NOOKSACK INDIAN TRIBE
CLIMATE CHANGE ADAPTATION PLAN FOR KEY SPECIES AND HABITATS

Prepared by
University of Washington Climate Impacts Group

In Partnership with
Nooksack Indian Tribe Natural and Cultural Resources Department

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Executive Summary

Why a Climate Change Adaptation Plan for the Nooksack Indian Tribe?

Recognizing the impacts climate change poses to the Nooksack Indian Tribe, the Tribe's Natural and Cultural Resources Department is engaged in an on-going process to prepare for risks to Tribally important fish, wildlife and habitats. Building off the Tribe's vulnerability assessment, completed in 2017 (Morgan and Krosby, 2017), this plan represents the critical next step in the adaptation planning process: identifying actions to guide the Tribe's efforts to increase the climate resilience of priority natural and cultural resources. This plan was developed for Water Resources Inventory Area 1, which encompasses the Nooksack River watershed and associated marine tributaries, a total area of 1,410 square miles (>900,000 acres).

Adapting to climate change is an on-going process for the Nooksack Indian Tribe, with the aim of building resilience to the adverse effects of climate change. There are several steps in this process that the Nooksack Indian Tribe has already completed, including:

(1) Assessing baseline conditions as influenced by past climate trends and legacy impacts from land use and management,
(2) Evaluating the climate vulnerability of priority natural and cultural resources, and
(3) Identifying adaptation actions to prepare for climate impacts on natural and cultural resources (*what this plan will do*).

Additional work is required to move from adaptation planning to implementation, and eventually to monitoring and evaluation to assess the effectiveness of these actions. Recommended next steps for the Nooksack Indian Tribe include:

(4) Develop an implementation strategy for climate adaptation actions,
(5) Implement adaptation actions and monitor their effectiveness in the Nooksack watershed, and
(6) Periodically review and update the adaptation plan and revisit adaptation actions that prove ineffective.

How is climate change expected to affect species and habitats of importance to the Nooksack Indian Tribe?

Western Washington is projected to warm rapidly throughout the 21st century. Increasing temperatures are projected across all seasons, with the greatest warming occurring during the summer. Projected changes in annual precipitation are small compared to year-to-year variability, however, heavy precipitation events are projected to increase in frequency and magnitude.

The Nooksack Indian Tribe vulnerability assessment (Morgan and Krosby, 2017) estimated the climate change vulnerability of 19 species and six habitat types of importance to the Tribe. Overall vulnerability scores ranged widely, from Less Vulnerable to Extremely Vulnerable, but the majority of species ranked as Moderately Vulnerable for the 2050s under a low greenhouse gas scenario and Extremely Vulnerable for the 2050s under a high greenhouse gas scenario. Most species also ranked as Extremely Vulnerable for the 2080s under both low (RCP 4.5) and high (RCP 8.5) greenhouse gas scenarios.

How was the Nooksack Indian Tribe Climate Change Adaptation Plan developed?

The Director of the Nooksack Indian Tribe Natural and Cultural Resources Department and the Tribe's Water Resources Program Manager worked together to identify a priority subset of the species and habitat types assessed in the 2017 Vulnerability Assessment (Morgan and Krosby 2017). This smaller set (Table 1) was used as the focus of this adaptation plan (available information, budgetary and time constraints prevented inclusion of all species and habitats evaluated in the 2017 Vulnerability Assessment).

Table 1. Species and habitats for which adaptation actions are identified in this plan.[1,2]

Species
Alaska yellow cedar (*Callitropsis nootkatensis*)
Western redcedar (*Thuja plicata*)
Evergreen huckleberry (*Vaccinium ovatum*)
Black bear (*Ursus americanus*)
Black-tailed deer (*Odocoileus heminous*)
Elk (*Cervus canadensis*)
Mountain goat (*Oreamnos americanus*)
Habitat Types
Alpine
Subalpine
Forest
Riparian
Wetland
Estuary
Marine

During three, day-long workshops, land and wildlife management stakeholders within the Nooksack watershed (including Nooksack Indian Tribe, Whatcom County, Whatcom Land Trust, Evergreen Land Trust, WA Department of Natural Resources, WA Department of Fish and Wildlife, U.S. Forest Service, Sierra Pacific Industries, Natural Systems Design; and the Stillaguamish Tribe of Indians; Table 2) evaluated, selected, and prioritized more than 200 potential adaptation actions compiled by the University of Washington Climate Impacts Group (CIG) from the scientific literature and existing adaptation plans. Stakeholders refined the list to the higher-priority adaptation actions included in this plan. During review of the results of the workshops and subsequent consultation, the Tribe and collaborators added some additional actions where gaps were identified, and/or modified descriptions of actions to clarify application and relevance.

[1] This plan does not address important salmonid species and riverine habitats in the Nooksack River watershed because the Nooksack Indian Tribe has already addressed these important treaty resources independently through collaborative research with EPA Region 10 and EPA Office of Research and Development (see below). See Morgan and Krosby (2017) for descriptions of habitat types.

[2] Environmental Protection Agency (EPA). 2016. Qualitative Assessment: Evaluating the Impacts of Climate Change on Endangered Species Act Recovery Actions for the South Fork Nooksack River, WA. EPA/600/R-16/153. Western Ecology Division, National Health and Environmental Effects Research Laboratory. Corvallis, OR.

Table 2. Nooksack watershed partners participating in adaptation planning workshops.

Nooksack Indian Tribe Natural and Cultural Resources Department		Washington Department of Fish and Wildlife	
Whatcom County		U.S. Forest Service	
Washington Department of Natural Resources		Whatcom Land Trust	
Sierra Pacific Industries		Natural Systems Design	
Evergreen Land Trust		Stillaguamish Tribe of Indians	

What's in the Nooksack Indian Tribe Climate Change Adaptation Plan?

The Nooksack Indian Tribe's Climate Change Adaptation Plan includes **140 high-priority adaptation actions** that, if implemented, are expected to increase the climate resilience of the priority species and habitats addressed in this plan. Actions are grouped according to the timeframe anticipated for progress.

71 On-Going Actions are those already being implemented within the Nooksack watershed, and which will continue to be important for enhancing long-term climate resilience. This also includes actions that have been initiated specifically in response to observed or expected impacts of climate change.

84 Near-Term Actions are those for which progress can likely be made over the next five years.

56 Long-Term Actions are those expected to require more than five years to make significant progress.

A wide range of actions will be needed to prepare the Tribe for climate change and to promote species and habitat resilience in the face of climate stressors. Through implementation and monitoring, these actions may be updated or modified, and new actions identified as a function of the Tribe's climate adaptation process. Changes to

practices and behavior are the most common type of adaptation action for almost all priority species and habitats. Other types of actions identified in the adaptation plan address **policy, outreach, partnerships, data collection and monitoring, and evaluation and assessment** (Figure 1 and Figure 2).

Adaptation actions focused on **evaluation and assessment** will likely be important for addressing concerns related to habitats that are particularly sensitive to warming temperatures (e.g., alpine and subalpine habitats) in order to increase knowledge of local vulnerabilities and expected impacts on specific portions of the Nooksack watershed.

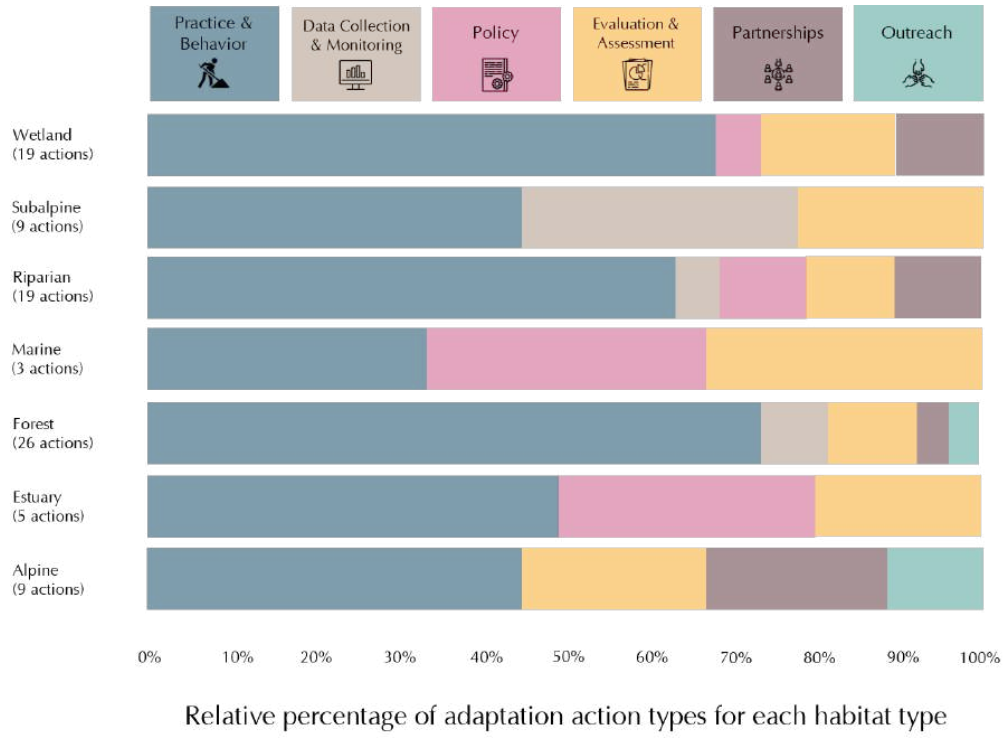

Figure 1. Summary of adaptation actions included in the plan for priority habitat types. Actions are grouped by habitat types and color-coded based on the action type (see Table 4 for description of action types). The width of the segments in each bar reflects the proportion of actions of that type. The total number of actions for each habitat type is shown on the left side of the figure.

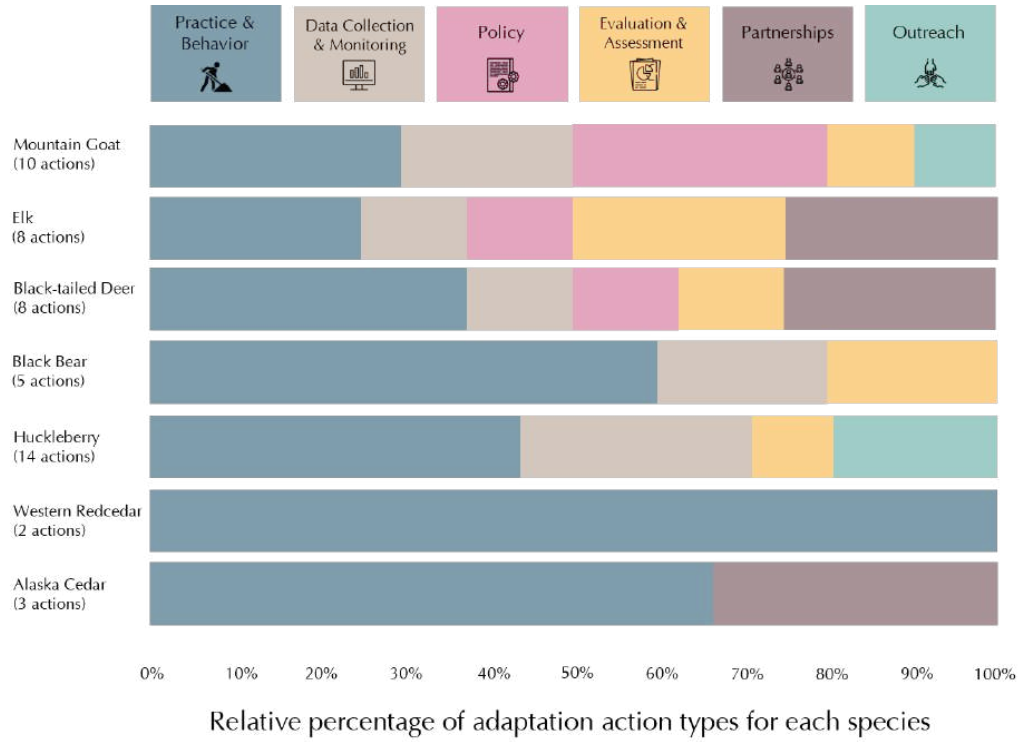

Figure 2. Summary of adaptation actions included in the plan for priority species. Actions are grouped by species and color-coded based on the action type (see Table 4 for description of action types). The width of the segments in each bar reflects the proportion of actions of that type. The total number of actions for each species is shown on the left side of the figure.

Partnership building is necessary for effective adaptation for most species and habitats included in this plan. Climate change poses challenges to species and habitats that span jurisdictional boundaries. Additionally, the Nooksack Indian Tribe has a relatively small reservation and trust land area (~4,000 acres) and most hunting and gathering occur beyond reservation and trust lands within its U&A area. Implementing adaptation actions for priority species and habitats will thus require partnership with management agencies, land owners and stakeholder groups outside the Tribe's limited geographic jurisdiction.

Federal and state land management policy changes will likely be important for effective climate adaptation for those species – such as mountain goat, elk, and deer – that are negatively affected by the location, design, or management of built infrastructure, or by the presence of recreation activities in core habitat areas. Establishing and implementing policies that help inform/regulate/control the location, size and management of new development (e.g., facilities, roads, recreation access) will be key to maximizing the resilience of such species.

How can adaptation actions be incorporated into natural resource management across the Nooksack watershed?

