WILDLIFE
IN MANAGED FORESTS

The North American Beaver

Oregon Forest
Resources Institute

Wildlife in Managed Forests – Project Overview

This publication is part of a series from the Oregon Forest Resources Institute that aims to synthesize current research findings and make information available to foresters, wildlife managers and interested parties such as conservation organizations, regulators and policymakers. As part of the Wildlife in Managed Forests outreach project, information is disseminated through publications such as this one, as well as workshops, tours and conferences.

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For copies of this report or further information, contact:

Oregon Forest Resources Institute
(971) 673-2944
KnowYourForest.org
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PREPARED FOR THE OREGON FOREST RESOURCES INSTITUTE BY:

Fran Cafferata, Cafferata Consulting; Vanessa Petro, Oregon Department of Forestry; and Jimmy Taylor, USDA National Wildlife Research Center
Project Manager: Julie Woodward, Oregon Forest Resources Institute

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Contents

The North American beaver is the state mammal of Oregon.

1.0 Introduction

The North American beaver (*Castor canadensis*) occurs statewide in all ecoregions of Oregon where suitable habitat occurs. Historic populations of the North American beaver were estimated to be over 60 million and were widespread throughout all of North America (Seton, 1929). Fur trapping greatly reduced beaver populations during the 1700s and 1800s. Regulations surrounding trapping beavers were implemented in 1899, and the beaver population has made a tremendous recovery throughout North America.

Today, the North American beaver occupies much of its historical range (see Figure 1). Published estimates of beaver population are not available for Oregon, although the Oregon Department of Fish and Wildlife (ODFW) furbearer report (Hiller, 2011) indicates healthy populations across the state based on current harvest levels. Beavers are known as ecosystem engineers for the benefits their dams provide to biological diversity. Dams attenuate water flow and provide seasonal habitat for many insects, amphibians, reptiles, birds, fishes and mammals.

However, beavers sometimes present challenges because altered habitats are not always compatible with landowner objectives or existing infrastructure. The effects of beaver behavior vary, and depend on landowner perspective.

This publication will summarize beaver biology and habitat needs, discuss current research, and provide science-based recommendations for managing lands that include beavers.

Figure 1. Current distribution of the North American beaver.
https://www.fs.usda.gov/Internet/FSE_DOCUMENTS/stelprdb5181919.pdf

2.0 Beaver identification and biology

General: The North American beaver is the largest rodent in North America. In Oregon, beavers are known to occur nearly statewide wherever suitable habitat exists. Beavers are mostly nocturnal, but are sometimes active during the day. They do not hibernate, but are less active during the winter months. Adult beavers average 40 pounds and measure 3 feet in length (including the tail). Beavers are known to live to at least 20 years in the wild (Singleton and Taylor, 2010).

Diet: Beavers require a year-round food supply in close proximity to water. Beavers eat the leaves, inner bark and twigs of aspen, alder, cottonwood, willow and other deciduous trees. They also eat shrubs such as vine maple and salmonberry, ferns, aquatic plants, grasses, blackberry stems and agricultural crops. Their diet in the spring is largely composed of aquatic vegetation. The majority of foraging occurs within 100 feet of the waterline. However, beavers are known to travel longer distances when food supplies are limited or there are few predators. Beavers have special intestinal microorganisms that allow them to digest 30 percent of the cellulose they ingest from vegetation.

The North American beaver is drastically different from the mountain beaver (called "boomers" in Oregon). Mountain beavers (***Aplodontia rufa***) are burrowing rodents and are not true beavers. They got their name because they are known to gnaw bark and cut off limbs of trees. Mountain beavers are found in the moist forests of western Oregon.

Beavers fell trees for use in building dams and lodges. Damage as shown here creates a challenge for land managers in some cases.

Habitat: Beavers are mostly found where their preferred foods are prevalent – usually along rivers and small streams, lakes and marshes that have adequate year-round water. Suitable beaver habitat consists of available food resources and aquatic habitat (pool availability/sufficient water depth/wide floodplain). This accounts for both damming and non-damming beaver. Beavers need their preferred food sources located throughout riparian areas. Note that preferred foods are critical in locating prime beaver habitat (Robert Gilman, pers. comm. 2016).

The sound of flowing water is thought to stimulate beavers to build or repair dams. However, they do allow leaks in dams to flow freely, especially when water levels are high.

Behavior: Beavers are known for building dams; however, not all beavers build dams. Dams are constructed to create deep water for protection from predators, for access to their food supply and to provide underwater entrances to their dens. Beavers construct lodges or bank dens as a place to rest, stay warm and raise their young. Both bank dens and lodges have multiple underwater entrances, a feeding area, a dry den chamber and a source of fresh air.

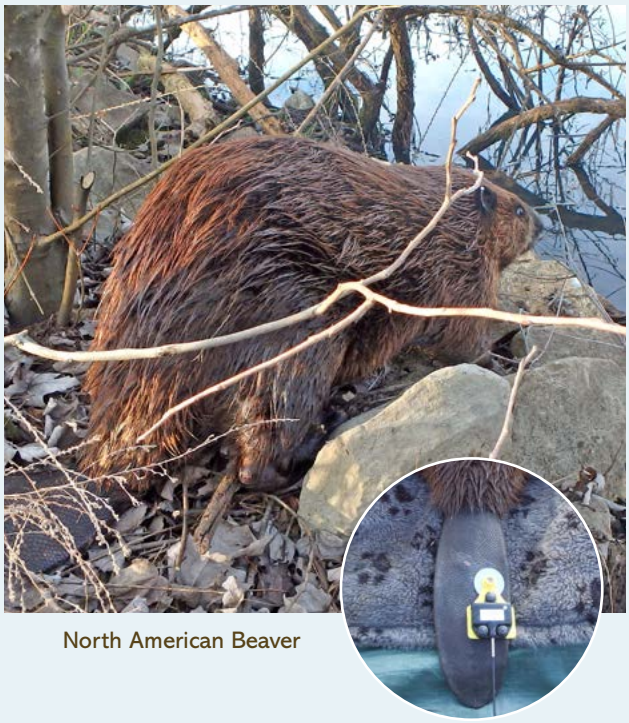
Reproduction: In Oregon, beavers breed between January and March. Beaver give birth between April and June. Their litters typically comprise of 2-4 kits that remain with the adults until they reach sexual maturity around 2 years of age (Baker and Hill 2003). Dispersing beavers are known to travel several miles to establish their own territory. Beavers live in family units that may contain many individuals, often comprising an adult breeding pair, plus kits of the current and previous years. If habitat is limited, family units are sometimes made up of larger groups including multiple breeding females (Fischer et al., 2010).

