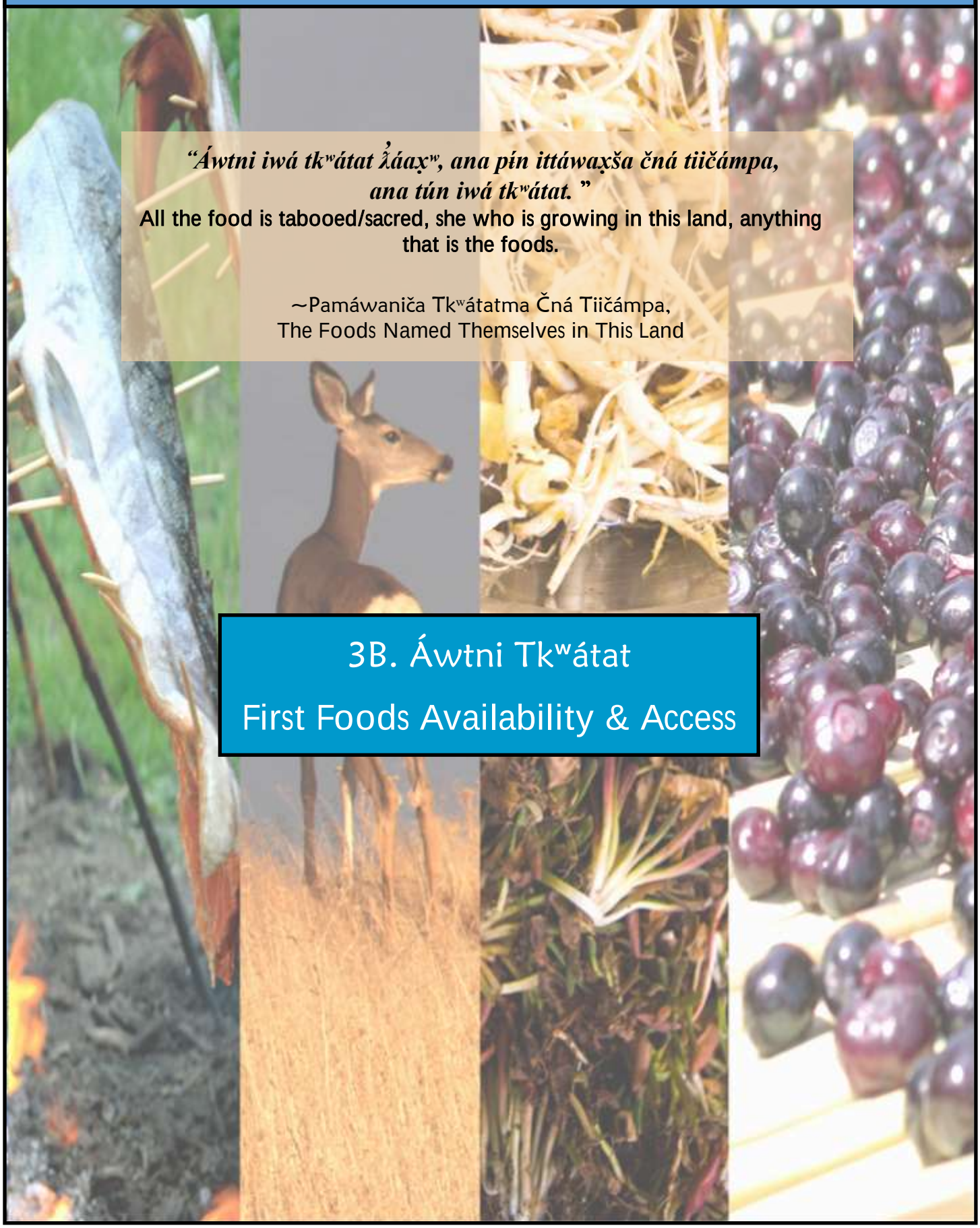


"Áwtni iwá tkʷátat ƛ̓áax̣ʷ, ana pín ittáwax̣ša čná tiičámpa, ana tún iwá tkʷátat. "

All the food is tabooed/sacred, she who is growing in this land, anything that is the foods.

~Pamáwaniča Tkʷátatma Čná Tiičámpa,
The Foods Named Themselves in This Land

3B. Áwtni Tkʷátat

First Foods Availability & Access

Climate Impacts for First Foods Availability

"The availability and long-term production of First Foods in the uplands throughout the Ceded lands requires healthy, functional ecosystems. Healthy ecosystems maintain their full array of ecosystem services, which are the benefits supplied to society by natural ecosystems."

(First Foods Upland Vision, 2019)

First Foods availability is challenged by climate change as a multiplier of existing threats to the success of these crucial species. There are many social, political, and economic barriers that threaten the health and abundance of First Foods. These complications interact with climate change impacts in ways that often make conditions worse for First Foods and for Tribal people who depend on them.

1. **Warming Surface Water Temperatures**

Peak winter stream flows will shift earlier into the year, and cause a reduction in water available in the summer season. Warmer air temperatures will also contribute to warming river systems, impacting aquatic species directly through potentially lethal temperatures and lower oxygen content, and terrestrial species through an increase in algal contamination.

17-20% increase in August stream temperatures at lower elevations and a 14-17% increase in higher mountain levels by the end of the century in 2100 (Clifton USFS 2018) in Figure 3B.1 (page 70).

2. Plant Habitat Suitability Migration

Habitat suitability depends on many factors such as stream temperature, vegetation type, topsoil erosion, and connection with environmental reciprocal relationships, such as with pollinators and host fish. As seasonal precipitation and temperatures change, suitable habitat for First Food species will shift as a result.

10—40% reduction in habitat suitability for huckleberries across much of CTUIR Ceded and traditional use lands, with some modest 15-30% increases in the Eagle Cap Wilderness, as in Figure 3B.2 (page 71). Timing of harvests may shift **1–2 months earlier** (Prevey et al 2019).

3. Impacts to Pollinators and Other Insects

Pollinators have complex plant-insect interactions that will be challenged by change, and First Foods ecosystems depend on native insects for heath and abundance. **Reduction in suitable habitat of 30% for Black-Notched Bumblebee (*Bombus bifarius*) and of 6% for the Fuzzy Horned Bumblebee (*Bombus mixtus*)** by mid-century as in Figure 3B.3 (Koch et al 2019) (page 73). Other pollinators to prioritize include **Narrow-Legged Miner Bee (*Andrena angustitarsata*), Blue-and-Black Miner Bee (*Andrena nigrocaerulea*), Small Green Miner Bee (*Andrena microchlora*),** and **Sweat Bees (*Lasioglossum*)** (Gardner 2019 and 2020).

4. Increased Invasive Species Pressure

Within aquatic systems, invasive mussel and predatory fish species thrive in hotter water temperatures which stress native fish. In terrestrial landscapes, invasive grasses are better suited to summer drought than native shrubs and trees. Additional atmospheric stress could increase invasive species competitive advantage over desired native First Foods and habitat species.

Aquatic Invertebrates (+59%) and Plants (+12%), and Terrestrial insects (+18%) will experience the largest Increase (Bellard et al 2013) in Figure 3B.3 (page 75). Specific weeds

"From this land in which the people lived and its incumbent seasons came the diet, the languages, and the customs that are distinctly appropriate and associated with the homeland. The traditional diet of fishes, meats, roots, greens, and fruits defined when and where the people traveled to harvest and process foods."

~ Wiyaxayxt| Wiyaakaa'awn: As Days Go By
(Conner and Lang, 2006)

5. Increased Riparian and Topsoil Erosion

Topsoil erosion is more likely to occur with climate change as a risk multiplier. As the seasonal hydrology shifts, opportunity for water infiltration into the soil will decrease, creating more potential for sediment to enter waterways. While conservation farming practices mitigate some impacts, erosion potential still increases.

Future erosion under conventional tillage experience 192% increase in soil loss, and roughly 115% increase under conservation tillage/no-till, for 4˚F (2.2˚C) scenario (Farrell et al, 2015) as seen in Figure 3B.5 (page77).

6. Disconnect Between Vegetation Growth and Big Game Nutritional Needs

Native plant forage will be impacted by changing precipitation patterns; this is likely to result in a disconnection in the seasonal window big game reproductive females have to produce calves and milk they will need. This could reduce fitness in some herds and could alter the frequency of seasonal calving.

Large data gaps exist; rough estimates anticipate peak forage growth will shift earlier in the year, affecting fat accumulation and milk production in female elk, and is likely to negatively impact elk calf success and frequency of birth (Wisdom et al, 2017) as seen in Figure 3B.6 (page 79).

7. Changes in Plant and Animal Pathogen Potential

Animals and plants are susceptible to disease and pathogens, which are likely to have an altered distribution and virulence under warmer conditions. New strains or changed relationships with existing illnesses are likely to cause impacts to First Foods success.

Many data gaps exist. **5°C (9°F) winter temperature increase results in a 15% increase in infection of one-year old conifer needles, and a 30% increase in infection for two-year old needles** (Stone et al 2008) as seen in Figure 3B.7 (page 80). Other diseases of note include: Big Game illnesses like **M. ovi**, and **Epizootic Hemorrhagic Disease (EHD)**; fish illnesses like **Ich and Furunculosis**; and conifer pests like **Western Pine Beetle, Mountain Pine Beetle, and Pine Engraver.**

1. Warming Surface Water Temperatures

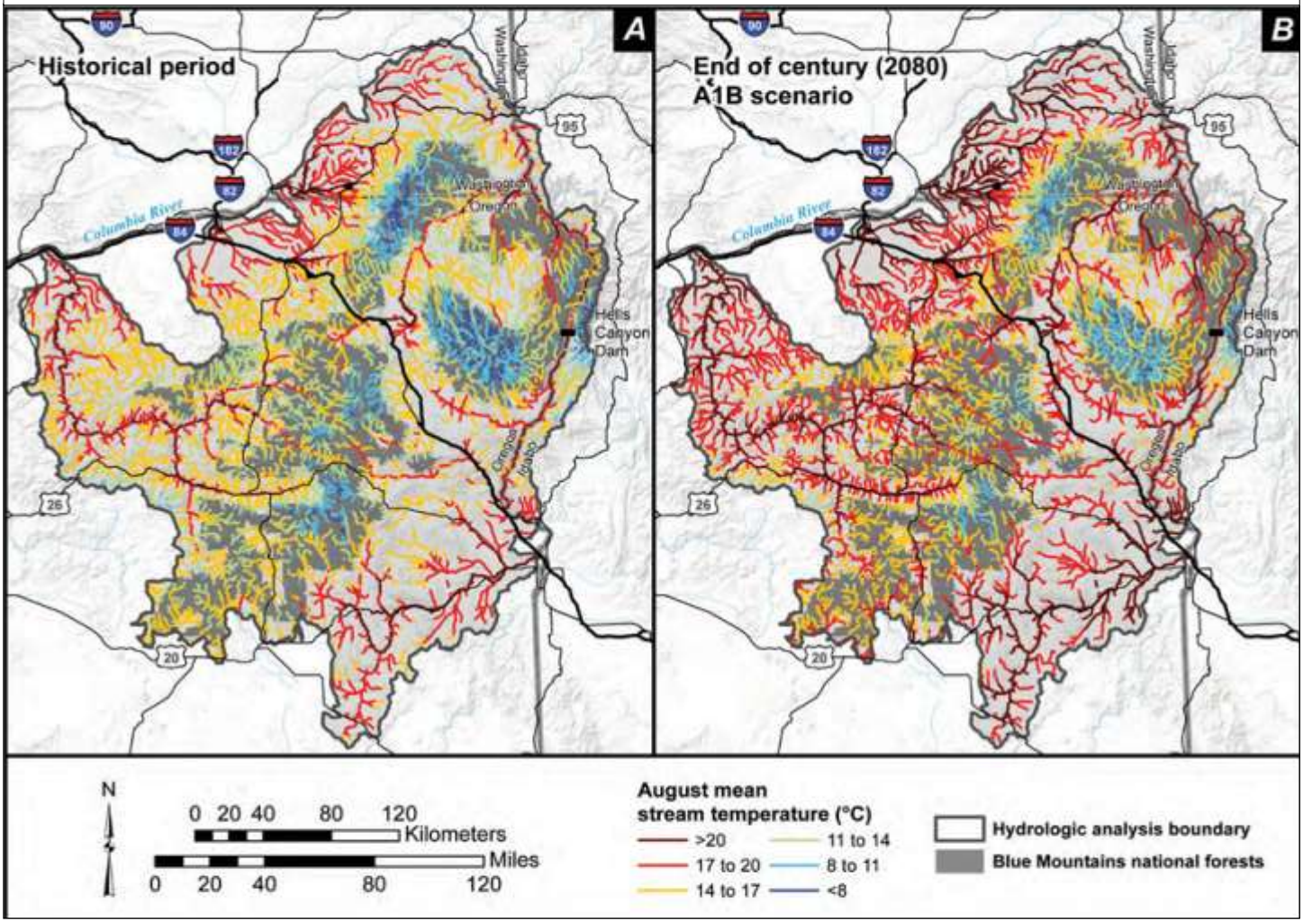
"Changes to surface water flows affect a variety of river functions, including connections between habitats for aquatic biota and patterns of floodplain water movement (Umatilla River Vision, 2011)."

As snow pack decreases and air temperature rises, stream temperatures will increase because of low flows and extreme heat. These temperatures might reach levels lethal to anadromous native fish and species of freshwater mussel in many places.

Figure 3B.1 illustrates projected historic and future stream temperatures on a map of the national forests within CTUIR's Ceded lands in the Blue Mountains (Halofsky and Petersen 2017). Color range of the riparian sections indicate the average stream temperatures in the month of August for observed historic conditions (1980's) (left, A) compared to projected future conditions by 2080 under Scenario A1B (right, B).

- In projected future, miles of **extremely cold waters (< 8˚ C, dark blue lines) is reduced by 70% from 1980 to 2040, and by 90% by 2080**;
- Conversely, the miles of **extremely hot waters (> 20˚ C, purple lines) increases by 98% from 1980 to 2040, and by 218% in 2080** (Halofsky and Pedersen).
- **17-20% increase in summer stream temperature at lower elevations**, and a **14-17% increase in higher mountain levels** by the end of the century in 2080.
- Least affected were **mid-elevation streams**, likely because they receive rain most years, even under historical conditions.

Figure 3B.1: Projected Change in Stream Temperature Historically (Left) and by 2080 (Right)



- Most impacted by increasing stream temperatures are low elevation tributaries including the **Wanakut Wildlife area, mouth of the Umatilla River at Columbia River confluence**, northern reaches of the Wenaha-Tucannon Wilderness, and southeastern slopes of the Strawberry Mountain and Monument Rock Wilderness areas.

In these areas, it would be beneficial to expand restoration of First Food aquatic species that are able to withstand warmer waters, such as Pacific lamprey (*Entosphenus tridentatus*), and floater (*Anodonta spp*.) freshwater mussel species.

- Least impacted areas are projected to be **Eagle Cap Wilderness, Grande Ronde River and Johnson Creek watersheds, and parts of the Elkhorn Mountains**.

In these areas, restoration of cold water fish species such as Chinook salmon (*Oncorhynchus tshawytscha*), Pacific steelhead (*Oncorhynchus mykiss*), bull trout (*Salvelinus confluentus*), Western Pearlshell (*Margaritifera falcate*) and Western Ridged Mussel (*Gonidea angulate*) could continue to be prioritized and expanded.