While the list of 140 potential adaptation actions is extensive, many actions are already represented among current practices being taken within the Nooksack watershed and can be implemented through existing land or species management policies, plans, and programs. Examples of existing practices through which adaptation actions can be implemented include:

- Washington Department of Natural Resources' (DNR) Good Neighbor Authority Partnership
- WA DNR Habitat Conservation Plan
- WA DNR Heritage Program
- Washington Forest Practices Act
- Washington Priority Habitat and Species Program
- Washington State Hydraulic Code
- South Fork Nooksack River Watershed Conservation Plan
- South Fork Nooksack River Reach-Scale Plan
- Beaver Restoration on the South Fork Nooksack: A Review and Conceptual Framework
- U.S. Forest Service's Burn Area Emergency Response (BAER)
- Whatcom County's Flood Hazard Reduction Program
- Whatcom County Shoreline Management Program
- Whatcom County Purchase of Development Rights
- Whatcom County Critical Areas Ordinance (CAO)
- Whatcom Land Trust Conservation Plan
- WRIA 1 Salmon Recovery Plan
- WRIA 1 Watershed Management Plan
- Firewise USA®
- Budget Development within the Nooksack Indian Tribe's NRCD
- On-going species and habitat monitoring efforts within the NRCD

What are the Next Steps?

The Nooksack Indian Tribe Climate Change Adaptation Plan reflects an important early step in the adaptation process. Additional effort will be needed to move from planning to implementation, and eventually to monitoring and evaluation to assess the effectiveness of these actions. Recommended next steps for the Nooksack Indian Tribe include:

- Develop an Adaptation Strategy Implementation Plan.
- Assign responsibility and support action by designating a lead person or persons from key programs, land management agencies, landowners, and other stakeholders to oversee implementation.
- Explore options to secure funding for the implementation of adaptation actions identified in this plan.
- Develop metrics and targets that can be used to measure progress over time.
- Update the plan at regular intervals or as new information becomes available.
- Implement adaptation actions on the landscape and monitor the effectiveness over time; re-evaluate actions after monitoring for effectiveness.
- Engage partners and provide support for existing programs such as those referenced above to maximize action implementation.

Table of Contents

1. Introduction and Background

The Nooksack Indian Tribe is already experiencing climate impacts on their natural resources, and these impacts are likely to become more severe in the future as climate change progresses. Increasing temperatures and a rising snowline are facilitating conifer encroachment into subalpine meadows and huckleberry patches, declining summer streamflows are reducing water availability within forested wetlands in the Nooksack watershed, and sea levels are rising along the coast. This Climate Change Adaptation Plan builds off the Tribe's 2017 vulnerability assessment by identifying a suite of potential adaptation strategies and actions aimed at reducing the climate vulnerability of species and habitats that are important to the Tribe.[3,4]

The goal of the Nooksack Indian Tribe adaptation planning process for key species and habitats was to collectively identify potential adaptation actions the Tribe and its partners in the Nooksack watershed can consider as they work to increase the climate resilience of priority species and habitats within the Nooksack watershed. Increasing climate resilience through effective adaptation will help to ensure that the Nooksack Indian Tribe Natural and Cultural Resources Department (NRCD) can continue to fulfill its mission to "protect, restore, and sustainably manage the Tribe's Treaty natural resources in the Tribe's 1.1 million-acre Usual and Accustomed (U&A) Grounds and Stations area spanning from the international border to the north, Samish Bay to the south, the crest of the North Cascades to the east, and the San Juan Islands to the west."

This plan was developed as a collaborative effort of the University of Washington Climate Impacts Group and Nooksack Indian Tribe NCRD. Because the Nooksack NCRD only manages natural and cultural resources on the Tribe's reservation and trust lands (~4,000 acres), a small fraction of the land the Tribe relies upon for treaty rights, successful

[3] This plan does not address important salmonid species and habitats in the Nooksack watershed because the Nooksack Indian Tribe has already addressed these important treaty resources independently through collaborative research with EPA Region 10 and EPA Office of Research and Development (see below).

[4] Environmental Protection Agency (EPA). 2016. Qualitative Assessment: Evaluating the Impacts of Climate Change on Endangered Species Act Recovery Actions for the South Fork Nooksack River, WA. EPA/600/R-16/153. Western Ecology Division, National Health and Environmental Effects Research Laboratory. Corvallis, OR.

adaptation will require partnership with land, fish and wildlife management entities across the Nooksack watershed and U&A area. This plan was thus prepared in collaboration with Whatcom County, Whatcom Land Trust, Evergreen Land Trust, Washington Department of Natural Resources (DNR), Washington Department of Fish and Wildlife (WDFW), U.S. Forest Service, Sierra Pacific Industries, Natural Systems Design, and the Stillaguamish Tribe of Indians.

This plan represents the second step in the Nooksack NCRD climate adaptation process. The plan ***describes the process*** (**Section 3**) used to identify potential, high-priority adaptation actions to increase the climate resilience of the Tribe's priority species and habitat types. This plan ***suggests over-arching principles*** (**Section 4**) for the Tribe's approach to climate adaptation that emerged from the process, and ***identifies common themes*** across the types of adaptation actions (**Section 5**) likely to be most important for addressing species and habitat vulnerabilities.

It is important to note that identifying these potential adaptation actions is just the beginning of adapting to climate change and promoting species and habitat resilience. Over time, the Tribe can take the ***next steps to continue climate change adaptation*** (**Section 7**) by refining adaptation actions, developing an implementation plan, integrating actions into existing plans, processes, and programs – a process referred to as mainstreaming. Ultimately, actions should be implemented and then monitored and evaluated to assess their effectiveness, informing future iterations of an ongoing adaptation process.

Through the adaptation planning process, Nooksack NCRD staff and Nooksack watershed partners identified ***140 potential high-priority adaptation actions***. These actions span a range of activities representative of on-going and anticipated work, including *policy development, partnership building, outreach, data collection and monitoring, evaluation and assessment, and on-the-ground practices.*

Of the 140 potential adaptation actions, there are *71 on-going* actions already underway by land, fish, and wildlife management entities in the watershed. These include existing actions that are likely to have benefits for long-term climate resilience, as well as actions that are already happening in the watershed in response to observed impacts of climate change. There are an additional **84** ***near-term actions*** **(Appendix A)** for which the Tribe and its partners in the watershed will strive to make progress on over the next five years. There are **56** ***long-term actions*** (**Appendix B**) for which the Tribe and its partners will likely take more than five years to make significant progress.

2. Vulnerability Assessment Summary

Vulnerability Assessment Goals & Objectives

In 2017, the Nooksack Indian Tribe's Natural and Cultural Resource Department partnered with the University of Washington Climate Impacts Group to complete a climate change vulnerability assessment for priority species and habitats within the Nooksack watershed and associated marine tributaries (i.e., WRIA 1; Figure 1). The report, *Nooksack Indian Tribe Natural Resources Climate Change Vulnerability Assessment* (Morgan and Krosby 2017), was the Tribe's initial step in the climate preparedness planning process and serves as the basis of this Adaptation Plan. The Tribe's vulnerability assessment summarizes the potential impacts of climate change on priority species and habitats.

Potential effects of climate change were assessed for 19 species and six habitats identified by NCRD staff and Tribal members as priorities for the Tribe. Through a series of workshops, NCRD staff and Tribal members identified relevant species-specific sensitivities and adaptive capacities, to help inform a relative vulnerability ranking generated using NatureServe's Climate Change Vulnerability Index.[5] Estimated climate change vulnerability rankings for the seven priority species addressed in this adaptation plan are shown in Table 1, and qualitative vulnerability rankings for the seven habitat types are shown in Table 2.

Figure 1. The Nooksack watershed and WRIA 1, the area of interest for the Nooksack Indian Tribe climate change vulnerability assessment. *Figure source: UW CIG.*

[5] Due to budgetary and time constraints, this adaptation plan developed potential, higher-priority adaptation actions for a subset (seven out the total 19) of the species evaluated in the vulnerability assessment.

Table 1. Vulnerability results for seven priority species included in this adaptation plan. Climate Change Vulnerability Index rankings for species assessed using NatureServe's CCVI. CCVI rankings: Less Vulnerable (none), Moderately Vulnerable, Highly Vulnerable, Extremely Vulnerable. "LOW" shows results from a low greenhouse gas scenario (RCP 4.5), and "HIGH" shows results from a high greenhouse gas scenario (RCP 8.5).

English Name	Species	2050 LOW	2050 HIGH	2080 LOW	2080 HIGH
Alaska yellow cedar	*Callitropsis nootkatensis*	Extreme	Extreme	Extreme	Extreme
Western redcedar	*Thuja plicata*	High	Extreme	Extreme	Extreme
Evergreen huckleberry	*Vaccinium ovatum*	Moderate	Extreme	Extreme	Extreme
Black bear	*Ursus americanus*	Moderate	Extreme	Extreme	Extreme
Black-tailed deer	*Odocoileus heminous*	Moderate	Extreme	Extreme	Extreme
Elk	*Cervus canadensis*	High	Extreme	Extreme	Extreme
Mountain goat	*Oreamnos americanus*	Extreme	Extreme	Extreme	Extreme

Priority Species

Results from the vulnerability assessment suggest that each species will be affected by climate change uniquely. Overall vulnerability scores ranged from Moderately Vulnerable to Extremely Vulnerable, but the majority of species ranked as Moderately or Highly Vulnerable for the 2050s under a low greenhouse gas scenario and Extremely Vulnerable for the 2050s under a high greenhouse gas scenario. All species ranked as Extremely Vulnerable for the 2080s under both low (RCP 4.5) and high (RCP 8.5) greenhouse gas scenarios. The vulnerability rankings shown in Table 1 reflect climate sensitivities for each species, including:

- **Alaska yellow cedar:** Limited seed dispersal distances, and dependence on specific habitat conditions, including snowpack and cool habitats.
- **Western Redcedar**: Sensitivity to drought.
- **Evergreen Huckleberry:** Dependence on specific habitat conditions and reliance on a subset of pollinators for pollination.
- **Black Bear**: Landscape connectivity issues related to natural and human-made barriers.
- **Black-tailed Deer**: Landscape connectivity issues related to natural and human-made barriers and sensitivity to disease and parasites.
- **Elk**: Landscape connectivity issues related to human-made barriers.
- **Mountain Goat**: Dependence on cool or cold habitats and occurrence of human-made barriers that impact habitat connectivity.

Table 2. Vulnerability Assessment Results for Habitats. Habitats identified by the Tribe as a high priority for assessment are shown in bold. Qualitative vulnerability rankings included Low, Moderate, and High.

Habitat Type	Vulnerability Ranking
Forest	Moderate to High
Wetland	High
Marine	Moderate
Estuary	Moderate to High
Riparian	Moderate to High
Montane (Alpine, Subalpine, Meadow)	High

Priority Habitat Types

As with the results for individual species, climate change is expected to affect the vulnerability of each habitat type uniquely. The vulnerability rankings shown in Table 2 reflect climate sensitivities for each habitat type[6], including:

- **Forest**: Sensitivity to climate-related changes in fire, disease, and pests.
- **Wetland:** Sensitivity to warming temperatures and declining summer moisture availability as these are expected to increase the risk of wildfire and beetle infestation in forested wetlands. Losses of forest cover due to disturbance (e.g., fire, pests) could significantly alter water balances in these wetlands. Projected declines in snowpack will impact the wet season of forested vernal pools and wet meadows in western Washington.
- **Marine:** Sensitivity to changes in sea surface temperature, sediment transportation, ocean acidification, and sea level rise
- **Estuary:** Sensitivity to changes to water chemistry in the nearshore may change due to increasing sea surface temperatures and may increase acidification. Sea level rise (SLR) is expected to significantly affect nearshore habitats. Some level of inundation may be offset or magnified by seasonal changes in streamflow and sediment delivery in some regions.
- **Riparian**: Sensitivity to changes in summer low flows, warming water temperatures, and winter flooding events
- **Subalpine** (the transition zone around tree line with scattered, stunted trees): Sensitivity to increasing air temperatures, shifts in precipitation patterns, and susceptibility to conifer encroachment as temperatures rise
- **Alpine** (the region above the tree line): Extreme sensitivity to increasing air temperatures, shifts in precipitation patterns, and a general sensitivity to disturbance events.

[6] Habitat types included in the 2017 vulnerability assessment (Morgan and Krosby 2017) are slightly different from the seven habitat types included in this Adaptation Plan. For this adaptation plan, the montane habitat type was broken-up into subalpine and alpine habitat. Refer to Morgan and Krosby 2017 for more detail on the habitat types.

3. Adaptation Planning Process

Adaptation Planning Process
This plan describes potential adaptation strategies and actions selected and refined by Nooksack NCRD staff in collaboration with Nooksack watershed land, fish and wildlife management entities and stakeholders through a series of workshops in 2019 and 2020. This list of potential actions is the first step in the adaptation planning process and these actions will be refined by the Nooksack NCRD over time. As part of the adaptation planning process, staff and collaborators participated in three workshops to identify, evaluate and prioritize adaptation actions included in the plan. Adaptation strategies and actions in the plan are organized by priority species and habitat type.

While developed for the Nooksack Indian Tribe, this plan includes adaptation actions that are relevant to other local stakeholders and the lands they manage. For example, while some of the entities participating in this process have agency-wide adaptation plans or strategies, very few include adaptation strategies for specific species and habitats found in the Nooksack watershed. As such, this plan has also been developed in the interest of providing climate adaptation strategies for land management agencies and other stakeholders in the Nooksack River watershed.

Initial Climate Adaptation Actions and Strategies
The University of Washington Climate Impacts Group and the Nooksack Indian Tribe reviewed and evaluated an initial list of adaptation actions for relevance and application to the area of interest. The Tribe and the Climate Impacts Group convened a stakeholder technical workgroup to evaluate the final list of actions through a series of workshops.

Across three workshops, Nooksack NCRD staff and Nooksack watershed partners evaluated, selected, and prioritized more than 200 potential adaptation strategies and actions compiled by UW Climate Impacts Group from the scientific literature and existing adaptation plans. Staff refined the list down to 140 higher-priority adaptation actions.

