



From Conflict to Coexistence: Strategies to Strengthen Human-Beaver Relations in Washington State

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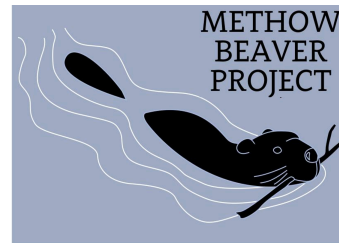
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Executive Summary

Recent legislative activity in Washington on beaver management presents a window to guide the development of a comprehensive management plan. This report investigates human-beaver interactions and human-wildlife coexistence strategies to inform the Washington Department of Fish and Wildlife's beaver management plan. Beavers provide integral ecosystem services, including riparian habitat restoration and wildfire mitigation.

WDFW's mission is to protect and perpetuate Washington's fish and wildlife, including beavers. Rising beaver populations and development across Washington can generate more human-beaver conflict and undermine beavers' ecosystem services. An effective beaver management plan should promote coexistence by minimizing human-beaver conflicts, maximizing ecosystem services, and prioritizing non-lethal methods.

The research team used a mixed methods analysis to review wildlife management practices in other states for data tracking and coexistence and semi-structured interviews with key stakeholders, including landowners, nonprofit organizations, and government agencies.

The team found inadequacies in current data collection practices on human-beaver interactions. However, WDFW can employ GIS tracking or cross-stakeholder collaborative efforts to examine conflict more comprehensively. Additionally, the team found that WDFW and nonprofit organizations provide some education and assistance on non-lethal coexistence strategies, but financial barriers and logistical complexities undermine their adoption. Strategies to strengthen beaver coexistence include releasing best management practices, implementing cost-share programs, and creating market-based incentive structures.

Based on these findings, the team conducted a policy analysis to determine the most feasible beaver management strategy for Washington. It compared five policy options—business as usual, public education, research investments, grant expansions, and market-based financial incentives—against five evaluative criteria—implementation complexity, environmental impact, public acceptance, cost, and distributional impacts. The analysis revealed a tradeoff in beaver management efficacy from limited public awareness about non-lethal strategies and fragmented data.

Therefore, WDFW should more fully educate the public and translate the benefits of beavers into terms Washingtonians care about, such as their impact on Washington's salmon population. WDFW should also prioritize investment into the resources, research, and infrastructure needed to gather beaver data and track human-beaver conflict to inform better evidence-based decision-making. This approach will improve stakeholder buy-in and data tracking in the short term and enable more effective financial incentive programs in the long term.

Table of Abbreviations

AFF	American Forest Foundation
ANR	Vermont Agency of Natural Resources
APHIS	USDA Animal and Plant Health Inspection Service
BLM	United States Bureau of Land Management
BRAT	Utah State University's Beaver Restoration Assessment Tool
CDFW	California Department of Fish & Wildlife
DNR	Washington Department of Natural Resources
"Ecology"	Washington Department of Ecology
FSA	USDA Farm Service Agency
FWP	Montana Fish, Wildlife, & Parks Department
GIS	Geographic Information System
HBCF	Human-Beaver Coexistence Fund
MBP	Methow Beaver Project
ODFW	Oregon Department of Fish & Wildlife
UDWR	Utah Division of Wildlife Resources
USDA	United States Department of Agriculture
USFWS	United States Fish and Wildlife Service
VFWD	Vermont Fish and Wildlife Department
WCO(s)	Wildlife Control Operator(s)
WDFW	Washington Department of Fish & Wildlife
WIR	California Wildlife Incident Reporting System
WPP	Washington Wetland Program Plan

Introduction

Client Overview: Methow Beaver Project

The Methow Beaver Project (MBP) is a non-profit organization based in Washington. MBP educates the public about beaver ecosystem benefits, promotes beaver coexistence, and provides beaver relocation services. Additionally, it executes beaver-based restoration strategies to improve the health and resilience of the Methow and Okanogan River watersheds in the Upper Columbia River basin of eastern Washington. MBP aims to create highly functioning watersheds that support the needs of people and the environment. The organization works with various funding, collaborative, and academic partners to promote restoration, coexistence, and sustainability within its community and the larger Washington ecosystem (MBP, 2024).

Project Importance

Once an abundant species in North America, beavers create complex riparian systems with rich biodiversity. Beaver populations significantly declined in the western U.S. due to over-trapping and hunting. Further, land use and infrastructure development decimated riparian habitats and increased lethal human-beaver interactions. Recent beaver restoration efforts and growing awareness about beavers' ecosystem benefits are changing Washingtonians' views on beavers from public nuisance to economic and environmental assets.

In January 2024, five state Senators introduced legislation that, if passed, would mandate the Washington Department of Fish and Wildlife (WDFW) to create and implement a beaver management plan (Washington SB5846 | 2023-2024 | Regular Session, n.d.). Likewise, MBP informed the team that WDFW may hire a consultant to work on the management plan, indicating a willingness to address the department's current practices. This momentum presents an opportunity to analyze current beaver management strategies and inform a coexistence-oriented management plan.

Research Objective and Questions

This research seeks to identify strategies to encourage human-beaver coexistence. Human-beaver coexistence allows beavers to remain in their habitats and provide ecosystem benefits without overly compromising the needs of landowners and other key stakeholders.

This report builds on previous research that found WDFW's beaver management was decentralized across multiple time- and resource-constrained departments (Windley et al., 2023). Accordingly, a sound beaver management plan includes comprehensive strategies to improve data collection and incentivize coexistence.

To understand the management strategies that will encourage human-beaver coexistence in Washington, this report answers the five following research questions:

1. *How is human-beaver conflict tracked and reported statewide, and what other tracking strategies exist?*
2. *What coexistence strategies exist, and how do they intend to reduce human-species conflict?*
3. *What regional differences will WDFW need to account for when encouraging human-beaver coexistence?*
4. *What stakeholder needs will WDFW need to account for when encouraging human-beaver coexistence?*
5. *How can WDFW strengthen conflict tracking and human-beaver coexistence incentives within its future beaver management plan?*

The report begins with background on beaver habitats and their ecosystem benefits, the nature of human-beaver conflict, and the current state of beaver management in Washington. Next, the team overviews the research methodology, including a mixed methods approach and policy analysis. Then, the team discusses findings for two critical areas: tracking human-beaver interactions and incentivizing human-beaver coexistence. Based on these findings, the team proposes five policy alternatives and weighs them against evaluative criteria. After a tradeoff analysis of the proposed options, the team makes a final recommendation to WDFW.

Background

North American beavers (*Castor canadensis*) are semi-aquatic rodents known for dramatically changing the flow of small streams by building dams and creating deep water and floodplain wetlands. They inhabit an array of ecosystems from Mexico to Alaska. While beavers can inhabit various habitats, they usually prefer slow-moving streams, ponds, and lakes near wooded areas, allowing them to build dams near stable sources of food (Smithsonian's National Zoo and Conservation Biology Institute, n.d.).

Historically, consumers prized beaver pelts for clothing and textiles. However, demand for beaver pelt-based clothing declined, and beaver populations recovered, increasing their distribution across North America.

Ecosystem Benefits of Beaver Habitats

Beavers provide integral services to the ecosystem. Beaver dams slow water movement through streams, creating new riparian habitats for semi-aquatic and aquatic vegetation, fish, mammals, and amphibians (Pollock et al., n.d.). Approximately 85% of Washington's terrestrial vertebrate wildlife species depend on riparian habitats for all or critical portions of their life spans (Cramer, 2012). Beavers improve water quality downstream and around the immediate area for these species by creating riparian habitats. Riparian habitats with aquatic vegetation also slow water moving through streams, decreasing erosion and increasing resilience to flooding and drought.

Furthermore, beaver dams provide upstream benefits as the ponds they create store water, replenish groundwater and aquifers, recharge nearby habitats with essential nutrients, and sustain complex ecosystems.

Economic Benefits of Beaver Habitats

Riparian habitats appeal to the public for recreational purposes, and beavers can help support these habitats. Economic studies estimate Washington's environment generates between \$216 billion and \$264 billion in benefits from water quality, biodiversity, and other environmental benefits each year (Mojica & Fletcher, 2020). Further, nearly 75% of the Americans' outdoor recreation—including walking, hiking, fishing, and wildlife viewing—occurs within a one-quarter mile of streams and other bodies of water in riparian habitats (United States Department of Agriculture [USDA] Forest Service, 2008). In Washington specifically, lands available for outdoor recreation directly contribute \$26.5 billion to Washington state's economy from activities such as camping, hiking, and fishing (Mojica & Fletcher, 2020). As beavers contribute to restoring riparian habitats, they create new venues for outdoor recreation and increase non-market environmental benefits for humans and other wildlife.

It is in Washington's best interest to protect riparian habitats and their beaver caretakers. However, human destruction of riparian habitats limits beavers' ecosystem services. Estimates suggest Washington lost between one-half and two-thirds of its two million acres of riparian habitats (Knutson & Naef, 1997). Restoration of these habitats costs the state and its taxpayers between \$50,000 and \$100,000 per acre. Since beavers create riparian habitats, they offer a low-cost, nature-based solution to protecting thriving riparian habitats and reversing decades of habitat loss.

Beavers and Climate Change

Anthropogenic climate change threatens Washington's historically moderate climate and poses new challenges to protecting the state's landscape, communities, and beaver populations. Warmer temperatures will likely increase beaver populations, allowing them to improve their influence on riparian habitats (Dewey et al., 2022).

Beavers may at least partially mitigate climate challenges, especially if human-beaver conflict decreases. Beaver-altered wetlands and floodplains can reduce the impacts of natural disasters. These altered habitats increase drought resilience, serve as wildlife breaks, and reduce flood risk from ice melt and stormwater runoff events (Corday, 2022).

However, the impacts of increased extreme weather can damage beaver habitats and human infrastructure. For instance, Washington's 74,000 miles of streams and waterways endure intense rainfall. This rain can destroy beaver dams, flood any property nearby, and exacerbate human-beaver conflict. Therefore, WDFW should consider the Pacific Northwest's changing climate when designing a beaver management plan.

Beaver Conflict in Washington

While beavers offer significant ecological benefits, their dam-building instincts can damage property, recreational areas, and farmland. This discrepancy, driven by environmental, economic, and social factors, fuels complex human-beaver conflict throughout Washington.

Such conflicts do not occur uniformly across the state. The cultural, economic, and environmental differences between Washington's regions require the WDFW to adapt beaver management practices to the needs of a particular area. Over the last century, economic development in Washington varied across the eastern and western portions of the state, divided by the Cascade Mountains. Regional differences in infrastructure, climate, economic activity, and population density shape the unique challenges of human-beaver conflict.