Suitable cold water habitat is likely to be limited to higher elevations and northern latitudes. This map shows lower reaches of the Umatilla Basin are at risk of being lost as potential habitat for cold water species under this change scenario, as streams experience temperature and hypoxia passage barriers for cold water migratory fish.

(Credit: Halofsky and Pederson USFS, 2017)

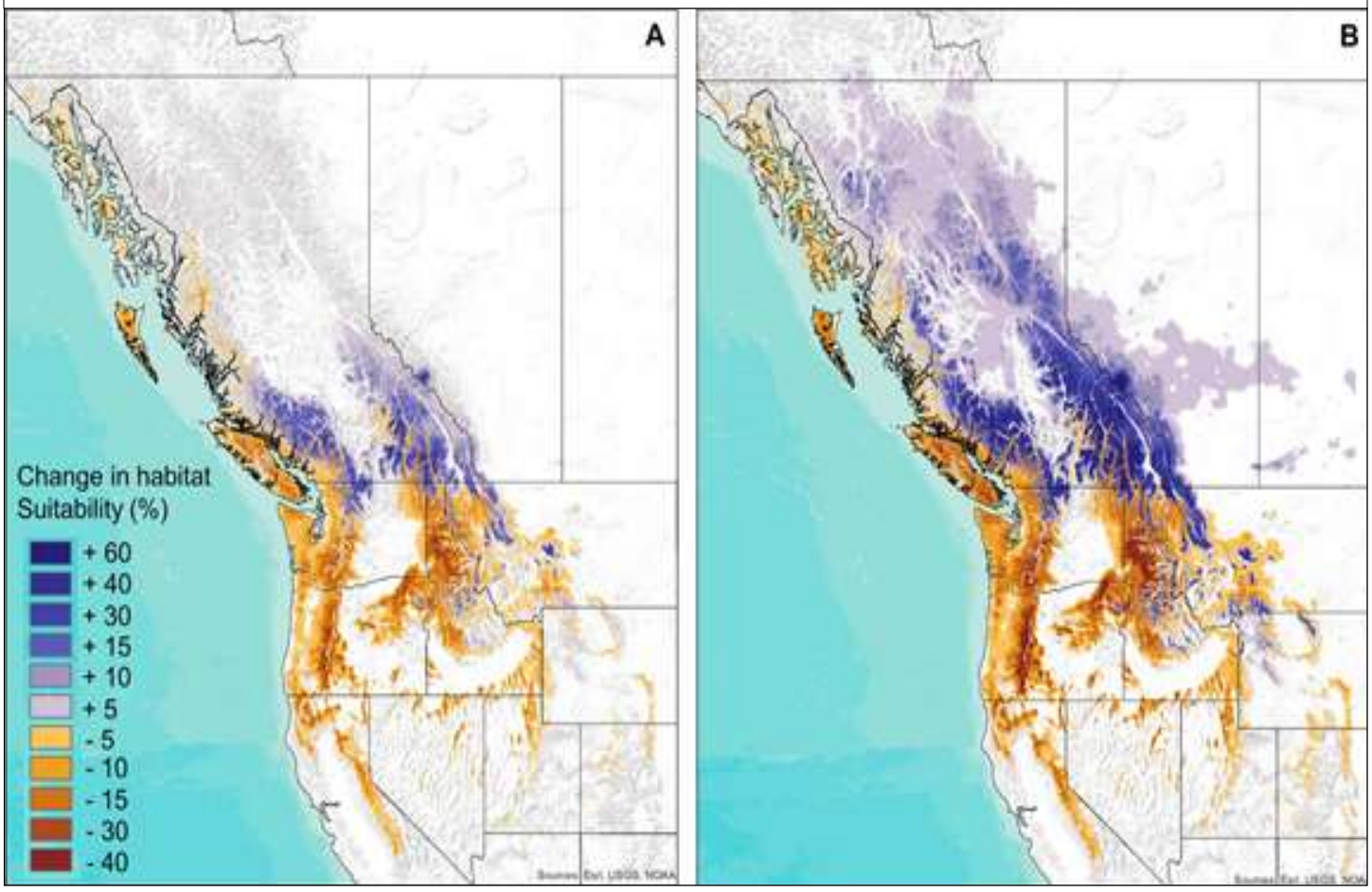
Gaps in Knowledge/Data/Policy:

- Magnitude of cold water release from floodplain restoration, and how this might buffer temperatures.

2. Plant Habitat Suitability Migration

"The availability and long-term production of First Foods in the uplands throughout the Ceded lands requires healthy, functional ecosystems. Healthy ecosystems maintain their full array of ecosystem services, which are the benefits supplied to society by

Figure 3B.2: Change in Huckleberry Habitat Suitability by 2100 Under Low (A) and High (B) Emissions Scenarios



natural ecosystems (First Foods Uplands Vision, 2019)."

Native plants in the Blue Mountains and Columbia Plateau have an internal set of environmental criteria that dictate where these species will thrive, and often have close symbiotic relationships with other animals and insects. Population and habitat monitoring of Men's Foods (fish and animal species) is part of Tribal management of riparian areas, while Women's Foods (root and berry species) have been largely unmonitored in grassland and forest slopes.

Large information gaps exist about climate impacts to many First Food species. Tribes are often at the forefront of collecting data and monitoring these important native species, like the Xáwš roots (pictured).

Plant First Foods like the big huckleberry (*Vaccinium membranaceum*) are likely to experience negative impacts from climate change, and are a useful indicator species due to its highly sensitive habitat requirements.

Figure 3B.2 shows the predicted change in habitat suitability for huckleberry species by the end of the 21st century (2100) for RCP4.5 on the left, and for scenario RCP8.5 on the right.

- Under both emissions scenarios, models anticipate **moderate degradation of 5—15 % in suitability of habitat** across much of the CTUIR Ceded lands and traditional use area.
- **Severe degradation of 30-40% at lower altitudes** (likely the lower limits in habitat range) is expected, with greatest decreases in the **Wenaha-Tucannon and North Fork Umatilla Wildernesses, and northern Elkhorn Mountains.**
- **Modest 15-30% gains in higher altitude locations** (expanding into previously unsuitable habitat) in the **Eagle Cap Wilderness Mountains**, as well as locations in central Idaho (Prevey et al 2019).
- Uplands habitat restoration at lower elevations and at the downslope range of current Root and Berry species should favor plants that are able to adapt to drier and warmer conditions. Plant species that require cold and wet conditions should be prioritized in higher elevation restoration locations than previously established.
- Temporal shifts also exist: timing of traditional harvests of culturally-important species may need to shift an estimated **1–2 months earlier** in the year (Prevey et al 2019). Huckleberry is an extremely sensitive species, and so can be used as a potential indicator of how other Women's Foods might migrate in response to warming temperatures. This study model also does not reflect other environmental factors for plant phenology, like snow depth and timing, day length, and chilling effects that are likely to influence species-specific adaptation capacity. More detailed research is necessary.

Land management strategies that allow for adaptive approaches will be essential for plant First Foods species health. CTUIR has robust forest management strategies and goals under the established Forest Management Plan (2010), and is in the process of creating similar standards and guidelines for range and grassland management, located within the forthcoming Rangeland Management Plan.

(Credit: Prevey et al USFS, 2019)

<u>Gaps in Knowledge/Data/Policy:</u>

- Animal species are also likely to be impacted by changing habitat suitability, and will need to migrate along with their symbiotic plant species. More information is needed about these specific interactions.
- First Food plant and medicine species are very diverse, and further information is needed to know more precise information about shifts in habitat for these species.
- Data collection of different phenological events on the same individuals and species to account for changes to seasonal cues.

3. Impacts to Pollinators and Other Insects

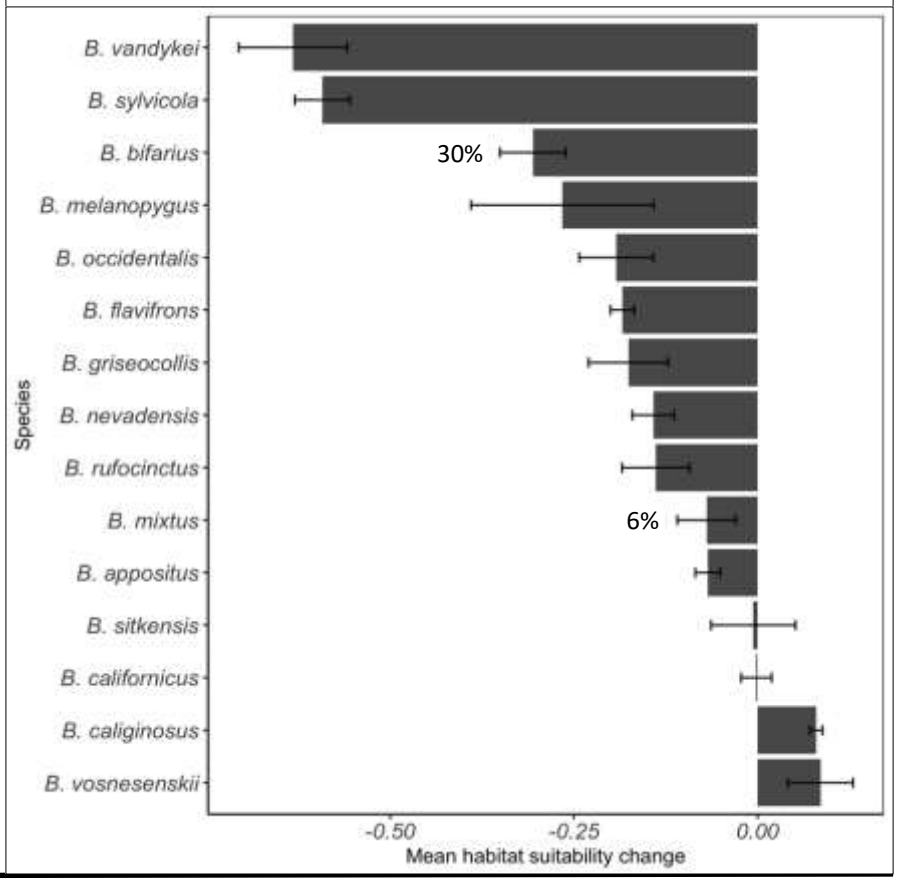
Land conversion and habitat suitability shift also affect insect communities that are closely related to First Foods and other important plants within ecosystems. Pollinators are a classification of insect that is essential to the health and abundance of food, both agriculturally and for First Foods. Native bee species particularly are important for native plant pollination.

Within these diverse species of native bees, the Bumblebee (*Bombus*) Family has been the most researched and has a large role in First Foods pollination. Much of this research focuses on Western Oregon and Washington sites, but can also provide insight into anticipated changes in habitat suitability range for these species in Eastern PNW habitats. In general, bumblebee diversity increases in higher elevation and mountain habitats (Koch et al 2019), while many of the study sites are found at sea level. More refined data is needed.

Figure 3B.3 shows the average change in habitat suitability for 15 bumblebee species found in the Pacific Northwest, and how climate change is projected to affect the availability of habitat in the future (Koch et al 2019).

- Data was from 23 field sites in seven US National Parks: Olympic National Park, Mount Rainier National Park, North Cascades National Park, Ebey's Landing National Historical Reserve, Lewis and Clark National Historical Park, Fort Vancouver National Historic Site, and San Juan Islands National Historical Park, all at sea level.
- Climate projections were modeling using three general circulation models (GCMs) with 4.5 and 8.5 representative concentration pathways (RCPs) for the year 2050 and 2070.
- Overall, 80% of bumble bees in the PNW may experience habitat loss in the next 50 years. Bumble bee species found predominantly in high alpine environments are at greatest risk of losing suitable habitat (Koch et al 2019).
- Most vulnerable species to least: Van Dyke's Bumblebee (*B. vandykei*) (1); Forest Bumblebee (*B. sylvicola*) (2); **Black-Notched Bumblebee (*B. bifarius*)** (3); Black Tail Bumblebee (*B. melanopygus*) (4); Western Bumblebee (*B. occidentalis*) (5); Yellow-headed Bumblebee (*B. flavifrons*) (6); Brown-Belted Bumblebee (*B. griseocollis*) (7); Nevada Bumblebee (*B. nevadensis*) (8); Red-Belted Bumblebee (*B. rufocinctus*) (9); **Fuzzy Horned Bumblebee (*B. mixtus*)** (10); and White-Shouldered Bumblebee (*B. appositus*) (11);
- Sitka Bumblebee (*B. sitkensis*), California Bumblebee (*B. californicus*), Obscure Bumblebee (*B. caliginosus*), Western Bumblebee (*B. occidentalis*), and the Yellowfaced Bumblebee (*Bombus vosnesenskii*) are least vulnerable and may experience an expansion in suitable habitat (Koch et al 2019).
- Species primarily found in high altitude environments are projected to incur a mean habitat suitability loss, with *B. vandykei* (63%), *B. sylvicola* (59%), and ***B. bifarius* (30%)** as largest losses. **Other species of note is *B. mixtus*, which will experience a reduction of 6%.**

Figure 3B.3: Changes in Habitat Suitability for Bumblebee Species under Combined RCP 4.5 and 8.5 Scenarios.



- As lower altitude bees are pushed to higher elevations where greater bee diversity and richness exist, species will compete for floral, nest, and hibernacula resources in an environment that is also spatially limited in comparison.

CTUIR is conducting its own inventory of important pollinators for First Foods. Data collection and reporting for these studies began in 2017, and a number of First Foods and other culturally important plants have been surveyed for the types and frequency of pollinators that visit their blooms.

Bumblebee species were identified as common pollinators for First Foods like Xmáaš (pictured); courtesy of Beecology (2020)

- Xáwš (*Lomatium cous*): largest percentage of pollinators seen to be native bees. The most abundant were multiple species in the genus Andrena (a ground nesting bee that emerges in the early spring), which comprised 60% of total insect abundance. Of these, the **Narrow-Legged Miner Bee (*Andrena angustitarsata)* was most abundant, composing 32.8%** (Gardner 2018).
- Wiwinu (*Vaccinium membranaceum*): most frequent pollinator was native bees. The most abundant were multiple species in the genus Bombus, representing 61.5% of the total insects collected (Gardener 2018), with **Fuzzy Horned Bumblebee (*Bombus mixtus*)** and **Black-Notched Bumblebee (*Bombus bifarius*)** were the most abundant pollinators. B. bifarius is projected to incur a loss of 30% in habitat suitability by mid-century (Koch et al 2019).
- Xmáaš (*Camassia quamash*): the most abundant were bumble bees at 24.4% of total insect abundance, with ***Bombus mixtus and Bombus bifarius*** as 63% of bumble bees species, and **Blue-and-Black Miner Bee (*Andrena nigrocaerulea*)** accounting for 17% of insects collected (Gardner 2020).
- Latítlatit (*Lomatium grayi*): largest percentage of pollinators found to be native bees (90.1%), with most abundant in genus Andrena (50%) (Gardner 2019). The most abundant species was **Small Green Miner Bee (*Andrena microchlora*)**, comprising 19.7%. The second most common were **Sweat Bees (*Lasioglossum)***, making up 24% of total insect abundance (Gardner 2020).

Many of these pollinators are generalist foragers, with known host associations on multiple species of First Foods and culturally significant plants. Additionally, many are ground nesting insects and require compact bare soils for nesting sites. Conservation of these pollinators would maintain diverse foraging resources, both temporally and spatially over the season, as well as providing nesting habitats. Ideas to maintain bumblebees could include keeping understory foraging materials available, and opening forest canopies to encourage flowering plant density (Gardner 2020).

