BIRDS

INTRODUCTION

Birds are important to the Port Gamble S'Klallam Tribe for a variety of reasons, including recreation and hunting, their role as indicator species, and their predatory interactions with other key cultural and subsistence resources.

Eagles, blue heron, cormorants, grebes, osprey, belted kingfishers, and loons all call Port Gamble Bay home for some or all of the year. Within the broader U&A area, there are additional species of interest, such as spotted owls and marbled murrelets, that can provide an indication of broader ecosystem health and resilience. From an ecological perspective, predatory birds are also important because of their impact on other key resources, such as juvenile salmon.

The Tribe has hunting seasons and corresponding hunting restrictions for a number of migratory birds, including ducks (mallard, canvasback, pintail, redhead, scoter, merganser), American coots, geese (except dusky Canada geese), band-tailed pigeons, brant, Wilson's snipe, and mourning dove. The Tribe anticipated a total harvest of fewer than 200 migratory birds for the 2015 to 2016 season [1]. Non-migratory birds mentioned in the Tribe's hunting regulations include grouse, quail, pheasant, and turkey. Hunting these birds is an important part of Tribal culture. Grouse, for example, are a traditional food. They are also used as a food supply when hunting for other species, as they can be harvested using rocks and slings without making any noise.

CLIMATE IMPACTS ON BIRDS

Recent studies indicate that climate change impacts such as temperature increases, precipitation change, and sea level rise are likely to have direct effects on bird distributions and survivability. Some of these effects are already visible. According to a scientific literature review covering 570 studied bird species, 24% have been negatively affected by climate change (e.g., through shrinking ranges), while 13% experienced positive impacts [2]. Impacts are still unclear for other species [2]. Other studies indicate that the number of species that will decline in distribution and abundance is twice as large as the number that will expand [2].

RESEARCH NEED: Do local models project the potential extinction of any birds in the Pacific Northwest as a result of climate change?

In 2016, the UW Climate Impacts Group assessed local vulnerabilities of some bird species in a report for the Stillaguamish Tribe, concluding that most species will still be stable in the 2050s and some will even increase in abundance [3]. Birds' ability to move easily to find new areas of climate suitability helps reduce their vulnerability. On the other hand, some species have tended to live in specific thermal niches and will be less prepared for expected temperature variations [3]. Few other available studies focus on Western Washington, but studies that assess trends across North America can provide insight into the potential consequences for bird species of interest to the Port Gamble S'Klallam Tribe.

TEMPERATURE AND GEOGRAPHIC DISTRIBUTION

As climate change increases average temperatures, many bird species are already shifting northward to follow suitable climatic conditions. According to a study by Hitch and Leberg, published in 2007, the average northern latitude of breeding birds in North America shifted northward by 2.35 km (1.46 miles) per year from the 1967–1971 baseline period to 1998–2002 [4].1 Species did not tend to shift southward, which led the authors to conclude that the shift was likely primarily due to a change in climate, rather than to other factors [4]. At the same time, the studied species were not abandoning the southern portions of their distributions.

In a study of over 300 species, National Audubon Society scientists found that species are wintering an average of 40 miles north of where they wintered in the 1960s [5]. A study by Bateman found that some species—particularly insect eaters, meat eaters, and species that forage on the forest floor or high in the trees—are shifting their breeding ranges as quickly as 3 miles per year [6]. Woodpeckers, non-migrants, and plant eaters are shifting less quickly or not at all at this point [6].

Landbirds make up 87% of all bird species [7]. A 2016 study of 285 landbird species found a mean rate of change in potential breeding distributions of 1.27 km (0.79 miles) per year over the past 60 years, mainly to the north or west [8]. Birds in the west coast lowlands, including Puget Sound, shifted less quickly (0.45 km or 0.3 miles per year) compared to species in other parts of the country [8]. Bird species shifted geographies more quickly than tree species and marine species, indicating that they may either be particularly flexible given their high degree of mobility or especially climate-sensitive [8].

Bird species may have varying levels of success in adapting to climate change by altering their ranges. Northward shifts could potentially be a problem if food sources cannot move north as rapidly [4] or if suitable land cover (e.g., the right amount of forest, grassland, or other land cover type) is not present in the new geographic area [8]. Climate change could also change the timing of food availability in the oceans such that it no longer coincides with the changing breeding or migration seasons of coastal birds [9]. Many forest birds have large ranges and high reproductive potential, making them relatively less vulnerable to climate change impacts. Species that depend heavily on specific resources or forest types are important exceptions [9]. For example, the marbled murrelet, spotted owl, and western grebe have very specialized diets which can increase their vulnerability (see descriptions of each species below).

