Petition to Initiate Rulemaking to Amend OAR 635-050-0070 to Permanently Close Commercial and Recreational Beaver Trapping and Hunting on Federally-Managed Public Lands and the Waters that Flows Through These Lands

Brought before the Oregon Fish and Game Commission on

September 10, 2020

Beaver ponds provide an "emerald refuge" in a landscape burned by the Sharps Fire, Idaho. Photo: Joe Wheaton
https://www.sagegrouseinitiative.com/beavers-water-and-fire-a-new-formula-for-success/

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BEFORE THE OREGON DEPARTMENT OF FISH AND WILDLIFE

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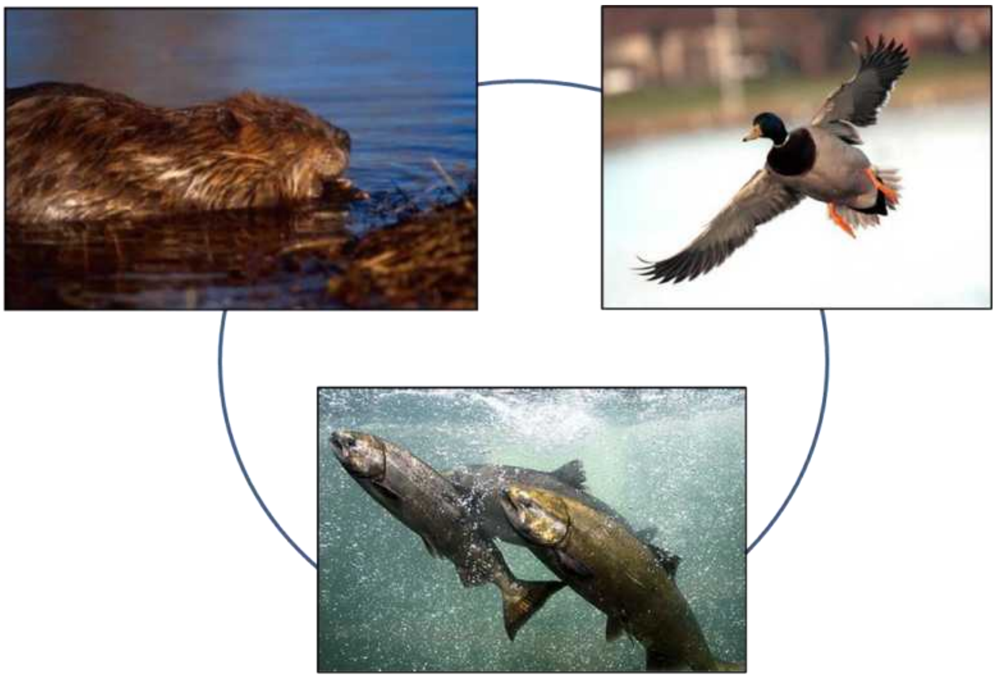

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II. EXECUTIVE SUMMARY

Oregon's existing wildlife laws categorize beavers variously as a rodent, a predatory animal, a nuisance animal, or furbearer. No mention is made that they are a keystone species and ecosystem engineer with the potential to bring large economic, ecological, and social benefits to Oregon and its fish and wildlife. Nor is any mention made of their ability to help Oregonians prepare for climate change or take a proactive approach towards addressing climate change, drought, wildfire, threatened and endangered salmon, and declining fish and wildlife as habitat quality and abundance shrinks. This Petition seeks to remedy these oversights and modernize Oregon's regulations to take advantage of these benefits. Specifically, Petitioners requests that the Oregon Furbearer Trapping and Hunting Regulations (OAR 635-050-0070) be amended to:

> **Permanently close commercial and recreational beaver trapping and hunting on the following federally-managed public lands and the waters that flow through these lands in the state of Oregon**: Bureau of Land Management lands, National Forests, National Monuments, National Parks, National Grasslands, and Federal Wildlife Refuges.

This amendment would leave half the state open to beaver trapping and hunting while allowing beavers to thrive on federally-managed public land where the species' benefits would be maximized. This amendment is at the scale needed to be ecologically and economically meaningful and is based on best available science as represented by peer-review literature and a number of ODFW reports. This amendment would improve Oregon's water security and help minimize impacts of climate change on human and wild communities. This amendment has no bearing on the ability of federal land management officials to remove beaver if necessary.

This amendment would bring ODFW's policies into alignment with its mission statement and its recently adopted Climate and Ocean Change Policy. It would help address the seven key conservation issues in the Oregon Conservation Strategy and directly benefit 82 strategic species. Finally, it would help bring ODFW's management of wildlife and fisheries into compliance with ORS 496.012 (Oregon's Wildlife Policy) which states:

> *It is the policy of the State of Oregon that* ***wildlife shall be managed to prevent serious depletion of any indigenous species*** *and to provide the optimum recreational and aesthetic benefits for present and future generations of citizens of this state. [emphasis added]*

Finally, this amendment would simplify the existing rule and create a uniform and easily enforced policy across the state. It would correct existing regulations by bringing them up-to-date with the 2013 change in beaver status due to changes to OAR 635-050-0050 (7). It would eliminate language ambiguities that leave closures open to interpretation. It would create biologically-relevant closures that allow for successful dispersal and expansion of beaver colonies.

The Petition addresses four misleading claims made by ODFW during the June 12, 2020 Commission meeting as justification for maintaining the existing furbearer regulations. They were 1) that trapping and hunting beavers during the breeding and pregnancy season has no effect on population numbers and distributions, 2) all suitable habitat is occupied in the state, 3) a beaver colony of six requires 18 acres of willows every year, and 4) there are no major economic effects of the existing rule. The information contained in the Petition will show that none of the arguments provided by ODFW wildlife staff as justification for continuing the existing rule are scientifically or economically defensible.

An economic analysis of the proposed amendment found that the market and non-market benefits of approving the amendment are in the 100s of millions to billions of dollars in ecosystems services and restoration savings. These benefits would be acquired at little to no cost to the taxpayer and increase in value over time. This makes the amendment a fiscally smart decision. Below are some of the benefits provided by beaver-created and maintained habitat.

- Water security and quality for municipal, ranching, and agricultural users improved
- Natural water banks or temporary storage areas created by wetlands and beaver ponds
- Fish and wildlife habitat improved, expanded and diversified
- Wetlands created
- Wildfire safety zones for wildlife and livestock created
- Carbon capture and store areas created
- Winter rearing habitat for 11 endangered salmonid stocks improved and expanded
- Migratory bird habitat created and expanded

- Stream temperatures improved
- Recreational opportunities expanded and improved
- Stream and riparian habitat restoration created and maintained by beavers
- Restoration dollars go further because of beaver partnership

Under current global greenhouse gas (GHG) mitigation strategies, salmon and other cold-water fish species are projected to be replaced in many areas of Oregon by less economically valuable fisheries over the course of the 21st century as stream temperatures continue to rise. Currently, Oregon has more than 23,000 stream miles 303d listed as already water quality-impaired for temperatures on streams of beaver dam-building size. While preserving existing cold water habitats in Oregon through GHG mitigation will require long-term global cooperation, approval of the amendment would allow ODFW to act independently to preserve cold water habitats in Oregon by protecting beavers and the wetlands and ponds they create which can significantly reduce stream temperatures.

A study commissioned by the Oregon Legislative Task Force[1] found that Oregonians care about habitat loss, lack of water, low/declining fish populations, urban sprawl, and conservation and management of resources. They value healthy fish and wildlife populations and safe and well-protected water resources. Thus, this amendment is in line with the values and interests of the majority of Oregonians. In addition, a report commissioned by ODFW found that there is a high tolerance for beavers even when there are conflicts.[2]

This proposed amendment and the existing rule are starkly different. The existing rule allows less than 164 people in a state of 4.2 million to trap and hunter beavers under the furbearer regulations for recreation. Since 2000 more than 48,000 beavers have been killed under the furbearer regulations. The percentage killed on federally-managed public lands is unknown because the data are reported only by county. Whatever the percentage, the annual culling of this species has prevented the expansion and maintenance of beaver-created habitat on our federally-managed public lands, as the breeding and pregnancy season occurs during the trapping/hunting season. The result is that the corresponding and much needed social, economic, and ecological benefits provided by beaver-created and maintained habitat, such as improved water security, water quality, water availability, and habitat are denied to Oregonians and our fish and wildlife.

Just as this amendment has the potential to create economic benefits in the 100s of millions to billions of dollars, the existing rule is currently creating yearly economic harm to 4.2 million Oregonians of a similar magnitude with limited economic returns. In 2018, the pelt price was $13 based on ODFW data. Based on the ODFW 2020 report to the Commission, less than 164 people reported a beaver take under the regulations. Of the 1022 beavers reported killed under the regulation[3], only 267 pelts were sold. The estimated economic gain was $3432. It is for these very small returns and the recreational enjoyment of a few that beaver are being prevented from creating and maintaining beaver ponds critical for juvenile coho salmon, bringing salmon ever closer to possible extinction. While the economic impact of continued salmon decline and possible extinction is in the hundreds of millions to billions of dollars, even these numbers do not compare to the cultural and social impact of salmon extinction.

This amendment would change this dynamic by eliminating the one mortality cause that ODFW has control over. The reduction in mortality would result in increased beaver populations over time. As population increases beavers will begin to restore stream and riparian systems across the state that will, in turn, decrease the stress on the fish, wildlife and human communities that depend on healthy ecosystems. These improvements in water-based systems will help decrease future water conflicts.

This amendment would help restore water-related ecosystems at a speed and scale commensurate with the scale of the problem: climate change. The amendment addresses declining state budgets and rising concerns related to wildfire, drought and water security. It allows Oregonians to partner with Oregon's state animal and ecosystem engineer – the beaver – in preparing for climate change and the economic and ecological changes ahead.

Petitioners do not make this request lightly. The request is the culmination of decades of work and study by scientists, land managers, and conservationists. Our understanding of species and habitats and ecosystems is rapidly changing, as is our use and enjoyment of federally managed public lands and concerns about water and habitat. The Department's management of fish and wildlife needs to evolve with these changes if there is to be fish and wildlife for future generations to enjoy.

III. INTRODUCTION

The American Beaver (*Castor canadensis*) creates and maintains a variety of stream and riparian habitat which benefit humans and a multitude of mammals, birds, amphibians, reptiles, insectivores and fish – including highly endangered coho salmon. Beaver-created and maintained habitat leads to improved water quality, decreased flood peaks and intensity (i.e. stream power) and higher water tables. In the process, this beaver-created habitat helps make human and wild communities resilient to climate change and its impacts. On public lands, Oregon lists the beaver as a "fur-bearing mammal" under ORS 496.004(8) which allows them to be legally trapped and hunted from November 15 to March 15. However, given the economic and ecological benefits of beaver-created and maintained habitat, this Petition requests that the Oregon Furbearer Trapping and Hunting Regulations (OAR 635-050-0070) be amended to:

> **Permanently close commercial and recreational beaver trapping and hunting on the following federally-managed public lands and the waters that flow through these lands:** Bureau of Land Management lands, National Forests, National Monuments, National Parks, National Grasslands, and Federal Wildlife Refuges.

Adopting the proposed amendment would leave half the state open to beaver trapping/hunting while ensuring closures at the scale needed to be ecologically and economically meaningful in the face of climate change. Figures 1 and 2 show the existing and proposed closures with larger maps found in Appendix A. The proposed closure size is the minimum scale needed to be ecologically and economically meaningful in the face of climate change
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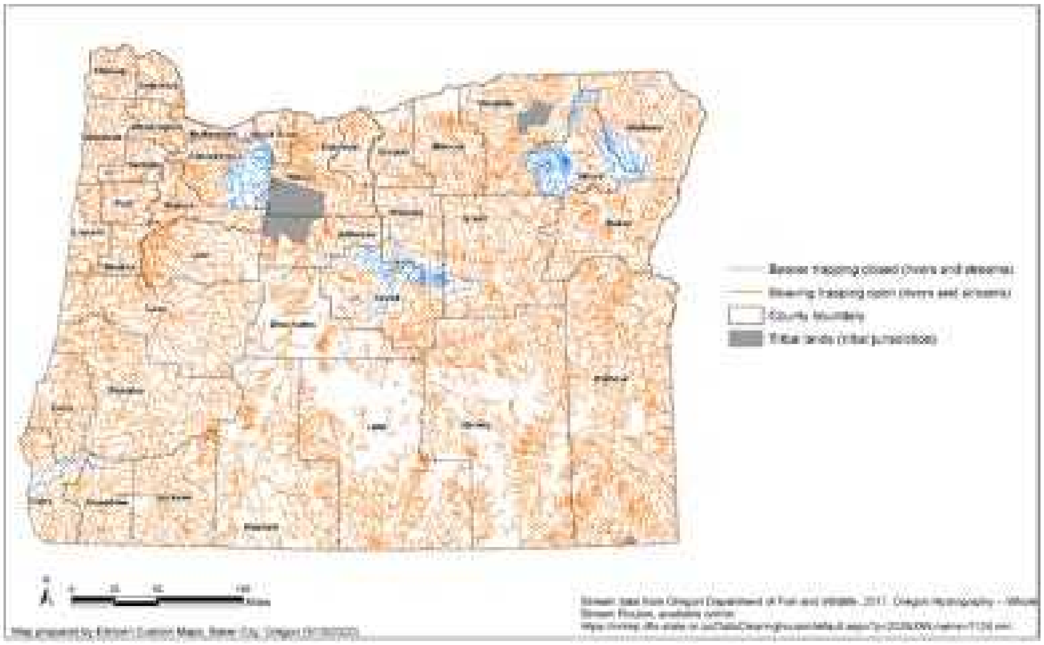

Figure 1. Areas open and closed to commercial and recreational beaver trapping and hunting in the state of Oregon under existing OAR 635-050-0070, Counties shown. *See Appendix A for larger version of this map (Map 2a)*

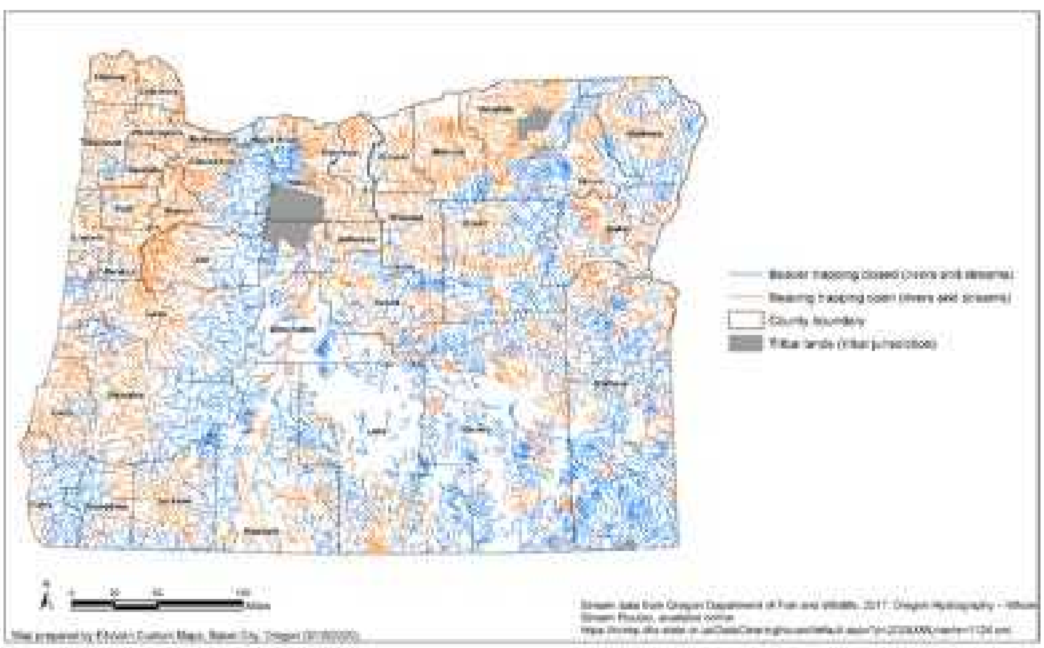

Figure 2. Areas open and closed to commercial and recreational beaver trapping and hunting in the state of Oregon under proposed amended OAR 635-050-0070. Counties shown. *See Appendix A for larger version of this map (Map 2b).*

Approving the Petition will help contribute to Oregon's water security and minimize impacts of climate change on human and wild communities. By improving fish and wildlife habitats, water quality, and water availability statewide, this Petition will support atmospheric carbon drawdown at little to no cost. It will help bring ODFW's management of wildlife and fisheries into compliance with ORS 496.012 (Oregon's Wildlife Policy), the Oregon Conservation Strategy (OCS), the Oregon Department of Fish and Wildlife (ODFW) mission statement, the recently adopted Climate and Ocean Change Policy (Climate Policy), and reflects the current best available science as represented by peer-review literature (**Appendix B-1)**. A number of ODFW reports support the value of beavers and the habitat they create and maintain (**Appendix B-2**). In addition, a Memorandum of Understanding (MOU) was signed in 2018 by ODFW and USFWS in which both agencies explicitly affirm the value of abundant and widely distributed beaver populations in their statement of "*support for the conservation and ecological recovery of beaver within their native range in Oregon, as well as the reduction of conflicts with humans and land managers*". Honoring this commitment between agencies and to the public also ties in with ODFW's mission statement "**to protect and enhance Oregon's fish and wildlife and their habitats for use and enjoyment by present and future generations"**. Given the magnitude of damaged streams and riparian ecosystems and climate change, meeting this commitment and the mission statement is only possible with the help of abundant beavers and the abundant and widely distributed habitat they create and maintain.

The rule amendment would address all seven Key Conservation Issues in the Oregon Conservation Strategy to varying degrees. These key conservation issues have been identified as posing the greatest potential impact to Strategy Habitats and Strategy Species statewide. Of the 11 Strategy Habitats, four are directly influenced and improved upon by beavers along with a number of specialized and local habitats. Improvement and expansion of these Strategy Habitats statewide would directly benefit 82 of the 294 (28%) Strategy Species listed in the Conservation Strategy and countless other species as well (Appendix C).

The rule amendment would create a uniform, clear, up-to-date, and easily enforced policy across the state. The proposed amendment would eliminate language ambiguities that leave closures open to interpretation. It would create biologically relevant closures (i.e. size and habitat appropriate) that are contiguous enough to allow for successful dispersal and expansion. Current closures only close the streams while leaving the land base open to trapping and hunting which ignores beaver foraging needs. The amendment would also bring the regulations up-to-date by reflecting the 2013 change in beaver status due to changes to OAR 635-050-0050 (7). Under the 2013 change, beavers are now considered a predatory animal on private lands and be killed anytime. Therefore, existing closures on private lands are ineffective and out-of-date.

The ability of beaver-created and maintained habitat to address the water and habitat needs of human and wild communities is well documented in peer-reviewed literature and ODFW reports and is reviewed and explained in this Petition. This literature documents the ability of beaver habitat to improve water quality, maintain or increase stream flows, create and increase the amount and distributions of wetlands, wet meadows, bogs, ponds and diverse riparian habitats, create refugia and fire breaks during wildfires, store carbon, and increase and diversify habitat and its connectivity to the benefit of many species. A sampling of this literature is found in Appendix B-1 and spans from 1924 to 2020. Not only do beavers and the habitat they create benefit a multitude of species, but they can alter conditions rapidly as shown in the photo series from Bridge Creek area in Wheeler County, OR and Susie Creek in Elko County, Nevada (Appendix D).

A decision by the Oregon Fish and Wildlife Commission (Commission) to approve this amendment would have far reaching beneficial effects. Given the critical nature of climate change, the declining number of salmon, and the rising concerns related to water quality and availability, wildfire prevalence and severity, and fish and wildlife habitat needs, it is imperative that this amendment be approved prior to November 15, 2020 in order to protect this year's surviving kits and breeding pairs and allow them to enter into and out of the breeding season without being trapped or shot. With this decision, beavers can begin the population growth and expansion needed to expand beaver-created and maintained habitat statewide, and to assist Oregonians, fish and wildlife in preparing for climate change.

<u>Currently OAR 635-050-0070 (Beaver Harvest Seasons) reads:</u>

Open Season: November 15, 2018 through March 15, 2019 and November 15, 2019 through March 15, 2020 in the following described areas:

(1) Clackamas County. All open except waters within the exterior boundaries of Mt. Hood National Forest.

(2) Crook County. All open except Prineville Reservoir below high water line and the Ochoco National Forest.

(3) Curry County. All open except the Rogue River from the east county line to the mouth.

(4) Grant County. All open except within the exterior boundaries of the Ochoco National Forest; Murderers Creek and Deer Creek, tributaries of the South Fork John Day River, within the exterior boundaries of the Malheur National Forest.

(5) Jefferson County. All open except that portion of Willow Creek and its tributaries on the National Grasslands.

(6) Josephine County. All open except Rogue River from the confluence of Grave Creek downstream to the county line.

(7) Union County. All open except:

(a) Waters inside exterior boundaries of National Forests. However, private inholdings within the National Forest remain open.

(b) Grande Ronde River above Beaver Creek.

(c) All tributaries of the Grande Ronde River above the confluence of Five Points Creek. (Five Points Creek open to the National Forest boundary.

(8) Wallowa County. All open except:

(a) Wallowa River and tributaries above Wallowa Lake.

(b) Lostine River, Hurricane Creek, Bear Creek and their tributaries above the Wallowa-Whitman National Forest boundary.
(c) Minam River and tributaries.
(d) Peavine Creek, a tributary of Chesnimnus Creek.

(9) Wheeler County. All open except within the exterior boundaries of the Ochoco National Forest and Bridge Creek at its tributaries within the exterior boundaries of Bureau of Land Management lands.

(10) Other counties: All of the following counties in their entirety: Baker, Benton, Clatsop, Columbia, Coos, Deschutes, Douglas, Gilliam, Hood River, Harney, Jackson, Klamath, Lake, Lane, Lincoln, Linn, Malheur, Marion, Morrow, Multnomah, Polk, Sherman, Tillamook, Umatilla, Wasco, Washington and Yamhill.

IV. LEGAL GROUNDS FOR PETITION

Pursuant to ORS 183.390, "[a]n interested person may petition an agency requesting the promulgation, amendment or repeal of a rule. The Attorney General shall prescribe by rule the form for such petitions and the procedure for their submission, consideration and disposition. Not later than 90 days after the date of submission of a petition, the agency either shall deny the petition in writing or shall initiate rulemaking proceedings in accordance with ORS 183.335 (Notice)." Pursuant to Attorney General rule:

The petition shall be legible, signed by or on behalf of the petitioner, and shall contain a detailed statement of:

(a) The rule petitioner requests the agency to adopt, amend, or repeal. When a new rule is proposed, the petition shall set forth the proposed language in full. When an amendment of an existing rule is proposed, the rule shall be set forth in the petition in full with matter proposed to be deleted and proposed additions shown by a method that clearly indicates proposed deletions and additions;

(b) Facts or arguments in sufficient detail to show the reasons for and effects of adoption, amendment, or repeal of the rule;

(c) All propositions of law to be asserted by petitioner.

OAR 137-001-0070.

Given that this is a petition to amend a rule, the petition must also comment on:

(a) Options for achieving the existing rule's substantive goals while reducing the negative economic impact on businesses;

(b) The continued need for the existing rule;

(c) The complexity of the existing rule;

(d) The extent to which the existing rule overlaps, duplicates, or conflicts with other state or federal rules and with local government regulations; and

(e) The degree to which technology, economic conditions, or other factors have changed in the subject area affected by the existing rule, since the agency adopted the rule.

Id.

V. AMERICAN BEAVER

A. Biology

NOTE 1: The information below in *italics* is taken directly from the ODFW's Living with Wildlife: American Beaver document (https://www.dfw.state.or.us/wildlife/living_with/docs/beaver.pdf).

NOTE 2: ODFW failed to include a major cause of mortality in the last paragraph -- human trapping and hunting. This mortality occurs under ODFW's Furbearer Trapping and Hunting Regulations (OAR 635-050-0070), under ODFW Furbearer and Unprotected Mammals Regulations (OAR 635-050-0050 (7)) which identifies beavers as a predatory animal in some circumstances, by Wildlife Services, by private individuals killing animals for sport, and by contract trappers not associated with Wildlife Services. As such the document needs to be corrected to reflect ALL causes of beaver mortality. To continue to exclude trapping and hunting and Wildlife Services in this document suggests a deliberate intent by ODFW to hide this information from the public.

Adult beavers average 40 pounds in weight and measure more than three feet in length, including the tail. They have a nose and ears that seal out water. These semi-aquatic mammals have webbed hind feet, large incisor teeth and a broad flat tail. They have poor eyesight, but excellent hearing and sense of smell. The beaver's sharp incisors, which are used to cut trees and peel bark while eating, are harder on the front surface than on the back so the back wears faster creating a sharp edge that enables a beaver to easily cut through wood. The incisors continually grow, but are worn down by grinding, tree cutting and feeding. Beavers are territorial and to mark their territory by creating small mounds of mud, leaves, and sticks, which they then cover with pungent oil called castoreum.

Once among the most widely distributed mammals in North America, beavers were trapped virtually to extinction in the 1800s to meet demand for beaver pelts. A subsequent *decline in demand coupled with proper wildlife management allowed beavers to become reestablished in much of their former range and are now common in many areas, including urban settings. Beavers are found where preferred foods are in good supply—along rivers and small streams, lakes, marshes and even roadside ditches that have adequate year-round water flow. In areas where deep, calm water is not available, beavers with enough building material available will create ponds by building dams across creeks or other watercourses to impound water.*

Beavers eat the leaves, inner bark, and twigs of aspen, alder, cottonwood, willow and other deciduous trees. They also eat shrubs, ferns, aquatic plants, grasses, blackberries and agricultural crops. Most foraging is done within 165 feet of the water's edge. In areas with few predators and a lean food supply, toppled trees and other signs of foraging may be found twice that distance from the den site. Foraging levels are most intense during late fall (earlier in cold winter areas of Oregon) as beavers prepare for winter. Fermentation by special intestinal microorganisms allows beavers to digest 30 percent of the cellulose they ingest from vegetation. When the surface of the water is frozen, beavers eat bark and stems from a food cache anchored to the bottom of the waterway for winter use. Food caches are seldom found where winters are comparatively mild, such as in the lowlands of western Oregon.

Beavers build dams to create deep water for protection from predators, for access to their food supply and to provide underwater entrances to their den. Resultant moist soil promotes growth of favored foods. Beavers living on water bodies that maintain a constant level (lakes or large rivers) do not build dams. Dams are constructed and maintained with whatever materials are available—wood, stones, mud and plant parts. They vary in size from a small accumulation of woody material to structures 10 feet high and 165 feet wide. The sound of flowing water stimulates beavers to build dams; however, they routinely let a leak in a dam flow freely, especially during times of high waters. Beavers keep their dams in good repair and will constantly maintain the dams as the water level increases in their pond. A family of beavers may build and maintain one or several dams in their territory. In cold areas, dam maintenance is critical. Dams must be able to hold enough water so the pond won't freeze to the bottom, which would eliminate access to the winter food supply.

Depending on the type of water body and the geographic area they occupy, beavers construct lodges or bank dens as a place to rest, stay warm, give birth and raise young. These may be burrows in a riverbank or the more familiar lodges in the water or on the shore. Both burrows and lodges consist of one or more underwater entrances, a feeding area, a dry nest den and a source of fresh air. Lodges consist of a mound of branches and logs plastered with mud. One or more underwater openings lead to tunnels that meet at the center of the mound where a single chamber is created. Bank dens are dug into the banks of streams and large ponds, and beavers may or may not build a lodge over them. Bank dens may also be located under stumps, logs, or docks. All family members concentrate on repairing the family lodge or den in late fall (earlier in cold winter areas of Oregon) in preparation for winter.

A mated pair of beaver will live together for many years, sometimes for life. Beavers breed between January and March, and litters of one to eight kits (average four) are produced between April and June. The number of kits born is closely related to the amount of food *available (more food, more kits) and the female's age. The female nurses the kits until they are weaned at 10 to 12 weeks of age. Most kits remain with adults until they are about two years old although some leave as early as 11 months and a few females stay until they are three years old. The kits then go off on their own in search of mates and suitable spots to begin colonies, which may be several miles away. Beavers live in colonies that may contain two to 12 individuals. The colony is usually made up of an adult breeding pair, kits of the year, and kits of the previous year or years. Populations are limited by habitat availability; the density of beavers appears not to exceed one colony per one-half mile under the best of conditions.*

Because of their size, behavior and habitat, adult beavers have few natural enemies. When foraging on shore or migrating overland, beavers may be killed by bears, coyotes, bobcats, cougars or dogs. Other causes of death include severe winter weather, winter starvation, disease, water fluctuations and floods, falling trees, and collisions with vehicles along roadways. Historically, beavers were one of the most commonly trapped furbearers. Beavers live five to 10 years in the wild.

B. Population Status[4]

Trapping/Hunting Impacts on Beaver Populations

There are two types of mortality related to harvest: Compensatory (animal would have died that year from other causes if not harvested) and Additive (harvest adds to mortality from other causes). The scientific literature demonstrates that discriminating between the two mortality types is extremely difficult, as is quantifying which process dominates at any given time and place (Williams et al. 2001).[5] It also demonstrates that timing of harvest may profoundly influence the impact on a population because reproduction usually does not coincide with mortality. As stated in *Optimal and suboptimal use of compensatory responses to harvesting* by Kokko (2001) [6]:

> *It is increasingly recognised that the timing of harvesting may profoundly influence the impact on the population [citations omitted]. The basic reason for this is that in seasonal environments, reproduction and (most of) mortality tend not to coincide in time, and this leads to annual fluctuations in population size. Consequently, removing an individual just prior to reproduction (spring harvesting) causes a larger reduction in the population than if the individual had been removed earlier (autumn harvesting). In the latter case it could have died in any case before ever reproducing again, and this reduces its expected contribution to population growth (see also Doubleday 1975).*

Beavers have an evolutionary strategy of long-term pair bonding. Their breeding season is between January and March and they give birth between April and June. The furbearer beaver trapping/hunting season is November 15 to March 15. Therefore, the trapping/hunting season occurs during the breeding and pregnancy season. Even if the pregnant female survives the trapping/hunting season, and there are enough family members left to maintain dams, there is a lag between birth and dispersal with most kits remaining with adults until they are about two years old. During this two-year period, the kits are also subject to trapping pressure which prevents dispersal and finding a mate. In addition, the now solo adult beaver must find another breeding partner, a time-consuming process when beavers are absent from many of Oregon's streams. Thus, maintaining a family unit is key to expanding populations.

The impact of trapping/hunting on beaver populations is demonstrated in Figure 3 below which shows the life table of a single beaver colony over 10 years. While a simple portrayal of a complex process, the figure is valuable because it shows how beaver trapping/hunting suppresses state-wide populations and distributions. Figure 3 reveals the following: 1) It takes up to two - three years before the first set of kits are of breeding age. During these two years kits are learning the skills needed to survive. 2) If a breeding pair is removed, then potentially 618 beavers are prevented from being born over the next 10 years. 3) If only one of the breeding pair is removed, population growth will stop until another mate is found. 4) Population growth requires that kits survive to adulthood, disperse, find a partner and begin raising families who will repeat the process. 5) Figure 3 represents a best-case scenario in which there is no mortality from other causes and that all kits immediately find a breeding partner not of their family unit. Because this is not true, population growth will also be slower.

Year	1	2	3	4	5	6	7	8	9	10
Adults	2	2	2	6	10	14	26	46	74	126
2 Yr Old	0	0	4	4	4	12	20	28	52	92
1 Yr Old	0	4	4	4	12	20	28	52	92	148
Kits	4	4	4	12	20	28	52	92	148	252
Total	6	10	14	26	46	74	126	218	366	618

Figure 3. Life Table of a single beaver colony over 10 years. (ODFW June 12, 2020 presentation, slide 40)

This simple analysis shows that death, by any means, influences population growth and especially when removed prior to reproduction as stated above by Kokko (2001). Thus the 48,408 beavers trapped/hunted under the Furbearer Regulations between FY 2000/01 to 2017/18 has had a huge impact on Oregon's beaver population. Tens of thousands of kits were not born, did not disperse into other habitat, did not create families of their own, and did not begin their ecosystem-changing activity. This loss of current and future potential is on top of mortality due to other factors, none of which can be quantified except the beavers killed by USDA Wildlife Services due to conflicts with humans. This loss brings great ecological and economic harm to Oregonians and their fish and wildlife (Appendix F).

Figure 3 is further instructive because it gives a sense of the time required to start increasing Oregon's beaver populations. In the figure, the 126 adults in year 10 are intended to represent an even number of males and females or 63 breeding pairs. If each breeding pair manages on average 0.75 linear miles of stream (ODFW slide 26), then in year 10 only 47 stream miles are being influenced by beavers. Based on information from ODEQ, there are 292,856 stream miles that are 4th order or less (Appendix F, SI-1). These streams are of beaver dam building size and many have unoccupied suitable beaver habitat as will be shown in the next section. If we use an extremely conservative estimate and assume only 25% of these streams could support beavers immediately (other miles either not suitable or requiring some additional restoration), then we have 73,214 stream miles, many of which likely exceed the state's stream temperature standards. Therefore, the repeated removal of a breeding pair, or one of the breeding pair, or kits that would later disperse and become a breeding pair has large impacts on habitat creation and maintenance and significantly delays Oregon's ability to restore stream/riparian ecosystems and minimize the impacts of climate change on its human and wild communities.

Beaver Response to Trapping and Hunting Closures

Table 1 lists six studies that examined changes in beaver activity in areas where beaver trapping and hunting did not occur or had ceased. These studies show that beaver activity and distributions increased in the absence of trapping and hunting. As a result, the abundance and distribution of the habitat they create and maintain also increased. While there was no mortality due to beaver trapping and hunting, all other mortality causes were still in play (i.e. predation, disease, accidental death) and still activity increased. Hence, trapping and hunting of beavers by humans has an effect on population.

Table 1: Beaver response in areas closed to beaver trapping and hunting.

Location and Source	**Study Years**	**Study Area and Feature Surveyed**	**Trapping/Hunting Status**	**Response**
Quabbin Reservation, MA (Bushner and Lyons 1999)	1952 to 1996	12,400 acres. Monitored active colonies and beaver numbers.	The beavers returned to this area after being absent for more than 200 years. No trapping/hunting permitted	1952-1968: Active colonies increase from 2 to 16. 1968-1975: Active colonies increase from 16 to 46. 1975-1983: Active colonies remain high but fluctuate between 42 and 54. 1983-1988: Active colonies decline from 44 to 12. 1988 – 1996: Number of active colonies fluctuate between 10 and 15. Beaver numbers follow a similar pattern.
Sagehen Ck, CA (Bushner and Lyons 1999)	1945 – 1991	8.4 miles of stream. Monitored beaver populations.	The population was started in 1945 with the introduction of four adults by CA Department of Fish and Game. No	1948 -1956: increase from 2 to 10 animals. 1956 -1959: increase from 10 to 20 animals. 1959 -1963: relatively stable, ranging between 18 and 22 animals. 1963 -1969: decline from a high of 22 to 2 animals. 1969 -1979: increase from 2 to 23 animals

Location and Source	Study Years	Study Area and Feature Surveyed	Trapping/Hunting Status	Response
			trapping/hunting permitted	1982 -1991: decline from 20 to 7 animals.
Bridge Creek, OR (Demmer and Beschta 2008)	1988 – 2004	15.8 miles of stream. Monitored beaver dams and ponds and pond dimensions.	Area was closed to beaver trapping after 1991 by ODFW. It is an ODFW existing closure.	1988: 36 beaver dams. 1989 – 1992: dams increase from 9 to 103. 1992 – 1998: dams decrease from 103 to 9. 1998 – 2002: dams increase from 9 to about 60. 2002 – 2004: dams decrease from about 60 to 40
Bridge Creek, OR (Weber et al 2017)	2007 - 2014	21 miles of stream Monitored beaver dams along	Area was closed to beaver trapping after 1991 by ODFW. It is an ODFW existing closure.	Beaver dams increased by an order of magnitude from 24 to 120 dams
Kabetogama Peninsula, Minnesota (Naiman et al 1988; Dr. John Pastor, email comm)	1940 to 1986	17.4 sq. miles Monitored beaver dams, vegetative changes, and impoundments	Timber operations on the Peninsula closed in the 1940s. The area remoteness and cessation of logging road maintenance made access difficult creating a de facto closure. In 1975, the Peninsula became part of Voyaguer NP which made it an official closure.	1940: 71 beaver dams and 1% of the peninsula impounded by beavers. 1986: 835 beaver dams and 13% of the peninsula impounded by beavers. An additional 12-15% of uplands in the riparian zone were altered during the same time due to beaver browsing.
Yellowstone National Park (Smith and Tyers 2012)	1921 to 2009 with focus on 1996 to 2009.	No acres or miles provided. Monitored beaver colonies initially on the Northern Range and then in later years the entire park.	Park established in 1872 but area was trapped. Sometime after establishment, trapping/hunting of beaver stops.	**Northern Range**. 1900s: beaver appear to have been abundant. 1950s to early 1990s: beaver numbers declined. Late 1990s – 2009: Population increasing. Triggered by release of willows. 1996 – 2009: number of active colonies increasing **Interior YNP:** Beaver numbers appear more stable

A similar response to trapping and hunting closures (beaver activity expands) is found in the 1960 Oregon Game Commission Bulletin.[7] This bulletin lays out the history of beaver closures in the state from 1899 to 1952. In this case changing beaver populations are discussed in the context of legislation made in response to increased numbers and beaver damage complaints rather than specific measurements. For example, from 1932 to 1952 the entire state was closed to commercial and recreational trapping and hunting with responsibility for removing nuisance beavers delegated to the Game Commission. During this time the bulletin stated:

> "*By 1945 when the emphasis was shifted to dead trapping and pelting [as opposed to transplanting nuisance beavers], over 3000 beavers had been relocated. A scarcity of suitable transplanting sites, increasing numbers of damage complaints, and* ***a rapidly increasing beaver population over the entire state necessitated this change. This restoration is a remarkable example of a fur species responding to protection and other management practices.*** *(p. 3-4)."* [Emphasis added]

Kebbe (1960) makes clear that trapping and hunting beavers were used as a means of population control:

> *"During the evolution of the present program, many changes in laws, policies, and procedures have occurred in attempts to keep abreast of population fluctuations. As more streams were brought into production and populations continued to increase, the number of damage complaints also multiplied. In 1942 only 656 beaver were removed from complaint areas, but by 1994 this figure exceeded 2,000." (p. 4)*
>
> *"The cropping of 6,000 beaver a year by state trappers under this program failed to remove a satisfactory number from complaint areas…"*
>
> *"It became obvious shortly after the [1952] season closed that beaver were far from annihilated in spite of the heavy trapping pressure. Complaints were received in numbers comparable to the previous year. One difference was noted however, in that most complaints involved only a pair of animals where previously large colonies had to be removed." (p.5-6)*

As this literature shows, closing areas to beaver trapping and hunting results in increases in beaver activity and distributions as long as the closures are at the proper scale and the regulations are clear. The role of scale and regulation clarity will be discussed later in the Historic and Existing Closures section where ODFW's existing closures are examined for effectiveness.

Petitioners Respond to ODFW's Population Statements

On June 12, 2020, ODFW's Wildlife Division presented information related to beaver populations based on its reported harvest data. ODFW wildlife staff stated that commercial and recreational beaver trapping/hunting has no effect on beaver populations because 1) harvest is below 30% of the total beaver population, 2) populations were stable based on their analysis of the Catch-per-Unit Effort, and 3) all available habitat is occupied. These statements are not scientifically defensible and are discussed below.

Impacts of Compensatory vs Additive Harvest Mortality Ignored

ODFW's claim that commercial and recreational beaver trapping/hunting has no effect on Oregon's beaver populations and distributions lacks supporting data and is counter to published literature. ODFW does not know how many beavers exist in the state or where they are. Beavers killed under the furbearer regulations are reported only by county and no other information is provided. Therefore, ODFW has no idea as to the age class, sex or pregnancy distributions of the beavers removed or those that remain. ODFW also has no information on family structure of the beavers removed or the number of beavers that die from other mortality causes occurring in an area. In stating that commercial and recreational beaver trapping/hunting has no effect on populations, ODFW ignores the fact that the beaver trapping/hunting season overlaps with the breeding and pregnancy season, and there is a two-year delay before kits begin dispersing.

ODFW"s claim can only be made if all beaver mortality caused by trapping and hunting was compensatory (animal would have died that year from other causes if not harvested). There is no scientific support for this assumption. As discussed earlier in this section, discriminating between Compensatory and Additive mortality is extremely difficult, as is quantifying which process dominates at any given time and place (Williams et al. 2001).[8] And contrary to ODFW's claim of no effect on populations and distributions, Kokko (2001) found that the timing of harvest may profoundly influence the impact on a population because reproduction usually does not coincide with mortality, a fact that ODFW ignores.[9]

Population Data Lacking

The population status of beavers in Oregon is unknown because ODFW, the agency responsible for monitoring and managing the state's fish and wildlife, has not been monitoring live beaver populations and distributions in the state. ODFW states this fact on slide 32 in their June 12 presentation to the Commission "*No contemporary nor science-based statewide population estimate exists."* After making this clear statement, ODFW presents a method for estimating a population based on a series of "if – then" assumptions (slide 35), none of which are verified.

The only real ODFW data available on beaver numbers is ODFW's harvest data of dead beavers, reported by county, and Wildlife Services data of dead beavers that is reported by state. However, there are five other mortality causes, none of which have data. They are beavers killed by humans under OAR 635-050-0050 (7) (no reporting requirement), beavers killed by humans for sport, beavers killed due to wild carnivore predation, beavers killed due to accidents (i.e. falling tree, hit by car), or death from natural causes (i.e. disease, old age).

The lack of information on live and total dead beavers and their locations across the state and on private vs. public lands means that there are only two defensible statements that ODFW can make related to beaver populations. They are that 1) some number of beavers are killed under the Furbearer Regulations and by Wildlife Services each year, and 2) beavers are present in all counties. Therefore, any live population estimates based on their assumptions are not supported.

Harvest Percent of Population Unknown

ODFW states that beaver harvest under the Furbearer Regulations is under 30% of the total population and therefore there is no effect on the population.[10] ODFW provides no scientific basis for this conclusion nor any data-based estimate of the harvest relative to the live population size. Rather, ODFW simply states "[t]hrough multiple studies, it is generally known that beaver populations can sustain an annual harvest of 30%...". ODFW then uses density estimates from outside Oregon and concludes "… nowhere in Oregon does the harvest likely come close to reaching that 30% population threshold.".[11] No citations are provided for these multiple studies. In addition, the statement ignores mortality from other causes which cannot be accounted for. The agency actually identified this problem in their 2005 publication titled *"The importance of beaver (Castor Canadensis) to coho habitat and trend in beaver abundance in the Oregon Coast coho ESU".* The agency states:

> *"Until recently ODFW has been able to reliably track the harvest of beaver in Oregon because all individuals trapping beaver were required to obtain a trapping permit and report their harvest. In the future, however, monitoring beaver harvest will be more difficult because recent changes in state regulations allow beaver to be killed on private lands without the need for a permit (Personal communication on Nov. 18, 2004 with Doug Cottam, ODFW District Wildlife Biologist)".*

The statement also ignores the fact that they have no live population or live or dead beaver location data. Thus, while beaver populations may be doing fine in some places, populations may be seriously on the edge in other areas. In addition, the use of an arbitrary generalized mortality rate of 30% of trapping and hunting of an unknown total population does not fit published population assessment models or conservation population goals.[12] Therefore, ODFW's statement that beaver furbearer mortality is under 30% of the total population is not scientifically defensible.

Finally, the question of harvest percentage of the population is not relevant to the Petition. The question is not whether there are enough beavers to trap and hunt but whether there are enough beavers to create and maintain the abundance and type of habitat needed to provide Oregonians and its fish and wildlife with critical ecosystem services in a time a rapidly changing climate. The answer this second question is no and the reason for the Petition.

Catch-per-Unit-Effort (CPUE) Method Unusable as Measure of Population Stability

ODFW's statement that their catch-per-unit-effort (CPUE) calculation indicates stable beaver populations is not supported by the scientific literature. The CPUE method is unreliable as a measure of population stability because it is based on the false assumption that there is a known relationship between effort and population size. This problem has been mentioned in wildlife management textbook as far back as 1984.[13] Contrary to ODFW's assumption about trap/hunt effort and population, success depends on who is trapping/hunting, when they are trapping/hunting, where they are trapping/hunting, conditions in the area, and distribution of beavers.

C. Habitat Availability

Abundant Unoccupied and Suitable Habitat Exists

Abundant unoccupied and suitable beaver habitat exists in Oregon. This reality is supported by results from the following three areas using readily accessible data.

1. Oregon coastal streams using ODFW's Aquatic Habitat Inventory (AHI) to assess recent location of beaver dams and ponds.

2. North Fork Burnt River watershed in eastern Oregon using the peer-reviewed Beaver Restoration Assessment Tool (BRAT)[14] to assess existing beaver dam potential.

3. John Day Basin in east-central Oregon also using the BRAT to assess existing beaver dam potential.

The areas presented in this section appear to have the habitat elements that beavers require or need only a small amount of human-driven restoration before beaver dams can persist. Examples of where some human-driven restoration might be needed are stream sections where channels have incised to the point that the stream power during high flows prevent the dams from persisting. This issue can be resolved by adding abundant large wood, creating debris dams, and/or building beaver dam analogs to decrease the unit stream power. In other areas, riparian vegetation may be minimal and restoration simply requires changing livestock grazing management to improve riparian habitat as seen at Susie Ck, Nevada.[15] In other areas some combination of passive and active human-driven restoration is required if restoration is to be accelerated. The combination occurred at some stream reaches in Bridge Creek, OR.[16] Therefore, field visits to the areas discussed below may find some sections requiring some human-driven passive or active restoration contribution before beaver dams can persist with many others simply lacking the ecosystem engineer.

ODFW Aquatic Habitat Inventories (AHI): Coast Range Streams

ODFW's Aquatic Habitat Inventory (AHI) database extends back to 1998. Seventeen one-mile reaches were selected for analysis (Table 2). They have multiple survey years and representing a broad cross-section of the coastal coho Evolutionary Significant Units. These reaches were examined for changes in beaver pond area and beaver dams over time (Appendix F, SI-3).The maximum beaver ponded surface area within each reach was compared to its most recent survey measurement of beaver ponded surface area to assess change. The totals of each group were then summed

Table 2. Location of the 17 AHI sites examined for changes in beaver ponds and dams over time

HUC 8	Coho Population	Creek		HUC 8	Coho Population	Creek
17080006	Big Creek	Gnat Ck trib		17100204	Yaquina	Montgomery Ck
17100202	Nehalem	Alder Ck		17100205	Alsea	Walker Ck
17100202	Nehalem	Buster Ck trib B				
17100202	Nehalem	Cedar Ck		17100206	Siuslaw	Russel Ck

HUC 8	Coho Population	Creek		HUC 8	Coho Population	Creek
17100202	Nehalem	Little Rackheap		17100206	Siuslaw	Russel Ck, sec 2
17100202	Nehalem	Sager Ck				
17100202	Nehalem	Selder Ck, trib B		17100303	Middle Umpqua	Heddin
17100203	Tillamook Bay	Joe Ck		17100304	Coos	Lillian Ck
17100204	Salmon	Curl Ck		17100306	Floras	Boulder Ck
17100204	Siletz	Miller Ck				

The analysis found that the beaver pond surface area has declined from 424,326 sq. meters to 34,818 sq. meters resulting in a massive decline in juvenile coho salmon rearing potential. This loss of beaver ponds leads to an estimated decline in adult escapement in these 17 stream reaches of 38,637 adult coho per year if fresh water habitats were fully seeded post winter (1.6 smolts / sqm of beaver pond surface area).[17] The loss of the beaver ponds is recent and it is likely that the habitat that recently supported the colonies that created and maintained these dams and ponds is still present in many places and available for colonization.