Land management and agricultural activity has a large role in ability to protect pollinator species. There are many connections to wildfire and cultural burning in forested and grassland ecosystems, pesticide use, habitat degradation/land conversion, and pathogens like *Nosema bombi* and *Crithidia* spp. Local examples of management and opportunities for research include CTUIR's existing pollinator research, partnerships with U.S. Forest Service, and the Nature Conservancy with the Zumwalt Prairie restored grassland in Wallowa County, OR. There are also opportunities to participate in research efforts and community/citizen science with initiatives like the Oregon Bee Project and the Pacific Northwest Bumblebee Atlas.

(Credit: Koch et al 2019)

<u>Gaps in Knowledge/Data/Policy:</u>

- Attribution of population loss to pathogens and land-use change;
- How population genetic data may inform the potential for habitat corridors as a mitigation strategy to ensure that vulnerable bumble bee species do not become isolated from adjacent populations;
- Species plasticity and ability to physically change to accommodate shifting floral resource availability.

4. Increased Invasive Species Pressure

"The introduction and spread of non-native plant species, particularly annual grass species exacerbated the effects of overgrazing by quickly colonizing disturbed areas. Invasion of shrub-steppe by non-native grasses such as annual bromes (*Bromus tectorum, B. arvensis, B. hordeaceus*, etc), ventenata (*Ventenata dubia*), and medusa-head (*Taeniatherum caputmedusae*) altered fire frequency and intensity, particularly in low-elevation areas (First Foods Upland Vision, 2019)."

As conditions change rapidly, naturally resilient native species may be constrained by factors that reduce their ability to adapt unassisted. Terrestrial invasive plants create additional challenges for native species, as they are often unpalatable to Big Game, out compete desired native vegetation, and increase the risk of catastrophic wildfire. Invasive aquatic species will also increase in potential distribution, as warming waters reduce cold water conditions that are favorable for native fish.

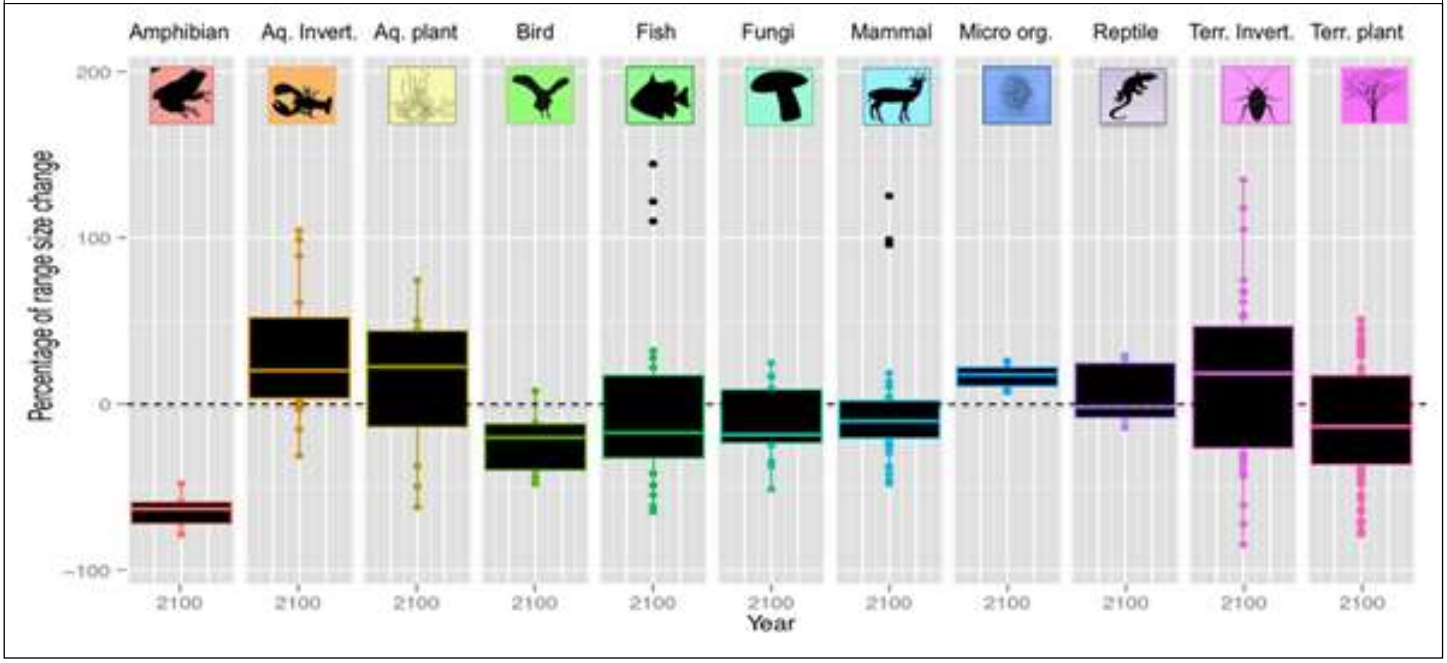
Figure 3B.4 displays a box plot graph which projects the anticipated global expansion and contraction of categories of invasive species. While these are global estimates, these trends can be used as proxy estimates to anticipate changes in the Pacific Northwest until refined data is available.

- Boxes show projected changes for different invasive species groups: those above the dashed line will expand their global range, and those below the dashed line will experience a constricting of range. The volume of the box shows the variation within each of these predictions.
- **Largest range expansions occur for aquatic invertebrates (+59%), terrestrial plants (+12%), and terrestrial insects (+18%)** (Bellard et al, 2013).
- Relatively little effect on Mammals, Reptiles, Fungi, and Microorganisms; loss of range for Amphibian and Bird species.

Feral pigs (*Sus scrofa*) have expanded throughout the PNW as winters in northern states have become milder, and established in Washington, Oregon, and Idaho by 2012. Feral cats (*Felis catus*) are also anticipated to increase (Gervais et al 2020). In the Pacific Northwest, few studies have been done for invasive species spread, but of those conducted:

- **Aquatic species predicted to increase**: Asian clam (*Corbicula fluminea*), Channeled apple snail (*Pomacea canaliculata*), Brazilian waterweed (*Egeria densa*), Water hyacinth (*Eichhornia crassipes*), Dioecious hydrilla (*Hydrilla veticillata*), Large-flower primrose (*Primula vulgaris*), Parrot feather (*Myriophyllum aquaticum*), and a slight expansion in Nutria (*Myocastor coypus*) range (Gervais et al 2020).

Figure 3B.4: Modeled Shift in Invasive Species Globally by Organism Classification



- **Plant species predicted to increase** include: Velvetleaf *Abutilon theophrasti*), Ragweed (*Ambrosia artemisiifolia*), **Cheatgrass (*Bromus tectorum*)**, Butterfly bush (*Buddleja davidii*), **Yellow starthistle (*Centaurea solstitialis*)**, Johnsongrass (*Sorghum halapense*), and **Saltcedar (*Tamarix* spp),** particularly in Eastern Oregon and Washington (Gervais et al 2020).
- **Insect species predicted to increase** include: Swede midge (*Contarinia nasturtii*), Brown marmorated stink bug (*Halymorpha halys*), Gypsy moth (*Lymantria dispar*), Potato tuber moth (*Phthorimaea operculella*), Apple maggot (*Rhagoletis pomonella*), and Wheat blossom midge (*Sitodiplosis mosellana*) (Gervais et al 2020).
- For CTUIR's reservation and Ceded lands, grasshoppers (*Orthoptera* spp.) and Mormon crickets (*Anabrus simplex*) have been identified as a large economic impact to agricultural resources in the region (Adams ODA 2021).
- Unmanaged horses (*Equus caballus*) can have a big impact on availability of forage for Big Game First Foods.
- **Species identified in CTUIR Invasive Weed Management Plan** include: Sweet Briar and Multiflora Rose (*Rosa multiflora* and *Rosa eglanteria*), Himalayan blackberry (*Rubus armeniacus*), Giant/Japanese/Bohemian knotweeds (*Fallopia sachalinensis, Reynoutria japonica,* and *Fallopia × bohemica)*, garlic mustard (*Alliaria petiolate*), leafy spurge (*Euphorbia esula*), sulfur cinquefoil (*Potentilla recta*), Russian olive (*Elaeagnus angustifolia*), rush skeletonweed (*Chondrilla juncea*), common crupina (*Crupina vulgaris*), bulbous bluegrass (*Poa bulbosa*), Russian thistle (*Salsola* spp.), Medusahead Rye (*Taeniatherum caput-medusa*), Ventenata (*Ventenata dubia*), and kochia (*Bassia scoparia*).
- Invasive species high concern watchlist includes saltcedar, Scotch broom (*Cytisus scoparius*), and purple starthistle (*Centaurea calcitrapa*) are species of priority concern for encroachment.

CTUIR RAF seasonal staff assist with invasive species monitoring and management, like GPS locating of priority noxious plants. This builds understanding of how these species are changing each year, and assists with management methods.

Columbia River Plateau and Blue Mountains ecosystems are very unique and few studies have been conducted for invasive species in the region. Aggressive management and monitoring protocols to control their spread could be effective in reducing their impact on First Foods. CTUIR's Agricultural Management Plan (2015) and Invasive Weed Management Plan details strategic approaches to terrestrial invasive species management; further details can be found in these integrated plans.

(Credit: C. Bellard, et al, 2013)

<u>Gaps in Knowledge/Data/Policy:</u>

- Knowledge to evaluate which invasive species may pose greatest regional threats due to feedback loops, symbiotic relationships, and other environmental and species dynamics;
- Disease organisms or their vectors, and how these might affect changing native and invasive species dynamics;
- How human impacts such as fish stocking, feral animal abandonment, and ballast water release impact these species distribution and spread;
- Out of date or absent list of priority species to control for states and other regional jurisdictions;
- Coordinated and integrated research and monitoring approaches, use existing data and improve data collection, access, analysis, and reporting.

5. Increased Riparian and Topsoil Erosion

"Water infiltration rates into soil are directly linked to management practices and disturbances (grazing systems, fire, shrub management, invasive species) that alter soil structure and vegetation cover (e.g. compaction, loss of biological soil crusts, type of vegetation). Water that does not infiltrate into the soil leaves a site via overland flow, not only reducing the water availability for vegetation uptake or groundwater recharge, but also contributes to soil erosion, further affecting soil stability, health, and productivity, and ultimately First Foods production (First Foods Upland Vision, 2019)."

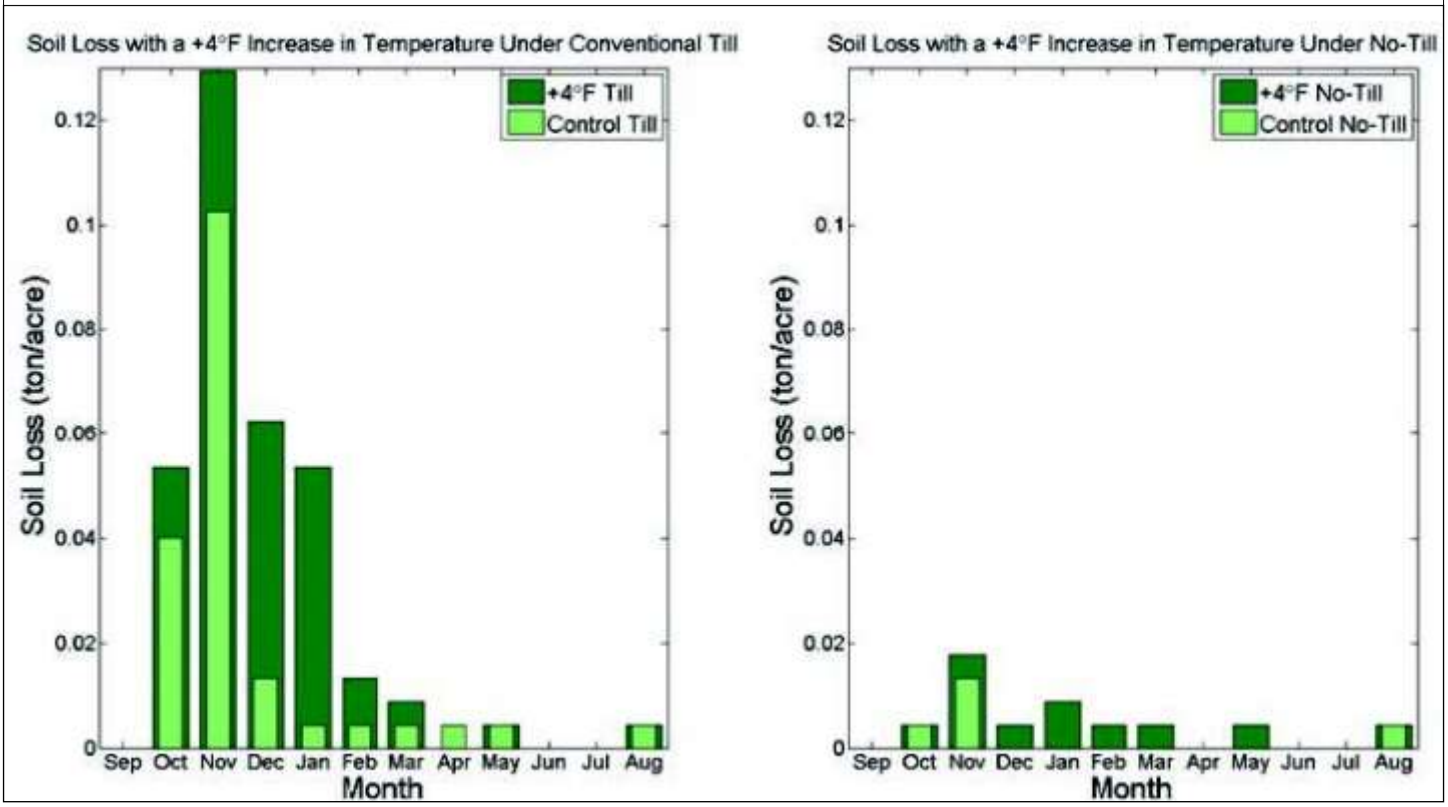
Soil erosion is a negative impact from land use practices, and will be made worse by climate change. Increasing runoff will create more soil erosion, which can flow into waterways and cause sedimentation, and challenges for aquatic organisms. CTUIR Ceded lands are heavily agricultural, including dryland grains (which typically undergo fallow periods of bare soil), and diversified irrigated farming. Both incorporate regular tillage practices, which increase potential for erosion to occur.

Figure **3B.5** provides a projection of changing weather conditions and the effect of increasing air temperature on soil erosion.

- Soil loss (in tons/acre) is shown for two different agricultural tillage intensities. Conventional tillage (left) is disruptive of soil connections, and No-Till (right) largely preserves soil connections through direct seeding. These two methods are compared under historic conditions (light green "Control" bars on the graph), and under an annual temperature increase of 4˚F (2.2˚C) (dark green bars) on a moderately flat slope over a 30 year study period.
- **Under conventional tillage, average changes in erosion could result in a 192% increase in soil loss** seasonally over time. Increases of soil loss of about 30% during the late fall under conventional tillage practices, and an estimated 75% increase in winter months (Farrell et al, 2015).
- **Under No-till direct seeding, average changing in soil loss is projected to still increase roughly 115%**, even with this the conservation tillage no-till strategy, with the largest increase, estimated 60%, in the winter months (Farrell et al, 2015).