Predators: Common predators of beavers include bears, coyotes, bobcats, cougars, dogs and people. Other causes of death may include starvation, disease, water fluctuations and floods, falling trees (ironically) and vehicle collisions.

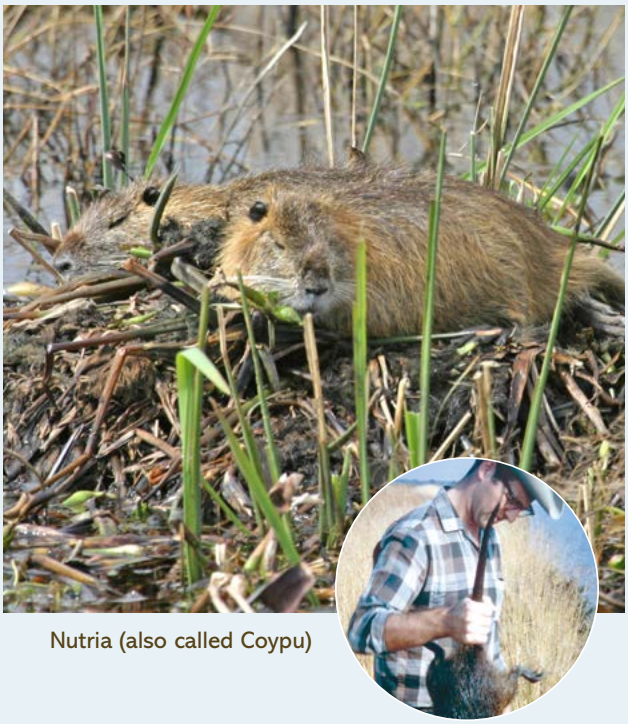
Above: Bank dens and lodges are constructed to provide a place to rest, stay warm and raise young.

Right: Bobcats are a common predator of beavers. This bobcat is visiting an active beaver slide.

How do you tell a beaver from a nutria?



North American Beaver



Nutria (also called Coypu)

Distingishing Features	Tail
Beaver	The tail of a beaver is broad (horizontally flattened) and almost hairless. The whiskers are black on a beaver.
Nutria (Coypu)	The tail of a nutria is round and almost hairless. Nutria have a white muzzle and whiskers.

Plant species known to be eaten by the North American beaver:

Willow, red alder, hazel, vine maple, wild cherry, cottonwood, salmonberry, bigleaf maple, western hemlock, thimbleberry, salal, western redcedar and Douglas-fir. Beaver typically avoid eating cascara and elderberry.

3.0 The North American beaver: benefits and landowner tolerance

Habitat modification by beavers, caused primarily by dam-building, is beneficial to fish, furbearers, reptiles, amphibians, bats, waterfowl, shorebirds, and cavity-nesting birds and mammals. However, the effects of these activities can be perceived as positive or negative depending on the objectives of the landowner.

Benefits of beavers: According to ODFW, beaver ponds and dams benefit Oregon's native fish and other wildlife. Beaver dams create ponds that provide fish with protection from strong winter flows. These dams are thought to increase water storage, which results in a more stable water supply. Beavers bring woody structure into the stream, which juvenile fish use to hide from predators. Beaver ponds also store leaf litter, which helps local insect (macro-invertebrate) production. Beaver dams contribute to improved nesting areas for waterfowl. They also provide habitat for many nesting songbirds and insects that are important fish and bird food. Even when a beaver dam is abandoned, the area continues to provide benefits to songbirds and other wildlife as deciduous shrubs and herbaceous vegetation develop.

Damage: Beavers directly damage trees or crops through gnawing. Beavers are also known to cause damage to property (e.g., trees, buildings and roads) as a result of dam-building, which may lead to localized flooding. Dams are typically constructed during low flows throughout the late summer and early fall (the principal dam-building period). The impact from flooding may not be realized until water levels are high. Dams may also fail, which causes a sudden increase in water velocity and volume. Major beaver dam breaches are known to destroy roads and railways, and in rare cases have removed homes from their foundations.

Beavers also cause damage to culverts, bridges, and roadways, forcing increased maintenance and repairs by landowners. Often the impact of the beaver is dependent on floodplain size (i.e., where the stream is located in the watershed), water availability, placement of road crossings over streams and wetlands, the number of beavers in the area, and how close the beaver is to the landowner. Additionally, beavers may degrade or destabilize stream banks through burrowing.

Beaver ponds like this one benefit Oregon's native fish and other wildlife.

Beavers cause damage to culverts, potentially causing damage to roadways and forcing increased maintenance and repairs by landowners.

Landowner tolerance: An increased understanding of beaver ecology can support successful management strategies. In a study conducted by Oregon State University in cooperation with ODFW, the Oregon Watershed Enhancement Board and the Bonneville Power Administration, researchers investigated landowner tolerances in Oregon for managing impacts from beavers. A primary focus of the study was to identify landowner attitudes and tolerance limits toward beavers and their habitats. Private landowners were surveyed in four regions (eastern, coast, Portland area and southwest). The survey was conducted in 2011, and more than 1,000 people responded. Perceived impacts from beaver are summarized in Table 1 and the results of the survey are summarized here:

- Only 20% of the landowners experienced impacts caused by beavers. Landowners in eastern Oregon and the coast regions were more likely than those in the Portland area or southwest Oregon regions to have experienced impacts.
- Most of the landowners had seen beavers in the wild, 85%, and 26% had seen them on their property or neighboring properties. Another 16% had beavers currently living on their property or neighboring properties.
- The majority of landowners were interested in seeing and having beavers live on their property or neighboring properties, with the greatest interest seen in the coast region.
- Respondents indicated that damage to trees and culverts, as well as flooding were the most common impacts. These appeared to occur most often in the eastern and coast regions.
- Landowners who had experienced impacts caused by beavers were much more likely to consider the presence of beavers a problem.
- Few landowners had taken action to deal with nuisance beavers.

TABLE 1. PERCENTAGE OF LANDOWNERS WHO CONSIDER THE FOLLOWING HYPOTHETICAL BEAVER IMPACTS TO BE A PROBLEM

Type of Damage	Percent Reported
Damage to trees	92
Damage to culverts	84
Overflow of a pond, lake or stream	81
Flooding of a road or driveway	79
Flooding of a well or septic system	74
Damage to flowers or bushes	74
Flooding of a basement or other building	71
Flooding of crops or fields	70

What is a furbearer?