Beaver Restoration Assessment Tool (BRAT): North Fork Burnt River watershed and John Day Basin

The NFBR watershed and the John Day Basin were modeled using the Beaver Restoration Assessment Tool (BRAT) developed by Utah State University.[18] The model uses readily available spatial datasets for parameters which are key factors in determining suitable beaver habitat. The model then outputs an estimated number of dams per length of stream (dam density) and a rough count of the maximum number of dams an area could support (capacity) given the conditions in and surrounding the streams. The model takes into account the various ambiguities and uncertainties inherent in the following parameters (model inputs) and uses them to estimate potential current and historic beaver dam density. Parameters included in the model are:

(1) a reliable water source;
(2) stream bank vegetation conducive to foraging and dam building;
(3) vegetation within 100 m of edge of stream to support expansion of dam complexes and maintain large beaver colonies;
(4) likelihood that dams could be built across the channel during low flows;
(5) the likelihood that a beaver dam on a river or stream is capable of withstanding typical floods;
(6) evidence of suitable stream gradient; and
(7) evidence that river is too large to allow dams to be built and to persist.
(8) LANDFIRE vegetation data from 2014 to estimate existing vegetation conditions. Historic vegetation conditions estimates are also from LANDFIRE and represent a pre-European settlement model of vegetation.

The North Fork Burnt River watershed is 124,084 acres and located in eastern Oregon.[19] The BRAT estimated its existing watershed capacity for beaver dams at 7,019 dams with numbers of dams per mile varying as a function of stream conditions (Appendix F, SI-2). Figure 4 shows the variations in existing dam building capacity. This total number (7,019 dams) is in contrast to the 53 dams that virtual reconnaissance using Google Earth and ground-based field work identified.

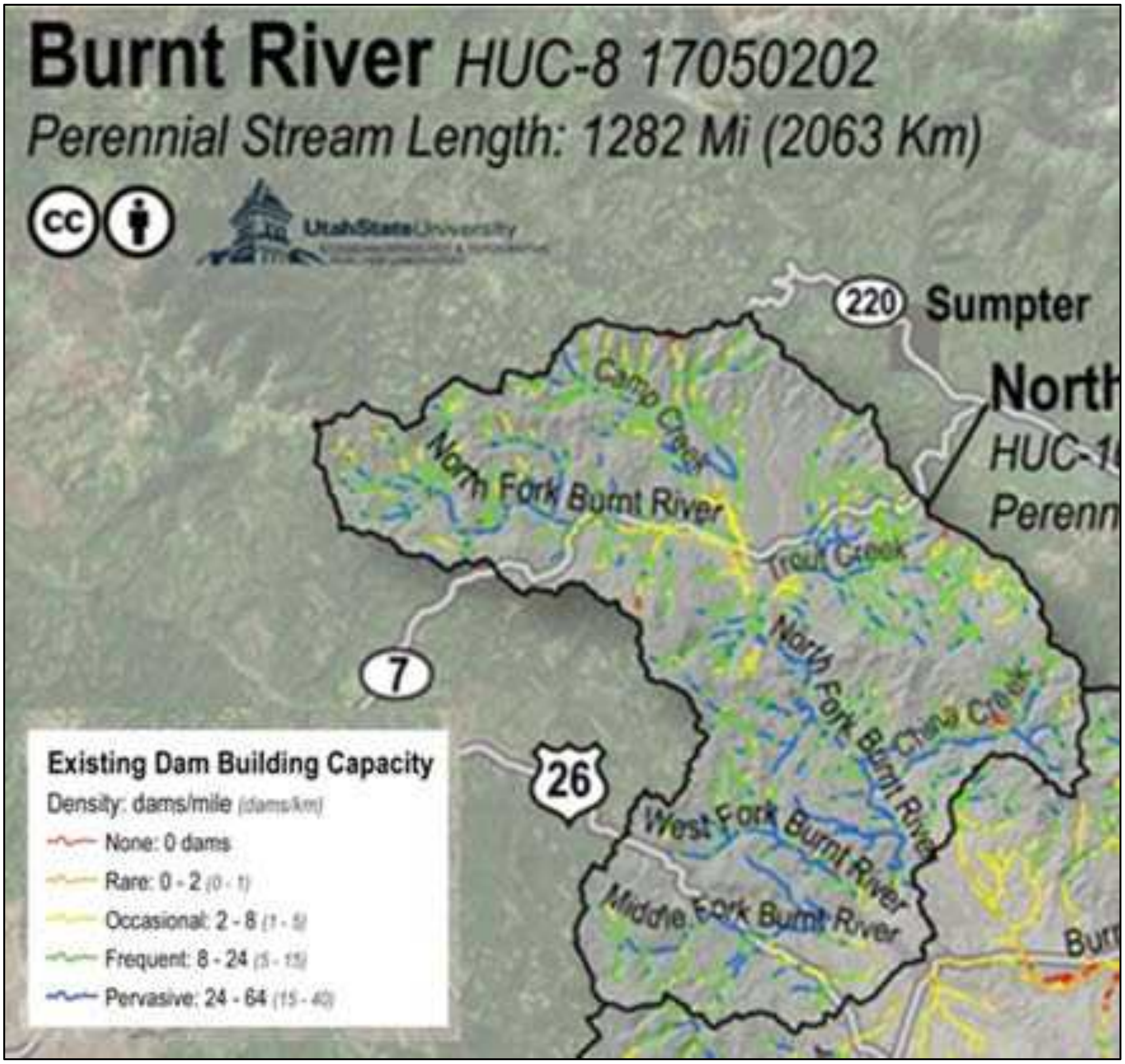

Figure 4: Close up of modeled beaver dam capacity for existing condition for the North Fork Burnt River watershed (MacFarlane et al 2019).

The John Day basin is 5.19 million acres and located in east-central Oregon. Given the size of the basin the model was run for its four subbasins: Lower John Day (2 million acres), Middle Fork John Day (508,000 acres), North Fork John Day (1.2 million acres), and Upper John Day (1.3 million acres). The maximum estimated existing dam capacity for the four subbasins ranged from 16,889 to 51,241 dams (Appendix F, SI-2).[20]

The existing dam capacity numbers for the NFBR watershed (7,019 dams) and the John Day basin (120,945 dams) represent upper limits. Given the uncertainties in the model inputs, the numbers are likely smaller. However, even if only 50% of potential dams actually were built and persisted, there would be 3,510 dams in the NFBR watershed and 60,407 dams distributed throughout the four subbasins of the John Day Basin. If one is even more conservative and assumes only 25% of the potential dams are actually built and persist, we are still looking at 1,755 dams for the NFBR watershed and 30,204 dams in the John Day subbasin. These numbers are much greater than current conditions and indicate considerable available unoccupied habitat.

Conclusions

These three examples show that there is abundant, unoccupied beaver habitat in Oregon. The examples also showcase some of the methods that can be used to assess the entire state. They also provide an idea of the scale of beaver habitat expansion possible with its accompanying ecosystems services of improved water quality and availability, fish and wildlife habitat, wildfire safety zones, and carbon capture and store zones to name a few.

Petitioners Respond to ODFW's Limited Habitat Availability Statements

On June 12, 2020, ODFW stated in their regulation proposals, a PowerPoint presentation, and in response to questions from the Commission that lack of habitat was the greatest factor limiting beaver expansion. They used county reported harvest data and made claims regarding habitat requirements to support this conclusion. The claims regarding habitat requirements were: 1) beavers require early seral habitat, 2) early seral habitat is lacking due to lack of fire and timber harvest, and 3) a beaver colony requires 18 acres of willows a year. Each of these is refuted below as is the assumption that county data can provide any information about habitat availability and occupancy.

County-Reported-Take Data Not a Measure of Available Habitat

ODFW states in their Furbearer Regulations Proposal (p. 8) that "*In the last 5 years, beaver harvest has occurred in 35 of 36 Oregon counties (no harvest in Curry Co since 2011) (Table 1) <u>and beaver continue to be found everywhere there is beaver habitat</u>.*" [emphasis added] No supporting documentation was provided to support the statement that beaver continue to be found everywhere there is beave habitat. In contrast, examination of existing data makes it clear that no link exists between reported harvest and habitat availability.

First, harvest data are reported by county only. No other location information exists. Second, counties range in size from 435 to 10,135 sq. miles with varying amounts of public and private lands (Table 3). Third, the counties have a combined total of 292,856 miles of stream that are 4th order or less.[21] These are the stream orders that beavers build dams on. The size of the counties and the miles of streams within the state make it impossible to link beaver take numbers with any statements about habitat availability. How, for instance, can a reported take of 12 beavers in FY 2017-2018 in Baker County (3,068 sq. miles) say anything about the amount of habitat in the county? Or the reported take of 32 beavers in Klamath County (5,945 sq. miles)? Or the reported take of 11 beavers in Grant County (4,529 sq. miles)? Does zero take mean zero habitat? The answer is clear --t no information can be gleamed from county harvest data about habitat availability.

In addition, the Oregon Coast Range, the North Fork Burnt River watershed and the John Day Basin examples above document the presence of unoccupied and suitable habitat. It is highly unlikely that these three examples represent the sum total of suitable and unoccupied habitat on the roughly 32 million acres (50,000 sq. miles) of federally-managed public lands in Oregon.

Table 3. Size of Oregon's Counties, reported beaver take, and percentages of county ownership/land management.

			% County Ownership/Land Management		
County	Area (sq. miles)[1]	FY 2017-2018 reported beaver take[2]	Federally-managed Public Lands[3]	State-managed Public Lands[4]	Private, County, City lands
Baker	3,068	12	51	1	48
Benton	676	66	18	6	76
Clackamas	1,868	21	54	1	46
Clatsop	827	95	0	29	71
Columbia	657	56	4	4	92
Coos	1,600	29	22	7	71
Crook	2,980	15	50	1	50
Curry	1,627	0	61	1	38
Deschutes	3,018	19	75	3	22
Douglas	5,037	15	51	1	48
Gilliam	1,204	0	7	1	92
Grant	4,529	11	59	1	40
Harney	10,135	1	72	3	25
Hood River	522	7	74	1	25
Jackson	2,785	9	52	0	48
Jefferson	1,781	5	51	0	49
Josephine	1,640	29	67	1	32
Klamath	5,945	32	56	3	41
Lake	7,940	12	75	2	23
Lane	4,554	117	57	1	42
Lincoln	980	17	31	4	65
Linn	2,291	86	38	2	60
Malheur	9,888	50	74	5	22
Marion	1,185	60	25	5	71
Morrow	2,033	5	16	0	83
Multnomah	435	1	34	2	64
Polk	741	32	10	2	88
Sherman	823	0	11	2	88
Tillamook	1,102	36	29	44	27

			% County Ownership/Land Management		
County	Area (sq. miles)[1]	FY 2017-2018 reported beaver take[2]	Federally-managed Public Lands[3]	State-managed Public Lands[4]	Private, County, City lands
Umatilla	3,215	32	25	1	74
Union	2,037	28	48	1	51
Wallowa	3,145	7	57	1	42
Wasco	2,381	12	42	2	56
Washington	724	50	4	11	85
Wheeler	1,715	1	26	0	74
Yamhill	716	54	16	0	84

[1]https://en.wikipedia.org/wiki/List_of_counties_in_Oregon
[2]ODFW electronic data
[3]https://www.oregonlive.com/news/erry-2018/07/8738566d8d2532/fight-for-public-land-which-or.html
[4]State of Oregon State Land Inventory Report (2017). https://www.oregon.gov/dsl/Land/Documents/2aSLIStateOwnershipbyCounty.pdf

Early Seral Habitat Not Required

ODFW states that beavers need "early seral habitat" and that fire suppression and lack of logging in riparian areas have limited this habitat type. This statement is not supported on three accounts. First, beavers are food generalists and thus take advantage of a wide variety of vegetation.[22] In addition, beavers are able to utilize a variety of habitat conditions and expand and transform them through foraging behavior and alteration of water tables. This ability to transform and expand habitat is shown in the Bridge Creek, OR and Susie Creek, NV photo series (Appendices D-1, D-2). It is also supported by ODFW's June 12, 2020 PowerPoint presentation where they state [beavers] *"Demonstrated use of highly manipulated and urban systems"* (slide 44). Since beavers can and do use highly manipulated and urban systems, they certainly do not require early seral habitat to successfully create and maintain habitat.

Second, ODFW's statement that early seral habitat is lacking due to fire suppression is incorrect. Wildfires have been common over the last 10 years (2009-2019) and more than 5.66 million acres of Oregon have burned.[23] These fires have triggered abundant regrowth of fire-adapted riparian vegetation and removed some of the overstory competition. Therefore, wildfires in Oregon are creating large areas where early seral vegetation is present. In addition, the frequency and sizes of wildfires are expected to increase with climate change, creating even more early seral vegetation. However, as stated above, beavers are generalists when it comes to food, so they are not restricted to early seral vegetation.

Finally, ODFW's statement that early seral habitat is lacking due to lack of timber harvest in riparian areas is also incorrect. Beavers predate commercial timber harvests in Oregon and were once much more abundant. Therefore, forests do not preclude beavers and dam building. In fact, properly functioning hydrological flows in forests facilitate more dams, side channels, and floodplain connectivity if coupled with abundant large tree instream structure. Second, creating hardwood and riparian species diversity has been identified in guiding vegetation management documents for federal land management agencies such as INFISH (1995) and

PACFISH(1995).[24] Therefore, while there are land managers who focus solely on growing conifers to the detriment of riparian vegetation and hardwoods, other land managers are incorporating actions to maintain and expand hardwoods and riparian species diversity in project areas. And again, as stated above, beavers are generalists when it comes to food, so they are not restricted to early seral vegetation.

Eighteen Acres of Willows per Year Not Required

ODFW stated that a beaver colony needs 18 acres of willows per year. ODFW made this assertion in their 2020 Furbearer Regulation Proposals (p. 8), in a presentation to the Commission on June 12, 2020 by Mr. Derek Broman (ODFW Carnivore/Furbearer Coordinator), and in Mr. Broman's responses to questions from the Commission. This claim has also been made by Ms. Vanessa Petro, an Oregon State University Senior Faculty Research Assistant who is a member of the ODFW Beaver Working Group and often collaborates with ODFW on beaver management issues. The assertion shows up in her February 2020 PowerPoint presentation to the Beaver Working Group. She repeats this assertion in *Episode 18* in ODFW's Beaver State podcast. the July 2020. No citation has been provided in any of these public presentations or written documents. In all instances, the 18 acre assertion is simply stated as fact. However, this assertion is not supported by the published literature which show that beavers are food generalists and use a variety of food sources.[25] It is also not supported by published literature that documents the ability of beavers to create, modify, and expand their habitat in areas with much less than 18 acres of willow.[26] It is also not supported by ODFW's PowerPoint presentation on June 12th which states that beavers have "*Demonstrated use of highly manipulated and urban systems"* (slide 44) or by the Bridge Creek, Oregon and Susie Creek, Nevada photo series (Appendices D1, D2).

The unsupported assertion is of concern because it is being stated in multiple venues as a key reason why beaver habitat is lacking. Therefore, the Petitioners requested the source of the 18 acres information. ODFW did not respond to our request and Ms. Petro responded but did not identify her source. Instead she provided three citations (1-3 below) that she said referenced the number. A separate search for possible source lead to a 1956 unpublished thesis.

1. Blackwell, B. H., & Pederson, J. C. (1993). Beaver distribution, habitat, and population survey (19711982). Utah Division of Wildlife Resources, Salt Lake City.

2. Saldi-Caromile, K., Bates, K., Skidmore, P., Barenti, J., & Pineo, D. (2004). Stream habitat restoration guidelines, Final draft. Washington Departments of Fish & Wildlife and Ecology, and the U.S. Fish and Wildlife Service. Olympia, WA.

3. Vore, J. (1993). Guidelines for the Reintroduction of Beaver into Southwest Montana Streams. Montana Department of Fish, Wildlife, and Parks.

4. MacDonald, D. (1956). Beaver carrying capacity of certain mountain streams in North Park, Colorado. M.S. Thesis. Colorado Agricultural and Mechanical College, Fort Collins, CO. 126 p.

We were able to acquire documents 2, 3, and 4 above with difficulty but not the Blackwell and Pederson document despite outreach to colleagues in Utah with connections to the Division of Wildlife. Upon reviewing the three documents, we found that the 1956 thesis was not the source of Ms. Petro's and ODFW's information, leaving us to conclude that the 18 acres statement came from the 2004 Washington State report. This assumption is based on the fact that the reference slide in Ms. Petro's February 2020 presentation lists both the 2004 report (citation 2) and the MacDonald (1956) thesis (citation 4) and an email in which she stated that she only has the 2004 report and portions of the thesis. The February 2020 PowerPoint appears to be the first time the 18 acres value is presented as a limiting habitat factor.

During our review we discovered that the 18 acres of willows per colony per year was created in 1993 by Vore and has no scientific basis. Below are our findings starting in 1956 with the MacDonald's unpublished master's thesis.

1. 1956: The title of the graduate student's thesis is *"Beaver carrying capacity of certain mountain streams in North Park, Colorado."* From the beginning the results are intended to be site specific (i.e. "certain mountain streams"). His five study sites are located at 8600 – 9000 feet elevation in North Park, Colorado in an area where aspen and willow dominate. The question he sought to answer was: "*What are the food requirements of a colony of beavers for sustained occupancy of a section of stream?[carrying capacity]"* He concluded that "*0.041 acres of aspen or 0.413 acres of willow, or combinations of lesser amounts of the two, would support one beaver for one year."* This equates to a yearly requirement of 0.25 acres of aspen or 2.5 acres of willows for a colony of 6 beavers for a year. Given this requirement, he estimated that 12 acres of willow or 4 acres of aspen or some combinations could provide a food and building material source that would be self-sustaining given growth rates of the two species at his sites.

2. 1993: Thirty-seven years later, Vore (1993) takes MacDonald's (1956) conclusions regarding 12 acres willows and 4 acres aspen and their ability to sustain a colony of beavers into the distant future and defines them in a new ways in his text and Table 1 (shown below).

Table 1. Carrying capacity by acreage and food types, North Park, Colorado, expressed as acres per colony per year[1] (from MacDonald 1946).

	Good	Average	Poor
Food Type[2]	Tall, ave. 40'; closed stand	Med., ave. 30'; ½-closed stand	Low, ave. 20'; open stand
Aspen	4	6	8
Willow	12	18	25

[1] Subject to modification as more extensive data become available.
[2] In the absence of competition from livestock and big game.

He defines MacDonald's (1956) 4 acres of aspen and 12 acres of willows as closed stands, defines them qualitatively as "Good", and references the aspen by heights, not diameter. Using MacDonald's two numbers, Vore makes some assumptions and proceed to generate two new sets of numbers and habitat categories. He doubles MacDonald's numbers to get 25 acres of willows[27] and 8 acres of aspen, defines these as open stands and gives them a qualitative value of Poor. He averages the Good and the Poor values to arrive at 18 acres willow and 6 acres aspen for his Average conditions which he defines as 1/2 closed stands.

Vore does not mention that he is the author of these numbers or explain how he arrives at the Average and Poor values. Instead he explicitly attributes all values to MacDonald (1956), implying that the numbers are based on research. His method was determined by Dr. Suzanne Fouty, one of the petitioners, after reviewing both documents.

Vore further confuses matters by incorrectly stating in his text that the values in Table 1 represent a yearly requirement for a colony of beavers. Then he states in the Table 1 caption "Carrying capacity by acreage and food types" and "expressed as acres per colony per year". These two descriptions have very different meanings – one the long-term sustainable amount (carrying capacity), the other a requirement that must be met every year. MacDonald was describing the former for his sites.

Vore does, however, provide several caveats to the numbers he presents. One caveat is found in his statement: "*It should be borne in mind that these acreages are for aspen-and/or willow-only diets and that beaver eat other foods. Therefore sites with less than the acreages given in Table 1 may still be tenable by beavers."* The other caveat occurs earlier in his <u>Food section</u> when he references authors who have identified cottonwood, alder, birch, chokecherry, wokas, lodgepole pine, Douglas fir, Engelmann spruce, shrubby cinquefoil and a variety of herbaceous vegetation such as water lily, potamogeton, sagittaria, and elodea as foods used by beavers. This variability makes clear that beavers are food generalists and not limited to willows and aspen.

3. 2004: Eleven years later, one set of Vore's (1993) numbers is selected to be included in the 2004 Washington Stream Habitat Restoration Guidelines report. The 2004 Washington report selects Vore's average numbers of 18 acres willow or 6 acres of aspen and drops the limited discussion surrounding the table and the caveats attached to the 1993 numbers. The 2004 report references 18 acres of willow and 6 acres of aspen in two places as restoration site recommendations but never as a yearly requirement:

> "*Beaver can be reintroduced to any watershed where they have been extirpated within the following parameters: There is an adequate food source (at least 18 acres of willow or 6 acres of Populus species within 100 feet of the stream) and dam building materials [Vore 1993]." (the 345th page)*
>
> *"In any stream where beaver restoration is being considered, first evaluate whether the habitat is suitable and if beavers once used the area. Eight variables are helpful in this evaluation: (the following information is **<u>adapted</u>** from Vore 1993 [emphasis added]: Food – winter food is often a limiting factor. There should be at least 18*

acres of willow or 6 acres of Populus species within 100' of the stream per beaver colony." (346th page)

In their adaptation, the 2004 report states that this food source should be within 100 feet of a stream but makes no reference to any timeframe, while Vore (1993) used those numbers for within 100 yards (300 feet) of the stream, not 100 feet and states in his text that these are yearly requirements. Whether this change is an error (100 yards to 100 feet) or intentional is unknown. However, like Vore (1993), the restrictive food recommendation is not supported elsewhere in the report. The 2004 report makes frequent mention of the ability of beavers to create, modify, and expand their habitat and their ability to help restore degraded stream/riparian systems. This ability of beavers to restore degraded systems is in direct opposition to the reintroduction recommendation of 18 acres of willows or 6 acres of aspen.

4. 2020: 16 years later, ODFW in their Furbearer Regulation Proposals, Mr. Broman in his June 12th Commission presentation and Ms. Petro in two public forums state that 18 acres of willows are required per year per colony, but never cite a source. As the above discussion should make clear, the 18 acres of willows number is simply a number Vore created based on assumptions he made about MacDonald's results, falsely attributed to MacDonald (1956), and incorrectly described in his text as a yearly requirement. Vore's misrepresentation was then picked up in 2004 Washington report and further reframed, only to be picked up in 2020 and reframed yet again by Mr. Broman and Ms. Petro as an absolute yearly requirement for a colony of 6 beavers.

In conclusion, our investigation into the 18 acres of willows statement found that this number is not based on any research. It does not accurately reflect beaver habitat requirements. Therefore, this value should have no bearing on our request for an amendment to the Furbearer Regulations.

<u>Two final notes.</u> The assertion that "18 acres of willow per year are required by a colony of beavers" needs to be removed immediately from all ODFW documents and presentations, including Ms. Petro's February 2020 presentation to the Beaver Working Group and the July 2020 Beaver State podcast (Episode 18). Allowing this incorrect assertion to remain is disrespectful to the public and their efforts at restoration and will only confuse things in the future. It also disrespectful to those who disagree with the Petition because it places them in the awkward position of stating an incorrect assertion as justification for any concerns they have with the Petition which wastes theirs' and the Commission's time.

In the future, any information provided by ODFW and used in decision making should be readily accessible to the public. This information was not. None of the four citations have been easy to acquire. With effort we were able to obtain the 2004 Washington and 1993 Montana reports but not the 1993 Utah report. We were able to acquire a copy of the 1956 thesis thanks to the efforts of a colleague at Colorado State University. The difficulty in acquiring these documents matters because ODFW presents this assertion as supporting information that lack of habitat is the greatest limiting factor preventing beaver expansion. Statements of this magnitude should be easy to confirm or correct. Transparency and ease of access to information is in the best interest of the public and Oregon's fish and wildlife.

D. Historic and Existing Closures

Closure History of Beaver Trapping and Hunting in Oregon

The 1960 Oregon Game Commission Bulletin provides an overview of the history of beaver trapping and hunting closures in the state from 1899 to 1952. The bulletin reveals two periods when the state is mostly or completely closed: 1899 -1923 and 1932 to 1952 (Table 4). The second statewide closure ended in 1952 when the legislature gave the Game Commission the authority to set trapping seasons and bag limits in 1951.

The next closure information we found is the 1980 Furbearer Trapping and Hunting Regulations. Based on the 1980 Furbearer Regulations, 24/36 counties are fully open with the remaining 12 having select closures. As of 2020, the number of counties fully open is 28/36 with 9 counties having select closures. As will be discussed later in the Petition, the closure language from 1980 on is ambiguous and in places so highly restrictive as to make most closures biologically ineffective based on the behavior and needs of beavers.

Table 4. Timeline of state closures from 1893 to 1952 from Kebbe (1960). 1980 and 2020 information showing what is open is from ODFW Furbearer Regulations for those years.

Year	Action	Time span between actions	Federally-managed public lands closure status
1893	closed season in Baker and Malheur Counties	*****	open
1899	State-wide closure	6 years	National Forests closed
1917 and 1918	Open Marion and Benton counties	18 to 19 years	National Forests open in Marion and Benton Counties. National forests closed everywhere else.
1923	Open entire state except National Forests and 5 SW counties (Coos, Curry, Douglas, Jackson and Josephine)	5 to 6 years	National Forests closed
1931	State closes trapping in all parts except Clatsop, Columbia, Multnomah, Marion and western Douglas County	8 years	National Forests remain closed
1932	Remaining open counties closed. Beaver relocation begins into mountain streams by US Forest Service, Bureau of Biological Survey (becomes USFWS in 1940) and Game Commission	1 year	National Forests remain closed
1937	Legislative action supports closures and delegates Game Commission responsibility of removing nuisance animals.	5 years	National Forests remain closed
1938	Federal Aid in Wildlife Restoration Act passed. Federal funds became available to the various states for wildlife research and management	1 year	National Forests remain closed

Year	Action	Time span between actions	Federally-managed public lands closure status
1946	Bureau of Land Management established	8 years	National Forests remain closed and BLM lands closed because state is closed
1951	1951 legislature passed a bill delegating broad powers of management to the Game Commission. Under the statute the Commission obtained the authority to set seasons and bag limits, open streams or areas and promulgate such other regulations as deemed necessary. Its initial action was to declare a three-month open season, the first in Oregon in 30 years, for the following November. In general, only agricultural lands were opened in order to confine trapping to areas of damage and prevent overtrapping on mountain streams.	5 years	National Forests remain closed and it looks as if BLM lands remain closed because it states only agricultural lands were open. BLM continued closure however uncertain.
1952	First 3-month open season in 30 years	1 year	National Forests remain closed and it looks as if BLM lands remain closed because it states only agricultural lands were open. BLM continued closure however uncertain.
1980	Counties open in their entirety (24): Baker, Benton, Clatsop, Columbia, Deschutes, Douglas, Gilliam, Grant, Harney, Hood River, Jackson, Klamath, Lane, Linn, Lincoln, Morrow, Multnomah, Polk, Sherman, Tillamook, Washington, Wasco, Wheeler, Yamhill. Counties with select closures (12): Clackamas, Coos, Crook, Curry, Jefferson, Josephine, Lake, Malheur, Marion, Umatilla, Union, Wallowa	n/a	Very limited closures on federally-managed public lands.
2020-2020	Counties open in their entirety (28): Baker, Benton, Clatsop, Columbia, Coos, Deschutes, Douglas, Gilliam, Harney, Hood River, Jackson, Klamath, Lake, Lane, Lincoln, Linn, Lincoln, Malheur, Marion, Morrow, Multnomah, Polk, Sherman, Tillamook, Umatilla, Wasco, Washington, Yamhill. Counties with select closures (9): Clackamas, Crook, Curry, Grant, Jefferson, Josephine, Union, Wallowa, Wheeler	n/a	Very limited closures on federally-managed public lands. Grant and Wheeler Counties get select closures on federally-managed public lands between 1980 and 2020. Coos, Lake, Malheur, Marion, and Umatilla Counties lose their closures between 1980 and 2020.

Criteria for Effective Closures

In preparation for our June 12, 2020 request to close federally-managed public lands to commercial and recreational beaver trapping and hunting, we examined the closure language in the beaver harvest seasons regulations (OAR 635-050-0070) for clarity and effectiveness. As part of this effort we mapped the existing closures based on our best assessment of regulation language (Appendices A and E). Detailed maps are presented for six of the closures to illustrate why many of the closures are ineffective (Appendix E, Maps 4a-4f).

Biologically-effective closures require that closure size and characteristics match the needs and behavior of the species in question. Beavers have been well studied (Appendix B) and their habitat needs, behavior and movements can be anticipated. They use both water and land, foraging up to 100 meters (328 feet) from the stream. They build and maintain multiple dams . They travel about the landscape. Records from the Methow Valley Project show that some beavers have travelled almost 100 km (62 miles).[28] Finally, they have preferences for certain stream characteristics. Therefore, we determined that a biologically-effective beaver closure must meet the following criteria:

1) The streams and the land are closed,
2) The stream and all its tributaries are closed,
3) The closure is an appropriate size to allow movement and dispersal,
4) The closure has suitable habitat,
5) Rule language is clear that the trapping and hunting closure applies to land and water,
6) Rule language is clear with respect to all jurisdictions that fall within a closure area (i.e. private inholdings, national monuments, state parks etc.).

Assessing ODFW Closure Language

In reviewing the language and mapping out closures, we found the regulation language to be ambiguous, highly restrictive, and/or out-of-date. The result is that most closures are either ineffective or having a high probability of being ineffective. The exceptions appear to be the Ochoco National Forest closure and possibly the Bridge Creek and its tributaries on BLM managed ground closure. However, the Bridge Creek closure has some language ambiguity that places its effectiveness at risk.

Rule Language Ambiguous and Ineffective

Three phrases compromise the effectiveness of existing closures. They are: 1) “within the exterior boundaries”, 2) “all open except those waters…”, and 3) “….creek and its tributaries…”

The phrase **“within the exterior boundaries…”** is ambiguous because it is unclear if private inholdings or parcels of land under other jurisdictions are included or exempt from the restrictions. This ambiguity matters because private inholdings are common on federally-managed public lands and often contain a portion of the stream system. Less common but still occurring are lands that fall under a different federal, state, or county jurisdiction.

The phrase **"all open except waters …"** or **"….creek and its tributaries…"** or the **naming of a specific river or creek** makes the closures with this language ineffective because it excludes the land base in the closure. This allows trapping on land and places the beavers at risk when foraging for food and building materials or when dispersing.

Rule Language Out-of-Date with Respect to Private Land Closures

The Furbearer Regulation related to beaver trapping and hunting (OAR 635-050-0070) recently approved on June 12, 2020 is out-of-date, and has been since 2013, due to statute changes related to beaver's predatory animal status. Prior to 2013, Oregon wildlife laws (ORS 496.004(8)) defined all beaver in the state as furbearers, regardless of land ownership. A take permit and reporting were required under the Furbearer Regulations. Meanwhile, predatory animal statutes (ORS 610.002, ORS 610.060, ORS 610.105) listed all rodents (which include beaver) as "predatory animals", overriding wildlife laws when landowners (or their agents) take predatory animals on their own land.

In June 2013, the definition of the beaver in OAR 635-050-0050 (7) was changed to bring the furbearer statutes/regulations and the predatory animal statutes into agreement. As a result, beaver ceased to be considered strictly a furbearer and are now managed as both furbearer and predatory animal depending on circumstances. There is no reporting requirement for take under this statute. Therefore, the harvest data underrepresents the number of beavers legally killed.

> *OAR 635-050-0050 (7): "Furbearers or furbearing mammals" means beaver, bobcat, fisher, marten, mink, muskrat, river otter, raccoon, red fox, and gray fox. For any person owning, leasing, occupying possessing or having charge of or dominion over any land (or an agent of this person) who is taking or attempting to take beaver or muskrat on that property, these two species are considered to be predatory animals.*

OAR 635-050-0050 (7) substantially reduces the effectiveness of any existing closure on private lands by classifying beavers as predatory animals because a private landowner, and any one they designate as 'agent', can now kill beavers on their property anytime without reporting. Therefore, the Furbearer Regulations (OAR 635-050-0070 need to be updated to accurately reflect this situation.

Assessing ODFW Closures for Effectiveness

Effective ODFW Closures

Based on the criteria identified above for a biologically-effective closure, only the Ochoco National Forest and the Bridge Creek closures are appropriately sized and only the Ochoco National Forest closure met all six criteria.

The closure language for the Ochoco National Forest closure is unambiguous. The closure applies to both land and water in all counties on this national forest. The restoration value of the Ochoco closure was made clear in a letter from the Ochoco's Forest Supervisor dated May

15, 2020 to ODFW staff in response to questions related to the closure. The Forest provided "two spreadsheets that describe and summarize restoration work that has been accomplished in the recent past, is ongoing, or is planned in the near future, along with stream survey/monitoring data that identifies beaver occupancy." In addition, the Forest Supervisor responded as follow to a question from ODFW related to "Beaver populations increasing and empirical data supporting this determination [request for continued closure]":

> *It is very rare that the USFS conducts a population census for wildlife species that fall under management by ODFW. With that said, the FS does often support efforts to assist ODFW with population census efforts that would benefit specific habitat work or focus our management where it is needed. Although no population estimates have been developed for beavers on the Ochoco NF and CRNG [Crooked River National Grassland], our stream inventory data documents beaver occupancy by stream and reach. Stream surveys are replicated over time and data is entered into our corporate database. This data can be referenced to display changes in beaver occupancy over time, based on the numbers of surveys completed. This data can be queried and provided to ODFW upon request.*

The Bridge Creek closure appears to be effective based on several studies in the area even though the closure language is more ambiguous (within the exterior boundaries) and limits the closure to the streams (Map 4b).[29] However, existing closure language puts this area at risk since the land adjacent to the streams is not closed and the closure status of the National Monument is unclear.

Ineffective ODFW Closures

The remaining 14 closures are ineffective because 1) the closure applies only to the water or streams, 2) they are only a single stream and tributaries are open, 3) closure status varies along the stream, and/or 4) portions of the closure have limited suitable habitat. All fall into at least two categories:

Closure Limited to Water or Streams: All closures, except the Ochoco National Forest, fall into this category. The regulation language restricts these closures to only the water or only the stream. The adjacent land base (foraging area) remains open to beaver trapping and hunting.

Single Stream: Two closures fall into the single stream category: Murderers and Deer Creeks on the Malheur National Forest (Map 4e) and the Rogue River in Josephine and Curry Counties (Map 4f). Only the main stems are closed while all of their tributaries remain open.

Shifting Closure Status: Three closures fall into this category. They are Willow Creek and its tributaries in the National Grasslands (Map 4a), Bridge Creek and its tributaries (Map 4b), and the Grande Ronde River and its tributaries (Map 4c). The closure status shifts between open and closed as the stream moves through different land management areas or ownership. The shifting closure status may make the closure ineffective (depending on the size of the closed areas) because beavers build multiple dams and move throughout their territory. Therefore, a beaver colony might build on both closed and open parts of the streams. If the colony is trapped in an open portion, none of the dams will be maintained and beaver-created habitat will eventually be lost in the closed area.

Limited Suitable Habitat: Availability of suitable habitat varies within a stream system. Therefore, all existing closures are expected to have some areas where beaver dams would not be able to persist due to stream characteristics or vegetation is limited. In some cases, limited human-driven restoration would be able to provide the missing piece for successful dam building.

Petitioners Respond to ODFW's Closure Misrepresentations

Closures and Beavers at Risk on Public Lands Grazing Allotments due to Incorrect Statement in ODFW Publication

The uncertainty created by overlapping furbearer/predatory animal regulations is exacerbated by ODFW's incorrect interpretation of who can kill beavers under the OAR 635-050-0050 (7) definition. In their "Living with Wildlife: American Beaver" document[30] they incorrectly state that public lands grazing permittees can take predatory animals under the predatory animal statutes. This inaccuracy is stated on page 9 under their "Explanation of terms":

> *"Predatory animals" means coyotes, rabbits, rodents, and feral swine which are or may be destructive to agricultural crops, products and activities. This definition is applicable where wildlife is taken under the authority of one who owns leases, occupies, possesses or has charge or dominion over the land.* ***On public land this typically includes one who has a grazing lease.*** *Refer to ORS 610.105 [Authority to control noxious rodents or predatory animals]. [emphasis added]*

ODFW's interpretation of grazing rights is not supported by federal grazing law and must be immediately corrected to prevent permittees from illegally taking beavers. Federal grazing law, and court decisions interpreting those statutes, make clear that obtaining a permit from a federal land management agency to graze livestock on federal public land "does not create any property rights." *See United States v. Estate of Hage*, 810 F.3d 712, 716-20 (9th Cir. 2016) (citing 43 U.S.C. § 3315b ("[T]he issuance of a permit pursuant to the provisions of this subchapter shall not create any right, title, interest, or estate in or to the lands."); *see also* 16 U.S.C. § 580l ("[N]othing herein shall be construed as limiting or restricting any right, title, or interest of the United States in any land or resources."); 43 U.S.C. § 1752(j). The Ninth Circuit Court of Appeals has "long…held that a grazing permit 'has always been a revocable privilege" and is not a 'property right." *Id.*

A grazing permit is akin to many other permits issued for use of our public lands – it does not convey property rights, or any kind of control or dominion over the land. A permittee has simply been granted limited permission to allow livestock to graze certain lands under various time, place, and manner restrictions imposed by the federal land management agency. It does not grant the permittee the rights that would be needed to have "charge or dominion over the land."

Therefore, a public lands grazing permittee cannot legally kill beavers outside the furbearer season. Any take is limited to the hunting and trapping season and requires a permit and reporting. ODFW needs to correct this inaccuracy.

ODFW Inflates Closure Sizes in Furbearer Regulations Proposal's Table 2

The caption for Table 2 in the ODFW June 12, 2020 Regulations Proposal on page 11 reads "Current areas explicitly closed to beaver harvest in Oregon." However, the caption overstates the extent of many of the closures as shown below.

1) Table 2 lists the entire Malheur National Forest in Grant County as closed. This is incorrect. Only the main stems of Murderers Creek and Deer Creek. All of their tributaries are open (Map 4e).

2) Table 2 lists the Grande Ronde River as fully closed by listing its name under location. This is incorrect. Closure status varies along the Grande Ronde River as the river moves in and out of national forest (Map 4c). This statement is further incorrect because all the streams on private lands that the regulations list as closed now fall under OAR 635-050-0050 (7). Beavers can now be legally killed any time and not reported if done under the confines of the regulation.

3) Table 2 lists the Wallowa River as fully closed by listing its name under location. This is incorrect. The regulations only apply to a small reach of river on private ground upstream of Wallowa Lake (Map 4d). The rest of the river is open to beaver trapping and hunting. This statement is also incorrect because closed rivers flowing through private lands now fall under OAR 635-050-0050 (7). Beavers can now be legally killed any time and not reported if done under the confines of the regulation.

4) Table 2 lists Bridge Creek as currently closed, though, in reality, the closure is more limited. The regulations only close Bridge Creek and its tributaries within the exterior boundaries of the Bureau of Land management lands (Map 4b). However, the phrase "within the exterior boundaries" is ambiguous because it is unclear if the closure applies to private inholdings and National Monument surrounded by BLM ground. While the status of the National Monument remains uncertain. Also, the regulation only specifies that the creeks are closed. The land base surrounding the creeks remains open.

5) Table 2 lists the Mt. Hood National Forest as closed in Clackamas County, but the regulations only says the "waters" are closed, legally allowing beaver trapping and hunting on land. In addition, the Forest also occurs in Hood River, Multnomah, Wasco and Marion Counties where it is open to beaver trapping and hunting. If one is unaware of the location of the national forest boundaries, the limited extent of the closure is missed. In addition, all private inholdings now fall under OAR 635-050-0050 (7). Beavers can now be legally killed any time and not reported if done under the confines of the regulation

6) Table 2 lists the Umatilla National Forest and Wallowa-Whitman National Forest as closed in Union County, but the regulations only say the "waters" are closed. Therefore,

beavers can be trapped and hunted on the land surrounding the waters. The table and the discussion also neglect to point out that only 7% of the Umatilla National Forest occurs in Union County. This portion of the Forest is high elevation headwaters which could make the area unsuitable habitat for beavers. The remainder of the Forest occurs in Grant, Umatilla, Wallowa, Marrow and Wheeler Counties and these areas are open. With respect to the Wallowa-Whitman NF, while it is closed in Union County, it is open in Baker, Grant, and Umatilla Counties, and in most of Wallowa County. If a person is unaware of the location of the national forest boundaries, the limited extent of these closures is missed. In the case of Union County, the regulations made clear from the beginning that private inholdings were open even prior to OAR 635-050-0050 (7). In addition, all private lands fall under OAR 635-050-0050 (7). Beavers can now be legally killed any time and not reported if done under the confines of the regulation, even those identified as closed.

7) The Furbearer Regulation Proposals document states on page 9 *"..., the Department began a voluntary program in 1997 to discourage the trapping of beaver in critical coho habitat in Oregon coastal streams.*" This statement is incorrect. It is the beaver dams that trappers are asked to protect on page 4 of the Oregon Furbearer Trapping and Hunting Regulations , not beavers: *"**Attention Coastal Beaver Trappers**: ODFW requests your continued cooperation in protecting beaver dams in coastal areas important to Coho salmon rearing."*

This voluntary request is thus meaningless because beaver dams require beavers to maintain their structural integrity if the beaver ponds that provide for coho needs are to persist. As noted in Appendix F (section SI-3), ODFW's own Aquatic Habitat Inventory data for coast streams show large decreases in beaver dams and beaver ponds over the past 3-18 years depending on the site.

E. Economic Benefits of Amending the Rule

On April 22, 2020 in ODFW's *Notice of Proposed Rulemaking including statement of need and fiscal impact* ODFW stated the following on page 2:

> *"There are no expected major fiscal or economic effects resulting from the proposed rule changes for the proposed season and bag limits for the 2020-2021 and 2021-2022 furbearer harvest and pursuit seasons."*

This statement is false. ODFW failed to do a proper economic analysis of the impact of continuing commercial and recreational beaver trapping on federally-managed public lands and the waters that flow through these lands. The economic evidence presented Appendix F and summarized in Table 5 shows that there has been, and will continue to be, a huge negative economic impact from continuing the existing rule. The economic, ecological, and social costs incurred by Oregonians as a result of the existing rule are, in fact, in the hundreds of millions to billions of dollars and will only increase with climate change. As to the potential extinction of salmon – this would be an extraordinary cultural and ecological loss to tribal nations and all Oregonians – one in which assigning a price tag to such an event should only be considered the starting place of its economic, social, and cultural impact.

If the Commission approves the Petition all Oregonians - 4.2 million of us - would potentially realize economic benefits from the improvements in ecosystem services that abundant and widely distributed beaver-created and maintained habitat would provide. These benefits would total in the hundreds of millions of dollars to billions of dollars per year. Implementing the amendment is an essential step if we are to realize these benefits because without beavers there is no beaver-created and maintained habitat. It is urgent that we take these steps now because the improvements in fish and wildlife habitat and other ecosystem services will help insulate the state from the effects of changes in climate such as increased frequency of drought and wildfire. Taking these steps now also is urgent because there will be a time lag between the cessation of trapping and hunting and the expansion and dispersal of beavers on federally-managed public lands and the waters that flow through these lands and the subsequent creation of habitat. Taking these steps now is the only way the Commission can help reverse the continued serious decline of salmon and other indigenous species and help provide optimum economic benefits to present and future generations of citizens of this state.

In contrast, if the Commission rejects the Petition, a few (< 164) will continue to enjoy small personal benefits from trapping/hunting on federally-managed public lands and the waters that flow through them. This will be to the detriment of the many that depend on beaver-created and maintained habitat and will increase the negative impacts of climate change on our human and wild communities.

Table 5. Comparison of value of continued beaver trapping/hunting on federally-managed public lands and the waters that flow through these lands versus closing these lands and allowing beaver-driven restoration to begin. (See Appendix F: Economic of Beaver-created Habitat)

Item	**Year**	**Action**	**Dollars**	**People and/or fish and wildlife served**
Continued Beaver trapping/hunting on federally-managed public lands and the waters that flow through these lands				
Total Beaver/Castor sales	2015-2019	Money earned by Trappers/hunters	< $48,596 (maximum)	< 164 because not all trap/hunt on federally-managed public lands and the waters that flow through these lands
Closure of beaver trapping/hunting on federally-managed public lands and the waters that flow through these lands				
Restored Salmon Runs	future	estimate of household willingness to pay for increased salmon populations in the future	Tribal Ceremonial and Subsistence: Value is incalculable $100 to $120 per household per year which results in an estimated value of $195 million in 2016 increasing to $241 million in 2035.	Countless salmon and communities who depend on or benefit from healthy salmon populations (4.2 million people) culturally and/or economically plus countless other species and individuals

Item	Year	Action	Dollars	People and/or fish and wildlife served
Improved Stream Temperatures on a Minimum of 23,413 Miles of 1st - 4th Order Streams	future	estimated cost of human driven restoration	$ 1.7 to 9.6 billion dollars	4.2 million people, unknown number of species and individuals
EPA and NOAA Restoration Dollars	2015-2019	Dollars lost due to failure to require water quality improvements. Voluntary compliance still only required	$5.8 million	4.2 million people, unknown number of species and individuals
Oregon Watershed Enhancement Board (OWEB) Restoration Expenditures	2014-2019	Spent	$35.6 million	4.2 million people, unknown number of species and individuals
Recreational Spending on Wildlife Viewing, Fishing, Hunting, and Shellfishing	2008	Spent	$2.8 billion	2.8 million people
Aquatic Habitat Ecosystem Value for two Beaver Restoration Assessment Tool (BRAT) Area Examples	future	estimated cost of human driven restoration	$8.8 million	County residents in these areas plus unknown number of species and individuals
Aquatic Habitat Ecosystem Value for ODFW Aquatic Habitat Inventory Area Example of 17 one-mile reaches	future	estimated cost of human driven restoration	$348,800	Salmon and communities who depend on or benefit from healthy salmon populations (4.2 million people) plus countless other species and individuals
Delayed Flow Upstream of Reservoir Due to Water Storage via Beaver Ponds for NFBR Example	future	estimated value of water to downstream uses	$5,499 to $32,990 per year	Fisheries, downstream irrigators

F. Social Benefits of Amending the Rule

In 2016 the Oregon Legislative Task Force on Funding for Fish, Wildlife, and Related Outdoor Recreation and Education asked Responsive Management to undertake a survey of Oregon residents' opinions on and values related to the Oregon Department of Fish and Wildlife (ODFW). The survey divided the state into three regions – East Region, West Region, and the Portland Metro Region. Oregonians ranked as most important "that healthy fish and wildlife populations exist in Oregon", followed closely by "that Oregon's water resources are safe and well protected." These top two values are purely ecological rather than utilitarian. The values that were more utilitarian were lower (but still rated quite high in absolute terms), such as the provision of opportunities for viewing wildlife, for hunting, or for fishing. Below are excerpts from the 2016 Survey.