These soil erosion estimates are conducted solely for monoculture planted in dryland agricultural grains, and is estimated for the Palouse region of Washington and Idaho, representing much of CTUIR's Ceded and traditional use lands. While conservation agriculture

Figure 3B.5: Projected Increases in Soil Erosion from Agriculture at 4˚F (2.2 C) Warming



Soil "slumps" (pictured left) result from erosion due to shallow rooting grasses like spring wheat under heavy precipitation. Unmanaged horses (pictured right) browse forage necessary for deer and elk species on grasslands.

practices reduce the potential for soil erosion under this climate shifted future, there is still an increase in the amount of soil that will potentially end up in nearby streams as runoff.

First Foods species like Pacific lamprey and *Anodanta* freshwater mussels provide filtration capacity to their habitat, and help to remove sedimentation from these waters. One mussel can filter 10 gallons of water in 30 minutes (CTUIR/Oregon Public Broadcasting, 2021), and 175,200 gallons of water per year; CTUIR is working to restore these populations through partnership with the Walla Walla Community College Water and Environmental Center (WEC) Pacific Lamprey and Freshwater Mussel Labs.

Given that many of these agricultural lands are likely to also experience additional water quality and quantity challenges, prioritizing these species —which are also able to tolerate warming waters —should be considered.

(Credit: Farrell et al REACCH Y4, 2015)

Gaps in Knowledge/Data/Policy:

- How land use and management strategies for agriculture in the region will change in response to climate.

6. Disconnect Between Vegetation Growth and Big Game Nutritional Needs

"Alterations to touchstone attributes that affect forage, cover, and movement across the landscape should be primary considerations with respect to dry forest use, management and restoration activities. Attributes of biotic integrity, namely, vegetation composition and structure, influence forage abundance and availability.

The diet of these species includes a wide range of grass, forb, and shrub species, and their relative importance changes throughout the year; grass and forb species dominate the diet from spring through summer, while shrubs become an important component of diets from late summer through winter as grass and forb species senesce (First Foods Upland Vision, 2019)."

First Foods Yaamas (mule deer, *Odocoileus hemionus*) and Wawukya (elk, *Cervus canadensis*) depend on native grasses and forbs for forage, and large quantities of forage are necessary to prepare deer and elk for the energetic expense of birthing and rearing calves. Historically, forage has been available to supply these needs, though this is not likely to remain the same in a changing climate.

Figure 3B.6: Modeled Changes in Factors that Affect Elk Success in a Warmer Future

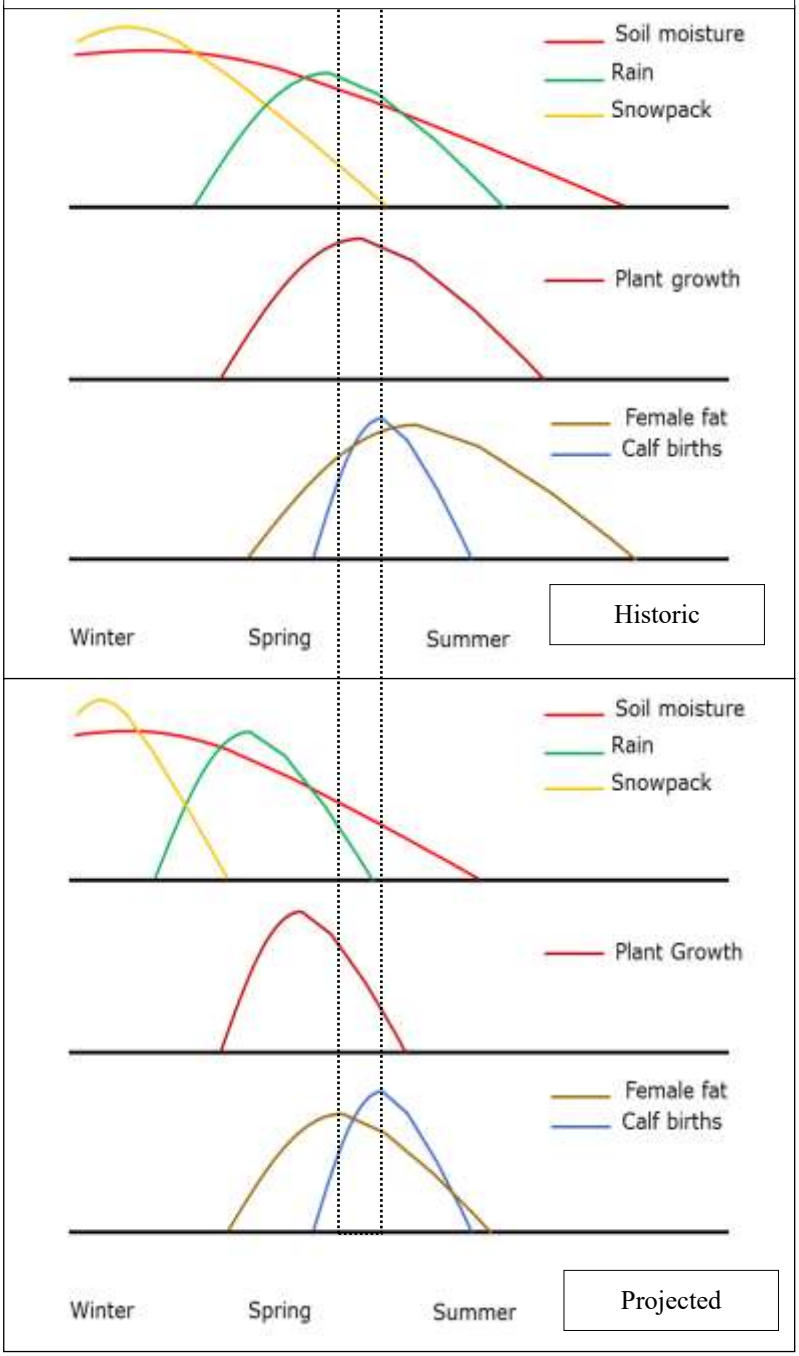


Figure 3B.6 shows very rough estimates of how climatic changes are likely to affect Big Game species based on forage and nutrition needs for calving, and modeled for the Starkey Experimental National Forest in the Blue Mountains.

- These graphs compare historic (top charts) and the projected changes (bottom charts) under a warmer future, and the way this alters the relationship between plant biomass development and elk seasonal grazing needs (Wisdom et al 2017).
- Colored lines show ambiguous availability of different elements: yellow line shows snow pack accumulation, green line shows precipitation as rain during the growing season, and the red line shows the soil moisture change as a result of these precipitation patterns.
- Seasonal plant growth shown in dark red lines, female elk fat availability in brown lines, and timing of calf births are shown in the blue lines. Hashed vertical lines have been added for comparison.
- Low resolution modeling anticipates that **plant growth is expected to shorten in its window of availability, and the peak biomass production will no longer coincide with the timing of elk calf births.**

Wildlife researchers predict a decline in the birth and survival rate of elk, but there are very few studies available to quantify this impact. This could cause local elk populations to modify their migration patterns to stay longer in places with better forage, potentially lingering on private agricultural lands outside of range of hunters.

This could also result in staggering of calving by female elk, potentially resulting in carrying calves every other year, or periodically to conserve body fat resources. This has an effect on the potential to supply elk to subsistence and Longhouse tables. Much more information is needed on how vegetation and migration pattern changes are affecting success and survival of Big Game, especially along the Columbia Plateau and Blue Mountain regions.

(Credit: M Wisdom, USFS et al, 2017)

<u>Gaps in Data/Knowledge/Policy:</u>

- Native forage vegetation biomass availability changes at a regional resolution;
- Deer and elk sensitivity to changes in forage and invasion from nonnative plants;
- Magnitude of range shifts are anticipated for primary forage plant species;
- Shifts in hunting windows and regulations in response to Big Game population and habit changes.

7. Changes in Plant and Animal Pathogen Potential

"Many ecological processes operate at scales beyond any particular site (e.g. wildfires, seasonal migration of elk, invasive species). Therefore, understanding and incorporating landscape context and connections between and among areas may be critical to successful stewardships at a local site (First Foods Upland Vision, 2019)."

Intensity and distribution of plant and animal diseases are affected by changing climate conditions. There is little information currently available on how pests and disease associated with First Foods species will also change. Much of the knowledge of disease shift comes from agricultural industries that to monitor issues within monoculture crop environments. While not perfectly accurate for estimating First Foods impacts, these can offer some insight into how this might occur in naturally functioning habitats.

Figure 3B.7: Swiss Needle Cast Disease and Temperature

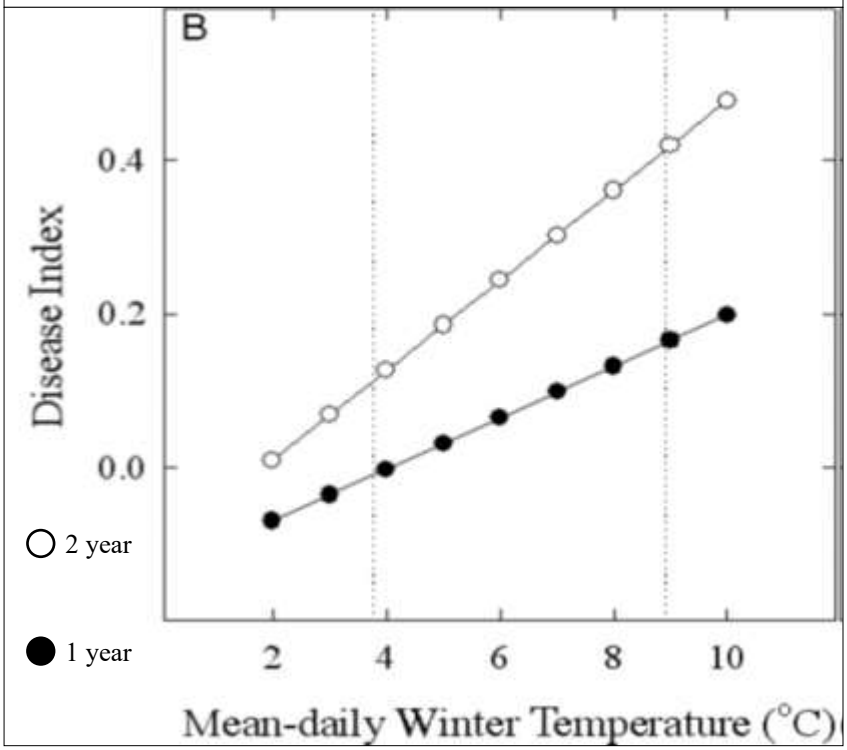


Figure **3B.7** shows projections of Douglas fir-affecting Swiss Needle Cast Disease (*Phaeocryptopus gaeumannii*), an infection that affects western Oregon and Washington conifer forests, but is of lower concern for Eastern Columbia Plateau forests. Modeling of this pathogen provides a proxy estimate that helps anticipate how Ponderosa (*Ponderosa pinus*) and other fire-adapted conifers might be affected by warming winters. In this figure, frequency of infections of Swiss Needle Cast are shown for warming winter conditions.

- Infection was modeled for one year old Douglas fir needles (closed circles), and for two year old needles (open circles) as winter temperatures rise.
- This model shows that the rate of needle infection increases for both vulnerable years for Douglas Fir as winter temperatures rise. Rough estimates from the graph show that in forests where the disease is already present, a 5˚C (9°F) temperature increase (shown by hatched lines of graph) results in a **15% increase in infection of one-year old needles, and a 30% increase in infection for two-year old needles** (Stone et al 2008).
- Currently winter temperatures are measured on average as 3 to -6 ˚C (37.4—21.2°F) for Ontario, Oregon, and 5.6 to -2 ˚C (42—28.4°F) for Pendleton, Oregon (Western Regional Climate Center, 2010). Recent climate projections estimate midcentury temperature increases 2.4 to 3.1˚C (4.3 - 5.6 ˚F) for Umatilla County (Dalton, 2020).
- Pendleton, Oregon with a current winter temperature average of -2 – 5.6 ˚C. With a projected increase of 2.4-3.1˚C, winter temperatures for Pendleton could reach almost 9˚C (16 ˚F)by 2050 and beyond. This corresponds to a 15-30% infection in conifer needle disease under these warmer conditions.

Swiss Needle Cast Disease can be used as a proxy for estimating increases in forest predation, but there are other species that are more relevant for inland Pacific Northwest forests:

- Western Pine Beetle (*Dendroctonus brevicomis LeConte*), Mountain Pine Beetle (*Dendroctonus ponderosae*), and Pine Engraver (*Ips pini*) have done extensive damage, affecting 30-50% of CTUIR standing pine volume in drier areas over

generally endemic to CTUIR forests like root fungal diseases (mostly caused by fungal infections), mistletoe (*Santalales* spp.), and episodic insect outbreaks like tussock moth (*Orgyia pseudotsugata*) or Western Spruce Budworm (*Choristoneura freemani*). However these are likely to shift or increase due to changing climate.

- Any agent, invasive or endemic, that chronically weakens a tree is likely to push it to mortality under drought conditions.

CTUIR forests are at risk from a number of climate impacts, including drought, pest insects, disease, and wildfire.

Men's animal and fish First Foods are also at risk from increased pathogenicity.

- Big Game and wildlife diseases that affect CTUIR Ceded and traditional use lands include:
  - ◊ M. ovi (*Mycoplasma ovipneumoniae*), a respiratory disease caused by a bacterial infection of the lungs in Bighorn Sheep (*Ovis Canadensis*). It is spread when Bighorn Sheep herds come in contact with domestic sheep (*O. aries*) and goats (*Capra hircus*). M Ovi was responsible for a die-off event in 2015-16 of the Bighorn Sheep herd in the Lower Owhyee River Canyon, Southern Oregon (Epps OSU 2017). More research is needed to know how land management and climate change will affect future distributions of this disease.
  - ◊ Chronic Wasting Disease (CWD) is a prion disease that poses risks to Big Game species like deer (mule deer, *Odocoileus hemionus*; black-tailed deer, *O.h. columbianus*; white-tailed deer, *O. virginianus*), elk (*Cervus canadensis*), and moose (*Alces alces*). Washington Department of Fish and Wildlife (WDFW) has developed a CWD Management Plan (2021) with a citizen science monitoring protocol, and Oregon Department of Fish and Wildlife (ODFW) also has information on the disease. As of summer 2022, CWD has not been detected in Washington State (WDFW 2022), and no known cases in Oregon State (ODFW 2021).
  - ◊ Epizootic Hemorrhagic Disease (EHD) is a hemorrhagic disease known as Bluetongue, caused by an infection of a virus transmitted by biting midges to white-tailed deer. Mule deer do not appear to be affected. This virus was responsible for the die-off event in 2020 of an estimated 2,000 white-tailed deer in eastern Oregon across the western face of the Blue Mountains from Milton-Freewater to the Pilot Rock area (DeVivo et al 2020). As drought conditions increase, deer are likely to be concentrated at fewer water access points, and will likely increase incidences of this disease.
  - ◊ Covid-19 (Sars-Cov-2) has also been detected in white-tailed (and suspected in mule) deer studied in 4 states: Illinois, Michigan, New York, and Pennsylvania. 33% of samples collected from January 2020 through 2021 tested positive, though no deer is known to have shown clinical signs of the disease (APHIS 2021). This highlights the potential for disease "spillover" between humans and wildlife, especially as climate change increases conditions for disease spread, and human/wildlife interactions in the Wildland-Urban Interface (WUI).