A furbearer is a mammal that has traditionally been hunted or trapped for its fur.

Damage to roads and culverts is one of the most common reasons why people report nuisance beavers.

Most landowners surveyed had positive attitudes about beavers. But potential damage to property by beavers was also a concern of most respondents. Learning to live with beavers, or relocating them, were widely viewed as acceptable ways to manage beaver-human interactions. Wrapping individual trees and installing control devices, fences or screens were perceived to be acceptable strategies for addressing beaver impacts. In general, those surveyed did not view removing beaver dams and lodges favorably, unless the impact from the beavers was severe. Note that not all potential management strategies work in all systems. See the research (Section 4) and management (Section 5) sections below for more detail.

The Methow Beaver Project

The Methow Beaver Project is a collaborative effort focused on reintroducing beavers into strategic locations of the Methow sub-basin in Washington for the benefit of wildlife, fisheries and local water users. Project partners include the Pacific Biodiversity Institute, the Methow Conservancy, the U.S. Forest Service (Okanogan-Wenatchee National Forest), the National Fish and Wildlife Foundation, Ecotrust, Audubon Washington, the Washington Department of Fish and Wildlife, the U.S. Fish and Wildlife Service Winthrop National Fish Hatchery, and many more.

The main goal of this project is to use beavers and their engineering abilities to enhance stream habitat complexity in the Methow watershed. Additional goals include:

- improve water quality
- restore watershed function
- delay runoff and store water
- add in-stream wood
- build support for this restoration method
- help other beaver projects succeed

Members of the project team trapped nuisance beavers and released them into strategic locations in the Methow watershed. The team released 30 beavers at seven sites in the spring of 2008. In June 2009, the team determined that three sites were still occupied. Beavers had constructed many dams at one site, but it is unknown whether these dams were constructed by released beavers or existing beavers. The release and monitoring process was repeated in 2009, with 24 beavers released at eight sites. Six of those sites were still active the following year. In total, 329 beavers have been released since 2008. Researchers noted that the outcome of relocated beavers is uncertain, most commonly due to mortality of released beavers, and that beavers often move from the release sites.

What does this mean for management?

Relocating beavers has produced mixed results. Landowners may consider non-lethal control prior to relocation.

Landowners wishing to relocate beavers need to consider potential causes of mortality and other factors such as food availability before relocating.

4.0 What does the current research say about the North American beaver?

Researchers are studying the North American beaver to learn more about its biology and its impact on the environment, and to determine best management practices. The following pages summarize the current research.

ODFW BEAVER WORK GROUP

ODFW formed the Beaver Work Group in 2007 to provide guidance and support to individuals seeking to use beavers for habitat restoration or manipulation. This group helps guide management of beavers in Oregon. The mission of the Beaver Work Group was to identify research and information gaps to help improve the understanding of beaver ecology and management in Oregon, in order to maximize the ecological benefits beavers provide, especially for federally listed coastal coho, and minimize any negative impacts. Members of this group included ODFW biologists and external stakeholders from academic institutions, other state and federal agencies, trapping organizations, landowners and others.

The ODFW Beaver Work Group developed an annotated bibliography in 2008 that organized the available beaver research by topic: http://www.dfw.state.or.us/conservationstrategy/docs/beaver_bibliography.pdf.

This group has transitioned into the Beaver Action Plan Partnership.

4.1 EVALUATING LANDOWNER-BASED BEAVER RELOCATION AS A TOOL TO RESTORE SALMON HABITAT

Researchers Vanessa Petro (Oregon State University), Jimmy Taylor (USDA, APHIS, Wildlife Services, National Wildlife Research Center) and Dana Sanchez (Oregon State University) conducted a study from 2010 to 2013 to evaluate whether relocating North American beavers from sites where they were not wanted to desirable sites is an effective tool to enhance in-stream habitat for coastal coho.

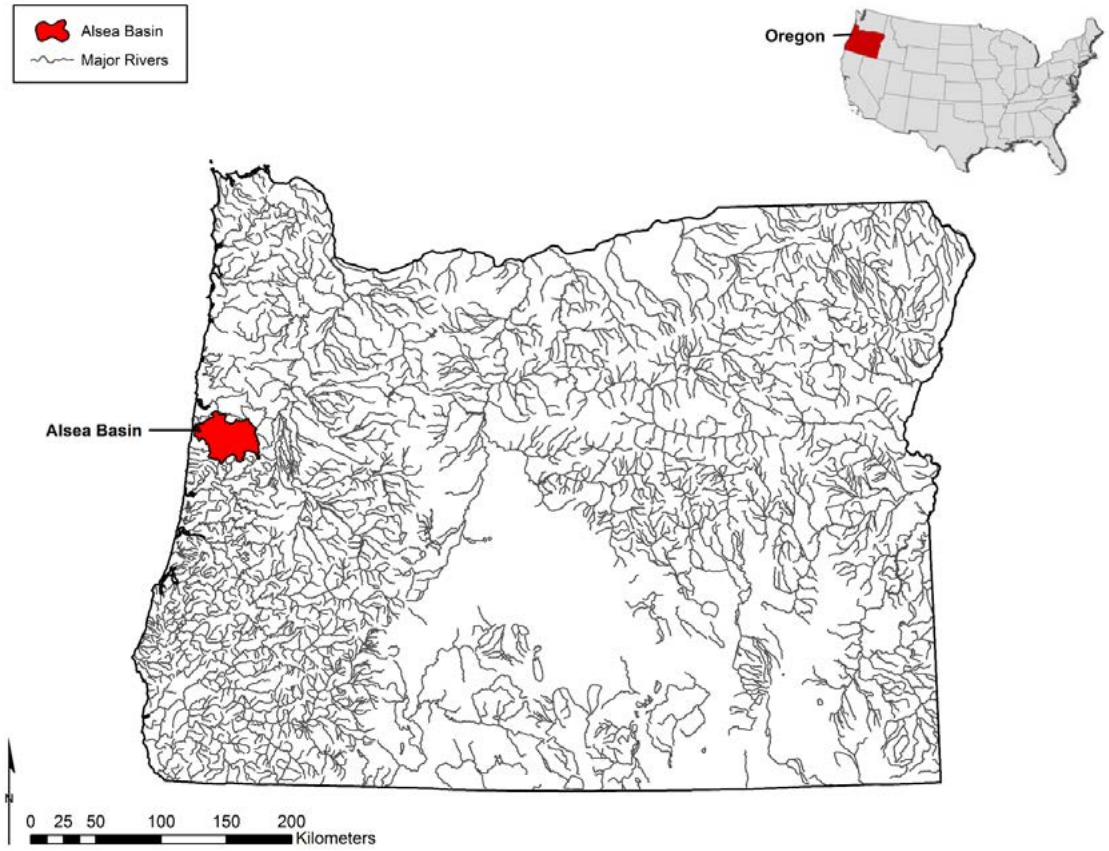
In western Oregon, overwintering/rearing habitat has been identified as one of the leading factors limiting the recovery of coho salmon. Projects that create or enhance these habitats for salmon include placing large wood in streams; however, these voluntary actions by landowners can be expensive. Beavers are known to create the same or similar habitats for no cost.

