Georgia, using different avian and environmental datasets. The bird datasets in the Salish Sea are a mix of standardized point count, line transect and distance-sampled datasets, including: 1) the British Columbia Coastal Waterbird Survey, 2) a series of marine bird surveys in five regions of the Canadian Salish Sea, 3) the Puget Sound Seabird Survey, 4) Washington Department of Fish and Wildlife Aerial Surveys and 5) Environment and Climate Change Canada at-sea surveys. These datasets share robust data collection protocols, have complementary attributes (high spatial precision in Puget Sound, broad seasonality in Strait of Georgia). However, environmental/ biophysical data layers were

yet to be compiled and assessed for consistency to determine their value to transboundary habitat modeling.

Biophysical layers incorporated into existing models or identified as potential predictors for our study include: shorezone (a transboundary habitat layer), bathymetry (TRIM), tidal currents, substrate types (including a new "bottom patches" dataset modified from Fisheries and Oceans Canada), eelgrass (a strong predictor for Brant in avian estuarine habitat suitability models) and shellfish. Aquatic vegetation and tidal current velocity were also strong predictors of sea duck abundance in Atlantic non-breeding areas, and others found that remotely sensed terrestrial and oceanic data were strong predictors of benthic-feeding birds in coastal British Columbia. This a priori knowledge of habitat selection may be used to guide transboundary model development.

Additionally, Bald Eagles are known to predate Long-tailed Ducks and alter scoter behavior. Eagles (and the predation risk they pose to sea ducks) can be considered an important (negative) component of the habitats used by sea ducks. We explored this priority research need using existing data to assess whether the predation risk from Bald Eagles may be an explanatory factor in observed scoter and Long-tailed Duck declines.

This project specifically addressed the following SDJV research needs:

1. To facilitate new information on sea duck habitat use to be integrated into coastal-marine conservation planning processes in a key continental wintering area for six sea duck species in the Salish Sea. This project was quite large-scale because it addresses the entire Salish Sea transboundary ecosystem, which is a Sea Duck Key Habitat Site in the recently published Sea Duck Key Habitats Sites Atlas.
2. To identify and characterize ecological attributes of habitats used by the priority sea duck species to identify spatial feature dependencies across a large-scale overwintering area with high human-use, and where development and human-use is anticipated to increase.
3. To assess the potential effect of a predator (Bald Eagle) population on long-term abundance and distribution patterns of priority sea duck species, and consider the implications the results may have for habitat modeling, and interpretation of long-term monitoring data showing ongoing 20-year declines in Surf, White-winged and Black Scoter and Long-tailed Duck in this region.

Project Objectives:

The overall goal of the projects was to pave the way for sea duck habitat suitability model outputs to inform ongoing conservation planning processes. To this end, we had four specific objectives:

i) Complete data identification and compatibility assessment (both avian and environmental datasets)
ii) Prepare a geospatial database of environmental / biophysical layers:
   a. Compile a comprehensive geospatial dataset (e.g., geodatabase) to support advancement of international sea duck habitat suitability models.
   b. Process and query spatial data consistently and efficiently for analysis within a GIS and render results in a standard format.
   c. Centralize the overall management and coordination of spatial data into an open access repository.

iii) Assess correlations between numbers of Bald Eagles and sea ducks in specific regions (sub-basins) of the Salish Sea using BC Coastal Waterbird Survey and potentially Christmas Bird Count data, and implications for sea duck habitat modeling.
iv) Align proposed model outputs with conservation planning processes.

To achieve objectives i) and ii), we coordinated a transboundary network of relevant technical expertise from the listed collaborating organizations and agencies to (1) identify and prepare key environmental data layers that may be suitable predictors of sea duck habitat (using bird data-driven models) and (2) identify an approach that either combines or aligns the two sea duck modelling processes underway/planned in British Columbia and Washington respectively.

The intent of the project was to create a process that produces Salish Sea ecosystem-scale outputs of key spatiotemporal areas for sea ducks in both near- and off-shore environments.

To achieve objective iv), we engaged and learn from resource managers (specific contacts in the agencies leading the conservation planning processes). Specifically, we identified the types of products and model outputs that would be most helpful to inform each of their processes and use feedback to inform model development. The coastal and marine management initiatives and agencies we targeted were: in British Columbia, the BC Coastal Marine Strategy (British Columbia Ministries of Environment and Forests, Lands, Natural Resource Operations and Rural Development), the Cumulative Effects of Marine Shipping Initiative (Environment and Climate Change Canada and First Nations), and Fisheries and Oceans Canada's Marine Spatial Planning process; and in Washington, National Oceanic and Atmospheric Administration and Washington Department of Ecology, the Washington Departments of Fish and Wildlife (for waterfowl) and Natural Resources (for aquatic reserves), and the U.S. Fish and Wildlife Service, and the Shoreline Master Plan Critical Areas process. Project products and model outputs were also included in the Pacific Birds Habitat Joint Venture's U.S. Coastal Wetlands planning process.

