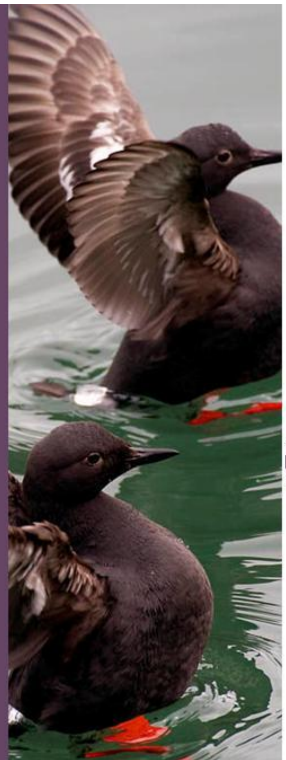
Audubon WASHINGTON



State of the Birds 2009

Birds & Climate Change: Washington's Birds at Risk

Washington Birds and Climate Change

Introduction

Birds and climate change

Birds are sensitive barometers of their environment. As climate change brings about changes in temperature, precipitation, wildfire behavior, and weather extremes, birds are already responding to these new conditions. As did canaries in coal mines, birds now alert us to environmental changes to which we need to pay attention.

Global climate change is an issue that is increasingly taking center stage in discussions of conservation threats. The interaction of all the effects of climate change are likely to be complex, making outcomes difficult to predict. The impacts, whether positive or negative, will extend to every ecosystem and every creature on the planet, changing some in profound ways. We are faced with decisions today that could have pronounced affects on our children and grandchildren, their quality of life, and the health of the planet that surrounds them.

Public debate on the climate change issue has shifted from *will it happen* to *how will it happen*. Scientists agree that our climate is changing, and all but a tiny minority concur that human activities are an important factor driving the climate change. For many groups of plants and animals, including birds, studies are already showing changes in behavior and shifts in distribution in response to climate change.

The material presented here focuses on the projected impacts of climate change on Washington's birds. This discussion draws on the small amount of literature specifically addressing Washington's avifauna, and, more widely on the larger group of studies discussing birds in the Pacific Northwest, the Arctic, the Neotropics, and North America. Anyone wishing to delve deeper into these issues or the background materials for this report is referred to the References/Resources section at the end of this document.

Why are birds at risk?

Research has already demonstrated that some species of birds are being negatively affected by climate change. For example, the recently released IUCN Red List assessment for birds found that climate change is accelerating many of the factors that have put one in eight of the world's birds at risk of extinction. The most injurious effects of climate change, and the ones hardest to predict, may come about because climate change interacts with other ongoing threats, such as habitat loss.

The direct effects of climate change on birds include loss of critical habitat, behavior, distribution, population dynamics, and phenology (the timing of key life history events); many of these effects are driven by changes in precipitation and temperature. Overall, climate change is expected to lead to significant range changes for many of our bird species.

Indirect effects of climate change on birds include sea level rise, changes in fire regimes, vegetation changes, land use changes, altered competitive interactions among species, and ecosystem reordering. Birds most at risk from habitat loss are those that are specialized in their habitat needs – including those species that are restricted to islands, alpine zones, or coastal beaches for critical parts of their life history.[i]

This site explores these topics, linking climate change to the Washington birds that could be most severely impacted.

To read more about the specifics of climate change, visit the following sites:

Figure 1. Beach-nesting species like the Endangered Western Snowy Plover are likely to suffer disproportionately from the effects of rapid sea-level rise. USFWS photo.

The Intergovernmental Panel on Climate Change shared the Nobel Peace Prize with Al Gore in 2008 for their landmark work to assess and publicize climate change.

The Climate Impacts Group focuses their research on the Pacific Northwest. In additional to technical information, the group has some digestible summary information for general reading.

Climate Solutions, a non-profit based in Washington, seeks viable solutions to climate change driven problems. They have an easy-to-read FAQ page.

Sea Level Rise

One of climate change's indirect effects is a rise in sea level. This rise has already been detected, but is expected to accelerate as polar ice caps and the world's glaciers shrink. Global average sea level is projected to rise 3.5"-to-35" between 1990 and 2100[ii]. Regional sea level rise will differ from the global average depending on factors such as changes in atmospheric weather patterns, tectonic processes, and regional differences in thermal expansion rates of ocean water.