Researchers followed ODFW's *Guidelines for Relocating Beaver in Oregon* to relocate beavers for this study. This is the first study to evaluate beaver relocation as a tool for improving in-stream habitat for salmon.

Researcher Vanessa Petro takes data on a captured beaver before releasing it into the project study area.

The study was conducted in the Alsea River basin of the central Oregon Coast Range (Figure 2). Researchers used models implemented in a Geographic Information System (GIS) to identify sites where beavers were most likely to establish dams, and where dams were most likely to provide high-quality in-stream habitat for coho salmon. Sites were inspected to ensure they were not already occupied by resident beavers.

Figure 2. Alsea River basin of the central Oregon Coast Range



During the study, the researchers captured 38 beavers from 12 separate family units. They released the captured beavers at nine unoccupied release sites. Three of the release sites had to be restocked with additional trapped beavers due to mortality or emigration.

The results of the study suggest that not all beavers build dams, and that beaver dams are seasonal (often washed out by high flows) in the Oregon Coast Range. Relocating may be an option for some regions in Oregon for nuisance beavers. However, this was not the case in the Alsea basin due to high mortality rates of released beavers (depredation by mountain lions was the largest source of mortality), lack of dam construction and establishment of territories outside targeted release sites. The results showed that small-scale beaver relocation (using the state guidelines for relocating beavers) designed to restore salmon habitat is not likely to be successful. Furthermore, a study published in 2021 found beaver dispersal was more common within than between watersheds in coastal Oregon (Epps et al., 2021). Their results suggest unoccupied suitable habitat may not require beaver relocation if beavers are present nearby within the watershed.

What does this mean for management?

Relocating beavers according to the current state guidelines was unsuccessful in the Alsea basin. Landowners wishing to relocate beavers need to consider potential predators and other factors before relocating beavers. Note that moving beavers requires a permit and that beaver cannot be moved without consulting with ODFW.

4.2 BEAVER RESTORATION IN SOUTHWEST OREGON – A PILOT PROJECT BY THE OREGON DEPARTMENT OF FISH AND WILDLIFE

ODFW conducted a beaver habitat and relocation project in the Umpqua watershed in 2009. The goal of this study was to examine beaver dam habitat relationships in the Umpqua watershed to inform beaver-related restoration actions (DeWaine Jackson, ODFW, pers. comm. 2016).

ODFW examined 740 stream reaches in the Umpqua watershed. They evaluated several habitat characteristics, including vegetation type, diameter at breast height (DBH) of riparian trees, active channel width and other key features important for beavers. ODFW assessed stream reaches with and without active beaver dams. They found that beaver dams occurred more frequently in low-gradient reaches (5% or less). A summary of the beaver dam habitat results is found in Table 2.

Relocating beavers in the Umpqua watershed had mixed results. Landowners need to consider potential causes of mortality and other factors such as stream habitat conditions before relocating beavers.

TABLE 2. HABITAT VARIABLE RESULTS

VARIABLE	DAM	NO DAM
Vegetation	Grass and deciduous	Conifer
Diameter at breast height of riparian trees	Small (15-30 cm)	Large (>30 cm)
Stream gradient	Gentle (5% or less)	Steep (greater than 5%)
Stream order	Order 3	Order 3
Active channel width	Narrow (4-6 m)	Wide (>8 m)
Wetted width	3.6 m	3.6 m
Percent open sky	23%	16%
Stem density	>1,000	>1,000

This table shows that beavers were found more often in narrow, low-gradient streams with grasses and deciduous vegetation with a more open canopy. ODFW used the results of this habitat analysis to conduct a beaver relocation pilot project. ODFW selected beavers that had been reported as causing damage. The beavers were then evaluated for physical condition, weight, age and sex. All beavers were

marked for identification in the field, and the adults were fitted with transmitters. The marked beavers were then transported and released at pre-selected sites. All the releases were made during the spring and summer of 2009. Thirty-seven beavers were released at 13 sites in the North Umpqua and South Umpqua river systems. More than 50% of the released beavers did not survive. They were lost due to:

- predation (9)
- accidental deaths (roadkill, drowning, waterfall) (5)
- natural causes (1)
- unknown (5)
- capture-related (1)

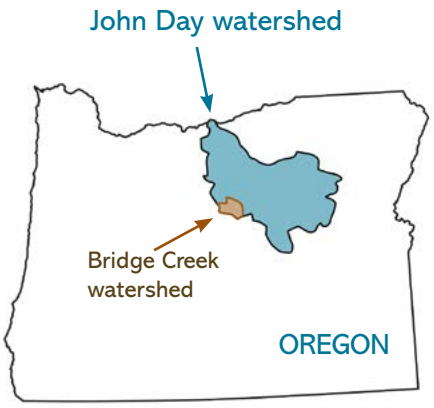
The surviving beavers were variable in their use of the habitat. Some stayed very close to release sites, while others traveled 8 miles from the release site. At the time of the study no new dams had been created, but released beavers were using vegetation available at the release sites.

What does this mean for management?

Relocating beavers in the Umpqua watershed had mixed results. Landowners wishing to relocate beavers need to consider potential causes of mortality and other factors such as stream habitat conditions before relocating beavers.

4.3 WORKING WITH BEAVERS TO RESTORE SALMON HABITAT IN THE BRIDGE CREEK INTENSIVELY MONITORED WATERSHED

The Bridge Creek watershed in eastern Oregon has experienced a history of beaver trapping and cattle grazing. The historic land use of the area, along with the semi-arid climate, has resulted in Bridge Creek's banks being steep and severely eroded, with a limited riparian area and floodplain (Demmer and Beschta, 2008; Pollock et al., 2007). Bridge Creek provides rearing and spawning habitat for an anadromous run of Middle Columbia River steelhead (*Oncorhynchus mykiss*) that is listed as threatened under the Endangered Species Act (ESA 71 FR 834). Due to Bridge Creek's current degraded status, its high potential for improving threatened steelhead populations and its potential to support additional salmonid species, it has been identified as a restoration priority (Columbia-Blue Mountain Resource Conservation and Development Area, 2005).