The first workshop focused on evaluating an initial set of adaptation actions for inclusion in the plan. Workshop participants then modified selected actions to increase their relevance to the Nooksack watershed. Workshop participants also added new actions that were not included in the initial list generated by the UW Climate Impacts Group.

In the second and third workshops, participants prioritized adaptation actions to generate a list of higher-priority adaptation actions that the Tribe may consider moving forward with. Workshop participants used their expertise to prioritize actions for each of the priority species and habitat types, using a simple, four-quadrant matrix (Figure 2). Table 2 and Table 3 show the criteria that participants used to inform decisions regarding whether an action was a lower or higher priority (Table 3) and whether an action could be accomplished in the near term or long term (Table 4). The Tribe will attempt to make marked progress on *near-term* actions over the next five years, while progress on *long-term* actions is expected to take more than five years. Throughout this process, workshop participants identified adaptation actions that are already on-going within the Nooksack watershed, as a way to highlight activities or programs within the watershed that are also beneficial for increasing resilience to the impacts of climate change.

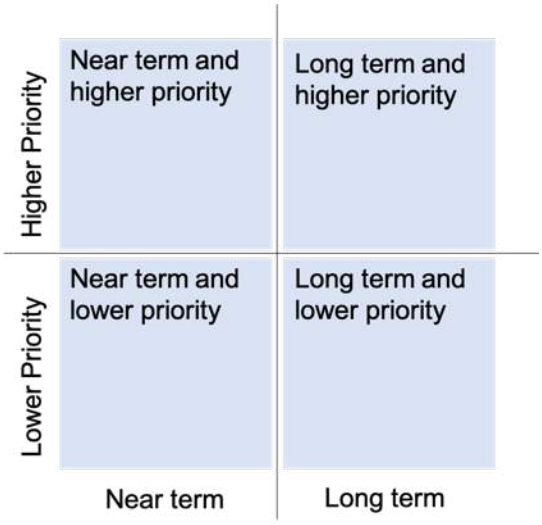

Figure 2. *The matrix used to prioritize adaptation actions in workshop 2 and 3. The two main criteria used to evaluate each adaptation action are priority and time.*

This adaptation plan includes actions classified by workshop participants as ***higher priority*** to ensure the Nooksack Indian Tribe NCRD has a manageable list of actions that address the most pressing vulnerabilities and are most likely to increase resilience to climate change. Of the 140 higher-priority actions, 71 were classified as on-going, or actions that are already in progress by the agency. An additional 84 were identified as new, near-term actions and an additional 56 were identified as new, long-term actions.

Figure 3. *Workshop participants in workshop 2. Participants are placing adaptation actions onto the prioritization matrix.*

Following workshop 2, participants completed a prioritization survey to finish identifying higher priority actions not addressed during the workshop due to lack of time.

Lower-priority actions are not included in this plan, but are archived in an Excel-based database provided to the Tribe's NCRD as a supplement to the adaptation plan. This Excel-based database lists the full set of actions reviewed by workshop participants and includes functions to allow the user to search actions by species and habitat type, action type, and timeframe.

Table 3. Criteria used by workshop participants to inform whether an adaptation action was lower or higher priority.

PRIORITIZATION CONSIDERATIONS	
Lower priority	**Higher priority**
• May not be effective at reducing vulnerability • Addresses a single climate vulnerability • Does not address other non-climate risks or priorities	• Highly effective (i.e., likely to reduce vulnerabilities) • Addresses multiple climate vulnerabilities • Has co-benefits for risks and priorities other than climate • Addresses more immediate climate vulnerabilities • Flexible (i.e., can be easily modified in the future to account for uncertainty) • Low regrets or win-win actions that will be valuable even if the climate does not change as currently projected • Robust action that will be effective even with uncertainty in projected climate changes

Table 4. Criteria used by workshop participants to inform whether an adaptation action was a near-term or a long-term action.

TIMEFRAME CONSIDERATIONS	
Near-term (<five years)	**Long-term (>five years)**
• Feasible in five years • Actions the agency is already doing that can be expanded or scaled up to increase climate resilience • Consistent with 5-year budget timeframe • Socially and politically acceptable now, or will require minimal effort to gain support. • Low regrets or win-win actions that will be valuable even if the climate does not change as currently projected • Flexible (i.e., can be easily modified in the future to account for uncertainty) • Robust action that will be effective even with uncertainty in projected climate changes	• May require new budget requests or funding • May require additional political, stakeholder, or public support that will take significant time to establish. • May require more information on vulnerability and impacts that cannot be gained in less than five years.

BOX 1: Mitigation and Adaptation: Two sides of the same coin.

Climate change mitigation and adaptation are the two primary means of reducing climate risk to society, natural systems, species, and habitats. Climate change mitigation responses focus on greenhouse gas emissions reduction and enhancing carbon sinks, while climate change adaptation is geared towards ameliorating or reducing climate change impacts. Both are essential, as adaptation helps us prepare for unavoidable climate change due to atmospheric warming and other impacts that are "already in the pipeline" while mitigation is critical for preventing additional warming that would commit us to increasingly significant impacts.

The forestry sector provides an interesting example to highlight how natural resource management practices can help reach both climate change adaptation and mitigation targets simultaneously. The management of our region's lumber producing forests is largely driven by the production and consumption of forest products.

As forest stands grow, they uptake carbon at varying rates and act as carbon *sinks* where carbon is bound up in the plant's tissues. Most forest stands are carbon sinks. In contrast, when stands are cut for harvest or during a natural disturbance event such as a wildfire, some stored carbon is released into the atmosphere rapidly, acting as a carbon *source*. However, those portions of harvested trees which are removed from the forest and converted to solid wood products may preserve a fraction of the sequestered carbon for decades or longer since the wood remains intact. A portion of the harvested wood may be burned in processing unutilized sawdust and slabs. The burning of logging slash also emits carbon and thus represents a carbon source. The overall status of a forest is based on the carbon balance of the individual stands within the forest. For lumber producing forests, there is a balance between increasing forest carbon stock and harvesting at an appropriate rate and age to meet the demand for forest products. Depending on the specific dynamics of forest management in a given area or stand, there may be a higher rate of carbon sequestration than carbon emission to the atmosphere. Thus, in many cases, forest management may result in more carbon sequestration than release thereby acting as a net carbon sink.

Forest sector mitigation strategies generally aim to reduce greenhouse gas emissions in this sector and other sectors that are affected by the supply and demand of forest products. For example, if lumber producing forests were not harvested, in an attempt to increase forest carbon stock, more carbon-intensive materials (e.g., concrete, steel, aluminum) would likely be used as a substitute for wood. Three relevant forest mitigation strategies include:

1. **Increase forest area through afforestation and reforestation.** Reforesting previous forested areas and converting non-forested land to forest can be achieved through seeding and planting on disturbed forest lands or non-forest areas. This will increase carbon sequestration on the land.
2. **Increase carbon density across stands and forests through forest management.** Management strategies that maintain forest cover on the landscape can help minimize the loss of carbon stored in soil through erosion. Planting or seeding after disturbance events can also help reduce losses of stored carbon. Management strategies which increase or maintain growth rates of woody species result in the higher levels of sequestration of atmospheric carbon.
3. **Where feasible, maximize the carbon sequestration capacity of our forests by incentivizing longer harvest rotations on commercial forest lands**. Lengthening the harvest rotations will increase the carbon pools in forest ecosystems, but will decrease the carbon pool of harvested wood products.

Climate change has the ability to influence the effectiveness of the above forest sector mitigation strategies. For example, the spread or prevalence of forest pests or pathogens may be exacerbated by increasing carbon density across forests. In contrast, reforestation and increasing carbon density may help combat increased rates of erosion or sedimentation. Likewise, climate change adaptation actions could negatively affect forest mitigation techniques, and options should be explored thoroughly prior to implementation.

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BOX 2. Forestry and Streamflow

Streamflow is a function of climate, topography, geology, soils, and vegetation cover of the watershed. Since the late 1800s, the effect of watershed vegetation cover on streamflow has been intensively investigated (Burt et al. 2015). Studies have shown that forest harvest influences streamflow timing and magnitude. The removal of forest cover over portions of a watershed has been shown to increase annual water yield from a watershed, which may be beneficial to water supply, particularly if there is a storage reservoir to capture and hold water for release during dry periods. However, the effect of vegetation manipulation on the timing of runoff is not as well studied.

In the Pacific Northwest, streamflows are lowest between August and September, when most snow has melted, there is little rainfall, and temperatures are the highest. These summer lowflows coincide with greatest demand for out-of-stream water uses (e.g., agriculture, industrial, commercial, residential, etc.) and instream uses (e.g., riparian maintenance, fish habitat, fish survival, etc.).

Recent research has highlighted the influence of forest harvest on late-summer streamflows. Perry and Jones (2016), Burt et al. (2015), and more recently Segura et al. (2020) found that streams flowing from watersheds covered by young (< 60 years old) regenerating stands had up to a 50% reduction in late summer flows compared to adjacent watersheds covered by mature, old growth stands dominated by Douglas-fir on the western slope of the central Cascades and Coast Range of Oregon. Furthermore, reductions in late summer streamflows caused by forest harvest were found to persist for up to 50 years without evidence of recovery to pre-harvest flows. This difference in streamflow was attributed to differences in transpiration rates of young regenerating forests compared to older mature and old growth stands. Younger regenerating trees have higher transpiration rates than mature and older stands. This interpretation is based on research completed by Moore et. al. (2004), which found that such transpiration rates can be three times greater in young regenerating stands compared to mature and old growth stands.

Applying these research findings to the Nooksack River watershed suggests that the extensive forest harvest could result in a substantial reduction in late summer streamflow. Because the cited research was conducted on the west slope of the Oregon Cascades, it is uncertain if the same influences of forest harvest on late summer streamflow in the Nooksack River watershed occur. The Tribe has recently initiated a research project to test the hypothesis that stand age and forest harvest have an influence on late summer streamflows in the Nooksack River watershed. Combining this reduction in streamflow with the observed and projected impacts of climate change could result in substantial cumulative impacts on streamflows. Modifying forest practices in the watershed to preserve and protect old growth and mature stands and extend the harvest rotation age from the current practice of 35- 40 years to 80 years or longer could be a voluntary climate adaptation strategy that addresses the impact of declining summer and early fall streamflows.

Burt, T., N. Howden, J. McDonnell, J. Jones, and G. Hancock. 2015. Seeing the climate through the trees: observing climate and forestry impacts on streamflow using a 60-year record. Hydrologic Process 29,473-480.

Moore, G, B. Bond, J. Jones, N. Phillips and F. Meinzer. 2004. Structural and compositional controls on transpiration in 40- and 450-year-old riparian forests in western Oregon, USA. Tree Physiology 24, 481–491.

Perry, T.D., and J.A. Jones. 2016. Summer streamflow deficits from regenerating Douglas-fir forest in the Pacific Northwest, USA. Ecohydrology 2016:1-13. DOI 10.1002/eco.1790.

Segura, C., K. Bladon, J. Hatten, J. Jones, C. Hale, and G. Ice. 2020. Long-term effects of forest harvesting on summer low flow deficits in the Coast Range of Oregon. Journal of Hydrology Volume 585, June 2020, 124749.

4. Adaptation Approach

Over the course of the adaptation planning process, two over-arching principles emerged for guiding the Nooksack Indian Tribe's climate adaptation efforts. These *suggested* principles reflect commonalities among many of the adaptation actions and can be used to guide how the Tribe approaches climate adaptation.

1. Center Traditional Knowledge in the implementation of adaptation actions.

Since time immemorial the Nooksack people have occupied the Nooksack River watershed, where they have hunted, fished and gathered foods. For thousands of years prior to European settlement the Tribe managed these lands using place-based knowledge systems that emphasized the conservation of natural resources for future generations. The Nooksack people have managed the land through periods of environmental change including recent observed climate change impacts, and projected changes in climate are expected to cause particularly rapid environmental change. The accrual of long-term, land-based observations throughout the Nooksack River watershed by the Nooksack people can help compare present-day conditions with observations the Nooksack people have accumulated over thousands of years, providing an environmental awareness that is not typically captured by Western science observations.

While the traditional knowledge of the Nooksack people is not necessarily reflected in the higher-priority, potential actions listed in this plan, this traditional knowledge can be incorporated into the implementation of actions throughout the Nooksack watershed. Doing so will likely enhance the effectiveness of adaptation actions while also better aligning them with the Tribe's cultural identity.

2. Strengthen partnerships with other natural resource management entities throughout the Nooksack watershed.

Species and habitats of importance to the Nooksack Indian Tribe span a diverse suite of jurisdictional boundaries; partnerships will thus be key to successfully ameliorating their

climate risks. Cooperation between the Tribe and local, state and federal governments, in addition to state agencies, non-profit organizations, and the private sector, will thus be essential to effective adaptation across the Nooksack watershed.

Because the Nooksack Indian Tribe manages only a small fraction of the land it relies upon for its treaty rights – which extend throughout the Nooksack watershed and beyond – an adaptation plan developed and implemented by the Nooksack NCRD, alone, would have little chance of succeeding in ensuring the future resilience of priority species and habitats at the scale required. Rather, strong partnership with the diverse jurisdictions and conservation stakeholders across the Nooksack watershed and treaty areas was recognized early on in the adaptation process as being key to successful planning and implementation. Thus, the Nooksack Indian Tribe's adaptation planning process brought together natural resource managers from across the Nooksack watershed with a common interest in effective management of the Nooksack Indian Tribe's priority species and habitats. These partnerships promise to bring additional capacity and resources to future implementation of the plan. Further, this plan provides information on climate adaptation strategies that other watershed stakeholders can use in promoting climate resilience on their lands.