> "*The survey presented ten efforts of the Department and asked residents to rate the importance that each one should be for the agency, using a scale of 0 to 10, where 0 is not at all important and 10 is extremely important. The survey then asked residents to rate the performance of the Department in each of the same areas. In looking at how important the efforts should be, the purely ecological efforts are at the top. These include "conserving and restoring fish and wildlife habitat," "protecting endangered species," and "protecting and restoring native fish and wildlife species in Oregon." More human-centered efforts are lower, such as the provision of opportunities for wildlife-related recreation and providing information and education. In looking at the performance, the effort with the highest mean rating is "providing opportunities for fish- and wildlife-related recreation" (a human-centered effort), but this is closely followed by "protecting endangered species" (an ecological effort). Thereafter, ecological efforts tend to be rated higher than the more human-centered efforts. In the mean ratings, the human-centered efforts, particularly informational efforts, were the lowest rated. (p. iv)"*
>
> *"The survey listed 12 outdoor activities and asked residents if they had participated in them in the past 12 months. Large majorities had visited a state or national park, hiked, taken a trip of at least a mile in which they had viewed wildlife or birds, and/or viewed wildlife and birds at home. A follow-up question asked if residents had participated in any other outdoor activities. Gardening, walking, and off-roading topped the list. (p. v)"*
>
> *"An open-ended question asked about the most important fish, wildlife, or habitat issue in Oregon (there was no answer set; residents could say anything that came to mind). The top issues are habitat loss, lack of water, low/declining fish populations, urban sprawl, and conservation/management of resources in general. The graph shows the full list. The survey asked respondents about the importance of eight fish/wildlife values. For each item, residents rated the importance they placed on it, using a 0 to 10 scale where 0 is not at all important and 10 is extremely important. The results of all eight questions are shown together.*
>
> *"That healthy fish and wildlife populations exist in Oregon" was the top-ranked value, closely followed by "that Oregon's water resources are safe and well protected." Note that these top two values are purely ecological rather than utilitarian. The values that are more utilitarian are lower (but still rated quite high in absolute terms), such as the provision of opportunities for viewing wildlife, for hunting, or for fishing. (p. 6)*
>
> *"In an open-ended question, the survey asked residents to name the programs, efforts, or issues that they think should be the most important to the Department. The*

top response category relates to the health of wildlife and habitat, invasive species, and the balance of species. The next most common response category is conservation and management of resources. (p. 47)"

The responses to the 2016 survey indicate broad support across the state for healthy ecosystems that provide water and habitat for wildlife, fisheries and people. All of these are positively influenced by beavers and in fact cannot exist on a state-wide, landscape scale without abundant beavers and the habitat they create and maintain. Climate change only increases the need for beaver and their habitat if the desired outcomes of Oregonians are to be achieved.

G. Additional Benefits of Amending the Rule

Amending OAR 635-050-0070 and closing federally-managed public lands and the waters that flow through them to commercial and recreational beaver trapping and hunting has four more benefits in addition to those described above in Sections D, E, and F.

Meets the Standards of the Climate and Ocean Change Policy

At its July 2020 meeting, the Commission unanimously adopted a Climate and Ocean Change Policy. This policy establishes a framework under which ODFW will evaluate the impacts of climate change on the resources under its stewardship, adopt management practices to safeguard those resources and minimize the impacts to communities that depend on these resources. Pursuant to OAR 635-900-007, the Commission must incorporate the relevant key principles of the policy into any new ODFW plans or policies and revise any existing plans or policies to incorporate these principles as needed. The amendment proposed in this Petition will bring the furbearer regulations in line with the policy, facilitate the natural climate change mitigation and habitat restoration services provided by beavers, and support the recovery of other imperiled habitats and species.

The Climate and Ocean Change Policy lays out multiple key principles for species and habitat management (OAR 635-900-0017). A touchstone of the policy is the precautionary principle. Pursuant to OAR 635-900-0017(4), the "Department should proceed with a precautionary approach that is most likely to result in conservation of native species across as broad a range of future conditions as possible, including when faced with scientific and management uncertainty." As we have explained at length throughout this Petition, there is robust scientific evidence to support the crucial role of beavers in restoring habitats for the benefit of myriad species, including humans. Likewise, there is scientific evidence demonstrating the impacts of trapping and hunting on beaver populations. In keeping with the policy, the data gaps and resulting uncertainties described in this Petition weigh in favor of a precautionary approach.

The policy further states in OAR 635-900-0017(5) that the "Department should prioritize conservation actions for native species and their habitats to be most efficient and effective in achieving conservation outcomes." Likewise, in OAR 635-900-0017(7)(b), priority should be given "to restoration and enhancement actions where such actions would result in creation of high functioning habitat despite the impacts of changing climate and ocean conditions." The requested amendment is directly in the Commission's purview. By taking action to support robust beaver populations and their habitation creation and maintenance, the Commission will also be taking action to support habitat restoration and the recovery of imperiled species like coho salmon. The Commission should prioritize this request because it is directly linked to multiple important conservation outcomes. While beaver trapping and hunting is not the only factor limiting beaver populations, it is a factor, and it is the factor over which the Commission has control and authority.

The Commission has had few opportunities to put the Climate and Ocean Change Policy into practice. This Petition provides a crucial testing ground for applying the key principles laid out in the policy. We expect the Commission to review the current and proposed furbearer regulations with an eye toward protecting Oregon's precious wildlife and habitats in the face of a rapidly changing climate.

Contributes to the Recovery of Threatened and Endangered Salmon

In a series of studies, the ODFW has repeatedly found that beaver are a vital contributor to the survival and increase in coho coastal populations, that the lack of stream complexity is a major factor limiting freshwater productivity for all coho populations within the Oregon Coast Coho Evolutionary Significant Unit (ESU), and that beaver ponds are considered to provide the highest value and quantity of limited coho winter rearing habitat. Even if the Commission is unconcerned about the status of beaver populations in Oregon, it cannot ignore the clear science supporting the necessity of increasing beaver populations to support the recovery of one of Oregon's most prized and ecologically and culturally valuable fisheries.

A 2005 ODFW publication *The Importance of Beaver (Castor Canadensis) to Coho Habitat and Trend in Beaver Abundance in the Oregon Coast Coho ESU* reports that stream reaches with beaver ponds tend to be more productive in terms of number and size of fish than undammed stream reaches.[31]

> *"Early observations of the impact of beaver dams on id [identified] species suggest detrimental effects due to increased siltation, elevated water temperatures, and impeded fish passage. Research has shown these concerns to be unfounded, and no study has been able to demonstrate a detrimental population-level effect on ids [identified species]. In fact, most studies support the contention that the habitat created by beaver dams is highly beneficial to fish and that many species are known to cross dams in both the upstream and downstream directions (Pollock et al. 2003)."*[32]

The 2005 report also noted that the greatest reduction in coho smolt production capacity was associated with the extensive loss of beaver ponds.[33] It states that a 94% reduction in smolt production potential in a western Washington basin is attributed to the loss of beaver pond habitat, and that in a summary of 14 Oregon coastal streams surveyed at winter base-flow, only three had greater than 1% of their area in beaver ponds or alcove habitat. The report concludes that this lack of winter habitat appears to be a limiting factor in the production of coho smolts.[34]

The 2008 ODFW *Oregon Plan for Salmon and Watersheds* concludes that recovery of coho populations will depend largely on improvement of freshwater habitat.[35] It finds that beaver ponds have been shown to increase juvenile coho production potential by providing refuge habitat during high flow events, increasing food resources, retaining gravel, and storing water.[36] In addition to the ponds, beavers create a complex and highly varied habitat which includes modified floodplains, dams, alcoves, burrows, tunnels, side channels and alter the vegetation composition and stature. They also improve water quality by creating systems that contributed to decreased water temperatures and turbidity. These stream system changes, created and maintained by beavers, further enhance salmon's survival potential.[37]

The 2018 ODFW Information Report Series Number 2018-01: *Winter Habitat Condition of Oregon Coast Coho Salmon Populations, 2007-2014* confirms that the Habitat Limiting Factors Model (HLFM) assigns the highest value to beaver ponds, alcoves, and pools with large wood.[38] The conclusions reached in the above ODFW reports are reinforced by the conclusions reached in a number of NOAA recovery plans as it relates to the importance of beaver ponds and juvenile coho salmon.

The 2009 Middle Columbia River Steelhead Recovery Plan discusses the biological value of currently existing and extensive beaver activity in this ESU that creates and maintains diverse instream habitats, with deep pools and robust floodplain connectivity.[39]

The 2011 Recovery Plan for Upper Willamette River Chinook salmon and steelhead identifies the importance of beaver dams to these ESUs as well. Recovery actions for the Upper Willamette River Chinook populations include providing incentives to landowners to allow beaver to remain on their lands and providing education and outreach materials on the benefit of beaver dams to juvenile rearing habitat.[40]

In 2012 a report was written by the Biological Review Team (BRT) formed in 2009 to evaluate the risk of extinction of the Oregon Coast Coho Salmon ESU.[41] In the report titled " Scientific conclusions of the status review for Oregon coast coho salmon (*Oncorhynchus kisutch*)", the BRT concluded that some aspects of status OC coho salmon had clearly improved since the initial status review in the mid-1990s.[42] Spawning escapements were higher in some recent years than they had been since 1970, recent total returns were higher than the low extremes of the 1990s, but still mostly below levels of the 1960s and 1970s. The review attributed the increases to a combination of lower harvest rates, reduced hatchery production, and improved ocean conditions. The review also noted that the ESU contained relatively abundant wild populations throughout its range, and that additional improvements to status from ongoing and past reductions in hatchery production could be expected in the future. However, the review focused on questions of the long-term viability of the ESU, and their examination of these questions were much less positive.

The BRT found that spawning abundance was at approximately 10% of historical abundance and the overall productivity of the ESU remained low compared to what was observed as recently as the 1960s and 1970s. The review concluded that most of the improvement in productivity seen in the early 2000s was due to improved ocean conditions, rather than improvements in freshwater conditions. The legacy of past forest management practices combined with lowland agriculture and urban development result in areas of highest potential habitat capacity being severely degraded. A joint ODFW/NMFS analysis of freshwater habitat trends for the Oregon coast also found little evidence for an overall improving trend in freshwater habitat conditions since the mid-1990s and evidence of negative trends in some areas. In particular, the review was concerned that recent changes in the protection status of beaver (Castor canadensis), an animal which creates coho salmon habitat, would result in further negative trends in habitat quality. The report on page 74 states:

> *In the past, ODFW has been able to track the harvest of beaver populations because all trapping required a permit and a harvest report. However, because of a change in the application of state regulations, no permit or harvest report is presently needed for trapping of nuisance animals on private land, making assessment of beaver harvest difficult (ODFW 2005).*

This information comes from the 2005 ODFW report titled "*The Importance of Beaver (Castor canadensis) to Coho Habitat and Trend in Beaver Abundance in the Oregon Coast Coho ESU*". The report states:

> *"Until recently ODFW has been able to reliably track the harvest of beaver in Oregon because all individuals trapping beaver were required to obtain a trapping permit and report their harvest. In the future, however, monitoring beaver harvest will be more difficult because recent changes in state regulations allow beaver to be killed on private lands without the need for a permit (Personal communication on Nov. 18, 2004 with Doug Cottam, ODFW District Wildlife Biologist)."(p.6)*

The review was particularly concerned with the interaction between habitat quality and climate change resilience. The long-term loss of high-value rearing habitat has increased the vulnerability of the ESU to near-term and long-term climate effects. Given poor freshwater rearing conditions, the ESU could rapidly decline in the near-term to the low abundance seen in the mid-1990s when ocean conditions cycled back to a period of poor survival for coho salmon. The review also pointed to global climate change itself leading to a long-term downward trend in freshwater and marine coho salmon habitat compared to current conditions. The review acknowledged the considerable uncertainty surrounding the size of specific impacts of climate change on salmon habitat, but was very clear that most impacts are expected to result in poorer and more variable conditions for OCCS in freshwater and marine environments. The continued removal of beavers through trapping and hunting will thus contribute significantly to ongoing declines in quality salmon habitat given their importance as noted by the Fisheries section of ODFW:

> *"Beavers have been recognized as important to OCCS recovery by the State of Oregon in the Oregon Plan (OCSRI 1997) and the Oregon Coast Coho Conservation Plan (Oregon 2007). Notably, the Fisheries Section of ODFW has long recognized the importance of beavers to recovery of OCCS (ODFW 2005) and is actively working to stress their importance to other sections of their agency as well as other state agencies (ODFW 2009)."*[43].

The 2013 Lower Columbia River Recovery Plan again identifies beaver-created and maintained stream features as one of the key habitats for active rearing juvenile coho salmon and fall and spring Chinook salmon.[44]

The 2014 Southern Oregon/Northern California Coast Coho Salmon Recovery Plan[45] also identifies beaver ponds as high-quality winter and summer juvenile rearing habitat for coho salmon. The 2014 SONCC Coho Salmon Recovery Plan also notes that the effect of decreased beaver abundance on coho salmon populations was likely very significant. As such, increasing beaver abundance is considered a recovery action in the SONCC Coho Recovery Plan because it will increase channel complexity and therefore help reduce the risk of extinction.

Finally, the December 2016 Final ESA Recovery Plan for Oregon Coast Coho Salmon from NOAA Fisheries repeatedly highlights the importance of beaver and beaver ponds for the imperiled Oregon Coast Coho Salmon.[46] Indeed, the Recovery Plan explains one of the primary limiting factors for Oregon Coast Coho Salmon populations and overwinter rearing of juvenile coho salmon is the reduced amount and complexity of habitat.[47] It then notes that the important habitat conditions for coho "are maintained through connection to the surrounding landscape. Beaver provide considerable help in providing this connection and in maintaining proper watershed functioning in Oregon coast streams."[48] The Recovery Plan includes beaver dams and beaver ponds as components of various strategies to improve coho habitat, specifically including a strategy titled: "Ensure long-term ecosystem functions and high quality habitat by reducing habitat-related threats and encouraging formation of beaver dams and beaver dam analogues."[49]

The 2016 Recovery Plan explicitly includes "removing beaver and beaver habitat" as one of the reasons why Oregon Coast Coho Salmon were listed under the federal ESA, explaining: "Removing beaver and beaver habitat has caused loss of beaver pond habitat which is high value for rearing juvenile coho salmon (ODFW 2005; Stout et al. 2012)."[50] The Recovery Plan then explains "[b]eaver removal, combined with loss of large wood in streams, has also led to degraded stream habitat conditions for coho salmon (Stout et al. 2012)" and concludes that "[b]ecause beaver ponds provide high-value coho salmon habitat on the Oregon Coast…their reduction constitutes degraded conditions for coho salmon."[51]

The Recovery Plan further lists a number of recommendations to meet the various recovery goals for Oregon Coast Coho Salmon. below are a few examples of the many references and recommendations related to beaver, beaver dams, and beaver ponds in the Plan.

- *"change beaver management to allow beavers to build more dams in Oregon Coast coho rearing habitat";*[52]

- *"revise regulations and statute(s) relating to beaver management to increase the number and size of beaver ponds";*[53]

- *"revise regulatory mechanisms to prohibit killing of beaver within the range of Oregon Coast coho salmon unless property or infrastructure damage is occurring and only when all other options are exhausted".*[54]

In conclusion, over the last 15 years, ODFW and National Marine Fisheries Service has repeatedly identified beaver ponds as critical salmon habitat. Because the beaver ponds can only persist if the beaver dams persist and beaver dams only persist if they are maintained by beavers, it is clear that increasing their numbers and distribution plays a key role in salmon recovery. As salmon are an indigenous species in serious decline, ODFW is required by law to take the steps within its power to address and reverse this decline. Therefore, expanding the density of beaver ponds, and its concurrent habitat changes, across the coastal region is a necessary condition for bringing about significant increases in the coho population and backing coho away from the threat of extinction. This can only happen if beaver trapping and hunting ceases.

Addresses Oregon Conservation Strategy[55]

The 2016 Oregon Conservation Strategy provides a shared set of priorities for addressing Oregon's conservation needs, particularly its fish and wildlife needs. The Conservation Strategy brings together the best available scientific information and presents a menu of recommended voluntary actions and tools for all Oregonians to define their own conservation role. The Strategy emphasizes proactively conserving declining species and habitats to reduce the possibility of future federal or state listings. It is not a regulatory document but instead presents issues, opportunities, and recommended voluntary actions that will improve the efficiency and effectiveness of conservation in Oregon. The purpose of Strategy is to help people and agencies make decisions more strategically about how they can invest time and resources in fish and wildlife conservation. Therefore, underlying the Strategy is the clear message that this is an action-driven document intended to help Oregonian proactively address growing concerns about water security, water quality, and fish and wildlife habitat quality and abundance.

Some of the goals and action items the Strategy presents related to the Petition are:

- *Prevent species from becoming imperiled, thereby reducing the risk of future species listings that could result in additional regulations for Oregon's businesses and industries.*

- *Leverage limited conservation resources, such as money, equipment, and time, in a more efficient and effective manner by:*

    - *Focusing conservation actions on the species and habitats of greatest conservation priority*

    - *Identifying areas where conservation activities will provide the greatest benefit at the landscape scale [such as federally managed public lands and the rivers that flow through these lands]*

    - *Increasing coordination, collaboration, and partnership to produce cumulative benefits [i.e. improve stream temperatures on many of the more than 23,000 miles of 1st to 4th order streams that exceed DEQ state temperature standards and further compromise Oregon's fisheries or expand size and distributions of wetlands for migratory birds and to serve as wildfire safe zones for wildlife and livestock]*

- *Provide guidance and coordination to preserve and restore the services provided by healthy ecosystems that benefit all Oregonians.*

- *Synthesize existing plans and credible, peer-reviewed science to provide a statewide context to address the state's conservation needs.*

- *Assist in managing landscapes to safeguard Oregon's high quality of life and natural resource legacy, which is one of the state's strengths in attracting and retaining businesses.*

- *Demonstrate Oregon's commitment to conserve its species and habitats.*

- *Serve as a long-term strategy for the next decade and beyond, while still remaining a dynamic, living approach that will be adjusted as new information and insights are gained.*

The proposed amendment to OAR 635-050-0070 to close commercial and recreational beaver trapping and hunting on federally-managed public lands and the waters that flow through these lands addresses the above points presented in the Conservation Strategy. It also helps address all seven Key Conservation Issues identified in the Conservation Strategy as posing the greatest potential impact to Strategy Habitats and Strategy Species statewide. The degree to which increased beaver populations and the habitat they create and maintain assist in meeting a conservation issue varies but they contribute in some fashion to all.

1) Climate Change

Goal 1. Use the best available science, technology, and management tools to determine the vulnerability of species and habitats to climate change at a landscape scale.

Goal 2. Identify, prioritize and implement conservation strategies to mitigate the negative impact of climate change on fish, wildlife and habitats.

Goal 2.1. ....Focus on strategies that are robust to a range of potential future climates and that maintain or restore key ecosystem functions and process.

- *Improve water quality and quantity;*
- *Increase natural water storage on the landscape;*
- *Maintain nutrient cycling processes;*
- *Promote an ecologically appropriate disturbance regime;*
- *Protect soil health*

2) Land Use Changes

*When Oregon's statewide land use planning program was created, **Goal 5** required local governments to adopt programs to protect natural resources, and conserve scenic, historic, and open space resources. Goal 5 was designed to protect and concern a wide range of natural resources, including:*

- *Riparian areas*
- *Wetlands*
- *Fish and wildlife habitat*

- *Groundwater*
- *Natural areas*

Action 1.3. Encourage strategic land conservation and restoration within Conservation Opportunity Areas.

3) Invasive Species

Local eradication of invasive species near high priority habitats and lands should be emphasized where practical, with the ultimate goal of restoring these lands to their full ecological or utilitarian potential……Restoration may be the best prescription for inoculating native plant communities against invasive plants because ecosystems are more resilient to invasion when they are healthy and function well. Entities involved in invasive species management should encourage landowners to consider ecologically-based restoration as part of any plan to manage invasive species.

4) Disruption of Disturbance Regimes

ALTERED FIRE REGIMES:

Uncharacteristically severe wildfires also pose higher risks to species and habitats because such fires can involve large areas and often result in complete mortality of overstory and understory vegetation (i.e., stand-replacing events). These stand-replacing fires can impact habitats, soils, and watershed beyond their adaptive limits. Uncharacteristically severe wildfires impact aquatic habitats by removing riparian vegetation, which result in higher stream temperatures, decreased bank stability, and increased sedimentation in stream channels.

Action 1.2. Work with landowners and other partners in these zones to lower risk of wildfires while maintaining wildlife habitat values….

ALTERED FLOODPLAIN FUNCTION

Goal 2. Maintain and restore floodplain functions, such as aquifer recharge, water quality improvements, soil moistening, natural nutrient and sediment movements, animal and seed dispersal and habitat variation.

Action 2.1. Restore floodplain function by: reconnecting rivers and streams to their floodplains, restoring stream channel location and complexity, ….allowing seasonal flooding, increasing infiltration or recharge, restoring and maintaining wetland and riparian habitats….

Action 2.4. Identify and restore important off-channel habitats and oxbows cut off by previous channel modifications

Action 2.6. Support and encourage beaver dam-building activity.

5) Barriers to Animal Movement

AQUATIC PASSAGE

Habitat connectivity is a key component to many facets of terrestrial and aquatic resource management. For Oregon's native migratory fish, connectivity between aquatic habitats is an important part of garnering successful and healthy populations.....Currently, many miles of stream habitat in Oregon are not producing fish because of passage barriers.

Goal 1: Provide conditions suitable for natural movement of fish and aquatic animals throughout their native range.

Action 1.2. Maintain and restore habitat to ensure aquatic connectivity in priority areas such as Conservation Opportunity Areas and areas with high road density such as urban centers.

Action 1.3. When planning aquatic passage projects, consider the needs of other aquatic species and terrestrial wildlife in addition to fish.

TERRESTRIAL ANIMAL MOVEMENT

Many species rely on the ability to move throughout the landscape to fulfill their needs for survival or complete their life cycles.... This may mean moving north and south across thousands of miles, or higher and lower in elevation. Human-caused changes to the landscape can affect the ability of wildlife to move across terrestrial landscapes by adding obstacles, impacting critical stopover sites and increasing habitat fragmentation.

Some wildlife, especially birds, need staging or stopover areas to rest and refuel during migrations. Habitat conversation or degradation can impact important staging or stopover sites, thus impacting the animals that depend on them..... Habitat fragmentation can be a barrier to animal movement for vulnerable species. For species that require large continuous habitat, fragmentation reduces the success of the species.

Habitat connectivity can be maintained for wildlife through....maintenance or restoration of important migratory stopover sites.

Goal 2: Provide connectivity of habitat for the broad array of wildlife species throughout Oregon.

Action 2.1. Promote conditions suitable for habitat connectivity throughout Oregon.

Action 2.3. Enhance wildlife habitat and connectivity with consideration of climate change impacts.

Action 2.4. Identify, maintain, and restore important stopover sites for migratory birds and bats.

6) Water Quality and Quantity

The droughts of the early 21st Century have heightened awareness of the issues related to water quality and quantity. Ensuring high quality water supplies is a top environmental goal for western states in the coming decades as natural resources managers grapple with the impacts of climate change.

WATER QUALITY

Goal 1: Maintain or restore water quality in surface and groundwater to support a healthy ecosystem, support aquatic life, and provide fish and wildlife habitat.

Action 1.2. Maintain and restore wetlands and riparian areas to increase filtration of sediments and contaminants and to provide shade, prevent channel erosion, and maintain stream habitat features.

Action 1.3. Implement water quality improvement projects and management frameworks.

Action 1.5. Maintain and restore native vegetation throughout watersheds, prioritizing riparian corridors, floodplains, wetlands, and upland areas.

WATER QUANTITY

Goal 2: Conserve, maintain, or enhance surface flows and groundwater levels that support healthy Strategy Species and Strategy Habitats. Seek opportunities to conserve, maintain, or enhance streams and lakes, as well as groundwater and spring-fed ecosystems that provide coldwater refugia for Strategy Species.

Action 2.1. Work with agencies, conservation groups, and other organizations to establish priorities, develop tools, and implement projects that maintain or restore streamflows.

Action 2.2. Seek opportunities to enhance aquifer recharge and maintain groundwater.

Action 2.3. Use established indicators to monitor watershed function and determine thresholds for action.

7) Challenges and Opportunities for Private Landowners to Initiate Conservation Actions.

Goal 1: Make it easier for landowners to find assistance on conservation projects.

Action 1.1. Expand technical assistance and site-specific restoration information for landowners. Technical support services include information to help evaluate habitat, information about best management practices, and monitoring.

Action 3.2. Encourage state agencies and organizations serving landowners to recognize and support the conservation value of working landscapes (i.e., farm and forest land).

Complies with ORS 496.012: Oregon's Wildlife Policy

The Oregon Wildlife Policy, codified as ORS 496.012, states:

> *It is the policy of the State of Oregon that* ***wildlife <u>shall</u> be managed to prevent serious depletion of any indigenous species*** *and to provide the optimum recreational and aesthetic benefits for present and future generations of citizens of this state. [emphasis added]*

In a March 10, 1997 letter to ODFW Acting Director Rod Ingram, Assistant Attorney General Cheryl Coon explained that "optimal recreational and aesthetic benefits can only exist to the extent that serious depletion of the species is prevented." Accordingly, the Attorney General's office asserted that the "Commission's and Department's overriding obligation is to manage to prevent serious depletion, which thereby enables the Department and Commission to provide optimum recreational and aesthetic benefits."

The Oregon Wildlife Policy also includes a list of goals that must be implemented in furtherance of the overarching policy:

> *In furtherance of this policy, the State Fish and Wildlife Commission shall represent the public interest of the State of Oregon and implement the following coequal goals of wildlife management:*
>
> *(1) To maintain all species of wildlife at optimum levels.*
>
> *(2) To develop and manage the lands and waters of this state in a manner that will enhance the production and public enjoyment of wildlife.*
>
> *(3) To permit an orderly and equitable utilization of available wildlife.*
>
> *(4) To develop and maintain public access to the lands and waters of the state and the wildlife resources thereon.*
>
> *(5) To regulate wildlife populations and the public enjoyment of wildlife in a manner that is compatible with primary uses of the lands and waters of the state.*
>
> *(6) To provide optimum recreational benefits.*
>
> *(7) To make decisions that affect wildlife resources of the state for the benefit of the wildlife resources and to make decisions that allow for the best social, economic and recreational utilization of wildlife resources by all user groups.*

Though these wildlife management goals are not necessarily consistent with each other or with the broader wildlife management policy they are supposed to implement, they must be balanced to remain consistent with the broader wildlife policy. The Commission and Department are given fairly broad deference to implement competing goals, but the Attorney General's office advised that "when the legislature establishes competing and potentially inconsistent goals, it necessarily also delegates to the implementing agency the discretion to decide how to balance those goals so long as the result is consistent with the policy." The amended rule would be in compliance with the Oregon Wildlife Policy and its goals as follows:

(1) To maintain all species of wildlife at optimum levels.

The rule amendment would comply with this point because the habitat that beavers create and maintain is critical for juvenile coho salmon survival (beaver ponds) and needed to improve water quality conditions and address habitat needs for a host of other species. Many of these species are currently listed as either threatened or endangered or are a strategy species identified in the Oregon Conservation Strategy.

(2) To develop and manage the lands and waters of this state in a manner that will enhance the production and public enjoyment of wildlife.

The rule amendment would comply with this point because **production and public enjoyment of wildlife** requires quality, abundant and widely distributed habitat that is resilient in the face of climate change. Beaver create and maintains habitat types that are resilient in the face of climate change such as wetlands, ponds, bogs, and complex stream and riparian systems.

The Runyan report (2009) [56], commissioned by ODFW and Travel Oregon, found that the number of Oregonians who participate in wildlife viewing or fishing was 2,300,000 compared to the less than 164 people who commercially and recreationally hunt and trap beavers. The rule amendment would result in an increase in the habitats that produce quality wildlife viewing and fishing and hunting opportunities.

(7) To make decisions that affect wildlife resources of the state for the benefit of the wildlife resources and to make decisions that allow for the best social, economic and recreational utilization of wildlife resources by all user groups.

The Responsive Management report (2016)[57], commissioned by the Oregon State Legislature, found the following set of values and concerns by Oregonians.

> *"That healthy fish and wildlife populations exist in Oregon" was the top-ranked value, closely followed by "that Oregon's water resources are safe and well protected." Note that these top two values are purely ecological rather than utilitarian. The values that are more utilitarian are lower (but still rated quite high in absolute terms), such as the provision of opportunities for viewing wildlife, for hunting, or for fishing. (p. ii)"*

The rule amendment would comply with "**best social utilization of wildlife resources**" because beavers provide critical ecosystem services to 4.2 million Oregonians The social benefits that would be provided to Oregonians with the rule amendment include, but are not limited to, quality wildlife viewing, fishing and hunting opportunities, improved water quality and stream flows, increased groundwater table and aquifer recharge, and expanded and widely distributed quality habitat as a result of beaver activity.

The rule amendment would comply with "**best economic utilization of wildlife resources**" because it would begin to repair the large economic harm done to the state and Oregonians as a result of the decline in or absence of quality beaver-created and maintained habitat. The amendment would do so by creating conditions that allow beavers to increase and safely disperse leading to expanding habitat statewide at the landscape scale.

Finally, the rule amendment would comply with "**best recreational utilization of wildlife resources**" because it would allow beavers to expand their numbers and their habitat, thereby improving recreational opportunities that come from wildlife viewing, fishing, and hunting as quality habitat increased. This would benefit the more than 2,300,000 people that the Runyan report (2009) [58] found who participated in these activities.

H. Inadequacy of Existing Regulatory Rule

The current language in OAR 635-050-0070 is inadequate for the following reasons:

1. Puts Oregon's future water security at risk leading to increased future conflicts

Continued removal of beavers is compromising Oregon's current water security and will place Oregon's future water security at greater risk. Beaver dams, ponds and resulting wetlands and wet meadows increase temporary surface water and groundwater in the headwaters resulting in water being more slowly and sustainably released. This temporary storage helps offset the impacts of drought and decreases the frequency and magnitudes of downstream flooding. Abundant wetlands and ponds lead to improved water quality (i.e. cooler stream temperatures, less sediment) and improves stream flows. National Forests are key to this effort because drinking water for a large percentage of Oregonians comes from national forests. And all of these public lands contribute to the waters used for ranching and agriculture. The visual and political importance of this contribution by beavers is captured in a series of photos and headlines from newspapers found in Appendix G.

2. Ignores the magnitude of the economic harm to Oregonians now and into the future.

ODFW stated in their Notice of Proposed Rulemaking (page 2) that *"There are no expected major fiscal or economic effects resulting from the proposed rule changes for the proposed season and bag limits for the 2020-2021 and 2021-2022 furbearer harvest and pursuit seasons."*

The statement ignores the huge economic harm currently being incurred by Oregonians because of past and continued beaver trapping and hunting. The harm occurs in the form of lost ecosystems services and declining salmon populations. The economic harm of continuing the existing rule is in the hundreds of millions to billions of dollars as shown in Appendix F and summarized in Table 5 in the Petition. As to the potential extinction of salmon – this would be an extraordinary cultural and ecological loss to tribal nations and all Oregonians – one in which assigning a price tag to such an event should only be considered the starting place of its economic, social and cultural impact.

3. Increases Potential for Salmon Extinction by Failing Coho Recovery Strategy

The continuation of the existing rule is directly contributing to the serious depletion of salmon and its possible extinction because it prevents beavers from building and maintaining a critical habitat need for juvenile coho salmon survival (beaver ponds) and improving conditions at multiple points along the life cycle of salmon (i.e. improved water quality, improved stream flows, improved habitat complexity). The importance of beaver ponds has been noted in multiple ODFW reports, peer-reviewed literature, and in numerous National Marine Fisheries recovery plans. Continued beaver trapping and hunting directly contributes to a loss of key habitat needed by juvenile coho salmon and damages habitat needed by salmon at other points in their life cycle. The existing rule is contributing directly to salmon's possible future extinction.

4. Allows Continued Degradation of Habitat Quality, Abundance, and Distributions

The existing rule allows for the continued degradation of fish and wildlife habitat across the state by preventing beavers from creating and maintaining habitat that would restore habitat connectivity, abundance, quality and complexity. The habitat changes that beaver would create, if allowed to increase in numbers and distributions, include improved waters quality and availability, increased stream flows, increased stream complexity, increased riparian habitat abundance and complexity, increased wetlands and restored habitat connectivity and complexity. These changes would increase the ability of species to survive increased uncertainty in climate (drought, wildfire, flooding) by making the habitat less sensitive and more connected and thus more resilient to climate variability. As recovery of stream and riparian systems will take time, the longer the existing rule remains in place the greater the potential that recovery may not happen soon enough or at all and species will become threatened, endangered or extinct.

5. Compromises and degrades rearing habitat for 11 endangered salmonid stocks throughout the state.

Winter rearing habitat is a key limiting factor and beaver ponds have been identified as a key source of winter rearing habitat. Beavers also create beaver bank lodges which are used as summer rearing habitat for juvenile coho and other salmonid species. The existing rule prevents beavers from creating and maintaining new habitat even as old dams fail and ponds drain due to lack of beaver presence and maintenance.

6. Compromises and degrades bird habitat.

Beaver ponds, wetlands, wet meadows and structurally complex and diverse riparian habitat across the state provides increased food sources, habitat resting areas, and rearing areas for migratory birds that can make the difference between survival and death. Human land uses and climate change has resulted in the loss of these habitat types and the existing rule prevents their restoration and expansion. This lack of habitat is contributing to the continued decline in migratory and local birds, a number of which have been identified in the Oregon Conservation Strategy as Strategy Species. Examples of strategy bird species that the existing rule is placing at risk include Black-necked Stilt, Greater Sage-Grouse, Greater Sandhill Crane, Willow Flycatcher, Yellow Warbler, Song Sparrow and Yellow-breasted Chat.

7. Prevents widely distributes improvements in stream temperatures and stream flows

The existing rule prevent improvement in stream temperatures and stream flows by preventing beavers from creating and maintaining wetlands, beaver ponds and channel complexity. These habitat changes increase water depths and the amount of groundwater stored and slowly returned to the streams which both lowers stream temperatures and increases stream flows. Under current global greenhouse gas (GHG) mitigation strategies, salmon and other cold-water fish species are projected to be replaced in many areas of Oregon by less economically valuable fisheries over the course of the 21st century as stream temperatures continue to rise and summer low flows drop. Currently, Oregon has more than 23,000 stream miles 303d listed as water quality impaired for temperatures on streams of beaver dam-building size. While preserving existing coldwater habitats in Oregon through GHG mitigation will require long-term global cooperation, approval of the amendment would allow ODFW to act independently to preserve coldwater habitats in Oregon by protecting beavers and the wetlands and ponds they create which can significantly reduce stream temperatures and increase stream flows. Continuation of the existing rule will accelerate the rise in temperatures and decline in stream flows with the ensuring challenges to fish and cities as water quality and availability declines.

8. Prevents the Creation of Wildfire Safe Zones at no cost

The existing rule prevents beaver from creating and maintaining a network of widely distributed, abundant and in some cases large wetland complexes. These wetlands can serve as wildlife and livestock safe zones that species can retreat to during wildfire. The scale and effectiveness of beaver wetlands is seen in photos in Appendix G and in recent publications.[59] As the frequency and intensity of wildfires increases due to climate change, the existing rule put fish, wildlife and livestock at every greater risk of being a causality.

9. Prevents the Creation of Carbon Capture-and-Store Areas

The existing rule prevents beavers from creating and maintaining wetlands and wet meadows which are high effective at extracting carbon from the air and storing it below ground in roots and decaying matter, and above ground in the abundant riparian vegetation. It also prevents beavers from creating and maintaining beaver ponds which also capture and store carbon as dead vegetation is submerged under water. This natural process of carbon capture and store related to wetlands, wet meadows and ponds directly addresses climate change and is currently an underutilized climate change response strategy. It is also a no-cost contribution to the climate change challenge, one that the existing rule continues to prevent from developing.

10. Ignores Peer-Reviewed Scientific Literature

Abundant peer-reviewed science identifies the large-scale, variety and distribution of ecosystem services provided by beavers via the habitat they create and maintain (Appendix B-1). The loss of these services and thus benefits to fish, wildlife, and humans creates cultural, recreational, economic, and ecological harm. Also ignores ODFW's own reports on the value of beavers (Appendix B-2)

11. Conflicts with Oregon's Wildlife Policy (ORS 496.012)

The Oregon Wildlife Policy, codified as ORS 496.012, states:

> *It is the policy of the State of Oregon that* ***wildlife <u>shall</u> be managed to prevent serious depletion of any indigenous species*** *and to provide the optimum recreational and aesthetic benefits for present and future generations of citizens of this state. [emphasis added]*

The existing rule is in conflict with the Oregon Wildlife Policy and its goals because:

It fails the Policy's intent because continued beaver trapping and hunting contributes directly to a loss of key habitat needed by juvenile coho salmon. Therefore, it is directly contributing to the serious depletion of salmon and other indigenous species.

It fails to comply with the goal "**to maintain all species of wildlife at optimum levels"** because beaver trapping and hunting prevents the creation and maintenance of the habitat critical for juvenile coho salmon survival, needed to improve water quality and stream flow conditions and address habitat needs for a host of other species. Many of these species are currently listed as either threatened or endangered or are a strategy species identified in the Oregon Conservation Strategy.

It fails to comply with "**best social utilization of wildlife resources**" because it denies critical ecosystem services and the benefits generated by the habitat that beavers create and maintain to 4.2 million Oregonians in order to serve the pleasure of less than 164 Oregonians who enjoy largely recreational beaver trapping/hunting.

It fails to comply with "**best economic utilization of wildlife resources**" because it contributes to the continued decline and degradation of wildlife resources and ecosystems thus facilitates existing economic harm related to the loss of ecosystem services provided by beavers. The economics harm of continuing the existing rule versus amending it are discussed in detail in Appendix F and was summarized in Table 5 in the Petition. The economic harm is in the hundreds of millions to billions of dollars.

It fails to comply with "**best recreational utilization of wildlife resources**" because it allows for the continued degradation and diminishment of recreational opportunities as a result of the decline in the habitat that beavers create and maintain as discussed under ORS 496.012 (2) above. The impact of the existing rule will only accelerate with continued climate change.

12. Fails to meet ODFW's Mission Statement.

The current rule fails to meet ODFW's mission statement because without the quality and abundant habitat created and maintained by beavers and needed by a diversity of species, it is not possible to protect and enhance Oregon's fish and wildlife and their habitats for use and enjoyment by present and future generations. This failure to comply with their mission statement is extremely serious because climate change continues to cause accelerate the degradation of habitats that a multitude of Oregon Conservation Strategy species and others depend on.

13. Fails to Address the Goals and Objectives of the Oregon Conservation Strategy.

The current rule fails to comply with the Oregon Conservation Strategy because it denies Oregon the ability to use all available strategies to address the seven Key Conservation Issues identified in the Strategy as posing the greatest potential impact to Strategy Habitats and Strategy Species statewide. Of the 11 Strategy Habitats and four are directly influenced and improved upon by beavers. They are 1) Estuaries, 2) Flowing Water and Riparian Habitats, 3) Natural Lakes and 4) Wetlands along with a number of specialized and local habitats. Failure to expand and improve these Strategy Habitats statewide would directly impact 82 of the 294 (28%) Strategy Species listed in the Conservation Strategy. Examples include the Western Pond Turtle, the Columbia Spotted Frog, the Willow Flycatcher, Greater Sandhill Crane and Western Brook Lamprey (Appendix C).

14. Does Not Meet the Standards of the Climate and Ocean Change Policy

At its July 2020 meeting, the Commission unanimously adopted a Climate and Ocean Change Policy. This policy establishes a framework under which ODFW will evaluate the impacts of climate change on the resources under its stewardship, adopt management practices to safeguard those resources and minimize the impacts to communities that depend on these resources. Pursuant to OAR 635-900-007, the Commission must incorporate the relevant key principles of the policy into any new ODFW plans or policies and revise any existing plans or policies to incorporate these principles as needed.

The current furbearer regulations do not meet the high standards set by the Climate and Ocean Change Policy. Rather, the current regulations impede the critical climate mitigation and habitat restoration work for which beavers are our natural allies by allowing widespread hunting and trapping of beavers.

The Climate and Ocean Change Policy lays out multiple key principles for species and habitat management (OAR 635-900-0017). A touchstone of the policy is the precautionary principle. Pursuant to OAR 635-900-0017(4), the "Department should proceed with a precautionary approach that is most likely to result in conservation of native species across as broad a range of future conditions as possible, including when faced with scientific and management uncertainty."

ODFW staff has used data gaps to justify the status quo. This is not in keeping with the letter or the spirit of the policy. Instead, the data gaps and resulting uncertainties described in this Petition weigh in favor of a precautionary approach.

The policy further requires provides in OAR 635-900-0017(5) that the "Department should prioritize conservation actions for native species and their habitats to be most efficient and effective in achieving conservation outcomes." Likewise, in OAR 635-900-0017(7)(b), priority should be given "to restoration and enhancement actions where such actions would result in creation of high functioning habitat despite the impacts of changing climate and ocean conditions."

The current rule impedes the growth of beaver populations and their dam building activity. This contradicts the policy because it deprives the state of an efficient and effective conservation action that directly supports habitat restoration and the recovery of imperiled species like coho salmon at little to no cost.

15. Ineffective and Out-of-Date Closure Language

The closure language is ineffective and out-of-date. The phrase **"***within the exterior boundaries"* leaves it unclear if private inholdings or parcels of land under other jurisdictions are included or exempt from the restrictions. The phrases **"***all open except waters"* or "*all open except .... creek and its tributaries"* restrict the closure to the physical stream but not the land base that beaver use when foraging for food and building materials or dispersing. This language makes many closures meaningless because it ignores beaver behavior and their use of land and water. In addition, the definition of beaver in OAR 635-050-0050 (7) changed in June 2013 and beaver ceased to be considered strictly a furbearer. They are now managed as both furbearer and predatory animal depending on circumstances. This change eliminated the reporting requirements for the private landowner or their agent and allows beavers to be killed in these areas anytime. As a result, the closures in the existing regulations that occur on private lands are ineffective and the existing rule is out-of-date.

Conclusions

In conclusion, the existing rule is not scientifically and economically defensible. The values and interests of the majority of Oregonians have changed as documented in reports commissioned by ODFW[60] as has their tolerance for beavers.[61] **While commercial and recreational beaver trapping/hunting is not the only cause of beaver mortality, it is the one that ODFW has control over.** Therefore, amending the rule to close all federally-managed public lands and the waters that flow through these lands would help bring ODFW into compliance with ORS 496.012, its mission statement and demonstrate to Oregonians that ODFW is committed to addressing climate change, salmon declines, and restoration efforts using all means at its disposal. Beavers are key to addressing these challenges. They will assist us at little to no cost but only if they are allowed to build and maintain beaver-created habitat which is the source of the benefits and ecosystems services needed by Oregonians and fish and wildlife.

I. Oregonians and Beavers: Conflicts and Resolution

While Oregonians' concern about beaver-human conflict would most likely emerge in the context of private land ownership, nevertheless beaver behavior can have an effect on a variety of public land infrastructure and amenities including roads, culverts, irrigation canals, grazing allotments, campgrounds, etc. which could be perceived as inconvenient or harmful to the public's use or enjoyment of public land. Therefore, it is worthwhile to look at the public's attitude regarding possible beaver-human conflict.

In 2011 the Oregon Department of Fish and Wildlife, the Oregon Watershed Enhancement Board and the Bonneville Power Administration investigated this question by sponsoring a study: *Landowner Incentives and Tolerances for Managing Beaver Impacts in Oregon* by Mark D. Needham, Ph.D. And Anita T. Morzillo, Ph.D., Department of Forest Ecosystems and Society, Oregon State University. While the study was directed at Oregon landowners only, the results are indicative of the general attitude of Oregonians.

This study (*n = 1,512)* found that:

- *The majority of respondents were interested in seeing (65%) and having (57%) beavers live on their property or neighboring properties.*

- *Most respondents believed that beavers create wetlands that benefit other living things (87%), are important to exist (86%), they would enjoy seeing beavers (83%), beavers are a sign of a healthy environment (82%), some beaver damage should be tolerated (75%), and beavers have a right to exist regardless of any impacts they cause (61%).*

- *No matter how severe the impacts caused by beavers, however, lethal control (i.e., destroying beavers) and trying to frighten beavers away were perceived as unacceptable responses across all regions and even among landowners who have already experienced impacts from beavers. It is clear that a "kill first" approach is likely not acceptable for most landowners…*

It is evident that the public is well-intentioned towards beaver despite possible beaver-human conflicts and is averse to killing beavers except as a last resort in extreme cases. Fortunately, many businesses, websites and publications exist that can provide land managers with non-lethal management options allowing beavers to remain and contribute vital ecological benefits. Also watershed councils, NRCS, and Soils and Water Conservation Districts are often interested in exploring these solutions and thus partnerships can be forged between public land management agencies to provide expertise in grant writing, funding and implementation. Success in resolving conflicts is greatly enhanced by the presence of organizations skilled in the implementation of non-lethal solutions[62] and publications that provide information on various techniques[63].

Three examples demonstrate the economic benefits and effectiveness of non-lethal control efforts when dealing with beaver-road conflicts. In all cases it was more cost-effective to address conflicts using non-lethal methods then trapping. The information provided is directly cited.

Example 1: BILLERICA, MASSACHUSETTS (Callahan et al 2019)[64]

The North American beaver, Castor Canadensis, is a Keystone species due to its dam building behavior. While critically important for biodiversity and a multitude of other ecological *benefits, beaver dams can cause significant flooding problems for humans. Beaver conflicts with humans are typically managed with either lethal beaver removal or nonlethal methods. This study compares traditional lethal control versus nonlethal management methods in the town of Billerica, MA. A total of 55 beaver conflict sites were studied from 2000 through 2019. This first of its kind study revealed that the sites managed with nonlethal control methods cost significantly less than sites that were managed with beaver removal. In addition, nonlethal control methods provided millions of dollars of ecological services to the town annually that would have been lost with beaver removal*.

Non-Lethal Beaver Control in Billerica

The 43 beaver conflict sites in Billerica that are successfully managed with non-lethal water control devices are all sites that would have traditionally been managed with trapping. Based upon the rate of trapping at "No Tolerance Zones", the use of non-lethal controls over 19 years has reduced the number of beavers trapped in town from 1,250 to 222.

Since 2000 a total of $83,731 has been spent by the town on flow device installations and maintenance for 43 no-trap sites. The average flow device costs $1,500 and lasts an average of 10 years before needing replacing, for an annualized cost $150. The monitoring and maintenance of a flow device site averages $79 per site per year. Therefore, each beaver conflict that is managed with flow devices costs an average of $229 per site per year.

Beaver Trapping in Billerica

Billerica's twelve "No Tolerance Zones" are monitored regularly for evidence of new beavers and beaver damming. Beavers relocate quicker and more frequently to some of these areas than others. Since the inception of the program a total of 222 beavers have been trapped from these "No Tolerance Zones". This corresponds to an average of 18.5 beavers trapped in town per year, or an average of 1.5 beavers per site per year. By law, all trapped beavers must be killed.

Cost Analysis of Trapping v. Flow Devices

Since 2000, the cost of beaver trapping and beaver dam breaching at the 12 "No Tolerance Zones" has totaled $51,350, or $225 per site per year. The monitoring costs for these 12 sites averages an additional $184 per site per year. Therefore, the annualized cost for each site managed with trapping is $409 per year. The flow device cost to taxpayers averages $229 per site per year. So, non-lethal beaver control saves an average of $180 per site per year. Altogether, the 43 nonlethal beaver management sites currently save Billerica taxpayers $7,740 annually versus trapping. Note, this does not mean that all sites should be managed non-lethally because flow devices are not feasible for every situation. Approximately 25% of the time beaver removal by trapping is the only viable option.