A dam site within the Bridge Creek watershed.

The Bridge Creek Intensively Monitored Watershed (IMW) project was a long-term study to restore stream and riparian habitat along the incised and degraded lower 20 miles of Bridge Creek. One of the objectives of the IMW project was to use beavers to aid in stream restoration. This included anthropogenic activities to entice beaver occupancy and possible beaver relocation into the project area. At the time this project was implemented, no information existed on residual beaver populations beyond annual dam counts along Bridge Creek (Demmer and Beschta, 2008).

Surveys along Bridge Creek were conducted from 1988 to 2004 by the U.S. Bureau of Land Management. Researchers analyzed these surveys and determined that most beaver dams along Bridge Creek were extremely short-lived, with many lasting less than a year. Spring flooding and flash floods appeared to be the main reason for dam breaches. Further analysis of elevational models found that beaver dams failed and were abandoned under many stream conditions. Most of the dams that were not repaired were originally built in stream reaches that were narrow and incised. Successful dams were found in lower-gradient streams in areas with active floodplains.

Researchers Julie Maenhout (Oregon State University) and Jimmy Taylor (USDA, APHIS, Wildlife Services, National Wildlife Research Center) investigated the ecology of beavers in Bridge Creek in the summer of 2011 and spring of 2012. Researchers used radio telemetry to estimate the home range size, habitat use and survival rates for beavers in Bridge Creek. Mitochondrial DNA was used to investigate the genetic diversity of beavers in Bridge Creek.

Maenhout found that home ranges generally did not differ by sex or age, and that beaver survival rates were very high (92%). The only known source of mortality in this study was illegal trapping. Home ranges encompassed nearly the entire study area of Bridge Creek, and in some cases overlapped, suggesting that beavers had reached biological carrying capacity in Bridge Creek. Habitat analyses showed that beavers generally used habitats randomly. However, beavers used areas of grasses and herbaceous vegetation in greater proportion than available in the spring, despite this being the least available habitat type in Bridge Creek. Genetic analyses showed that diversity of Bridge Creek beavers was much less than beavers from western Oregon.

What does this mean for management?

Although beaver relocation is an attractive tool for managing nuisance beavers while potentially restoring fish habitat, Maenhout's results indicate that Bridge Creek has a healthy beaver population and was not a candidate for beaver relocation. The study confirmed that not all beavers build dams, and that in-stream structure added by humans does not increase dam building by beavers. Although genetic diversity was lower than western Oregon beavers, it did not negatively affect population dynamics at Bridge Creek. Studies such as this are very important to assess the status of local beaver populations before relocation is suggested as a management tool.

Researcher Julie Maenhout tracks beavers in the Bridge Creek watershed.

4.4 LINKING AQUATIC AND TERRESTRIAL ENVIRONMENTS: CAN BEAVER CANALS SERVE AS MOVEMENT CORRIDORS FOR AMPHIBIANS?

Beaver canals like this one located in the Willamette Valley are used by beavers to reach additional food sources.

In Alberta, Canada, researchers examined how beaver canals are used by pond-breeding amphibians during dispersal and migration between aquatic and upland habitats. The focal species for this study was the wood frog (*Lithobates sylvaticus*). This study showed that wood frogs were found more often in beaver canals and declined with distance from canal edges. Researchers conducted visual surveys along pond perimeters. Both young and adult wood frogs were recorded. The frogs were up to nine times more abundant on beaver canals than along shorelines not modified by beavers. Researchers determined that beaver canals provided habitat for adult wood frogs. Additionally, the beaver canals provided movement corridors for emigrating frogs.

In a Washington state study, researchers found that more amphibians were present in areas that had been dammed by beavers (Romansic et al., 2020).

A view of beaver canals not filled with water. Beaver canals are used by many species of wildlife to move between habitats.

What are beaver canals?

Beavers build canals for various reasons. Sometimes canals serve to link one pond to another, or if a beaver family finds a good source of food away from the lodge and wants to use the area, they will build a canal to travel safely between the two areas. Beavers build canals by starting at a water point and pushing through the soil and vegetation using their forepaws to push material to the sides and move rocks away. Beaver canals benefit species besides the beaver such as by offering thermally consistent microhabitats and hiding cover for both juvenile and adult frogs.

Throughout North America, beaver-modified ponds are used by many species of amphibians that need to move seasonally between aquatic and terrestrial habitats in order to reproduce and disperse. Beavers may be useful as a restoration tool for amphibian species beyond the traditional dam-building beavers are known for.

What does this mean for management?

Canal habitat is important for some species of amphibians, especially for dispersal. Beavers are known to create this type of habitat. It may be possible for land managers to use the efforts of beavers to create habitat for amphibians.

Do beaver dams increase the over-winter survival of coho salmon?

The availability of preferred winter habitat is considered one of the limiting factors for survival of juvenile coho salmon in freshwater systems (Nickelson et al., 1992). Studies have shown that over-winter survival of juvenile coho salmon is consistently higher in areas with off-channel rearing habitat, such as ponds created by beavers, than in areas identified as main-channel habitat (Brakensiek and Hanken, 2007). Survival was up to three times better in areas with greater winter habitat complexity (Solazzi et al., 2000; Brakensiek and Hanken, 2007).

What does this mean for management?

Beaver ponds provide benefits to many species, including salmonids. Their activities add complexity to stream systems and can result in the creation of off-channel habitat, which is critical for over-wintering coho salmon. Beavers may play an important role in providing quality over-wintering salmon habitat. Land managers should maintain or encourage beaver ponds on their property in areas where it won't interfere with other management objectives.

Beaver dams like this one create off-channel pond habitat used by over-wintering juvenile coho salmon.

What about beavers and barriers to fish movement?

The Oregon Department of Forestry does not consider a beaver dam a natural barrier in its determination of the upstream extent of fish use.