- Fish diseases are driven by high water temperatures and low flows, which are projected to increase as climate changes. Highly relevant diseases for salmonids include:
  - ◊ Furunculosis (*Aeromonas salmonicida*), a water-borne bacterium contracted through scratches, lesions or the digestive system. This bacteria becomes toxic and eventually kills the fish. Outbreaks are driven by water temperatures over 60˚ F.

- ◊ Hexamita, a parasitic intestinal disease that predominantly affects salmonids. This illness doesn't cause high mortality but weakens the fish and reduces its ability to grow.
- ◊ Ich (*Ichthyophthirius multifiliis*), a fish parasite that proliferates in water exceeding 60-65˚ F. This parasite can cause high mortality if present at enough density in the environment. In 2021, CTUIR experienced issues with Ich: temperatures associated with the May-June heat dome exposed Spring Chinook hatchery broodstock to river temperatures exceeding 65˚F. Overall, the parasite caused 13% loss (an 8.5% increase over the typical 4.5% loss) of CTUIR hatchery brood.
- ◊ Ceratonova (*Ceratomyxa shasta*), a myxozoan parasite that infects fish intestines, and was widespread in salmonids throughout the Columbia River Basin in 2021.
- ◊ Columnaris disease (*Flavobacterium columnare*), a bacteria which thrives in high water temperature and low flow conditions that stress fish and occurred in 2021.

- Less relevant diseases affecting salmonids include Infectious Salmon Anemia Virus (ISAV) and Infectious hematopoietic necrosis virus (IHNV), which is highly contagious, highly fatal, and not treatable. Screening of hatchery fish in the Columbia River Basin indicates very low prevalence of IHNV in recent years.
- For Pacific Lamprey (*Entosphenus tridentatus*), Furunculosis (*Aeromonas salmonicida*) is a widespread pathogenic bacteria throughout the Columbia River basin. It causes organ damage and sepsis in fish, and is associated with hot water temperatures, poor water quality, and crowding. Salmon Kidney Disease (*Renibacterium salmoninarum*) is another infectious bacteria detected in the basin, though to a much lesser extent.

Combined threats of climate change and land use are likely to shift distributions and virulence of existing pathogens, and increases potential for new pathogens to be introduced. Impacts to vegetation and water temperature also become relevant, as forage and water quality play a large role in animal health.

<u>Gaps in Knowledge/Data/Policy:</u>

- How wild and domestic species interactions are likely to be altered; which wild/domestic spillovers exist at high concerns;
- Human influence on environmental change and how it impacts disease dynamics. This includes distribution of domestic and invasive species;
- How animal immunity and plant defenses respond at different time and distribution scales;
- How natural and restored ecosystem disturbance like low intensity fire may affect these pathogen and host relationships.

Fish species, particularly those raised in artificial conditions such as CTUIR hatchery population supplementation programs, are at risk from pathogens that thrive in warm water conditions.

A. Anticipate Habitat Shift and Migration

i. Map and Model Potential New Habitat Ranges

"Many ecological processes operate at scales beyond any particular site (e.g. wildfires, seasonal migration of elk, invasive species). Therefore, understanding and incorporating landscape context and connections between and among areas may be critical to successful stewardships at a local site. Engaging and when possible developing a shared vision for ecosystem and landscape attributes that support First Foods production should increase management and restoration success (First Foods Upland Vision, 2019)."

Predictive modeling efforts to anticipate First Foods habitat shifts and the effect of fragmentation will require data to develop.

Short Term

- **Identify information gaps and develop additional data sets** and monitoring protocols to fill these information gaps. This can provide data to inform GIS models that aim to track changes in species distribution.

- **Develop climate projection models for plant and wildlife First Foods migration** to predict where new harvest and habitat locations they shift. These can inform the building and strengthening of partnerships in locations where First Foods are likely to find suitable habitat and provide harvest opportunities. USFS maybe have some initial research information, and be good partners in future activities.

- **Coordinate engagement with citizen and Tribal community scientist opportunities,** both within CTUIR and with external partners and networks. Many community-led research initiatives exist for various plant and animal species. Examples include:
  - ◊ Species-specific initiatives like Oregon Bee Project (https://www.oregonbeeproject.org/); Pacific Northwest Bumblebee Atlas (https://www.pnwbumblebeeatlas.org/), and others.
  - ◊ Observation Reporting initiatives on social media and other platforms, like the Local Environmental Observer (LEO) Network (https://www.leonetwork.org/) and others.

Rotary fish traps like this one on the Umatilla River temporarily trap fish to be counted before being released, as part of CTUIR project monitoring and effectiveness evaluation. This kind of data collection also informs harvest regulation and management actions.

Long Term

- **Cultivate legally defensible data and modeling for First Foods migration** that can be used to inform long term management strategies, provide justification for capital investment and securing funds, and is admissible as evidence for regulatory and legal actions.

ii. Strengthen or Build Partnerships in Potential New Habitat Ranges

Since land use and climate change impacts are inseparable, working with new and existing partners in land management will be necessary to promote the stewardship of First Foods.

Short Term

- **Actively cultivate new partnerships with an expansion of land managers and conservation/restoration opportunities** to maintain First Food harvest migration to new suitable habitat

Ranges. Existing partnerships include organizations like Blue Mountain Land Trust; federal land managers within USFS; private land and home owners with an interest in native plant restoration; corporate entities such as Amazon Inc. that are responsible for providing project mitigation funds; and others.

Long Term

- **Proactively cultivate relationships** that facilitate continued and expanded opportunities for the exercise of Treaty Rights. These include agreements, easements, and cooperative partnerships with land cooperatives and trusts, federal land managers within USFS, BLM, BOR and others, private land and home owners within the WUI, and with commercial and industrial interests that manage affected lands.

B. Invasive & Displaced Species Management and Monitoring

i. Of Aquatic Invasive & Displaced Species

"Likewise, the native riparian vegetation community is adapted to patterns of floodplain inundation (Rood et al. 2005). Inundation events scour floodplain soils, influence the germination of seedlings, and carry large wood into the river channel. Prevention of such events, then, may favor introduced or even nonriparian species over native riparian species. (Umatilla River Vision, 2011)."

Cold, clear water throughout the seasons is essential for native aquatic species to thrive. When stream temperatures become hotter, conditions benefit aquatic invasive plants, invertebrates, and animals that encroach and threaten First Foods in various ways.

Short Term:

- **Coordinate with other water and conservation management agencies** involved with plant and invertebrate invasive species. Regional coordination of monitoring and management support of species sighting and eradication efforts. Tribal fishermen should be at the forefront of this work, and is likely to include the mosquito control districts, county watershed councils, state and federal agencies like Fish and Wildlife services, and community interest groups such as water recreationalists, anglers and fishermen, bird appreciation societies, and boaters, among others.

- **Expand and support public engagement and reporting** of aquatic invasive species through improved awareness, identification and sighting knowledge, and interactive reporting tools to improve mapping and knowledge. DNR Fisheries and organizations like Columbia River InterTribal Fish Commission (CRITFC) already conduct outreach to Tribal fishermen, and would be excellent partners with which to coordinate.

- **Pursue funding to support DNR Fisheries staff capacity in reporting aquatic invasive species**. Tribal staff routinely manage specific locations year after year, and many of these sites are visited daily. Protocols for sighting invasive species should be developed, as well as support with staff and AWP objectives, and in equipment like GPS to conduct mapping to determine trends.

Long Term:

- **Maintain cool, clean water** as much as possible (see "Umatilla River Vision" for details on Touchstones and strategies).

- **Determine appropriate management actions for other displaced native and non-invasive species that impact salmonid survival**, like pelicans (*Pelecanus erythrorhynchos*), terns (*Hydroprogne caspia*), gulls (*Larus spp.),* and sea lions (*Eumetopias jubatus*). DNR Fisheries staff are currently working on a proposal

for an avian predation study in the Umatilla River Basin for 2023. Sea lions and avian predators have both been concerns for management for some time, and are likely to continue to have an impact.

- **Species of Concern** include (but are not limited to): plant species like riparian tuber grasses (Yellow Flag Iris, Water hyacinth), and invertebrates like Asian Clams (*Corbicula fluminea*) and Zebra Mussels (*Dreissena polymorpha*). Although not classified as invasive, non-native species such smallmouth bass, largemouth bass, and walleye are piscivorous species that have impacts on salmonids, and large populations of American shad introduced the Columbia River system as well.

Invasive species like Himalayan Blackberry (pictured top left) grow in riparian and upland places. Many species can exacerbate drought effects and create access barriers to reach harvest locations.

ii. Of Terrestrial Invasive & Displaced Species

"Forage production can also be impacted by the invasion of dry forest understories by non-native species, the majority of which are unpalatable and/or have less nutritive quality than native species. Annual bromes (cheatgrass), medusahead, and ventenata all readily invade dry conifer forest reducing forage quality and quantity (First Foods Upland Vision, 2019)."

Terrestrial invasive species are closely linked to agricultural, forestry, and recreational alterations of the land. Disturbance of soils and functioning ecosystems allows invasive species to take hold. Changes to hotter climatic conditions tend to benefit these invasives over native species.

Short Term:

- **Coordinate with other land and conservation management agencies** involved with plant and invertebrate invasive species. Regional coordination of monitoring and management in support of species sighting and eradication efforts is likely to include weed control boards, county conservation districts, state and federal agencies like Natural Resources Conservation Services, and community interest groups like recreational trail restoration and native plant appreciation societies.

- **Expand and support public engagement and reporting** of invasive species through improved awareness, identification and sighting knowledge, and with interactive reporting tools to improve mapping and knowledge. DNR Range, Agriculture, and Forestry (RAF) Program currently provides outreach to communities about noxious weeds of concern, and would be excellent partners with which to coordinate future initiatives.

- **Consider supporting and cultivating so-called "Invasi-vore" gathering and foraging groups** to be aware and active within CTUIR traditional use lands. Community gathering groups that focus on harvesting invasive species can help non-Tribal recreators reconnect with the land in ways that preserves Tribal Member access to First Foods and culturally significant species. Examples of people trailblazing this approach include social media platforms like:

  ◊ Tribal ethnobotanist Linda Black Elk (https://www.instagram.com/linda.black.elk/);
  ◊ Invasive species fermenter Pascal Baudar (https://www.instagram.com/pascalbaudar/);
  ◊ Urban and wildcraft forager Alexis Nikole (https://www.instagram.com/blackforager/).

Long Term:

- **Maintain soil stability and structure** that supports First Foods (see "First Foods Uplands Vision" for touchstones and strategies).

- **Develop a methodology to inventory risk vectors for relevant invasive species**. This methodology could be used to assess disturbances on changing distributions of invasive species. Data collected could help determine effectiveness of management actions on specific species of concern, (ex: which species respond positively or negatively to controlled burning, etc) and future decision-making.

- **Species of note** include plants listed in the CTUIR Invasive Weed Management Plan:
  - ◊ Annual forbs like Giant/Japanese/ Bohemian knotweeds, garlic mustard, leafy spurge, sulfur cinquefoil, Scotch broom, and purple starthistle.
  - ◊ Grasses and grassland species like rush skeletonweed, common crupina, bulbous bluegrass, Russian thistle, Medusahead Rye, Ventenata, kochia, and bromes like Cheatgrass.
  - ◊ Understory shrubs like Sweet Briar and Multiflora Rose, Himalayan blackberry, Russian olive, and saltcedar.
  - ◊ Insects like grasshoppers and Mormon crickets, Western Pine Beetle, Mountain Pine Beetle, Pine Engraver, Tussock Moth, and Western Spruce Budworm.

- **Continue to implement the CTUIR Forest Management Plan (2010) and the forthcoming Range Management Plan (expected 2022)** on relevant CTUIR lands, and provide these documents to other land management entities for collaboration as appropriate.

C. Proactively Address Wildfire Risk

i. Support and Expand Prescribed and Cultural Burning

"Fire suppression, which began in the early 1900's resulted in increased stand density, fuel loads, and the abundance of fire intolerant species (e.g. grand fir) within forest stands. As a result, fire regimes have changed from predominantly small, frequent, low-severity fires, to large, infrequent, high severity fires. This alters soil attributes as increased fire severity reduces nutrients (especially nitrogen), organic matter, and soil microorganisms. Increased severity also increases injury and mortality rates of plants, whose roots help stabilize soil and prevent erosion (First Foods Uplands Vision, 2019)."

Benefits of returning these low intensity burns to conifer forests in the CTUIR Ceded and traditional use lands will reduce wildfire risk through vegetation fuels management, and increase the success and harvest opportunities of First Foods.

Short Term:

- **Continue to coordinate with other grassland and forest management agencies** on opportunities to conduct prescribed and cultural burning implementation as appropriate; these include: Bureau of Indian Affairs (BIA) Fire Operations, Oregon Department of Forestry (ODF) and US Forest Service (USFS), as well as CTUIR's DNR Range, Agriculture, and Forestry (RAF) Program.

- **Support and expand Tribal-led capacity to implement intentional burn pre-treatment management activities** like selective thinning for CTUIR forest management areas (see Forest Management Plan for detail). This may include grant and program

funding for CTUIR DNR and BIA Umatilla Agency, as well as support for Tribal entrepreneurs and volunteer community members to access and participate in trainings and opportunities. See Ch 3F pages 227-229 for additional detail.

- **Inventory opportunities and implementation needs for intentional burning on the UIR and CTUIR Ceded lands**, including across different land ownerships. An inventory could also include an assessment of barriers that operators and land managers face in meeting requirements to implement intentional burning treatments.

- **Consider organizing and hosting a Prescribed Fire Training Exchange (TREX)** and continue to participate with these trainings as they are held in other locations. TREX programs emphasize interagency collaboration and have been held with host Tribes in the Pacific Northwest in recent years (http://waprescribedfire.org/trex).

Prescribed burn crews with the Umatilla Agency Fire Operations conduct a helicopter ignition of a prescribed burn at Stage Gulch on the Umatilla Indian Reservation (UIR).

Long Term:

- **Advocate for cultural and prescribed burn strategies** in state, national, and international land management policy. This could include assessing communities for barriers that have slowed implementation, and opportunities for collaboration.

- **Support program and capacity need for data collection and information gathering equipment** that can support safety and organizational decision making for intentional burn activities. First Foods Policy Program (FFPP) and RAF Program collaborated to provide a Remote Automated Weather Station (RAWS) to the BIA Umatilla Agency Fire Operations program to improve "go/no go" decision-making for prescribed burns, as part of a Meyer Memorial Trust grant.

- **Connect with other Indigenous communities in this work,** especially those with functional partnerships with land management government agencies and organizations. Tribes like Yurok, Karuk, Hoopa, and Klamath River Tribes in Northern California and Southern Oregon have been working with US Forest Service to conduct intentional burn research and implementation led by Indigenous knowledge, as well as the Cultural Fire Management Council (https://www.culturalfire.org/) and others.

ii. Develop Education and Engagement Preparedness for Homes and Families

"Fire and other disturbances (e.g. bark beetle outbreaks) are also fundamental components of healthy, properly functioning moist conifer forests. Therefore, in order to support First Foods production, the goal is not to eliminate disturbance events but rather to ensure that disturbance events and regimes remain within the natural range of variation, and that ecological systems are capable of recovering touchstone attributes following disturbance (First Foods Uplands Vision, 2019)."