Example 2: State of VIRGINIA (Boyles and Savinsky 2008)[65]:

Road damage caused by beavers is a costly problem for transportation departments in the U.S. Population control and dam destruction are the most widely used methods to reduce road damage caused by beavers, but the benefits of such measures in some situations are often very short-term. At chronic damage sites, it may be more effective and cost-beneficial to use flow devices to protect road structures and critical areas adjacent to roads. To determine the potential benefits of using flow devices at chronic beaver damage sites, from June 2004 to March 2006 we installed 40 flow devices at 21 sites identified by transportation department personnel as chronic damage sites in Virginia's Coastal Plain.

Following installations, study sites were monitored to determine flow device performance and any required maintenance and repairs. Between March 2006 and August 2007, transportation department personnel were surveyed to collect data on flow device efficacy and comparative costs. As of August 2007, transportation department personnel indicated that 39 of the 40 flow devices installed were functioning properly and meeting management objectives. The costs to install and maintain flow devices were significantly lower than preventative road maintenance, damage repairs, and/or population control costs at these sites prior to flow device installations. Prior to flow device installations, the transportation department saved $0.39 for every $1.00 spent per year on preventative maintenance, road repairs, and beaver population control. Following flow device installations, the transportation department saved $8.37 for every $1.00 spent to install, monitor, and maintain flow devices. Given the demonstrated low costs to build and maintain flow devices, transportation agencies may substantially reduce road maintenance costs by installing and maintaining flow devices at chronic beaver damage sites.

Example 3: ALBERTA, CANADA (Hood et al 2017)[66]:

We installed 12 pond levelers to counter flooding by beavers and developed a cost–benefit analysis for these sites in Alberta, Canada. We also documented beaver management approaches throughout Alberta. Over 3 years, one site required regular maintenance until we designed a modified pond leveler; another required minor modifications. Others required almost no maintenance. Based on a "willingness-to-pay" (WTP) of $0 and discount rate of 3%, installing pond levelers resulted in a present value net benefit of $81,519 over 3 years and $179,440 over 7 years. Scenarios incorporating discount rates of 3% and 7%, horizons of either 3 or 7 years, and varying WTPs resulted in significant net benefits. Provincially, municipalities employed up to seven methods to control beavers: most commonly lethal control and dam removal. Total annual costs provided by 48 municipalities and 4 provincial parks districts were $3,139,223; however, cost-accounting was sometimes incomplete, which makes this a conservative estimate.

VI. RULEMAKING REQUEST

Petitioners request the Department initiate rulemaking to amend the Beaver Harvest Season regulation (OAR 635-050-0070) to prohibit commercial and recreational trapping and hunting of beavers on federally-managed public lands and the waters that flow through these lands.

Proposed Rule Language (Proposed new language is underlined and italicized, deleted language is struck through)

OAR 635-050-0070 (Beaver Harvest Seasons)

(1) Open Season: November 15, 2018 through March 15, 2019 and November 15, 2019 through March 15, 2020. ~~in the following described areas:~~

(2) Open Area: *Entire state open* except the Prineville Reservoir below high water line in Crook County *and the following federally-managed public lands and the waters that flow through these lands: Bureau of Land Management lands, National Forests, National Monuments, National Parks, National Grasslands, and Federal Wildlife Refuges.*

~~(1) Clackamas County. All open except those waters within the exterior boundaries of Mt. Hood National Forest.~~

~~(2) Crook County. All open except Prineville Reservoir below high water line and Ochoco National Forest.~~

~~(3) Curry County. All open except the Rogue River from the east county line to the mouth.~~

~~(4) Grant County. All open except within the exterior boundaries of the Ochoco National Forest; Murderers Creek and Deer Creek, tributaries of the South Fork John Day River, within the exterior boundaries of the Malheur National Forest;~~

~~(5) Jefferson County. All open except that portion of Willow Creek and its tributaries on the National Grasslands,~~

~~(6) Josephine County. All open except Rogue River from the confluence of Grave Creek downstream to the county line.~~

~~(7) Union County. All open except:~~

- ~~(a) All open except waters inside exterior boundaries of National Forests. However, private inholdings within the National Forest remain open.~~
- ~~(b) Grande Ronde River above Beaver Creek.~~
- ~~(c) All tributaries of the Grande Ronde River above the confluence of Five Points Creek. (Five Points Creek open to the National Forest boundary).~~

~~(8) Wallowa County. All open except~~

- ~~(a) Wallowa River and tributaries above Wallowa Lake.~~

~~(b) Lostine River, Hurricane Creek, Bear Creek and their tributaries above the Wallowa-Whitman National Forest boundary.~~

~~(c) Minam River and tributaries.~~

~~(d) Peavine Creek, a tributary of Chesnimnus Creek~~

~~(9) Wheeler County. All open except within the exterior boundaries of the Ochoco National Forest and Bridge Creek at its tributaries within the exterior boundaries of Bureau of Land Management lands.~~

~~(10) Other counties: All of the following counties are open in their entirety Baker, Benton, Clatsop, Columbia, Coos, Deschutes, Douglas, Gilliam, Hood River, Harney, Jackson, Klamath, Lake, Lane, Lincoln, Linn, Malheur, Marion, Morrow, Multnomah, Polk, Sherman, Tillamook, Umatilla, Wasco, Washington and Yamhill.~~

Considerations Pursuant to OAR 137-001-0070(2):

The proposed rule amendments will have a negligible economic impact on businesses because the amendments are limited to federally-managed public lands and the waters that flow through these lands. The proposed amendment serves to clarify ambiguous language, and restrict beaver hunting and trapping to certain parts of the state. While some individual trappers may need to find new places to harvest beaver, much of the state of Oregon would still be open for those purposes. Oregon businesses on a whole would see significant benefit from the proposed amendment resulting from better water security, improved water quality and stream flows, climate change mitigation, reduced fire risk, enhanced habitat for salmonids, intact, healthy ecosystems, and improved and expanded recreational opportunities.

(a) The effect of closures on the sale of furtaker licenses should be negligible. Furtakers hunting or trapping beaver equaled 19% of furtakers in 1997 and 9% in 2016. All or nearly all furtakers pursue other species unaffected by this Petition and beaver accounts for only a small slice of the annual take.

(b) The existing rule needs to be amended for the reasons discussed throughout this Petition. The rule if amended would still meet the Oregon Fish and Wildlife Commission's statutory requirement that it regulate furbearer hunting and trapping, including beaver.

(c) The existing rule is complex, ambiguous and out-of-date. This amendment simplifies and clarifies the existing rule and creates a uniform, easily understood and enforceable beaver trapping and hunting regulation for Oregon.

(d) The existing rule does not overlap or duplicate existing state or federal rules.

(e) We believe technology, economic conditions, and other factors such as climate change, have changed in the state affected by the existing rule (increased frequency of drought, flooding, declining coho salmon populations, poor water quality for fish, loss of wetlands, need to take effective and proactive action on climate change etc.). See Sections D, E, and F above for details.

VII. CONCLUSION

Petitioners formally request that the Oregon Fish and Wildlife Commission accept this Petition and initiate rulemaking to eliminate beaver trapping and hunting on Oregon's federally-managed public lands and the waters that flow through them as described at the beginning of this Petition. Our proposed rule language, if accepted, would provide Oregonians and their fish and wildlife with the benefits discussed in this Petition. Our proposed rule language would also simplify the existing rule and make it uniform for both people and enforcement, pursuant to ORS 183.390 and OAR 137-001-0070.

Petitioners believe this an ideal time for the Commission to consider an amendment to OAR 635-050-0070 given that the next furbearer trapping and hunting season on beavers does not begin until November 15.

Petitioners look forward to the Department's written response within 90 days of receipt of this Petition concerning whether the Petition presents substantial information to warrant the action requested, and whether the agency will initiate the requested rulemaking by issuing public notice. ORS 183.335. Please contact Petitioners with any questions concerning this Petition. To contact Petitioners please address:

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VIII. LITERATURE CITED

Literature is cited at the end of this document.

IX. APPENDICES

APPENDIX A: Maps Showing Areas Open and Closed Under Existing Rule and Proposed Amendment

APPENDIX B-1: Studies Related to Beavers and Beaver-Generated Benefits. Studies From 1924 To 2020

APPENDIX B-2: ODFW Publications Relevant to the Petition

APPENDIX C: Strategic Species Listed in the Oregon Conservation Strategy that rely on Beaver-Created Habitat

APPENDIX D-1: A Case Study in Photos Showing the Magnitude and Speed of Beaver-Related Water and Habitat Changes on Bridge Creek, Wheeler County, Oregon

APPENDIX D-2: A Case Study in Photos Showing the Magnitude and Speed of Beaver-Related Water and Habitat Changes on Susie Creek, Elko County, Nevada

APPENDIX E: Maps Showing Specific Areas Open Under Existing Rule to Address Lack of Closure Effectiveness

APPENDIX F: Economics of Beaver-created Habitat

APPENDIX G. Beaver Contributions and Importance in Photos

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[2] Needham, M. D. and Morzillo, A. T. 2011. Landowner incentives and tolerances for managing beaver impacts in Oregon. *Conducted for and in cooperation with: Oregon Department of Fish and Wildlife, Oregon Watershed Enhancement Board, and Bonneville Power Administration.* 139p.

[3] ODFW electronic data. This differs from the 2020 report. It is unclear in the 2020 report which fiscal year the years presented in Appendix 11 and 14 represent. Therefore, for the above discussion the ODFW electronic data is used.

[4] This section was written with input from and reviewed by Dr. Dan Rosenberg of Oregon Wildlife Institute and Cindy Haws, retired Forest Service Wildlife Biologist

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[9] We also note the issue of effect on beaver populations ignores that beaver presence beneficially impacts other imperiled species, such as salmonids and Oregon spotted frogs.

[10] ODFW Furbearer Regulations Proposal, p. 8 and repeated in their June 12, 2020 presentation to the Commission and during the question and answer period with the Commission.

[11] ODFW Furbearer Regulation Proposals, p. 8

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Petition to Initiate Rulemaking to Amend OAR 635-050-0070 to Permanently Close Commercial and Recreational Beaver Trapping and Hunting on Federally-Managed Public Lands and the Waters that Flows Through Them

APPENDICES

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APPENDIX A

MAPS SHOWING AREAS OPEN AND CLOSED UNDER EXISTING RULE

AND PROPOSED AMENDMENT

and

TABLE SHOWING COUNTY SIZE AND PERCENT OWNERSHIP/LAND MANAGEMENT

Map 1a: Areas open and closed to commercial and recreational beaver trapping and hunting in state of Oregon under existing OAR 635-050-0070

Map 1b: Areas open and closed to commercial and recreational beaver trapping and hunting in state of Oregon under amended OAR 635-050-0070

Map 2a: Areas open and closed to commercial and recreational beaver trapping and hunting in state of Oregon under existing OAR 635-050-0070 with counties shown.

Map 2b: Areas open and closed to commercial and recreational beaver trapping and hunting in state of Oregon under amended OAR 635-050-0070 with counties shown.

Map 3a: Areas open and closed to commercial and recreational beaver trapping and hunting in state of Oregon under existing OAR 635-050-0070 with requested federally managed public lands shown.

Map 3b: Areas open and closed to commercial and recreational beaver trapping and hunting in state of Oregon under amended OAR 635-050-0070 with requested federally managed public lands shown.

Table A-1. Size of Oregon s Counties and percentages of ownership/land management.

County	Area (sq. miles)[1]	% Federally-managed Public Lands[2]	% State-managed Public Lands[3]	% Private, County, City lands
Baker	3,068	51	1	48
Benton	676	18	6	76
Clackamas	1,868	54	1	46
Clatsop	827	0	29	71
Columbia	657	4	4	92
Coos	1,600	22	7	71
Crook	2,980	50	1	50
Curry	1,627	61	1	38
Deschutes	3,018	75	3	22
Douglas	5,037	51	1	48
Gilliam	1,204	7	1	92
Grant	4,529	59	1	40
Harney	10,135	72	3	25
Hood River	522	74	1	25
Jackson	2,785	52	0	48
Jefferson	1,781	51	0	49
Josephine	1,640	67	1	32
Klamath	5,945	56	3	41
Lake	7,940	75	2	23
Lane	4,554	57	1	42
Lincoln	980	31	4	65
Linn	2,291	38	2	60
Malheur	9,888	74	5	22
Marion	1,185	25	5	71
Morrow	2,033	16	0	83
Multnomah	435	34	2	64
Polk	741	10	2	88
Sherman	823	11	2	88
Tillamook	1,102	29	44	27
Umatilla	3,215	25	1	74
Union	2,037	48	1	51
Wallowa	3,145	57	1	42
Wasco	2,381	42	2	56
Washington	724	4	11	85
Wheeler	1,715	26	0	74
Yamhill	716	16	0	84

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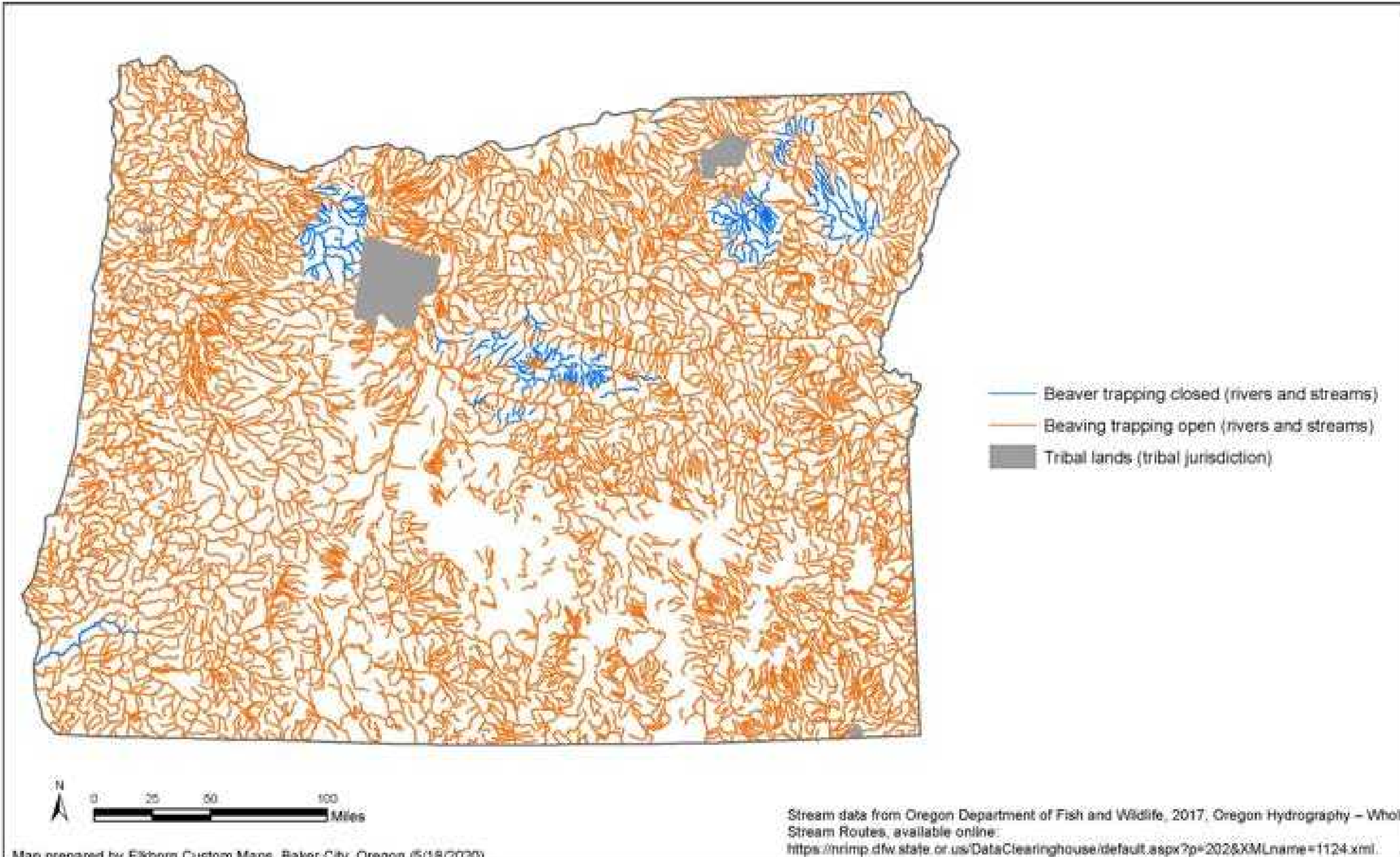
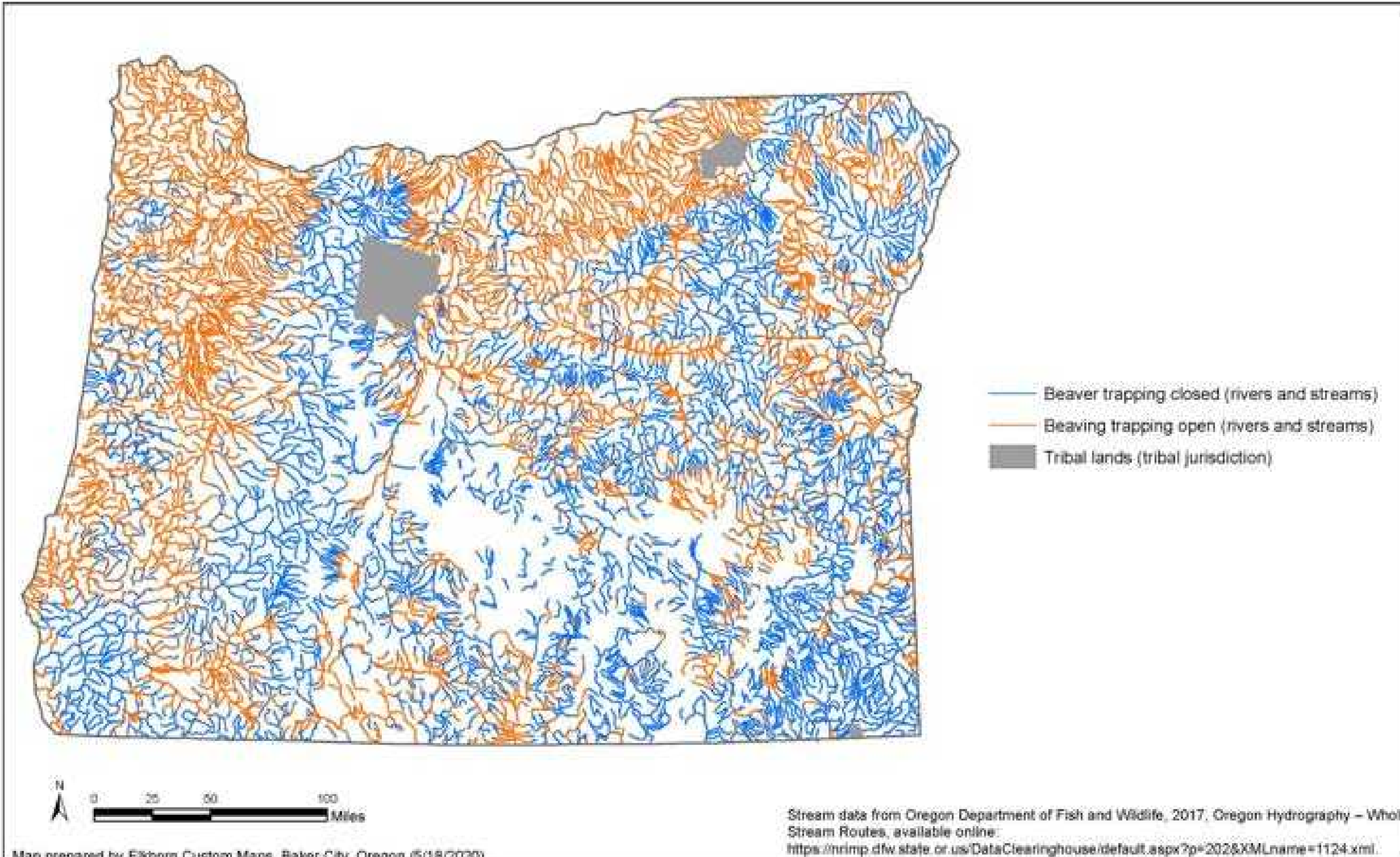
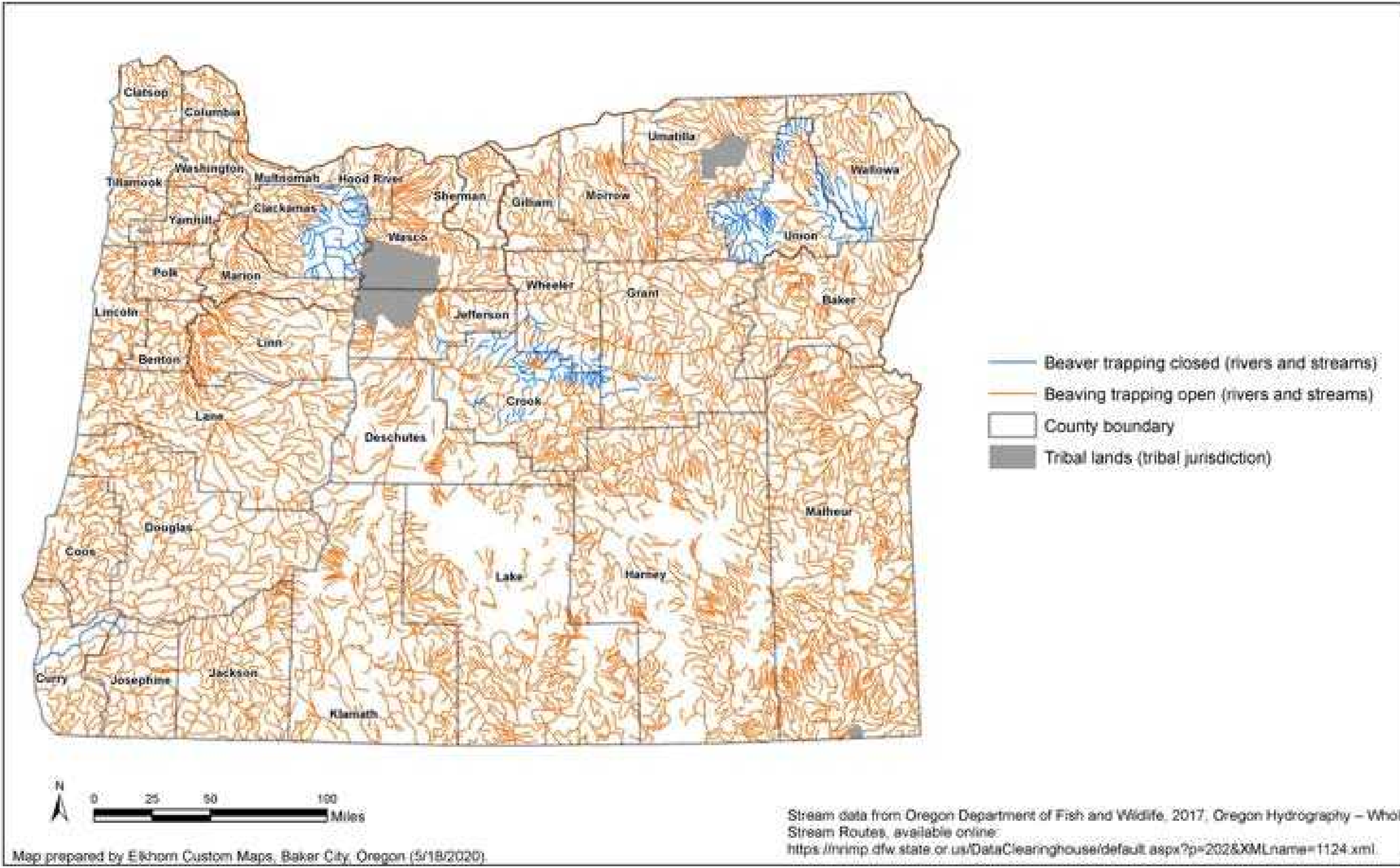


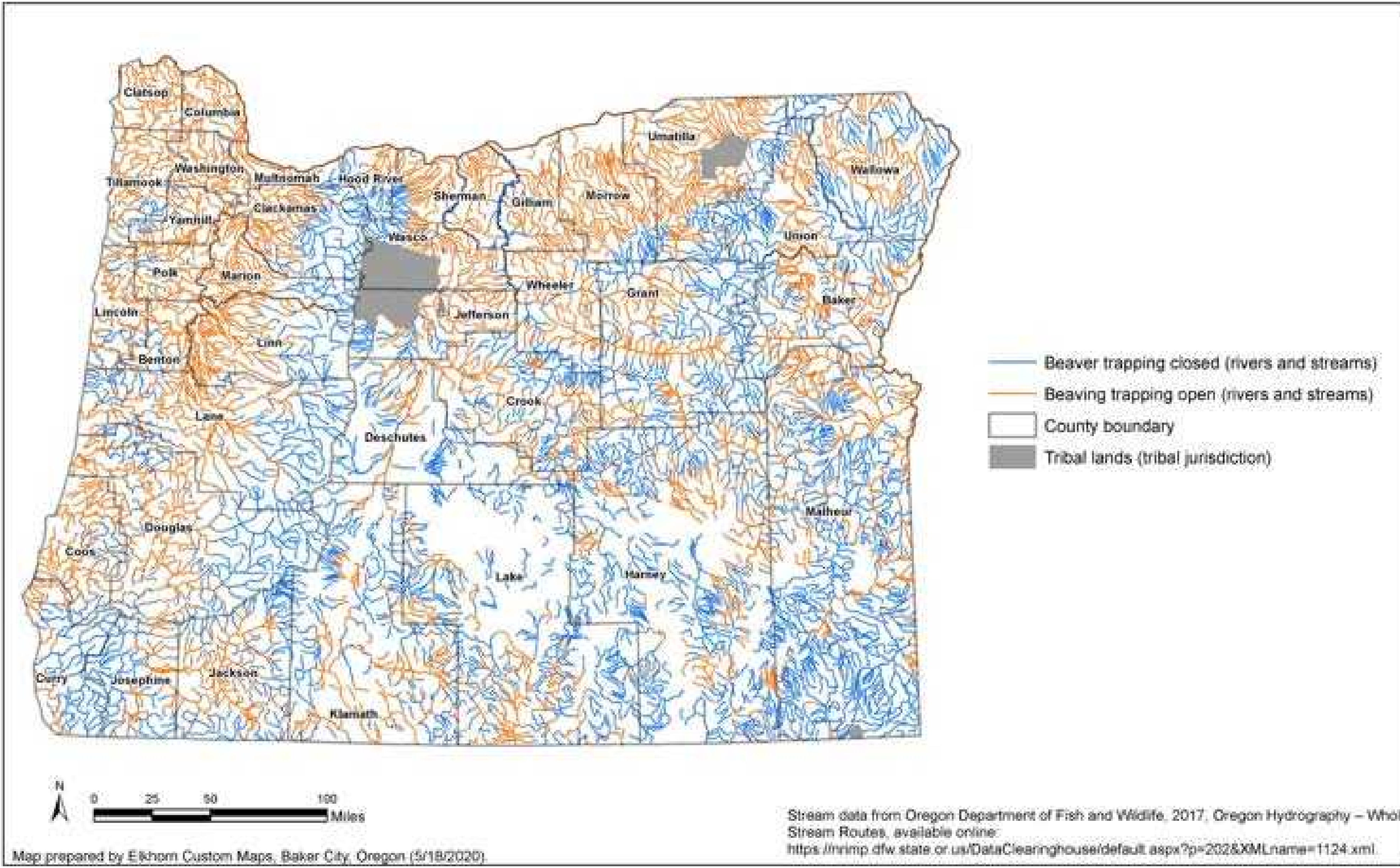
Map 1a. Areas open and closed to commercial and recreational beaver trapping and hunting in the state of Oregon under existing OAR 635-050-0070. Stream segments limited to lengths greater than 30,000 feet for clarity.



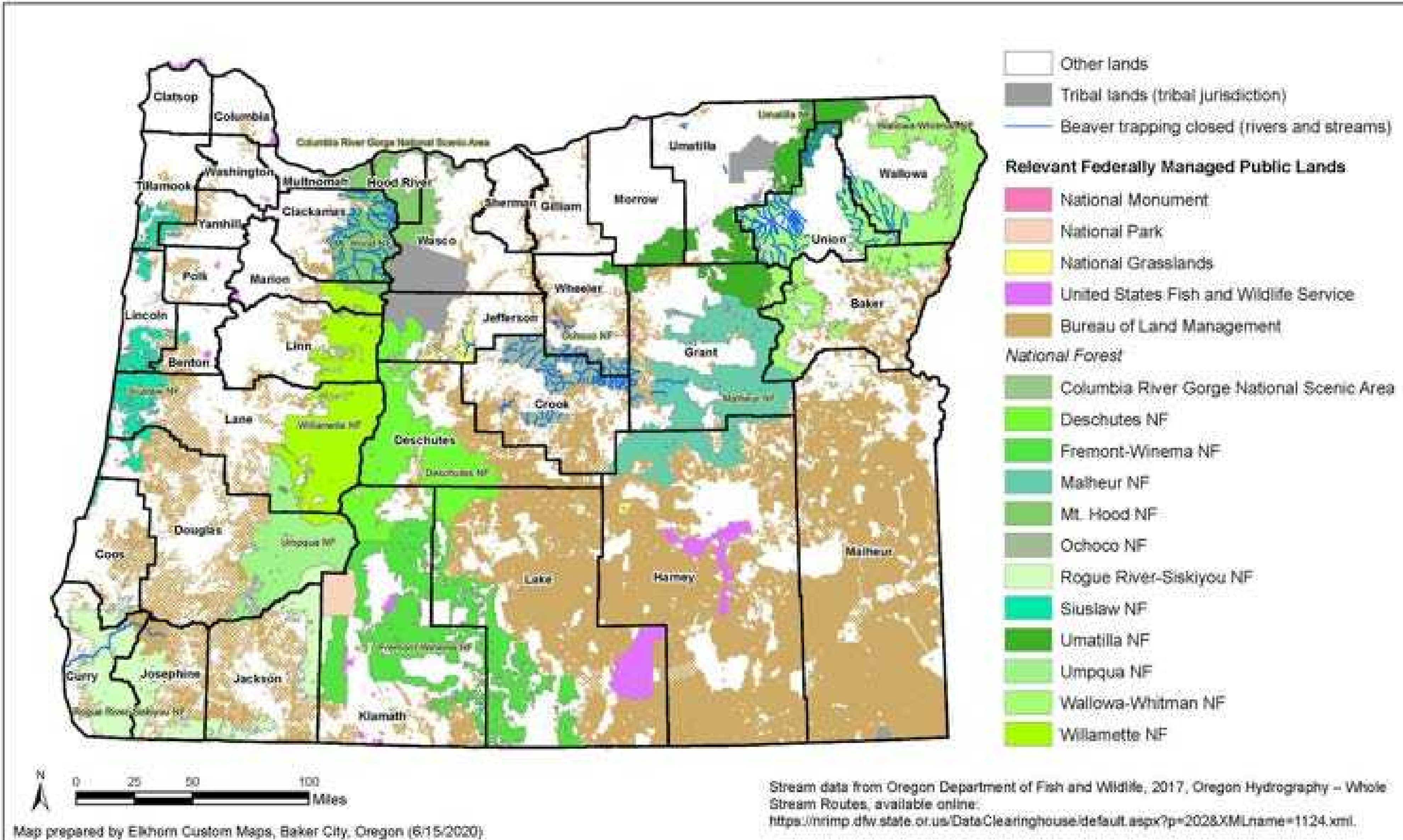
Map 1b. Areas open and closed to commercial and recreational beaver trapping and hunting in the state of Oregon under amended OAR 635-050-0070. Stream segments limited to lengths greater than 30,000 feet for clarity.



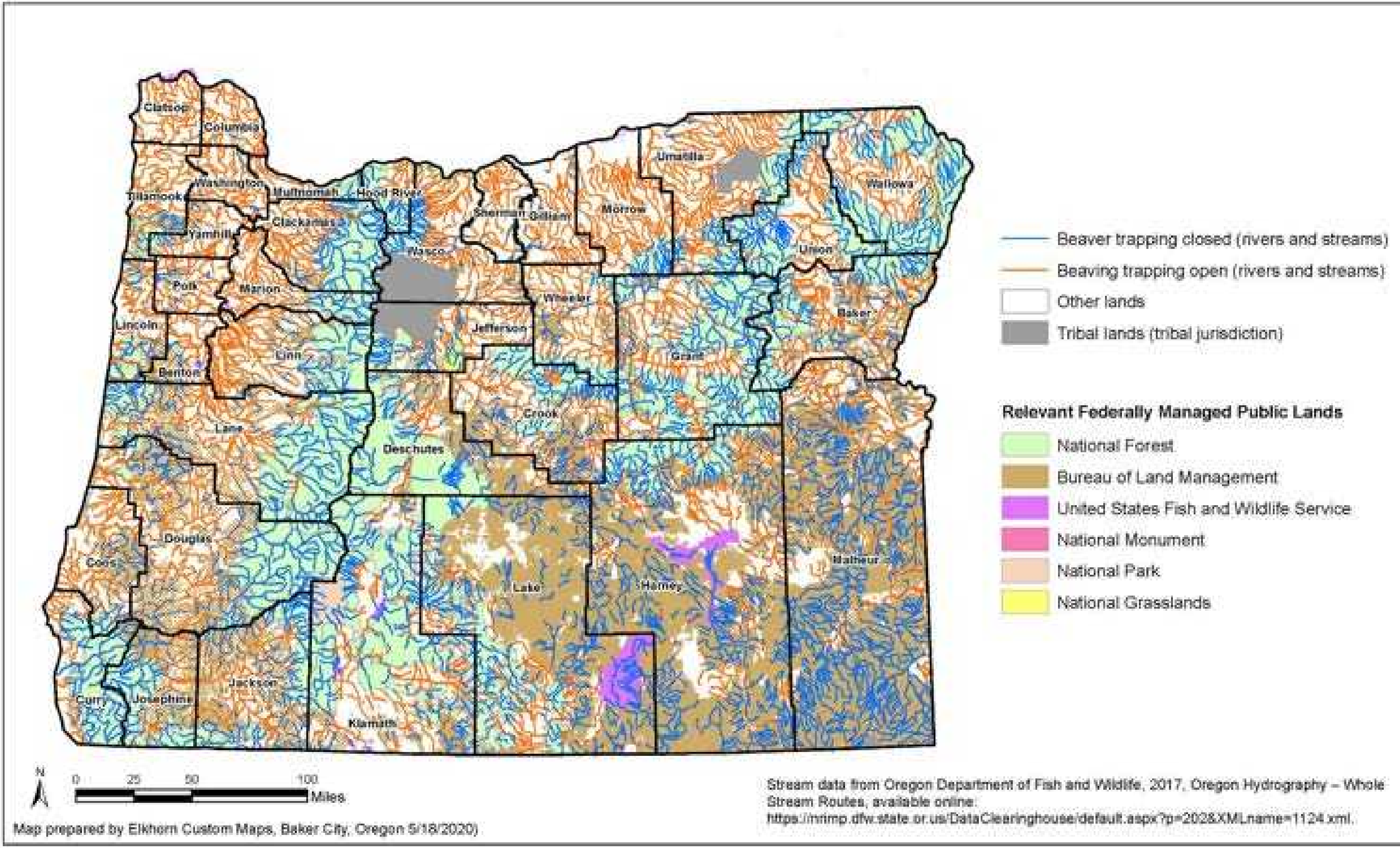
Map 2a. Areas open and closed to commercial and recreational beaver trapping and hunting in the state of Oregon under existing OAR 635-050-0070 with counties shown. Stream segments limited to lengths greater than 30,000 feet for clarity.



Map 2b. Areas open and closed to commercial and recreational beaver trapping and hunting in the state of Oregon under amended OAR 635-050-0070 with counties shown. Stream segments limited to lengths greater than 30,000 feet for clarity.



Map 3a. Areas open and closed to commercial and recreational beaver trapping and hunting in the state of Oregon under existing OAR 635-050-0070 with requested federally managed public lands and counties shown. Stream segments limited to lengths greater than 30,000 feet for clarity.



Map 3b. Areas open and closed to commercial and recreational beaver trapping and hunting in state of Oregon under amended OAR 635-050-0070 with requested federally managed public lands and counties shown. Stream segments limited to lengths greater than 30,000 feet for clarity.

APPENDIX B-1

STUDIES RELATED TO BEAVERS and BEAVER-GENERATED BENEFITS
Studies from 1924 to 2020

This bibliography is a subset of a much larger document. These citations were selected to show the diversity and magnitude of beaver influences on systems and organisms, the value of those benefits, and the longevity of that interest

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APPENDIX B-2

OREGON DEPARTMENT OF FISH AND WILDLIFE PUBLICATIONS

RELEVANT TO THE PETITION TO AMEND OAR 635-050-0070 AS IT RELATES TO COMMERCIAL AND RECREATIONAL BEAVER TRAPPING AND HUNTING ON FEDERALLY-MANAGED PUBLIC LANDS AND THE WATERS THAT FLOW THROUGH THEM

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APPENDIX C

STRATEGIC SPECIES LISTED IN THE OREGON CONSERVATION STRATEGY THAT RELY ON BEAVER-CREATED HABITAT

Taxa	Species Common Name	Special Needs	Conservation Actions
Amphibian	Cascades Frog	Cascades frogs inhabit mountain meadows, **bogs, ponds**, or potholes above 2,400 feet elevation. They re uire access to **clean, permanent water sources**. Cascades frogs lay eggs in slow-moving water, at **shallow, sunny edges of ponds, or on low vegetation near ponds** where warm sunlight speeds egg development. Larvae may “school” in large masses.	**Maintain habitat connectivity. Monitor and address impacts of** fish stocking and **poor water quality. Carefully manage** livestock grazing in **occupied wet meadows**. Use prescribed burning or hand-felling of trees periodically to manage plant succession. If reintroductions are warranted, use individuals from nearby sites and consult results of feasibility studies. Conservation actions in Oregon are particularly valuable given reductions in other parts of the range.
Amphibian	Clouded Salamander	Clouded salamanders prefer forest habitat or burned areas. They are often found among talus, debris, or in large, decaying logs.	Retain patches of intact habitat, including large logs, during forest management activities. Identify areas of high salamander density and leave them undisturbed as seed populations from which remaining habitat can be recolonized as it recovers from alteration. **Provide adequate riparian buffer strips** see Partners in Amphibian and Reptile Conservation recommendations and downed wood.
Amphibian	Columbia Spotted Frog	Columbia spotted frogs breed and forage in **permanent ponds, marshes, and meandering streams through meadows, especially areas of shallow water and emergent vegetation.** They use **springs and other sites with low, continuous water flow** for overwintering.	Identify occupied sites and **maintain vegetation buffers.** Control bullfrogs and invasive fish at priority locations.
Amphibian	Northern Red-legged Frog	Northern red-legged frogs are typically associated with **shallow-water ponds and wetlands with emergent vegetation**. For breeding, they re uire forested sites with exposed sunny , **still-water habitat**. Breeding habitat may be seasonal or permanent, provided the water persists at least 5 months in duration.	Revise wetland hydroperiod re uirements for mitigation and other created wetlands in occupied areas to reduce population sinks . Create upland buffer and a uatic habitat retention re uirements for housing developments to minimize local extirpations in the Willamette Valley. Identify regionally important sites to the species and maintain connectivity between them. **Maintain wetland habitat with emergent plants** and ad acent forest.

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		Adults and uveniles also use **moist riparian** and upland forests.	Address barriers and/or culverts at key road crossings to reduce mortality of lowland Willamette Valley and Coast Range frogs. Control bullfrogs and invasive fish at priority sites.
Amphibian	Oregon Spotted Frog	Oregon spotted frogs use **permanent ponds, marshes, and meandering streams through meadows** for breeding and foraging**, especially those with shallow water and a bottom layer of dead and decaying vegetation.** They rely on **springs and other sites with low, continuous water flow** for overwintering.	**Protect vegetation buffers around occupied sites. Improve hydrology** to benefit overwintering and larval habitat. Control bullfrogs and invasive fish at priority sites. **Carefully manage** livestock grazing at occupied **montane wet meadows**. Use results of feasibility studies to guide specific conservation actions and management decisions for reintroductions.
Amphibian	Rocky Mountain Tailed Frog	Rocky Mountain tailed frogs breed in **clear, cold streams**. Larvae are typically found in reaches with cobbles or boulders and are adapted to cling to rocks and scrape diatoms. Adults forage for insects at night.	Identify, protect, and provide connections among key habitat areas, including upland refugia. Maintain the integrity of stream substrates and microclimates at occupied sites. **Protect vegetation buffers around occupied sites**. Reduce stream substrate disturbance. Retain upland canopy cover. Restrict chemical applications, non-native predators in streams, and livestock grazing.
Amphibian	Western Toad	Western toads use **wetlands, ponds, and lakes** for breeding. They prefer extensive, sunny **shallows with short, sparse, or no vegetation** for egg-laying and for tadpole schools to move widely as they forage on organic mud and surface diatoms.	**Maintain water levels and vegetation buffers at major breeding sites**. Install culverts or drift fences at problem road crossings near ma or breeding sites. Inform recreationists about the importance of minimizing shoreline impacts. Perform periodic control of vegetation height and density at occupied sites where these factors could interfere with breeding. Use distribution information when considering new developments, especially at mid- or low-elevation locations.
Bird	Black-necked Stilt	Black-necked Stilts are generally found in alkali wetlands and **freshwater ponds and lakes**. They prefer foraging sites with **extensive shallows** and those that are free of human disturbance.	Maintain suitable nesting and foraging areas across the landscape to provide sufficient habitat, regardless of annual variation in precipitation and water levels. Monitor and address polluted runoff concerns, including organochlorine pesticides, selenium, and mercury.

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Bird	Common Nighthawk	Common Nighthawks use gravel bars and other sparsely-vegetated grasslands or forest clearings for nesting. As aerial insectivores, they re uire an ade uate prey base.	Maintain sparsely-vegetated grassland patches. Restore natural disturbance regimes. **Restore riparian and wetland habitat** to support the insect prey base of nighthawks.
Bird	Greater Sage-Grouse	Greater Sage-Grouse re uire expansive sagebrush habitat that encompasses a mosaic of conditions. They use **wet meadows and playas** during brood-rearing, especially areas with native forbs.	See the detailed presentation in the Greater Sage-Grouse Conservation Assessment and Conservation Strategy for Oregon Hagen 2011 .
Bird	Greater Sandhill Crane	Greater Sandhill Cranes re uire **relatively large wetland-wet/dry meadow complexes with a mosaic of aquatic and herbaceous conditions** for nesting and foraging.	**Maintain and/or enhance hydrological conditions** to support suitable habitat conditions for nesting and foraging in tracts 20 acres. Where hydrology can be managed, include both **wet and dry meadow habitat** through the nesting season. Minimize disturbance during the breeding season April 15-July 31 at known nesting areas. Use prescribed burning or hand-felling of trees periodically to set back plant succession.
Bird	Lewis's Woodpecker	This species has five ma or habitat types: ponderosa pine forests, oak woodlands, oak-pine woodlands, **cottonwood riparian forests**, and areas burned by wildfires. In all cases, special needs include aerial insects for foraging, large snags for nesting especially soft or well-decayed snags , and relatively open canopy for flycatching.	Maintain or restore open oak, ponderosa pine, and cottonwood woodlands, along with post-fire ponderosa pine habitat. Use nest boxes to enhance habitat in known nesting areas.
Bird	Long-billed Curlew	Long-billed Curlews are found in open habitat with relatively short grass and little woody vegetation. In the Northern Basin and Range ecoregion, much of the suitable habitat is comprised of **sub-irrigated meadows created by adjoining flood-irrigated meadows.**	Expand partnerships with private landowners to maintain and restore large patches of short grass habitat, including ranching operations. Minimize human disturbance from March 15-July 1 at known nesting areas. **Increase water availability** during key brood-rearing periods **through impoundments**, securing water rights on public and private lands, and the development of incentives for private land managers to use more compatible water management practices when practicable.

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Bird	Mountain Quail	Mountain Quail are found in shrubby, **riparian habitat adjacent to grassy uplands**.	Expand partnerships with private landowners to maintain and/or provide suitable habitat. **Coordinate riparian restoration** with management of suitable ad acent uplands.
Bird	Olive-sided Flycatcher	Olive-sided Flycatchers are generally associated with open forests, often near water and with **tall, prominent trees and/or snags**. They may use open, mature coniferous forest, forested **riparian areas**, forest openings e.g., burns, harvested forest , and forest edges. They prefer hemlocks or true firs for nesting and re uire abundant insects for prey.	Maintain scattered, large, dead trees in patchy wildfire zones. Maintain natural openings, but minimize harvested forest openings within mature forest landscapes.
Bird	Red-necked Grebe	Red-necked Grebes inhabit large lakes and ponds within a forested landscape. They re uire deep water for foraging and **marshy, emergent vegetation** for nesting.	Maintain and **enhance marshy vegetation** at occupied site s . Minimize disturbance at breeding and roosting locations. This species readily uses artificial wetlands. Artificial nest platforms have been used successfully on Lake Ontario.
Bird	Short-eared Owl	Short-eared Owls re uire **large expanses of marshes and wet prairies** for foraging and nesting.	**Maintain and restore wetland habitat**, with an emphasis on maintaining large patches and/or expanding smaller ones. Minimize disturbance at communal roost sites.
Bird	Trumpeter Swan	Trumpeter Swans are closely associated with **wetlands**. Breeding pairs, wintering birds, and migrants need high- uality **marshes, ponds, or other water bodies** with **submerged aquatic plants** for foraging and **emergent vegetation** for nesting. They re uire sites with minimal human disturbance.	Improve and **protect emergent wetlands** through enhanced water distribution and management capability. Mark/modify known powerline collision hazards. Continue translocation efforts to enhance/expand the Oregon breeding population.
Bird	Upland Sandpiper	Upland Sandpipers have large breeding area re uirements. They use **wet and dry meadows** in small valleys, such as Logan Valley, Bear Valley, and around Ukiah. They prefer medium-height grasses with **high plant diversity**. They can also be found in lodgepole pine and sagebrush ad acent to grasslands.	Expand partnerships with private landowners to determine and implement appropriate conservation on suitable habitat patches. Remove encroaching lodgepole pine trees in meadows.

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Bird	Willow Flycatcher	Willow Flycatchers are dependent upon **riparian shrub habitat.** They re uire a **dense, continuous or near-continuous shrub layer, especially of willows**.	**Restore brushy patches of willow and other native shrubby habitat near water.** Control non-native plants to maintain native shrub communities. Discourage Brown-headed Cowbird use of riparian areas through seasonal grazing and/or maintaining high grass heights in priority areas. **Restore riparian and early seral/montane meadow habitat** in the West Cascades.
Bird	Yellow Rail	Yellow Rails use **sedge meadows** for breeding. They prefer a **narrow range of water depths** and re uire the **presence of senescent vegetation**.	Maintain preferred water levels of approximately 2.4-2. inches during the breeding season. **Retain at least 50% of senescent vegetation** from year to year.
Bird	Yellow-breasted Chat	Yellow-breasted Chats are found in dense, brushy thickets, **especially near streams**.	**Restore large, dense thickets of native shrub-dominated riparian habitat**.
Fish	Bull Trout	Re uires **cool temperatures** for spawning and rearing. Re uires **channel complexity** and **available migratory corridors**.	Adaptively manage bull trout and kokanee harvest in Lake Billy Chinook. Angler education. Maintain or restore a uatic and riparian habitat. Restore connectivity. Manage against brook trout/lake trout. Habitat restoration. Restore connectivity. Manage against brook trout. Screening. Brook trout control. Establishment of additional populations . Gravel augmentation. Evaluate potential for lake trout control. Continue ongoing restoration efforts involving landowners, tribes, and agency partners NOAA, NMFS, ODFW, OWEB . Finalize draft USFWS recovery plan.
Fish	Chinook Salmon	Re uire **streams with clean gravel, complex habitat, and cool temperatures** for spawning and rearing. Re uire access for anadromous migration. Productive nearshore marine habitat that provides high- uality prey in sufficient uantity for rapid growth at time of ocean entry.	**Maintain or restore aquatic and riparian habitat.** Continue ongoing restoration efforts involving landowners, tribes, and agency partners NOAA, NMFS, ODFW, OWEB . Manage for sustainable harvest.
Fish	Chum Salmon	Re uire **stream gravel bars with upwelling flow and side channels** near tidewaters for spawning. Migrate to ocean soon after emergence. Productive nearshore marine habitat that provides high-	**Maintain or restore** a uatic, estuarine, and **riparian habita**t. Continue ongoing restoration efforts involving landowners, tribes, and agency partners NOAA, NMFS, ODFW, OWEB . Manage for sustainable harvest.