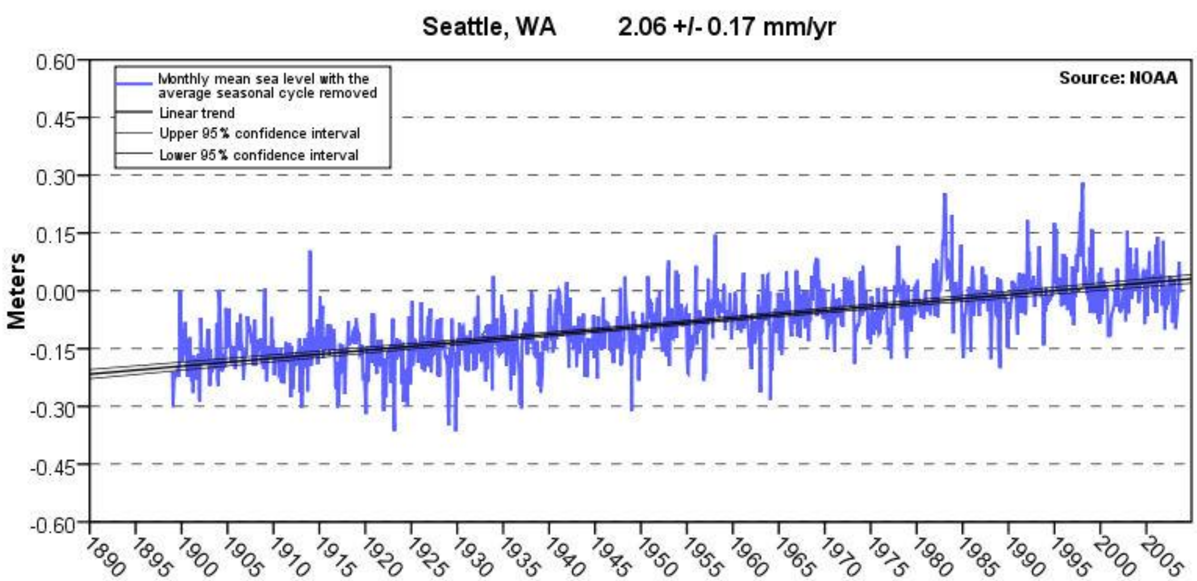


Figure 2. The plot shows the monthly mean sea level at Seattle (dashed curve), a 5-month average (solid curve), and the linear trend with its 95% confidence interval which was obtained after accounting for the average seasonal cycle. http://tidesandcurrents.noaa.gov/sltrends/sltrends_station.shtml?stnid=9447130, December 12, 2008.

Sea-level rise is expected to affect parts of the Northwest coast, causing permanent inundation in low-lying areas. The mean sea level trend from 1898 to 1999 at Seattle is a rise of 2.11 millimeters/year (0.69 feet/century)[iii].

Relative land motion is currently downward due to tectonic activity (e.g., Olympia), increasing the severity of sea level rise. Impacts include accelerated erosion at the base of bluffs and along the coast, shrinking wetlands, loss of sandy beaches to erosion, and reduced mud flats for foraging and resting birds. Other changes may include more landslides (if winters are wetter, as predicted).[iv]

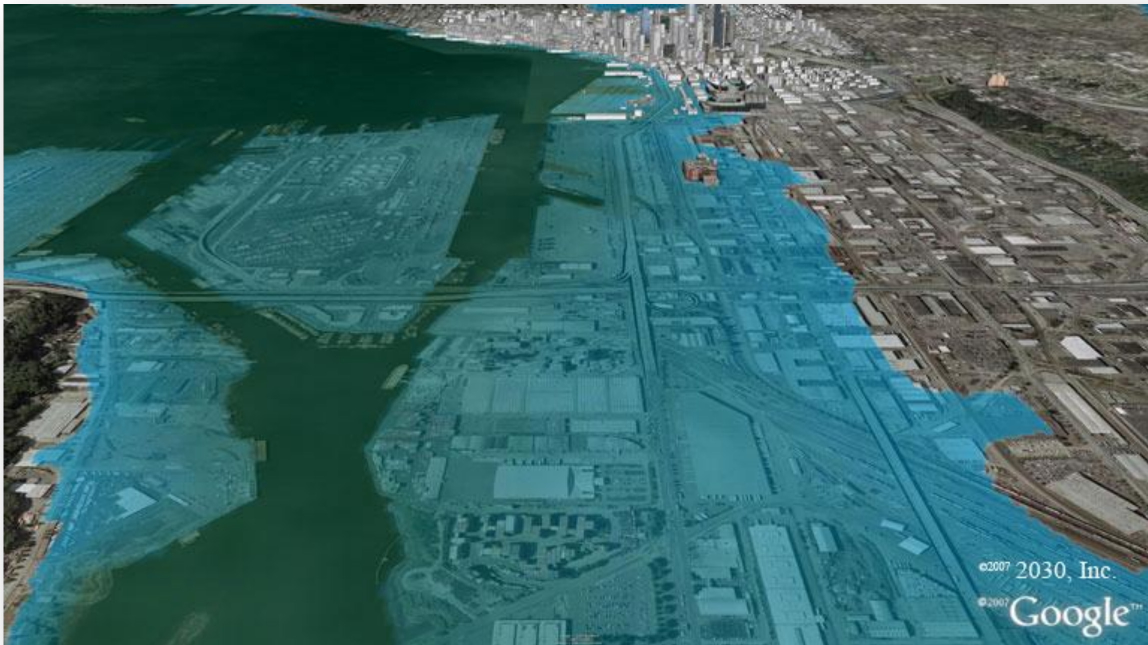


Figure 3. Increasing sea level may threaten human and animal habitat. Computer graphic shows with a 3 m (~10 ft.) rise in sea level (note this level is three times the "worst case" rise estimated for this century, because GIS data with 1 foot elevational resolution were not available).[v]

Without an extensive coastal plain (as one finds in the Southeast US), Washington's coastal marsh habitat is likely to be subjected to "coastal squeeze." As rising seas levels inundate estuaries and river deltas, natural and man-made barriers such as cliffs, steep land morphology, hard sea defenses (e.g., dikes), and agricultural or urban land will form barriers against the natural retreat of these habitats up shore[vi].

Waders and shorebirds would be disproportionately affected by this change. While Washington provides some breeding habitat for these birds, arguably the state's most critical role for these birds is the support this habitat provides for millions of migrants. The Threatened Western Snowy Plover currently nests on Washington beaches, where its persistence is already tenuous. Other key species threatened by degradation or loss of coastal wetland habitats include Long-billed Curlew, Red Knot, Black Oystercatcher, Whimbrel, Marbled Godwit, Ruddy Turnstone, Black Turnstone, Surfbird, Sanderling, Rock Sandpiper, and Short-billed Dowitcher.

Figure 4. Where development encroaches on coastal beaches and marshes, rising sea levels may eliminate important bird habitat. Jeff Larson Photo.