Beaver dams are usually composed of wood and are partially sealed with mud, rocks and vegetation. They create semi-permeable barriers to the upstream and downstream movement of fish (Kemp et al., 2012). Blocking movement access to fish may cause them to not be able to reach spawning and rearing habitat. However, the magnitude of impact is not easily predictable and dams may only restrict fish movement during periods of low flow. There are studies that emphasize the potential for beaver dams to impede fish movement and significantly impact populations; however, the majority of these studies are speculative and not data-driven (Kemp et al., 2012). In the Pacific Northwest, beaver dams represent temporary structures often washed out during the same high flows that pacific salmon species use to reach their spawning grounds (Taylor, 1999). When not breached or blown out, dams have adjacent side channels that provide additional areas for fish to pass through during high flows. Additionally, the Oregon Department of Forestry does not consider a beaver dam a natural barrier in its determination of the upstream extent of fish use.

What does this mean for management?

Beaver dams are not typically considered permanent fish passage barriers. Land managers should consider leaving beaver dams in place, where practicable.

5.0 Rules addressing beaver conflict on private forestland

Contact your local ODFW office if you have a beaver conflict. They may provide advice, resources or the appropriate permits to resolve your issue.

ODFW adopted new rules regarding beavers on June 14, 2024, as part of House Bill 3464. These rules went into effect July 1, 2024. The new rules no longer classify beavers as predatory animals, which means ODFW regulates the removal of nuisance beaver. Beavers are fur-bearers and may be recreationaly trapped according to current trapping rules during the trapping season of November 15 to March 15.

Emergency beaver conflict

You can address immediate threats to infrastructure caused by beavers without advance notice to ODFW. In the case of emergency beaver conflict, a landowner may:

- destroy the beaver dam
- install mitigation devices (e.g., beaver deceivers), as long as these are in compliance with fish passage requirements
- lethally remove the beaver without advance notification, but any lethally removed beaver must be reported to ODFW

For non-emergencies (e.g., beaver are not damaging infrastructure), you will have up to 30 days to work with ODFW on non-lethal solutions before lethal action is allowed. After 30 calendar days, forest landowners may choose to lethally remove beavers at their discretion.

Note that the 30-day wait period for lethal beaver removal only applies to landowners who do not meet the definition of a small forestland owner (SFO).

Dam removals

Except as needed for road maintenance, operators must submit a written plan to the Oregon Department of Forestry (ODF) prior to removing beaver dams and other natural obstructions from water bodies during forest operations. If the beaver dam is within 25 feet of a culvert, it is considered road maintenance.

A written plan for a beaver dam or obstruction removal must demonstrate that at least one of the following:

- the beaver dam or obstruction threatens existing forests or tree plantations
- the beaver dam removal is part of a population control program approved by ODFW
- retaining the beaver dam or obstruction would result in greater environmental harm than benefit

Recreational beaver hunting and trapping

Beaver hunting and trapping regulations are the responsibility of ODFW, even on private lands. Recreational trapping with a license (i.e., trapping not associated with damage) of beaver on private forestlands, other than small forestlands, must be for personal use only. A licensed fur trapper, who is not the landowner or an agent of the landowner addressing damage, who traps a beaver on privately owned forestland, excluding small parcels of forestland, may not sell or exchange the pelt of the beaver.

Beavers trapped for causing damage on forestland, excluding small forestland parcels, those lethally removed after the 30-day wait period, or those lethally removed due to damaging infrastructure, may still be sold.

Beaver removal

All lethal removal of beavers on private forestlands must be reported to ODFW, where records will be maintained in the agency's wildlife damage complaint system. This action can be accomplished by the landowner or the person doing the removal (landowner's agent). Landowners are responsible for compliance with the reporting requirements. ODFW will likely require the following information:

- name of the person who lethally removed the beaver
- location of the lethal removal (take)
- reason for the take
- number of beavers taken

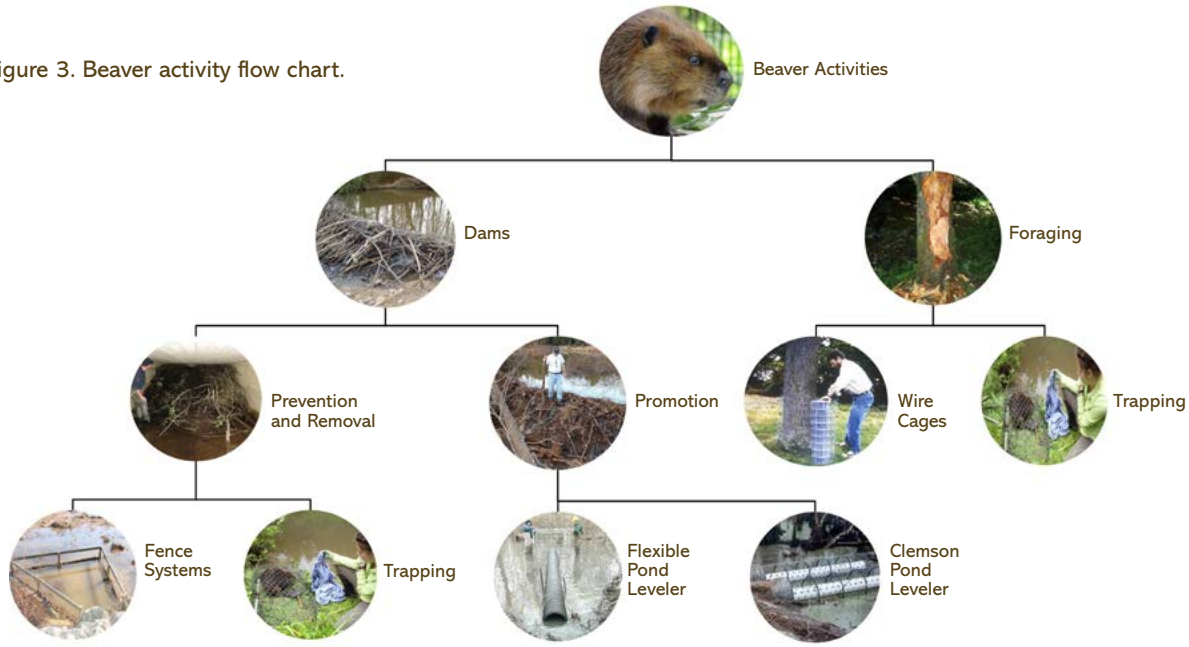
Contact information for ODFW beaver removal reporting at https://www.dfw.state.or.us/agency/directory/contact_us.asp.

Beaver trapping regulations are the responsibility of ODFW. Contacting your local ODFW office is a good idea if you have a non-infrastructure-related beaver conflict.