Western Washington is primarily urban and is home to 78% of the state's population (Kruger et al., 2021). This area is susceptible to human-beaver conflict between residential and commercial landowners. While most assume rural areas are a concentration for human-beaver interactions, Washington's largest city, Seattle, is home to at least twelve beaver colonies. One journalist writing on beaver colonies in Seattle described the city as "chock full of beavers" (Engelson, 2021). Washington's urban area provides a non-contiguous habitat for beavers. As such, beavers are more likely to encounter human-built barriers when migrating between lands.

Unlike western Washington, eastern Washington is shaped by the 1,200-mile-long Columbia River and its tributaries. This water system supports agriculture, salmon spawning, nutrient cycling, and hydroelectric power generation. Beaver management in eastern Washington must consider habitats ranging from deserts, old-growth forests, rivers, shrub steps, and mountainous areas. Eastern Washington is primarily rural and agricultural, so landowners who depend on their land for their livelihoods may experience human-beaver conflict differently than urban residents. Therefore, human-beaver conflict can impact economic productivity and landowners' revenues.

Beaver Management in Washington

WDFW is responsible for managing beavers. WDFW's legislative mandate directs the agency to preserve and protect the state's fish and wildlife ecosystems while providing recreational and commercial opportunities (WDFW, 2024). WDFW (2015a) prioritizes beaver restoration to protect ponds and habitats with the greatest conservation need. However, beavers are legally classified as furbearers, or game animals, which impacts their management, especially for trapping permits (WAC 220-400-020, n.d.). WDFW allows property owners to use four strategies when encountering a beaver: tolerance, live removal, lethal removal, or harvest. WDFW (2024b) strongly recommends that landowners tolerate beaver activity when possible. The current game management plan (WDFW, 2015b) outlines three alternatives when tolerance is not an option:

1. **Trapping:** Washingtonians who wish to hunt or trap beavers must abide by trapping and seasonal regulations. Beaver trapping season occurs annually from November through March; hunters must acquire a trapping license and use specific traps to minimize harm to beavers. Licensed trappers must report their tracking activity online, noting the location and the number of animals trapped.
2. **Removal and Relocation:** WDFW certifies individuals, known as Wildlife Control Operators (WCOs), who act on behalf of WDFW to manage public complaints. WCOs assist landowners with managing wildlife on their property. However, landowners often kill nuisance beavers themselves or seek a licensed trapper.

After the Washington legislature recognized the benefits of beaver relocation, WDFW (2024c) now issues permits for live removals under a pilot project launched in 2019. WDFW intends to use this pilot to evaluate the relocation program and develop a rule to establish permit criteria (WDFW, 2024b).

3. **Dam Management:** WDFW only justifies beaver dam removals if there is an imminent threat to private or public land (WDFW, 2021). If the dams do not pose an imminent threat, they can be modified with water level control devices that maintain a desired water level. To remove or alter a beaver dam, individuals must have a Hydraulic Project Approval (HPA) permit issued by WDFW (WDFW, 2024c).

Key Stakeholders

A comprehensive species management plan impacts a diverse array of individuals, organizations, and agencies. WDFW must remain mindful of four key stakeholder groups as it develops a beaver management plan: government agencies, nonprofit organizations, commercial and residential landowners, and wildlife management personnel. Figure 1 below provides examples of each stakeholder group.

Government Entities	Nonprofits	Wildlife Management	Residential and Commercial Interests
<ul style="list-style-type: none"> • Responsible for implementing and enforcing beaver-related policies. • Examples include Washington Department of Fish and Wildlife, Washington's State Legislature, and USDA Animal Plant Health Inspection Service, and Tribal Governments. 	<ul style="list-style-type: none"> • Responsible for implementing beaver coexistence services, relocation services, and advocating for coexistence. • Examples include the Methow Beaver Project and Beavers Northwest. 	<ul style="list-style-type: none"> • Responsible for implementing beaver coexistence and relocation services. • Examples include Wildlife Control Operators, Trappers, Hunters, and Fisheries. 	<ul style="list-style-type: none"> • Responsible for maintaining private land and associated businesses. • Examples include residents, commercial landowners, timberland managers, foresters, and agriculturalists.

Figure 1: Key Stakeholders

Methodology

The research team used two primary methodologies to answer the five research questions: mixed methods analysis and classical policy analysis. The mixed methods analysis examines the technical, environmental, and behavioral components of species management. The classical policy analysis applies these components to comprehensive policy options to reveal strategic tradeoffs.

Mixed Methods Analysis

This research report utilized mixed-methods qualitative analysis to understand the core principles that drive wildlife management plans. First, the team examined qualitative data on beaver populations, habitats, trapping, and permitting for removals and relocations. Then, the team interviewed key stakeholders and analyzed beaver management practices in different states.

Illustrative Examples from Other States

In addition to reviewing data tracking, coexistence, and education tools developed by organizations, the team identified states with notable management practices for wildlife data collection and coexistence. Specifically, the team reviewed the program characteristics and tracking methods of state beaver management plans in Oregon, California, and Utah. Then, the team reviewed strategies for incentivizing coexistence in Montana, Vermont, and California.

Semi-structured and Written Interviews

The team conducted semi-structured and written interviews with critical stakeholders and extracted themes from their responses. The interviews targeted three stakeholder groups: government entities, nonprofits, and landowners. Seventeen individuals consented to the interviews; thirteen participated in a video conference call, and four provided written responses due to their limited availability. *For the complete list of interviewees, see Appendix A.*

The client supplied most initial interview contacts, but the team interviewed other interested parties by asking interviewees for additional contacts to interview for the report. For example, the team used this method to identify additional landowners to interview. The interviews employed a core set of questions with targeted variations for specific participant groups (i.e., landowners, nonprofit personnel, and government staff). Each interview included a lead interviewer and a note-taker. *For the complete list of interview questions, see Appendix B.*

After the interviews, the team created a spreadsheet organized by interviewee and thematic code. This structure enabled the team to analyze themes across interviewees and stakeholder groups. As such, the team wove these findings into this report's data tracking and coexistence sections.

Classical Policy Analysis

The team also applied the findings and interview themes in a classical policy analysis. This method entails consistently evaluating policy alternatives against a fixed set of evaluative criteria to determine a final recommendation. Accordingly, the team first identified a list of comprehensive strategies (i.e., alternatives) that Washington might use to enhance data collection and incentivize coexistence. The evaluated criteria are then applied to each alternative and displayed in a criteria-alternative matrix. This matrix enabled comparison between policy options to determine the most effective approach and reveal tradeoffs. Although the team solicited high-level feedback from the MBP on these comprehensive strategies and evaluative criteria, the MBP did not direct the team's analysis and final recommendations.

Findings: Tracking Human-Beaver Conflict

WDFW must locate human-beaver conflict to understand and address it effectively. Currently, no comprehensive statewide data reporting and tracking mechanism exists on beaver habitats and population numbers. WDFW must incorporate data reporting and collection into a statewide beaver management plan to better target areas that experience more human-beaver conflict.

The following section identifies current conflict-tracking practices in Washington. Then, it reviews potential data collection strategies to track and anticipate human-beaver conflict. Lastly, it analyzes findings from data reporting strategies, other state data collection techniques, and stakeholder input.

Current Beaver Data Collection and Conflict Tracking

A wildlife management plan needs complete and reliable information on a species' population size, habitats, and threats to its survival and protection. WDFW found that beaver restoration likely increased beaver populations, but data on beaver abundance and distribution are limited at the state and regional levels (Burgher et al., 2023). Historically, lethal harvest data and aerial surveys have been a proxy for beaver population estimation. However, these techniques can be flawed due to beavers abandoning habitats or not engaging in behaviors found in aerial surveys, like damming (Burgher et al., 2023). Nearly every interviewee agreed that Washington conducts minimal tracking of the beaver population.

Further, previous beaver-related restoration studies are limited in geographic scope; they do not examine the long-term effects of restoration on beaver populations, which may undermine the objectives and outcomes of beaver restoration efforts (Burgher et al., 2023). This limitation highlights the importance of beaver demographic and geographic data for decision-making and informing coexistence efforts. For instance, one interviewee stated that WDFW is considering changes to beaver removal and trapping practices; however, it does not have the data to make an evidence-based decision. Specifically, the department could benefit from an occupational study to

understand current beaver habitation and translational research on Washington beavers' effect on critical issues like salmon populations, riparian zones, and fire resilience (Interview 8). Additionally, data helps demonstrate coexistence's benefits in mitigating climate change and increasing biodiversity. This data can help sway landowners to choose to coexist with beavers instead of lethal or live removal.

Despite these pervasive data gaps, Washington state agencies hold some data on beaver removals and relocations. Washington state law requires the WDFW to publicly report beaver trapping and relocations (RCW 77.36.160: Request for Relocating Beaver., n.d.). The dataset relies on WCOs, trappers, and permitted beaver relocators to submit annual reports on beaver relocation and takings. Interviewees reinforced this finding, stating that state agencies track conflict, and nonprofits participating directly in conflict resolution track data on those cases; also, Washington surveys WCOs and other trackers about their annual beaver tracking (Interviews 3, 12, & 16). Figure 2 shows that reported beaver removals decreased in Washington by almost 30% between 2016 and 2022 (WDFW, 2023b). The data also reveals that beaver relocations represent a small share of the total reported beaver removals in the state. Additionally, relocations have also decreased by 83% between 2016 and 2022. The statistics suggest that WDFW could do more to raise awareness of non-lethal beaver relocations as an option for landowners and other stakeholders.