Washington IBA species of concern at risk from sea level rise.		
Low Risk	**Moderate Risk**	**High Risk**
Black-bellied Plover	Semipalmated Plover	Snowy Plover
American Golden Plover	Wandering Tattler	Rock Sandpiper
Pacific Golden Plover	Black Turnstone	Short-billed Dowitcher
Greater Yellowlegs	Red Knot	
Lesser Yellowlegs	Sanderling	
Whimbrel	Long-billed Dowitcher	
Long-billed Curlew	Black Oystercatcher	
Marbled Godwit	Surfbird	
Ruddy Turnstone		
Semipalmated Sandpiper		
Western Sandpiper		
Least Sandpiper		
Baird's Sandpiper		
Pectoral Sandpiper		
Dunlin		

Figure 5. Rising sea level increases the risk of coastal flooding. (c) Jeff Larson.

Figure 6. Black Oystercatchers are at home in the tumultuous meeting place of rocks and waves. Such places could become rarer with sea level rise. © Jeff Larson.

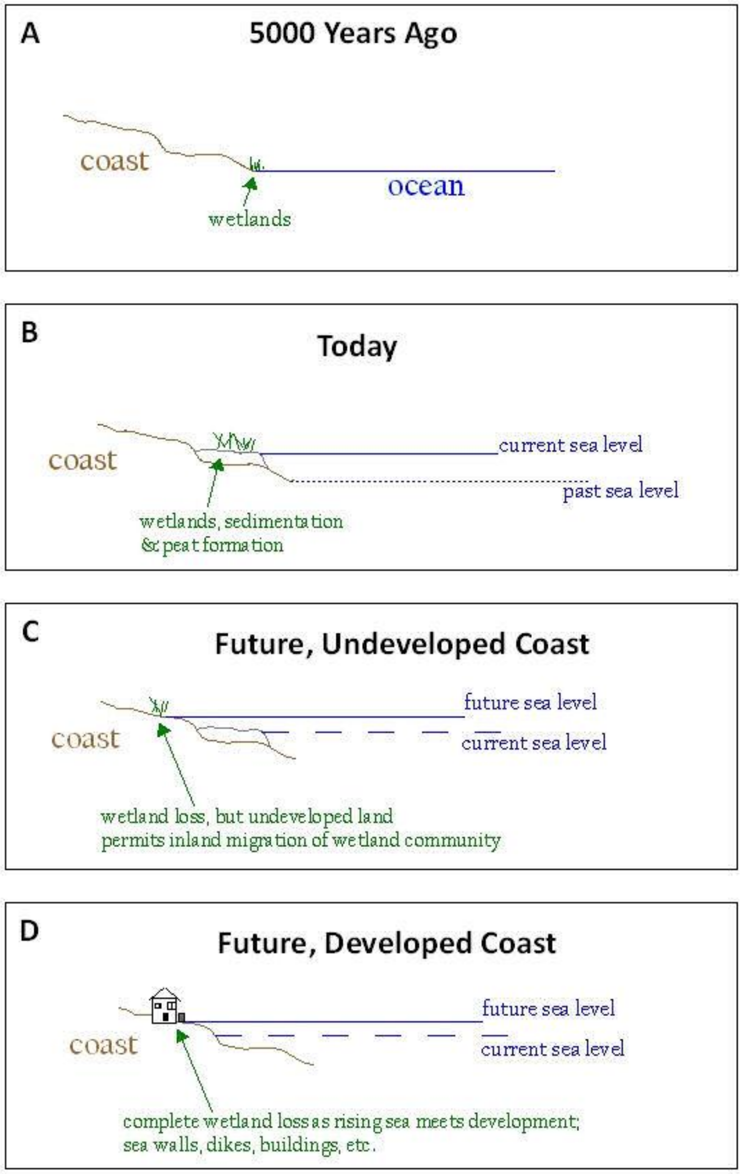


Figure 7. With the slow rate of historic sea level rise, coastal wetlands (A) have been able to move inland as sea level has risen (B). Thus, the area of wetlands increased as new lands were inundated. If in the future (C) sea level rises faster than the ability of the wetlands to keep pace, the wetland area will decline. Construction of bulkheads or dikes to protect developed areas (D) would prevent new wetlands from forming inland, resulting in a total loss in some areas. Source: Titus (1991).

Changes in Fire Regimes

Part of what makes climate change such a complex topic is that its effects are expected to interact with each other to create as-yet unforeseen problems. For example, climate change is expected to make conditions more favorable for weed invasions, which are likely to reduce habitat quality and food availability for native species, and increase the risk of fire in some vulnerable ecosystems. As these effects ripple through the ecosystem, fire altered landscapes become more vulnerable to erosion, reducing soil water retention and reducing water quality and quantity in streams and rivers that receive runoff.

In the Columbia Basin shrub-steppe ecosystem (a northern extension of the Great Basin), one of Washington's most altered and threatened habitat types, fire and weeds act in unison to completely change plant and animal communities. Cheatgrass, an introduced annual from Eurasia, is particularly injurious in the shrub-steppe of the Columbia Basin, where it is widespread. Its success comes from the fact that it greens-up and reaches maturity before natives, "cheating" native grasses of valuable moisture. Each season while native grasses struggle to complete their life cycles, cheatgrass has already dropped seed and dried into highly combustible fuel. As natural or human-caused wildfires erupt, creating conditions that promote more cheatgrass. With more cheatgrass, the fire cycle occurs more frequently, until native plants cannot recover and ultimately disappear from the landscape. In this fashion, millions of acres of habitat continue to be permanently converted to cheatgrass, and lost as useful wildlife habitat or livestock range. It is this type of cycle, already severe, that climate change stands to make even worse.

Figure 8. Fire in the shrub-steppe community tends to lead to conversion from native to cheatgrass dominated habitat. ©D.E. McIvor/Hinterlands.

Figure 9. Sage-grouse live only in the shrub-steppe biome, North America's most critically threatened ecosystem. ©D.E. McIvor/Hinterlands.