6.0 What are the current management recommendations for beavers?

Beavers modify habitat. These habitats can be highly beneficial to many other species, including fish, furbearers, reptiles, amphibians, bats, waterfowl, shorebirds, cavity-nesting birds and mammals. Elk also benefit from beavers; they are known to use beaver ponds for wallowing during the summer months. These benefits may come at a cost to some land managers. Management actions may be required to reduce the unwanted influence of beaver habitat modification. Thoughtful tradeoffs in forest management plans should be considered, to accept some beaver influences while managing to reduce the unwanted effects of beaver activity. Traditionally, beavers have been lethally removed from areas where their behavior is unwanted. However, there are many non-lethal ways to manage beavers. We suggest that landscapes can be managed to include beavers and accomplish land management goals. Landowners can meet their objectives using a combination of tools and techniques. The following management tools will assist land managers in maintaining a balance between the need to protect forest stands and road systems and the desire to support healthy beaver populations. Figure 3 shows various beaver activities and an associated methods of management. Details regarding these management strategies are described below.

Figure 3. Beaver activity flow chart.

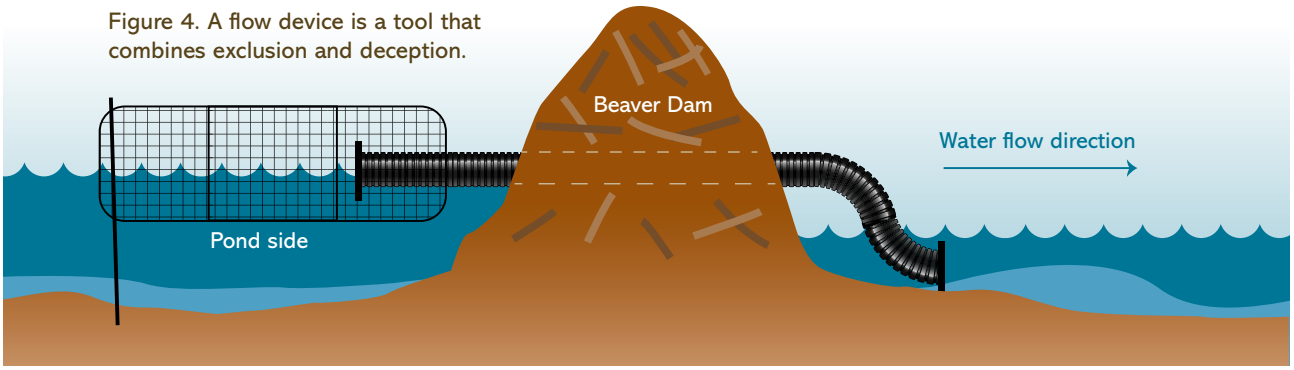


Research wildlife biologist Jimmy Taylor installing a flow device to prevent beaver damage.

FLOW DEVICES AND EXCLUSION

Flow devices can be used to maintain and level out water flow where beavers dam culverts and streams (Taylor and Singleton, 2014). A flow device is a tool that combines exclusion and deception (Figure 4). There are several kinds of

Figure 4. A flow device is a tool that combines exclusion and deception.



flow devices available, but the flexible pond leveler is commonly used to address water level impacts from damming activity. The two flow devices commonly used are the beaver deceiver (trapezoid fence system) and a flexible pond leveler (flexible-pipe-and-fence system). Both systems use a pipe that goes through the beaver dam. The ends of the pipe are protected from the beavers, allowing water to flow through the dam. Flow devices do require maintenance to remain effective, and may be too constraining in areas that experience high water flows.

The best way to protect individual trees from beaver gnawing is to exclude beavers from the tree with fencing. Fencing also prevents movement of other wildlife, which may not be desirable. Chain-link fence will keep beavers away from individual trees. Placement of fencing is important, because high water levels could allow beavers access over a fence. Fencing large areas to keep beavers out is expensive and maintenance-intensive, and may be cost-prohibitive. Additionally, individual tree protection and/or fencing is generally only practical when trying to protect a small number of trees.

Beavers are also known to plug culverts. Fencing can be used upstream of culverts to protect the culvert intake from beavers. The most effective way to prevent beavers from plugging culverts is to combine exclusion fencing with a flow-through pipe.

BEAVER DAM ANALOG (BDA)

Beaver dam analogues (BDAs) are structures put in place during stream restoration efforts to simulate and/or supplement the presence of beaver dams. They are constructed with intent to mimic both the form and function of a naturally created beaver dam, to provide the same ecological and hydrological benefits, and to promote habitat conditions that encourage thriving beaver family units. Like natural beaver dams, BDAs are made of sediment and vegetation, are semi-porous, and are both temporary and biodegradable. Unlike their natural counterpart, BDAs are usually supported by a skeleton of wooden posts driven down into the ground, providing a high level of strength and durability. Risks associated with the use of BDAs are limited, and are generally considered to be outweighed by potential benefits. Risks of BDA failure, and possible negative outcomes such as flooding of infrastructure, can be minimized through careful placement, monitoring and planning (Pollock et al., 2023). BDAs may require routine maintenance, particularly if beavers are not attracted to them.

BDAs are a management tool used to manage landscapes with beavers.

As a restoration tool, BDAs are highly versatile, and can be built to suit the needs of a specific project. BDAs may be helpful for the following:

- creating pool habitat
- improving floodplain connectivity
- expanding riparian vegetation
- creating a more sinuous stream channel
- creating a multi-threaded stream channel
- nourishing streams with sediment
- reducing erosion
- establishing beaver colonies and creating habitat for relocated beaver

While the primary effect of using BDAs in restoration is the reduction and dispersal of stream power, the true scope of impacts is broad, varied, and ecologically far-reaching. BDAs may have the following effects:

- trapping of sediment
- repairing incised channels
- floodplain connectivity and creation
- raising of the water table
- groundwater recharge
- creating conditions for riparian vegetation to expand
- increasing aquatic habitat diversity
- increasing bird habitat
- creating and expanding wetlands
- water temperature buffering in a localized area

REPELLENTS

No chemical repellents have been registered for use to control beavers. Past research efforts have tried to determine the effectiveness of potential repellent materials; however, none were found to be effective, environmentally safe or practical (Miller and Yarrow, 1994).

Biologists relocating a nuisance beaver. Studies have shown that mortality rates are high with relocation.