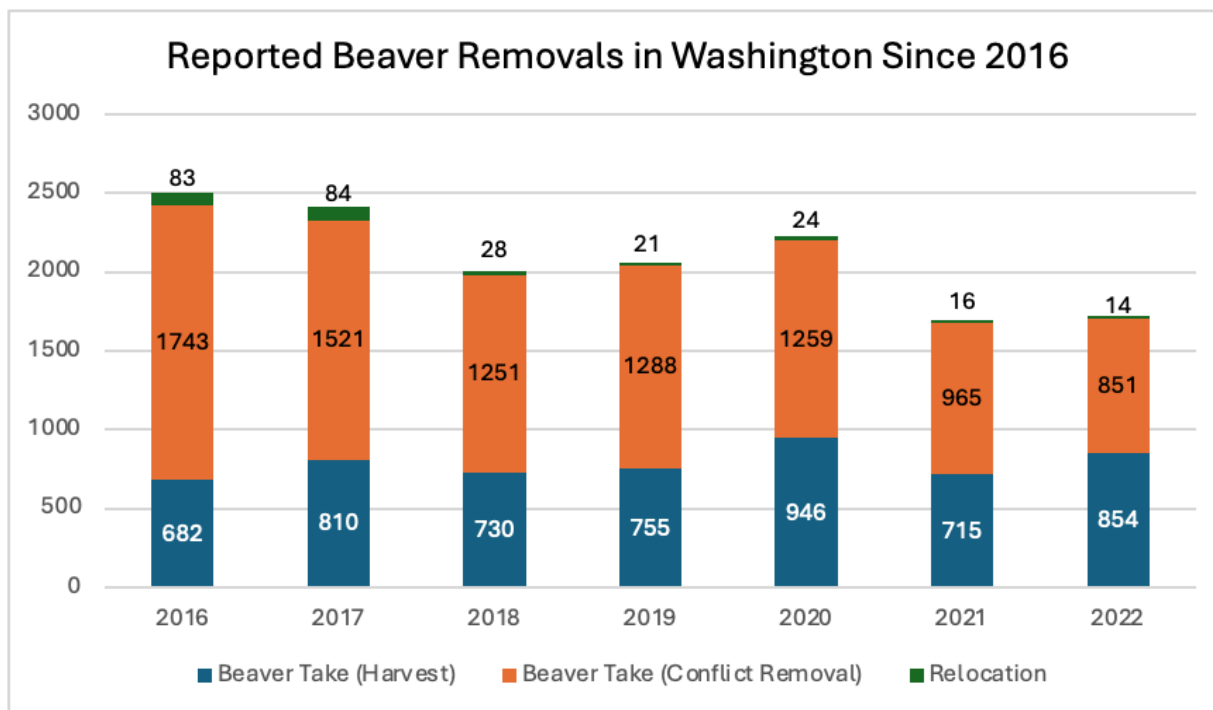


Figure 2: Reported Beaver Removals in Washington Since 2016 (WDFW, 2023b)

However, the data must be interpreted cautiously as WDFW does not receive reports on all beaver removals. Land managers do not need a permit to trap or lethally remove beavers that threaten humans or damage property. For example, forest owners

may lethally remove beavers that destroy trees essential to their business, and agriculturalists may remove beavers that flood farmland and destroy crops.

Further, multiple stakeholders suggested that data is likely underreported due to unofficial lethal removal, as landowners can self-identify when they view a beaver on their property as a nuisance and lethally remove it without a permit (Interviews 5 & 12). Therefore, the state of beaver conflict is not accurately reflected in WDFW's database because beaver trapping permits are not universally required or enforced, and lethal removal is underreported. This gap also limits the ability to measure the effectiveness of beaver coexistence efforts because of the missing data from vital stakeholders.

In addition to beaver conflict on private land, beavers can disrupt public transportation infrastructure. For example, beavers can burrow under roads, cause sinking issues, plug culverts, and flood roads. Further, the interviews with county and state public works officials revealed no beaver-specific data tracking for public transportation entities at either level (Interviews 3 & 4). Although state and local transportation agencies monitor some conflict-prone areas, there is no official statewide mechanism to track all bridges, roads, and waterways at risk from beaver activity. This disconnected approach undermines state agencies' ability to proactively avoid damage to transportation infrastructure, thus increasing the risk of unnecessary damage costs and undermining public safety statewide.

Strategies to Collect Data and Track Human-Beaver Conflict

This section reviews strategies for tracking wildlife activity and their applications to species management plans, including GIS mapping, cross-stakeholder data, and tactics used in other states.

Comprehensive GIS Mapping

A Geographic Information System (GIS) is an automated system that can spatially manage and analyze geographic information. GIS can map location, density, and quantities of things and find patterns and what is near something of interest. For instance, the USDA Farm Service Agency (FSA) uses GIS to measure land characteristics, empower landowners to make sensible management decisions for their land, and streamline interactions with FSA staff (USDA, 2017). In Washington, GIS could assist in understanding where humans and beavers are having conflict and aid in making decisions on the best locations to prevent or resolve conflict.

WDFW (2018) currently uses GIS mapping through WDFW Open Data, a platform to share wildlife, hunting, and environmental data with the public in an accessible and interactive way. Unfortunately, the platform does not have comprehensive maps of beaver populations and conflicts. However, WDFW could adapt some of the coexistence strategies used for other species to track human-beaver interactions and regulations.

For example, the Washington State Fish Passage GIS map tracks the quantity and location of human-made barriers to fish passage across the state (WDFW, n.d.-a).

Additionally, WDFW (n.d.-b) operates SalmonScape, an interactive GIS map to help wildlife managers pinpoint opportunities for salmon protection and habitat restoration. The SalmonScape map operates most effectively by synthesizing data from state, federal, tribal, and local sources (WDFW, n.d.-b). Therefore, improved data tracking strategies for human-beaver interactions, especially integration of statewide and localized data, could reveal strategic pathways to minimize conflict, incentivize coexistence, and protect ecosystems. Further, the fish passage maps and SalmonScape demonstrate that, with improved data collection, WDFW can integrate beavers into their existing GIS mapping tools.

Cross-stakeholder Data

In addition to WDFW-managed GIS mapping, WDFW could compile human-beaver data from other key stakeholders. The Washington Department of Ecology (hereafter referred to as “Ecology”) recently conducted a statewide survey to understand the state of wetland mapping and identify data gaps (Ecology, n.d.). The Washington State Department of Natural Resources (DNR) (n.d.) created an interactive map, WatershedConnect, to support their salmon recovery and restoration efforts with partners statewide. DNR anticipates this tool will help secure new funding by better identifying project-level needs, motivating new partners to join restoration, and helping the public visualize the benefits of salmon restoration projects. Given beavers’ critical role in wetland habitat creation, WDFW should adopt other agencies’ wetland mapping methods toward beaver management or collaborate with agencies to supplement mapping the distribution and population density of beavers across the state.

Lastly, nonprofit organizations, such as Beavers Northwest, have filled in data collection and sharing roles. They have a “Find your Neighborhood Beaver” visual map of active beaver colonies in Seattle (Beavers Northwest, 2024). The data collected from nonprofits like Beavers Northwest represents an opportunity to consolidate data from various sources to provide a more comprehensive understanding of beaver populations in Washington.

Lessons from Other States: Oregon, California, and Utah

Oregon

Recently, the Oregon Department of Fish and Wildlife (ODFW) commissioned a Beaver Management Working Group—consisting of researchers, government officials, hunters, farmers, and trappers—to make recommendations for improving beaver management in Oregon (Damon & Meysohn, 2022). The group recognized a need for improved data collection to inform beaver coexistence activities. Additionally, the group championed collaborative data collection because ODFW’s resource constraints limited its internal capacity. WDFW also faces this challenge, underscoring the shared responsibility of all stakeholders in improving beaver data tracking.

The Oregon working group recommended improved harvest reporting cards to survey trappings and track wildlife population changes (see Figure 3). Harvest reporting

cards typically require the hunter or trapper’s identification, the harvested species’ names, and the number of animals harvested. The Oregon working group recommended that ODFW use more precise geographic data (e.g., GPS coordinates or local address data), specify habitat type, collect land ownership information from the harvesting site, and examine beavers physically to better estimate the age range and male-to-female ratios of beavers in the area (Damon & Meysohn, 2022).

Standard Survey Worksheet: Some surveys will not include all questions; other surveys will ask additional questions. This sheet is intended to help you answer questions when you report. Reports turned in on this form will not be accepted.

Question (yes/no or numeric answers)	Buck Deer (100 Series)	Antlerless Deer (600 Series)	Elk	Pronghorn Antelope	Bear	Cougar	Turkey
Hunter/Angler ID# _____							
Did you hunt?							
How many total days did you hunt?							
In which Unit did you hunt most? (two digit Unit number)							
How many total days did you hunt in this Unit?							
Did you mentor one or more youth during this hunt?							
How many youth did you mentor during this hunt?							
How many days did you mentor youth during this hunt?							
Did a mentored youth shoot the animal?							
Did you kill an animal?							
Was it male or female?	M / F	M / F	M / F	M / F	M / F	M / F	M / F
How many antler points on the side with the most points?				-----	-----	-----	-----
Was it a black-tailed, white-tailed, or mule deer?	BT / WT / MD	BT / WT / MD	-----	-----	-----	-----	-----
In which Unit did you take your animal? (two digit Unit number)							
How many days did you hunt in the unit the animal was taken?							

Figure 3: Sample Harvest Survey, Oregon.

Note: this sample card helps individuals report harvests on Oregon’s online interface.

Furthermore, the working group recommended improved beaver habitat monitoring. For example, they recommended that ODFW survey streams and habitats to document suitable beaver habitats and activities using a standardized protocol. Additionally, the working group recommended that ODFW overcome resource

constraints by working with universities and other interested organizations to help survey beaver ecosystems.

Lastly, the working group advised ODFW to assess beaver populations' impacts on federally managed public lands where beaver trapping and hunting are prohibited to inform similar restrictions on other lands (Damon & Meysohn, 2022).

Based on the working group's findings, ODFW (2023) released a three-year action plan for beaver-modified landscapes. The plan emphasizes data and science heavily. Specifically, ODFW (2023) plans to gather all existing beaver data into one location, assess the data quality, and explore ways to standardize future data collection. ODFW (2023) also plans to conduct field surveys to assess beaver activity and habitats, providing a baseline for evaluating other beaver coexistence strategies. Further, ODFW (2023) will develop a standardized protocol for identifying beaver-hospitable environments to improve data reliability.

ODFW's plan channels these newfound data collection strategies into its beaver management techniques. For example, ODFW will add new reporting requirements to beaver harvest data. Although the plan does not specify the reporting requirements ODFW intends to add to harvest reporting cards, it references the state's administrative code as the source for the additional required data fields (ODFW, 2023). According to the referenced administrative code, information will include the location of the harvest, land ownership of the harvest site, reasons for harvest, and the environmental features of the harvest site (Oregon State Archives, n.d.).

California

California's approach to human-wildlife tracking engages the public directly. The California Department of Fish and Wildlife (CDFW) (2024a) uses an online reporting system called the Wildlife Incident Reporting (WIR) system to allow residents to report incidents with wild animals. After a resident submits a WIR report, CDFW assigns a wildlife biologist or officer to investigate the report (2024a).

As seen in Figure 4, residents may receive a response from CDFW about the incident or report it for statistical purposes only. Residents may also request supplemental information about the species they encountered. Additionally, all incident reports include an option to specify the location of the incident, further improving CDFW's dataset.

CDFW can use the data from WIR to identify areas prone to beaver conflict. Figures 5 and 6 illustrate how CDFW tracks the quantity and location of human-beaver incidents. Other species tracked include black bears, bobcats, coyotes, foxes, mountain lions, mule deer, raccoons, squirrels, and wild turkeys.

Tell us what you saw:

Date Incident Occurred:

What species are you reporting?