Washington IBA species of concern at risk from increased range fire frequency and intensity.		
Low Risk	**Moderate Risk**	**High Risk**
	Swainson's Hawk	Greater Sage Grouse
	Prairie Falcon	Ferruginous Hawk
	Burrowing Owl	Sharp-tailed Grouse
	Short-eared Owl	Sage Thrasher
	Loggerhead Shrike	Sage Sparrow
	Grasshopper Sparrow	Brewer's Sparrow

Fires are also predicted to become more frequent, greater in intensity, and larger in extent in Washington's forested ecosystems. This cycle will be driven by faster plant growth (longer growing season with more carbon available to plants), drier fire season conditions (earlier snowmelt, less summer rainfall), and increasing insect infestations. Already areas from the Intermountain West to the Cascades have seen epidemic outbreaks of pine bark beetles. These natural pests were once kept in check by the kind of deep winter cold that has not been experienced in this region for decades. As these beetles spread throughout the forest they kill their hosts, leaving thousands of acres of standing dead and highly flammable trees.

Figure 10. Intense wildfire swept through this conifer forest bordering shrub-steppe. The fire was so intense it sterilized the soil in many places, requiring human intervention to spread desirable plant seeds to recover the site. ©D.E. McIvor/Hinterlands.

Washington IBA species potentially impacted by increased forest fire intensity.			
Beneficial	**Low Risk**	**Moderate Risk**	**High Risk**
Black-backed Woodpecker	Sooty Grouse	Northern Goshawk	Flammulated Owl
Olive-sided Flycatcher	Williamson's Sapsucker	Dusky Grouse	
		White-headed Woodpecker	
		Hermit Warbler	

Vegetation Changes

As a number of variables—especially precipitation and temperature—shift away from current conditions, the vegetation covering our landscapes and defining our ecosystems is also expected to change. Habitat, in turn, defines the suite of animals that can live and thrive there.

A number or researchers have been developing computer models to predict how vegetation can be expected to change as global warming proceeds. This is an active field of research and we can expect refinement of the complex models and an ever-improving understanding of how impacts may unfold.

One useful existing model is from the Mapped Atmosphere-Plant-Soil System (MAPPS) project. While fascinating, informative, and thought-provoking, one of the limitations of this model is that it is course, offering only 8 km resolution.

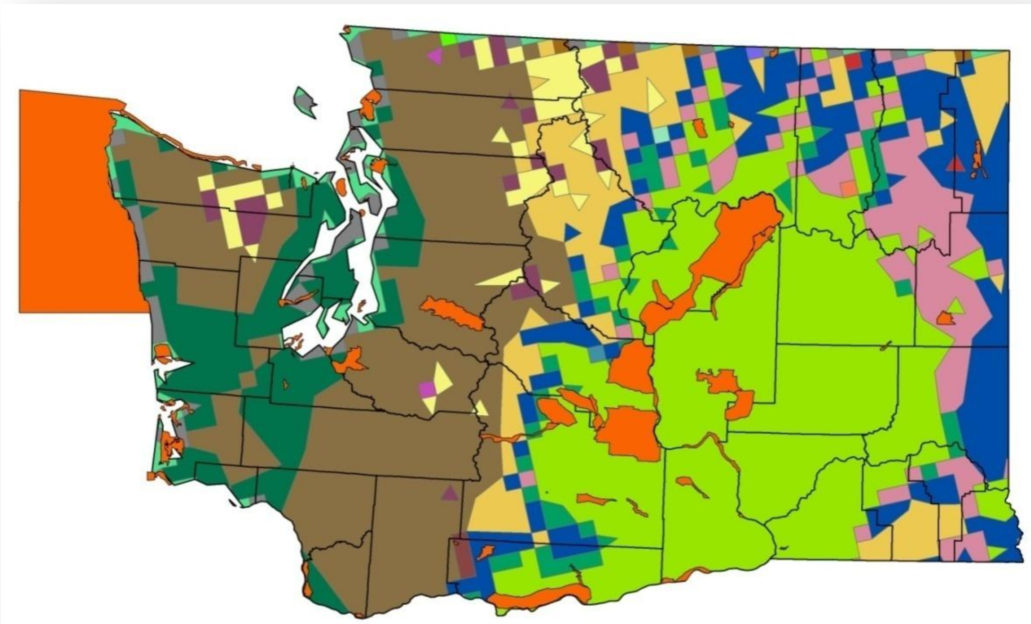
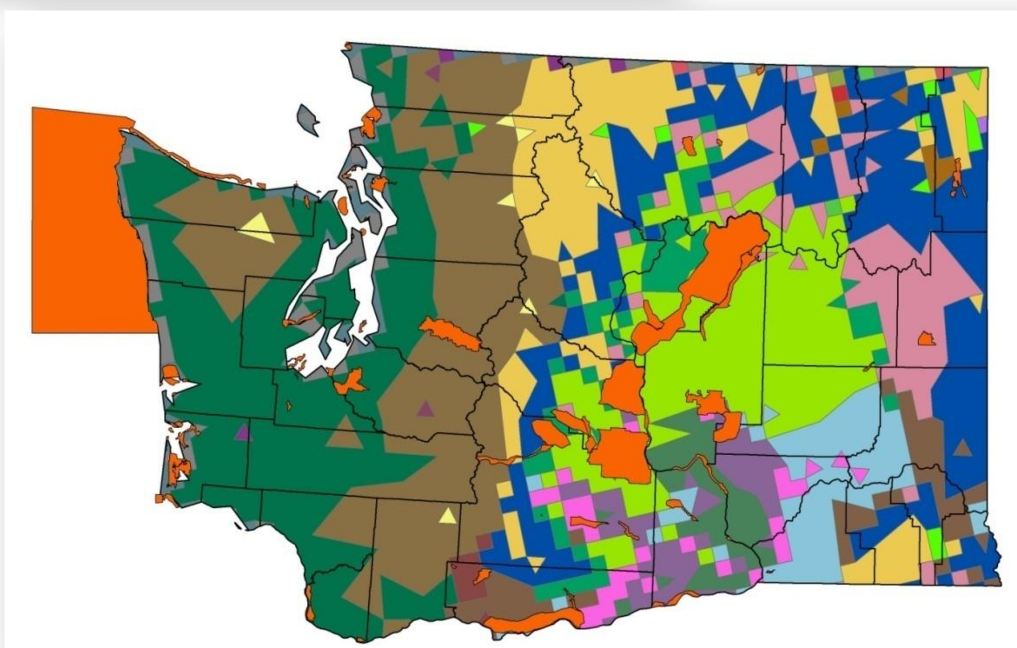