Proactive and intentional fire is necessary to reduce wildfire risk, and education about the beneficial role of fire may be necessary for collective acceptance.

Short Term:

- **Support and expand education and preparedness initiatives** for landowners and families in the Wildland/Urban Interface (WUI) to encourage understanding and acceptance of utilization of prescribed fire. BIA Umatilla Agency currently provides some community education, and would be excellent partners with which to collaborate with on future initiatives.

Long Term:

- **Identify barriers that exist for popular implementation of intentional burns**. This could include policy barriers such as liability insurance, as well as physical barriers like electrical and communications infrastructure. Oregon State University (OSU) and University of Oregon have previously conducted mapping research on intentional burning potential and could be good partners in future research.

D. Species Migration Information and Practices

i. Conduct Community Planning and Listening Sessions around Facilitated Species Migration

"This responsibility is part of the reciprocal relationship that the CTUIR has with their traditional foods and an acknowledgement that the First Foods are not only important for health, but also for cultural identity. Gathering traditional plant foods is an activity that is inextricably linked with the ceremonial and ritual life of the CTUIR and is essential for continued cultural identity and sovereignty (First Foods Upland Vision, 2019)."

Tribal communities are not a monolith, and issues of First Foods migration can be very sensitive, especially around cultural and traditional knowledge.

Short Term:

- **Organize and host community listening sessions** on attitudes around intentional and facilitated migration of First Foods and other culturally significant species. Such events would attempt to synthesize and document the spectrum of feelings and perspectives within the CTUIR community around intentional and assisted species migration.

- **Develop site- or species-specific coordinated plans and protocols for First Foods** and culturally significant species, and/or associated habitat species, that will need to migrate. This is likely to involve mapping of existing habitat ranges, future projections using downscaled climate modeling, and ground-truthing of models to determine significant habitat and topographic characteristics. This effort is also likely to include species-specific research on micro-population differences that exist. DNR Cultural Resource Protection Program (CRPP) and the Tribal Native Plant Nursery (TNPN) would be excellent partners in these efforts.

Long Term:

- **Build and support stakeholder engagement in planning** to maximize opportunities to collaborate on facilitated migration. These could include agreements and easements with private landowners individually, and with collective organizations like Blue Mountain and Wallowa Land Trusts, as well as with government agencies and public land managers.

- **Identify data and information gaps that exist,** and develop data collection initiatives to respond to these gaps to provide additional relevant information. These initiatives should examine gaps and opportunities for both plant and wildlife First Foods species, as well as other

culturally relevant species and ecosystem connections.

ii. Develop and Implement Facilitated Migration Opportunities

"The ultimate goal of this First Foods-focused management approach is to ensure the sustainable stewardship of natural ecosystems within CTUIR Ceded lands. Using the long-term production and harvest of the full First Foods order as a benchmark for success helps ensure natural resource management and restoration priorities, plans, and actions support the continuity of Tribal cultural traditions, First Foods and the ecosystems in which they are found (First Foods Upland Vision, 2019)."

CTUIR Fisheries staff regularly undertake fish salvage activities using backpack electroshockers to stun fish to be relocated.

Protecting and preserving First Foods into an uncertain future means looking at new potential habitat locations as climatic suitability changes.

Short Term:

- **Conduct an assessment and inventory mapping project to identify new potential locations** appropriate for specific First Foods. This project would involve using accurate and updated climate projections for CTUIR's traditional use area to determine migration opportunities as they are expected to change through the century. One example is the potential for steelhead reintroduction to colder waters of McKay Creek above the McKay Dam and Reservoir.

- **Collaborate with community partners who are actively engaged with facilitated migration of First Foods**. There are many community members and groups that are taking this work on already; an example is the Indigenous stewardship nonprofit, Naknuwithlama Tiichamna (Caretakers of the Land), in Cove, Oregon, and would be excellent to collaborate with on these efforts.

Long Term:

- **Conduct research and protocol development** into site-specific First Foods species bio-plasticity (ability of species to change life cycling timing in response to environmental conditions) to determine if some species sub-populations are more resilient to change. This research is likely to involve many government and university partnerships to conduct.

- **Develop genetic materials sourcing capacity with DNR Fisheries Population Supplementation Program and the Tribal Native Plant Nursery**. Understanding genetically distinct micropopulations that exist within CTUIR's First Foods could help identify trends that might emerge as subpopulations of these species adapt (or fail to adapt) to changing conditions. Developing a program/project that – as much as is possible for recalcitrant (seeds unable to be dried for storage and require living genetic materials sources), and orthodox (seeds can be dried for storage without a living source) plant species with the TNPN, would be an excellent complement to existing DNR Fisheries genetic materials collection and propagation efforts.

E. Research and Regulatory Understanding for First Foods Harvest

"The First Foods-focused mission provides resource managers in the basin with a framework for involving Tribal Members in management dialogues. Within such a framework, monitoring and restoration efforts can concentrate on improving the ecological functionality of the Umatilla River, which ultimately sustains First Foods (Umatilla River Vision, 2011)."

While maintaining Tribal Member ability to exercise Treaty Rights, it is also important to have generations of Tribal community members understand their responsibility to these First Foods, practice sustainable harvesting techniques, and have respect for the land and water that support these relationships.

Short Term:

- **Expand awareness, appreciation, and knowledge of species like Pacific lamprey and Freshwater Mussels.** These species are incredibly resilient and will be essential in climate adaptation, though are currently underappreciated as important members of functioning ecosystems, as well as the cultural and ecosystems services they provide.

- **Organize and facilitate opportunities for the Tribal community to learn about Indigenous knowledge, sustainable First Foods harvesting practices** that don't harm long-term prosperity, identification of signs of illness or injury on plant and animal species, and other teachings from Indigenous knowledge keepers. Learning experiences are likely to prioritize CTUIR Tribal Members and community, but could also be accessible for non-Tribal audiences in appropriate.

Long Term:

- **Continue and support needs that allow for First Foods regulatory capacity and adaptive harvest monitoring**, particularly for species that experience other challenges like commercial harvest and pollution pressures. Coordination with other regulatory and monitoring organizations like the Columbia River Inter-Tribal Fish Commission (CRITFC) and the Inter-Tribal Bison Management group is likely to be necessary for setting and enforcing regional First Food harvesting limits, and for understanding how these species are adapting.

Wetland restoration and Wapato planting with Naknuwithlama Tiichamna (Caretakers of the Land) volunteers in Cove, Oregon (Feb 2021). These First Foods are being returned to these lands through Indigenous-led volunteer initiatives like this one, and have had varying success across the region.

Measuring Success and Gaps in First Foods Availability Adaptation

How Do We Measure the Success of These Adaptations?

"Our vision of sovereignty is much the same as it was before the coming of the Europeans – we want to preserve and protect our families, hunt and fish as we always have, and live in an environment that is relatively safe for all. We independently and collectively for the community to preserve our ways in the future. The key is that we want to do it ourselves (Johnson, 2006)."

- **First Foods Upland Vision Touchstones** (soil stability, hydrologic function, landscape pattern, and biotic integrity) and how it impacts First Foods availability.
- **Comprehensive Plan Objective 5.6.2:** To develop sustainable fish harvest opportunities throughout the usual and accustomed fishing stations (see Comp Plan page 81 for benchmarks);
- **Comprehensive Plan Objective 5.6.4:** To provide sustainable harvest opportunities for Big Game species of the First Food order by protecting, conserving, and restoring Big Game populations and their habitats (see Comp Plan page 81 for benchmarks);
- **Comprehensive Plan Objective 5.8.1:** Develop and implement policies and strategic plans to restore, protect and provide for the exercise of each 1855 Treaty-reserved Right – fishing, hunting, gathering, livestock pasturing and associated water rights (see Comp Plan page 81 for benchmarks);
- **Comprehensive Plan Objective 5.14.7:** Ensure all commercial and institutional properties on the reservation comply with the international fire code through the annual inspection process (see Comp Plan page 124 for benchmarks);
- **CTUIR Mission Community Plan (1993) Part D**: Tribal Services Element 2.1 Ensure effective fire prevention and suppression for high value and high hazard structures in the Mission Community.
- **CTUIR Water Code (2005) Section 1.05. Statement of Policy K:** Provide Water For Fish And Wildlife Resources. The fish and wildlife populations and traditional plants of the Reservation are important subsistence, cultural, and recreational resources, and as such, in managing water resources, the Confederated Tribes shall allocate water and provide sufficient water quality for the protection and conservation of these resources;
- **CTUIR Water Code (2005) Section 1.05. Statement of Policy L:** Provide Water for Wetland Resources. Wetlands provide critical habitat for fish and wildlife populations, traditional plants, and other natural resources of the Reservation;
- **CTUIR Water Code (2005) Section 1.05. Statement of Policy M:** Protection of Stream Flows. Streams are an integral and vital element of the culture of the Confederated Tribes.
- **CTUIR Hazard Mitigation Plan (2021) Section 3**: Hazard Identification and Risk Assessment Results (page 68-190).
- **CTUIR Hazard Mitigation Plan (2021) Section 4:** Hazard Mitigation Strategy (page 192-212)
- DNR Annual work plans and activities.
- CTUIR Fish and Wildlife Commission annual reports
- Anticipate flood, drought, and air quality impacts on First Foods.

What Gaps in Knowledge, Policy, Capacity, or Education Exist?

- Detailed understanding and projections of Big Game forage and vegetation changes;
- Disease and pathogen changes for important plant, animal, and habitat species;
- Sufficient understanding of migration patterns of wildlife of high priority;
- Compounding effects of heat and drought on water quality and quantity for aquatic species.

Climate Impacts for First Foods Access

"Privatization of land and agricultural development beyond reservation boundaries have also further reduced the CTUIR's ability to access its traditional foods. Today, just 24% of the Ceded territory are public lands where Tribal Members can exercise their Treaty Rights.

While the CTUIR's Treaty guarantees the Right of access, there is no guarantee that the Tribe's First Foods and other culturally important resources will be present for them to harvest. Moreover, because the goals of state and federal land management agencies do not explicitly include management or stewardship for First Foods, it is the responsibility of the CTUIR to speak on behalf of the First Foods and engage public lands managers (First Foods Upland Vision, 2019)."

Many effects of climate change will threaten not only the abundance of First Foods, but also how readily they can be accessed. Access barriers can be tangible impacts, such as flooding that damages roadways necessary to access public lands, as well as intangible, like heavy smoke inundation events that create poor air quality conditions over large areas. These impacts reduce how easily Tribal Members and families are able to reach known and new locations for First Foods harvest.

"To Tribes all over the land, the earth was their Mother, wise and loving in her care for her children. Our love, therefore, is a kind of mystical devotion, for this wise Mother has cradled our race since the beginning of time.

~ Maudie C. Antoine, CTUIR BOT Chair (1955)

8. Seasonal Flooding Magnitude

Precipitation will become unpredictable, and heavy rainfall causes flooding that can devastate roadways necessary to access First Foods.

Higher elevations are likely to experience an increase of 20-30%; greatest impact will be to the Eagle Cap Wilderness and Hells Canyon area, which will see 30% and greater increase (Clifton USFS, 2018) as seen in Figure 3B.8 (page 93).

9. Increased Frequency & Severity of Wildfire Risk

Land management and climate impacts increase the possibility of experiencing a catastrophic wildfire.

2-3 times increase in risk along the Columbia River, with the Blue Mountains likely to experience 6 times greater risk of fire for a 1˚C (1.8˚F) increase (USFS, 2017) as shown in Figure 3B.9 (page 94).

10. Poor Air Quality over Large Areas

With conditions for wildfire increasing, smoke from near and distant fires will create poor air quality conditions that restrict the ability for Tribal Members to safely exercise Treaty Rights.

7.6% per day increase in exposure to particle pollution during smoke events if outdoors without respiratory protection (Henderson et al 2005)**.** This can be calculated to be **15-45% increase in smoke exposure potential during future fire seasons,** as seen in Figure 3B.10 (page 95).

8. Seasonal Flooding Magnitude

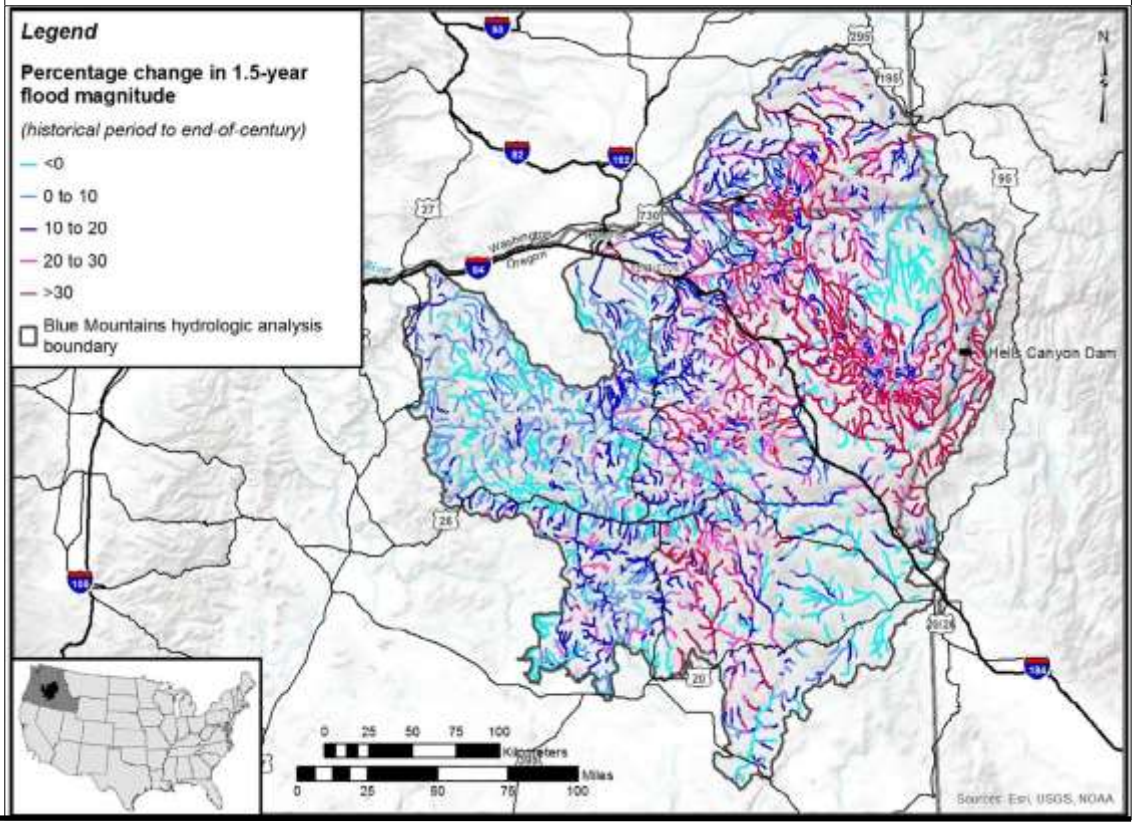
"Streams that pass through moist conifer forests are often important for Salmonids (spawning and rearing), lamprey and associated species, and land management and disturbance events can remove vegetation and group cover, exposing soil and increasing soil erosion, overland flow, and subsequent sedimentation of streams and rivers beyond natural ranges. This can affect stream habitat and water quality, so management should include considerations to ensure the maintenance and functioning of soil stability, hydrologic function, and other touchstones (First Foods Upland Vision, 2019)." As hydrologic regimes shift to rain-dominant systems, winter season flooding issues are likely to increase.