5. Adaptation Themes

Adapting to climate change and promoting resilience will require a wide range of adaptation actions that address impacts through different means. Several key types of adaptation actions (Table 5) are likely to be required for addressing climate vulnerabilities of species or habitats. High priority adaptation actions in this plan are organized into two groups: near-term actions are in Appendix A and long-term actions in Appendix B.

Table 5. *This plan includes six different types of adaptation actions: policy, outreach, partnerships, data collection and monitoring, evaluation and assessments, and practice and behavior. A description of each adaptation action type is provided as well as associated icons used to discuss themes throughout the report.*

ACTION TYPE	ACTION TYPE DESCRIPTION
Policy	Actions taken to revise policy (e.g., establishment of new policies or policy revisions or removals) to better empower decisions or actions promoting the resilience of priority species and habitats.
Outreach	Actions taken to engage and communicate with the public to build support for adaptation actions or promote specific activities or behaviors that may enhance the resilience of priority species and habitats.
Partnerships	Actions taken to build relationships with other governments, agencies and organizations in order to better share information and coordinate decision-making to promote the resilience of priority species and habitats.
Data Collection & Monitoring	Actions taken to monitor and collect data to better understand how priority species and habitats are responding to climate change and the impact of adaptation actions.
Evaluation & Assessment	Actions taken to evaluate the success of adaptation actions in promoting the resilience of priority species and habitats.
Practice & Behavior	"On-the-ground" actions taken to increase the resilience of priority species and habitats (e.g., specific forest management practices).

Adaptation actions that involve changes in **practice and behavior** are the most common type of actions for almost all priority species and habitat types, reflecting that workshop participants believe on-the-ground action will be critical for reducing the impacts of climate change. Different types of adaptations actions (Figure 4) emerged as being especially important for different species and habitat types.

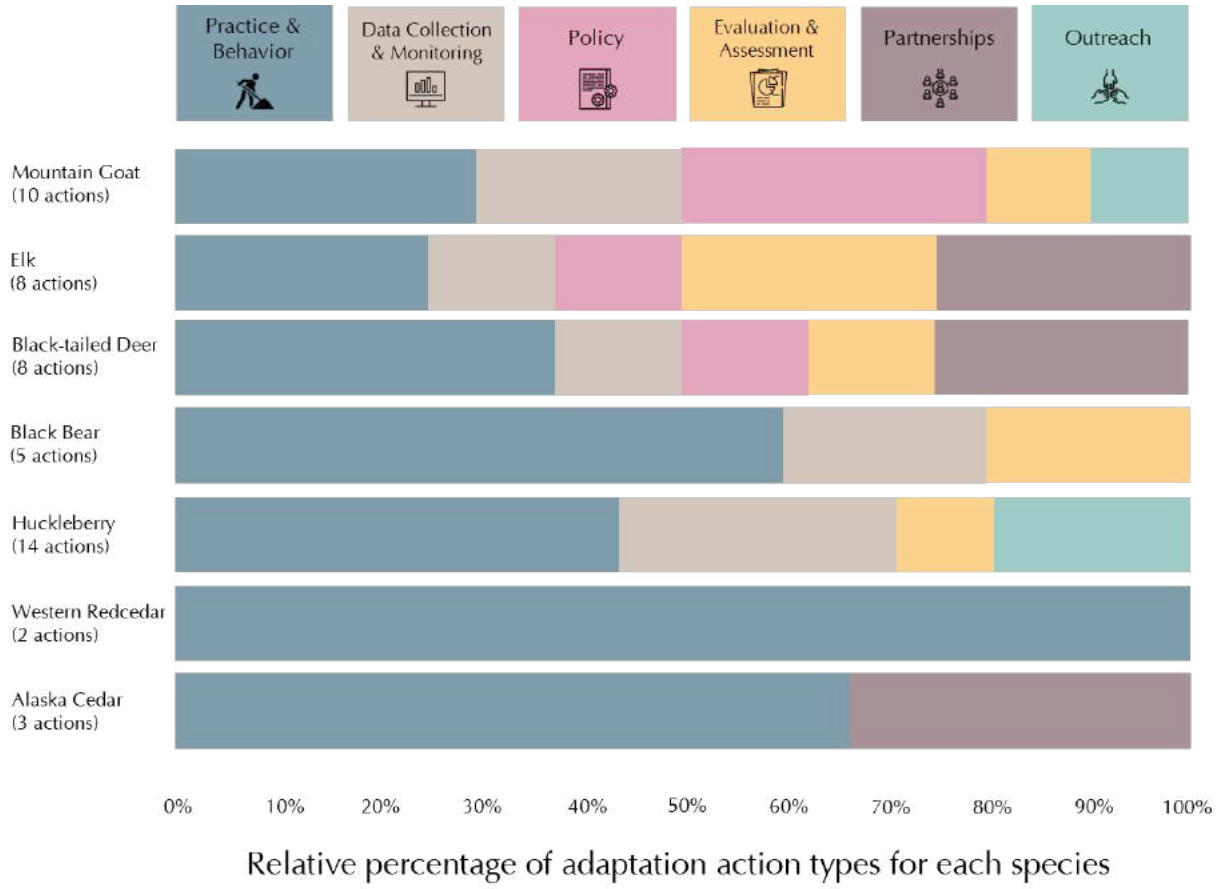


Figure 4. Summary of adaptation actions included in the plan for priority species. Actions are grouped by species and color-coded based on the action type (see Table 4 for description of action types). The width of the segments in each bar reflects the proportion of actions of that type. The total number of actions for each species is shown on the left side of the figure.

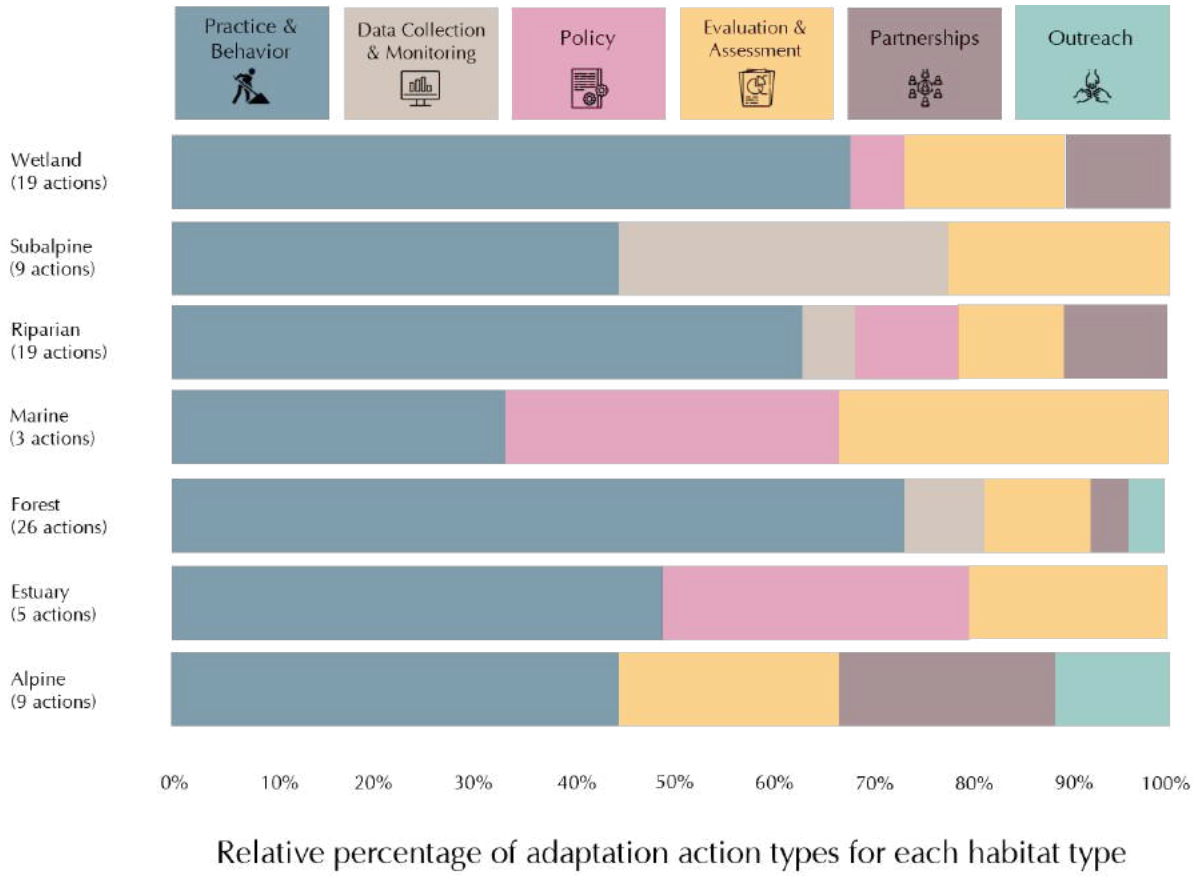


Figure 5. Summary of adaptation actions included in the plan for priority habitat types. Actions are grouped by habitat types and color-coded based on the action type (see Table 4 for description of action types). The width of the segments in each bar reflects the proportion of actions of that type. The total number of actions for each habitat type is shown on the left side of the figure.

Evaluation and assessment will likely be important for effective adaptation for elk (25% of actions), alpine habitat (22% of actions) and subalpine habitat (22% of actions).

Evaluation and assessment of local climate impacts can be used to address knowledge gaps and increase understanding of how climate change may affect the priority species and habitats included in this assessment. Adaptation actions related to evaluation and assessment for elk, alpine habitat, and subalpine habitat include:

1. **Assess priority species' and habitat types' ranges to identify which portions are most vulnerable to climate change.** An important initial step prioritizing and/or protecting habitat in the Nooksack watershed is to identify the area of a species range or area of habitat that may be most negatively affected by climate change. By evaluating specific portions of the watershed at a finer spatial scale, natural resource managers will have a deeper understanding of how projected changes in climate are expected to play out on the landscape, informing management response.

2. **Use results from fine-scale assessments to prioritize specific areas for protection, restoration, or creation of suitable habitat for species or vegetation types.** To help maximize the impact of limited available resources for natural resource management in the watershed, prioritization efforts can help provide guidance on where to protect, restore, and possibly create suitable habitat. These assessments can help identify where the implementation of adaptation actions will be most effective for a specific species or habitat type. The 2017 vulnerability assessment (Morgan and Krosby 2017) found that each species and habitat type is likely to experience climate-related impacts differently. Future climate impacts on a species or habitat will depend on the exposure of a species or habitat to changes in climate, a species' or habitat type's sensitivity to those changes, and its adaptive capacity.

Partnership building will likely be important for effective adaptation for Alaska yellow cedar (33% of actions), elk (25% of actions), and black-tailed deer (25% of actions) and the riparian (11% of actions) habitat type.

Impacts of climate change on species and habitat types do not stop at the boundaries of tribal, public, or private lands, and the magnitude of risks to species and habitat types often surpasses the ability of any one management entity to address in isolation. Many of the climate impacts affecting the Nooksack Indian Tribe may be similar to those faced by governments, agencies and NGOs working within its treaty areas, including Washington Department of Fish and Wildlife, Washington Department of Natural Resources, U.S. Forest Service, National Park Service, or Whatcom Land Trust. Coordinating climate adaptation efforts among these entities will help address shared risks while leveraging western Washington's limited natural resource funding. Partnership building is especially crucial for effective natural resource management across the Nooksack Indian Tribe's U&A Area, which is managed under a checkerboard of federal, state, local government and private land ownership. Partnering with these entities will help ensure the Nooksack Indian Tribe is able to collaborate on land and wildlife management practices in these areas and in turn help these agencies and landowners address their own climate adaptation needs and responsibilities. Adaptation actions related to partnership building for Alaska yellow cedar, elk, black-tailed deer, and the riparian habitat type include:

1. **Strengthen and grow partnerships to facilitate information sharing.** Climate impacts of concern to the Nooksack Indian Tribe will be most successfully addressed through collaboration with outside entities. Many federal and state agencies, other regional tribes, local governments and NGOs are already gathering data on the effects of climate change on natural resources. Through working collaboratively and building partnerships, resulting relationships can offer a network for sharing data and monitoring results to facilitate regional learning and pooling of resources to better understand climate impacts and effective adaptation responses. Additionally, partnerships can help reduce data collection redundancy

across different entities. Several actions related to partnership building thus highlight the importance of leveraging established monitoring programs and increasing information-sharing to support coordinated natural resource management across western Washington. Additionally, some actions focus on creating partnerships with universities for knowledge generation of relevant climate impacts information.

2. **Engage with relevant entities/partners when making development decisions that may impact landscape connectivity, and, where appropriate, incorporate different ways of knowing.** Development on the landscape can have significant impacts on the ability of species and habitats to move to more optimal areas as the climate changes. Building partnerships and sharing relevant information on landscape corridors, species dispersal routes, and frequently used wildlife trails can help inform the siting and structure of new development (e.g., roads, buildings, recreation sites, etc.) so that it is less likely to impede climate-driven movement of species or habitats across the landscape. Since time immemorial, the Nooksack Indian Tribe has hunted throughout the watershed and is deeply familiar with the migratory paths and movements of species throughout the watershed and region. This traditional knowledge should be – if and as deemed appropriate by the Tribe – incorporated into decisions related to landscape development in potential habitat corridors.

Policy-related actions will likely be important for effective adaptation for mountain goat (30% of actions) and estuary habitat (20% of actions).