Figure 11. IBAs (shown in orange) projected over the MAPSS current vegetation model.

Figure 12. IBAs (in orange) projected against the MAPPS modeling of Canadian Climate Center data for predicted vegetation change in the years 2070 - 2099. The Canadian Climate Center model is based on doubling of atmospheric CO_2 from 1961 - 1990 conditions.



Audubon Washington is just beginning to explore the implications of these possible vegetation changes for our IBAs. For example, in Figures 4 and 5, you can readily identify two large swatches of habitat—the montane/Cascades area shown in brown and the Columbia Basin/shrub-steppe region shown in lime green. Both of these regions shrink in extent under project climate change conditions, with the shrub-steppe becoming severely fragmented.

One challenge that IBAs, national parks, national forests, state parks and all public lands face is that their boundaries are fixed—drawn in hard lines on maps. With climate change, the vegetation that characterizes these landscapes appears likely to shift, possibly no longer occurring within our drawn boundaries, possibly no longer even occurring in the state. For example, the White-tailed Ptarmigan is a bird limited to the alpine regions of our state. This vegetation type is expected to move upward in elevation as temperatures warm. The ptarmigan will likewise move up in elevation until it runs out of "up," at which point its populations may become too small for the bird to persist in our state.

IBAs will almost certainly lose some of the species for which they were recognized. Whether these species will remain as residents of our state is a complex question dependent not only on vegetation, but also conditions on wintering grounds, predator-prey relationships, ecosystem reordering, and many other factors linked to climate change.

Many—if not all—bird species in Washington would be effected by such wide-scale vegetation changes. In the illustrations above, it is easy to recognize the grassland and shrub-steppe birds such as Greater Sage-Grouse, Sharp-tailed Grouse, Sage Sparrow, and Sage Thrasher are likely to be hard hit by habitat loss and fragmentation.

Changes in Precipitation and Temperature

Temperature affects birds both directly and indirectly. Birds are warm-blooded and must maintain a near-constant body temperature. With large flight muscles designed to rapidly convert energy into propelled flight, dissipating heat can be a significant challenge for birds. Furthermore, temperature influences the timing of migration. Birds are expected to shift their distributions either northward or upward in elevation to maintain optimum temperatures and to remain associated with their preferred habitats. Some species are adversely affected by temperature increases as small as 1°C and will face a difficult future if they cannot shift their range to respond to climate change.[vii] Temperature (in conjunction with precipitation), is likely to trigger the earlier departure of migrants from their wintering grounds.

Global climate models project mid- 21st century temperatures in the Pacific Northwest that are well outside the natural range of temperature observed in the 20th century. While the temperature in the Pacific Northwest increased at the rate of 0.08°C per decade over the past 100 years, temperature in the coming century is projected to increase at the average rate of 0.3°C per decade. Temperature increases occur across all seasons with the largest increases in summer.[viii]

For Washington's birds, temperature change is most likely to directly affect those species with limited ability to seek new ranges. This includes species that are already near the southern or altitudinal limit of their ranges. White-tailed Ptarmigan, a species of alpine zones, could be pushed from its mountain top ranges. This includes a population of ptarmigan near Mount Rainier, which is isolated from other Washington populations and may be genetically unique. Ptarmigans are not migrants and typically move only short distances during the year, so the likelihood that individuals would migrate northward is remote.

Gray-crowned Rosy-Finch, another summer denizen of the alpine zone, would likely see its habitat shrink. These finches are strong fliers and do range widely. In response to increased temperatures they may simply move their range northward, with their numbers in Washington much reduced.

The American Pipit, another alpine breeding bird, barely has a range toehold in Washington. This species would likely shift northward as its mountain top habitat shrinks.

The three examples above all refer to birds that breed in Washington. Also potentially affected are birds that traditionally winter in Washington. Birds such as the Northern Shrike, Snowy Owl, and Common Redpoll that now descend from the northern boreal forests and subarctic may find Washington too warm in winter to meet their life history needs, or may find themselves competing with species that once migrated out of the state for winter, but no longer migrate under milder winter conditions.

Temperature change will influence other variables that will then indirectly impact birds. For example, increased temperatures will mean a reduced snowpack, earlier melting, earlier runoff, and a greater rate of evaporation during summer. These changes will likely influence water availability for wetlands, lakes, reservoirs, and rivers (including the Columbia), thereby impacting wetland birds. Shallow lakes and seasonal wetlands could be reduced in size or disappear altogether, taking valuable bird habitat with them.