Figure 3B.8 is a visual representation of the changes in seasonal flooding likely to occur for the Blue Mountain region by the end-of-century. Colored lines show various streams with in this region, and the magnitude of predicted changes in flooding.

- Pale blue lines indicate streams that will see changes of 10% or less, while dark blue lines show an increase of 10-20%. Pale purple lines show streams that will see a 20-30% increase, and dark purple indicates watersheds that will experience greater than 30% increase in flooding (Clifton et al, 2018).
- **Moderate change of 10-20% increase is expected at low elevation watersheds** like the confluence of the Umatilla River and Butter and Sand Hollow Creeks in Morrow County, at the southwestern foot of the Blue Mountains. This is likely because these streams systems have historically been rain-fed and will continue to be so in the future.
- **Higher elevations are likely to experience a much larger change of 20-30% increase**, as locations like the **Wenaha-Tucannon Wilderness, and the Elkhorn Mountain range** will experience greater melting of snow pack from warming winters.
- **Greatest impact will be to the Eagle Cap Wilderness and Hells Canyon area, which will see over 30% change in flooding.**

Floods can destroy roads and create emergency conditions that threaten Tribal family safety, ability to exercise Treaty Rights, and has the potential to reduce First Foods access. But flooding is also an essential event in healthy functioning ecosystems, and creates opportunities for water infiltration into aquifers. Built infrastructure in the floodplain is threatened by flooding, and reactive strategies for flood management often make the problem worse by channelizing rivers and reducing infiltration opportunities through dikes and levees.

Figure 3B.8: Percentage Change in Flooding Magnitude by 2080



Expanding natural stream meander, including woody debris and vegetation, improving channel connectivity, and reconnecting floodplains to their rivers is an effective way to mitigate for flooding upstream of immovable build infrastructure such as towns and dams, and mitigate for reduction in access to First Foods harvest caused by flooding. Utilizing touchstones found in the Umatilla River Vision can help water and resource managers reconnect floodplains for adaptation.

(Credit: Clifton et al, 2018)

Figure 3B.9: Projections of Increase in Wildfire Due to 1˚C Temperature Increase

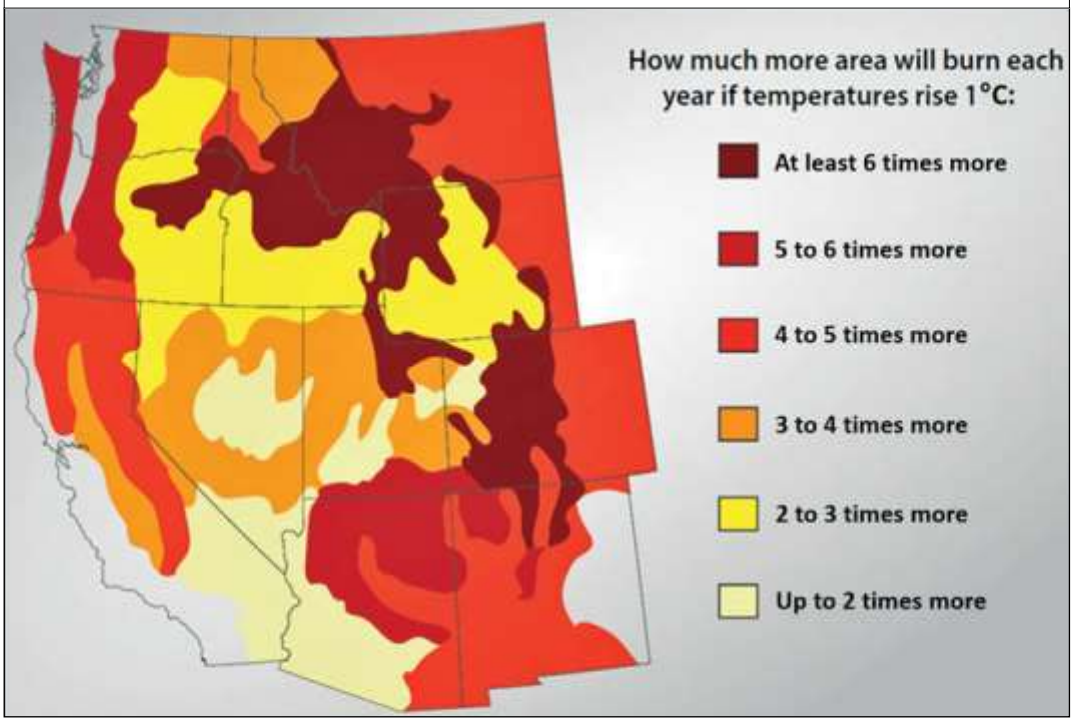


Figure 3B.9 is a projection of increases in wildfire risk in the Western United States for 1˚C (1.8 ˚F) of heating in global temperatures.

- Colored regions demonstrate severity of wildfire risk increase: yellows and oranges indicate 2-4 times increase in area burned; red colors show 4-6 times increase; and darkest red indicates where lands are at least 6 times more likely to be at risk of fire.
- While the scale of this map makes it difficult to estimate for specific CTUIR Ceded and traditional use lands, projections anticipate **2-3 times increase in fire risk along the Columbia River, with the Blue Mountains likely to experience 6 times greater risk of fire.**

Gaps in Knowledge/Data/Policy:

- How floodplains are projected to expand in specific watersheds due to flood magnitude;
- Capacity of Federal assistance programs that fund acquisition of riparian properties impacted by flooding.

9. Increased Frequency and Severity of Wildfire Risk

"Prior to Euro-American settlement, it is thought the historic fire regime primarily consisted of small, high intensity fires at an interval of 30-80 years, which created a heterogeneous landscape with patches of shrub-steppe dominated by different species and in various stages of recovery. As fire return intervals have shortened and the size of fires increased, structural and species complexity of shrub-step has been simplified and large areas are dominated by non-native invasive grass and forb species affecting biotic integrity of the system (First Foods Upland Vision, 2019)."

Several feedback mechanisms interact with a naturally fire-prone landscape to increase the risk of catastrophic wildfire occurrence as a result of climate change.

Tribal people in the West have carried out traditional burning to reduce vegetation fuels on forest floors, release nutrients back into the soil, and cull small "sucker" trees that crowd healthier ones and reduce soil moisture. Returning cultural burns to the landscape could help reduce the risk of wildfire, though there are complicating factors like human development in the Wildland/Urban Interface (WUI) that adds complexity to this issue. Smoke also reduces visibility for traveling, and creates dangerous conditions on roads and rivers when vehicles and vessels aren't able to see clearly.

(Credit: Halofsky 2017, Ojima et al. 2014)

Gaps in Knowledge/Data/Policy:

- Fine detail knowledge on how fire conditions are likely to change in eastern Oregon and Washington;
- How insect and pathogen activity will affect tree establishment and survival, and thus fire activity;
- How landscapes and ecosystems may be altered due to changing habitat suitability and species migration.

10. Poor Air Quality over Large Areas

Harvesting and perpetuating First Foods is a deep and essential connection for Tribal people, and many who are dedicated to exercising Treaty Rights are willing to do so in all kinds of inclement conditions. As conditions for wildfire increase, frequency of heavy smoke from fires burning throughout the western U.S. is likely to inundate CTUIR traditional use lands from fires near and far.

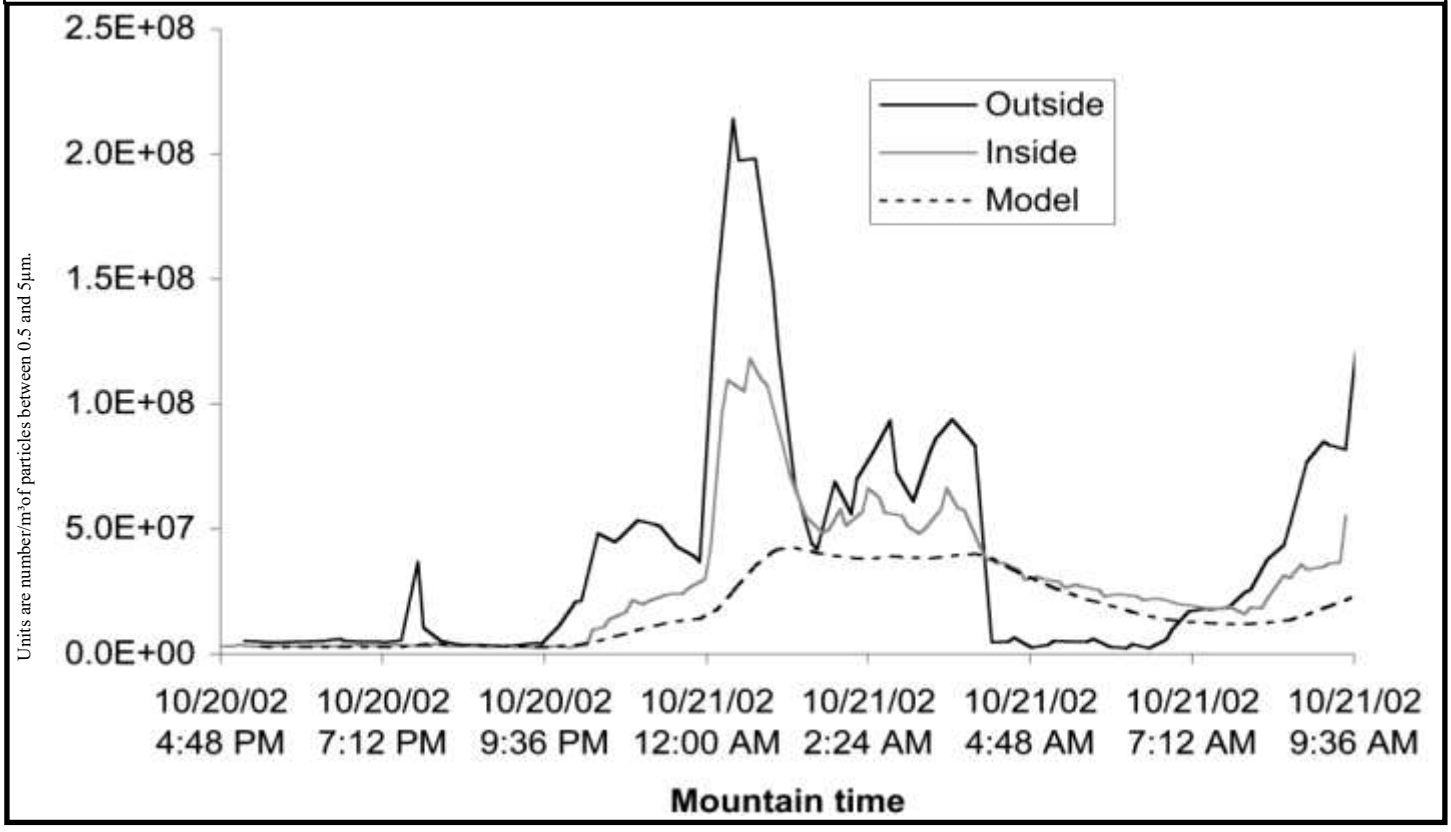
Exposure to chronic smoke can cause respiratory issues in healthy people, and worsen existing respiratory issues like asthma and chronic pulmonary obstructive disorder (COPD).

Smoke can also increase complications from existing medical conditions such as cardiac illness, high blood pressure, and diabetes. Because of this, wildfire smoke creates a barrier for Tribal Members to access Treaty Rights and First Foods harvest opportunities. Particulate Matter of 2.5 μm (PM2.5) is a particle size that makes up most wildfire smoke, and is able to pass the blood barrier in the lungs in humans and other organisms and can affect the ease of which blood is moved by the circulatory system around the body.

Figure 3B.10 is a real-time measure of smoke pollution from a large wildfire in Colorado, charting the levels of PM 2.5 μm present in the air during a controlled burn. Particle pollution from wildfire is measured in outside conditions (solid line), at specific indoor location near the burn (gray line), and compared to an atmospheric model of indoor air quality for the scenario (hashed line).

- Over the course of a 12-hour period, smoke inundation changes for all three were measured as wind speed, precipitation, and air temperature affect the density of these harmful particles.
- Most dense inundation of smoke occurred at night

Figure 3B.10: Filtered and Unfiltered Conditions of Particle Pollution from Wildfire Smoke



Umatilla Agency BIA Fire Operations control helicopter patrols an aerial ignition prescribed burn over Stage Gulch in October 2021

(10 PM to 4 AM in this instance) for all measures. This peak is higher for outdoor conditions, though there is also a corresponding increase in indoor air pollution during this time as well. As shown, sheltering indoors reduces the levels of particle pollution exposure at times, but there were periods where outdoor air is measured as cleaner than indoor air (between 4 and 7 AM).

- Within this house **without** air cleaning equipment operating, PM2.5 was 6.4 times higher during the prescribed burn compared with a non-burn event, and was much higher than was predicted by indoor air quality model for smoke events estimated. This shows that **being outside during smoke events expose a person to an estimated 15 µg/m³ of particle pollution in a 12-hour period**, for a home that does not operate air cleaners during these events. This corresponds to a 30 µg/m³ exposure on average over the course of a 24 hour day.
- This represents **a 7.6% increase per day in exposure to particle pollution during smoke events when Tribal Members are out exercising Treaty Rights without respiratory protection** (Henderson et al, 2005). As risk of wildfire increases 2-6 times by 2100 (USFS, 2017), this exposes Tribal Members exercising Treaty Rights to **15-45% increase in smoke exposure potential** during future fire seasons.

While this study compared smoke from a controlled burn rather than a wildfire, this proxy estimate gives us a conservative estimate for the particle pollution exposure for people outside during smoke inundation events. As smoke events become the new seasonal normal, it will be impossible for Tribal Members to continue their exercise of Treaty Rights and connection to First Foods without encountering some level of smoke exposure.

Non-Tribal public health entities often issue "shelter-in-place" orders during these events, but with the frequency of large wildfires increasing, these events are likely to coincide with First Foods harvest opportunities, forcing Tribal Members to make choices to prioritize either health or cultural connection. Adaptation measures that focus on reducing poor air quality burdens for Tribal Members both inside and outside, and increasing awareness of the importance of air quality will hopefully mitigate harm from smoke pollution.

Priority should be given to strategies that facilitate safety during Treaty Rights exercise — like respirator give-aways, that preserve connection to First Foods — with additional strategies aimed at improving decision-making around air quality, and improving home indoor air.

(Credit: Henderson et al 2005)

<u>Gaps in Knowledge/Data/Policy:</u>

- Atmospheric seasonal patterns are increasingly variable, and are likely to be a source of uncertain for fire and smoke impacts;
- Seasonal variability is likely to create big differences in severity of fire season year after year, though smoky conditions should be expected at any point during summer and fall seasons.

F. Anticipate Health Impacts for Tribal Harvesters

"Some hazards can almost be expected to occur. In eastern Oregon, cold winters and hot, dry summer months are normal conditions. Because these conditions exist every year, the possibility of a winter storm, a thunder storm or fog occurring is much greater than an earthquake or a volcano. These types of hazards are "chronic" hazards as they occur with some regularity and can sometimes be predicted through historic evidence and scientific methods. (CTUIR Hazard Mitigation Plan 2016)."