Please select the option which best describes what you are reporting:

I saw a wild animal...
 ...and feels threatened by its presence, for self or others, or made human contact
 ...I want to report for statistical purposes only. Does not require a CDFW response.

There is/are wild animals on or around my property...
 ...that I would consider pests and I would like more information.
 ...that is/are disturbing my garbage, causing noise or creating some other type of disturbance
 ...that is/are molesting/killing my pets/livestock, and/or causing property damage (e.g. depredation)

Ear Tag # (if observed):

Please select the location where the incident occurred:

To focus the map near the incident location, either:

Select a county:

or

Enter an Address (ex: "123 My Street, My Town and/or My Zip") then click Enter:

Figure 4. California Wildlife Incident Reporting System (CDFW, 2024b)

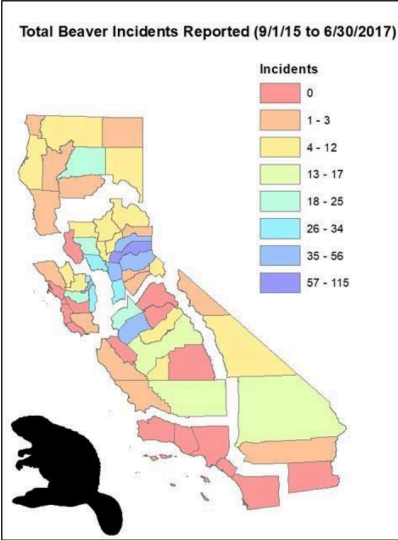


Figure 5: Total Human-Beaver Incidents by County in California (CDFW, 2019)

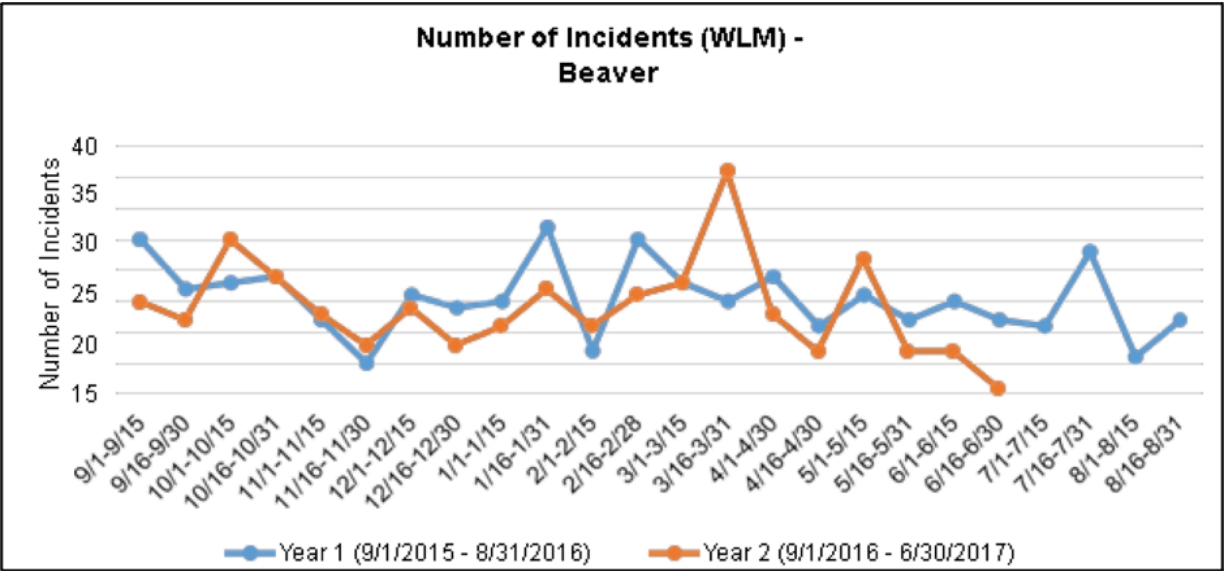


Figure 6: Total Human-Beaver incidents in California from 2015-2017 (CDFW, 2019)

Utah

The Utah Division of Wildlife Resources (UDWR) developed a beaver management plan with several key stakeholder groups, including the Utah Farm Bureau, Utah Trappers Association, and the Utah Cattleman's Association (Baker et al., 2017). This beaver management plan seeks to mitigate beaver damage by leveraging non-lethal coexistence options (Baker et al., 2017).

UDWR prioritized improving beaver-conflict data collection to better understand the scope of beaver damage complaints across the state. For example, the plan recommends UDWR implement a database to track beaver conflict using GPS locations, including on beaver nuisance compliant forms. Accordingly, UDWR committed to developing a centralized beaver conflict reporting form to track and map nuisance and damage complaints across the state.

In addition, UDWR will pair the conflict reporting with data from Utah State University's Beaver Restoration Assessment Tool (BRAT). BRAT helps identify areas where beavers can provide ecosystem services and restore riparian regions. According to the BRAT website (n.d.), the tool uses publicly available data to identify areas that best support beaver damming.

According to Utah's beaver management plan, UDWR will leverage BRAT data to identify areas that could benefit environmentally from beavers. The plan first encourages nuisance beaver relocation to areas BRAT identifies as ecologically beneficial. In addition, UDWR will use BRAT to avoid unsuitable areas for beavers. Therefore, BRAT enhances beaver survivability through relocation.

Key Takeaways: Tracking Human-Beaver Interactions

Overall, WDFW's current data collection practices and strategies in other states revealed the following:

- Currently, no comprehensive statewide data reporting and tracking mechanism for beaver conflict exists.
- Existing data on habitats, population numbers, relocations, and lethal removals by WCOs and private landowners is either missing or inconsistent.
- State agencies can use Geographic Information Systems (GIS) for species management, restoration, and protection. GIS analyzes spatial data and patterns and can be a centralized decision-making tool to reduce human-wildlife conflict.
- Other states track human-wildlife conflict through damage incident reporting systems, nuisance complaint forms, and mapping tools.

Findings: Encouraging Coexistence

A beaver management plan with sound data collection practices can also incentivize coexistence between humans and beavers. Further, human-beaver coexistence is a cost-effective strategy to mitigate climate-crisis-related impacts, including lowering stream temperatures, storing water, and creating fire-resistant areas (Animal Welfare Institute, n.d.). Therefore, beaver coexistence, if appropriately managed, is an investment to prevent costly climate challenges in the future.

The following section overviews current WDFW management guidance regarding coexisting with beavers and the critical stakeholders responsible for installing coexistence tools. Next, it reviews potential new strategies to encourage coexistence, drawing from stakeholder feedback and existing efforts by other agencies and states. These findings will inform the proposed and analyzed policy alternatives for WDFW to implement to encourage coexistence.

Current Coexistence Policies in Washington

WDFW provides some education and guidance online on general tools for coexistence and mitigating conflict. Human-beaver conflict typically arises from two beaver behaviors: tree felling and dam building. Tree protection is the preferred method of controlling beavers' tree felling behavior, and flow devices are used to mitigate the negative impacts of damming (Shockey et al., 2022).

Beavers are most likely to harvest trees closest to a water body, up to 100 meters from the water source. Beavers primarily prefer cottonwood, aspen, and willow trees, but they will target a variety of trees and shrubs. This tree-cutting behavior can cause conflict with landowners and managers invested in protecting specific trees for their economic or environmental value. Tree fencing is a simple and effective coexistence

strategy to mitigate this behavior because it deters chewing. This technique consists of surrounding trees with a cylindrical wire mesh structure about one to two feet wider than the tree extending three to four feet above the ground (Pollock et al., n.d.).

WDFW currently provides education for pond levelers and exclusion fencing. Exclusion fencing is a proactive coexistence strategy for critical narrow waterways such as culverts. The fencing is typically a trapezoidal wire fencing structure that physically prevents beavers from accessing the passageway to dam it. The device also keeps beavers away from the fast-running water associated with these narrow waterways, decreasing the cues that trigger beavers' dam-building behavior (Shockey et al., 2022).

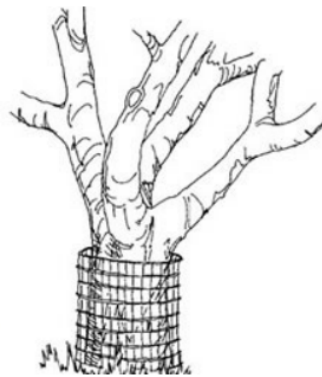


Figure 7. Tree Fencing Illustration (WDFW, 2024c)

Pond levelers are flow devices that function like the overflow drain in a bathtub. They control the maximum water height of a beaver pond to mitigate conflict caused by flooding while providing little disruption to a beaver or existing dam. The main structure of a leveler is a pipe beginning with a caged intake, running over the dam, and outputting on the dam's downstream side. If properly maintained, the device lasts five to ten years as built or longer (Shockey et al., 2022).

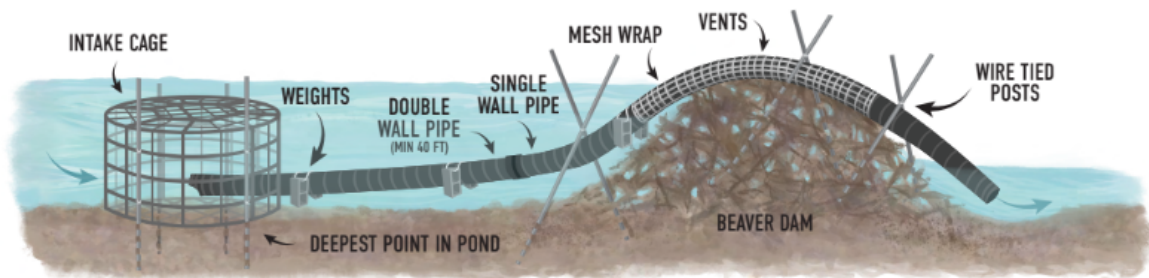


Figure 8: Pond Leveler Illustration (Shockey et al., 2022)

Interviews with stakeholders revealed that all involved parties are increasingly aware and supportive of beaver coexistence, but high administrative and financial costs undermine the adoption of these strategies. Although some landowners with beavers residing on property reported awareness and appreciation for beaver ecosystem

services (interviews 1, 7, 14), the generally higher cost of coexistence-oriented solutions compared to removal remains a significant deciding factor for them (Interviews 3, 5, 6, 7, 9, 14, 16).