RELOCATION

Guidelines for relocating North American beavers in Oregon have been developed by ODFW (ODFW, 2017). The purpose of these guidelines is to establish standards for when, where and by whom beavers may be relocated on public and private lands in Oregon, and to provide a process for monitoring and evaluating the success of beaver relocation efforts (ODFW, 2012). Individuals who desire to relocate beavers need to coordinate with ODFW to determine feasibility.

Separate from the ODFW guidelines described above, the *Beaver Restoration Guidebook* was revised and released in March of 2023. This guidebook was prepared by the U.S. Fish and Wildlife Service, the National Oceanic and Atmospheric Administration, Portland State University and the U.S. Forest Service. The goal of this publication is to provide guidance for using beavers to improve ecosystem functions. The guidebook's approach is to use beavers as a partner in restoration. The guidebook is available online (https://www.fws.gov/sites/default/files/documents/The-Beaver-Restoration-Guidebook-v2.02_0.pdf) and may be useful for individuals seeking to relocate beavers or those who seek to use beavers as a tool for restoration. However, land managers should be aware that current research does not support all the recommendations and guidance it presents.

Studies discussed in section 4.0 have shown that mortality rates are high with relocation. Monitoring and establishing measures of success for planned relocation efforts is essential to successful implementation of relocation projects.

"Relocation is not always a solution for troublesome beavers. We are not just going to move the problem," says Eric Rickerson, former deputy administrator, ODFW Wildlife Division. "But there are times where a watershed or land manager knows of an area that could benefit from beaver introduction. That's really what our guidelines are intended to address."

Interview with Robert "Bob" Gilman – Observations from the field

Bob Gilman, the late well-known wildlife damage and control professional and expert trapper in Oregon, started trapping the North American beaver when he was 11 years old. He conservatively estimated he walked more than 80% of the upper tributaries of the Siuslaw River from 1960 to 2000 looking for and trapping beavers. In other words, Bob had more experience with beavers than most. He believed beavers should be managed, and that it's quite possible to have beavers on your property and still manage for timber production.

One thing Bob noticed through the years is that beaver populations appear reduced in areas where wider riparian buffers are required. Bob thought this is because the new vegetation that is preferred and sometimes required by beavers is often excluded by the mature timber along streams. Though wide riparian buffers (with a large conifer component) are great for some species, they aren't for beavers. The wide riparian areas force beavers to travel farther for food, making them vulnerable to predators, especially cougar (*Puma concolor*).

Another reason beavers struggle in some areas is the influx of invasive species such as reed canarygrass (*Phalaris arundinacea*). Reed canarygrass prevents the establishment of food preferred by beavers. If beavers are released into sites with extensive reed canarygrass, their likelihood of survival is low. Bob believed relocating beavers is often unsuccessful because they are released into sites that don't provide refuge habitat or food sources. Beavers need side tributaries where they can build ponds, and deep water to escape predators. In addition, they need food sources close to the water.

Vanessa Petro and Bob Gilman working together to trap beavers for a research project.

Bob Gilman passed away in 2017. Bob was a trapping advocate, author, husband and father. He is missed by family, friends and the community.

Some folks will tell you that beavers don't target Douglas-fir (*Pseudotsuga menziesii*) trees, but Bob saw beavers target them in some cases. In fact, beavers will eat Douglas-fir if it is the only food available. After a generation or two, it may become a preferred food source. Bob spent years trapping beavers from industrial timberland in Oregon. He believed, though, that it isn't necessary to eliminate beavers from forested areas. Instead, he said beaver populations should be managed to the food source (i.e., enhance riparian areas with food species for beavers and/or make sure the number of beavers does not exceed the available food source). Bob suggested that industrial tree farms may not provide suitable beaver habitat in some areas due to required riparian buffer sizes along streams that lack appropriate food sources for beavers.

For people who are interested in maintaining beaver habitat, Bob suggested that by managing beaver populations through annual trapping and other methods, managers can extend the life of a beaver pond (i.e., making sure that the number of beavers present do not exceed the available food). Beaver ponds are known to provide habitat for many wildlife species, and usually occur in areas that aren't great for growing trees. Also, he thought managing the population to match the available food source can limit the damage to Douglas-fir trees.

7.0 Summary

Land managers generally understand the critical role beavers play in the ecosystem. They can improve aquatic and floodplain functions, and their dams help create wetlands and habitat for fisheries recovery (Needham and Morzillo, 2011). However, beavers can create conflict with humans and land managers because they alter habitats in ways that are not always compatible with landowner objectives.

Whether the effects of beavers are positive or negative depends on the perspective of the individual landowner. Habitat modification by beavers, caused primarily by dam-building, is often beneficial to many species. However, the same benefit to wildlife may have a negative impact on an individual landowner. It is important to understand beaver ecology in order to implement successful management strategies. Beaver research is ongoing. The research presented here suggests the following for land managers:

- Not all beavers build dams, and many beaver family units live in bank dens rather than traditional beaver lodges. Counting dams and lodges is not a good means to determine whether beavers are present in a watershed.
- Beaver ponds provide benefits to many species. Land managers may want to maintain or encourage beaver ponds on their property in areas where they won't interfere with other management objectives.
- Beavers are known to create off-channel habitat. Off-channel habitat is important for over-wintering coastal coho salmon and other salmonid species as well as many other native species. Beavers may play a role in improving salmon habitat quality. Land managers may use this information when making management decisions regarding beavers on their property.
- Canal habitat is important for some species of amphibians, especially for dispersal. Beavers are known to create this type of habitat. It may be possible for land managers to use the efforts of beavers to create habitat for amphibians.
- Beaver dams do not always impede passage for fish. Land managers should consider leaving beaver dams in place, where practicable.
- The benefits of beavers for overall watershed health are many. Relocating beavers into watersheds may be an effective restoration tool in some areas. However, it is important for land managers to consider that beavers may not stay in areas where they are relocated. Additionally, site selection is extremely important. Selecting inadequate sites could lead to emigration and high mortality rates of relocated beavers.

A beaver making improvements to a dam at night.

There are many ways to manage beavers. Suggestions for beaver management include:

- flow devices
- exclusion
- lethal trapping
- relocation

These management techniques will help managers maintain a balance between protecting forest stands and road systems while still providing healthy beaver populations. Understanding more about the role of beavers in the ecosystem will help land managers achieve this balance.

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Oregon Forest Resources Institute

About the Oregon Forest Resources Institute (OFRI)

The Oregon Forest Resources Institute supports the forest sector and the stewardship of natural resources by advancing Oregonians' understanding of the social, environmental and economic benefits of our forests.

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