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		uality prey in sufficient uantity for rapid growth at time of ocean entry.	
Fish	Coastal Cutthroat Trout	**Large woody debris, in-stream structures, and vegetation** important for protection while in freshwater. Juveniles prefer **side channels, backwaters, or pools** for rearing. **Clean gravel** for spawning and rearing. **Migratory corridors.**	**Maintain or restore** a uatic, estuarine, and **riparian habitat, providing suitable water quality and habitat complexity**. Continue ongoing restoration efforts involving landowners, tribes, and agency partners NOAA, NMFS, ODFW, OWEB . Reduce localized impacts where populations could become increasingly fragmented.
Fish	Coho Salmon	Re uire **streams with clean gravel, complex habitat, and cool temperatures** for spawning and rearing. Re uire access for anadromous migration. Productive nearshore marine habitat that provides high- uality prey in sufficient uantity for rapid growth at time of ocean entry.	Implement measures identified in Coastal Coho Assessment with landowners and agency partners NOAA, NMFS, State of Oregon ODFW, OWEB, Independent Multidisciplinary Science Team , and Coastal Coho Stakeholder Team. Maintain or restore a uatic and riparian habitat. Continue ongoing restoration efforts involving landowners, tribes, and agency partners NOAA, NMFS, ODFW, OWEB . Manage for sustainable harvest.
Fish	Great Basin Redband Trout	Several life history types with different migratory patterns. **Pools provide important habitat** for all life stages.	Address passage barriers. **Restore flow and riparian quality.** Screening.
Fish	Lahontan Cutthroat Trout	Restricted distribution. Found in small streams lacking numerous other fish species.	Continue ongoing recovery efforts to **monitor water availability and improve riparian condition and channel structure** implementation of current recovery plan .
Fish	Lost River Sucker	Spawn in **rivers, streams, or springs associated with lake habitat**. After hatching, migrate to lakes. Need **shoreline river and lake habitat with vegetative structure** during larval and uvenile rearing.	Restore or enhance spawning and nursery habitat. **Reduce negative impacts of poor water quality** where necessary. Clarify and reduce the effects of introduced species on all life stages by conducting and applying scientific investigations. Reduce the loss of individuals to entrainment. Establish a redundancy and resiliency enhancement program. Increase uvenile survival and recruitment to spawning populations. Maintain and increase the number of recurring, successful spawning populations.
Fish	Miller Lake Lamprey	Spawn in **lakes.** Also inhabit **marshes or rivers.** Adults are smaller than late-stage larvae, possibly because of difficulty finding food, yet still can spawn. Adults parasitic potential role of	Implement conservation plan adopted by ODFW in summer 2005. Also, increased understanding of biology will help in identifying habitat re uirements and potential conservation actions. Remove barrier on Miller Creek.

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		reducing egg predators.	
Fish	Millicoma Dace	**Cool, swift streams. Cobbles and gravel** for rearing and spawning.	**Create and maintain gravel habitat. Maintain or restore flow and sediment regimes to improve habitat quality. Maintain or improve riparian conditions,** including habitat for beavers.
Fish	Pit Sculpin	Occupies fast-flowing rocky riffles of **cool, well-shaded, small streams, spring-fed creeks, and small boulder-strewn rivers.**	Continue habitat restoration.
Fish	Shortnose Sucker	Spawn in **rivers, streams, or springs associated with lake habitat.** After hatching, migrate to lakes. Need **shoreline river and lake habitat with vegetative structure** during larval and uvenile rearing.	Restore or enhance spawning and nursery habitat. **Reduce negative impacts of poor water quality** where necessary. Clarify and reduce the effects of introduced species on all life stages by conducting and applying scientific investigations. Reduce the loss of individuals to entrainment. Establish a redundancy and resiliency enhancement program. Increase uvenile survival and recruitment to spawning populations. Maintain and increase the number of recurring, successful spawning populations.
Fish	Steelhead / Rainbow / Redband Trout	Re uire **streams with clean gravel, complex habitat, and cool temperatures** for spawning and rearing, but able to spawn successfully in streams that are naturally intermittent in summer. Re uire access for anadromous migration, including ade uate streamflow during downstream fry migration on naturally intermittent streams, and upstream passage for uveniles in winter during multiple years in freshwater.	**Maintain or restore** a uatic and **riparian habitat**. Continue ongoing restoration efforts involving landowners, tribes, and agency partners NOAA, NMFS, ODFW, OWEB . Maintain momentum for restoration of fish passage throughout the Rogue watershed by continued funding of passage pro ects. **Restore streamflows** through cooperative pro ects.
Fish	Ump ua Chub	**Off-channel habitat (low flow, silty organic substrate, abundant vegetation, and cover).**	Reduce pollution. **Restore flow.** Reduce density of invasives in key habitat. Reintroductions useful at some sites. Limit nonpoint source pollution through Total Maximum Daily Load allocation process.
Fish	Warner Sucker	**Lakes and low-gradient stream reaches** of Warner Valley. Prefer **pool habitat in streams**. Juvenile stage is vulnerable to predation.	Maintain or restore spring waters. **Maintain or restore migration corridors** among habitat areas. **Increase stream flows** in lower sections of tributaries. **Restore wetland habitat.** Evaluate

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			likelihood of long-term persistence in the presence of non-natives.
Fish	Western Brook Lamprey	May aggregate in high densities. Re uires **fine gravel beds** for spawning. Larvae burrow in **fine sediment**. Timing of development closely linked to water temperature.	Improve passage. Alter timing of water draw-down. Use species-specific habitat re uirements to guide management actions. See results of Lamprey Workgroup 2005 for strategies.
Fish	Westslope Cutthroat Trout	Specializes in foraging for invertebrates. Prefers **cool, clear streams** with coarse sediment.	**Maintain riparian cover** and other factors that can provide thermal cooling. Reduce localized impacts where populations could become increasingly fragmented.
Invertebrate	Bulb Juga	The bulb uga inhabits gravel-boulder riffles in cold, highly-oxygenated water.	**Maintain or restore high water quality.**
Invertebrate	California Floater Freshwater Mussel	In Oregon, California floater freshwater mussels use speckled dace as a primary host and likely many other fish species as well . These mussels occur in lakes, slow rivers, and some reservoirs with mud or sand substrates. They are sedentary filter feeders that consume plankton and other particulate matter suspended in the water column, thereby contributing to nutrient cycling. California floater freshwater mussels may prefer **higher reaches of streams with high water quality.**	Protect known populations of host fish. **Maintain water quality.**
Invertebrate	Columbia Clubtail	Columbia clubtails are found in river and **stream habitat**. They lay eggs in the water, and larvae are a uatic.	Protect habitat known to support Columbia clubtails. Manage invasive species in occupied areas.
Invertebrate	Columbia Gorge Caddisfly	This species occurs only in **small streams** in the Columbia Gorge.	**Maintain stream water quality** and sediment regimes.
Invertebrate	Crater Lake Tightcoil	These terrestrial snails are generally found in **riparian areas**, **wet meadows**, and moist forests, often among shrubs and at the bases of plants.	**Maintain appropriate water flow and qualit**y. Prevent or mitigate for water diversions, dredging, or other activities that could increase sediment or nutrient levels.
Invertebrate	Great Spangled Fritillary	Great spangled fritillaries feed strictly on violets mostly on *Viola glabella* in western Oregon .	Protect locations of preferred host plants. **Manage meadows to reduce conifer encroachment. Maintain hydrology** at known sites of occurrence.

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Invertebrate	Highcap Lanx	The highcap lanx inhabits spring-influenced areas of larger rivers and tributaries.	**Maintain appropriate water flow and quality.** Prevent or mitigate for water diversions, dredging, or other activities that could increase sediment or nutrient levels.
Invertebrate	Insular Blue Butterfly	Insular blue butterflies typically inhabit **wet, open habitat, such as bogs, meadows, and ditches**. They also use coastal salt-spray meadows. Clovers serve as important host plants. Conifer trees ad acent to meadows can serve as shelter and windbreaks. This species is currently known to exist at only three sites, two of which are in Oregon Cape Blanco and Bullards Beach State Parks .	Protect known sites of occurrence. Restore meadow habitat.
Invertebrate	Pacific Walker	Pacific walkers are semi-a uatic snails that inhabit **riparian areas**. They are typically found among wet vegetation along freshwater sources.	Protect known sites of occurrence. Investigate habitat re uirements and use these to guide management actions.
Invertebrate	Purple-lipped Juga	The purple-lipped uga inhabits **gravel-boulder riffles in cold, highly-oxygenated water.**	**Maintain or restore high water quality.**
Invertebrate	Rotund Lanx	These freshwater mollusks are found in **large rivers**, such as the Ump ua, and **major tributaries**. They are generally associated with **rocky substrates and swift currents**.	**Maintain or restore watershed function and flow dynamics.**
Invertebrate	Vernal Pool Fairy Shrimp	Vernal pool fairy shrimp re uire **vernal pools or similar, ephemeral pools** to complete their life cycle. They prefer **small pools with cold water**. Prior to seasonal drying of the pools, females produce eggs cysts . These cysts can dry out and lie dormant until pool re-filling occurs, at which time the eggs will hatch.	**Maintain or restore vernal pools** to provide habitat. **Maintain or restore water quality** in vernal pools.
Invertebrate	Western Ridged Mussel	Western ridged mussels are found in **cold creeks and streams**. They are filter-feeders with long lifespans.	**Maintain water quality and availability.**

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Invertebrate	Winged Floater Freshwater Mussel	Winged floater freshwater mussels re uire a fish host. They occur in lakes, slow rivers, and some reservoirs with mud or sand substrates. They are sedentary filter feeders that consume plankton and other particulate matter suspended in the water column, and thereby contribute to nutrient cycling. These mussels **may prefer higher reaches of streams with high water quality**.	Protect known populations of host fish. **Maintain water quality.**
Mammal	California Myotis	This species is generally associated with forests. California myotis **use large snags** for day roosts. They are occasionally found night-roosting under bridges.	**Maintain and create large snags** during forest management activities. Complete bridge replacement and maintenance when bats are absent.
Mammal	Columbian White-tailed Deer	The Columbia River DPS is **strongly associated with riparian habitat** along the lower Columbia River. The Ump ua population is also found in **riparian areas** and may use lower-elevation oak woodlands as well.	For the Columbia River DPS, continue to implement conservation actions identified in the Columbian white-tailed deer recovery plan. For the Ump ua population, continue to monitor population status, manage habitat at North Bank Habitat Management Area, and evaluate translocation issues and priorities.
Mammal	Fisher	Fishers are found in forests and **riparian corridors** with moderate to dense canopy cover and diverse structural stages and plant communities. They use cavities in live or dead standing trees for den sites. Fishers prey on small mammals, including snowshoe hares and porcupines.	Maintain complex forest structure with large trees within the fisher s range. Improve habitat patch size and connectivity to provide for dispersal, genetic interchange, and population expansion. Use results of feasibility studies to guide specific conservation actions and management decisions for potential reintroductions. Work with Washington Department of Fish and Wildlife, U.S. Fish and Wildlife Service, and National Park Service to review outcomes of conservation actions. Develop a fisher conservation strategy.
Mammal	Fringed Myotis	Fringed myotis re uire forest habitat. They **use large snags** and rock features for day, night, and maternity roosts, and caves and mines for hibernacula. They feed primarily on beetles. They occasionally use bridges for night-roosting.	Use gates and seasonal closures to protect known hibernacula. **Retain and create** large-diameter hollow trees and large-diameter, tall, **newly-dead snags** during forest management activities.

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Mammal	Long-legged Myotis	Long-legged myotis are found in forested areas. They are often associated with late-successional conifer forests or other forested habitat with late-successional components. They re uire large snags and hollow trees for day, night, and maternity roosts. They may also use bridges in forested habitat for night-roosting, and caves and mines for roosting and hibernating. They typically forage along **riparian corridors** and forest edges. In the East Cascades ecoregion, long-legged myotis are often associated with ponderosa pine, grand fir, and white fir.	**Maintain and create large-diameter hollow trees and large-diameter, tall, newly-dead snags in riparian** and upland **habitat**. **Maintain and restore diverse riparian areas**. Complete bridge replacement and maintenance when bats are absent. Incorporate snags of pine and fir species into forest management plans.
Mammal	Pallid Bat	Pallid bats are found in dry, open habitat. They use crevices in cliffs, caves, mines, or bridges and sometimes, buildings for day, night, or maternity roosts, or hibernacula. In some areas, they use snags as day roosts. Pallid bats prefer grassland, shrub-steppe, and dry forest ecotones for foraging. They also **associate with open-water sites within the landscape**.	Use gates and seasonal closures to protect known roost sites during sensitive times raising young and hibernation . **Maintain open-water sources** in dry landscapes. Manage rock features, such as cliffs, to avoid conflict with recreational use and rock removal. Complete bridge replacement and maintenance when bats are absent. Maintain large pine snags in shrub-steppe/forest ecotones. Maintain and restore native grassland, shrub-steppe, and open ponderosa pine habitat.
Mammal	Ringtail	Ringtails occupy low-elevation forests with large-diameter snags and logs for dens. They are typically associated with late-successional forests. They may **also use riparian** and rocky **areas**.	Collect information on data gaps.
Mammal	Sierra Nevada Red Fox	Sierra Nevada red foxes inhabit high-elevation meadows and forests. This species is experiencing greater conservation threats at the southern edge of its range, so efforts to provide habitat in Oregon are especially beneficial.	**Maintain and/or recruit high-elevation conifer forest and meadow habitat.** Continue monitoring programs. Support data collection efforts to distinguish between eastern red fox and Sierra Nevada red fox.

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Mammal	Silver-haired Bat	Silver-haired bats inhabit late-successional conifer forests. They use **large snags** and hollow trees for day, night, and maternity roosts. They may be found in other habitat types during migration.	Maintain late-successional conifer habitat. Maintain and create large-diameter hollow trees and snags. Implement impact reduction strategies e.g., operational minimization at wind energy facilities to reduce fatalities. Investigate other best management practices for implementation at wind energy facilities.
Mammal	Spotted Bat	Spotted bats use crevices in cliffs, caves, and canyon walls for day and night roosting. They also roost in trees ad acent to meadows at night. They typically forage in **meadows**, shrub-steppe, or along **riparian corridors and water sources**.	**Maintain open-water sources** in desert landscapes. Manage rock features, such as cliffs, to avoid conflict with recreational use and rock removal. Maintain and restore native shrub-steppe habitat.
Plant	Applegate s Milkvetch	Applegate s milkvetch occurs in flat, open, **seasonally-moist grasslands** with alkaline soils. Historically, habitat included sparse, native bunch grasses and patches of bare soil.	Continue to implement actions identified in the recovery plan, including managing and monitoring known sites. Evaluate the potential for establishing new populations in suitable habitat.
Plant	Arrow-leaf Thelypody	Arrow-leaf thelypody occurs with western unipers along streambanks, **seasonally-moist areas,** seeps, and under isolated uniper trees away from obvious moisture.	Minimize grazing at priority sites. Collect and store seeds.
Plant	Boggs Lake Hedge Hyssop	Boggs Lake hedge hyssop is found in semi-a uatic habitat. This species typically occurs in **mud or damp soils at lake edges**, generally around 5360 feet altitude. Occupied **wetlands** are often surrounded by sagebrush flats.	The only known Oregon population occurs on Bureau of Land Management lands. Monitor the existing population. Survey for suitable habitat for establishment of new populations.
Plant	Coast Range Fawn Lily	The Coast Range fawn lily is found in a variety of habitat types, including open meadows, brushland, rocky cliffs, open to closed coniferous forests, and at the **edges of sphagnum bogs**.	Survey potential habitat for new populations. Continue efforts to protect known sites and monitor populations. Collect and store seeds. Consider reintroductions.
Plant	Cook s Desert Parsley	Cook s desert parsley occurs in two ma or population centers. In Jackson County, this species is found in the Agate Desert in **vernal pools**. These pools usually range from 3-100 feet across and no more than 12 inches deep. In Josephine County, this	Maintain current populations and restore vernal pool habitat at priority sites, including Denman Wildlife Management Area. Manage road construction and maintenance pro ects to avoid impacts to hydrology in and around known populations.

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		species is found in **seasonally-wet, grassy meadows on alluvial floodplains** in the Illinois Valley, with underlying soil forming clay pan.	
Plant	Dwarf Meadowfoam	Dwarf meadowfoam typically grows along the edges of **deep vernal pools**. This species is associated with ancient basalt lava flows on Upper and Lower Table Rocks in Jackson County, above 1950 feet.	Minimize impacts from trail construction and maintenance. Continue population monitoring. Note: this plant occurs only on federal land.
Plant	Gentner s Fritillary	Gentner s fritillary occurs in a wide range of habitat types, including woodlands dominated by Oregon white oak, **moist riparian areas**, Douglas fir forests, and serpentine sites. This species generally prefers ecotones between meadows and open woodlands.	Minimize impacts from road maintenance and construction on existing roadside populations. Continue monitoring existing populations.
Plant	Howell s Spectacular Thelypody	Howell s spectacular thelypody occurs in low-elevation 3000-3500 feet river valleys and moist, alkaline plains. This species is often found at the intersection of black greasewood and **riparian habitat**. Howell s spectacular thelypody **may be dependent on seasonal flooding**.	Locate protected sites in potential habitat. Create new populations. Minimize grazing and mowing during the growing season at priority locations. Control key invasive plants. Continue voluntary cooperative efforts with private landowners. Collect and store seeds.
Plant	Howellia	Howellia is typically found at the **edges of low-elevation vernal pools**, generally in shaded areas.	**Maintain or restore seasonal wetland habitat.** Control invasive plants at priority sites. Conduct surveys of potential habitat to locate additional populations. The draft recovery plan identifies additional conservation actions.
Plant	incaid s Lupine	incaid s lupine occurs in **seasonally-wet native prairies**.	Restore prairie habitat using site-appropriate tools e.g., burning, mechanical removal of encroaching vegetation . Develop seed production fields for each recovery zone. Conduct long-term demographic monitoring. Conduct surveys of potential habitat to locate new populations. Limit impacts from road construction/maintenance at occupied sites.

Taxa	Species Common Name	Special Needs	Conservation Actions
Plant	Large-flowered Rush Lily	The large-flowered rush lily occurs in **bogs, moist, open meadows, seeps, and wetland areas**, generally at elevations of 1150-2300 feet. This species is often associated with overlying serpentine or peridotite soils. It is commonly found in open areas, with gentle slope.	Maintain California pitcher-plant bogs, which provide habitat for many rare species. Minimize water withdrawals from bog sites. Carefully manage or eliminate grazing at sites where this species occurs. Collect/store seeds, including seeds from both white and purple flowers.
Plant	Nelson s Checkermallow	Nelson s checkermallow occurs in wet and dry prairies, **wetlands**, edges of woodlands, and **riparian areas**. Remnant populations occur in roadsides and ditches.	Maintain or restore grass-dominated habitat. **Maintain or restore hydrology.** Control key invasive plants. Use mowing or prescribed fire to control brush and trees. Maintain populations in roadsides and ditches.
Plant	Oregon Semaphore Grass	Oregon semaphore grass occurs in **moist meadows and marshland**, at around 3300-5600 feet in elevation. This species is found on gravelly silt loam or clay soil inundated by slow-moving water.	Manage grazing at occupied sites. Collect and store seed. Monitor current introductions into suitable habitat on public land.
Plant	Rough Popcornflower	Rough popcornflower occurs in shaded, **seasonally-wet pools (vernal pools).**	Avoid herbicide spraying on roadside populations. Work cooperatively with private landowners to maintain rough popcornflower on private land. Ac uire land with uality habitat for population creation pro ects. Continue monitoring of existing populations. Carefully manage grazing and fence priority sites, if necessary.
Plant	Western Lily	The western lily occurs in **bogs composed of damp, slightly acidic and organic soils**. This species is generally associated with small shrubs with nearby sunlight, and may use shrubs for mechanical support.	Continue current conservation efforts, such as grazing management, propagation, and experimental vegetation management e.g., prescribed fire, mowing . **Maintain and restore bog hydrology.** Avoid herbicide application during the growing season for roadside populations and use “No Spray” signs for educational purposes.
Plant	White-topped Aster	White-topped aster occurs in open grasslands, including **seasonally-wet prairies** and oak savannah.	Maintain or restore grass-dominated habitat. Control key invasive plants. Use mowing or prescribed fire to control brush and trees. Maintain populations in roadsides and ditches. Collect and store seeds.

Taxa	Species Common Name	Special Needs	Conservation Actions
Plant	Willamette Daisy	The Willamette daisy is found in **seasonally-wet prairies** and drier upland prairie sites, where woody cover is nearly absent and herbaceous vegetation tends to be low in stature.	Continue prairie management where extant populations occur to maintain and expand populations. Identify suitable protected sites for introductions. **Maintain or restore hydrology.** Control invasive and woody plants through use of well-timed mowing, prescribed fire, and selected herbicide use, as appropriate. Collect seeds for storage and grow out for outplanting.
Reptile	Western Painted Turtle	Western painted turtles inhabit **marshy ponds, small lakes, slow-moving streams, and quiet off-channel portions of rivers**. They prefer **waters with muddy bottoms and aquatic vegetation**. Western painted turtles use open, sparsely-vegetated and sunny ground for nesting. They re uire sunny logs/vegetation for basking and safe movement corridors between a uatic and terrestrial habitat.	Provide basking structures and nesting habitat. Control invasive plants and animals. Protect important nesting sites from disturbance. Use wire cages to protect nests from raccoons at key sites in the short-term where this is a problem. Implement the Oregon Department of Fish and Wildlife s Turtle Best Management Practices. Prevent illegal collection. Prevent release of pet turtles. Reduce risk of mortality from roads.
Reptile	Western Pond Turtle	Western pond turtles are found in **marshes, streams, rivers, ponds, and lakes**. They use sparsely-vegetated ground nearby for digging nests and moist, shrubby or forested areas for aestivation and over-wintering. They re uire sunny logs/vegetation for basking and safe movement corridors between a uatic and terrestrial habitat.	Identify population centers. Use distribution data to establish priority areas for protection and management. Provide basking structures and nesting habitat. Control invasive plants and animals. Minimize disturbance in nesting areas. Protect ad acent upland habitat. Implement the Oregon Department of Fish and Wildlife s Turtle Best Management Practices. Prevent illegal collection. Prevent release of pet turtles. Reduce risk of mortality from roads.

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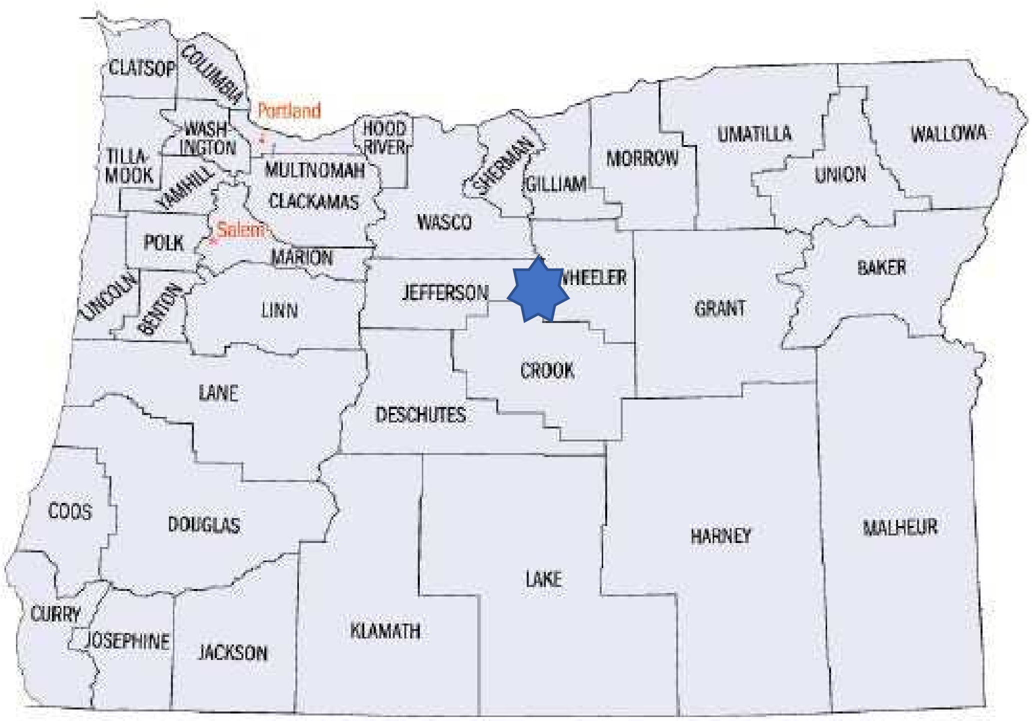
APPENDIX D-1

A CASE STUDY IN PHOTOS SHOWING THE MAGNITUDE AND SPEED OF

BEAVER-RELATED WATER AND HABITAT CHANGES ON BRIDGE CREEK

WHEELER COUNTY, OREGON



Bridge Creek (blue star) in central Oregon is a tributary to the John Day River.

Beavers in Bridge Creek after 19[illegible]

Bridge Creek is a low-gradient stream in the John Day River basin of eastern Oregon. After decades of grazing, riparian vegetation along a 31.7 km reach was sparse and low in diversity, vegetated floodplains were typically narrow, and the stream was relatively wide and shallow. Cattle grazing within this reach was reduced in 1988, irrigation diversion ditches were replaced with culverts in 1989, and beaver (*Castor canadensis*) trapping was discontinued after 1991. Between 1988 and 2004 (17 yrs), beaver dams and ponds were surveyed twice a year to estimate their dimensions.

Field notes and photographs were used to document habitat use and better understand the potential role of beaver with regard to channel morphology and riparian plant communities. The annual number of beaver dams present in the study reach ranged from 9 to 103. On average, dams were nearly 8 m in length with ponds extending upstream 26 m. Over time, beaver dams/ponds typically accumulated sediment, improved conditions for establishment and growth of riparian plants, and altered channels. Dams that breached during periods of high flow often contributed to long-term increases in channel complexity through the formation of new meanders, pools, and riffles. Exposed sediment deposits associated with breached dams provided fresh seedbeds for regeneration of willows (*Salix* spp.), black cottonwood (*Populus balsamifera* ssp. *trichocarpa*), and other riparian plants. Although portions of the study reach were periodically abandoned by beaver following heavy utilization of streamside vegetation, within a few years dense stands of woody plants normally occupied a larger portion of the floodplain. Observations indicated that beaver facilitated recovery of riparian vegetation, floodplain functions, and stream channels, as well as habitat for multiple aquatic and terrestrial wildlife species.

* Adapted from Demmer R, Beschta RL. 2008. Recent history (1988-2004) of beaver dams along Bridge Creek in central Oregon. Northwest Sci. 82: 309-318.

Representative reaches of Bridge Creek in September 1987; the top photo is at river mile 5.0 and the bottom photo at river mile 9.25. Note the general lack of streamside vegetation, eroding banks and over-widened channels, and a lack of pool habitat and cover for fish.

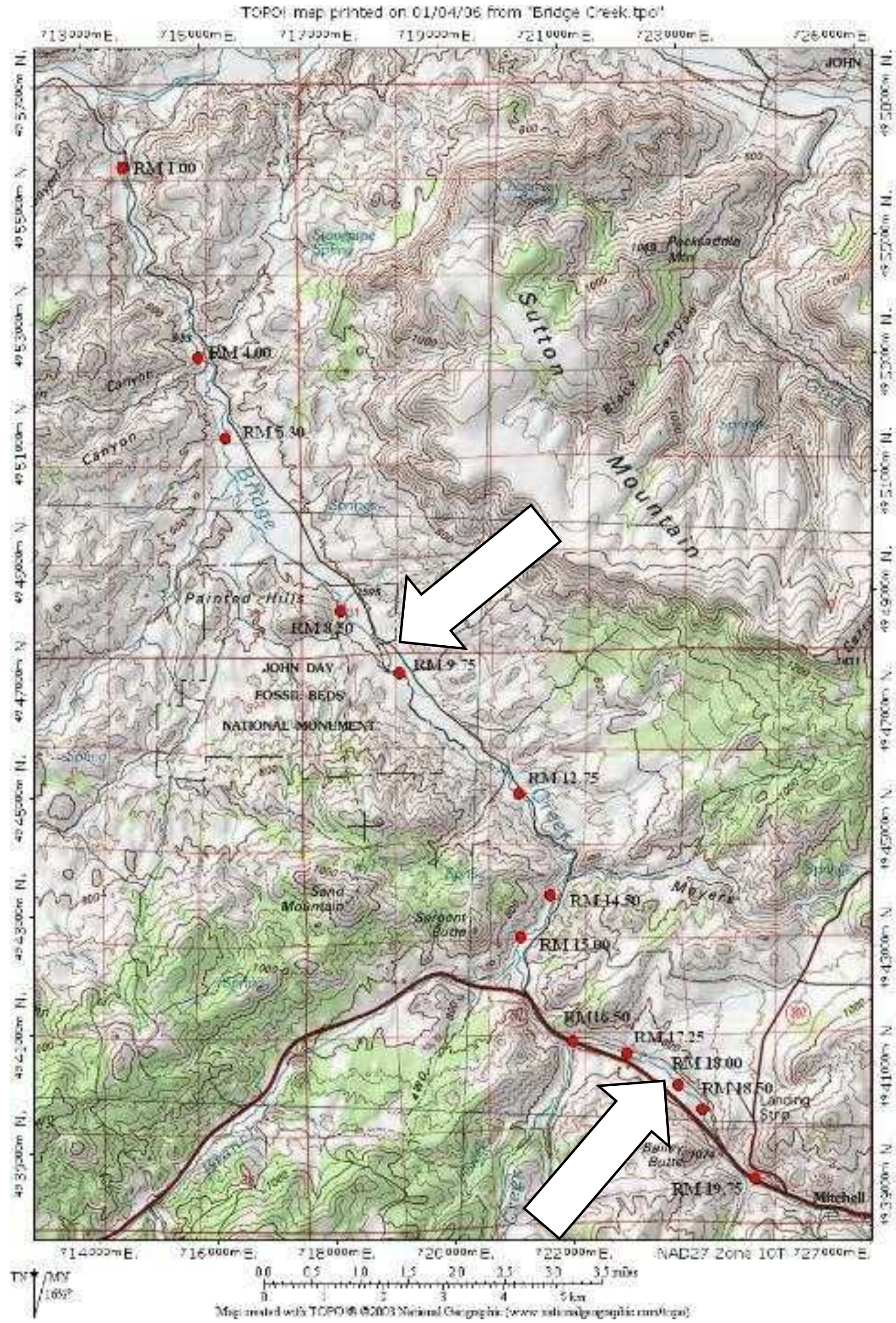
Chronosequence of photos for lower reaches of Bridge Creek. Top photo is from 1993, about the time that grazing was being reduced and beaver trapping curtailed. Bottom photo is from 2009 showing extensive recovery of riparian vegetation along the stream has occurred.

Beaver dams/ponds along Bridge Creek in December 2000 (top) and November 2001 (bottom). Note the recovering riparian plant communities and large pools upstream of each dam.

Flood surge along Bridge Creek in August 5, 2003. Top left photo is at 3:10 PM and top right photo is the same location six minutes later, showing the rapidity of change in flows. The bottom photo is further downstream and was taken at 3:47 pm. Healthy riparian plant communities help to stabilize banks during use events and beaver ponds can trap some of the sediment in transport.

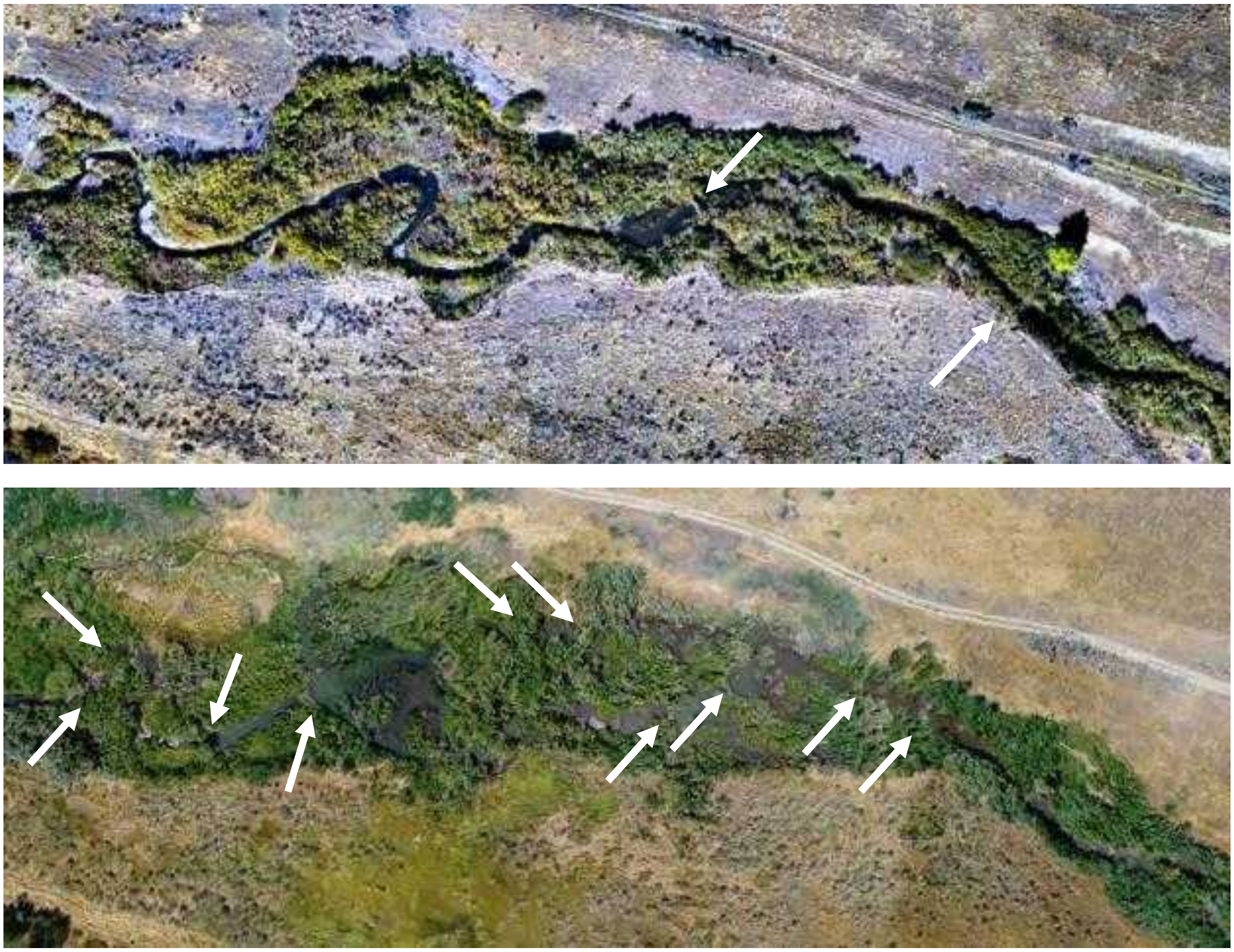
Beaver dams/ponds along Bridge Creek in October 2003 (top photo) and June 2006 (bottom photo). Note the dense riparian vegetation lining the banks of the stream as well as the pool habitat upstream of each dam.

Beaver dams/ponds along Bridge Creek in June 2004 (top four photos) and November 2004 (bottom photo). Again, dense riparian vegetation is present along the banks and floodplain of the stream and extensive pool habitat has been created upstream of each dam.



Portion of Bridge Creek Topographic Map showing "river miles" (RM) upstream from the John Day River (at top of map); the town of Mitchell occurs at the lower right and upstream of RM 19.75. Arrows point to location of aerial images on the following pages: (a) upper arrow is at ~RM 9.3, (b) lower arrow is at ~RM 18.

Bridge Creek reach near River Mile 9.25 and within the Painted Hills National Monument. Aerial images for this reach are for July 2013 (top), August 2014 (center), and July 2017 (bottom). The top two images have three beaver dams present (arrows) while the center dam no longer exists in the lower image. Extensive riparian plant communities are supported, in part, by water spreading, sediment deposition, and higher water tables associated with beaver dams/ponds along this reach. Photo credit: Aerial images from Google Earth ©.



Bridge Creek reach near River Mile 18. Aerial images for this reach are for August 2005 (top), and July 2014 (bottom). Although 2 beaver dams are present in the top image, in a few years, having built another 10 or so dams, the effects are much more noticeable in the bottom image. Again, the extensive riparian plant communities present along this reach are supported, in part, by water spreading, sediment deposition, and higher water tables associated with beaver dams/ponds. Photo credit: upper from Google Earth ©; lower from Weber et al. 2017, DOI: 10.1371/journal.pone.0176313.

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APPENDIX D-□

A CASE STUDY IN PHOTOS SHOWING THE MAGNITUDE AND SPEED OF

BEAVER-RELATED WATER AND HABITAT CHANGES ON SUSIE CREEK

ELKO COUNTY, NEVADA

These repeat photos of Susie Creek in Elko County, Nevada show changes over time to vegetation, fish and wildlife habitat and water abundance as a result of changes in livestock management and the arrival and establishment of beavers. The photos are of Bureau of Land Management ground.

1991: At this time, livestock grazing occurred throughout the growing season on an annual basis. Growth of streamside vegetation was limited.

1999: Beginning in □□□□, BLM in cooperation with Maggie Creek Ranch and other partners constructed a series of livestock management fences along Susie Creek. By □□□□, changes in grazing management, including replacing annual growing season grazing with spring and/or fall grazing, allowed for growth of riparian plants including sedges, rushes and willows.

Pre-2007: Beaver arrive in this part of the creek and begin to use the riparian vegetation to build their dams and expand their water-storing complexes. Their arrive and establishment further alters the water abundance and vegetation conditions in Susie Creek.

2007: By □□□□, the development of well-established willow communities resulted in extensive colonization of the area by beaver. In Northeastern Nevada, where willows become established, beaver are not far behind.

2012: The site has transitioned from a willow community to a cattail marsh as a result of willows being drowned out by water being impounded behind dams.

Photos and text by Carol Evans, retired fisheries biologist, Elko District, Bureau of Land Management (1988- 2016). Photos taken from photo point #3


April
Photo by Carol Evans

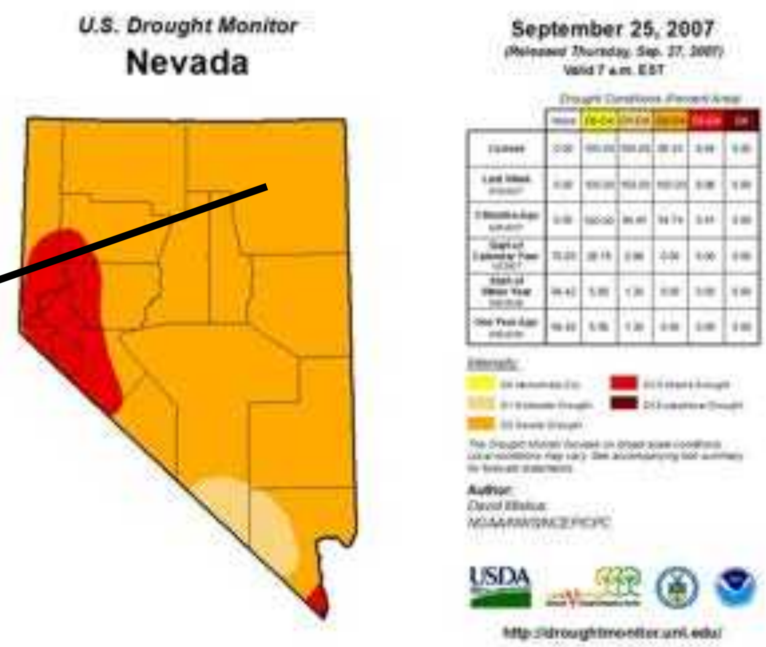

Photo by Carol Evans


September 23, 2007
Photo by Carol Evans


June 14, 2012
Photo by Carol Evans

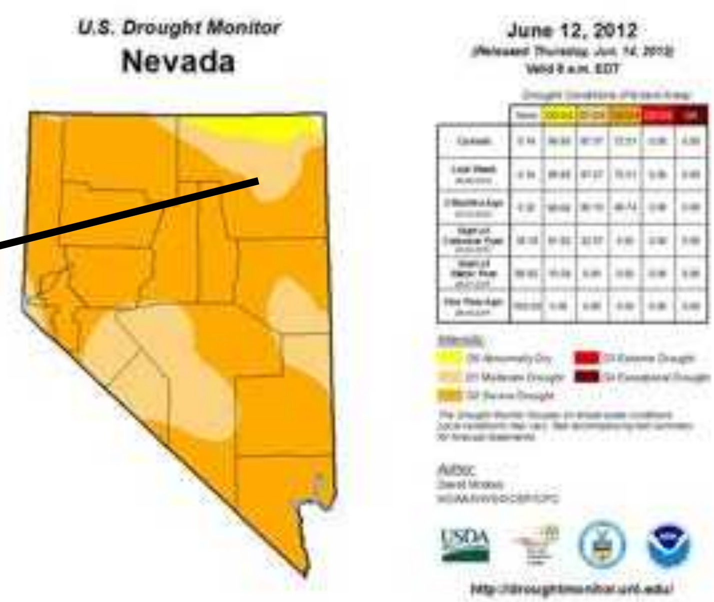
Susie Creek, Elko County, NV

In □□□□, livestock gra□ing is season long and beavers are absent. This changes in □□□□ with the initiation of Spring and Fall gra□ing and the later arrival of beavers. There is a strong vegetation response to the gra□ing management change and beaver arrive sometime prior to □□□□ in response to improved vegetation conditions. In □□□□, Elko County in Nevada is in a **SEVERE** drought for most of the summer. □et Susie Creek provides abundant water for fish, wildlife, people, and livestock all summer long because of beaver activity and continued good livestock management.



Susie Creek

In □□□□, livestock gra□ing is season long and beavers are absent. This changes in □□□□ with the initiation of a gra□ing management change to Spring and Fall gra□ing and the later arrival of beavers. As in □□□□, the benefits of those changes are e□perienced again in □□□□ when Elko County, Nevada is in a **MODERATE** to **SEVERE** drought. Again, Susie Creek provides abundant water for fish, wildlife, people, and livestock because of long-term and continued beaver activity and continued good livestock management. Drought continues through the summer increasing to **EXTREME** in some parts of the county.



Maggie Creek, Elko County, Nevada. In □□□□ MODERATE to SEVERE drought yet □□ miles of water-abundant landscape due to abundant beavers and continued good livestock management.

APPENDIX E

MAPS SHOWING BEAVER TRAPPING/HUNTING CLOSURES UNDER EXISTING RULE

Map 4: Location of inset maps 4a-4f.

Map 4a. National Grasslands in Jefferson County.

Map 4b. Bridge Creek and tributaries in Wheeler County.

Map 4c. Sections of the Wallowa-Whitman National Forest, Grande Ronde and its tributaries in Union County.

Map 4d. Sections of the Wallowa Whitman National Forest in Union and Wallowa Counties.

Map 4e. Murderers Creek and Deer Creek on the Malheur National Forest in Grant County.

Map 4f. Rogue River in Curry and Josephine Counties.