Ensuring policies are in place to support effective regulation of the location, size and management of new development (e.g., facilities, roads, recreation access) will be critical to minimize stress on priority habitats and species. Minimizing existing stressors is a key means of increasing climate resilience. Adaptation actions related to policy focus on two areas:

1. **Establish regulations to minimize existing stressors to species and habitats.** Development (e.g., roads, buildings, infrastructure, etc.) often acts as a non-climatic stressor to habitats and populations. Regulations that limit or restrict development or specific types of recreation (e.g., motorized trail use) during times of the year that coincide with specific behaviors (e.g., denning, emergence from hibernation, etc.) can help minimize disturbances to species or habitats projected to be impacted by climate change.

2. **Incorporate climate change considerations into jurisdictional regulations.** There are many policies in place across the various levels of government (e.g., federal, state, county, city) that regulate development across the Nooksack watershed. Example regulations include zoning requirements, setback distances, critical area regulations, floodplain regulations and buffer distances. Despite the pervasiveness

of these regulations, they are typically based on historical climatic conditions and do not account for observed and projected changes in climate. For example, setback distances – which determine the distance a building or road needs to be separated from an estuary, river or stream – should account for projected changes in streamflow and sea level rise. If they do not, the effective distance between infrastructure and habitat will not comply with regulations as sea levels continue to rise and floodplains flood more frequently and with greater magnitude, placing undue stress on potential priority habitats. The policy actions in this adaptation plan highlight opportunities for designing beyond current regulatory requirements to account for potential climate risks to priority species and habitats.

Monitoring and data collection efforts will likely be important for effective adaptation for evergreen huckleberry (29% of actions), and subalpine habitat (33% of actions).

Some adaptation activities may benefit from additional research, data collection, and monitoring specific to the needs of the Nooksack Indian Tribe. Taking the necessary steps to address these knowledge gaps will deepen the Tribe's understanding of how climate change may affect priority habitats and species, and ultimately help ensure that adaptation efforts are being designed and implemented effectively. Additionally, monitoring can help establish existing or baseline conditions against which climate impacts can be measured and better understood. Adaptation actions that build capacity to monitor and collect data for the above species focus on two areas:

1. **Implement or expand existing monitoring efforts focused on likely pathways of invasive species introduction.** As temperatures rise, invasive plant species not previously found in the region may be able to establish and spread within Nooksack treaty areas. While invasive species are not a direct climate stressor, they can still indirectly reduce a native species' or population's resilience to climate change. Monitoring and data collection efforts increase the likelihood that new invasions will be detected earlier, maximizing the effectiveness of interventions.

2. **Collect data to detect changes in the distribution, composition, or structure of habitats or populations.** As the climate continues to change, impacts on habitats and species will occur at different rates across the landscape. Monitoring these changes will help generate real-time data that can be used to help prioritize restoration projects or land acquisition efforts.

6. Mainstreaming | Incorporating Adaptation into Existing Practices

This plan provides a list of proposed, higher-priority, near-term and long-term adaptation actions. While the list includes more than 140 adaptation actions, many of these actions can be incorporated into existing practices, planning documents, infrastructure investments and budgetary decisions as a part of on-going, day-to-day operations. A subset of examples of existing practices that can be used to implement adaptation actions include:

Washington Department of Natural Resources

Washington DNR's Good Neighbor Authority Partnership. The Good Neighbor Authority Partnership, which came from the 2014 Farm Bill, is an agreement between Washington DNR the U.S. Forest Service, and Washington Department of Fish and Wildlife that allows DNR to work with local companies to engage in a suite of restoration activities across watersheds, rangeland and forests that span federal and state boundaries. The Good Neighbor Authority aims to restore unhealthy forests within Washington state to reduce wildfire risk on state trust lands and to local communities, while increasing resilience of forest stands to insects and disease. The framework provided by this Authority serves as an appropriate mechanism for addressing several of the forest habitat type adaptation actions that are included in this report. A number of actions could be addressed through DNR's Good Neighbor Authority, including Action 25.1 and Action 25.2 (Appendix A).

Washington DNR's Habitat Conservation Plan. DNR developed the Forest Practices Habitat Conservation Plan (HCP) for private lands and the Washington Trust Lands Habitat Conservation Plan in response to the federal listing of certain threatened and endangered fish species. The HCP describes how those listed fish species would be protected. The purpose of the HCP is to ensure that landowners who conduct forest practices activities in compliance with the Forest Practices Act and rules will also be following the requirements of the Federal Endangered Species Act for those species. The HCP seeks to provide long-term conservation of designated species, support an economically viable timber industry, and create

regulatory stability for landowners. The Washington Trust Lands Habitat Conservation Plan is an extensive, multi-year agreement with the federal government that guides DNR's revenue-producing activities on forested trust lands in western Washington while protecting habitat for at-risk species, such as the northern spotted owl. In addition to meeting, monitoring and reporting its performance with conservation plan goals, DNR's forest management activities, including timber sales, are subject to public review through the State Environmental Policy Act (SEPA). There is an opportunity to include climate change adaptation planning into this plan. Many adaptation actions in this plan could be implemented through the application of DNR's HCP. For example, Action 39.2 aims to "Identify, protect, and where possible, create critical wetland habitat."

WA DNR's Natural Heritage Program. The Washington Natural Heritage Program (WNHP) catalogs the plants, animals and ecosystems of Washington in a comprehensive database. This information is used to help prioritize the conservation needs of these species. This species-specific information is recorded in the Natural Heritage Information System, an integrated database that currently contains more than 7,000 records of rare species and rare, high quality ecological communities. These data help planners and landowners make more informed land-use decisions that seek to balance development with conservation of our state's natural heritage. There is an opportunity to include climate change adaptation planning into conservation recommendations presented by this program.

Washington Forest Practices Act. The Forest Practices Board is an independent state agency chaired by the Commissioner of Public Lands that creates standards for timber harvesting, pre-commercial thinning, road construction, fertilization, or forest chemical application. The Board also provides guidance on how to implement the Forest Practices Act and Stewardship of Non-industrial Forests and Woodlands. The rules established by this board aim to protect water quality and fish habitat while simultaneously maintaining a viable timber industry. The standards in this act provide an opportunity to address adaptation actions for forest habitat addressed in this plan.

Washington Department of Fish and Wildlife

WA Priority Habitats and Species Program. The WA Department of Fish and Wildlife (WDFW) runs the Priority Habitats and Species (PHS) Program. This program is the primary way WDFW transfers fish and wildlife information from agency experts to local governments, landowners and others who use it to protect habitat and species. PHS information is frequently used by cities and counties when implementing and updating land use plans and development regulations under the Growth Management Act and Shoreline Management Act. WDFW also developed *Management Recommendations for Washington's Priority Habitats: Riparian*, which addresses several management issues and recommendations relevant to climate adaptation planning.

WA State Hydraulic Code. Washington State law requires a Hydraulic Project Approval (HPA) from WDFW for individuals planning hydraulic projects in or adjacent to state waters (which include most marine and fresh waters). The HPA helps ensure that project construction minimizes impacts to fish and their aquatic habitats. A hydraulic project is construction or other work activities conducted in or near state waters that will "use, divert, obstruct, or change the natural flow or bed of any of the salt or fresh waters of the state." A number of wetland and riparian habitat type adaptation actions could be addressed through the HPA process.

Whatcom County

Whatcom County's Flood Hazard Reduction Program. This program is housed within Whatcom County Public Works Department and aims to reduce local flood hazard by implementing both structural and nonstructural projects that reduce damage from future floods, minimize repair costs following a flood, and reduces the likelihood that flooding problems are transferred to another location within the basin. Adding climate change considerations into these flood hazard reduction activities would provide a key means of implementing many of the adaptation actions. For example, Action 35.1is focused on restoring floodplain function by establishing setbacks and stabilizing banks.

Whatcom County Critical Areas Ordinance (CAO). Whatcom County's Critical Areas are environmentally sensitive natural resources that have been designated for protection and management in accordance with the requirements of the Growth Management Act. Protection and management of these areas is important to the preservation of ecological functions and values of the natural environment, as well as the protection of the public health, safety and welfare of our community. The CAO applies to geologically hazardous areas, frequently flooded areas, critical aquifer recharge areas, wetlands, and fish and wildlife habitat conservation areas. The CAO applies to any land use or development within an area that meets the definitions and criteria for critical areas and protective buffers as established in the ordinance. There is an opportunity to include climate change adaptation planning into conservation recommendations presented by this program. Many of the riparian and wetland adaptation actions could be implemented through the provisions of Whatcom County's Critical Area Ordinance, including Action 29.1, Action 30.1, and Action 38.1.

Whatcom County Shoreline Management Plan. This plan implements, for Whatcom County, the goals, policies and regulations of the Shoreline Management Act, which outlines how the shoreline should be used, managed and developed. This plan covers the county's over 130 miles of marine shoreline, over 60 miles of lake shorelines, and over 220 miles of stream channels. Actions related to these shorelines include buffers, setbacks, vegetation management, public access, residential development and mitigations. Identifying where adaptation actions fit within the Shoreline Management Plan can provide a ready means of

implementation. For example, Action 42.1 looks to prevent the construction of armoring or other barriers that can negatively affect nearshore habitats.

Whatcom County Purchase of Development Rights Program. This county program, developed in 2001 in response to the loss of farmland, aims to help preserve farmland in Whatcom County and protect forested lands and areas of ecological importance. The acquisition of development rights aims to preserve farming and forestry practices while supporting healthy, functioning ecosystems. Several adaptation actions from the forest habitat section could be incorporated into the Development Rights Program. For example, the Development Rights Program could be utilized for Action 6.2, which aims to focus habitat protection efforts on riparian and wetland corridors, which are frequently utilized by black bears for dispersal through dry habitats.

Firewise USA®. Firewise USA® is a program of the National Fire Protection Association that teaches people how to adapt to living with wildland fire and encourages neighbors to work together and take action now to prevent future losses. Greater adoption of Firewise USA® practices and outreach efforts to communities through the WA Department of Natural Resources and other agencies or organizations could help expand these efforts into the westside of the state. For example, Whatcom County has a Community Wildfire Resilience Program which provides free wildfire risk assessments to homeowners, incorporates Firewise USA assistance, organizations community presentations on wildfire presentations, provides planning assistance to communities and agencies. Action 21.2 in this plan specifically calls out promotion of the Firewise program, something Whatcom County's Community Wildfire Resilience Program is currently doing.

Whatcom Land Trust

Whatcom Land Trust Conservation Plan. This plan outlines the land protection efforts being undertaken by Whatcom Land Trust, aimed at protecting Whatcom County's threatened lands, while ensuring retention of working farms and forested lands. The plan relies on three primary mechanisms: (1) securing a legal interest protecting lands, (2) promoting the protection of public land by public agencies, and (3) promoting the stewardship of lands. Several adaptation actions could be incorporated into the conservation plan. For example, habitat corridors or vulnerable parcels of habitat could become higher priorities for land acquisitions made by the Land Trust (Action 6.1; Action 7.2; Action 12.1).

Nooksack Indian Tribe

South Fork Nooksack River Watershed Conservation Plan (Draft 2017). This plan is based upon several years of research and analysis of watershed conditions, and aims to provide information and recommendations for protecting and restoring water resources and watershed functions. The Nooksack Indian Tribe Natural and Cultural Resources Department, along with numerous other stakeholders, embarked upon this process with the hopes that this Watershed Conservation Plan

would be helpful for residents, landowners, and other parties who are concerned about the long-term health of the watershed. Above all, this document is intended to serve as a tool for engaging dialogue and thinking holistically about watershed management decisions. This plan makes several recommendations for restoring watershed health that also relate to climate adaptation actions.

South Fork Nooksack River Reach-Scale Plan. (June 2017). This plan was prepared as a deliverable pursuant to the Nooksack Indian Tribe's approved work plan under a National Estuaries Program grant as administered by the Washington Department of Ecology. The intent of the approved work plan was to develop a "reach-scale" plan for the protection and restoration of the riparian zone of the South Fork Nooksack River (SFNR) in agricultural areas from its confluence with the North Fork Nooksack River at river mile 0.0 upstream to the confluence with Skookum Creek, at river mile 14.3. This reach-scale plan presents, at a conceptual scale, 1) a description of the geographical setting of the SFNR watershed, 2) legacy impacts, 3) impacts of projected climate change on aquatic resources, 4) an inventory of riparian areas and their condition along the river, 5) opportunities for riparian protection and restoration, and 6) identification of land areas (while maintaining confidentiality) that may qualify for funding for protection and restoration activities on lands along the river and/or its tributaries. This reach-scale plan is intended to provide a basis for more detailed analysis and planning on land parcels where there is substantive opportunity for the protection and restoration of riparian areas. It also provides watershed-wide information that has been excerpted from the Draft Watershed Conservation Plan (NIT 2017) prepared by the Nooksack Indian Tribe for the SFNR.

Budget Development/Grant Opportunities. The Nooksack Indian Tribe has an established process for evaluating funding requests, and adaptation actions requiring funding would be assessed as part of that process. If needed, the Tribe could potentially bundle adaptation actions into a grant proposal to the Bureau of Indian Affairs or other federal and state granting agencies. Additionally, the Tribe could partner with other organizations' existing programs and financial support or partner on grant applications.