Results:

We were able to complete the majority of the objectives set out for the project. We were able to;

1. Convene an online meeting of project partners to identify and determine the availability of relevant avian and biophysical data layers, and to determine spatial data integration needs and statistical integration frameworks for transboundary model development. Specifically, we determined what types of data products can most effectively inform coastal and marine spatial planning work (e.g., simple polygons, ecosystem elements/processes that are indicators of sea duck habitat). During this phase of the project, we identified key avian and geospatial data layers for habitat suitability modelling, both in Canada and the U.S., and creation and/or compilation of metadata for all datasets to be used in the modelling process.
2. Invite researchers, key collaborators and analysts to an in-person meeting at the Canadian Wildlife Service office in Delta, BC to strategize a Salish Sea wide data integration process, for both combining spatial layers, and for statistical integration of avian count data that could be used to create and validate cross border modeling. During the workshop, we determined if and how existing bird monitoring datasets (near and off shore) can be harmonized across borders, including data gap identification, spatial and temporal considerations, and effort correction. Collaborators shared detailed knowledge regarding limitations of the bird data (including many zeros and aggregated high-counts) and habitat layers used to date, to

improve model development and fit. The workshop also determined how predictive approaches from one jurisdiction can be projected onto the other for both the nearshore and offshore habitats (e.g., data-rich offshore models developed in Puget Sound may be projectable across the entire Salish Sea and validated using Canadian data), and how scoter GPS logger tracking data (to be collected November 2021 through April 2022), could be used to validate, or otherwise inform model development.

3. Generate a final list of spatial data layers for model development, and clarification of data compilation needs (combining predictive datasets into databases for later statistical integration): extent, coordinate systems, harmonization of disparate data attributes, identification of spatial data gaps, and/or interpolation. Another workshop output will be frameworks for both avian data compilation, and for statistical integration, including effort/detectability corrections, spatial and temporal autocorrelation, and analytical methods for over dispersed, zero-inflated count data (e.g., Poisson hurdle models).
4. Following the workshop, we completed the final avian data acquisition for inclusion in NatureCounts and/or other database platforms. We also completed final spatial data acquisition for inclusion in a geodatabase. We prepared the data layers for inclusion in model(s) following workshop recommendations, and completed a set of metadata and guidelines for applying data layers to aid date users. The outcome of this was an online Github webpage that outlines the project and the datasets, and how to access them using R code. The webpage is available here: https://birdscanada.github.io/TransboundaryData_SalishSea/index.html
5. We presented a final project report to stakeholders in an online format. For those unable to attend the presentation, we provided a link to the presentation on YouTube https://youtu.be/w6KGgy44wK8.
6. As a final deliverable, we wrote up and submitted a manuscript to Waterbirds entitled “Bald Eagle and Priority Sea Ducks Interact Over Space and Time in the Salish Sea: A Transboundary Perspective”. This manuscript describes a proof of concept application of the transboundary dataset, which combines seaduck and eagle data from the BC Coastal Waterbird Survey (in Canada) and the Puget Sound Seabird Survey (in the US) into a common framework. The analysis revealed that, suggest that Bald Eagles more often than chance overlap with priority sea ducks in the Salish Sea. However, there was no evidence of second-order effects of latitude, longitude, or year on sea duck occurrence in the presence or absence of Bald Eagles, suggesting that these factors are acting independently. The manuscript if currently in review.

Project Status:

The project was successfully completed, and the objectives were met. Our future plans are to work with our partners in the US to utilize the transboundary datasets to model sea duck in an occupancy framework so as to examine seasonal and spatial patterns of sea duck distribution, as well as the effects of management actions.

Project Funding Sources (US$). Complete only if funded by SDJV in FY23. This is used to document: 1) how SDJV-appropriated funds are matched, and 2) how much partner resources are going into sea duck work. You may include approximate dollar value of in-kind contributions in costs. Add rows as needed for additional partners.

(NOTE: The following match was reported for FY22.)

SDJV (USFWS) Contribution	Other U.S. federal contributions	U.S. non-federal contributions	Canadian federal contributions	Canadian non-federal contributions	Source of funding (name of agency or organization)
$46,574					SDJV (USFWS)
		$40,000			University of Washington
		$5,000			WDFW- Waterfowl Section
			$25,000		PBHJV
				$11,930	Birds Canada

Total Expenditures by Category (SDJV plus all partner contributions; US$). Complete only if project was funded by SDJV in FY23; total dollar amounts should match those in previous table.

ACTIVITY	BREEDING	MOLTING	MIGRATION	WINTERING	TOTAL
Banding (include only if this was a major element of study)					
Surveys (include only if this was a major element of study)					
Research				$128,504	**$128,504**