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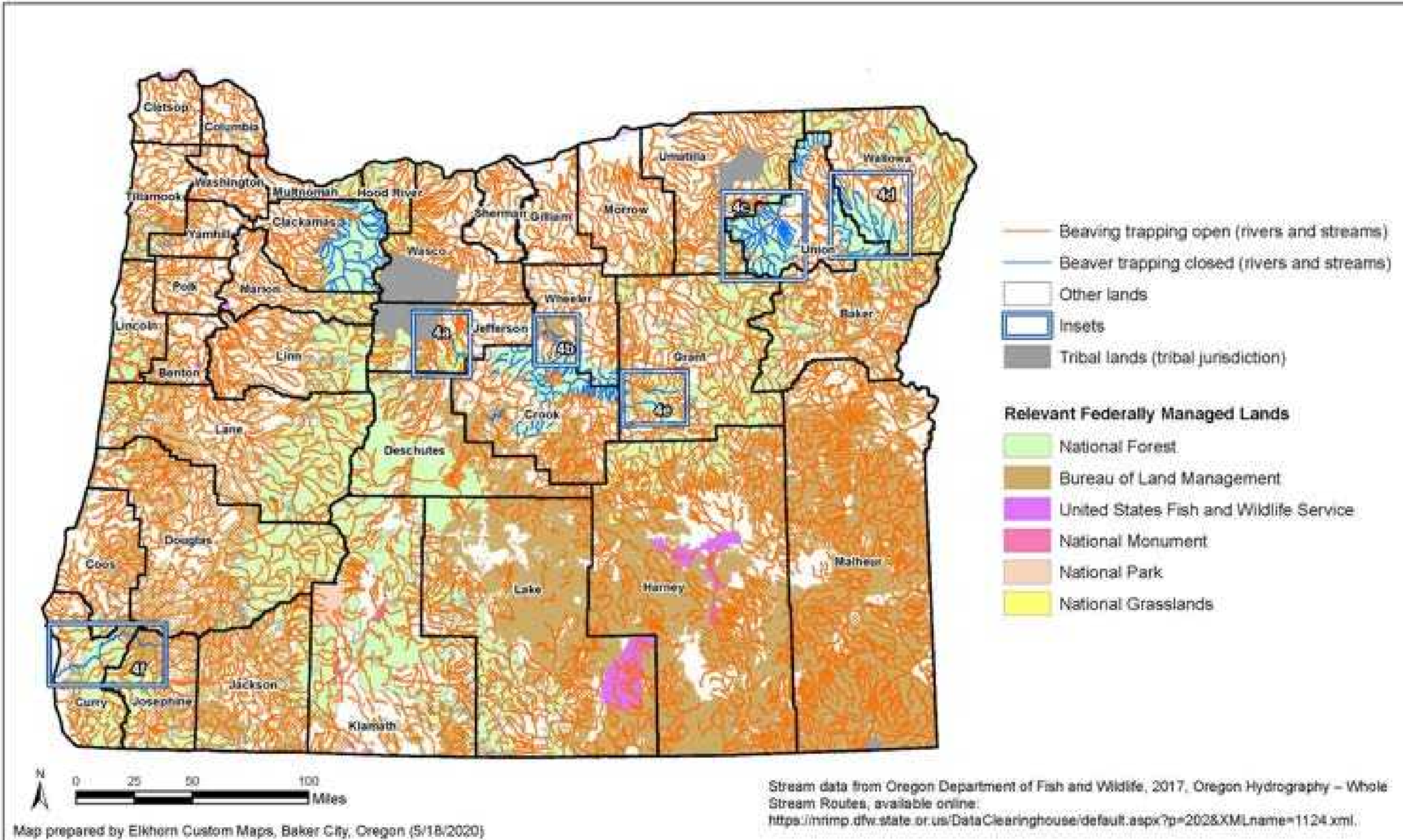
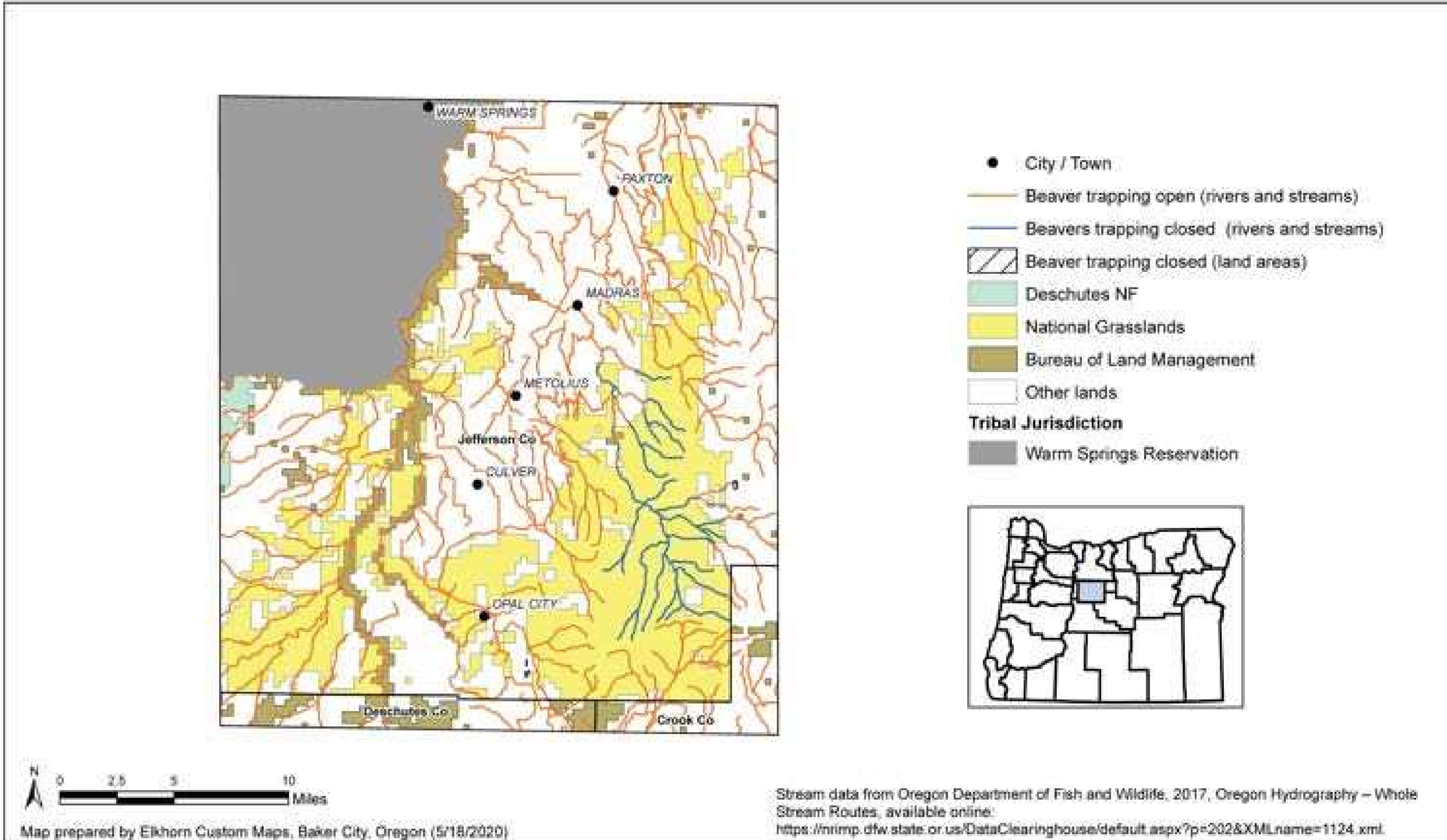
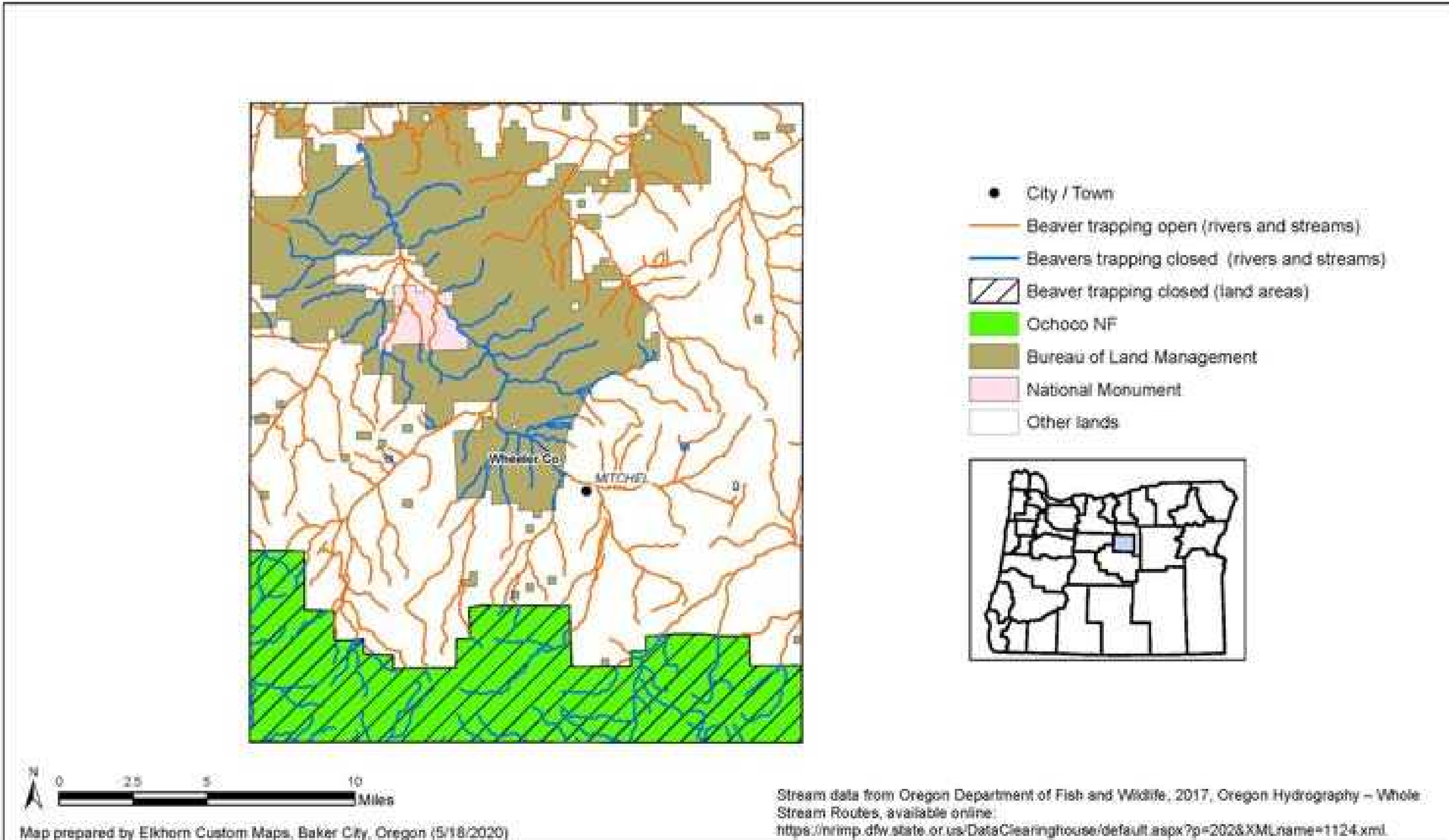


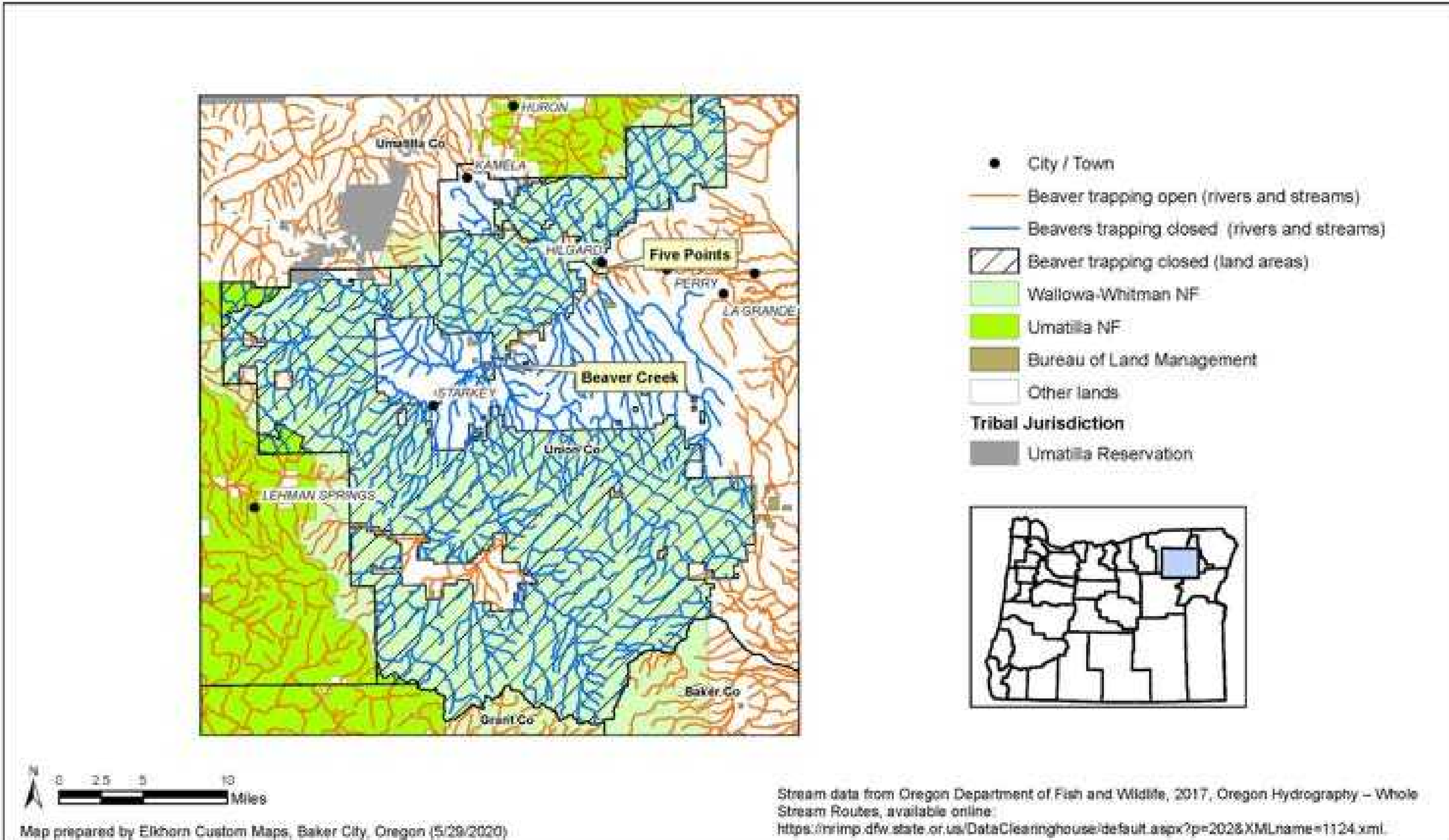
Map 4. Location of inset maps 4a-4f. These inset maps show commercial and recreational beaver trapping status (open vs. closed) for streams in these areas as described in the Oregon Furbearer Trapping and Hunting Regulations (2018-2020) (OAR 635-050-0070). Note how streams change beaver trapping status as they cross different ownerships, management, and/or counties. Stream segments shown in Maps 4a to 4f are limited to GIS segment lengths greater than 30,000 feet for map clarity.



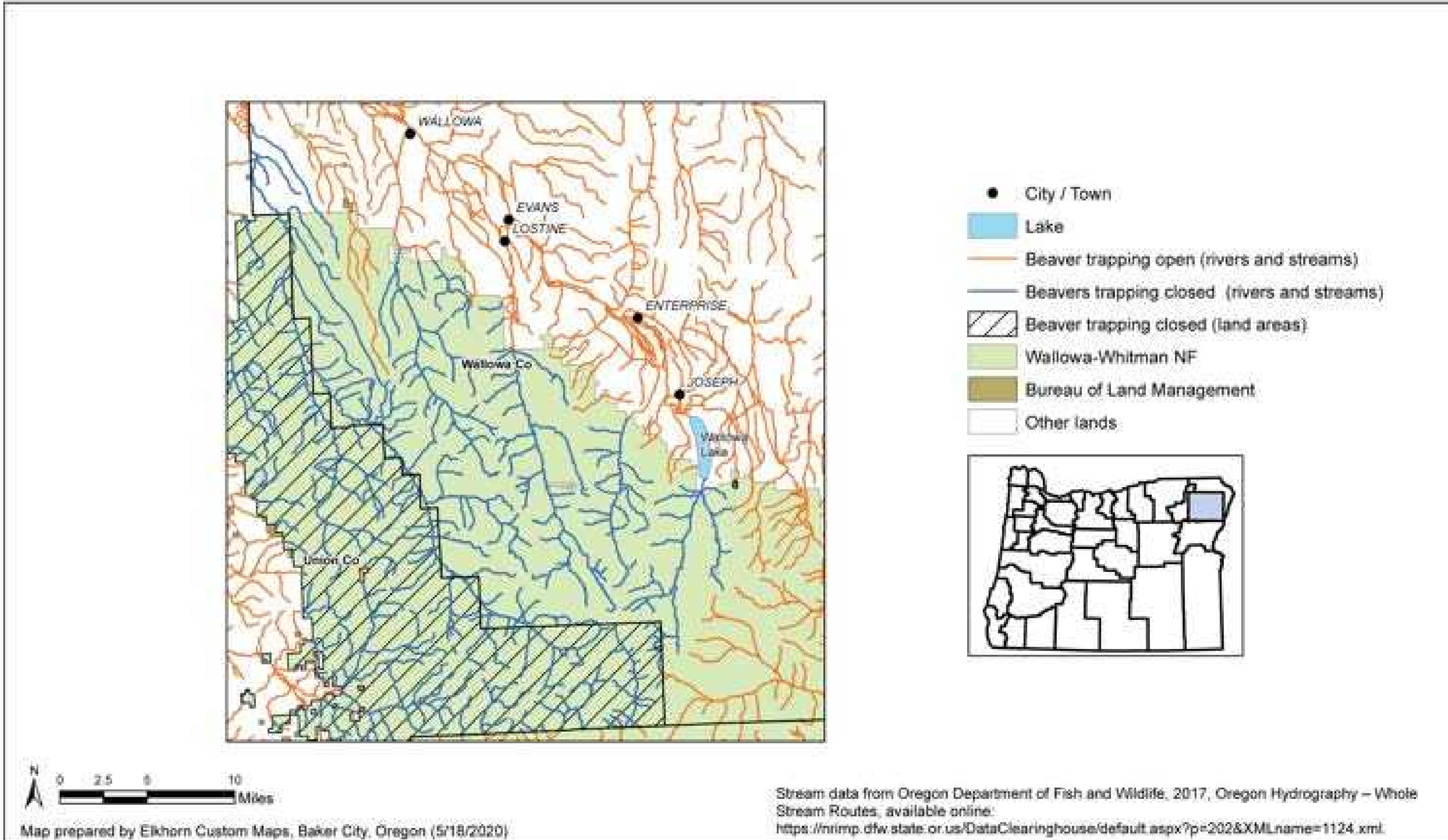
Map 4a. National Grasslands in Jefferson County. NOTE: Under the existing OAR 635-050-0070 (2018-2020) Willow Creek and its tributaries repeatedly change beaver trapping status as streams cross between private land and the National Grasslands.



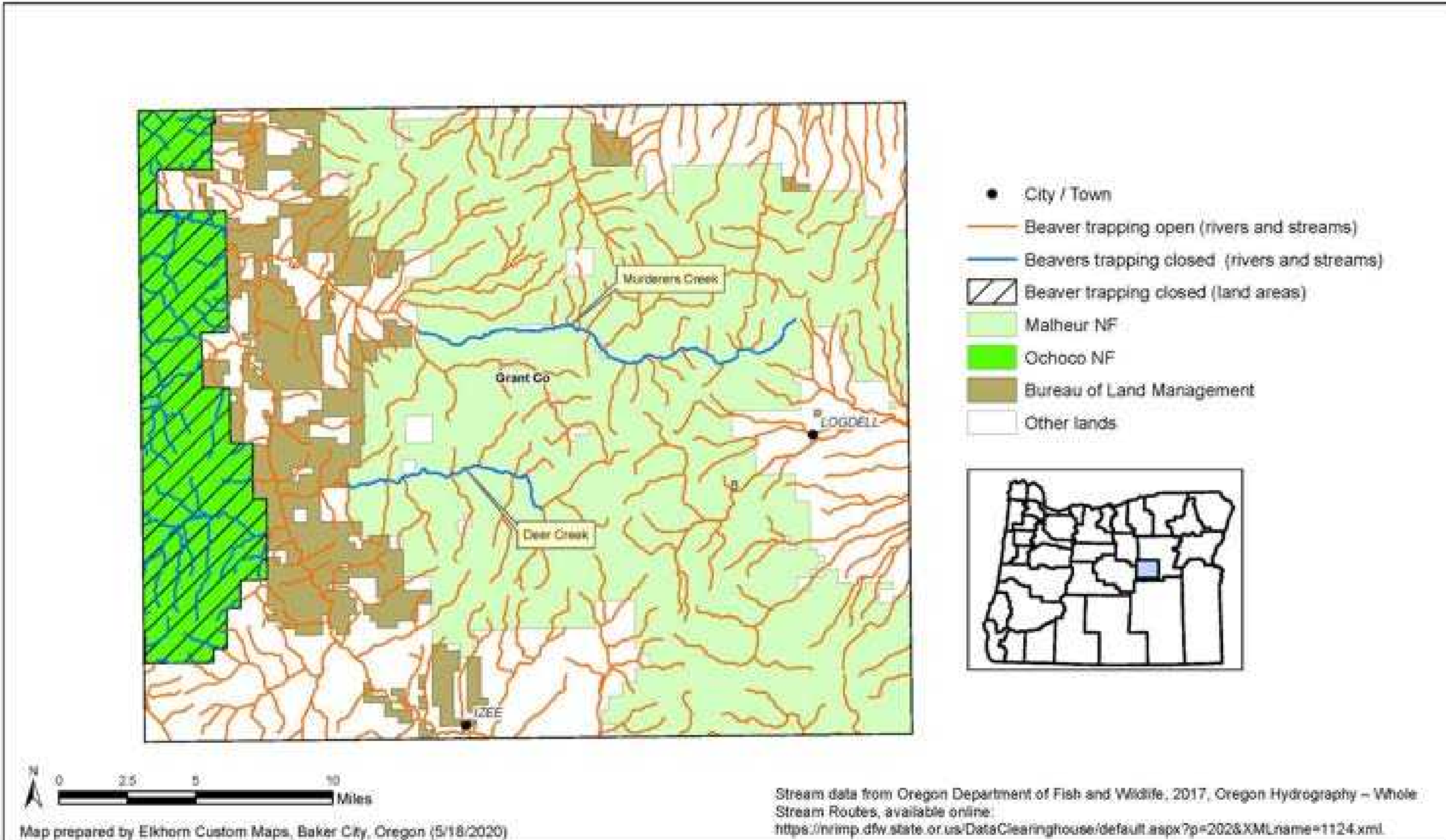
Map 4b. Bridge Creek and tributaries in Wheeler County. NOTE: Under the existing OAR 635-050-0070 (2018-2020) Bridge Creek and its tributaries repeatedly change beaver trapping status (open vs. closed) as streams cross private lands and different federally managed public land boundaries



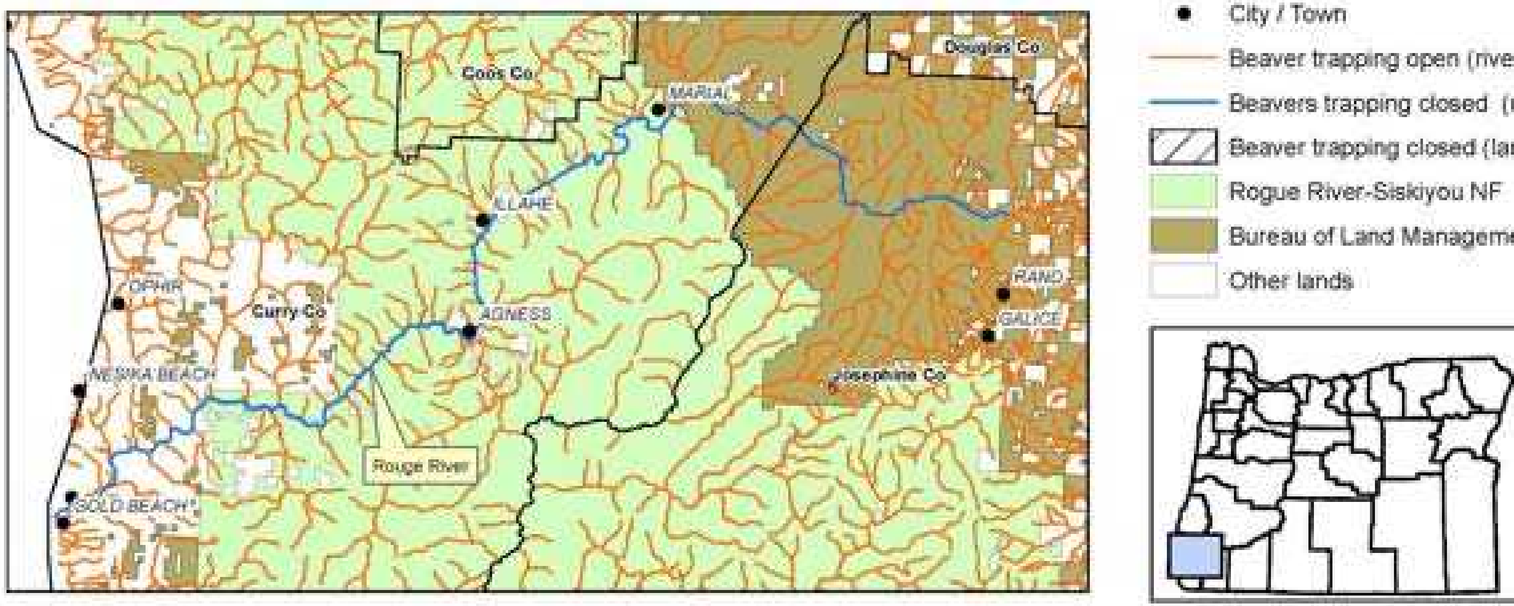
Map 4c. Sections of the Wallowa-Whitman National Forest, Grande Ronde and its tributaries in Union County. NOTE: Under the existing OAR 635-050-0070 (2016-2020) beaver trapping status (open vs. closed) changes as streams cross National Forest and private land boundaries. All streams on the Forest in Union County are closed to commercial and recreational trapping. Some streams on private lands are closed, while others are not.



Map 4d. Sections of the Wallowa Whitman National Forest in Union and Wallowa Counties. NOTE: Under the existing OAR 635-050-0070 (2018-2020) beaver trapping status (open vs. closed) is different for streams on the same National Forest. In Union County all streams are closed to beaver trapping on the Forest, but in Wallowa County only some. This example shows the beaver trapping status difference at the county line and within Wallowa County. Several streams and their tributaries are closed while the stream and its tributaries in the next drainage are open.



Map 4e. Murderers Creek and Deer Creek on the Malheur National Forest in Grant County. NOTE: Under the existing OAR 635-050-0070 (2018-2020) only the main stems of these two creeks are closed to commercial and recreational beaver trapping. All of their tributaries remain open.



N 0 2.5 5 10 Miles

Map prepared by Elkhorn Custom Maps, Baker City, Oregon (5/18/2020)

Stream data from Oregon Department of Fish and Wildlife, 2017, Oregon Hydrography – Whole Stream Routes, available online: https://nrimp.dfw.state.or.us/DataClearinghouse/default.aspx?p=202&XMLname=1124.xml

Map 4f. Rogue River in Curry and Josephine Counties. NOTE: Under the existing OAR 635-050-0070 (2018-2020) only the main stem of the Rogue River is closed to commercial and recreational beaver trapping. All of its tributaries remain open.

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APPENDIX F

ECONOMIC BENEFITS OF BEAVER-CREATED AND MAINTAINED HABITAT AND RESULTING ECOSYSTEM SERVICES

by

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Suzanne Fouty, Ph.D., Hydrologist/Soils Specialist
Steve Trask, Senior Fish Biologist, Bio-Surveys, LLC and Trask Consulting, Inc.

Table of Contents

INTRODUCTION

On April 22, 2020 in ODFW's *Notice of Proposed Rulemaking* the agency stated the following on page 2:

> *"There are no expected major fiscal or economic effects resulting from the proposed rule changes for the proposed season and bag limits for the 2020-2021 and 2021-2022 furbearer harvest and pursuit seasons."*

This statement is false. ODFW failed to do a proper economic analysis of the impact of lost ecosystem services. As Appendix F will show, the economic, ecological, and social benefits that Oregonians would gain as a result of beavers and the habitat they create and maintain is in the hundreds of millions to billions of dollars. The value of this habitat and the ecosystems services they provide is only increasing with climate change. Therefore, the costs being incurred now by Oregonians as a result of continuing the existing rule are in the 100s of millions to billions of dollars. These costs are in the form of lost ecosystems services, declining salmon, declining fish and wildlife, rising stream temperatures, increased water conflicts during droughts, declining water quality and availability, and the failure to create carbon capture and store areas.

Beaver create and maintain habitat with multiple impacts on aquatic and terrestrial ecosystems. The resulting ecosystem services provide both market and non-market economic benefits for human society. Much of the economic benefits accrue by restoring and enhancing habitat for a multitude of species, including humans and species at risk of extinction at little to no cost. Benefits are broad and diverse. Beaver habitat retains water behind beaver ponds and on floodplains, reducing flood risk for landowners immediately downstream, and improving water quality and stream flows. Public utilities which manage reservoirs benefit as improved floodplain connectivity and channel complexity evens out peak highs and lows in streamflows. Oregonians from across the state benefit as opportunities for outdoor recreation such as wildlife viewing, fishing, and hunting expand. Ranchers and farmers benefit as water stored in beaver-created wetlands and behind beaver ponds provides valuable water during droughts. And in addition to all these benefits, there is also the creation of carbon capture and store areas as wetlands and wet meadows increase in size and abundance, a response strategy to climate change that has yet to be assigned a monetary value.

Then there are the economic benefits related to salmon as it moves through its life cycle. Beaver-created and maintained habitat provide key juvenile coho salmon winter rearing habitat, decrease stream temperatures, increase channel complexity and habitat connectivity, and expand riparian habitat all along migration corridors. These improvements along migration corridors not only enhance the potential for salmon to survive and expand within a changing climate but provide the same services to migratory birds. Increases in beaver-created habitat could therefore aid ODFW and to the state in their efforts to achieve conservation goals for affected species at little to no cost. In addition, there is the chance to prevent the extinction of salmon due to lack of habitat, something that abundant beavers and their habitat can remedy. An extinction event would be a devastating cultural and ecological loss. Assigning a price tag to such an event should only be considered a point when considering salmon's economic, social and cultural importance and value.

The market and non-market benefits from the water and habitat-based changes brought about by increased beaver numbers creating and maintaining their habitat are clearly broad. These economic and ecological benefits are, however, currently only future potential benefits. They require landscapes where there are abundant beavers creating and maintaining abundant beaver habitat. Only then can Oregonians begin to conceive of a sustainable, ecologically water-rich future that brings economic benefits in the 100s of millions of dollars and immeasurable social and cultural benefits. The details in this appendix are the type of economic analysis worthy of any decision that involves our collective fish and wildlife and future.

BEAVERS AND THEIR ECOSYSTEMS SERVICES

Beaver create habitat that has multiple impacts on aquatic and terrestrial ecosystems. They provide both market and non-market economic benefits for human society (Appendices B, C, D). Market-defined economic benefits involve goods and services traded in markets and involve monetary transactions, which provide information useful for measuring the economic importance society places on the goods and services. The transactions may derive directly from the habitat that beavers create, e.g., when recreationists spend money to take advantage of recreational opportunities created by beaver habitat such as fishing or wildlife viewing. They also may occur indirectly, e.g., when landowners and public agencies can avoid spending money to restore a wetland or decrease stream temperatures because beavers have already created the habitat that brings about these outcomes.

Non-market economic benefits involve goods and services not traded in markets. These benefits can materialize as beavers have increased and improve habitat for at-risk species, thereby increasing the likelihood that these species will avoid extinction. Because these goods and services are not traded in markets, they do not involve monetary transactions. The absence of transactions does not mean the goods and services have no economic value. Indeed, these goods and services often are not traded in markets because society considers them too important to be bought and sold. Economists measure the economic importance of non-market goods and services using sophisticated survey techniques. These techniques estimate society's potential willingness to pay to acquire goods and services they do not already possess, or the amount of money they would require as compensation to give up those they already possess. This text illustrates the technique: [1]

> "We find that the average household WTP (willingness to pay) for the most ambitious recovery program is $179/year. This is the recovery program involves OC [Oregon Coast] Coho salmon reaching recovered status under the ESA. . Upon aggregating to the broader population of PNW residents, the WTP for this most ambitious recovery program ranges from a lower bound of $321 million/y to an upper bound of approximately $1.46 billion/y depending on aggregation assumptions. Given that the most ambitious recovery program in our experimental design is based on the OC Coho

Conservation Plan for the State of Oregon [10], the population benefit estimates represent the non-market economic value associated with successfully implementing this state-level conservation plan. Importantly, we also find that the public has significant WTP for habitat restoration programs that generate much smaller changes in salmon abundance, even for programs that do not result in the stock becoming delisted from the ESA. For example, the average household WTP of approximately $60/y for the least ambitious scenario in our experimental design (100,000 more returning fish with no change in the threatened status under the ESA) still produces between $107 million/y (lower bound) to $518 million/y (upper bound) in non-market economic benefits (**Table 3**). Given that no ESA-listed species of Pacific salmon have been delisted as of 2018, our results provide evidence that the public values ESA conservation activities that have yet to achieve a recovered status for their target species."

The key point of the above analysis is that recovery of salmon promises to yield economic benefits up to $500 million a year. However, we can only realize those benefits if we have abundant beavers creating and maintaining abundant beaver habitat across the landscape.

ASSIGNING VALUE TO ECOSYSTEM SERVICES

Table F-1 presents the potential economic benefits of the ecosystem service Oregonians would realize by ending commercial and recreational beaver trapping/hunting on federally managed public lands. These can also be thought of as the ongoing economic losses Oregonians are experiencing from the past and continued removal of beavers and loss of beaver-created habitat.[2] The Commission and ODFW should anticipate that the per-unit values shown in Table F-1 will only increase over time as climate change brings increased frequency of drought, declining snow pack, and a change in the timing of melt with their impacts to water quality and habitat conditions for fish, wildlife and human communities.

Table F-1. Ecosystem Services Potentially Provided by Beavers via habitat creation and per-unit Value. Shaded services will be discussed with case study examples provided in this appendix.[3]

Ecosystem Service Provided	Per unit value for service
Sediment retention	$2 per cubic yard
Riparian habitat	$1,000 per acre per year
Wetland habitat	$8,000 per acre per year
Aquatic habitat	$4,000 per acre per year
Sensitive-species habitat	$9–$256 per household per year
Pollutant Removal through Sediment Capture	$100,000 per year per percent improvement
Recreation	$75-$375 per recreation day
Delayed Water Flow upstream of reservoirs	$50 per acre-foot
Water temperature	$74,000 – $411,000 per river mile
Aesthetic Benefits	Qualitative Description
Existence Value	Qualitative Description
Flood Resilience	Qualitative Description

The assignment of value for the shaded ecosystem services is based on the following sources:

Increased Adult Salmon Returns: Assigning a value to salmon recovery is complicated and the reader is directed to Appendix F-1 where market and non-market values are explained in depth and multiple examples are given.

Improved Stream Temperature: The value assigned ranges from $74,000-$411,000 per mile. These values are based on estimates of costs incurred in the Gifford Pinchot National Forest for restoration work aimed largely at reducing stream temperatures. [4]

Increased Aquatic Habitat: The value assigned is $4000 per acre per year. The value is based on a meta-analysis examining willingness to pay (WTP) estimates for various freshwater ecosystems. The meta-analysis suggests that freshwater ponds are about half as valuable as river-fed wetlands.[5]

> If aquatic habitat created by beaver activity has half the value of wetland habitat, we estimate that ponds upstream of beaver dams may be worth about $1,200–$6,200 per acre per year. For our analysis, we assume the value of aquatic habitat (ponds) generated from beaver activity is in the middle of the range, about $4,000 per acre per year. Throughout our analysis, we have assumed averages for the surface area of beaver ponds in the Escalante River Basin of 0.5 and 1.5 acres. Using the middle value of ecosystem service provided by ponds, $4,000, we estimate the value of each pond may be $2,000–$6,000 per year. Basin-wide, we estimate beaver activity could generate about 34,500–103,500 acres of pond habitat, and that these ponds could produce ecosystem services worth up to $138 million - $414 million per year.

Delayed water flow upstream of reservoirs: The value assigned is $50 per acre-foot. The value is based on the average value of water used downstream from national forests for irrigation or municipal /industrial uses. This value increases during droughts. Irrigators in California, for example, often pay more than $1,000 per acre-foot during drought periods.[6]

It is important to note that the above economic benefits would accrue to diverse segments of Oregon's society. Much of the economic benefits would accrue by restoring and enhancing habitat for a multitude of species, including species at risk of extinction and the 82/294 strategy species in the Oregon Conservation Strategy that require the habitat beavers create (Appendix C). Oregon's fish and wildlife would benefit from improved habitat quality, greater habitat connectivity and complexity, and expanded distribution and size of the habitat types thus increasing their survival under a changing climate. Increases in beaver-created habitat could therefore reduce costs to ODFW and to the state, aiding efforts to achieve conservation goals for affected species.

Many Oregonians would also realize the benefits that come from the retention of water behind beaver ponds and on floodplains in terms of both reduced flood risk for landowners immediately downstream and improved water quality and stream flows. Public utilities that manage reservoirs would also benefit from beaver-created habitat such as ponds, restored floodplain connectivity, and increased channel complexity because these features help attenuate peak highs and lows in streamflows. Oregonians from across the state would realize benefits as increased populations of beavers on federally managed public lands create habitat resulting in new and better opportunities for outdoor recreation. Finally, there would be a positive impact on climate as the wetlands and wet meadows increase in size and become carbon capture and store areas.

POTENTIAL ECONOMIC BENEFITS OF PROPOSED AMENDMENT, QUANTIFIED

As the above paragraph notes, there are many benefits that come with beavers and the habitat they create and maintain. For the petition, we have quantified the economic benefits using data from Oregon for four ecosystem services that would result from an expansion of beaver-created habitat. The data represent only a small portion of Oregon but even this limited scale captures the significance of beaver and the economic harm being done to Oregonians, and Oregon's fish and wildlife as a result of existing regulation:

1) Increased adult salmon returns
2) Improved water quality via decreases in stream temperatures
3) Increased aquatic habitat as a result of increased beaver ponds, and
4) Delayed water flow upstream of reservoirs due to pond storage.

Economic Benefits of Improved Salmon Populations

Determining the economic value of salmon is complex but economists have developed categories of value that provide a useful basis for describing the different ways in which salmon are important to Oregonians (Figure F-1). "Use value" materializes through commercial and recreational fishing activities, as individuals directly interact with and extract fish from the environment. It also includes values generated indirectly by salmon/steelhead, as when healthy fish habitat helps reduce the severity of downstream flooding. "Non-use value"(sometimes called "passive-use value") materializes when people derive satisfaction not through interactions with fish but from knowing that they exist and through the interactions of others who enjoy fishing for recreational or commercial purposes.

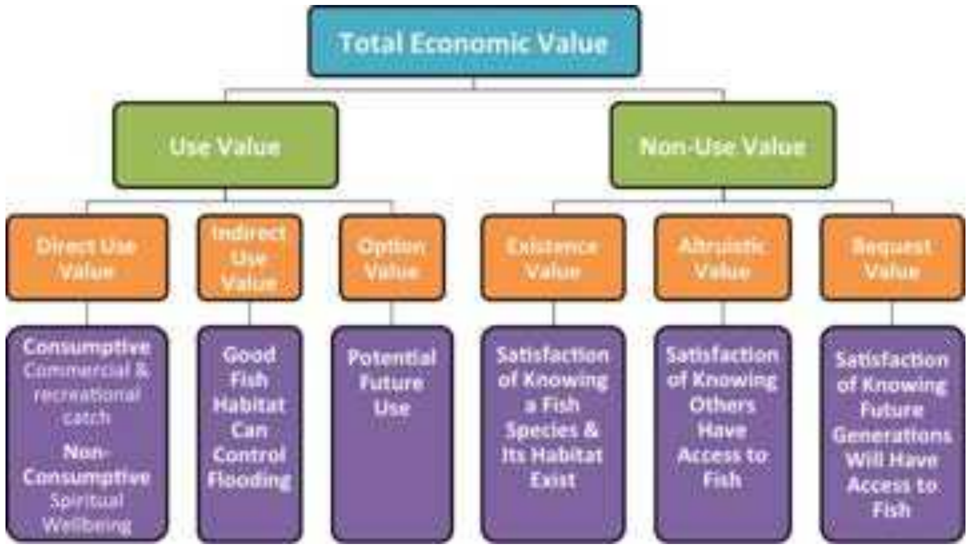

Figure F-1. Components of the value Oregonians place on the state's salmon, trout, and other cold-water fish.[7]

These use and non-use values reflect the multiple ways in which these Oregonians and others realize a benefit from their interactions with these fish. A summary by Weber (2015)[8] described these interactions this way:

> "Valuing societal impacts from changes in salmon proceeds from recognizing various pathways of human benefit. Some benefits are relatively obvious, such as resource use and extraction in the market economy, e.g., commercial fish harvest, and revenue from fishing-related expenditures. A less recognized but important dimension are nonmarket benefits, such as the recreational enjoyment of a fishing experience. An angler may contribute only minimally to a local economy through the act of fishing—yet the opportunity to engage in this pastime may be of extraordinarily high value to that individual. Yet human appreciation of natural resources such as salmon goes deeper still. For decades environmental economists have recognized an important category of benefits known as non-use values. Essentially, resources may be valued without the necessity of direct experience. Notions of value predicated on resource extraction, harvest, and even nonconsumptive recreational use are overly limiting. Categorically neglecting non-use values can lead to significant underestimates of public welfare. … Salmon recovery within a relatively small watershed has been found to be valuable to households across the nation. … [S]tudies consistently indicate that households in the Pacific Northwest and beyond have a high WTP [willingness to pay] for increased salmon." [citations omitted]

The studies mentioned in the last sentence, reaching back more than 30 years, have consistently found that households place a high value on actions that result in increases to salmon/steelhead populations. The economic benefits from increases in salmon populations is high in part because those populations have declined significantly and the outlook is bleak given climate change predictions and the degraded condition of many stream systems.

Valuing salmon for its use value ($ spent)

- **Commercial use values** represent the estimated profits associated with harvest. The literature suggests that profitability in the relevant industries ranges from 43 percent to 99 percent. This analysis assumes a profitability percentage of 80 percent. It uses weighted 5-year averages to estimate harvest value and catch in each fishery. It assumes the Integrated Plan's impact on fish populations would not affect prices in the relevant fishery markets.

- **Sport use values** represent both expenditures ($ spent) and consumer surplus[9] associated with sport fishing in the relevant geographies. The literature describes these values per fishing day. This analysis uses sport-fishing data to estimate the number of days spent fishing per fish harvested in the different geographies. It applies the days spent fishing, per fish harvested, to the increase in fish populations, and then multiplies by the daily use value associated with sport fishing. Furthermore, it assumes that use values associated with sport fisheries are directly related to the number of fish harvested. The literature supports the assumption that sport fishermen fish more often as their harvest rate (fish caught per day spent fishing) increases, with their consumer surplus directly proportional to their harvest rate.[10]

Table F-2 summarizes the use values (per fish in 2012 dollars). This analysis applies to the increase in fish harvests attributable to the Yakima River Basin Integrated Plan for managing water resources. The per-fish values represent updated data but remain similar to those used by the Bureau of Reclamation in similar analyses for this area.[11] Use values range from about $10 to about $750 per fish, with the variation representing factors such as species, size of fish, location of the fishing site, catch rate, time of year, and fishing regulations. The use values associated with sport fishing are higher than those associated with commercial fishing, which is consistent with the literature.[12]

Table F-2. Economic use value per fish by species and fishery (2012 dollars)

Harvest Category	Coho	Spring Chinook	Fall Chinook	Steelhead	Sockeye
Ocean Commercial	$10	$50	$50	-	-
Ocean Sport	$160	$120	$120	-	-
Lower Columbia Commercial	$10	$60	$30	-	$10
Lower Columbia Sport	$330	$330	$330	-	$330
Columbia Tribal Commercial	$10	$50	$20	$10	$10
Columbia Tribal Ceremonial and Subsistence	Value is incalculable				

Recreational fishing-related expenditures provide insights into the use value of Oregon's cold-water fish. The most recent estimates exist for 2008[13]. That year, 631,000 anglers spent about $780 million on gear, boats, guides, travel, and other items associated with recreational fishing in Oregon. Trip-related travel expenditures associated with freshwater fishing occurred throughout the state and totaled about $270 million. In addition, anglers spent more than $70 million on trip-related travel associated with saltwater fishing, and $441 million on equipment and other items (Table F-3). Almost all of this spending focused on cold-water fish.

Oregon's commercial fishery demonstrates another category of use value for salmon. Over the five-year period of 2010-2014, commercial boats delivered to fish processors 3.4 million pounds of salmon worth more than $11 million per year, on average. [14]

Table F-3. Recreational fishing expenditures in Oregon, 2008

Type of spending	Amount (million)
Total	$780
Equipment, etc.	$441
Travel expenditures	
Saltwater fishing	$70
Freshwater fishing	$269
Willamette Valley	$43.3
North Coast	$21.0
Central Coast	$24.0
South Coast	$11.6
Portland Metro/Columbia	$34.7
Southern	$39.6
Central	42.7
Eastern	$33.7
Mt. Hood/Gorge	$18.3

Source: Dean Runyan Associates (2009)

Valuing salmon for its non-use value

Economists have made several attempts to estimate the total value Oregonians place on salmon. To do this, they've had to look beyond the spending that indicates the use value to also capture the non-use values, which typically do not involve spending. The best studies to date have focused on the value people place on increasing salmon populations to insulate them from going extinct. These studies generally indicate that, on average, households are willing to spend about $100–$120 per year for a program that promises to increase salmon populations (Table F-4). Some of these studies have focused on Washington, but evidence indicates that Washingtonians and Oregonians place similar values of salmon (ECONorthwest 2012).

Table F-4. Estimates of household willingness to pay (WTP) for increased salmon populations in the future (2012 dollars)[15]

Location	Columbia River[a]	Elwha River, WA[b]	Coastal OR and WA[c]	Columbia River[d]
Increase in salmon population	2,500,000	300,000	165,000	300,000
Average WTP/year	$100	$100	$120	$110

[a] Olsen et al. (1991). [b] Loomis (1996). [c] Bell et al. (2003). [d] ECONorthwest and ESA (2012).

Olsen et al (1991), Loomis (1996) and Bell et al (2003) were published in peer-reviewed academic journals. The analysis in ECONorthwest and ESA (2012) was peer-reviewed and approved by economists at the Bureau of Reclamation. Bell et al. (2003) estimated the WTP for increases in coho populations of residents living within 30 miles of five Pacific Northwest estuaries: Grays Harbor and Willapa Bay in Washington and Tillamook Bay, Yaquina Bay, and Coos Bay in Oregon.

An important finding from the research on the total value Oregonians place on salmon is that they are willing to pay now for the enjoyment they receive from increases in salmon population that will materialize in the future. The same research showing that Oregonians are willing to pay about $100–$120 per household per year to support a program that promises to increase salmon populations also indicates that the prospect of climate and habitat-related reductions in salmon populations imposes an economic harm of at least the same dollar amount. However, it is also reasonable to expect that Oregonians will place a greater value on a population loss than the value they place on a comparably sized gain because the potential for loss of salmon will generate a greater sense of urgency and thus a greater willingness to pay to reverse conditions. Therefore, this analysis uses the upper bound of the range of values in Table F-4, $120/household, to indicate the annual economic harm to Oregon's households from the prospect of widespread extinctions.

Oregon is expected to have about 1.6–2.0 million households over the next two decades[16]. These numbers suggest that the annual economic harm from the prospect of population declines will range from about $195 million in 2016 to about $241 million in 2035, and the overall economic harm for 2016–2035 (20 years) will total $4,400 million, or $4.4 billion (Table F-5).

Table F-5: Economic harm to Oregonians from projected widespread extinctions of salmon. Using $120/household and adjusting to reflect increased population over time. Sum includes use and non-use values.

	2016	2017	2018	2019	2020	2025	2035	Sum 2016-2035
Total economic harm (million)	$195	$198	$200	$202	$204	$218	$241	$4,400

The annual economic harm may vary from the indicated amounts. In the near term, the economic harm may be less than indicated insofar as most Oregonians do not yet perceive the full extent of the extinction threat to salmon. Over time, though, the annual economic harm likely will exceed the estimates as climate change and continued loss of salmon habitat brings about declines in salmon populations and the threat of widespread extinction becomes more apparent. Oregonians will experience additional economic harm from population declines for steelhead, trout, and other cold-water species. If, over the two decades, declines in salmon and trout populations materialize and Oregonians perceive the imminent threat of widespread extinctions, the total economic harm from the effects of climate change and habitat loss on salmon and trout could far exceed $4.4 billion.

Total Economic Value: the LBP Study and the Yakima River Basin

[Note: This section contains text and data excerpted from ECONorthwest and ESA (2012)][17]

This section summarizes research conducted in the Yakima River Basin to provide a foundation for understanding recent estimates of the economic benefits that would result from potential increases in Oregon's salmon populations. It draws on research completed in 1999, when the Washington Department of Ecology commissioned the development and application of a model (*LBP Study)* for estimating the total economic value of benefits derived from potential programs to increase fish populations in waterways across the state (Layton et al., 1999).[18] Though never published in an academic journal, the *LBP Study* has received considerable peer review through other channels.[19] One review "recommend[s] that any reliable economic estimates of impacts on salmon and steelhead [in the Columbia River Basin] should be assigned values based upon the methodology developed in [the *LPB Study*]".[20] This conclusion is reinforced insofar as the values developed in the LBP study are similar to those found in other comparable peer reviewed studies, as discussed below. This section applies the *LBP Study* model to data specific to the Yakima River Basin (YRB) Integrated Plan for managing water resources to estimate the economic benefits associated with increases in fish populations resulting from it. Specifically, this section (1) describes the *LBP Study*'s methodology and findings, (2) summarizes the parameters for applying its model to the YRB Integrated Plan, and (3) summarizes the total economic value of the YRB economic benefits from anticipated increases in salmon populations. This description provides the foundation for understanding the potential economic benefits from beaver-related increases in salmon populations in Oregon.

