Greater Yellowlegs. Photo: Mellisa James/Audubon Photography Awards

Avian Habitat Suitability Models for Puget Sound Estuary Birds

EXECUTIVE SUMMARY

Audubon | WASHINGTON

Extensive habitat loss and ecosystem degradation associated with human settlement in Puget Sound estuaries has resulted in an untold decrease in bird abundance and distribution. Protection and restoration actions associated with the Puget Sound Action Agenda, the state plan that charts the course for recovery in Puget Sound, have the potential to benefit birds. However, meaningful recovery of estuary bird communities in Puget Sound requires that we have a clear understanding of species status and trends, where and when they occur, and the environmental conditions and human pressures that influence their occurrence.

In this report, we present bird-habitat suitability models for five "narrative" species that represent unique niches associated with Puget Sound estuaries: Brant, Dunlin, Greater Yellowlegs, Marsh Wren, and Northern Pintail. These species were selected to help inform and tell the story of the complexity of avian habitat use across tidal gradients and seasons in Puget Sound estuaries. Our study used avian monitoring data from tribal, state, federal and NGO partners, as well as community science data, to build separate habitat suitability models of occurrence and abundance by season for the five narrative species. Of the 21 environmental variables included in the models, the three that most strongly influenced probability of occurrence included proportions of estuarine emergent wetland, mudflat, and palustrine wetland cover. Where study species occurred, relative abundance was most strongly influenced by survey effort (survey distance and duration), followed by proportions of agriculture, estuarine emergent wetland, and mudflat cover.

This study provides valuable information about the environmental drivers of spatial patterns of bird distribution and abundance and identifies important areas for birds around the Puget Sound. It also points to specific actions that land managers can take to ensure Puget Sound continues to serve as a vital link for Pacific Flyway birds. Our analytical approach can be replicated for other species, and the information can be used at a regional scale to identify priority areas for conservation. Similarly, the maps can be used to identify areas where birds are currently less abundant, but that are proximate to suitable habitat or marsh migration opportunities, suggesting that restoration may be beneficial. For example, we used our models to evaluate the potential benefit of estuarine wetland restoration for Northern Pintail and Greater Yellowlegs across the entire Puget Sound as well as a case study area in Port Susan Bay. Our identification of the environmental conditions that are most important to narrative species as well as the form of the relationship can also inform smaller scale habitat management.

An important theme that emerged from this exercise is that data quantity and quality are essential for a robust understanding of bird-habitat relationships and distributions in Puget Sound, which in turn informs habitat management and restoration actions. Model performance may be constrained for some species by insufficient monitoring data across relevant seasons, the concentration of monitoring data in certain well-studied estuaries, and differences in species detectability across habitat types. The development of a regional monitoring framework for estuarine birds that aligns bird survey and sampling methods is an ambitious but critical step that will dramatically improve our ability to develop predictive tools and generate adaptive feedback for land and species managers in a time of rapid environmental change.

Recommendations for Restoration and Monitoring

Restoration

- Wetland restoration may greatly increase the carrying capacity of estuarine wetlands for wetland-dependent species, notably Northern Pintail.
- Where possible, target restoration to areas within the historical wetland extent with currently low numbers of birds, where the potential for bird abundance increases may be greatest, and where marsh migration potential is high.

Northern Pintail. Photo: Angela Vogel/Audubon Photography Awards

- Involve avian specialists in restoration planning and design to maximize potential for achieving multi-species benefits.
- Coordinate restoration efforts with land trusts, nonprofits and other entities interested in a resilient ecosystem approach to restoration rather than a species-specific approach.

Monitoring

- Additional monitoring is needed, especially for species and seasons with poor model fit, such as Greater Yellowlegs and Brant (spring, fall), Dunlin, Northern Pintail (fall). Monitoring commonly occurs during breeding and winter seasons, while most waterfowl and shorebird species are migratory and use estuarine habitats throughout the year. In order to answer more complex questions about habitat associations monitoring during migration windows may also be warranted.
- Where possible, survey methods that are standardized and/or that include gathering of ancillary data needed to correct for imperfect detection (e.g., repeat surveys) would enable us to better understand species abundance, especially for comparisons across habitat types.
- Future monitoring efforts (e.g., regional avian monitoring framework) should consistently collect effort data such as survey distance and duration. Efforts to standardize monitoring efforts and house data in shared databases would greatly enhance our ability to understand habitat suitability and, ultimately, populations of birds in the Puget Sound region.
- Target additional monitoring to gap areas with little monitoring to date.
- Develop a better understanding of the impact of current ecosystem restoration practices have on a broader suite of estuarine-reliant species working with agencies, non-profits, and tribes to incorporate avian monitoring into restoration activities.
- Coordinate avian monitoring with other biotic and abiotic monitoring efforts (e.g., salmon, vegetation, geomorphology) to develop predictive models that can be applied to restoration planning and monitoring. Doing so would help elucidate data gaps and monitoring needs and improve social support for restoration, raising the profile of estuary birds in restoration planning.

Top two environmental variables in each species-season model that explain the greatest variation in occurrence and relative abundance. The form of the relationship between occurrence / relative abundance and the environmental variable is indicated in parentheses (positive: +, negative: -).

		Occurence		Relative Abundance	
Species	**Seasons**	Variable 1	Variable 2	Variable 1	Variable 2
Brant	Winter	Distance to shore (+)	Proportion eelgrass (+)	Proportion agriculture (+)	Length sand/gravel beach (+)
	Spring	Proportion eelgrass (+)	Length sand/gravel beach (+)	Proportion estuarine emergent wetland (+)	Proportion mudflat (+)
Dunlin	Winter	Proportion mudflat (+)	Proportion estuarine emergent wetland (+)	Proportion agriculture (+)	Proportion estuarine emergent wetland (+)
	Spring	Proportion mudflat (+)	Proportion estuarine emergent wetland (+)	Proportion mudflat (+)	Proportion estuarine emergent wetland (+)

		Occurence		Relative Abundance	
Species	**Seasons**	Variable 1	Variable 2	Variable 1	Variable 2
Greater Yellowlegs	Winter	Proportion estuarine emergent wetland (+)	Proportion mudflat (+)	Proportion open water (-)	Proportion palustrine wetland (+)
	Spring	Proportion estuarine emergent wetland (+)	Proportion mudflat (+)	Tidal amplitude (+)	Proportion mudflat (+)
	Fall	Proportion estuarine emergent wetland (+)	Proportion agriculture (+)	Proportion estuarine scrub/shrub wetland (+)	Proportion mudflat (+)
Marsh Wren	Winter	Proportion palustrine wetland (+)	Proportion estuarine emergent wetland (+)	Proportion palustrine wetland (+)	Tidal amplitude (-)
	Breeding	Proportion palustrine wetland (+)	Proportion estuarine emergent wetland (+)	Proportion palustrine wetland (+)	Proportion estuarine emergent wetland (+)
Northern Pintail	Winter	Proportion estuarine emergent wetland (+)	Proportion mudflat (+)	Length of man-made structures (+)	Proportion palustrine wetland (+)
	Spring	Proportion estuarine emergent wetland (+)	Proportion mudflat (+)	Distance to protected area (-)	Proportion mudflat (+)
	Fall	Proportion estuarine emergent wetland (+)	Proportion forested wetland (+)	—	—

FOR MORE INFORMATION

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Appendix A: Species Profiles

Appendix B: Species Relative Abundance Maps

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