EPA Region 10 Climate Change and TMDL Pilot Qualitative Assessment: Evaluating the Impacts of Climate Change on Endangered Species Act Recovery Actions for the South Fork Nooksack River, WA. EPA Region 10 and WA Department of Ecology undertook preparing the South Fork Nooksack River Temperature Total Maximum Daily Load (TMDL) project in 2011. The Tribe was engaged early in the development of the TMDL and a major comment provided by the Tribe was that if the TNDL was a tool to address water temperature exceedances in the SFNR, it should also address climate change as a major environmental stressor. EPA Office of Research and Development (ORD) teamed with the Tribe to develop the above referenced report to integrate Clean Water Act compliance, endangered species recovery, and climate change planning into a pilot research project aimed to support the TMDL in addressing climate change and the primary beneficial use of the river: Pacific salmon. The qualitative assessment is

a comprehensive analysis of climate change impacts on freshwater habitat and Pacific salmon in the South Fork. This project also evaluated the effectiveness of restoration tools that address Pacific salmon recovery. The objective of the assessment is to identify and prioritize climate change adaptation strategies or recovery actions for the South Fork that explicitly include climate change as a risk. The qualitative assessment makes recommendations of several climate actions and strategies beyond the riverine environment including riparian, agriculture and forest areas in the SFNR watershed, as well as recommending the preparation of a watershed conservation plan that also addresses climate change adaptation.

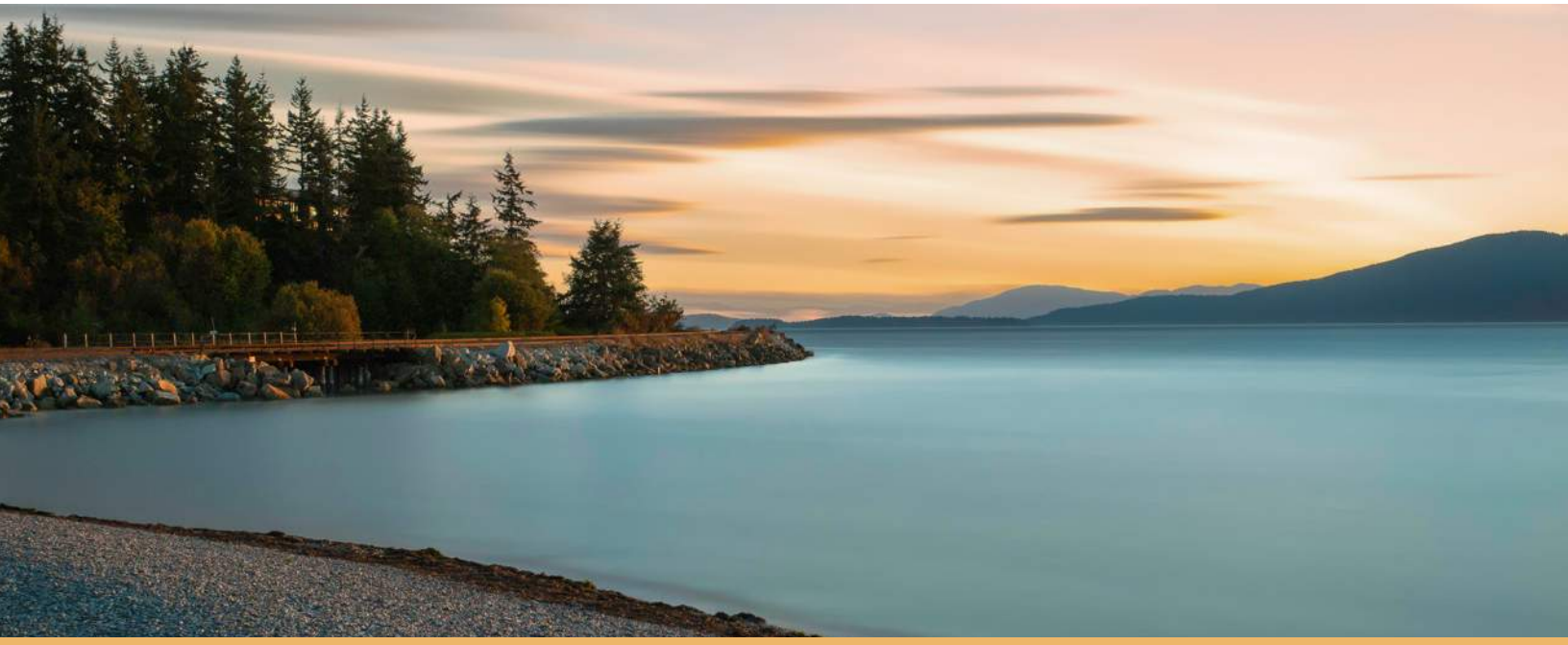
Water Resources Inventory Area (WRIA) 1 Salmon Recovery Plan. This plan – developed in partnership between the Nooksack Indian Tribe, Lummi Nation, WA Department of Fish and Wildlife, Whatcom County, City of Bellingham and Whatcom Public Utilities District 1 – guides restoration work within the Nooksack River and in adjacent basins. Restoration activities that benefit threatened populations of Chinook salmon and other species are prioritized. Restoration activities associated with this plan include installation of engineered logjams to provide deep, cool pools for spawning, upgrading culverts to facilitate fish migration, and stabilization of eroding banks. Many of the riparian adaptation actions addressed in this adaptation plan would integrate seamlessly into the Salmon Recovery Plan.

Beaver Restoration on the South Fork Nooksack: A Review and Conceptual Framework. The Nooksack Indian Tribe contracted Ingram Environmental to review best available science on beaver dam function and beaver management and develop a conceptual framework for beaver restoration projects and modeled beaver habitat potential in the South Fork Nooksack River (SFNR). Reintroducing beaver in the context of watershed restoration projects requires extensive planning and a certain amount of trial and error for successful results. Beaver cannot be guaranteed to stay at a release site even if all aspects of the site appear to present prime beaver habitat. Additionally, there can be adverse opinion on the reintroduction of beaver from local landowners and regulatory agencies, particularly when beaver activities are less than two years old. The beaver habitat modeling identified ample streams in the SFNR watershed that have physical characteristics conducive to beaver reintroduction and management. All riparian and in-stream habitat restoration projects should consider beaver reintroduction and management as a major tool toward success. The study made several general recommendations for the development and implementation of an effective beaver reintroduction and management program that address climate adaptation in riverine, riparian, wetland, and forest habitats. These report recommendations tie in with Actions 68.1 and 73.1 included in this plan.

U.S. Forest Service

U.S. Forest Service's Burn Area Emergency Response (BAER). This program works to support emergency rehabilitation of burned land after a fire to prevent issues related to flooding, soil stabilization and water quality, as well as protecting

Federal property and critical, at-risk natural or cultural resources. It would be relatively straightforward to incorporate into the BAER adaptation actions from this plan that address post-fire recovery. For example, Action 22.1 (Appendix A) aims to restore and revegetate burned area to store sediment.



7. Next Steps | Implementation

The development of this Climate Change Adaptation Plan is only the first step in the adaptation planning process for the Nooksack Indian Tribe. The goal of this plan is to identify *potential* adaptation actions expected to reduce the climate risks to species and habitat types identified in the vulnerability assessment. While identifying potential actions is a critical first step, additional steps will be necessary to move from planning to implementation.

Recommended next steps for implementing this plan include:

Develop an Implementation Plan. One or several separate implementation plans will likely be necessary to identify the sequencing and timing of actions, as well as any barriers that will need to be overcome to move actions forward. The last three recommendations listed below can be included in an implementation plan or developed separately.

Assign Responsibility and Support Action. Designate a lead person or people from key programs as a point of contact for overseeing implementation. This could also involve an interdisciplinary team that regularly meets to consider implementation of the plan. Agency leadership can also play a role by supporting employees to take time to work on implementing the plan.

Explore Funding for Adaptation Actions. Many of the actions identified in this plan are modifications to existing plans, programs and procedures that may be accomplished with little additional funding. Others, including specific evaluations and assessments, may require additional funding. Identifying potential funding sources for these actions will be needed.

Monitor and Measure Progress: Look at metrics and targets that can be used to measure and report progress over time, and establish a regular process to do so. This process may also require establishing how progress will be monitored and by what entity. Although the long-term goal is to reduce species and habitat

vulnerability and increase climate resilience, more near-term goals and metrics may need to be established to show progress.

Update the Climate Change Adaptation Plan. Identify a mechanism or schedule for updating the plan via adaptive management. This could be done at regular intervals, such as every five years, or in response to major events or new information.

BOX 3: References and Resources

The following documents are the key resources from which most of the adaptation actions in the Adaptation Plan were selected. Workshop participants selected relevant actions from an initial list and refined those actions to reflect the specific practices, programs, policies, and plans within the Nooksack watershed. Workshop participants also added new actions they consider important but were not in the original list.

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Documents referenced in the main body of this report:

Environmental Protection Agency (EPA). 2016. Qualitative Assessment: Evaluating the Impacts of Climate Change on Endangered Species Act Recovery Actions for the South Fork Nooksack River, WA. EPA/600/R-16/153. Western Ecology Division, National Health and Environmental Effects Research Laboratory. Corvallis, OR.

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Appendix A. | Near-Term Adaptation Actions

Near-term adaptation actions were identified by workshop participants as actions where significant progress could be made in the next five years. Near-term actions generally include those that are already on-going in the watershed and could be easily expanded or scaled up to increase climate resilience in the short term. These actions are also feasible from a budgetary standpoint, as actions that require a budget request are unlikely to be completed in the next five years. Near-term adaptation actions are furthermore considered to be socially and politically acceptable, and thus not requiring additional time to gain necessary buy-in.

NEAR-TERM ADAPTATION ACTIONS | ALASKA YELLOW CEDAR (*Cupressus nootkatensis*)

STRATEGY 1. Monitor and detect long-term change in species health, species distribution, species growth, and disturbance processes.

Actions	Status	Category
1.1: Leverage the forest health program of the Forest Service, WA State, and private forestry, to map active locations of Alaska-cedar tree death visible from aircraft or drones to detect to progressive mortality in some maladapted Alaska yellow cedar forests and identify the pattern of expansion of Alaska yellow-cedar decline.	Not on-going	Partnerships

STRATEGY 2. Increase resistance to invasion by non-native insects.

Actions	Status	Category
2.1: Assertively apply early detection/rapid response to limit non-native insect (e.g., gall midge) infestations.	On-going	Practice & Behavior

NEAR-TERM ADAPTATION ACTIONS | EVERGREEN HUCKLEBERRY (*Vaccinium ovatum*)

STRATEGY 3. Prioritize, protect, and manage evergreen huckleberry habitat to reduce potential for habitat loss

Actions	Status	Category
3.1: Implement proper wetland management practices, including conservation and strategic management.	On-going	Practice & Behavior
3.2: Identify and inventory areas with berries and suitable berry habitat.	On-going	Data collection & Monitoring

STRATEGY 4. Communicate the importance of a sustainable evergreen huckleberry population.

Actions	Status	Category
4.1: Promote sustainable harvesting of berries.	On-going	Outreach
4.2: Educate the public on the threats of overharvesting culturally significant plants and devise management strategies to help reduce the risk of overharvesting.	Not on-going	Outreach
4.3: Provide public education about the importance of berries and the need to maintain a sustainable population.	Not on-going	Outreach

STRATEGY 5. Prevent widespread outbreaks of non-native species to maintain integrity of evergreen huckleberry populations.

Actions	Status	Category
5.1: Work across property boundaries to respond to and limit the spread of invasive species that have the potential to out-compete native huckleberries.	On-going	Practice & Behavior
5.2: Utilize best practices for managing invasive species.	On-going	Practice & Behavior
5.3: Conduct invasive species management (e.g., monitoring, prevention, control, education/outreach) to limit competition to evergreen huckleberry.	On-going	Data collection & Monitoring

NEAR-TERM ADAPTATION ACTIONS | BLACK BEAR (*Ursus americanus*)

STRATEGY 6. Enhance landscape connectivity to facilitate range shifts

Actions	Status	Category
6.1: Where feasible, identify corridors and resources (e.g., wetlands or other water sources) likely to facilitate bear movement across low elevation valleys, in order to maintain connectivity among high elevation core habitat areas.	Not on-going	Evaluation /assessment
6.2: Focus habitat retention and protection efforts on corridors, riparian and wetland habitats; black bears frequently utilize these for dispersal through dry habitats, which may become less permeable to black bear movement as climate warms.	On-going	Practice & Behavior

NEAR-TERM ADAPTATION ACTIONS | BLACK-TAILED DEER (*Odocoileus heminous*)

STRATEGY 7. Enhance landscape connectivity to facilitate range shifts.

Actions	Status	Category
7.1: Where possible, ensure that temporary roads or structures adjacent to black-tailed deer habitat are decommissioned to restrict vehicular traffic once harvest and plantation establishment are achieved.	Not on-going	Practice & Behavior
7.2: Focus habitat retention efforts on riparian habitats, which span climatic gradients and are frequently used by black-tailed deer as movement corridors.	On-going	Practice & Behavior

STRATEGY 8. Reduce human-made barriers to increase black-tailed deer habitat connectivity.

Actions	Status	Category
8.1: Where feasible, use large parcel zoning and purchase of development rights to maintain connectivity of natural areas, including black-tailed deer habitat. Work with private landowners and with environmental policy to maintain contiguous swaths of suitable land that will facilitate connectivity.	Not on going	Policy

STRATEGY 9. Identify, protect, and enhance black-tailed deer habitat that may be affected by climate change.

Actions	Status	Category
9.1: Use local and traditional knowledge to identify important black-tailed deer habitat (dispersal and migration corridors; winter ranges; trails), and formally include identified black-tailed deer habitat in resource use decisions.	Not on-going	Partnerships

NEAR-TERM ADAPTATION ACTIONS | ELK (*Cervus canadensis*)

STRATEGY 10. Work with the appropriate land and road management agencies to ensure adequate secure elk habitat during the development of road and trail projects.

Actions	Status	Category
10.1: Coordinate with local municipalities or agencies to discourage development of areas important to elk.	Not on-going	Partnerships
10.2: Manage high levels of human recreation to avoid negative impacts on key elk habitat features.	On-going	Practice & Behavior

STRATEGY 11. Increase understanding of changes in elk populations through monitoring.