The researchers used survey responses to develop a model of households' willingness to pay (WTP) for increases in fish populations. Figure F-2 shows a graph with their corresponding curves. The blue curve describes households' average annual WTP for increases in salmon populations when the baseline fish population remains stable over the next 20 years. The red curve describes households' average annual WTP for increases in salmon populations when the baseline fish population declines over the next 20 years.

Figure F-2 shows that, as the potential for decreases in salmon populations and possible extinction go up, so do the urgency to reverse the trends and households' willingness to pay more. However, thresholds can be crossed that no amount of money can fix and the public, regardless of how much they value salmon, have limited extra dollars to spend. This is why beaver-driven restoration is so critical and cost-effective. Beaver-driven restoration can restore key winter rearing habitat, decrease stream temperatures, increase channel complexity and alter riparian habitat for salmon along their migration corridors, thereby enhancing their potential for survival and expansion. All of this can be done at little to no monetary cost.

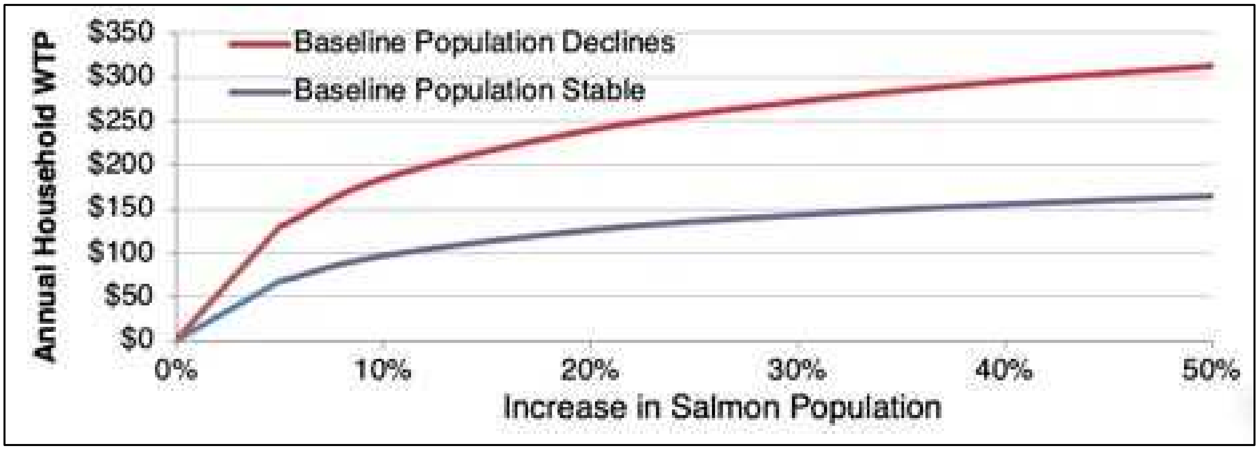

Figure F-2. Annual household willingness to pay for an increase in the Columbia River and Eastern Washington salmon/steelhead population

Use Values: *LBP Study*[21]

[Note: This section contains text and data excerpted from ECONorthwest and ESA (2012)

This section isolates the portion of the total value ($4.4 billion) noted in Table F-5 above that would be captured by activities that entail direct use of the potential increase in fish populations.

> Note: Direct use values are components of total economic value as shown in Figure F-1. They should not be added to the estimate of total value presented in Table F-6 below. The harvesting might occur in several ways: commercial, sport, subsistence, and Tribal ceremonial.

- **Commercial use values** represent the estimated profits associated with harvest. The literature suggests that profitability in the relevant industries ranges from 43 percent to 99 percent. This analysis assumes a profitability percentage of 80 percent. It uses weighted 5-year averages to estimate harvest value and catch in each fishery. It assumes the Integrated Plan's impact on fish populations would not affect prices in the relevant fishery markets.

- **Sport use values** represent both expenditures ($ spent) and consumer surplus[22] associated with sport fishing in the relevant geographies. The literature describes these values per fishing day. This analysis uses sport-fishing data to estimate the number of days spent fishing per fish harvested in the different geographies. It applies the days spent fishing, per fish harvested, to the increase in fish populations, and then multiplies by the daily use value associated with sport fishing. Furthermore, it assumes that use values associated with sport fisheries are directly related to the number of fish harvested. The literature supports the assumption that sport fishermen fish more often as their harvest rate (fish caught per day spent fishing) increases, with their consumer surplus directly proportional to their harvest rate.[23]

Table F-6 summarizes the use values (per fish in 2012 dollars) this analysis applies to the increase in fish harvests attributable to the Yakima River Basin Integrated Plan for managing water resources. The per-fish values represent updated data but remain similar to those used by the Bureau of Reclamation in similar analyses for this area.[24] Use values range from about $10 to about $750 per fish, with the variation representing factors such as species, size of fish, location of the fishing site, catch rate, time of year, and fishing regulations. The use values associated with sport fishing are higher than those associated with commercial fishing, which is consistent with the literature.[25]

Table F-6. Economic use value per fish by species and fishery (2012 dollars)

Harvest Category	Coho	Spring Chinook	Fall Chinook	Steelhead	Sockeye
Ocean Commercial	$10	$50	$50	-	-
Ocean Sport	$160	$120	$120	-	-
Lower Columbia Commercial	$10	$60	$30	-	$10
Lower Columbia Sport	$330	$330	$330	-	$330
Columbia Tribal Commercial	$10	$50	$20	$10	$10
Columbia Tribal Ceremonial and Subsistence	Value is incalculable				

Pacific Ocean Commercial

The method used to calculate the average use value per fish caught in the commercial ocean fishery has two components: (1) the average profit per fish caught by commercial ocean fisheries in Alaska, Washington, Oregon, and California, and (2) the distribution across the fisheries of fish originating from the Yakima River Basin. The average profit per Chinook ranged from about $50 per fish in Alaska to about $60 in Oregon, and average profit per Coho ranged from about $8 per fish in Alaska to about $10 per fish in Oregon. The distribution of fish originating in the Yakima River Basin in Washington that were harvested by these fisheries was calculated using historical tracking records.[26] For example, from 1984–2011, Alaska accounted for about 90 percent of the take of Chinook that originated in the Yakima River Basin and were harvested in the commercial ocean fishery. The economic use value, per fish, in the commercial ocean fishery is about $10 for Coho and $50 for Spring and Fall Chinook. Steelhead and Sockeye are not harvested in the Pacific Ocean commercial fishery.

Pacific Ocean Sport

The method used to calculate the average use value per fish caught in the ocean sport fishery has three components: (1) the average value per fishing day (which includes expenditures and consumer surplus),[27] (2) the number of sport fishing days off the California, Oregon, and Washington coasts, and (3) the number of fish caught by recreational anglers off the California, Oregon, and Washington coasts. A literature review of studies estimating the total use value associated with ocean sport fishing in the region concluded that each fishing day is worth about $128 (Reclamation, 2008). This value includes expenditures (e.g., fishing gear, fuel, transportation, fishing guides) and consumer surplus. The average number of days it took for anglers to catch a Coho or Chinook ranged from 0.7 days in Washington to 3.2 days in California. Each state's catch rate (days per fish harvested) was weighted by the percentage of fish harvested in the ocean sport fishery off each state's coast, then multiplied by the average value per fishing day to calculate the average value per fish. The economic use value, per fish, in the ocean sport fishery is about $160 for Coho and $120 for Spring and Fall Chinook. Steelhead and Sockeye are not harvested in the Pacific Ocean sport fishery.

Lower Columbia River Commercial (zones 1–5)

The method used to calculate the average use value per fish caught in the Lower Columbia River's commercial fishery has two components: (1) the average profit per pound of Chinook and Coho harvested in the Lower Columbia River commercial fishery, and (2) the average weight per fish. From 2007–2011, the average Coho harvested in the Lower Columbia commercial fishery weighed about 10 pounds, the average Fall Chinook weighed about 18 pounds, and the average Winter/Spring/Summer Chinook weighed about 14 pounds. The economic use value, per fish, in the Lower Columbia River commercial fishery is about $10 for Coho, $60 for Spring Chinook, and $30 for Fall Chinook. Steelhead and Sockeye are not targeted in the Lower Columbia River commercial fishery. Some Sockeye will be caught as incidental catch; however, the analysis assumes those Sockeye have a use value of about $10 per fish.

Lower Columbia River Sport (zones 1–5)

The method used to calculate the average use value per fish caught in the Lower Columbia River sport fishery has three components: (1) the average value per fishing day (which includes expenditures and consumer surplus), (2) the number of sport fishing days on the Lower Columbia River, and (3) the number of fish caught by recreational anglers in this area. A literature review of studies estimating the total use value associated with sport fishing in the region concluded that each fishing day is worth about $76.[28] This value includes expenditures (e.g., fishing gear, fuel, transportation, fishing guides) and consumer surplus. From 2007–2011, anglers spent about 351,500 days per year fishing on the Lower Columbia River. Each year, they caught an average of 81,500 fish. In other words, they caught one fish every 4.3 days. These numbers indicate the economic use value, per fish, is about $330 for each fish species in the analysis.

Columbia River Tribal Commercial (zone 6)

The method used to calculate the average use value per fish caught in the Columbia River's Tribal commercial fishery has two components: (1) the average profit per pound of Chinook and Coho harvested in the Columbia River (zone 6), and (2) the average weight per fish. The average Coho harvested in the Lower Columbia commercial fishery (zone 6) weighed about 10 pounds, the average Fall Chinook weighed about 17 pounds, and the average Winter/Spring/Summer Chinook weighed about 14 pounds. The economic use value, per fish, is about $10 for Coho, $50 for Spring Chinook, and $20 for Fall Chinook. Sockeye and steelhead have not been harvested in this fishery for several years. With no data from which to derive Sockeye- and steelhead-specific values, this analysis assumes they have the same value as the Coho harvest, $10 per fish.

Summary

Fish-population modeling determined that it is reasonable to assume implementation of the Integrated Plan would cause annual populations of catchable adult salmon/steelhead produced by the Columbia River Basin to increase beginning in 2013, with the increase leveling off at 181,650–472,450 additional fish in 2042.[29] Table F-7 provides an estimate of the monetary value of salmon based on the categories in Figure F-1. Table F-7 shows an estimate of the present value of households' willingness to pay for the expected increases in salmon/steelhead populations: $5.0–$7.4 billion accounting for households in Washington and Oregon. Because these estimates do not consider the benefits accruing to residents of other regions, both estimates underestimate the full value, from a national perspective, of the increase in salmon/steelhead populations.

Table F-7. Summary of fish-related benefits from anticipated increases in salmon populations originating in the Yakima River Basin. (See Figure F-1)

Value Category	Sub Category	Washington and Oregon
Total Economic Value		$5.0–$7.4 billion
Use Value	Direct use value, Indirect use value, Option value	$0.1–$0.3 billion
Passive-Use (Non-Use) Value	Existence value, Altruistic Value, Bequest Value	$4.9–$7.1 billion

Increases in future salmon/steelhead populations would potentially support increases in fish harvests and the associated use values. Under expected fish-harvest regimes, annual fish harvests would increase to 37,997–102,603 fish by 2042. Table F-7 shows the use values associated with the additional annual harvests have a present value of $0.1–$0.3 billion. This estimate was developed independent of the estimate of total economic value. The estimate of use value is a component of, not an addition to the estimate of total value. The difference between total value and use value represents the passive-use (nonuse) value of the increases in salmon/steelhead populations expected to result from the Yakima River Basin Integrated Plan. The passive use value is estimated to be $4.9–$7.1 billion, when total value reflects Washington and Oregon households combined.

Rogue River Salmon Example

[Note: the text and data in this section are excerpted from Helvoigt and Charlton (2009).[30]]

We conclude with one final example from the Rogue River to help make clear the economic benefits that would result from abundant beaver-created and maintained habitat and the variety of widely distributed improvements in salmon habitat it brings.

In 2008, the *Save the Wild Rogue Campaign* engaged ECONorthwest to analyze the economic value of salmon and steelhead in the Wild & Scenic Rogue River. In this report, we summarize the results of our analysis, which is based on peer- reviewed, published research, results from the Oregon Population survey, and fish-count data published by the Oregon Department Fish and Wildlife.

In this analysis, we develop estimates for only three of the economic values associate with Rogue River salmon: commercial fishing, sport fishing, and non- use value. Non-use values represent the vast majority of the economic value of Rogue River salmon.

- − $1.4 million annually associated with commercial fishing
- − $16 million annually associated with sport fishing
- − $1.5 billion annually associated with non-use values

For more than a decade, Oregonians have consistently stated that improving salmon habitat is important and have expressed a willingness to pay more than $70 million dollars per year to enhance salmon habitat in Oregon. By protecting salmon and steelhead populations in the Rogue River, Oregon is protecting an asset important to residents of the Pacific Northwest. For example, studies indicate that households in Washington and Oregon are willing to pay $30-$130 per year to finance salmon recovery efforts. [citation omitted] Salmon populations also help sustain jobs in the Pacific Northwest. If salmon populations were restored sufficiently to allow increases in commercial harvest, fishers and those in related industries would enjoy new business and job opportunities in Oregon, Washington, and elsewhere along the salmon's migration routes. Further benefits accrue to recreational anglers and all residents of the Pacific Northwest who benefit from the clean water, flood control and open spaces associated with salmon habitat. Since the values of many of these benefits accruing from salmon habitat are not captured by market prices, economists must employ different methods to measure the aggregate benefits that salmon and steelhead provide to the Northwest. Hence, the household surveys provide a means to estimate the extent to which Northwest residents value salmon and enhancements to salmon habitat – enhancements that can be gained at little to no cost if beavers are allowed to expand their numbers and build and maintain their water-rich and complex habitats.

Economic Benefits of Improved Stream Temperatures

Stream temperature is an important water quality parameter because of its impacts on aquatic species and municipal drinking water. Currently, Oregon has at least 11,057 stream miles, 5th order or greater, that are 303d listed as water quality impaired for stream temperatures. In the case of first through fourth order streams, the size of streams where beavers tend to build dams, the number exceeds 23,413 miles (see SI-1). The stream miles exceeding the state standard is expected to rise even further in the next decades in response to climate change. Under current global greenhouse gas (GHG) mitigation strategies, salmon and other cold-water fish species are projected to be replaced in many areas of Oregon by less economically valuable fisheries over the course of the 21st century (Figure F-3). While preserving existing coldwater habitats in Oregon through GHG mitigation will require long-term global cooperation, ODFW can act independently to preserve coldwater habitats in Oregon by immediately closing all federally managed public lands to commercial and recreational beaver trapping and hunting. A decision to do so would allow beaver populations to increase and begin building and expanding the habitat conditions that lead to improvements in stream temperatures (i.e. wetlands, wet meadows, increased floodplain connectivity, high water tables, ponds).

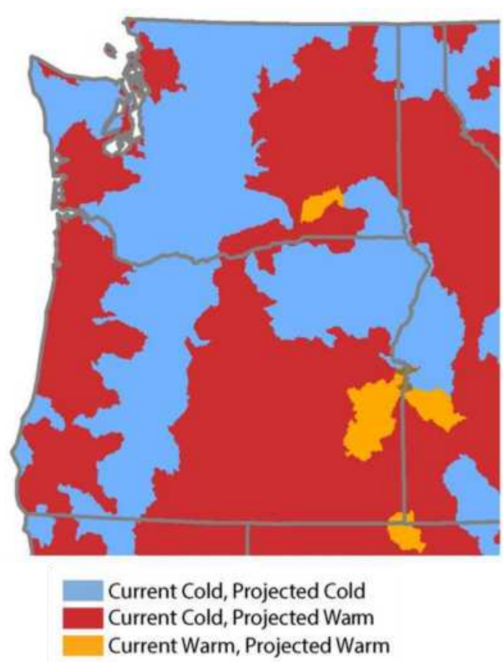

Figure F-3. Projected impact of climate change on potential cold-water fish habitat in the year 2100 if global emissions continue at their current rate. BLUE areas are locations where there will be streams still cold enough to support salmon and other cold-water fish in 2100. RED areas are locations that currently have streams that can support cold-water fish but will have warmed enough by 2100 to compromise fish survival.[31]

Eliminating Costly Stream Temperature Restoration

Reductions in stream temperatures are valued at $74,000-$411,000 per mile (Table F-1).[32] Given the miles of streams currently exceeding the state standard, the human-powered restoration activities needed to bring about these reductions would cost between $818 million to $9.6 billion (Table F-8). A portion of these costs could be avoided if beavers were allowed to build and maintain dams that create the habitat conditions that lead to reduced stream temperatures. The beaver-driven restoration might occur solo or in partnership with human-powered restoration (e.g. debris jams, BDAs) when historic channel changes have altered stream hydraulics to the point that beaver dams are unable to persist through the spring high flows. This partnership is important given the scales and magnitudes of the climate changes expected and current improvement needs.

Table F-8. Estimated costs to decrease stream temperatures on 303d listed streams.

Category	5th order or greater streams	1st - 4th order streams
Stream miles	11,057	23,413
Restoration cost @ $74,000/mile	$818,218,000	$1,732,562,000
Restoration cost @ $411,000/mile	$4,544,427,000	$9,622,743,000

Stream Temperature Reductions in Beaver-dominated Systems

The ability of beaver-created habitat to decrease Oregon’s stream temperatures at little to no cost was documented in two recent studies in Oregon. The Morgan-Hayes (2018)[33] study looked at long-term temperature data at multiple sites in the North Fork Burnt River (NFBR) watershed on national forest in eastern Oregon. Data span years 1995 to 2017. This watershed currently has Redband trout but once was home to salmon prior to the building of the Hells Canyon dams. Weber et al (2017)[34] examined temperature changes on Bridge Creek in central Oregon from 2007 to 2014. Juvenile steelhead use Bridge Creek as summer rearing habitat. Both studies found temperatures positively influenced by the beaver-created habitat.

One example of reductions in temperature due to beavers is presented using data collected in the NFBR watershed in 2019. Two temperature loggers were deployed on a section of Trout Creek, tributary to the NFBR, with data collected every half hour. Trout.83D.5 recorded stream temperatures as it exited a long section of private land with little shade onto national forest. The stream then flowed through the beaver dam-controlled reach for about 747 feet before reaching the Trout.83D.1 site. The tributary then flowed another 208 feet to its confluence with the NFBR. A comparison of the daily maximum stream temperatures at these two sites found temperatures at Trout.83D.1 cooler than Trout.83.D.5 (Figure F-4) during the summer months with temperatures up to 6°F lower (Figure F-5).

The economic benefit of this temperature improvement, pro-rated to account for the shorter stream length, was $9,620 - $53,430. This economic value is in addition to the aquatic habitat and water storage economic values already assigned to other benefits of beaver-created habitat.

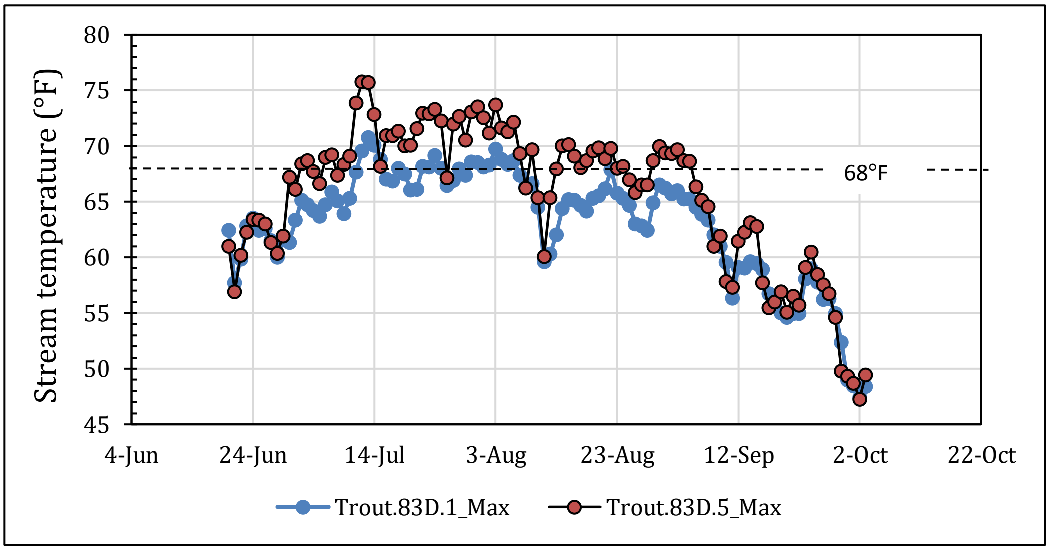

Figure F-4. Comparison of the daily maximum stream temperatures of Trout.83D.5 and Trout.83D.1 in 2019.

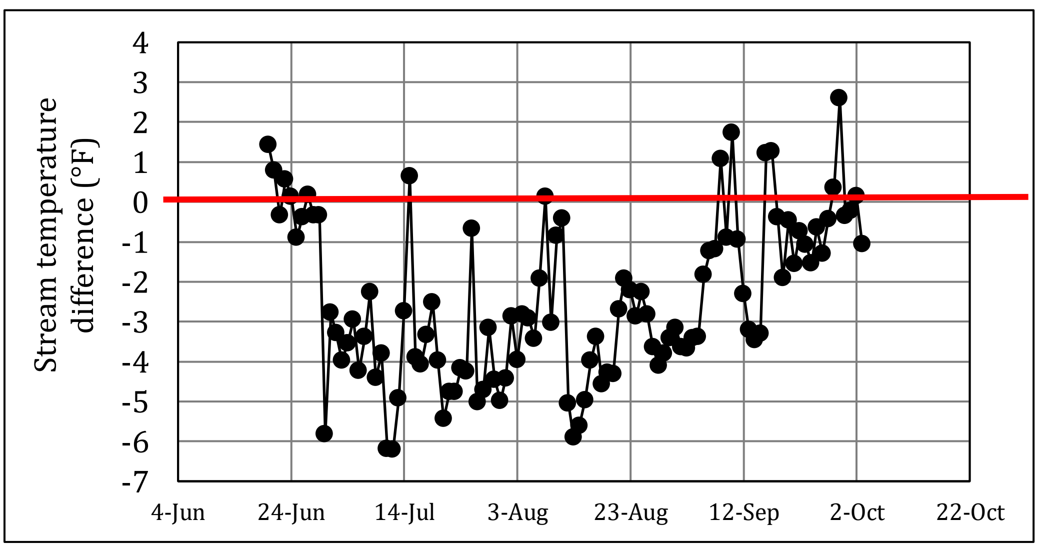

Figure F-5. Difference between the daily maximum stream temperatures of Trout.83D.5 and Trout.83D.1 sites in 2019. Values were calculated as Trout.83D.1 – Trout.83D.5.

The significance of this improvement in temperature on Trout Creek due to habitat conditions created by beavers is underscored by data collected at the NFBR.83E.2 site in 2019. This site is about 1320 feet upstream of its confluence with Trout Creek and about 230 stream feet downstream of a long section of unshaded, private land. A comparison of the three sites found that the logger in the beaver dam-dominated reach (Trout.83D.1) was cooler than the other two sites, had fewer days where it exceeded the state standard, and the maximum it exceeded the standard was only 2.8°F. In contrast, Trout.83D.5 exceeded the standard by up to 7.8°F and the NFBR.83E.2 site by as much as 13.8°F (Table F-9). Temperatures exceeded the state standard for 51 and 84 days respectively.

Table F-9: Comparison of daily maximum stream temperatures and days exceeding the state standard.

Creek	Site number	Dates deployed	State standard (°F)	Max Daily stream temperature (°F)	Max date	# Days exceeding state standard	Total days measured	Elevation (ft)
Trout	Trout.83D.1*	6/20/19 - 10/3/19	68	70.8	13-Jul	15	106	4111
Trout	Trout.83D.5	6/20/19 - 10/3/19	68	75.8	12-Jul	51	106	4113
NFBR	NFBR.83E.2	6/5/19 - 9/26/19	68	81.8	12-Jul	84	114	4112

*in the beaver dam dominated reach

The value of temperature reductions generated by beaver-created habitat will extend beyond individual streams by contributing these cooler waters to larger streams at multiple points. Reductions in stream temperatures in vast miles of first through fourth order streams, the size that beavers build dams on and create habitat, would improve water quality conditions for salmon and humans along the length of the system.

Economic Benefits of Increased Aquatic Habitat

The potential economic value of beaver-created aquatic habitat resulting from the banning of trapping/hunting on federally managed public lands was assessed for: 1) Five areas where beaver dam capacity had been quantified for existing watershed conditions using the Beaver Restoration Assessment Tool (BRAT) developed out of Utah State University and 2) 17 one-mile reaches in the Coast Range using ODFW Aquatic Habitat Inventory (AHI) data. Each acre of beaver-created aquatic habitat represents money that would not need to be spent on human-driven restoration efforts. Increased aquatic habitat created by beavers is valued at $4000 per acre per year (Table F-1).

Contributions based on BRAT

The existing watershed beaver dam capacity was modeled for the North Fork Burnt River watershed and the John Day Basin using BRAT under existing conditions (see SI-2). The dam numbers generated were used to estimate potential acres of ponds and aquatic habitat created by beavers (Table F-10). The acres presented are a conservative number because only 50% of dams modeled by the BRAT were assumed to be present and maintained (see SI-2) and pond sizes used in calculations were only 20 feet wide by 75 feet long (Table F-10). These numbers are only intended to give a sense of potential because they do not include ponds that are larger or extend onto the historic floodplain or other elements of aquatic habitat that come with increased stream system complexity. However, even these simplistic calculations for a small portion of Oregon capture the economic benefit of this beaver-created and maintained habitat, done at little to no additional taxpayer cost. For the North Fork Burnt River watershed and the John Day Basin, the combined value of these small beaver ponds in terms of aquatic habitat created is close to $9 million.

Table F-10. Potential beaver-created aquatic habitat (i.e. ponds) based on potential beaver dam numbers and different ponds sizes for areas modeled using the BRAT and existing conditions. Value at $4000 per acre per year.

						50% of total existing capacity		
Name	**% public lands**	**HUC #**	**Drainage area**	**Perennial streams (km)**	**Total existing watershed dam capacity**	**# of dams**	**Aquatic Habitat (acres)**	**Value per year ($)**
North Fork Burnt River watershed	83	1705020201	124,084	495	7019	3510	121	$483,402
Lower John Day subbasin	0	17070204	2,000,000	2,905	19,781	9891	341	$1,362,328
Middle Fork John Day subbasin	60	17070203	508,000	1,474	16, 929	8465	291	$1,165,909
North Fork John Day subbasin	66	17070202	1,200,000	3,535	51,241	25621	882	$3,528,994
Upper John Day subbasin	51	17070201	1,300,000	3,317	32,994	16497	568	$2,272,314
TOTAL				**11,726**	**111,035**	**63, 984**	**2203**	**$8,812,947**

Contributions based on ODFW Aquatic Habitat Inventory

The second example of beaver-created aquatic habitat and its economic value used data from ODFW's AHI database that extends back to 1998. Seventeen stream reaches were selected from eight different subbasins, each reach a mile in length (see SI-3). These reaches have multiple interannual replicates and represent a broad cross-section of the coastal coho Evolutionary Significant Units (ESU). The analysis compared the maximum beaver ponded surface area within each reach to its most recent beaver ponded surface area. The analysis found dramatic declines in beaver ponds, an aquatic habitat that has been touted by many research publications as the most beneficial for coho production. The maximum beaver pond area for the 17 reaches of streams dropped from 424,326 sq. meters to 34,818 sq. meters resulting in a massive decline in juvenile coho production potential (Table F-11). This drop in critical winter rearing habitat directly impacts fresh water production resulting in lower adult escapement from the ocean.

Table F-11. Changes in beaver dam pond surface area based on ODFW AHI data.

			YEAR		Number of dams		Pond surface area (sq. m)	
HUC 8	**Coho Pop**	**Creek**	**MAX pond surface area**	**Most Recent Survey**	**MAX year**	**Most Recent Survey**	**MAX year**	**Most Recent Survey**
17080006	Big Creek	Gnat Ck trib	2009	2018	4	0	10,795	0
17100202	Nehalem	Alder Ck	2007	2019	10	0	26,842	0
17100202	Nehalem	Buster Ck trib b	1999	2010	11	2	91,139	20,194
17100202	Nehalem	Cedar Ck	2001	2019	9	2	5,975	335
17100202	Nehalem	Little Rackheap	2001	2010	13	0	6,905	0
17100202	Nehalem	Sager Ck	2000	2018	9	0	20,883	0
17100202	Nehalem	Selder Ck, trib B	2013	2016	14	0	15,620	0
17100203	Tillamook Bay	Joe Ck	2002	2017	7	0	19,279	0
17100204	Salmon	Curl Ck	2015	2018	10	0	8,111	0
17100204	Siletz	Miller Ck	2005	2017			89,407	0
17100204	Yaquina	Montgomery Ck	2005	2019	6	0	23,750	0
17100205	Alsea	Walker Ck	2001	2019	11	0	4,210	0
17100206	Siuslaw	Russel Ck	2011	2019	9	3	26,853	4,859
17100206	Siuslaw	Russel Ck, sec 2	2007	2016	7	0	15,530	0
17100303	Middle Umpqua	Heddin	2001	2018	11	4	37,619	2,204
17100304	Coos	Lillian Ck	2003	2006	10	4	14,384	7,226
17100306	Floras	Boulder Ck	1999	2019	3	0	7,024	0
					155	**19**	**424,326**	**34,818**

Considering only the lost aquatic habitat, these 17 stream reaches represent an economic loss of $384,800 per year (Table F-12). Implementation of the proposal to ban trapping/hunting of beavers on federally managed public lands could reverse this loss.

Table F-12. Comparison of acres and value of beaver-created aquatic habitat (i.e. ponds) based on subset of ODFW's AHI surveys. Valued at $4000 per acre per year

17 AHI stream reaches	**Total # dams recorded**	**Aquatic Habitat (sq. meters)**	**Aquatic Habitat (acres)**	**Value per Year ($)**
MAX year	155	**424,326**	104.8	$419,200
Most recent surveyed year	19	**34,818**	8.6	$34,400
Difference	**- 136**	**- 389,508**	**- 96.2**	**- $348,800**

Economic Benefits of Increased Water Storage

In addition to the increased amount of aquatic habitat described above as a result of abundant beaver ponds, there is the added benefit of increased surface and groundwater storage on these federally managed public lands. Water flowing from national forests has an average economic value exceeding $50 per acre-foot (Table F-1).[35] Some of this value comes from the ecosystem services, such as fish habitat, recreational opportunities, etc. that result from improvements of instream flows. Other values materialize as downstream users remove the water from the stream and use it to irrigate crops and for industrial-municipal purposes.

The value of water in Oregon's streams rises during late summers and drought years, when water is scarce. We can expect scarcity and, hence, values will increase sharply in the foreseeable future as changes in climate increase the risk of low streamflows during late summer, and during both short-term and prolonged droughts.[36] Irrigators in California, for example, often pay more than $1,000 per acre-foot during drought periods.[37]

Using data from the BRAT analysis for the North Fork Burnt River (see SI-2), Table F-13 provides some idea of the monetary value that could be gained by increased temporary beaver pond storage and delayed water flow upstream of Unity Reservoir in Baker County. Volume stored varies as a function of pond dimensions and beaver dam numbers (see SI-4).

Table F-13. Economic benefit of stored water behind beaver dams upstream of Unity Reservoir, Baker County as a function of number and size of beaver ponds. Valued at $50/acre-foot.

Ecosystem Service Provided	Water stored (gallons)	Water stored (acre-feet)	Households served for a year	Economic Benefit
Delayed water flow upstream of reservoirs if the watershed is at maximum modeled dam capacity (7019 dams)	4.2 to 12.7 million	725 -2,175	220 -660	$10,997 - $32,990
Delayed water flow upstream of reservoirs if the watershed is at half modeled dam capacity (3510 dams)	2.1 to 6.3 million	363 -1,088	110 - 330	$5,499 - $16,497

The benefits of the water stored behind beaver ponds can also be considered in terms of the number of household of four who could be served by this water. Assuming each household uses on average about 19,200 gallons of water per year, the example above shows that 363 to 660 households would benefit. Other studies support the significance of beaver ponds with actual pond measurements. In the Methow Valley area, a biologist measured the amount of water stored in 62 ponds created by beavers which had been released under the Methow Valley Project. She found they stored 5 million gallons of water, enough for an average Twisp household for 5 years.[38] And research by Walker et al (2010) examining water storage potential behind existing beaver dams in a number of counties in Washington State found that the potential was high to meet eastern Washington's water needs with increased beaver ponds storage. Their study examined both surface water and groundwater storage potential.[39]

Economic Benefits of Improved Recreational Opportunities

Oregon statute ORS 496.012 states "It is the policy of the State of Oregon that wildlife shall be managed to prevent serious depletion of any indigenous species and to provide the optimum recreational and aesthetic benefits for present and future generations of citizens of this state. In furtherance of this policy, the State Fish and Wildlife Commission shall represent the public interest of the State Oregon and implement the following coequal goals of wildlife management:

(7) To make decision that affect wildlife resources of the state for the benefit of the wildlife resources and to make decision that allow for the best social, economic and recreational utilization of wildlife resources by all user groups. "

The Runyan report (2009), commissioned by ODFW and Travel Oregon, found that the economic returns of fishing, hunting, wildlife viewing, and shellfishing were $2.8 billion.[40] Of this, wildlife viewers spent just over $1 billion and people who fish $783 million. These numbers matter because beavers directly influence the abundance, distribution and quality of many of the habitat types needed by fish and wildlife, 82 of which are listed as strategy species in the Oregon Conservation Strategy (Appendix C).

> ...nearly 2.8 million Oregon residents and nonresidents participated in fishing, hunting, wildlife viewing, and shellfish harvesting in Oregon. Of the total number of participants, 631 thousand fished, 282 thousand hunted, 175 thousand harvested shellfish, and 1.7 million participated in outdoor recreation where wildlife viewing was a planned activity.
>
> When all three categories [travel generated, local recreation, equipment purchases] are combined, fish and wildlife recreation resulted in expenditures of $2.5 billion in 2008. Oregon residents and nonresidents who traveled overnight and on day trips of 50 or more miles (one-way) from homemade travel-generated expenditures of $862 million. Local recreation expenditures of $147 million were made by Oregon residents while participating in these activities less than 50 miles from home. State residents and nonresidents also spent an additional $1.5 billion on specialty equipment and other activity-related purchases from retail establishments and suppliers based in Oregon. (p. 1)

The Responsive Management report (2016)[41], commissioned by the Oregon State Legislature, found the following set of values and concerns by Oregonians:

> An open-ended question asked about the most important fish, wildlife, or habitat issue in Oregon (there was no answer set; residents could say anything that came to mind). The top issues are habitat loss, lack of water, low/declining fish populations, urban sprawl, and conservation/management of resources in general.

> The survey asked respondents about the importance of eight fish/wildlife values. For each item, residents rated the importance they placed on it, using a 0 to 10 scale where 0 is not at all important and 10 is extremely important.
>
> "That healthy fish and wildlife populations exist in Oregon" was the top-ranked value, closely followed by "that Oregon's water resources are safe and well protected." Note that these top two values are purely ecological rather than utilitarian. The values that are more utilitarian are lower (but still rated quite high in absolute terms), such as the provision of opportunities for viewing wildlife, for hunting, or for fishing. (p. ii)"

These findings reinforce the findings of earlier research: Oregonians place high economic value on the non-market goods and services they derive from fish, wildlife, and habitat. This high value has important implications: improvements in fish, wildlife, and habitat will yield large economic benefits for Oregonians. Beaver-created habitat can assist in creating these benefits at a state-wide scale with little to no monetary cost. Conversely, failure to expand beaver populations and their habitat on federally managed public lands likely will be accompanied by deteriorations in fish, wildlife, and habitat and, hence, large economic losses.

Conservation Investments

Ending commercial and recreational beaver trapping/hunting on federally managed public lands would increase the productivity of the state's investments in conservation. These increases would occur through 1) restoration of conservation funding currently being withheld from the state and 2) improved effectiveness of conservation expenditures.

Restoration of Conservation Funding

Between 2015 and 2019 Oregon lost about $6 million of federal funds from Clean Water Act Section 319 and Coastal Zone Management Act Section 306 as a result of the state's refusal to adopt measures to achieve and maintain water quality standards under the Clean Water Act (Table F-14). Instead, the funds were allocated to other states and will continue to be until measures are implemented that address the water quality concerns (see SI-5). In the meantime, the state budget continues to decline while the salmon recovery needs increase.

Improvements sought in coho habitat included improved stream temperatures, more wood in medium, small and non-fish-bearing streams and improved stream hydrology. These are improvements that can be accomplished by abundant, widely distributed and stable colonies of beavers actively building and maintaining habitat at little to no cost to the taxpayer.

Table F-14. Dollars withheld from DEQ and State Lands as a result of Oregon's refusal to comply with the Coastal Zone Act Reauthorization Amendments of 1990.

Year	Withheld from DEQ	Withheld from State Lands	Total
2015	$631,500	$598,800	$1,230,300
2016	$435,540	$637,500	$1,073,040
2017	$516,000	$637,500	$1,153,500
2018	$509,100	$696,900	$1,206,000
2019	$523,035	$642,675	$1,165,710
TOTAL	**$2,615,175**	**$3,213,375**	**$5,828,550**

Improved Effectiveness of Conservation Expenditures

Beavers can build and maintain habitat and thus accomplish conservation objectives faster and more cheaply than engineered activities and infrastructure. They can also improve human-driven restoration efforts by adding additional complexity, stability and resilience into the project area without additional dollars spent.

The significance of their contribution is indicated in Table F-15 which shows different restoration expenditures by OWEB (Oregon Watershed Enhancement Board) for coastal wetlands, streams, and riparian areas. Many of these restoration efforts could have been accomplished or enhanced by beavers through their habitat modification without expending any additional dollars. Examples include beaver ponds leading to higher water tables which leads to wetland creation or human wood placement supplemented by beaver dams leading to increased habitat complexity and stability.

Table F-15. OWEB Expenditures on Stream, Riparian, and Wetland Restoration Efforts (2014-2019)

Category	Dollars invested
Coastal Wetlands	$3,638,006
Other Wetland Enhancement/restoration	$1,456,212
Large Wood Placement	$1,196,208
Riparian Restoration/Enhancement	$3,620,742
Floodplain Reconnection, Enhancement, Restoration	$3,560,756
Other stream-related restoration	$22,151,656
TOTAL	**$35,623,581**

An example of conservation expenditures that either beavers could have done better or would enhance is the construction of beaver dam analogues (BDAs). These are often necessitated because of the absence of real beavers to construct real beaver dams or by the need to improve stream hydraulics post channel incision so that beavers can build dams that persist through the high spring flows.[42] The Upper Nehalem Watershed Council recently estimated that it would cost more than $225,000 to construct 27 BDAs, or more than $8,300 each. It is important to note that these BDAs are intended to be a short-term solution. They are designed to help improve stream conditions in a way that can only be enhanced or maintained by the presence of stable and abundant beaver populations. They are not a substitute for healthy, abundant, stable and widely distributed beavers which will maintain and repair their dams for free. In contrast, it is unlikely that were the BDAs to fail that funds would be available for their repair.

POTENTIAL ECONOMIC BENEFITS OF PROPOSED AMENDMENT, UNQUANTIFIED

The economic benefits described above are just a small subset of the numerous benefits that would result from ending commercial and recreational trapping and hunting on federally-managed public lands. However, there are other benefits that cannot be quantified at this time. This does mean the value of these benefits is zero. Instead, they merely reflect the absence of suitable information for developing a credible quantitative estimate. Potentially significant, but unquantifiable economic benefits include, but are not limited to:

- Increases in earnings, jobs, and wages by agricultural producers, farm workers, and urban commercial water users in response to increased summer streamflows.
- Increases in the disposable incomes of households that consume municipal water, resulting from higher stream flows and, hence, lower water costs, during droughts.
- Increases in the value of the benefits enjoyed by outdoor recreationists, resulting from the positive impacts of beavers on stream flows, habitats, and the species dependent on them.
- Increases in the earnings, jobs, and wages of firms and workers related to outdoor recreation.
- Increases in the amounts of carbon sequestered and stored in wetlands and other ecosystems impacted by beavers.
- Reductions in wildfire risks and costs, resulting from beaver-related expansion of wetlands and riparian areas.
- Increases in earnings, jobs, and wages associated with commercial fishing, resulting from beavers' positive impacts on salmon populations.

ECONOMICS OF EXISTING RULE

Commercial and recreational beaver hunting and trapping under Oregon's Furbearer Trapping and Hunting Regulations occurs on both public and private land. However, locations are reported to ODFW only by county and therefore the number of beavers taken from the various types of public lands (federal, state, county, city) versus private lands is unknown. Several tables and figures are provided to give an idea of the value of commercial and recreational beaver trapping and hunting state-wide and used to compare against the economic values of not trapping and hunting beavers and acquiring the various ecosystems services generated by beaver-created and maintained habitat.

Table F-16 estimates the maximum dollar return on beaver pelts if all beaver take reported to ODFW were sold. Table F-17 indicates that the values found in the last column of Table F-16 overstate the economic return of beaver trapping and hunting because beaver take was much greater than beaver pelts sold. Table F-18 shows beaver sales (pelts and castor) at the Oregon Territorial Council on Furs sales. Economic return between 2015 to 2019 ranged from $ 6,899 to $11,669. During these same years, OWEB spent from $35.6 million dollars on coastal wetland and stream and riparian restoration. The information presented above indicates that much of this spending could have been avoided, or made more effective, if beavers had not been removed from the landscape.

It is important to note that the dollars listed in Tables F-16, 17, and 18 reflect the economic return of beaver trapping and hunting on a statewide basis (includes both private and public lands). The petition to amend OAR 635-050-0070 only applies to federally managed public lands. Therefore, the economic losses from the approving the amendment is much less than presented in these tables.

Table F-16: Data related to commercial and recreational trapping, beaver take, pelt prices, and statewide economic return if all pelts sold.

Year	Oregon's population	Furtaker Licenses sold (all) [1]	Furtakers reporting a beaver take[1]	Beaver take reported to ODFW [1]	Pelt price[1]	Maximum $ state-wide if all sold at pelt price
2000		1,580	250	3,385	$13	$44,005
2001	3,470,000	1,615	256	3,900	$10	$39,000
2002		1,815	256	3,178	$11	$34,958
2003		2,102	236	2,581	$14	$36,134
2004		2,238	257	2,771	$17	$47,107
2005	3,617,000	2,254	211	2,880	$21	$60,480
2006		2,556	276	3,251	$18	$58,518
2007		2,616	239	2,497	$20	$49,940
2008		2,782	284	2,501	$17	$42,517
2009		2,491	281	2,814	$19	$53,466
2010	3,856,000	2,353	268	3,246	$17	$55,182
2011		2,477	251	2,731	$21	$57,351
2012		2,491	278	2,869	$17	$48,773
2013		2,635	310	3,293	$20	$65,860
2014		2,339	214	1,945	$14	$27,230
2015	4,017,000	2,073	171	1,326	$11	$14,586
2016		1,851	161	1,231	$12	$14,772

[1]Oregon Furtaker License and Harvest Data: Appendices are from the Staff Summary at the ODFW Commission Meeting; June 7 2018, Baker City, OR. Appendix 1, p. 3 (licenses sold); Appendix 10, p. 12 (take and furtakers); Appendix 5, p. 7 (pelt prices). NOTE: Take numbers in the Staff Summary vary slightly between appendices in the document. The Staff Summary data differ from data obtained from ODFW and so differ slightly from those found in Table F-16.

Table F-17: Comparison of beaver take reported to ODFW compared to the number of beaver pelts offered for sale at the annual OTC auctions corresponding to the beaver trapping and hunting season. The number of pelts, if any, sold outside of OTC auctions is unknown.

Season	ODFW Reported Take[1]	Pelts Offered at OTC[2]	Pelts Sold at OTC[2]	ODFW Reported Take Sold (%)
2013-2014	3320	570	557	17%
2014-2015	1981	355	334	18%
2015-2016	1312	381	334	29%
2016-2017	1290	501	499	39%
2017-2018	1022	274	267	26%
TOTAL	**8925**	**2081**	**1991**	**22%**

[1]ODFW Harvest data provided by ODFW.
[2]Oregon Territorial Council on Furs, Inc. (http://www.otcfursales.com/sale-prices.html)

Table F-18: Published sales figures of the Oregon Territorial Council on Furs, Inc. from the annual fur auctions from 2015 to present and the portion of those sales related to beavers (pelts and castor). The total fur sales do not include antler sales. Data for earlier years is not publicly available. Pelt values are taken from actual OTC sales.

Year	Total Fur Sales[1]	Beaver Sales[1] Including Castor	% of Total Fur Sales	Beaver Pelt Value[1]	Castor Value[1]
2015	$341,684	$11,669	3.4%	$14	$41/oz
2016	$206,021	$ 8,871	4.3%	$11	$39/oz
2017	$549,501	$ 9,880	1.8%	$12	$44/oz
2018	$459,538	$ 6,899	1.5%	$14	$52/oz
2019	$532,153	$ 7,489	1.4%	$13	$63/oz
2020[2]	$157,024	$ 3,788	2.4%	$ 8	$83/oz
TOTAL	**$2,245,921**	**$48,596**	**2.1%**		

[1]Oregon Territorial Council on Furs, Inc. (http://www.otcfursales.com/sale-prices.html),
[2] In 2020, 1 of 2 sales canceled due to the coronavirus

In summary, income generated over the last six years based on available data show that only $48,596 worth of beaver pelts and castor were sold (Table F-18). In the five years with data, the total beaver pelts sold were 1991 or only 22% of the total number reported to ODFW (8925) (Table F-17). This means that 6934 pelts were not sold suggesting that many were discarded. If one assumes that the beavers trapped were likely family units and use the estimate of 6 beavers/family, then the total number reported trapped could represent up to 1487 colonies. Of the 1487 colonies, it would appear based on the lack of sales to match the amount of take that as many as 1155 colonies were simply killed and discarded. This represents hundreds of millions to billions of dollars of lost ecosystem services. These lost ecosystem services could have been helping Oregonians weather climate change, create systems more resilient to wildfire and drought, restore salmon runs, make conservation investments more effective, and offset pandemic-related declines in the state budget.

ECONOMIC COMPARISON: PROPOSED AMENDMENT vs EXISTING RULE

The information presented in this appendix and the comparison between adopting the proposed amendment versus maintaining the existing rule reveals a stark economic, social and cultural tradeoff (Table F-19). If the Commission rejects the petition, a few (< 164) will continue to enjoy the small benefits from largely recreational trapping/hunting on federally managed public lands to the detriment of the many that depend on beaver-created and maintained habitat. However, if the proposed amendment is approved, all Oregonians—4.2 million of us—and countless fish and wildlife, including threatened and endangered salmon and 82 strategy species, would realize benefits that total in the hundreds of millions to billions of dollars per year. These benefits come from the improvements in ecosystem services that arise from abundant and widely distributed beaver-created and maintained habitat.

Implementing the proposed closure on commercial and recreational trapping/hunting on federally-managed public lands and the waters that flow through them is required in order to receive these benefits because without beavers there is no beaver-created and maintained habitat. Taking these steps now is essential in order to set in motion the processes that will improve fish and wildlife habitat and other ecosystem services. These improvements will help insulate the state from the effects of changes in climate. Taking these steps now is also essential because there will be a lag between the cessation of trapping and hunting and the expansion and dispersal of beavers on federally managed public lands and the creation of habitat. Taking these steps now, thus, is the only way the Commission can help reverse the serious and ongoing decline in salmon populations and other indigenous species and provide optimum economic, ecological, social and cultural benefits to present and future generations of citizens of this state.