TEMPERATURE AND ELEVATIONAL DISTRIBUTION

In addition to shifting northward, many bird species are moving upslope to follow preferred temperature or precipitation conditions [10]. While non-climate stressors like habitat loss have primarily affected lowland species, montane species may be greatly affected by climate change impacts on temperature [7]. Species with narrower elevation ranges will be more vulnerable to climate change, as small range size is already a predictor of extinction from non-climate stressors like land use change [10, 7]. New disease vectors may also appear at higher elevations as temperatures rise, with impacts on bird health [7].

A global study by Sekercioglu et al. estimated that a worst-case warming scenario (6.4°C warming by 2100) and upslope shifts in suitable bird ranges would result in the extinction of 30% of all landbirds in the Western Hemisphere; 21% of those species are already threatened with extinction today [7]. Migratory birds had lower projected levels of extinction due to their mobility [7]. Given that this projection may not

[1] This study looked at birds such as sparrows, warblers, chickadees, and flycatchers; it did not include birds dependent on aquatic habitats.

accurately quantify what can be expected in specific locations, such as Western Washington, further analysis using local climate and ecological models would be useful [7].

Further study is also needed to document the current elevation limits of bird species to understand vulnerabilities and monitor impacts [7]. In 2011–2012, scientists collected data on elevation ranges of birds in Olympic, Mount Rainier, and North Cascades National Parks [10]. This study will provide a baseline against which to monitor shifts in elevation ranges as the climate changes [10]. The data include species such as the band-tailed pigeon, bald eagle, and several types of woodpecker, jay, chickadee, warbler, sparrow, and finch, among others [10].

TEMPERATURE AND REPRODUCTION

While no studies were found that focused specifically on changes in the laying dates of birds in the Pacific Northwest, studies in other regions found correlations between increasing temperatures and advances in laying dates.

In a study of pied flycatchers in Europe, researchers found that increasing temperatures caused these migratory birds to lay their eggs earlier in the year and to lay more eggs [11]. As the warming trend continues, the birds' ability to further advance their lay date may be constrained by the timing of their arrival at the breeding ground [11]. Bird populations could remain stable if the timing of peak food supply advances at the same rate as laying dates or if food is abundant enough that the peak timing is less important [12].

A 2014 review of 196 relevant studies by Dunn and Møller found that increased temperatures have been correlated with advances in laying dates and that these advances were larger for herbivorous or predatory birds that had multiple broods per season [12]. They did not find evidence that changes in laying date were affecting overall population trends but noted that effects are likely to differ across different types of species [12].

PRECIPITATION AND WATER AVAILABILITY

RESEARCH NEED: Have increasing temperatures affected laying dates of bird species in the Pacific Northwest?

Species are shifting faster than the shift in temperature alone because temperature is not the only climatic factor affecting bird species' survivability [8]. Precipitation, water availability, pH, humidity, and extreme conditions also play a part [8]. These other factors affect survival and reproductive success by affecting food availability, disease vectors, and vegetation structure, among other things [8, 13]. While increasing temperature has been linked to shifts northward, precipitation changes may explain why some bird species also shift westward [8]. A study focused on Western North America concluded that precipitation was a major determinant of changes in the abundance of terrestrial bird species over a 32-year period [13]. This study found that precipitation was a more important predictor than temperature in the abundance and distribution models.

Combined changes in precipitation and temperature—leading to increased evapotranspiration—will also have impacts, such as on the extent of inland wetland habitats for birds. One-third of the 165 wetland breeding species in the country are ranked as having medium or high climate change vulnerability, however this study did not specify the time period or the temperature increase used to make these determinations [9]. These vulnerable species include the Western grebe.

SEA LEVEL RISE

Tidal sand and mud flats provide important foraging habitat for shorebirds. Rising sea levels may reduce the extent of this foraging habitat [14]. Increasing water temperatures and storms will also affect habitats and the availability of food sources [9].