The USDA Animal and Plant Health Inspection Service (APHIS) State Director for Washington noted that landowners experiencing conflict prefer not to remove beavers but want the damage to stop; however, the permit for flow devices can take nearly half a year (Interview 12). Streamlining the permit process for flow devices and culvert protectors could increase the adoption of coexistence measures (Interview 17). For example, tribal groups can bypass specific regional permitting processes due to their tribal resolution, providing more flexibility and quicker mitigation (Interview 13). WCOs identified that landowners often seek assistance reactively, not proactively, and the longer timeframes and high costs of coexistence alternatives corner landowners—and WCOs—into the lethal option (Interviews 2 & 11). Additionally, WCOs said landowners are often unwilling to pay more to implement coexistence tools or relocate a beaver, as they are more complex than lethal removals (Interviews 2 & 11). Therefore, current wildlife management practices are biased toward lethal removal because of financial and feasibility constraints.

Additionally, multiple state agencies are working to broaden landowner awareness about property management resources. For example, the Washington Department of Natural Resources (DNR) launched a portal to consolidate such resources for landowners in one location. However, there is no indication that coexistence resources are now part of this portal. The absence of these resources presents an opportunity for collaboration between WDFW and DNR to add resources for the WDFW-endorsed coexistence strategies to the portal resources. These resources may increase landowners' awareness and willingness to adopt coexistence (DNR, 2022).

Nonprofit Coexistence Efforts

Nonprofit organizations work to fill the gap between WDFW's guidance on coexistence strategies and their implementation. Specifically, they provide landowners and public employees with direct support and technical assistance. Beavers Northwest (2024b) helps to determine beaver-related risks to trees and assess the feasibility of a coexistence device on privately owned properties. Likewise, the Tulalip Tribes (2017) work to relocate beavers from land when coexistence is infeasible.

Furthermore, interviews revealed public officials' willingness for government agencies to collaborate with nonprofit organizations on beaver coexistence and relocation. The USDA APHIS State Director for Washington indicated that his department works closely with MBP and local tribes to guide beaver conflict resolution (Interview 12). A county-level public works director remarked that their department follows the lead of nonprofit partners to decide whether to pursue coexistence, relocation, or lethal removal in specific contexts (Interview 4). However, many land

managers are unaware of coexistence options and nonprofit resources, so they remove beavers lethally before intervention is possible (Interview 6).

Strategies to Mitigate Human-Beaver Conflict and Promote Coexistence

Aside from general guidance on tools that allow beavers and humans to coexist, multiple strategies exist to educate and incentivize coexistence, including cost-share funding and market-based benefit-sharing mechanisms.

Financial Assistance Incentives

The first approach leverages financial incentives, such as a cost-share grant program. Without such a program, landowners bear the costs of beaver conflict mitigation and coexistence investments, but the broader community benefits from beaver environmental services (Interviews 2, 7, 8, & 10). One popular suggestion was to focus coexistence efforts on financial benefits to land managers in beaver-prone areas, whether through education about the long-term economic benefits of beaver activity (Interviews 5, 12, 13, & 16) or additional financial incentives provided to land managers coexisting with beavers (Interviews 2, 6, 7, & 10).

The Beaver Institute, the only national beaver nonprofit, has a nationwide financial assistance program for private and public landowners experiencing beaver conflicts to solve conflict in a way that maximizes the benefits beavers provide to ecosystems. The BeaverCorps Grant Program incentivizes landowners to hire BeaverCorps professionals to resolve beaver issues nonlethally, thus increasing beaver wetlands that improve climate resilience. After a site visit and cost estimate, the landowner can apply for the grant program and receive a decision less than two weeks later. The grant program reimburses the landowner up to a third of the cost of installing the water control device or restoration project. Unfortunately, the grant excludes funding for the upkeep and maintenance of the project; however, the straightforward application process and quick approval time increase the chances that landowners will choose coexistence over lethal removal. Applications are accepted year-round with no geographic limitations, indicating that Washington residents can apply (The Beaver Institute, n.d.).

Additionally, the Human-Beaver Coexistence Fund (HBCF) (2024) is a Mid-Atlantic nonprofit organization that operates a cost-share program to help landowners with nonlethal removal strategies by partially funding flow device installations and tree protection projects. Like the BeaverCorps program, the cost for each project varies from hundreds to thousands of dollars. However, unlike the BeaverCorps program, HBCF prioritizes long-term evaluation and will follow up with landowners after completing the project.

Lastly, the U.S. Fish and Wildlife Service (USFWS) and the American Forest Foundation (AFF) use a cost-share structure for their region-wide habitat improvement initiative. USFWS biologists identify private landowners with at-risk species on their land and then work with them by providing cost-share funding and technical assistance for

habitat improvement. The landowner commits to working with AFF and USFWS for ten years to monitor species and provide data on species populations (AFF, 2021). Many interviewees held positions that responded to beaver conflicts, such as WDFW biologists, private WCOs, and staff at beaver-focused nonprofits. A common theme among these interviews was that their work with landowners is often reactive. The administrative obstacles that come with funding and implementing coexistence tools that one interview participant termed “green tape” would be less of a deterrent if they were working with land managers proactively. A habitat improvement initiative geared towards beavers in Washington would be a proactive approach to working with and alleviating the financial burden for landowners while also strengthening data collection techniques by filling in missing gaps about beavers on private land.

Broad Market-Driven Incentives

Market innovations such as mitigation and conservation banking are a second statewide strategy for encouraging coexistence. In wildlife conservation, these benefit-sharing mechanisms require governments to create markets for nature restoration and preservation by establishing a trading structure and regulating trade between private actors. In the US, the Clean Water Act and the farm bill authorize mitigation banking; therefore, federal agencies oversee it. Some states have created mitigation banking programs, such as the Arkansas Wetland Mitigation Bank Program administered by the Arkansas Soil and Water Commission (Casey et al., 2006).

Mitigation banking requires developers or agricultural producers to purchase credits to compensate for the wetlands they damage (Casey et al., 2006). Banks will create or restore habitats and earn credits from regulatory agencies. Then, they can sell these credits in the marketplace, and when landowners buy credits, it reduces their need to conduct on-site mitigation. Conservation banking is a similar market-based approach but focuses on preserving the ecosystem and species where they exist. It allows private landowners to obtain conservation credits to maintain endangered species or their habitats on their land (Casey et al., 2006). Like mitigation banking, statewide conservation banking initiatives exist in Colorado and North Carolina.

Washington could strengthen its current mitigation banking efforts or create a statewide conservation banking program to mitigate wetland development and thus help protect the beavers that live on the conserved land.

Mitigation banking efforts in Washington would require a cross-agency approach, with participation from the Washington Departments of Agriculture, Commerce, Ecology, Fish and Wildlife, Natural Resources, and Transportation (Ecology, 2015). Currently, the Washington Wetlands Mitigation Banking Act (n.d.) established that banking is an essential regulatory tool to provide compensation for wetland impacts. The Act directs Ecology to certify mitigation banks across the state, and the agency works with the U.S. Army Corps of Engineers and EPA to do so (Ecology, n.d.-b). Additionally, WDFW was instrumental in developing the Washington State Wetland Program Plan (WPP), a coordinated statewide wetland protection and management

effort published in 2015. WDFW could continue working with Ecology on wetland mitigation efforts. However, it should better emphasize beavers' vital role in wetland ecosystems and incorporate their nature-based services into future wetland management plans.

Another approach is a statewide market-incentive program for conservation banking to mitigate development and help protect beavers already living on the conserved wetlands. These approaches would shift WDFW's game management of beavers toward an ecosystem management approach, with beavers becoming integral species to protected and conserved wetland habitats statewide. The limitations and implications of market-based approaches are discussed further in the analysis section below.

Coexistence may not be optimal in every case of human-beaver conflict, but it enables beavers to provide crucial ecosystem services. Unfortunately, the high implementation costs and limited public awareness of coexistence currently undervalue this strategy. Therefore, the development of a beaver management plan presents an opportunity to address financial barriers and provide installation resources. The elimination of these obstacles can help transform beaver habitats from a nuisance to an asset.

Lessons From States: Montana, California, and Vermont

Montana

The American Prairie Foundation in Montana creates large nature reserves and manages wildlife in partnership with the U.S. Fish and Wildlife Service, U.S. Bureau of Land Management (BLM), Montana Department of State Lands, and the Montana Fish, Wildlife & Parks Department (FWP). Specifically, American Prairies provides financial incentives in five different land management categories to encourage coexistence among other species of animals. Landowners voluntarily enroll in a land management category that benefits wildlife and compensates owners based on species type. The Cameras for Conservation program pays landowners to capture pictures of specific species on their land (American Prairies, 2024). One enrolled property can earn up to \$6,000 a year based on wildlife presence, and the American Prairie staff works with owners to install cameras, reducing the implementation burden. If implemented in Washington, this approach could double as public education about beavers' location and coexistence benefits to landowners about what coexistence looks like in practice.

The Montana FWP collaborates with crucial state agencies, nonprofit organizations, and federal agencies to manage beavers. In 2023, the Montana Beaver Working Group (2023) released an updated Beaver Action Plan to advance working with beavers to create resilient and healthy watersheds. Key goals of the Action Plan are to integrate beavers into wetland restoration efforts and provide education on the benefits of beavers and related restoration efforts (Montana Working Group, 2023).

The Montana FWP also sponsors a Freshwater Partners' Beaver conflict resolution program that provides landowners tools, resources, and training on managing beavers effectively. Freshwater Partners also has a channel migration easements program that financially compensates landowners for allowing the Yellowstone River to flood their property (Montana Freshwater Partners, 2021b). Washington could implement a similar incentive program to financially compensate landowners who allow beavers to exist on their property and risk damage, such as flooding, in doing so. Also, these examples continue to show the importance of nonprofit organizations in promoting coexistence with beavers alongside state agencies.

California

In 2023, CDFW's (2023) Beaver Restoration Program announced a \$2 million grant to support ecosystem restoration and protection through 2025. CDFW stated that beavers are crucial to healthy ecosystems and that California must implement new approaches to maintain healthy beaver populations. This funding opportunity supports that transition toward non-lethal beaver management (CDFW, 2023).

Approved projects will promote human-beaver coexistence strategies, and funding will offset implementation costs and provide technical assistance for landowners in implementing coexistence tools promptly (CDFW, 2023). CDFW made efforts to streamline the application process, such as giving notice of funding within 30 days of application submission, to accelerate restoration efforts. Private landowners cannot apply directly but could be reimbursed or reach out to eligible applicants—tribes, non-governmental organizations, and public agencies.

This grant program incorporates proactive and reactive approaches to beaver management. Similar to strategies in Montana, this strategy emphasizes the importance of providing financial and technical support to landowners to encourage non-lethal beaver management. It also highlights how collaboration between public agencies and nonprofits supports beaver management more comprehensively. With additional funding, WDFW can implement a similar grant into its beaver management plan to remedy and prevent human-beaver conflict.