Table F-19. Comparison of value of continued beaver trapping/hunting on federally-managed public lands and the waters that flow through these lands versus closing these lands and allowing beaver-driven restoration to begin.[43]

Item	Year	Action	Dollars	People and/or fish and wildlife served
Continued Beaver trapping/hunting on federally-managed public lands and the waters that flow through these lands				
Total Beaver/Castor sales	2015-2019	Money earned by Trappers/hunters	< $48,596 (maximum)	< 164 because not all trap/hunt on federally-managed public lands and the waters that flow through these lands
Closure of beaver trapping/hunting on federally-managed public lands and the waters that flow through these lands				
Restored Salmon Runs	future	estimate of household willingness to pay for increased salmon populations in the future	Tribal Ceremonial and Subsistence: Value is incalculable $100 to $120 per household per year which results in an estimated value of $195 million in 2016 increasing to $241 million in 2035.	Countless salmon and communities who depend on or benefit from healthy salmon populations (4.2 million people) culturally and/or economically plus countless other species and individuals
Improved Stream Temperatures on a Minimum of 23,413 Miles of 1st - 4th Order Streams	future	estimated cost of human driven restoration	$ 1.7 to 9.6 billion dollars	4.2 million people, unknown number of species and individuals
EPA and NOAA Restoration Dollars	2015-2019	Dollars lost due to failure to require water quality improvements. Voluntary compliance still only required	$5.8 million	4.2 million people, unknown number of species and individuals
Oregon Watershed Enhancement Board (OWEB) Restoration Expenditures	2014-2019	Spent	$35.6 million	4.2 million people, unknown number of species and individuals
Recreational Spending on Wildlife Viewing, Fishing, Hunting, and Shellfishing	2008	Spent	$2.8 billion	2.8 million people

Item	Year	Action	Dollars	People and/or fish and wildlife served
Aquatic Habitat Ecosystem Value for two Beaver Restoration Assessment Tool (BRAT) Area Examples	future	estimated cost of human driven restoration	$8.8 million	County residents in these areas plus unknown number of species and individuals
Aquatic Habitat Ecosystem Value for ODFW Aquatic Habitat Inventory Area Example of 17 one-mile reaches	future	estimated cost of human driven restoration	$348,800	Salmon and communities who depend on or benefit from healthy salmon populations (4.2 million people) plus countless other species and individuals
Delayed Flow Upstream of Reservoir Due to Water Storage via Beaver Ponds for NFBR Example	future	estimated value of water to downstream uses	$5,499 to $32,990 per year	Fisheries, downstream irrigators

SUPPLEMENTAL INFORMATION (SI)

SI-1: Stream Temperature

A request was made to ODEQ by Dr. Suzanne Fouty for the number of streams that are listed in Oregon as water quality impaired for stream temperatures. The results are shown in Table S1.1. The explanation of the data is the result of multiple conversations with Becky Anthony, DEQ Water Quality Assessment, in June 2020.

Table S1.1: Summary of ODEQ stream temperature data. Source: ODEQ

Category	River Miles	Miles assessed for one or more parameters	Miles listed for Temp
5th order or greater streams (Total miles)	17,608	13,193	11057
4th order or less (Total stream miles in watershed assessment units)	292,856	128,400*	78,044**
Total in the state	310,464		

* Not all streams within a watershed assessment unit (WAU) measured but at least one stream for at least one parameter was.
** Not all streams within the WAU were measured and above impaired for temperature, but at least one was. Therefore, all included in the number.

Seventy-five percent (13,193 miles) of Oregon's total miles of stream 5th order or larger have been measured for one or more water quality parameter. Of these miles, 11,057 miles are above the state temperature standard. These miles represent a minimum because 25% of the streams in this size category have no water quality data.

Interpreting the 78,044 miles within the watershed assessment units (WAU) shown as temperature impaired is less direct because of the method used. In the case of the WAUs, if at least one stream was above the standard in a WAU than all streams in that WAU are categorized as above. Therefore, this number overstates miles within these WAUs that are actually above the state standard. However only 26% of the WAUs were surveyed (810/3076) for temperature leaving a lot of WAUs without any temperature data. If only 30% of the streams in the WAUs listed for temperature were above the state standard, then at least 23,413 miles are above the standard. However, there are miles of streams without any data and the 23,413 miles is considered is a very conservative number because only 26% of the WAU were surveyed for stream temperatures.

11,057 + 23,143 = 34,470 minimum miles impaired for temperature and most of those miles are in the upper watersheds and many of these are on these federally managed public lands. These streams are of the size where beavers build dams and create ponds and habitat.

SI-2: AQUATIC HABITAT AVAILABILITY (BRAT)[44]

This appendix was generated by Dr. Suzanne Fouty, retired Forest Service hydrologist.

The BRAT model was developed out of Utah State University. It is a capacity model developed to assess the upper limits of riverscapes to support beaver dam-building activities. It outputs an estimated density of dams (i.e. dams per length of stream) and a rough count of an upper limit (i.e. capacity) of how many dams the conditions in and surrounding a reach could support. Both existing and historic capacity were estimated using readily available spatial datasets to evaluate seven lines of evidence:

(1) a reliable water source;
(2) stream bank vegetation conducive to foraging and dam building;
(3) vegetation within 100 m of edge of stream to support expansion of dam complexes and maintain large beaver colonies;
(4) likelihood that dams could be built across the channel during low flows;
(5) the likelihood that a beaver dam on a river or stream is capable of withstanding typical floods;
(6) evidence of suitable stream gradient; and
(7) evidence that river is too large to allow dams to be built and to persist.

Fuzzy inference systems were used to combine these lines of evidence while accounting for categorical ambiguity and uncertainty in the continuous inputs driving the models. The existing model estimate of capacity was driven with LANDFIRE vegetation data from 2014, whereas the 'historic' estimate represents a pre-European settlement model of vegetation, also from LANDFIRE.

BRATs were done for two areas in Oregon: North Fork Burnt River watershed and John Day Basin. The North Fork Burnt River watershed is 124, 084 acres and the GIS layer used noted about 307.8 miles of perennial streams. The BRAT estimated the existing NFBR watershed capacity for beaver dams at 7,019 dams with dam densities varying throughout the watershed (Figure S2.1, Table S2.1). In contrast only 53 dams were found either by virtual reconnaissance in Google Earth or ground based field work identified. The John Day basin is about 5.19 million acres. The estimated existing John Day basin (HUC 6) capacity is 120,945 dams. The Basin was analyzed based on its four subbasins: Lower John Day (2 million acres), Middle Fork John Day (508,000 acres), North Fork John Day (1.2 million acres) and Upper John Day (1.3 million acres). As is the case with the NFBR watershed results, dam densities varied throughout the subbasins as shown in Tables S2.2 to S2.5.

The same model was used to determine historic dam numbers based on estimates of historic vegetation types. The historic estimates for the NFBR watershed-wide capacity were 11,036 dams reflecting a 36% loss compared to historic capacity. Values for the John Day Basin watershed-wide with estimates of historic vegetation types were 169,781 dams reflecting a

29% loss compared to historic capacity. In both areas, the capacity losses can be explained in terms of vegetation loss and degradation associated with land use including 1) conversion of valley bottoms to agricultural land uses, 2) overgrazing, and 3) conifer encroachment of wet meadow areas. However, despite these losses, both areas are still capable of supporting and sustaining a substantial amount of beaver dam-building activity. Even if only 50% of existing potential was achieved, there would be 3510 dams (NFBR) and 60,407 dams (John Day Basin), numbers much greater than current conditions.

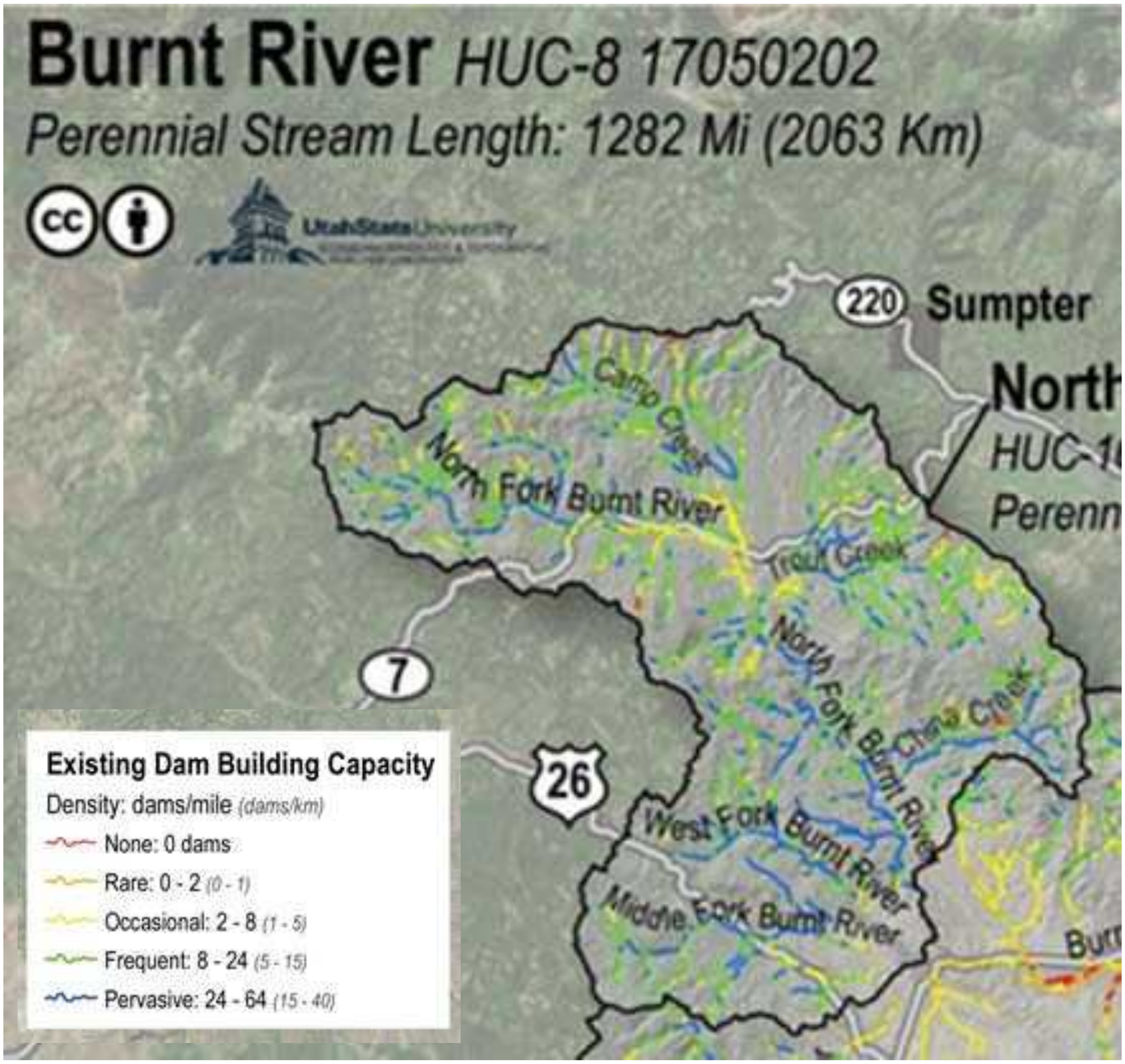

Figure S2.1: Close up of modeled beaver dam capacity for existing condition for the North Fork Burnt River watershed (MacFarlane et al 2019).

Table S2.1. Distribution of existing dam building capacity by category for the North Fork Burnt River Watershed (HUC 10: 1705020201). Drainage area = 124,084 acres

Category	Perennial Streams (miles)	# Beaver Dams	Dam density (dams/mile)
Pervasive	101.99	3,911	38
Frequent	151.9	2,702	18
Occasional	50.468	393	8
Rare	0.93	13	14
None	1.86	0	0

Table S2.2. Distribution of existing dam building capacity by category for the Lower John Day subbasin (HUC 8: 17070204). Drainage area = 2,000,000 acres

Category	Perennial Streams (mile)	# Beaver Dams	Dam density (dams/mile)
Pervasive	133.4	4,873	37
Frequent	300.3	5,345	18
Occasional	903.8	7,606	8
Rare	218.1	1,957	9
None	0.0	0	0
TOTAL	**1555.6**	**19,781**	

Table S2.3. Distribution of existing dam building capacity by category for the Middle Fork John Day subbasin (HUC 8: 17070203). Drainage area = 508,000 acres

Category	Perennial Streams (miles)	# Beaver Dams	Dam density (dams/mile)
Pervasive	231	8,618	37
Frequent	352	6,266	18
Occasional	257	1,947	8
Rare	11	98	9
None	0	0	n/a
TOTAL	**849.6**	**16,929**	

Table S2.4. Distribution of existing dam building capacity by category for the North Fork John Day subbasin (HUC 8: 17070202). Drainage area = 1,200,000 acres

Category	Perennial Streams (miles)	# Beaver Dams	Dam density (dams/mile)
Pervasive	836	32,850	39
Frequent	876	15,803	18
Occasional	310	2,388	8
Rare	23	200	9
None	146	0	0
TOTAL	**2192**	**51,241**	

Table S2.5. Distribution of existing dam building capacity by category for the Upper John Day subbasin (HUC 8: 17070201). Drainage area = 1,300,000 acres

Category	Perennial Streams (miles)	# Beaver Dams	Dam density (dams/mile)
Pervasive	344.7	12,761	37
Frequent	789.9	13,965	18
Occasional	703.1	5,481	8
Rare	93.6	787	8
None	124.6	0	0
TOTAL	2055.9	32,994	

SI-3: Aquatic Habitat Availability (ODFW AHIs) and Potential for Salmon Recovery

This appendix authored by Steve Trask, Senior Fish Biologist, Bio-Surveys, LLC and Trask Consulting, Inc.

Table S3.1 presents the quantified loss of beaver dams and resulting ponded surface area documented in ODFW's own Aquatic Habitat Inventory (AHI) database that extends back to 1998. Seventeen reaches were selected from this database that have multiple interannual replicates and represents a broad cross-section of the coastal coho Evolutionary Significant Units (ESU). The data set compared the maximum ponded surface area within the same reach over multiple years (1998 – 2019) to the most recent survey's measurement of ponded surface area. The analysis found dramatic declines in the beaver-created aquatic habitats that have been touted by many research publications as the most beneficial for coho production. The maximum pond area for the 17 reaches of streams surveyed dropped from 424,326 sq. meters to 34,818 sq. meters resulting in a massive decline in juvenile coho production potential. This drop in critical winter rearing habitat directly impacts fresh water production resulting in lower adult escapement from the ocean.

A comparison calculation was done assuming all other things remained the same except for beaver pond area. Based on this simplified scenario, the very recent loss of ponded surface area in the form of beaver ponds leads to an estimated decline in adult escapement of 38,637 adult coho if fresh water habitats were fully seeded post winter in both cases (1.6 smolts / sq. meter of beaver pond surface area). The dramatic decline in beaver pond area documented by ODFW indicates an ESU wide systemic crisis is in play for our most important aquatic keystone species. Because the observed decline is very recent, it is likely that the habitat that recently supported vast beaver pond surface areas still exhibits functional beaver habitat and that some combination of other factors are contributing to the decline of beavers. Therefore, if beavers were able to expand their numbers and build and maintain beaver dams to even contemporary levels of abundance (post 1998), then there is the potential for a large recovery of listed OCN coho to follow.

The key to this recovery is providing the remaining beaver (a fraction of their historical abundance) the ability to build, maintain, and expand their beaver dam complexes. While a number of factors contribute to beaver mortality, most are outside the ability of ODFW to affect. However, commercial and recreational beaver trapping is under their jurisdiction and one area where mortality can be decreased. The potential benefits to coho salmon of retaining more beaver on the landscape that could employ a dam building life history are great. ODFW's assumption that the lack of viable habitat (early seral vegetative resources) is the primary limiting factor controlling the proliferation of beaver on the landscape is poorly vetted and contradicted by its own readily available AHI data as well as field verified models such as the BRAT.

Table S3.1. Changes in Beaver dam pond surface area, smolt potential and adult returns.

			YEAR		Number of dams		Pond surface area (sq. m)		Smolt Potential at full seeding*		Adult Returns**	
HUC 8	Coho Pop	Creek	MAX pond surface area	Most Recent Survey	MAX year	Most Recent Survey	MAX year	Most Recent Survey	MAX year	Most Recent Survey	MAX year	Most Recent Survey
17080006	Big Creek	Gnat Ck trib	2009	2018	4	0	10,795	0	17,272	0	1,071	0
17100202	Nehalem	Alder Ck	2007	2019	10	0	26,842	0	42,947	0	2,663	0
17100202	Nehalem	Buster Ck trib b	1999	2010	11	2	91,139	20,194	145,822	32,310	9,041	2,003
17100202	Nehalem	Cedar Ck	2001	2019	9	2	5,975	335	9,560	536	593	33
17100202	Nehalem	Little Rackheap	2001	2010	13	0	6,905	0	11,048	0	685	0
17100202	Nehalem	Sager Ck	2000	2018	9	0	20,883	0	33,333	0	2,067	0
17100202	Nehalem	Selder Ck, trib B	2013	2016	14	0	15,620	0	24,992	0	1,550	0
17100203	Tillamook Bay	Joe Ck	2002	2017	7	0	19,279	0	30,846	0	1,912	0
17100204	Salmon	Curl Ck	2015	2018	10	0	8,111	0	12,978	0	805	0
17100204	Siletz	Miller Ck	2005	2017			89,407	0	143,051	0	8,869	0
17100204	Yaquina	Montgomery Ck	2005	2019	6	0	23,750	0	38,000	0	2,356	0
17100205	Alsea	Walker Ck	2001	2019	11	0	4,210	0	6,736	0	418	0
17100206	Siuslaw	Russel Ck	2011	2019	9	3	26,853	4,859	42,965	7,774	2,664	482
17100206	Siuslaw	Russel Ck, sec 2	2007	2016	7	0	15,530	0	24,848	0	1,541	0

HUC 8	Coho Pop	Creek	YEAR: MAX pond surface area	YEAR: Most Recent Survey	Number of dams: MAX year	Number of dams: Most Recent Survey	Pond surface area (sq. m): MAX year	Pond surface area (sq. m): Most Recent Survey	Smolt Potential at full seeding*: MAX year	Smolt Potential at full seeding*: Most Recent Survey	Adult Returns**: MAX year	Adult Returns**: Most Recent Survey
17100303	Middle Umpqua	Heddin	2001	2018	11	4	37,619	2,204	60,190	3,526	3,732	219
17100304	Coos	Lillian Ck	2003	2006	10	4	14,384	7,226	23,014	11,562	1,427	717
17100306	Floras	Boulder Ck	1999	2019	3	0	7,024	0	11,238	0	697	0
					155	**19**	**424,326**	**34,818**	**678,840**	**55,708**	**42,091**	**3,454**

* Full seeding expansion utilizes 1.6 coho / sqm of BD surface area from Nickelson, 2012

**Smolt to Adult ocean survival utilizes 6.2%, the 10-year average from Life Cycle monitoring sites between 2001-2010 from Nickelson, 2012

SI-4: WATER STORAGE

This section was generated by Dr. Suzanne Fouty, retired Forest Service hydrologist. Source of beaver dam numbers is the BRAT done by Utah State University of the North Fork Burnt River watershed. See SI-2.

Table S4.1: Potential inchannel surface water stored behind the beaver dams estimated for the entire NFBR watershed using 7019 dams. This number was presented in BRAT as existing watershed capacity.

NFBR watershed dams	water depth (ft)	Channel widths (ft)	pond lengths (ft)	Water stored (cubic feet)	water stored (gallons)	water stored (acre-feet)	Households served for a year (4 per family)	Economic value @ $50/acre-foot
7019	3	20	75	31,585,500	4,222,660	725	220	$10,997
7019	3	20	150	63,171,000	8,445,321	1450	440	$21,993
7019	3	30	75	47,378,250	6,333,991	1088	330	$16,495
7019	3	30	150	94,756,500	12,667,981	2175	660	$32,990

Table S4.2: Potential inchannel surface water stored behind the beaver dams estimated for entire NFBR watershed if use 3510 dams. This number represents 50% of the BRAT estimate of 7019 dams.

NFBR watershed dams	water depth (ft)	Channel widths (ft)	pond lengths (ft)	Water stored (cubic feet)	water stored (gallons)	water stored (acre-feet)	Households served for a year (4 per family)	Economic value @ $50/acre-foot
3510	3	20	75	15,795,000	2,111,631	363	110	$5,499
3510	3	20	150	31,590,000	4,223,262	725	220	$10,998
3510	3	30	75	23,692,500	3,167,447	544	165	$8,249
3510	3	30	150	47,385,000	6,334,893	1088	330	$16,497

Table S4.3: Potential inchannel surface water stored behind the beaver dams estimated for entire NFBR watershed if assume only 25% of the 7019 dams persists post-high spring flows.

NFBR watershed dams	water depth (ft)	Channel widths (ft)	pond lengths (ft)	Water stored (cubic feet)	water stored (gallons)	water stored (acre-feet)	Households served for a year (4 per family)	Economic value @ $50/acre-foot
1755	3	20	75	7,897,500	1,055,816	181	55	$2,750
1755	3	20	150	15,795,000	2,111,631	363	110	$5,499
1755	3	30	75	11,846,250	1,583,723	272	82	$4,124
1755	3	30	150	23,692,500	3,167,447	544	165	$8,249

CONVERSIONS: 1 cubic foot = 7.48 gallons; 43560 cubic feet = 1 acre-foot; Average water use for household of 4 = 19,200 gallons/yr

SI-5: Restoration of EPA and NOAA Funding

Source: This appendix was authored by Paul Koberstein using material from an unpublished book manuscript "Canopy of Titans" by Paul Koberstein and Jessica Applegate. Paul Koberstein is also the editor of Cascadia Times out of Portland, OR.

Past Funding Withheld Due to Failure To Improve Water Quality

A search of more than 1,000 documents obtained through the Oregon Public Records Law by Cascadia Times has revealed that the state of Oregon has failed to comply with federal Clean Water and Coastal Zone Management statutes protecting water quality and salmon habitat in Coast Range streams, resulting in multi-million-dollar fines levied by two federal agencies. Cascadia Times also found that the state's failure to comply these laws and its failure to protect beaver in coastal streams have combined to negatively impact wild coho salmon populations in the Coast Range. Cascadia Times plans to publish its findings in a forthcoming book on the coastal forest, Canopy of Titans.

1. In 1998, the federal government determined that the state of Oregon has failed to protect coastal streams as required by the Clean Water Act Section 319 and the Coastal Zone Management Act Section 306. Pursuant to 16 U.S.C. § 1455b(c)(3) and (4), the US Environmental Protection Agency (EPA) and National Oceanic and Atmospheric Administration (NOAA) are withholding grant funds from Oregon until it submits a fully approved Coastal Nonpoint Pollution Control Program as required by section 6217(a) of the Coastal Zone Act Reauthorization Amendments of 1990. EPA and NOAA agencies have withheld approximately $1 million yearly from the Oregon Department of Environmental Quality and the Oregon Division of State Land since withholding began in 2015. As shown in Table S5.1., the total amount is approaching $7 million.[45]

Table S5.1. Funding withheld from Oregon as a result of its refusal to take restoration actions required by the Coastal Zone Act Reauthorization Amendments of 1990.

Year	Withheld from DEQ	Withheld from State Lands	Totals
2015	$631,500.00	$598,800.00	$1,230,300.00
2016	$435,540.00	$637,500.00	$1,073,040.00
2017	$516,000.00	$637,500.00	$1,153,500.00
2018	$509,100.00	$696,900.00	$1,206,000.00
2019	$523,035.00	$642,675.00	$1,165,710.00
2020 (Projected)	$523,035.00	$642,675.00	$1,165,710.00
TOTALS	$3,138,210.00	$3,856,050.00	$6,994,260.00

2. The federal court order to withhold grant funds was signed July 1, 2015 by US Magistrate Judge Paul Papak.[46]

3. The Section 6217 coastal non-point program includes all Oregon Coast streams excluding the Columbia River basin and the Umpqua and Rogue.[47]

4. Since withholding began in 2015, NOAA and EPA have been working with the State to address the conditions laid out in the Papak order. The State has made incremental modifications to its program and has since met most, but not all, of those conditions. The federal agencies objected to portions of the state program allowing actions that are voluntary but not mandatory.[48]

5. Specifically, EPA/NOAA required Oregon to apply certain mandatory management measures where water quality impairments and degradation of beneficial uses attributable to forestry exist and where voluntary efforts were unsuccessful.[49]

6. EPA/NOAA identified specific areas where Oregon's Forest Practices Act must be strengthened to attain water quality standards and fully support beneficial uses. These areas include protection of medium, small, and non-fish bearing streams, including intermittent streams. Under existing State forest practices, these streams may be subject to loss of sediment retention capacity, increases in delivery of fine sediments, and increases in temperature due to loss of riparian vegetation. The agencies determined that the Oregon's Forest Practices Act does not adequately address stream temperature increases stemming from forestry practices.[50]

7. EPA/NOAA are also concerned about the lack of adequate long-term supplies of large woody debris in medium, small, and non-fish bearing streams, a shortage of which can result in decreased sediment storage in upstream tributaries, increased transport and deposition downstream, and overall adverse impacts to beneficial uses.[51]

8. A 2011 report by the National Marine Fisheries Service points out that beaver ponds and side channels are "principal habitat features for coho salmon." The report notes that notes juvenile coho salmon may be dependent upon beaver dams "within the landscape."[52]

9. In 1997, the Oregon Department of Fish and Wildlife observed, "[t]he quality of freshwater habitat was one factor that was identified as potentially influencing the decline of coho in the ESU. Pools formed by the dam building of beavers (Castor canadensis) may be an important component of high-quality habitat for coho." It concludes that "[a]lthough the harvest of beaver in the ESU appears to have declined, habitat surveys conducted in the Oregon Coast Coho ESU from 1997-2003 show high annual variability but no significant trend in the occurrence of beaver pools." *Id*. at 9." Despite the importance of beavers to OC coho habitat protection and restoration, Oregon continues to enforce only voluntary, compliance with regulations.[53]

10. NMFS, in its 2016 5-Year Review: Summary & Evaluation of Oregon Coast Coho Salmon said for mid-coast streams, the recovery strategy is to protect current high quality summer and winter rearing habitat (including estuarine habitat) and strategically restore habitat quality in adjacent habitat for rearing and spawning, including the restoration of beaver populations.[54]

    The same document said the primary limiting factors are stream complexity in the Salmon, Siletz, Yaquina, Alsea and Siuslaw rivers and spawning gravel, including the lack of beaver. The secondary limiting factors are stream complexity, lack of beavers, and water quality. The continuing loss of beavers whose damming activities improve coho salmon rearing habitat, primary productivity, nutrient retention/cycling, floodplain connectivity, and stream flow moderation remains an ongoing habitat concern, as does fish passage and access in the Yaquina, Alsea, and Siuslaw rivers and Beaver Creek estuaries. (Reeves et al. 1989; Stout et al. 2012 as cited in NMFS 2016)[55]
    Among NMFS recommendations under the ESA:

    a. Implement the primary recovery strategy for the populations in this stratum to protect current high-quality summer and winter rearing habitat (including estuarine habitat) and strategically restore habitat quality in adjacent habitat for rearing and spawning including restoring beaver populations.

    b. Restore ecological processes to improve water quality (temperature and dissolved oxygen), instream habitat/channel complexity, and spawning gravel conditions. including restoring beaver populations.

    c. By protecting from adverse timber management and agricultural practices, urbanization, and beaver control.

NMFS' Recommended Future Actions

• Implement the primary recovery strategy for this stratum to protect current high-quality summer and winter rearing habitat and strategically restore habitat quality in adjacent habitat by improving instream flow, water temperature, and channel complexity by protecting the stratum from adverse timber management and agricultural practices, and lethal beaver control.

• Develop and implement a beaver conservation plan that includes reducing lethal control, improving public education and acceptance of beavers, and developing non-lethal beaver management practices to address winter and summer rearing habitat for this stratum.

State Regulatory Mechanisms Affecting Beaver Management

Beavers were once widespread across Oregon. There is general agreement that beavers are a natural component of the aquatic ecosystem and beaver dams provide ideal habitat for overwintering coho salmon juveniles. Some scientists argue that restoring beavers and beaver ponds would be the single most effective habitat action that we could take to rebuild OC coho salmon populations.

Implement the Strategic Action Plans to protect and restore ecosystem processes and functions and coho salmon habitats. Activities should include restoring habitat capacity for rearing juvenile coho salmon by increasing large wood loading, beaver habitat, and wetland/off-channel connectivity, and by increasing native riparian vegetation to provide bank stability and shade stream reaches during warm summer months.

Improve floodplain connectivity by increasing beaver abundance and reducing or limiting development of channel confining structures, including roads and infrastructure.

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[1]David J. Lewis, D.J. S.J. Dundas, D.M. Kling, D.K. Lew, and S. Hacker. The non-market benefits of early and partial gains in managing threatened salmon

[2] The research underlying the figures in Table 1 focused on southern Utah, which has ecological and economic characteristics similar to those of eastern Oregon and, hence, it is reasonable to anticipate that restoring healthy beaver populations across this region would yield similar benefits. Many of the benefits would be even greater in western Oregon, in part because this region has a higher density of humans who would enjoy the benefits.

[3] Buckley, M.T., T. Soulhas, E. Niemi, E. Warren, and S. Reich. 2011. The economic value of beaver ecosystem services.

[4] Bair, B. 2004. *Stream Restoration Cost Estimates*. US Department of Agriculture, Forest Service. Gifford-Pinchot National Forest

[5] Brouwer, R., I. Langford, I. Bateman, R. Turner. 1999. “A Meta-analysis of Wetland Contingent Valuation Studies.” *Regional Environmental Change*. 1(1):47-57.

[6] University of California, Davis. 2014. California: drought and jobs.

[7] Adapted from Loomis, J, P. Kent, L. Strange, and others. 2000. Measuring the total economic value of restoring ecosystem services in an impaired river basin: results from a contingent value survey.

[8] Weber, M.A. 2015. Navigating benefit transfer for salmon improvements in the Western US

[9] Consumer surplus is the difference between what one is willing to pay for something and the amount one actually pays. If the amounts that one is willing to pay and actually pays are the same, there is no consumer surplus. If the amount that one is willing to pay for something is greater than what one actually pays, then there is a consumer surplus. Consumer surplus varies from person to person for the same item and, hence, economists measure it using carefully designed surveys. Consumer surplus is especially important because it represents an increase in economic well-being. Consider a person who has $100 cash and is willing to pay $70 for a recreational fishing trip. If they pay $70 for the trip, they have no consumer surplus—they’ve

traded $70 of the cash for a fishing trip worth $70. They still have $30 of cash, plus $70 worth of pleasure from the fishing trip, so their total well-being remains $100. But, if they can take the fishing trip paying only $20, then they get $70 worth of fishing pleasure by spending only $20 and enjoy a consumer surplus of $50. After the trip, they have $80 of cash plus $70 of fishing pleasure, and their total economic well-being is $150.

[10]Loomis, J. 2006. "Use of Survey Data to Estimate Economic Value and Regional Economic Effects of Fishery Improvements." *North American Journal of Fisheries Management*.

[11]Bureau of Reclamation (Reclamation). 2008. *Economics Technical Report for the Yakima River Basin: A Component of Yakima River Basin Water Storage Feasibility Study, Washington.* Technical Series No. TS-YSS-23.

[12] Anderson, D. and M. Scott. 1993. *Valuing the Salmon Resource: Columbia River Stocks Under Climate Change and Fishery Enhancement.* April. Northwest Regional Economic Conference.

[13] Dean Runyan Associates 2009

[14]The Research Group. 2016. Oregon commercial fishing industry in 2015: Briefing report. With assistance from the Coastal Oregon Marine Experiment Station. http://www.dfw.state.or.us/agency/docs/OR%20Comm%20Fish%20Ec%20Impacts%20Brief%202015.pdf.

[15]Olsen, D., J. Richards, and R. Scott. 1991. "Existence and Sport Values for Doubling the Size of Columbia River Basin Salmon and Steelhead Runs." Rivers. 2(1):44-56; Loomis, J. 1996. "Measuring the Economic Benefits of Removing Dams and Restoring the Elwha River: Results of a Contingent Valuation Survey." *Water Resources Research*. 32(2):441-447. http://onlinelibrary.wiley.com/doi/10.1029/95WR03243/pdf; Bell, K., D. Huppert, and R. Johnson. 2003. "Willingness to Pay for Local Coho Salmon Enhancement in Coastal Communities." *Marine Resource Economics*. 18: 15-31. http://www.journals.uchicago.edu/doi/pdfplus/10.1086/mre.18.1.42629381; and ECONorthwest and ESA. 2012. Yakima River Basin Integrated Water Resource Management Plan: Four Accounts Analysis of the Integrated Plan.

[16]Oregon Office of Economic Analysis. 2015. *Oregon Economic and Revenue Forecast*. September http://www.oregon.gov/DAS/OEA/docs/economic/forecast0915.pdf.

[17]ECONorthwest and ESA. 2012. Yakima River Basin Integrated Water Resource Management Plan: Four Accounts Analysis of the Integrated Plan

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[19] Examples of peer review include Richardson, L., and J. Loomis. 2009. "The Total Economic Value of Threatened, Endangered and Rare Species: An Updated Meta-Analysis." *Ecological Economics*. 68: 1535-1548; Goodstein, E. and L. Matson. 2007. "Climate Change in the Pacific Northwest: Valuing Snowpack Loss for Agriculture and Salmon Frontiers." *Environmental Valuation and Policy.* Edward Elgar New York; and Niemi, E. 2009. *An Overview of Potential Economic Costs to Washington of a Business-As-Usual Approach to Climate Change*. University of Oregon, Climate Leadership Initiative. The last report included review by these members of an Economics' Steering Committee: Katie Baird, *U. of Washington, Tacoma,* William Barnes, *U. of Portland,* Randall A. Bluffstone, *Portland State U.,* Gardner Brown, *U. of Washington,* Trudy Ann Cameron, *U. of Oregon,* Janie Chermak, *U. of New Mexico,* Bonnie G. Colby, *U. of Arizona,*

Paul N. Courant, *U. of Michigan,* Peter Dorman, *Evergreen State College,* Kristine M. Grimsrud, *U. of New Mexico,* David Ervin, *Portland State U.,* Joel Hamilton, *U. of Idaho,* Hart Hodges, *Western Washington, U.* Daniel Huppert, *U. of Washington,* Don Negri, *Willamette U.,* Andrew Plantinga, *Oregon State U.,* Michael J. Scott, *PNW National Laboratory, and* W. Douglass Shaw, *Texas A&M U.*

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[22] Consumer surplus is the difference between what one is willing to pay for something and the amount one actually pays. If the amounts that one is willing to pay and actually pays are the same, there is no consumer surplus. If the amount that one is willing to pay for something is greater than what one actually pays, then there is a consumer surplus. Consumer surplus varies from person to person for the same item and, hence, economists measure it using carefully designed surveys. Consumer surplus is especially important because it represents an increase in economic well-being. Consider a person who has $100 cash and is willing to pay $70 for a recreational fishing trip. If they pay $70 for the trip, they have no consumer surplus—they've traded $70 of the cash for a fishing trip worth $70. They still have $30 of cash, plus $70 worth of pleasure from the fishing trip, so their total well-being remains $100. But, if they can take the fishing trip paying only $20, then they get $70 worth of fishing pleasure by spending only $20 and enjoy a consumer surplus of $50. After the trip, they have $80 of cash plus $70 of fishing pleasure, and their total economic well-being is $150.

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[48] NOAA and EPA letter to Jim Rue, director Oregon Department of Land Conservation (now Division of State Lands) and Dick Pederson, director of Oregon Department of Environmental Quality, July 28, 2015

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[50] NOAA and EPA letter to Jim Rue, director Oregon Department of Land Conservation (now Division of State Lands) and Dick Pederson, director of Oregon Department of Environmental Quality, July 28, 2015

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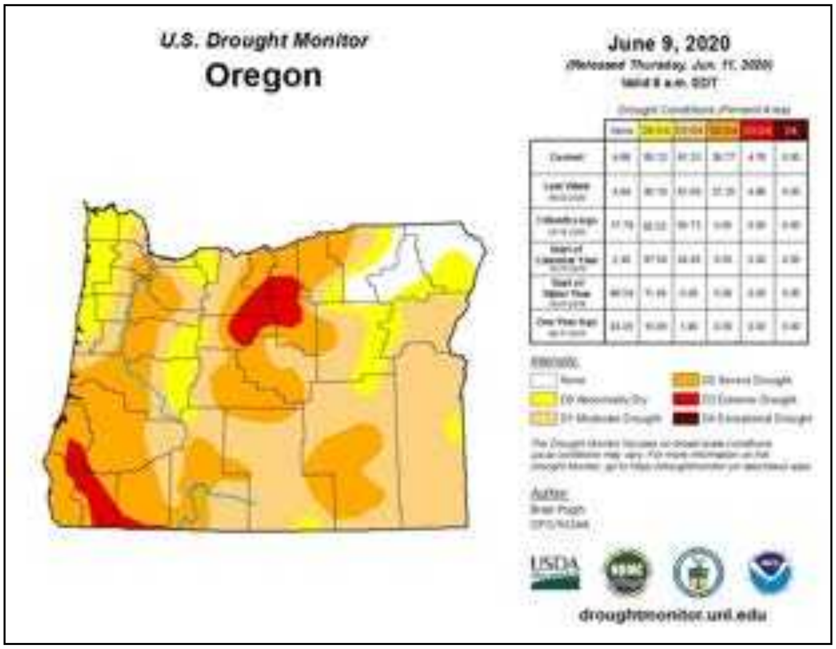
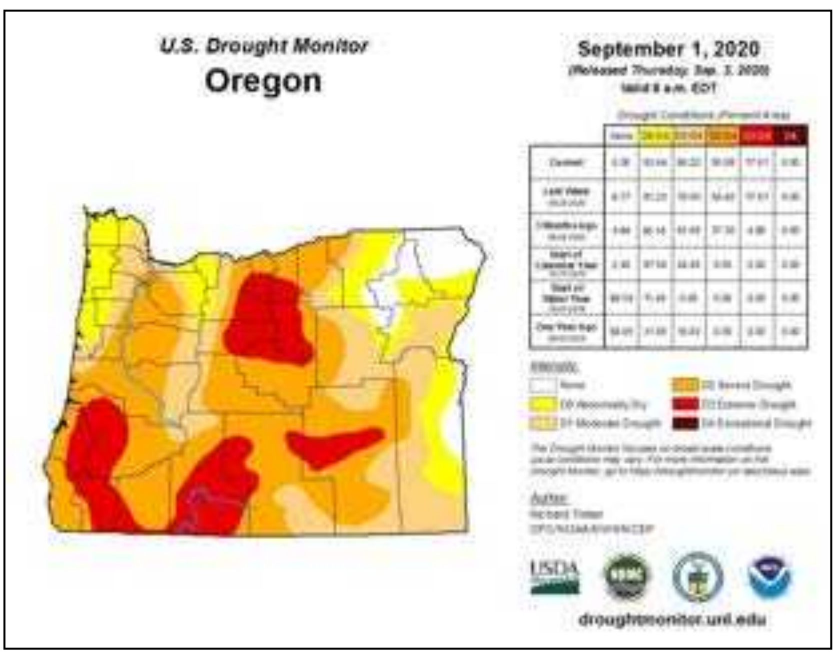
APPENDIX G

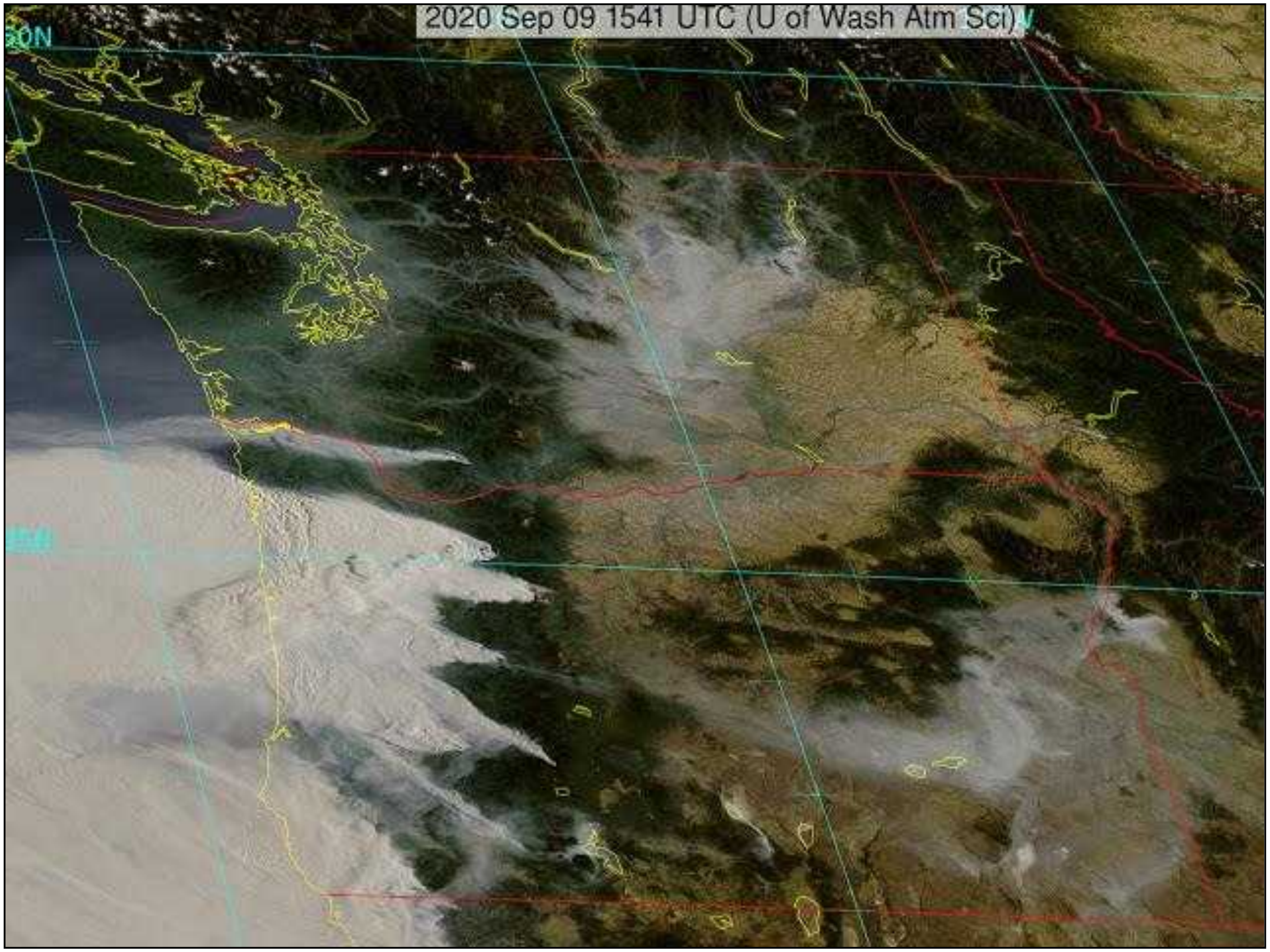
BEAVER CONTRIBUTIONS AND IMPORTANCE IN PHOTOS

June 9, 2020: 81% of the state in Moderate to Extreme Drought



September 1, 2020: 80% of the state in Moderate to Extreme Drought





September 9, 2020. This visible satellite image taken on September 9, 2020 shows huge, active fires involving hundreds of thousands of acres on the western slopes of the Oregon Cascades, with massive smoke plumes blowing to the west.

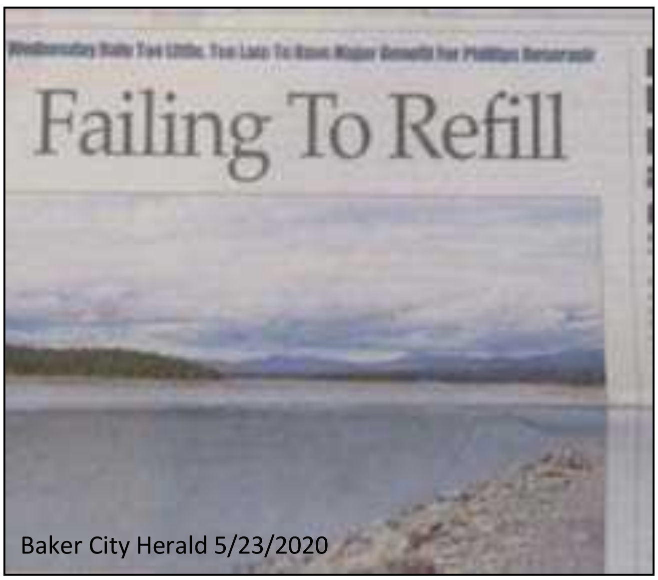
WATER AND WILDFIRE
Yearly issues of concern

Baker City Herald 5/30/2020

Summer of struggle: Fires and the virus

Harvest 2007

The year the rains never came



Failing To Refill

Baker City Herald 5/23/2020

5/29/2020

Capital Press

WILDFIRE DILEMMA

Changes ahead in how the West's forests are managed

6/2/2020

Klamath County farmers gather to protest water shutoff


EXPORTS: APPLES TO FLOW BETWEEN THE U.S. AND CHINA Page 7

Capital Press
The West's Ag Weekly

FRIDAY, MAY 29, 2015 ★ VOLUME 88, NUMBER 22 WWW.CAPITALPRESS.COM

NO WATER FOR NOW

5/29/2015

Fight over Clean Water Act rule enter[s] new phase

Political action likely, lawsuit possible, experts say

By MATEUSZ PERKOWSKI
Capital Press

The fight over the U.S. En[vironmental Protection Agen]cy's Clean Water Act rule [is] entering a new phase no[w] that the controversial regula[tion] has been finalized.

Opponents of the rule a[re] expected to galvanize poli[tic]al pressure against it an[d] potentially resort to litigati[on]


OUTDOORS, 1C

[B]aker City Herald

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Water Worries


SPORTS, 6A

Baker City Heral[d]

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Water Worries

Baker City Herald 7/17/2015

Biologists blame warm water for salmon deaths

■ State restricts fishing on many streams to protect native fish

By Jayson Jacoby
jjacoby@bakercityherald.com

State biologists say unusually warm water killed about 120 wild chinook salmon earlier this month on the Middle Fork of the John Day River about 50 miles southwest of Baker City.

This is the third summer in the past decade in which water temperatures in the Middle Fork rose to the mid-70s, fatally high for some salmon, said Brent Smith, a biologist at the Oregon Department of Fish and Wildlife's John Day office.

Biologists also blame warm water for chinook die-offs along the Middle Fork in 2007 and 2013, Smith said.

Cooler temperatures and heavy rain the past week have at least temporarily eased the threat to the salmon, he said.

See Fish / Page 8A

WILDFIRE SAFE ZONE
The Possibility of Survival

Beaver ponds provide an "emerald refuge" in a landscape burned by the Sharps Fire, Idaho. Photo: Joe Wheaton
https://www.sagegrouseinitiative.com/beavers-water-and-fire-a-new-formula-for-success/

WATER IN THE MIDST OF A SEVERE DROUGHT (2007)

Susie Creek, Elko County, NV

1991: Pre grazing management change and beaver activity

2007: Post grazing management change and beaver activity

TIME SCALE OF CHANGE < 16 years

TEMPORARY WATER STORAGE, CARBON CAPTURE AND STORE, AND HABITAT CONNECTIVITY

Maggie Creek, Elko County, Nevada. In 2012 MODERATE to SEVERE drought yet 28 miles of water-abundant landscape due to abundant beavers and continued good livestock management. Note lush vegetation in wetlands versus dry uplands.