A 2007 study by the National Wildlife Federation looked at several study sites in Puget Sound, including one that included Port Gamble and other parts of the upper Hood Canal. The study's projections for 2050 with 11.2 inches of sea level rise were no change in tidal fresh marsh acreage, a 60% loss of estuarine beach, minor expansion of estuarine open water (1%), and extreme expansion of tidal flat (1,455%) and saltmarsh (6,533%). Projections for 2100 with 1.5 meters of sea level rise were no change in tidal fresh marsh habitat, an 85% loss of estuarine beach, minor expansion of estuarine open water (4%), and extreme expansion of tidal flat (1,411%) and saltmarsh (4,960%) [15]. Table 1 lists some of the species that the National Wildlife Federation noted could be vulnerable given these amounts of sea level rise and other climate change impacts.

Table 1. Sea level rise impacts on waterfowl and seabirds [15].

Climate change impact	Type of birds that could be affected	Sample species
Reductions in habitat quality due to sea level rise and other impacts	Diving ducks	Canvasbacks, greater and lesser scaup, goldeneyes, bufflehead
Loss of tidal flats	Dabbling ducks and geese	Gadwalls, American wigeon, mallards, northern pintails, green-winged teal, snow geese, brant
Reductions in forage fish and other food sources due to sea level rise	Seabirds	Surf scoters, common murres, pigeon guillemots, marbled murrelets, Caspian turns, rhinoceros auklets, brown pelicans

See the Wetlands chapter for more details about climate change impacts on shoreline ecosystems.

SPECIES

The following section summarizes potential vulnerabilities of some of the key species of interest to the Port Gamble S'Klallam Tribe.

BALD EAGLE

In Olympic National Park, bald eagles have been detected between 7 and 102 meters of elevation [10]. Across the U.S., the bald eagle is projected to lose 74% of its current summer range by 2080 but acquire significant summer range in new places if adequate habitats and food sources are available [16]. The bald eagle could be vulnerable to climate change impacts if large nest trees are damaged by fire or flooding [3]. Other impacts on forests—such as pest and disease outbreaks—could also affect the quality and extent of eagle habitat. The Climate Change Sensitivity Database gave the bald eagle a sensitivity score of 47 (medium) with a confidence score of 3 (fair) [17]. Changes in eagle abundance would have a cascading effect on their prey, which are primarily fish but also include wading birds [17, 18].

Audubon models found that the following bird species of importance to the Port Gamble S'Klallam Tribe could be seriously threatened by climate change at the national level [16]:

Climate endangered (may lose over 50% of current range by **2050**)

- Bald eagle
- Black oystercatcher
- Mallard
- Osprey
- Redhead
- Spotted owl

Climate threatened (may lose over 50% of current range by **2080**)

- Band-tailed pigeon
- Brant

GREAT BLUE HERON

In 2010, the Tribe found signs that a family of herons had built a rookery on the reservation [19]. The great blue heron is not expected to be especially vulnerable to climate change impacts because it is mobile and has a flexible diet that includes fish, insects, amphibians, mice, and crustaceans, among other creatures [3]. While some of these food sources could be adversely affected by climate change—for example, crustaceans are likely to be affected by ocean acidification—the great blue heron can shift to other food sources as needed. Rookeries could be impacted by coastal flooding and sedimentation, and marsh and estuary habitats are also sensitive to climate change [3]. Herons could be affected by increases or decreases in predation risk, depending on how climate and non-climate stressors affect predators such as bald eagles [18].

SCOTER

Scoters winter in the Puget Sound region. The scoter depends on coastal marshes, estuaries, and beaches, which are likely to be affected by sea level rise, as well as small lakes, which could be impacted by rising temperatures and drought [20]. A large portion of the scoter's diet is made up of shellfish, which may become less abundant in the context of ocean acidification and rising water temperatures [21]. Scoters have already declined in Puget Sound in the last three decades, possibly due to contaminated shellfish [21]. Continued increases in harmful algal blooms may exacerbate that problem, as harmful algae leads to shellfish toxicity (see the Harmful Algal Blooms chapter for more detail). The Climate Change Sensitivity Database entry gave the scoter a sensitivity score of 45 (medium) with a confidence score of 2 (poor) [20]. More research would be needed to better undertand their vulnerability.

BRANT

The Climate Impacts Group found that the Climate Change Vulnerability Index (CCVI) ranked brant in Puget Sound as "presumed stable" for both the 2050s and the 2080s because the species has a flexible diet and can easily move to new places if necessary [3]. The species has a range of more than 100 km [3]. The CCVI did not, however, specifically examine whether increased coastal flooding or sedimentation could affect the birds' ability to forage for eelgrass, green algae, or other plants. Audubon's climate model shows that

the black brant is likely to be more affected by climate change impacts in the winter than in other seasons and that the suitable wintering area may be further north in the future [16].