Timing and amount of precipitation are strong determining factors for the type of habitat that characterizes a landscape. Precipitation is expected to influence birds' migration behavior, affecting the decision to depart based on food availability. Drought at critical migratory stopover sites will affect birds' ability to refuel and rest before completing migration journeys.[ix]

Precipitation trends in the Pacific Northwest are more variable than trends in temperature, but most monitoring stations show increases over the past 80 years. The largest relative increases were observed in northeast Washington and south central British Columbia, especially in spring. Along with an increase in precipitation, scientists have recorded a decline in snowpack, particularly at lower elevations, since 1950. It is the lower elevations that are more sensitive to temperature change and warming trends. Declines have been largest in the central and southern Cascade Mountains.[x]

Nearly all of the climate models project wetter winters and drier summers in the 2020s and the 2040s in the Pacific Northwest.[xi] As mentioned, the timing and distribution of water in conjunction with increased temperature is expected to have widespread impacts on Washington habitats, and therefore birds. Waterbirds in Eastern Washington would be faced with less breeding habitat. Shallow lakes that produce ducks and support migrating waterfowl each year could dry before birds fledge, and long before fall migrants arrive.

Washington IBA species potentially impacted by changes in temperature and precipitation driven by climate change.		
Low Risk	**Moderate Risk**	**High Risk**
Black-crowned Night-Heron	American Bittern	Western Grebe
Cinnamon Teal	Canvasback	Clark's Grebe
Common Goldeneye	Ring-necked Duck	Black-necked Stilt
Hooded Merganser	Lesser Scaup	American Avocet
Osprey	Ruddy Duck	Long-billed Curlew
Lewis's Woodpecker	Virginia Rail	Black Tern
	Sora	
	Sandhill Crane	
	Long-billed Dowitcher	
	Wilson's Snipe	
	Wilson's Phalarope	
	Forster's Tern	
	Willow Flycatcher	

Migration and Phenology

Migration is ultimately about access to food resources, rather than escaping cold winters as humans are prone to do. But changes in both temperature and precipitation are expected to affect bird migration by affecting the decision to depart wintering or breeding areas based on food availability.

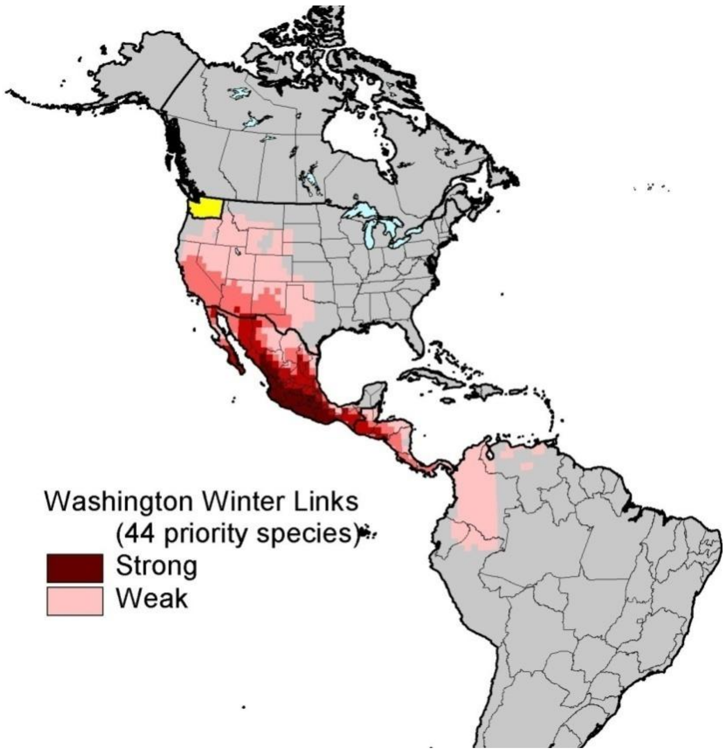


Figure 14. Washington's migration connections based on the winter destinations of 44 species of breeding birds. The "Links" are created by the species that we share in common, the places where Washington's summer breeding birds spend their winter.

About 70 percent of Washington's birds migrate, meaning a huge percentage of our birds are vulnerable to climate change as it affects migration. Mitigating this circumstance is the fact that many of our breeding birds are medium-distance migrants, wintering from California through Central America. Long distance migrants that travel as far as the high arctic to South America will continue to face greater obstacles to survival. Climate change is expected to produce more severe storms (e.g., hurricanes), which further threaten birds along their migration routes.

Migratory species are particularly vulnerable to disruptions in predator – prey interactions. This is due to the fact that migration cues—the environmental signal that tells an individual it is time to start migrating—can become completely disconnected from the timing of prey availability along the migration route and at the summer breeding site. This is known as *phenological disjunction*. Migration is an exquisitely balanced phenomenon, relying on the availability of resources for refueling along the travel route. Many species also appear to time their migrations to arrive on their breeding ground just as food resources become available. For those who arrive at just the right moment, the best territories are uncontested and food is available for survival. In a world of disrupted predator – prey interactions, food may not exist to refuel migration journeys, and insects may not have hatched when an individual arrives on its breeding ground. Drought at critical migratory stopover sites will affect birds' ability to refuel and rest before completing migration journeys.[xii]