Exercise of Treaty Rights for Tribal Members is essential, and is a climate adaptation itself. Reducing impacts that challenge those opportunities are priority for mitigating threats to health while maintaining cultural connection.

i. Plan for Poor Air Quality Events During Harvest Seasons

Shelter-in-place orders for poor air quality events are highly likely to be a frequent seasonal occurrence. It is unrealistic and unjust to expect Tribal Members to forego Treaty Rights opportunities during these times, thus adaptation measures need to be in place to preserve capability for First Foods harvest as much as possible. For more information see Chapter 3D: Human Health and Happiness, page 157-158 for additional detail.

Short Term:

- **Fund and implement opportunities to provide personal protective equipment to Tribal community, staff, and others** to reduce impacts to health while out on the lands. This could include (but is not limited to): access to P100 respirators, N95 masks, and other equipment that preserve mobility and filters particulate matter. Emphasis should be placed on those with pre-existing health issues, Tribal harvesters, and those who work and/or live outdoors.

- **Fund and implement opportunities to improve indoor air quality of homes and facilities on the UIR through expanded use of air purifiers**, including (but not limited to): pre-manufactured models, and do-it-yourself fan and filter constructions, as well as other technologies as they become available.

- **Fund and develop Tribal government capacity for a dedicated Air Resource Advisor position,** either within CTUIR or BIA Fire Operations employment structures. This position would support expanded analysis of air quality impacts to wildfire controlled and prescribed burning implementation, and would work with DNR's Air Quality program to provide relevant outreach and information sharing with the Tribal community.

Long Term:

- **Expand access to personal protective and air filtration equipment** for community members through grants and advocacy. Many funding sources provide for planning exercises, but few include equipment in allowable costs. Advocating for funding and other frameworks to include bulk equipment purchases will expand capacity.

- **Improve understanding and decision-making** around air quality for the Tribal community through education and outreach. Understanding atmospheric science basics like ventilation and patterns of air movement, as well as the effect of varying exposures to air pollution can help families make decisions that protect health, cultural and community

connection, and empower families to plan to mitigate for quality of life impacts from smoke.

- **Prioritize vulnerable groups and invite them to be a the forefront of strategies and implementation.** Elders and children are at risk due to their health and activity levels, and young mothers who are pregnant or nursing are also susceptible due to infant development. Those who lack access to reliable and safe shelter are also at greater risk of exposure. Engaging these groups in planning for seasonal exposure will help protect those who are most at risk. See Ch 3D pages 157-159 for additional detail.

ii. Plan for Extreme Heat, Harmful Algal Blooms, and Additional Insect Vectors

Extreme heat, water-borne illness, and insect threats like mosquitos and ticks are impacts that reduce safe access and create health challenges for the exercise of Treaty Rights. See Ch 3D: Human Health and Happiness pages 157-158 for additional information.

Short Term:

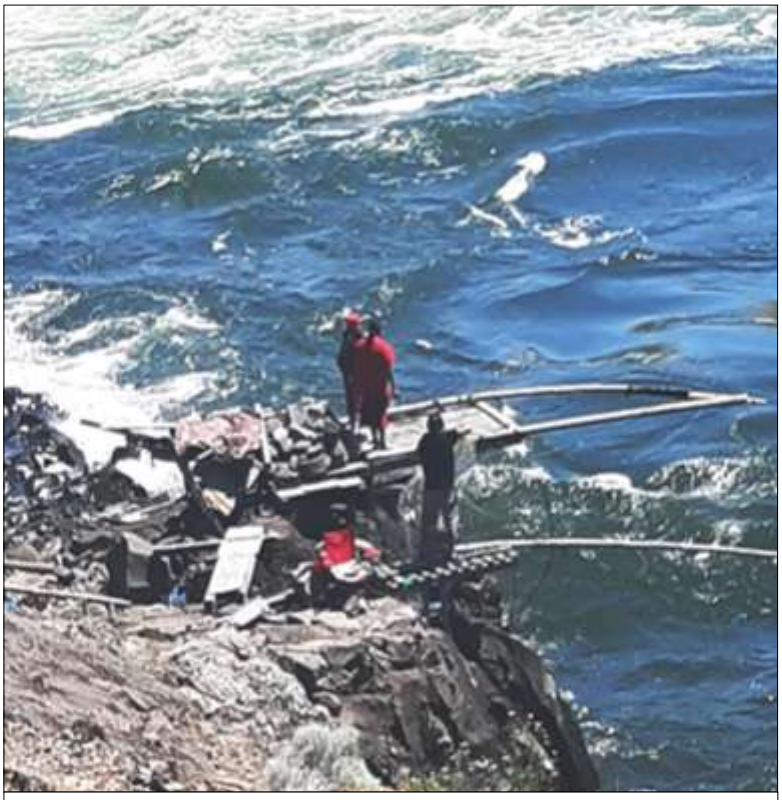
- **Support and expand health education and first aid skills** necessary to identify and treat heat-related illnesses. Informational outreach on heat related illness and how to respond accordingly has been conducted as short media posts and as part of other first responder training, but opportunities that involve scenario and response practice that is broadly accessible could help reduce incidences of heat exposure and illness.

- **Support and expand health education and first aid skills** necessary to identify and treat insect vectored illnesses. This includes outreach about mitigating for exposure to mosquitoes and ticks, awareness of signs and symptoms of insect-vectored illness documented or suspected in the region like Lyme Disease, West Nile, and Zika Viruses, and knowledge of how and where to have diagnostic tests and treatments performed.

- **Support and expand health education and first aid skills** necessary to identify and treat toxin exposure from harmful algal blooms (HABs). This should include awareness of health issues associated with HABs for humans and animals, knowledge of how to identify when algal blooms may be toxic, understanding of land and resource management issues that drive the formation of unusual algae growth, and steps to respond to and mitigate for illness and injury caused by contact with HABs.

Long Term:

- **Develop and expand disease identification and monitoring tools regionally**, and collaborate with other public health agencies on data collection/sharing and response. Building capacity to test and treat locally for affected diseases, as well as providing community outreach and support for awareness and decision-making, will improve community response to existing and emerging climate-driven illnesses.



Tribal fishermen on the Columbia River are an example of Tribal Members who experience impacts from seasonal smoke, extreme heat, and harmful algal bloom exposures.

G. Engage in Policy and Agency Land Management Discussions

"Upland ecosystems within CTUIR Ceded lands are owned and managed by a diverse mix of individuals, communities, government and Tribal agencies. Many critical ecological processes necessary for the sustained production of First Foods cross ownership and management boundaries, and some managers may be unaware of the importance of First Foods to CTUIR culture or their goals do not explicitly include stewardship of First Foods. Therefore, achieving the goal of sustained production of First Foods by natural ecosystems and the ability of Tribal members to harvest requires communication and close collaboration across land ownership and management boundaries (First Foods Upland Vision, 2019)." Tribes are often not in direct control of the lands that support First Foods, and so coordinating with other management agencies is required to promote Tribal stewardship approaches.

i. Advocate for Proactive Wildfire Management within State/Federal Agencies

Many land management agencies are still operating on wildfire suppression policies, and while the acceptance of prescribed fire as a proactive risk reduction tool is gaining popularity, it still lags behind what is required. Implementation of prescribed fire in many places is driven not by Treaty Rights and Indigenous knowledge, but by commodification of this process.

Short Term:

- **Continue to participate in co-management opportunities for forested lands in Ceded and traditional use areas**. CTUIR has existing coordination with other forest management agencies, particularly between the DNR Range, Agriculture, and Forestry (RAF) Program, BIA Umatilla Agency Fire Operations staff, and partners with the US Forest Service (USFS) and Oregon Department of Forestry (ODF) through co-management and Good Neighbor Authority agreements.

Long Term:

- **Expand Tribal businesses, enterprises and community groups to organize opportunities to implement prescribed and cultural burning** in a way that re-connects Tribal Members with the land, and benefits them economically. Yurok Tribe in Northern California provides a good example of Tribes working with a range of entities to return cultural burning to public lands. Support from non-governmental fire users could have a role in expanding and implementing intentional burns. See Ch 3F pages 227-229 and 249 for additional detail.

- **Advocate for capacity to implement prescribed and cultural burning** in legislative action at state and national levels. This may include advocating for funding to Tribes to compact fire services within Tribal government structures, supporting opportunities to provide training for intentional burning, expanding mechanisms that facilitate Tribal management of public lands, and improving insurance mechanisms that protect landowners who want to work with Tribes to conduct intentional burns.

ii. Expand Opportunities for Treaty Rights Exercise and Understanding

Cultural connection should be at the forefront of climate adaptation, and wildfire risk management is an opportunity for expanding culturally-significant land management practices.

Short Term:

- **Develop CTUIR community-led plans for identifying new First Foods harvest locations**, for facilitated migration of important species, and for mutual aid support in times of crisis. Actively and continuously engaging the Tribal community in planning and discussion will improve the quality of these efforts, as well as expand capacity for observation and monitoring through community science frameworks, and will increase accountability of Tribal government services to the CTUIR people being served.

- **Continue to educate non-Native people and agencies about Tribal Rights** to fish, hunt, gather, graze, and administer water in the region. Many incorrectly believe that Tribal people exist in the past, while Tribal people have always persisted and will always persist on these homelands. Education about the ongoing contributions of Tribal people and practices to sustainable and resilient landscapes demonstrates the essential need for continued presence of Tribal people practicing culture, religion, and connection with First Foods for the prosperity of all.

Long Term:

- **Prioritize adaptation strategies that maintain cultural connection and First Foods harvest**, especially when extended "shelter-in-place" alternatives are proposed. First Foods harvest windows are responsive to environmental conditions and annual variability is likely to be huge. Prioritizing adaptation strategies that allow for mobility and engagement with natural resources will preserve First Foods connections.

- **Advocate for use of a variety of vegetation management and rights advocacy approaches** for wildfire control and invasive species risk. This is likely to include (but is not limited to): herbicide application, seasonal grazing, intentional burning, mowing and manual removal. Many options can be used concurrently, and an emphasis on Tribal Rights within these strategies could strengthen sovereignty and Indigenous land stewardship. Examples include developing frameworks to prioritize Tribal grazing rights on public lands above the needs of commercial livestock producers, and efforts to quantify grazing "rights" held by deer, elk, and other Big Game First Foods as they are connected to Treaty Rights to harvest and Tribal 5th Amendment rights.

Pacific Lamprey (left) and Fresh Water Mussels (right) are aquatic First Foods that will have an important role in adapting to the climate crisis. Lamprey can live in warmer waters than salmon, and fresh water mussels filter sediment from streams to reduce debris that harm fish. Expanding opportunities to supplement and monitor these species is essential in climate adaptation.

Measuring Success and Gaps in First Foods Access Adaptation

How Do We Measure the Success of These Adaptations?

"The Treaty of 1855 illustrates the vision and foresight our peoples had for future generations. The flame of sovereignty continues to burn through oral traditions given to us throughout time. This is our true law – our language, tradition, and custom. (Johnson, 2006)"

- **Comprehensive Plan Objective 5.6.5:** To assess the distribution and security of cultural foods plants (roots, berries) and protect and enhance them for CTUIR member use (see Comp Plan page 81 for benchmarks);
- **Comprehensive Plan Objective 5.6.6:** To protect, preserve, and perpetuate the CTUIR's culturally significant places and resources for the benefit of current and future generations (see Comp Plan page 81 for benchmarks);
- **Comprehensive Plan Objective 5.7.9:** Improve the accuracy of external perceptions of the Tribes' cultures by creating opportunities for others to experience our world, our work, and our challenges through the eyes of Tribal people (see Comp Plan page 86 for benchmarks);
- **Comprehensive Plan Objective 5.14.8:** Ensure appropriate levels of fire equipment, fire flows and prevention programs consistent with the level of commercial and residential construction on the reservation (see Comp Plan page 124 for benchmarks).
- **CTUIR Water Code (2005) Section 1.05. Statement of Policy N:** Protection of Stream Zones. Protection of stream zones of the Umatilla Indian Reservation is vital to the preservation of Tribal traditional values and religion, and the Confederated Tribes' hunting, fishing, and gathering rights and the way of life that depends on them as provided by the Treaty of 1855;
- **CTUIR Water Code (2005) Section 1.05. Statement of Policy O:** Watershed Protection. Watershed practices which serve to capture water or reduce its rate of flow from the Reservation shall be promoted;

CTUIR DNR Fisheries Lamprey Restoration Project is introducing juvenile Pacific lamprey to the river to restore this First Food species

- **CTUIR Water Code (2005) Section 1.05. Statement of Policy Q:** Anti-degradation Policy. The protection of existing instream uses and the level of water quality and quantity necessary to provide full support to those uses must be maintained and protected.
- **CTUIR Hazard Mitigation Plan (2021) Section 5:** Mitigation Strategy Implementation and Integration (page 214-225)
- Harvest restrictions or prohibitions set by FWC, DNR Fisheries, CRITFC and other regulating entities.
- Adaptive Big Game hunting seasonal windows, locations, and regulations responsive to conditions over static annual dates.
- Community observation of First Foods illnesses and injury, Tribal Member safety during harvesting activities, and noxious weed spread.

What Gaps in Knowledge, Policy, Capacity, or Education Exist?

- Insurance liability and access to knowledge/ equipment is a barrier for prescribed fire implementation;
- Carbon pricing approaches and how these might reduce/impact opportunities for First Foods harvest and cultural practices;
- Current and future energy project development impacts on First Foods access corridors.

First Foods Adaptation Summary

First Foods Availability Adaptation

A. Anticipate Habitat Shift and Migration

B. Invasive & Displaced Species Management and Monitoring

C. Proactively Address Wildfire Risk

D. Species Migration Information and Practices

E. Research and Regulatory Understanding for First Foods Harvest

Details of how conditions will change are currently lacking, and would facilitate First Foods adaptation. Changes in vegetation, pest, pathogen, and drought stress are likely to impact habitat suitability and availability of First Foods. Community-led facilitated migration and regulation could ease these impacts.

Measures of Success:

- First Foods Upland Vision touchstones provide technical metrics that can be measured.
- CTUIR Comprehensive Plan Objectives 5.6.2, 5.6.4, 5.8.1, and 5.14.7, and their associated benchmarks.
- CTUIR Water Code (2005) Section 1.05. Statement of Policy K, L, and M.
- CTUIR Hazard Mitigation Plan (2021) Section 3 and 4
- Fish and Wildlife Commission (FWC) Annual Reports
- DNR annual work plans and activities

First Foods Access Adaptation

F. Anticipate Health Impacts for Tribal Harvesters

G. Engage in Policy and Agency Land Management Discussions

Tribes often do not have direct control over lands that sustain First Foods, and land use and management is inextricably linked with climate impacts. Working with private, public, and industry collaborators on returning Indigenous knowledge and stewardship to CTUIR Ceded and traditional use lands is essential.

Measures of Success:

- CTUIR Comprehensive Plan Objectives 5.6.5, 5.6.6, 5.7.9, and 5.14.8 and their associated benchmarks.
- CTUIR Water Code (2005) Section 1.05. Statement of Policy N, O, and Q.
- Harvest restrictions or prohibitions set by FWC, DNR Fisheries, CRITFC and other regulating entities.
- CTUIR Hazard Mitigation Plan (2021) Section 5
- Adaptive Big Game hunting seasonal windows, locations, and regulations responsive to conditions over static annual dates.
- Community observation of First Foods illnesses and injury, Tribal Member safety during harvesting activities, and noxious weed spread.

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