NORTHERN SPOTTED OWL

Northern spotted owls—which are listed as "threatened" under the Endangered Species Act—help to indicate the health of old-growth forests [22]. Impacts on forests, such as disease outbreaks and forest fires that damage trees and corresponding habitats, would have repercussions for spotted owl health (see the Forest Resources chapter for more information). Non-climate stresses such as logging and forest thinning also affect the spotted owl, including by affecting its primary food source: the northern flying squirrel [3].

The spotted owl is somewhat sensitive to temperature. Rising temperatures could affect the spread and dominance of the barred owl, whose competition creates a continued non-climate stressor for the spotted owl [3, 23]. In a vulnerability assessment for the Stillaguamish Tribe, the Climate Impacts Group found that the CCVI ranked the spotted owl as "presumed stable" for the 2050s but "extremely vulnerable" by the 2080s. Meanwhile, the Climate Change Sensitivity Database gave the spotted owl a sensitivity score of 71 (high) with a confidence score of 3 (fair) [24].

MARBLED MURRELET

The marbled murrelet, a small seabird that nests in old-growth forests and feeds in the ocean, is listed as threatened in Washington, Oregon, and California [25]. In 2011, the Marbled Murrelet Recovery Implementation Team (RIT) met to evaluate the causes of murrelet decline, noting climate variability and change as relevant threats. The RIT noted that murrelets' terrestrial habitat and nesting areas could be affected by changing wildfire risk or changes in temperature and moisture that alter moss growth [26]. They also noted the potential impact of climate variability and change on food webs, such as through harmful algal blooms (see the Harmful Algal Blooms chapter for more detail). Marbled murrelets also eat mollusks and crustaceans [3], which could be affected by ocean acidification. These birds have been observed to defer breeding during food shortages [3]. The CCVI ranked the marbled murrelet as "presumed stable" for the 2050s and "moderately vulnerable" by the 2080s for the nearby Stillaguamish region. The University of Washington, U.S. Forest Service, and U.S. Fish and Wildlife Service are currently doing research to better understand how a range of changes—including in climate and associated changes in forage food availability—affect the abundance and distribution of murrelets [27]. In a 2016 article, they reported that factors influenced by climate variability and change (e.g., wildfires and insects) contributed to the loss of nearly 27,000 acres of nesting habitat between 1993 and 2012 across the bird's range [28].

OSPREY

Across the country, osprey are projected to lose 79% of their current summer range by 2080 at the same time that their winter range will grow [16]. Osprey are likely to be directly affected by climate change impacts on fish, which make up nearly all of their diet [29]. Reciprocally, changes in osprey abundance would in turn affect the quantity of fish in the area. The Climate Change Sensitivity Database entry gave the osprey a sensitivity score of 55 (medium) with a confidence score of 2 (poor) [29].

WESTERN GREBE

The western grebe is sensitive to changes in flood and drought cycles, which will be affected by climate change. It also depends on wetlands with adequate water levels to support nesting. The grebe builds a floating nest mat connected to a snag or plant, and increased flooding could damage this construction [3]. As temperatures rise and precipitation patterns change, available wetland habitat could shrink [30]. The grebe also relies on nearby accessible fish prey, which could in turn be affected by rising ocean temperatures, ocean acidification, and other climate change impacts [3]. As the grebe rarely flies outside of the migration season, it depends on having adequate food sources close to its breeding ponds [3].

LOOKING AHEAD

In general, birds will likely be impacted through the combination of reductions in habitat quality, loss of habitat (e.g., tidal flats), and reductions in food sources (e.g., forage fish).

The Tribe is also concerned that if marbled murrelet populations drop any lower—as a result of climate change impacts or other stresses—it will increase the chances of having fishing restrictions with Tribal gillnets, as these birds occasionally get caught in fishing nets. This would in turn dramatically lower fishing opportunities for Tribal members.

The Tribe has partnered with Northwest Indian College and Kitsap Audubon Society to count and catalog bird species found around Port Gamble Bay [31]. This kind of effort will help provide monitoring data to understand trends in populations affected by both climate and non-climate stressors.

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