Actions	Status	Category
11.1: Monitor elk populations and consider adjusting hunting permits, as needed, to ensure a healthy, resilient elk population that is more likely to be resilient to environmental shifts related to climate change.	On-going	Monitoring / Data Collection

STRATEGY 12. Enhance landscape connectivity to facilitate range shifts.

Actions	Status	Category
12.1 Where feasible, ensure timber management actions maintain or enhance elk habitat quality and that downed wood restoration is conducted to improve elk habitat and habitat connectivity.	On-going	Practice & Behavior

NEAR-TERM ADAPTATION ACTIONS | MOUNTAIN GOAT (*Oreamnos americanus*)

STRATEGY 13. Identify, protect, and enhance mountain goat habitat that may be affected by climate change.

Actions	Status	Category
13.1: Use local and traditional knowledge to identify important mountain goat habitat (kidding/early rearing; dispersal and migration corridors; winter ranges; mineral licks, trails). Once identified, important habitat for mountain goats should be formally included in resource use decisions.	Not on-going	Evaluation /assessment
13.2: Implement habitat protection in areas where the disturbance risk to mountain goat habitat is relatively greater (e.g., in areas with dispersed recreation, merchantable forest).	Not on-going	Practice & Behavior

STRATEGY 14. Minimize recreational disturbance on mountain goat habitat.

Actions	Status	Category
14.1: Implement outreach/education and regulatory enforcement to prevent adverse human-wildlife interactions.	Not on-going	Outreach
14.2: Minimize motorized ground-based and dispersed recreation activities in the vicinity of critical mountain goat habitat during all life-stages.	Not on-going	Policy

STRATEGY 15. Support reduction of the amount and persistence of roads in and near mountain goat habitat.

Actions	Status	Category
15.1: Consider access control measures where roads in proximity to mountain goat habitat could remain in place for an extended period of time.	Not on-going	Policy
15.2: Where possible, ensure that temporary roads or structures adjacent to mountain goat habitat are decommissioned to restrict vehicular traffic within two years after completion of industrial development activities (e.g., during timber harvest or restoration projects).	Not on-going	Policy

STRATEGY 16. Increase understanding of changes in mountain goat populations through monitoring.

Actions	Status	Category
16.1: Augment currently stressed populations of mountain goats from populations that are large and more robust, and or nuisance individuals from the Olympic Mountains.	On-going	 Practice & Behavior
16.2: Continue with annual aerial population surveys and consider expanding the survey area to include the traditional goat areas.	On-going	 Practice & Behavior

NEAR-TERM ADAPTATION ACTIONS | ALPINE HABITAT

STRATEGY 17. Increase resilience to climate change by preserving biodiversity in alpine habitat.

Actions	Status	Category
17.1: Prioritize alpine habitats for active management, restoration, and protection across jurisdictional boundaries.	On-going	Evaluation /assessment

STRATEGY 18. Prioritize, protect, and manage alpine habitat to reduce potential for habitat loss.

Actions	Status	Category
18.1: Coordinate efforts across the Forest Service, National Park Service, WA DNR, and private landowners in the Nooksack watershed to collect cones and produce seedlings.	On-going	Partnerships
18.2: Increase education and regulatory enforcement to prevent adverse human-wildlife interactions in the alpine zone.	Not on-going	Outreach

NEAR-TERM ADAPTATION ACTIONS | SUBALPINE HABITAT

STRATEGY 19. Prioritize, protect, and manage subalpine habitat to reduce potential for habitat loss.

Actions	Status	Category
19.1: Where feasible, continue to restore degraded subalpine meadow sites and identify priority areas for acquisition, protection, and restoration.	On-going	Practice & Behavior

STRATEGY 20. Increase invasive species management efforts in subalpine meadow habitat.

Actions	Status	Category
20.1: Identify, remove, and monitor invasive plant species that are expected to negatively affect subalpine meadow habitat.	On-going	Practice & Behavior
20.2: Use certified weed-free forage for grazing or pack animals that travel near meadows.	On-going	Practice & Behavior

NEAR-TERM ADAPTATION ACTIONS | FOREST HABITAT

STRATEGY 21. Plan and prepare for a greater wildfire risk.

Actions	Status	Category
21.1: Develop partnerships to increase research and monitoring efforts to detect wildfire response to climate change, and identify processes and conditions that create fire refugia.	On-going	Partnerships
21.2: Support the establishment and promotion of the Firewise program throughout the primary wildfire risk zones (urban/forest interface) to reduce vulnerability to potentially damaging wildfire.	On-going	Outreach
21.3: Manage forest restoration for future range of variability in fire severity and area burned.	On-going	Practice & Behavior
21.4: Increase forest maturity and structural diversity at the landscape scale to reduce risk and severity of wildfire.	Not on-going	Practice & Behavior

STRATEGY 22. Increase resilience through postfire management.

Actions	Status	Category
22.1: Restore and revegetate burned area to store sediment and maintain channel geomorphology.	On-going	Practice & Behavior

STRATEGY 23. Increase resilience by promoting native genotypes and adapted genotypes of native species.

Actions	Status	Category
23.1: Apply the appropriate techniques (e.g., weed-free seed standards) during restoration projects to facilitate a transition from non-native species to native species.	Not on going	Practice & Behavior

STRATEGY 24. Prevent widespread outbreaks of non-native species or pathogens to maintain integrity of native plant populations.

Actions	Status	Category
24.1: Implement strategies to prevent the introduction and spread of non-natives species during projects (e.g., implementing USDA Forest Service and NPS weed-free standards).	On-going	Practice & Behavior

STRATEGY 25. Increase resilience of forest stands to disturbances by increasing tree vigor and ecosystem health.

Actions	Status	Category
25.1: Consider the use of silvicultural prescriptions to increase biodiversity and tree vigor.	On-going	Practice & Behavior
25.2: Manage stem density for tree vigor (even-age timber plantations) on federal lands.	On-going	Practice & Behavior

STRATEGY 26. Manage forest structure to enhance snowpack retention.

Actions	Status	Category
26.1: Create and maintain forest gaps for maximum snow retention in appropriate zones, focusing on elevation bands where seasonal snowpack is likely in the future and on topographic positions that minimize direct sunlight.	Not on going	Practice & Behavior
26.2: Heavy thinning of forests (to <= 50% canopy cover) where topographic positions maximize direct sunlight.	Not on going	Practice & Behavior
26.3: Retain forests in topographically exposed or windy locations to act as snow fences and retain high elevation snow.	Not on going	Practice & Behavior

STRATEGY 27. Increase resiliency in forests at the landscape level.

Actions	Status	Category
27.1: Prioritize habitats for active management and protection across jurisdictional boundaries.	On-going	Evaluation /assessment
27.2: Continue to create and protect legacy structures (e.g., snags, downed logs, old trees) in forests.	On-going	Practice & Behavior
27.3: Incentivize the restoration of floodplain forests.	On-going	Practice & Behavior
27.4: Maintain and recruit mature forests in the Nooksack River watershed as older forests are more resilient to drought events than younger forests.	Not on-going	Practice & Behavior

STRATEGY 28. Increase resilience to climate change in tree communities with vulnerable species.

Actions	Status	Category
28.1: Where appropriate, establish permanent monitoring plots of vulnerable species and share data with relevant partners.	Not on going	Data collection & Monitoring
28.2: Identify sites that are less likely to be affected by climate change (refugia), and focus on those sites for protection and restoration.	Not on-going	Evaluation /assessment

NEAR-TERM ADAPTATION ACTIONS | RIPARIAN HABITAT

STRATEGY 29. Increase riparian resilience to changing hydrologic conditions.

Actions	Status	Category
29.1: Increase protection and restoration of riparian areas, including headwaters, groundwater recharge areas, wetlands, and springs, to maintain summer base flows and reduce water temperatures, and consider riparian treatments that enhance these benefits.	On-going	Practice & Behavior

STRATEGY 30. Improve understanding of and protect surface flows and groundwater.

Actions	Status	Category
30.1: Map water sources and aquifers to understand spatial and temporal connections between surface flows and groundwater.	On-going	Evaluation /assessment
30.2: Where feasible, improve forest practices to afford surface and groundwater protections in headwater areas; use above data to inform forestry management and increase forest management protections.	Not on-going	Practice & Behavior
30.3: Map known springs and land cover type in order to prioritize protection.	Not on-going	Evaluation /assessment

STRATEGY 31. Preserve native riparian habitat and maintain habitat connectivity.

Actions	Status	Category
31.1: Establish protective land designations (e.g., wilderness, wild and scenic rivers, wildlife corridor), focusing on intact riparian habitat.	Not on-going	Policy
31.2: Restore and protect vegetation to increase shading of riparian habitat and maintain cool, wet areas.	On-going	Practice & Behavior

STRATEGY 32. Reduce the impact of public use and infrastructure on erosion and sediment deposition in riparian areas.

Actions	Status	Category
32.1: Upgrade road crossings (e.g., install higher capacity culverts) in areas that are prone to sedimentation and/or provide habitat for sensitive species.	On-going	 Practice & Behavior

STRATEGY 33. Manage grazing to reduce impacts on riparian vegetation and soil structure.

Actions	Status	Category
33.1 Build livestock exclosures to protect riparian habitats that are easily damaged by grazing.	On-going	 Practice & Behavior

STRATEGY 34. Reduce the impact of invasive species on riparian habitat.

Actions	Status	Category
34.1 Remove invasive plants to reduce competition with native species for water.	On-going	 Practice & Behavior

STRATEGY 35. Identify and restore key ecosystem functions to increase resilience to higher peak flows and erosion.

Actions	Status	Category
35.1 Restore floodplain function by establishing setbacks, stabilizing banks and headcuts, and restoring degraded channels to support current and future hydrology.	Not on going	 Practice & Behavior
35.2: Remove or modify infrastructure to allow channel migration within the floodplain.	Not on going	 Practice & Behavior

STRATEGY 36. Improve watershed health and functioning.

Actions	Status	Category
36.1 Develop partnerships with university programs with a research focus on hydrology, groundwater, and/or watersheds.	On-going	 Partnerships
36.2: Develop partnerships with recreation users to educate and enhance public understanding of watershed health.	On-going	 Partnerships
36.3: Increase roughness on the floodplain.	Not on going	 Practice & Behavior

NEAR-TERM ADAPTATION ACTIONS | WETLAND HABITAT

STRATEGY 37. Maintain the hydroperiod and water supply for wetlands.

Actions	Status	Category
37.1: Increase protection and restoration of wetlands and groundwater recharge areas.	On-going	Practice & Behavior
37.2: Address water loss at water diversions and ditches.	Not on-going	Practice & Behavior
37.3: Remove human-made hydrologic structures (e.g., culverts, ditches, berms, and dikes) to restore natural hydrologic processes in wetlands.	On-going	Practice & Behavior
37.4: Decommission roads and reduce road connectivity in critical wetland habitat areas to encourage interception and retention of water.	On-going	Practice & Behavior

STRATEGY 38. Maintain and enhance wetland function and conditions, particularly in priority wetlands, including upland forested wetlands.

Actions	Status	Category
38.1: Reduce direct human impact on sensitive wetland habitats.	On-going	Practice & Behavior
38.2: Plant native vegetation to increase shading of wetlands and microhabitats.	On-going	Practice & Behavior
38.3: Maintain plant cover outside of the wetland areas and, where appropriate, install natural material fencing to prevent increased sediment deposition in wetlands.	On-going	Practice & Behavior

STRATEGY 39. Prioritize, protect, and manage wetland habitat to reduce potential for habitat loss.

Actions	Status	Category
39.1: Prioritize wetland habitats for active management, restoration, and protection across jurisdictional boundaries.	On-going	Evaluation /assessment
39.2: Identify, protect, and where possible, create critical wetland habitat.	On-going	Practice & Behavior

STRATEGY 40. Increase invasive species management efforts in wetlands.

Actions	Status	Category
40.1: Coordinate invasive species management, funding, and support across tribes and natural resource managers in the region.	Not on-going	 Partnerships

NEAR-TERM ADAPTATION ACTIONS | ESTUARY HABITAT

STRATEGY 41. Increase resilience to sea level rise and shoreline erosion by maintaining and restoring estuary habitat.

Actions	Status	Category
41.1: Identify and restore pocket estuaries and eelgrass beds, important habitat for many fish and crustacean species, through fill removal, or sediment deposition.	On-going	Evaluation /assessment
41.2: Incorporate best available sea level rise projections in restoration site designs.	Not on-going	Practice & Behavior
41.3: Consider land exchange programs where land-owners exchange property in the floodplain for county-owned land outside of the floodplain.	On-going	Practice & Behavior
41.4: Integrate coastal management that accounts for sea level rise into land use planning.	On-going	Policy

STRATEGY 42. Where possible, limit the use of shoreline armoring and development to improve the resilience of nearshore habitats to sea level rise and erosion.

Actions	Status	Category
42.1: Where possible, prevent, prohibit, and remove barriers, armoring, or other structures used to protect structures from wave-driven erosion or flooding.	On-going	Policy

NEAR-TERM ADAPTATION ACTIONS | MARINE HABITAT

STRATEGY 43. Restore coastal habitat for climate change adaptation.

Actions	Status	Category
43.1: Continue to restore degraded marine habitat and acquire, protect, and restore priority areas.	On-going	Practice & Behavior
43.2: Identify and prioritize marine habitats most valuable for restoration and protection.	Not on-going	Evaluation /assessment
43.3: Use regulatory and non-regulatory approaches to designate and secure natural buffer areas of marine habitats.	Not on-going	Policy

Appendix B. | Long-Term Adaptation Actions

Long-term adaptation actions were identified by workshop participants as actions where significant progress would likely take more than five years. Long term actions generally include those that are not currently on-going within the watershed, and would likely require spin-up time. Long-term actions often include those actions that are not currently feasible from a budgeting standpoint, meaning new budget requests would need to be successful before implementation could commence. Additionally, some long-term adaptation actions are presently considered to be socially and politically unacceptable, which will require additional time to generate buy-in.