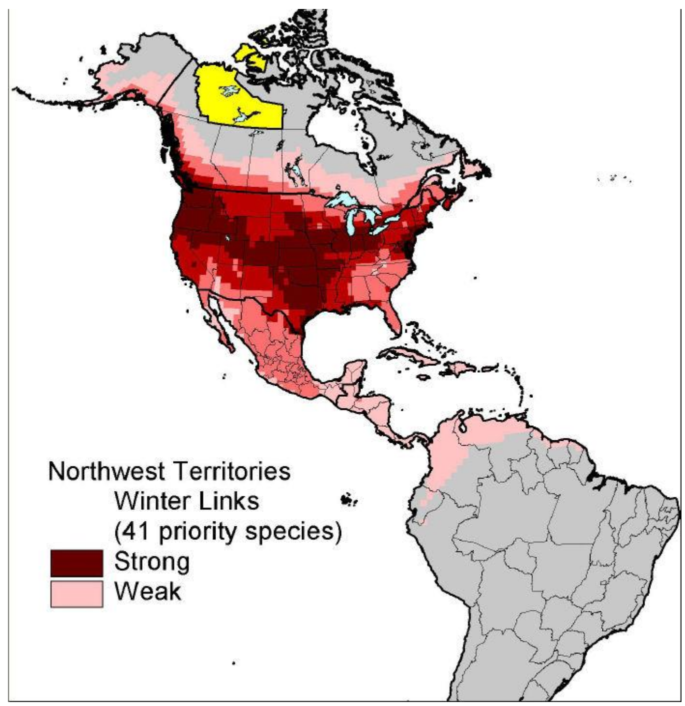


Figure 13. Washington has strong migratory bird links--and therefore stewardship responsibility--for birds that breed in the Northwest Territories (shown) and the Yukon, and winter in Washington.

Figure 15. Will the millions of migrating birds that rely on Washington to provide food and resting sites twice each year still find our state welcoming? Our collective actions to reduce the risks of climate change will determine the answer to that vital question. © Jeff Larson.

Range Changes

Research into Washington's birds changing their ranges in response to climate change is in its earliest stages. However, enough research and examples of this phenomenon from other parts of the US and the world exist to suggest that Washington's birds will respond, and probably are already doing so.

The combination of variables influenced by climate change is expected to result in a range contraction for many bird species, reflecting less suitable habitat for these birds. In fact, range contractions are expected to be more common than range expansions.[xiii] Species of birds with ranges that both contract and shift are likely to be most threatened by climate change.

In a publication entitled *The Bird Watcher's Guide to Global Warming*, the National Wildlife Federation and the American Bird Conservancy predict that the Pacific Northwest will lose 32 percent of the bird species currently in our area.[xiv] Some new species are predicted to move into the rearranged climate and habitats of the region, resulting in a net loss of 16 percent of the total number of species now occurring here.

Some species of birds are shifting their ranges, showing up earlier in spring, and initiating nesting earlier in the year, a behavior pattern consistent with climate change effects.[xv] A recent study examined 56 species of birds in eastern and central North America, examining changes in their distribution over a 26 year period.[xvi] Researchers at Audubon are working to expand this type of study across the US, but for now it is interesting to look at the range shifts of the species from the study that also occur in Washington.

In a similar study examining changes in the distribution of 254 species across the US and southern Canada, researchers found "broad-scale geographic and taxonomic evidence that poleward shifts in geographic ranges occurred for avian species wintering in North America" between 1975 and 2004.[xvii] This trend appeared to be due to colonization events on the northern boundary of species' ranges, driven by a combination of climate change and regional human activities (though this latter factor explained a relatively small proportion of the poleward movement).

Washington birds showing a pronounced northward movement in their ranges (National Audubon Society's 2009 State of the Birds Report).			
Species	**Distance (miles) moved to north continentally over 40 yrs.**	**Center of Abundance Relative to WA**	**40-yr State Cumulative Population Change**
Marbled Murrelet	361.9	North	-95.9%
Rock Sandpiper	93.9	North	-84.3%
Gadwall	148.9	South	2927.7%
Surfbird	61.1	South	344.5%
Spotted Towhee	215	South	226.2%
Tundra Swan	129.1	South	398.9%
American Crow	88.8	South	1638.5%
Red-winged Blackbird	99.3	South	631.3%
Rock Wren	10.6	South	631.3%
Hermit Thrush	91.4	South	1141.6%
Mourning Dove	147.3	South	1993.4%
Golden-crowned Sparrow	155	South	1397.4%
Say's Phoebe	29.9	South	1704.4%
Wood Duck	37.1	South	9543.3%
Western Scrub-Jay	45.8	South	67673.3%

Ecosystem Disconnect

Climate change is forcing a shift in phenology—the timing of key life history events. Predator, prey, parasites, and host plants are not necessarily responding at the same rate, leading to ecological disconnects and ultimately, ecosystem reordering. Nesting and migration are two elements of bird life history that are well studied, with a growing number of studies already suggesting a strong response to climate change in birds. These changes can force a species' life cycle out of synchrony with the ecosystem of which it is a part. The Common Murre, a species that has declined 93 percent in Washington since the 1970s[xviii], has advanced its breeding date 24 days *per decade*, apparently in response to climate change[xix]. A study evaluating more than 50 years of data found that four species occupying diverse niches are laying eggs earlier in conjunction with warming local climates[xx]. A study of 3,450 Tree Swallow nest records found that this species advanced its egg-laying date by nine days between 1959 and 1991[xxi].

An excellent example of a disconnection between an animal and the environment to which it is adapted involves the Gray Jay. In Washington, Gray Jays are found primarily in mature, humid, sub-alpine spruce forests. They do not generally breed below 2,000 feet, and are most often found above 3,000 feet to the tree line, and they also prefer undisturbed forests[xxii]. Gray Jays collect and cache food in order to stay at high elevations, and also to begin feeding their chicks. This caching behavior allows them to breed earlier than most other birds in their elevational range. But Gray Jays have declined by as much as 60 percent along the southern edge of their range. The reason appears to be food caches that are rotting because of warmer than normal temperatures, affecting the Gray Jays' ability to feed their young[xxiii].

Figure 16. Gray Jay, an iconic bird of high elevation conifer forests. Jeff Larson Photo.

Changes in Atmospheric and Ocean Circulation

One of Washington's outstanding features, of course, is the Pacific Coastline and the wealth of marine resources the state offers. In the context of climate change, the impacts of sea level rise are discussed elsewhere on this site. Climate change is affecting the oceans in other ways as well, and seabirds are indicating early responses to climate change.