Vermont

Vermont's Fish and Wildlife Department (VFWD) classifies beavers as keystone species because of their ecosystem benefits. Consequently, VFWD developed best management practices to determine if beaver conflict is a potential threat to public safety and, if so, practices to resolve the reported problem with minimal environmental damage (VFWD, 2002).

VFWD's management practices emphasize a collaborative approach between landowners and state agencies. They require landowners to report wildlife incidents to the Fish & Wildlife warden and a contact at the Agency of Natural Resources (ANR) regional office closest to the incident. In the initial consultation with an ANR representative, the landowner determines if they can resolve the problem through

prevention techniques; if not, the representative will discuss other options. The plan outlines different types of conflicts and appropriate management responses for each, emphasizing educational materials and coexistence device resources. When the response is to arrange for lethal reduction or removal, it recommends removing beavers during the regular trapping season to minimize costs to the landowners and ensure the “most appropriate and humane methods” are used (VFWD, 2002).

Vermont's best practices lay out a centralized plan to handle three types of common human-beaver conflict with clear roles for appropriate public representatives and guidance for private landowners. The Vermont plan also emphasizes the importance of maintaining coexistence tools to increase effectiveness and lists “tips and tricks.” Washington could emulate the best management practices established in Vermont to provide landowners with greater education about options for coexistence and more precise guidelines for public employees on responding to common conflict instances.

Key Takeaways: Incentivizing Human-Beaver Coexistence

Washington's current coexistence practices, models for coexistence, and coexistence measures in other states reveal that:

- The perceived threat of beaver activity to infrastructure, business operations, and property influences landowners' decisions on whether to pursue coexistence.
- Public awareness of beavers' ecosystem benefits has grown across stakeholder groups in Washington.
- The existing incentive structures make relocation and coexistence measures more costly and time-consuming for landowners and wildlife managers than lethal removal.
- Subject matter experts identified a lack of funding as a crucial obstacle to increasing beaver/human coexistence.
- Two strategies to incentivize coexistence include cost-share programs and market innovations.
- Montana, California, and Vermont approach beaver coexistence through financial incentives, public education, and enhanced collaboration between state agencies and nonprofit organizations.

Policy Analysis

Based on critical themes from interviews and case studies, Washington may benefit from increased knowledge of human-beaver interactions, public education about beaver coexistence benefits, and funding to implement said coexistence strategies. As such, this section first defines the core criteria chosen to evaluate potential policy

options. Then, it proposes five policy options and evaluates each against the core criteria. Finally, this section concludes with a tradeoff analysis of the policy options.

Evaluative Criteria

The team selected five evaluative criteria—implementation complexity, environmental impact, public acceptance, cost, and distributional impacts—based on WDFW’s needs and key stakeholders’ perspectives. Figure 9 details each criterion and provides a scale for measurement.

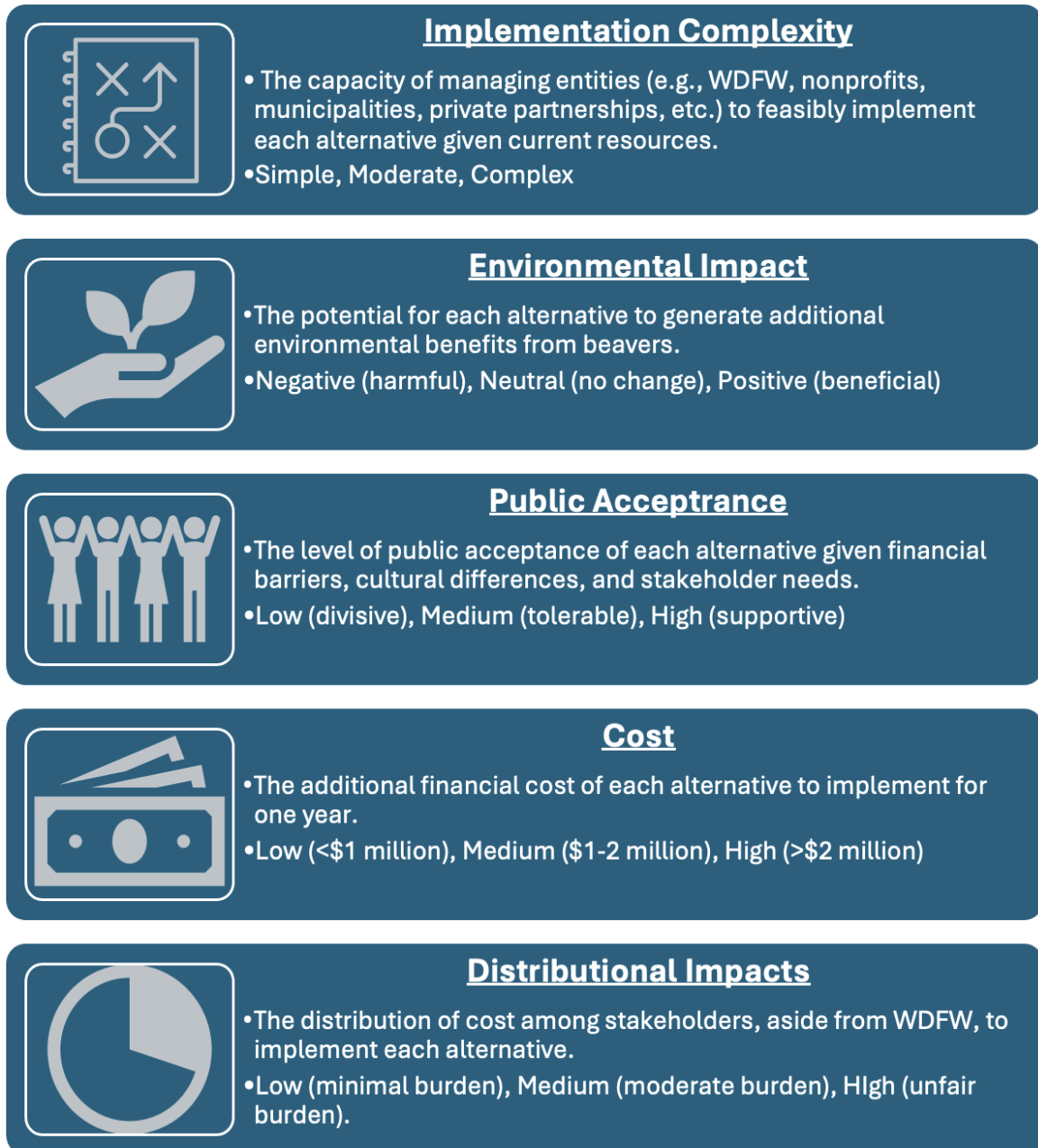


Figure 9: Evaluative Criteria

Policy Alternatives

The policy alternatives below encompass potential solutions to resolving human-beaver conflict in Washington state based on interviews with key stakeholders and a literature review of strategies reducing human-beaver conflict in other states and incentivizing species conservation.

Option 1: Business as Usual

This policy option represents the current state of affairs in Washington's beaver management and its natural progression. Some data show positive trends in Washington's human-beaver coexistence. For instance, a WDFW Furbearer Biologist reported that trappers and beaver harvest in Washington had decreased significantly since 2000 due to Initiative 713, a state policy that limited allowable animal trapping (Interview 16). Also, interviewees reported beaver populations increasing in Washington (Interviews 6 and 11), but the state's lack of scientific population tracking makes this difficult to confirm. However, beaver populations in the state remain well under their pre-colonial numbers. The long timeframes and high costs of coexistence and relocation in the current system motivate land managers and WCOs to use lethal removal to resolve beaver conflict (Interview 2 & 11). Given the immense environmental and ecosystem benefits the keystone species provides, the business-as-usual policy option undervalues beavers.

Option 2: Public Education

Conservation groups often use educational outreach to increase awareness of the benefits of beaver conservation. While some individuals are likely to support beavers for their cute and cuddly appearance, they are less likely to know about beavers' ecosystem benefits. This knowledge gap is a liability because successful human-beaver co-existence depends on individuals willing to tolerate beavers for their ecosystem benefits. The public would be more accepting of coexistence strategies if a public awareness campaign explained beavers' benefits and available coexistence resources. Tactics of such a campaign may include mailers, billboards, social media advertising, and television advertisements. Findings from the interviews suggest the public has been becoming more aware of the benefits of beavers. A large-scale effort could accelerate acceptance.

A public awareness campaign can also enhance the tracking of human-beaver conflict. The campaign can strategically promote a beaver hotline or website where Washingtonians can report beaver nuisances and receive context-specific resources to mitigate the conflict. Such a hotline or website can also easily track and map instances of human-beaver conflict, helping foster more proactive and responsive beaver management. Therefore, a holistic public education program allows Washingtonians to understand beaver ecosystem services, learn about coexistence strategies, and take action to resolve conflict non-lethally.

According to beaver management plans in other states and interviews with key stakeholders, public education is essential to improving species management. While public education has been the focus of other beaver management plans, strategic outreach to key stakeholders would be even more effective when paired with public education. For instance, messaging could target new landowners in beaver-prone environments.

Furthermore, WCOs resolve the vast majority of human-beaver conflicts. They are key stakeholders who influence their clients' decisions on wildlife conflict resolution. When resolving human-beaver conflicts, WCOs can pursue various options, such as relocation, mitigation, and lethal removal. As part of the education policy alternative, WDFW and beaver nonprofits would offer educational seminars and training in beaver management to WCOs as part of their training and certification.

WCOs are in the most direct position to make recommendations to clients arguing about beaver coexistence. However, WCOs need more information on existing incentives for coexistence to uphold these recommendations. When WCOs don't know enough about coexistence strategies and incentives, they cannot fully inform their clients about it, leading to them favoring relocation or lethal removal over coexistence. Like Vermont's Best Management Practices, a centralized document with clear roles and guidelines for handling human-beaver conflict can be an educational tool for both WCOs. Further, interviews with WCOs revealed that a WCO may lose money on non-lethal alternatives. Therefore, WCOs are ill-equipped to advise clients about non-lethal options and disincentivized to propose those options.

In an ideal scenario, WCOs would receive compensation and provide their clients with estimates for the long-term costs and benefits from coexistence, with relocation or lethal removal given equal weight. While the WCO would unlikely facilitate the coexistence strategies, WDFW can compensate them for encouraging said outcome. If a client favors lethal removal or relocation, it is also essential to have WCOs informed on methods and partners for relocation.

This policy option includes educating WCOs on the positive ecosystem services beavers provide. WCOs are stewards of species management in Washington state. However, due to uninformed attitudes towards beavers, they mostly see them as a nuisance. While WDFW could mandate coexistence training as part of this alternative, it should frame coexistence as an essential way to contribute towards WCOs as stewards of species management. Instead of mandating preferences for coexistence, WDFW and beaver nonprofits should highlight the benefits and ideal situations for coexistence measures.