LONG-TERM ADAPTATION ACTIONS | ALASKA YELLOW CEDAR (*Cupressus nootkatensis*)

STRATEGY 44. Use judicious managed relocation of genotypes where appropriate.

Actions	Status	Category
44.1: Consider the use of assisted migration to facilitate the movement of Alaska yellow cedar, which has poor dispersal ability and narrow resource requirements.	Not on-going	Practice & Behavior

STRATEGY 45. Increase Alaska yellow cedar habitat area and quality.

Actions	Status	Category
45.1: Plant and thin to expand the realized niche of Alaska yellow cedar. Alaska yellow cedar should be favored over other tree species (e.g., western hemlock, Sitka spruce, and western redcedar) that can outcompete Alaska yellow cedar through greater rates of reproduction and faster growth.	On-going	Practice & Behavior

STRATEGY 46. Increase resilience of forest stands to disturbance by increasing tree vigor.

Actions	Status	Category
46.1: Plant resistant western redcedar genotypes where species-specific insects or pathogens are a concern.	On-going	Practice & Behavior

LONG-TERM ADAPTATION ACTIONS | EVERGREEN HUCKLEBERRY (*Vaccinium ovatum*)

STRATEGY 47. Prioritize, protect, and manage evergreen huckleberry habitat to reduce potential for habitat loss.

Actions	Status	Category
47.1: Develop and implement a treatment effectiveness monitoring plan for evergreen huckleberry, which would assess direct and indirect benefits of evergreen huckleberry enhancement by tracking productivity and availability of evergreen huckleberry.	On-going	Data collection & Monitoring
47.2: Where feasible, thin, girdle, prune, and burn to control structure, composition, and distribution of trees on a evergreen huckleberry suitable site.	On-going	Practice & Behavior

STRATEGY 48. Remove trees that are encroaching into evergreen huckleberry habitat.

Actions	Status	Category
48.1: Remove encroaching trees via commercial- or non-commercial-sale if trees are of sufficient size and volume to reduce dominance in potential evergreen huckleberry habitat.	Not on going	Practice & Behavior

STRATEGY 49. Prioritize, protect, and manage evergreen huckleberry habitat to reduce potential for habitat loss.

Actions	Status	Category
49.1: Monitor evergreen huckleberry plant condition, fruiting, and survival.	On-going	Data collection & Monitoring
49.2: Establish evergreen huckleberry plants in new suitable areas, where appropriate.	On-going	Practice & Behavior
49.3: Include evergreen huckleberry enhancement in land management planning by incorporating evergreen huckleberry enhancement potential as a weighted prioritization factor for planning areas.	Not on-going	Evaluation /assessment

LONG-TERM ADAPTATION ACTIONS | BLACK BEAR (*Ursus americanus*)

STRATEGY 50. Prevent and control widespread outbreaks of invasive species or pathogens.

Actions	Status	Category
50.1: Consider engaging traditional ecological knowledge to help guide implementation, referencing the forest and grazing practices of landowners to identify traditional strategies for managing fire risk and other potential climate impacts.	Not on-going	Practice & Behavior
50.2 Prescribe burn and thin to reduce the risk of catastrophic wildfires and pest outbreaks that could negatively impact black bear core habitat areas and corridors.	On-going	Practice & Behavior

STRATEGY 51. Address the potential for climate change to impact connectivity through increased potential for human-bear interactions due to declines in snowpack.

Actions	Status	Category
51.1: Monitor black bear denning, foraging, and dispersal behavior to identify and respond to increased human-bear interactions stemming from changes in the timing and location of bear movements due to climate change.	Not on going	Data collection & Monitoring

LONG-TERM ADAPTATION ACTIONS | BLACK-TAILED DEER (*Odocoileus heminous*)

STRATEGY 52. Enhance landscape connectivity to facilitate range shifts.

Actions	Status	Category
52.1: Maintain and restore corridors that span elevation gradients, to ensure that black-tailed deer have the ability to disperse in moist, higher elevation habitats as the climate warms.	Not on-going	Practice & Behavior

STRATEGY 53. Reduce human-made barriers to increase black-tailed deer habitat connectivity.

Actions	Status	Category
53.1: Review and implement existing guidance and plans relating to black-tailed deer habitat management. Evaluate these existing recommendations for opportunities to address climate impacts to black-tailed deer.	Not on-going	Evaluation /assessment
53.2: Coordinate with transportation planning and resource management agencies to minimize road impacts to black-tailed deer habitat connectivity, and ensure that new roads do not negatively impact important black-tailed deer corridors under climate change.	On-going	Partnerships

STRATEGY 54. Increase understanding of changes in black-tailed deer populations by monitoring the populations.

Actions	Status	Category
54.1: Monitor black-tailed deer populations for emerging bacterial diseases and parasites (e.g., blue tongue virus) which may become more prevalent or severe with climate change.	Not on-going	Data collection & Monitoring

LONG-TERM ADAPTATION ACTIONS | ELK (*Cervus canadensis*)

STRATEGY 55. Work with the appropriate land and road management agencies to ensure adequate secure habitat during the development of road and trail projects.

Actions	Status	Category
55.1: Limit roads, trails, and other infrastructure to locations that avoid habitat components important to seasonal elk use.	Not on-going	Policy
55.2: Coordinate with all relevant parties to identify, protect, and create an adequate wildlife corridor/overpass for elk.	Not on-going	Partnerships
55.3 Review all transportation corridor development plans and ensure that methods are incorporated to minimize direct mortality via vehicle-elk collisions and to ensure the roadway is permeable to elk.	On-going	Evaluation /assessment

STRATEGY 56. Increase understanding of changes in elk populations through monitoring.

Actions	Status	Category
56.1: Develop, encourage and support research to enhance our understanding of diseases and parasites, their impact on elk populations and prescriptions to manage the disease or parasite as well as the population impact.	On-going	Evaluation /assessment

LONG-TERM ADAPTATION ACTIONS | MOUNTAIN GOAT (*Oreamnos americanus*)

STRATEGY 57. Identify, protect, and enhance mountain goat habitat that may be affected by climate change.

Actions	Status	Category
57.1: Identify, monitor, and maintain connectivity of forest cover between suitable mountain goat habitats at the landscape level.	Not on-going	Data collection & Monitoring

STRATEGY 58. Increase understanding of changes in mountain goat populations through monitoring.

Actions	Status	Category
58.1: Collect baseline data on mountain goats in forest/montane habitats using GPS collars to track daily/seasonal movements and habitat use.	On going	Data collection & Monitoring

LONG-TERM ADAPTATION ACTIONS | ALPINE HABITAT

STRATEGY 59. Increase resilience to climate change by preserving biodiversity in alpine habitat.

Actions	Status	Category
59.1: Identify and protect alpine areas with rare and disjunct plant populations, and plant or encourage regeneration in these areas where appropriate.	On-going	Evaluation /assessment
59.2: Identify appropriate seed sources (e.g., consider using Seed lot selection tool) that will be suitable for future climatic conditions.	Not on-going	Practice & Behavior
59.3: Establish relationships with nurseries in the places where you want to source your seed (analogous climate areas).	Not on-going	Partnerships
59.4: Emphasize use of plant species that will be robust to climate change in restoration projects.	Not on-going	Practice & Behavior
59.5: Consider planting desired species and seed sources rather than relying on natural regeneration and migration.	Not on-going	Practice & Behavior

STRATEGY 60. Prioritize, protect, and manage alpine habitat to reduce potential for habitat loss.

Actions	Status	Category
60.1: Apply an adaptive management cycle of learn, implement, and reassess to periodically update alpine management priorities.	Not on going	Practice & Behavior

LONG-TERM ADAPTATION ACTIONS | SUBALPINE HABITAT

STRATEGY 61. Prioritize, protect, and manage subalpine habitat to reduce potential for habitat loss.

Actions	Status	Category	Response time
61.1: Identify, protect, and where possible, create critical subalpine meadow habitat.	Not on-going	Evaluation /assessment	Anticipatory
61.2: Prioritize subalpine meadow habitats for active management, restoration, and protection across jurisdictional boundaries.	On-going	Evaluation /assessment	Anticipatory
61.3: Plant subalpine meadow species that have a broader range of moisture tolerance.	Not on-going	Practice & Behavior	Anticipatory

STRATEGY 62. Increase invasive species management efforts in subalpine meadow habitat.

Actions	Status	Category	Response time
62.1: Implement or expand existing monitoring efforts focused on likely pathways of introduction for invasive species.	Not on going	Data collection & Monitoring	Anticipatory

STRATEGY 63. Gather information and data that can be used to prioritize and adapt subalpine meadow habitat to the effects of climate change.

Actions	Status	Category	Response time
63.3: Monitor subalpine meadow vegetation and species to assist in detecting changes in the distribution, composition, and structure of subalpine meadow species.	On-going	Data collection & Monitoring	Anticipatory
63.4: Increase research efforts to evaluate how climate change could affect the distribution and composition of subalpine meadow habitat in the Nooksack watershed.	Not on-going	Data collection & Monitoring	Anticipatory

STRATEGY 64. Increase resilience through postfire management.

Actions	Status	Category
64.1: Use wildfires as an opportunity to facilitate establishment of current and future climate-adapted species and communities.	Not on-going	Practice & Behavior
64.2: Experiment with planting native species to compete with invasive species post-fire.	On-going	Practice & Behavior

STRATEGY 65. Promote diversity of forest age and size classes to enhance biodiversity and increase resilience of forest ecosystems.

Actions	Status	Category
65.1: Restore relict Forest Service plantations to help increase forest stand age diversity and species diversity.	Not on-going	Practice & Behavior
65.2: Promote the establishment of community forests that utilize uneven-age forest management to pursue a wider range of natural resource and cultural objectives.	Not on-going	Practice & Behavior
65.3: Encourage DNR to implement selective thinning practices (instead of conventional even-age management) in strategic locations to increase summer streamflow and improve habitat connectivity.	Not on-going	Practice & Behavior

STRATEGY 66. Increase summer streamflows through changes in forest management.

Actions	Status	Category
66.1: Where feasible, retain and protect mature stands and old growth stands, and increase the duration of harvest rotations from 35-40 years to 80 years or longer.	Not on-going	Practice & Behavior
66.2: Extend and expand the research the Tribe is conducting on the influence of stand age and the implementation of small harvest gaps to promote snow accumulation and melt and to increase late summer streamflows.	On-going	Data collection & Monitoring

STRATEGY 67. Prevent loss of relict populations of vascular and nonvascular species.

Actions	Status	Category
67.1: Identify and restore areas where relict plants could be established.	On-going	Evaluation /assessment

LONG-TERM ADAPTATION ACTIONS | RIPARIAN HABITAT

STRATEGY 68. Increase riparian resilience to changing hydrologic conditions.

Actions	Status	Category
68.1: Protect, conserve, and encourage beaver introductions to help store water in riparian areas.	Not on-going	Practice & Behavior

STRATEGY 69. Improve understanding of and protect surface flows and groundwater.

Actions	Status	Category
69.1: Monitor the water level in springs to detect changes over time.	Not on going	Data collection & Monitoring

STRATEGY 70. Reduce the impact of invasive species on riparian habitat.

Actions	Status	Category
70.1: Manage invasive species that may increase with climate change (e.g., grasses, bullfrogs).	Not on-going	Practice & Behavior

STRATEGY 71. Improve watershed health and functioning.

Actions	Status	Category
71.1: Require wider buffers to increase riparian areas.	Not on going	Policy
71.2: Remove bank armoring and increasingly tolerate flooding in floodplain.	Not on going	Practice & Behavior

LONG-TERM ADAPTATION ACTIONS | WETLAND HABITAT

STRATEGY 72. Maintain the hydroperiod and water supply for wetlands.

Actions	Status	Category
72.1: Manage forest cover to increase snow retention in areas that will benefit water availability in wetland habitat.	Not on-going	Practice & Behavior
72.2: Restore habitat in degraded headwater streams that are expected to retain adequate summer streamflow and will benefit wetland habitat.	Not on-going	Practice & Behavior

STRATEGY 73. Maintain and enhance wetland function and conditions, particularly in priority wetlands.

Actions	Status	Category
73.1: Translocate and increase beaver populations to create and restore wetland habitat.	Not on going	Practice & Behavior
73.2: Increase microhabitat structures (e.g., woody debris) for microclimate refugia, nesting habitat, and egg deposition structures for wetland-dependent species.	On-going	Practice & Behavior
73.3: Define the extent and distribution of high-elevation wetlands for the purposes of establishing a baseline to help quantify future changes.	Not on going	Evaluation /assessment

STRATEGY 74. Prioritize, protect, and manage wetland habitat to reduce potential for habitat loss.

Actions	Status	Category
74.1: Plant species that have a broader range of moisture tolerance.	On-going	Practice & Behavior
74.2: Apply an adaptive management cycle of learn, implement, and reassess to periodically update wetland management priorities.	Not on-going	Practice & Behavior
74.3: Work with partners and landowners to reduce impacts of livestock on wetlands by installing fencing, modifying duration and/or	Not on-going	Partnerships

intensity of grazing, and relocating water troughs away from wetland habitat.			
74.4: Increase the size and enforcement of buffer zones around wetlands.	On-going		Policy

LONG-TERM ADAPTATION ACTIONS | ESTUARY HABITAT

No long-term adaptation actions were identified for estuary habitat.

LONG-TERM ADAPTATION ACTIONS | MARINE HABITAT

No long-term adaptation actions were identified for estuary habitat