Prey distributions are changing at some locations in the oceans. Plankton communities, at the base of the marine food chain, have made significant shifts of as much as 10° latitude in response to changes in sea surface temperature.[xxiv] The world-wide distribution and abundance of shorebirds has been shown to be related to the productivity of adjacent coastal waters.[xxv] These processes affect not only birds in the open ocean, but coastal species as well.

Figure 17. Pigeon Guillemots are one of many seabirds that would likely decline as food resources become more scarce with the increasing frequency of El Nino events. Photo (c) Jeff Larson.

Climate change also appears to be having an effect on the El Nino – La Nina cycle. Since 1976, cycles have been exceptionally long with an imbalance between phases, with five El Nino events to every two La Ninas.[xxvi] El Nino events tend to drive atmospheric temperatures higher, exacerbating the effects of climate change. In fact, a feedback cycle seems to be created whereby small rises caused by greenhouse gases are amplified, feeding back and amplifying the intensity of the El Nino cycle. El Nino events are associated with floods, droughts, and other disturbances in a range of locations around the world. The Pacific Northwest states tend to experience dry but foggy winters and warm, sunny, and early springs during an El Niño. Furthermore, El Niño is associated with increased wave-caused coastal erosion along the US Pacific Coast. Offshore, El Nino events bring warmer, nutrient-poor water to coastal Washington, compromising the base of the marine food chain.

The table below lists the IBA species of concern that may be impacted by changes in oceanic circulation and upwelling. Of immediate concern are Common Murre, which has declined 93 percent since the 1970s, and the Western Grebe, which has declined by 81 percent in the same time period.[xxvii] Whether these declines are linked to climate change is unknown at this time.

Washington IBA species potentially impacted by changes in atmospheric and ocean circulation.		
Low Risk	**Moderate Risk**	**High Risk**
Brandt's Cormorant	Red-throated Loon	Common Murre
Pelagic Cormorant	Sooty Shearwater	Pigeon Guillemot
Western Grebe	Pacific Loon	Cassin's Auklet
Black-legged Kittiwake	Black-footed Albatross	Rhinoceros Auklet
	Northern Fulmar	Tufted Puffin
	Pink-footed Shearwater	
	Buller's Shearwater	
	Sooty Shearwater	
	Fork-tailed Storm-Petrel	
	Ancient Murrelet	

What You Can Do

At best, greenhouse gasses already in the atmosphere will linger and impact our planet's climate for decades; swift action to reduce emissions is urgently needed. Adding to this sense of urgency is a recent study concluding that the effects of climate change may in fact be *irreversible*[xxviii], suggesting that any damage we do now will require long-term adaptation. To achieve the 60% reduction in greenhouse gas emissions that the scientific community believes is necessary will require not only individual action, but also the collective action of governments and societies around the world.

- Urge action from your legislators at both the state and federal levels. Though far from perfect, legislation supporting Cap and Trade programs to regulate carbon are a step forward.
- Support local planning actions that result in improved public transportation systems and pedestrian and bicycle friendly communities.
- Take personal action to reduce your own carbon footprint.
    - Understanding the size of your carbon footprint is a good place to start. Many on-line calculators such as the one provided by The Nature Conservancy or SafeClimate are available and will give you a quick snapshot of where you stand as a carbon contributor.
    - Make your home as energy efficient as you can. Many important changes are easy, quick, inexpensive, will result in reduced energy bills, and in some cases may even be subsidized by local utility companies. For a list of actions, see Audubon's web site.
    - Recycle everything. Most of the items that pass through our hands on a daily basis produced greenhouse gasses in their manufacture and delivery. The more we can reuse and extend the life of these items, the more we will improve the efficiency of our systems.
    - Cars are a significant source of greenhouse gasses. Make a commitment to use public transportation whenever possible. When you do need to drive, combine errands to make maximum use of your trip. When your current vehicle reaches the end of its useful life, replace it with a low-emissions vehicle that also gets good gas mileage, such as Toyota's Prius.
    - Become a locavore—eat foods that are produced near your home to reduce the quantity of carbon-based fuels needed to ship your food.
- Green your workplace, where 40% of greenhouse gas emissions in developed countries arise. Easy and helpful changes include turning off lights, copiers, and computers at the end of the work day. More difficult but no less important is getting the thermostat set to more reasonable levels, both summer and winter. Check out the World Wildlife Fund's Climate Savers initiative.

- Join Audubon's activist team and urge our elected official to make global warming a top priority by signing our petition at birdsandclimate.org. Voice your support for new approaches to help solve global warming, move us toward a 100 percent clean energy future, reduce our dependence on oil, and protect our environment. Stay informed, write letters to your leaders, and support candidates who promise to take the aggressive and farsighted actions necessary to curb global warming.
- Support conservation efforts that protect and restore essential bird habitat, keeping it healthy to better withstand global warming. Visit www.audubon.org to learn how the Important Bird Areas program is building a national network of conservation stewards. And join in Citizen Science efforts like the Christmas and Great Backyard Bird counts http://www.audubon.org/bird/citizen/index.html to help us monitor how climate change may be impacting birds and habitats.
- Manufacturing, packing, transporting, and selling goods not only use huge amounts of energy but also release excessive amounts of greenhouse gases. When shopping, always ask, "Do I really need this? Does the Earth really need this?" You'll probably save money as well.
- An average tree absorbs ten pounds of pollutants from the air each year, including four pounds of ground level ozone and three pounds of particulates. So, plant leafy trees around your house to provide windbreaks and summer shade. When shopping for lumber, ask about certified wood to support sustainably managed forests that are bird-friendly.
- Power plants are the single largest source of heat-trapping gases in the United States, but in some states you can switch to utilities that provide 50 to 100 percent renewable energy. You may also want to consider installing solar panels on your home.

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