Option 3: Research Investments

Comprehensive research is the foundation of any species management plan looking to increase the benefits of ecosystem services, and beavers are no different. Although there is extensive nationwide research on beavers' ecosystem benefits, WDFW

and other key stakeholders (e.g., wildlife managers, other government entities, and nonprofits) must understand the social impacts of beavers. Efforts to fill the knowledge gap on human-beaver interactions will help policymakers make informed decisions about managing the species.

Washington state needs substantial data on the distribution of beavers because it is integral to a species management plan. Species-specific research benefits managers and policymakers alike because they create policies to resolve human-beaver conflict. For example, research will help WDFW determine beavers' location, habitat preferences, and distribution. Despite the diverse array of habitats within Washington, beavers likely prefer some habitats over others, creating hotspots where human-beaver conflicts occur more frequently. WDFW needs additional staff time to understand the population distribution of beavers further and anticipate potential hotspots. This alternative proposes that WDFW fund new research capacity within WDFW to study beaver populations and their impact on regional species and ecosystems.

New research capacity can take advantage of existing data collected by WCOs. WCOs must track the number of beavers they trap and remove at any time and location. Additional staff and support at WDFW could compile these data logs better to assess the intensity of human-beaver conflict across Washington state. If WDFW integrates WCOs' data with cross-stakeholder data collection efforts, researchers could inform policymakers on the distributional incidences of human-beaver conflict.

The ideal beaver management plan must understand public perceptions of beavers and best accommodate stakeholders with different—and sometimes conflicting—views. This policy option suggests that WDFW survey a representative sample of Washingtonians to better ascertain critical stakeholders' opinions on beaver coexistence. This survey may reveal public openness to coexistence alternatives and identify motivating factors for greater adoption. Consequently, policymakers can design socioeconomically and culturally responsive incentives.

WDFW can survey Washingtonians. The agency previously surveyed a smaller part of Washington to understand views towards beaver coexistence; the results provided concrete support for increasing education and outreach efforts (Kruger et al., 2021), but the survey findings are not generalizable statewide. Alternatively, a larger-scale statewide survey positions WDFW to develop a more comprehensive and responsive beaver management plan.

WDFW should also fund research on beaver relocation strategies. Successful beaver relocation requires suitable habitat selection because relocation may resolve human-beaver conflict in one area but incite it in another. Although WDFW requires relocation permits (WDFW, 2024b), additional research is needed to provide comprehensive data on potential relocation sites. This research would expand to benefit permitted relocation service providers, including the Methow Beaver Project. Specifically, these providers would be better equipped to relocate beavers to habitats suitable for beavers and humans.

Lastly, WDFW should research innovative solutions to human-beaver conflict and capacity constraints. If WDFW disincentivizes lethal removal, coexistence strategies will experience increases in demand. For example, beaver relocation increases the demand for suitable habitats for relocation, a finite resource. However, additional research can examine possible compensation models for landowners willing to allow beaver relocation near their property. Therefore, expanded research capacity can maximize the effectiveness of the Washington beaver management plan.

Option 4: Grant Expansions

In Washington, existing beaver conservation grants are relatively small, overlooked, and indirectly aimed at coexistence. Grant programs can share the cost of implementing tools for non-lethal beaver management to incentivize coexistence. From 2019 to 2023, Ecology (2024) has funded \$77 million for projects to improve stream flow, protect habitats, and provide water for rural homes, known as the Streamflow Restoration Competitive Grants Program. The grant prioritizes beaver-based habitat restoration projects adhering to WDFW regulations. For example, a grant-funded Conservation District project employed beavers to establish ponds for watershed recharge and riparian habitat creation (Ecology, 2022). Despite this grant's promising applications, beavers compete with other stream restoration methods, such as human habitat restoration, which is often less effective (Ecology, 2019). Therefore, Ecology could take multiple avenues to expand funding going toward beavers by increasing funding for the program and changing funding priorities.

First, this policy option prioritizes nature-based solutions for streamflow grant projects, such as beaver restoration. Currently, the streamflow grants emphasize project outcomes such as stream restoration, aquatic species protection, and aquatic degradation mitigation (Ecology, 2023). Although a beaver-focused project meets these grant review criteria, the grant criteria also undervalue sustainable watershed restoration. Out of the 300 points available for projects to receive, the sustainability criterion only accounts for up to nine points for projects with complete sustainability. WDFW and Ecology can collaboratively encourage beaver restoration by increasing the weight of the sustainability criterion in project selection. Alternatively, Ecology can integrate beaver services in its streamflow restoration grants with a new criterion emphasizing species-driven nature-based solutions.

Second, this policy option proposes directly increasing funds for the streamflow grants. The Washington legislature authorized \$300 million for streamflow restoration projects over fifteen years, or about \$20 million annually until 2032 (Ecology, 2018). This authorization needs to be higher to restore streams across the state adequately. Specifically, Ecology estimates that Washington needs \$4.7 billion to recover salmon populations, with most of those funds going to riparian habitat restoration (State of Salmon, n.d.) Private, non-profit, local, and federal resources may help finance restoration efforts; however, WDFW and Ecology can lead by example by allocating resources to expand this grant program as a part of a comprehensive beaver management plan. Of course, state agencies will use some additional funds for projects

unrelated to beaver coexistence, but this expansion reduces competition among proposed projects.

Further, this expansion enables beaver-focused nonprofits to apply for more funding. Therefore, a combination of expanded funding and grant criteria aimed at nature-based restoration projects would increase funding for beaver coexistence and restoration projects. Expanded funding for beavers would replace projects using artificial beaver dams rather than replacing all other activities with grant funds.

As states and the federal government have been increasingly funding grants advancing nature-based solutions, WDFW, beaver nonprofits, and other environmental groups could leverage these funds for beaver management. Under this alternative, WDFW and beaver non-profits would provide their expertise and partnership towards other environmental non-profits restoring habitats by including beavers in their restoration plans. By rebranding beavers as a nature-based solution to habitat restoration, WDFW and beaver nonprofits can bring in additional funding from out-of-state for beaver management without increasing their funding sources.

Option 5: Market-Based Financial Incentives

Economic incentives for beaver coexistence would meet Washington State's need for ecosystem services beavers provide. This policy option proposes that WDFW and the Washington legislature work together to design and fund a conservation bank that incentivizes landowners to keep beavers on their property. A conservation bank is a market-based incentive for landowners to protect species and habitats on their land (U.S. Fish & Wildlife Service, 2019). They function to offset adverse impacts on species that occurred elsewhere. In exchange for protecting species and habitats on their land, landowners receive credits to sell to land developers responsible for offsetting environmental impacts from development, not near the conservation bank. In California, conservation bank credits are worth anywhere between \$2,500 to \$300,000 to landowners, depending on the species the state is trying to conserve (Conservation Finance Network, 2020).

When a developer wishes to build on land that would negatively impact the environment, they purchase these credits from the landowner, allowing the developer to mitigate the landowner's project's impacts elsewhere. Conservation banks can lead to more overall conservation than if developers performed onsite mitigation, as land protected in a conservation bank typically receives more funding yearly. A conservation bank not only acts as a means to preserve the species and habitat, it also actively provides funds to restore and maintain them. A conservation bank creates an endowment to provide enough annual interest to fund restoration projects. For example, a conservation bank controlled a \$554,000 endowment to manage 354 acres of space for salmon conservation (The Conservation Fund, 2010).

When beavers inhabit a landowner's property, the landowner enters into an agreement with the state and receives conservation credits to sell to developers looking

to mitigate the impact of their development. These credits allow landowners to recoup some costs associated with beaver coexistence while mitigating conflict on developing lands when landowners sell their credits. Nationwide, conservation banks are permitted and regulated by the U.S. Department of Fish and Wildlife Service (USFWS) by 16 U.S. Code § 1531 of the Endangered Species Act. Accordingly, private, tribal, state-owned, and local government lands are eligible to become conservation banks after entering into an agreement with the USFWS that establishes a long-term management plan. Often, the establishment of a conservation bank places the cost burden on taxpayers, which imposes comparatively more financial barriers than the other policy options.

If Washington State and WDFW were to create a conservation bank aimed at purely conserving beavers, the cost and complexity could become an issue. Conservation banks often preserve threatened or endangered species. Given beavers' relative commonality, this alternative could attract support by expanding to a statewide conservation bank to conserve riparian habitat, focusing on salmon, stream restoration, and beaver coexistence. Salmon and stream restoration is a significant goal of state agencies, fisheries, local conservation groups, and the federal government. Given an estimated \$4.7 billion need for restoration, a conservation bank aimed at riparian habitats can leverage beavers' naturally restorative ecosystem services (State of Salmon, n.d.). With a broader restoration goal, a conservation bank will likely attract more support to benefit beavers than a beaver-exclusive bank.

A state-wide conservation bank would provide more credits to lands, allowing beavers to coexist on the property than if beavers weren't there. With a large enough endowment, the interest generated from it could fund the management of the land, boosting restoration and protecting property owners from potential losses. As such, a conservation bank would help Washington State meet its restoration goals while compensating landowners for keeping beavers on their property from the conservation bank's endowment.

Tradeoff Analysis

The comparison of policy options in a criteria-alternative matrix (Figure 10) reveals that the public education and research investment policy alternatives are clear winners. Due to their ease of implementation and stakeholders' current capacity, these options can yield high environmental impacts relative to cost.

Educational campaigns rely on the existing network of nonprofits and beaver experts to perform state-funded research and educational outreach. For example, MBP and similar organizations perform outreach to high schools, colleges, and the general public. WDFW could allocate resources to these organizations to expand educational opportunities across the state. The campaign may address non-lethal control methods, beavers' natural restoration techniques, and coexistence strategies. Furthermore, educational campaigns may appeal to WCOs because they equip them with information to better inform their clients on non-lethal alternatives, such as relocation.

Figure 10: Criteria-Alternative Matrix



		ALTERNATIVES				
		OPTION 1: Business as Usual	OPTION 2: Public Education	OPTION 3: Research Investments	OPTION 4: Grant Expansions	OPTION 5: Market-Based Financial Incentives
C R I T E R I A	Implementation Complexity	Simple No substantive new changes	Simple Infrastructure to educate the public exists and subject matter expertise is accessible.	Moderate WDFW may need to expand capacity or leverage nonprofits, but limited conflict data hinders both options.	Moderate Requires more expertise to connect and encourage coexistence using financial incentives.	Complex Connecting funding with property owners requires tailored approaches for WDFW, WCOs, and nonprofits
	Environmental Impact	Negative Human-beaver conflict continues to undermine beavers' ecosystem services.	Neutral Overtime education would encourage coexistence, allowing beaver ecosystem services to increase.	Neutral Human-beaver conflict persists as research is conducted but might reveal future pathways to increasing benefits.	Positive Individuals would coexist with beavers more, restoring riparian ecosystems.	Positive Would allow WDFW and provide financial incentives for beaver coexistence, restoring riparian ecosystems.
	Public Acceptance	Low Human-beaver conflict persists and lack of management perpetuates negative attitudes.	High Public understanding of beaver services and conflict resolution resources grows in tandem.	Low Research in isolation is unlikely to impact public perceptions.	Medium Coexistence becomes more affordable, driving more people to allow human-beaver coexistence near them.	Medium Expands stakeholder options through developer-funded conservation credits for beaver coexistence.
	Cost	Low to Medium Lack of beaver management negatively impacts all stakeholders.	Low Giving existing entities resources needed to expand outreach efforts would have small costs relative to inaction.	Low Expanding expertise in existing programs would have a small cost relative to inaction	High Expansion of programs and compensation for WCOs will require new funds	High Conservation credits provided to landowners to sell to developers. Requires large endowments to maintain protected lands.
	Distributional Impacts	Medium Lack of beaver management negatively impacts all stakeholders.	Low Joint implementation between WDFW and non-profits results in relatively low costs for both entities.	Low Joint implementation between WDFW and non-profits results in relatively low costs for both entities.	High Washington state and taxpayers bear the brunt of the cost of providing financial incentives.	High Washington state and taxpayers bear the brunt of the cost of managing the fund.

Strong public awareness about a species' ecological value is essential for conservation. WDFW and beaver nonprofits need a more robust understanding of beavers' value to communicate the species' importance effectively. As such, additional research can explain and quantify the benefits of beavers to Washington residents who are hesitant about beaver coexistence. Stakeholder interviews revealed the public increasingly welcomes the idea of beaver coexistence, but this trend has likely been stronger in western suburban areas. In eastern Washington, landowners embrace lethal removal and relocation over coexistence. Therefore, additional research would most effectively unearth beaver perceptions in eastern Washington.

Although the two financial incentive policy options—expansion of grants and market-based incentives—would increase beaver coexistence, they will encounter implementation and efficacy challenges. Financial incentives would only provide marginal enhancements because of limited awareness of beavers' vital role in riparian restoration. For example, landowners with more antagonistic views of beavers will be less likely to pursue coexistence incentives (Ramsdell et al., 2015). WDFW should consider implementing incentive programs after it invests in additional research and public education. As Washingtonians increasingly understand and embrace coexistence, the incentive programs could see wider adoption. Therefore, financial incentives become worthwhile if the beaver management plan prioritizes public education and consolidates critical data into a comprehensive system.

Recommendations

WDFW should allocate resources for public education (Option 2) and research (Option 3) to enhance understanding of conflict areas, coexistence benefits, and available options. Specific strategies include:

1. Launch a public awareness campaign promoting beaver coexistence practices
2. Invest in a central reporting system, such as a beaver hotline or website.
3. Train WCOs on beaver coexistence tools and resources
4. Fund new research capacity on beavers and their impact on species and ecosystems.

WDFW's emphasis on public awareness and research will lay the groundwork for more effective cost-shared and market-based financial incentive programs (Options 4 and 5).

Conclusion

The current legislative and regulatory landscape allows Washington to become a leader in beaver management. The state legislature created the opportunity to enhance beaver management practices with a corresponding bill. WDFW then took preliminary steps with its proposal for contracted assistance. Additionally, Washingtonians are eager to pursue coexistence.

WDFW should capitalize on this momentum with a comprehensive coexistence-oriented beaver management plan. However, WDFW must confront underlying barriers to coexistence adoption, especially device installation complexity and financial barriers.

The answers to this report's core research questions—revisited below—can guide WDFW in maximizing opportunities for coexistence across the state.

Research Questions, Revisited

1. *How is human-beaver conflict tracked and reported statewide, and what other tracking strategies exist?*

There is a crucial need for a comprehensive central data collection and conflict reporting system within beaver management practices. A comprehensive data system can provide a factual basis for decision-making and help WDFW better target areas that experience human-beaver conflict. Specifically, WDFW should consider using GIS mapping and strengthening cross-agency and stakeholder collaborations.

2. *What coexistence strategies exist, and how do they intend to reduce human-species conflict?*

WDFW provides education on tools that can non-lethally solve conflict, and nonprofit organizations offer technical assistance and expertise in partnership with state agencies to assist landowners. Despite growing acknowledgment of coexistence benefits, financial and time barriers to implementing coexistence strategies still need to be addressed. WDFW can strengthen coexistence by increasing education on coexistence practices, creating cost-share programs, and expanding market-based incentives.

3. *What regional differences will WDFW need to account for when encouraging human-beaver coexistence?*

Although human-beaver conflict is more likely to impact residential interests in Western Washington and agricultural and commercial interests in Eastern Washington, limited data on beaver populations undermines a beaver management plan's responsiveness to these regional interests. Therefore, WDFW should implement a comprehensive GIS beaver tracking system to better locate and interpret different types of beaver conflict throughout the state. Furthermore, research investments will help WDFW diversify the range of coexistence resources it publicizes to account for different regional needs.

4. *What stakeholder needs will WDFW need to account for when encouraging human-beaver coexistence?*

The perceived threat of beaver activity to infrastructure, business operations, and property is the focal point in a landowner's decision to pursue coexistence or removal. Although Washingtonians and wildlife managers are more aware of beavers' services, they are less likely to pursue non-lethal options because of financial and logistical constraints. Therefore, WDFW should aim to reduce the financial burden on landowners and streamline best management practices to assist wildlife managers.

5. *How can the WDFW strengthen conflict tracking and human-beaver coexistence incentives within its future beaver management plan?*

WDFW should develop a beaver management plan that balances the concerns of key stakeholders and avoids lethal removal. The plan should improve data collection with a comprehensive system for identifying hotspots for conflict. The plan should also educate the public on non-lethal management alternatives via a responsive reporting system, such as a hotline. Specifically, WDFW should translate beavers' benefits into terms Washingtonians care about, such as their impact on Washington's salmon population.

Limitations and Future Research

Public education and research investments will have a lower environmental impact than cost-share programs and market-based incentives in the short term. Despite this limitation, education and research rely on continuing partnerships with nonprofits and wildlife managers for successful implementation. Therefore, this hybrid approach is affordable and easier to implement than financial incentives.

An early emphasis on public education and research maximizes the potential of financial incentive programs in the long term. Specifically, increased buy-in from critical stakeholders will encourage wider adoption of economic incentives for coexistence and magnify environmental benefits across the state.

In the future, WDFW should evaluate the effectiveness of a public education campaign with a pre- and post-tracking statewide survey. WDFW can substantiate the survey results with stakeholder feedback to identify additional barriers to public acceptance. WDFW should also examine how public acceptance varies between Washington's geographic regions. Researchers should also quantitatively analyze the relationship between market-based innovations and wildlife preservation to help Washington's government agencies make evidence-based decisions in future beaver management plans.

Lastly, further research should explore the potential budgetary impacts of financial incentive programs for beaver coexistence. With a clearer picture of how grant expansions or a conservation bank might affect existing budgets, it will be easier to predict the opportunity costs of these incentives.

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Appendices

Appendix A: Interviewees

Semi Structured Interviews

Interview 1: Ema and Grant Johnson, Landowners in Massachusetts with beavers on property

Interview 2: Vernon Craig, WCO, tahomapest.com

Interview 3: Joe Williams, Regional Maintenance Environmental Coordinator, Washington Department of Transportation

Interview 4: Josh Thompson, Director/County Engineer, Okanogan County, WA Public Works

Interview 5: Elyssa Kerr, Executive Director of Beavers Northwest

Interview 6: Jennifer Vanderhoof, Senior Ecologist in King County, WA, and President of Beavers Northwest

Interview 7: Andrea Watts, Landowner and Family Forest Owner in Washington with beavers on property

Interview 8: Shawn Behling, Furbearer Biologist for WDFW

Interview 9: *This interviewee requested to remain anonymous. They have a background in wildlife habitat management and ecosystem services.*

Interview 10: Jackie Watts, Wetland Science & Management Certificate (ongoing), University of Washington

Interview 11: Timothy Fry, WCO

Interview 12: Mike Linell, State Director for Washington, USDA APHIS

Interview 13: Brandon Rossi, Habitat Biologist, Yakama Nation Fisheries

Written Interviews

Interview 14: Dave New, Landowner and Family Forest Owner in Washington with beavers on property

Interview 15: Patrick Shults, Washington State University Extension Forester

Interview 16: Lindsay Welfelt, Furbearer Biologist for WDFW

Interview 17: Wes Smith, Wildlife Biologist, USDA APHIS

Appendix B: Interview Questions

Questions for Individuals from Advocacy or Nonprofit Organizations

1. Give us a brief overview of your role.
2. What is the range of opinions surrounding beaver management in Washington state? Is that opinion changing?
3. What policies would constitute an effective state beaver management plan?
4. In your experience, what factors decide whether a landowner or land manager pursues coexistence versus removal strategies on their land? What would motivate that person to change their approach?
5. What could be improved in the state's current beaver removal permitting and population tracking practices?
6. Is there anything else that you think we should have asked you?
7. Is there anyone else you recommend we interview? Is there anyone else you know who would be interested in being interviewed?

Questions for Government Program Staff

1. Can you provide us with a brief overview of your role?
2. What is the range of opinions surrounding beaver management in Washington state? Is that opinion changing?
3. Do you collect data on beaver conflict or report on it in any way? If so, what data do you collect and how is it collected?
4. In your experience, what factors decide whether a landowner or land manager pursues coexistence versus removal strategies on their land? What would motivate that person to change their approach?
5. Do you work with any other entities related to beaver management? (Ex. Methow Beaver Project, other nonprofits, state agencies) If so, how? [optional]
6. What could be improved in the state's current beaver removal permitting and population tracking practices?
7. If you could design your dream state beaver management plan, what would you be sure to include? [optional]
8. Is there anything else that you think we should have asked you?

9. Is there anyone else you recommend we interview? Is there anyone else you know who would be interested in being interviewed?

Questions for Landowners

1. Give us a brief overview of your relationship with beavers on your land.
2. How would you currently report beaver conflict on your land, if at all?
3. Would you see beavers on your land as a net benefit or negative?
4. Have you worked with any public or nonprofit organizations regarding beaver conflict? What was your experience?
5. What are the main improvements you'd like to see regarding beaver management?
6. If you were experiencing beaver conflict on your land, what would incentivize you to pursue coexistence strategies instead of removal?
7. Is there anything else that you think we should have asked about?
8. Do you know anyone else that you think we should talk to or anyone who would be interested in being interviewed?