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# Institutional Obstacles to Beaver Recolonization and Potential Climate Change Adaptation in Oregon, USA

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## ABSTRACT

Across the American West, stream flows are becoming more seasonal. Climate models predict that this trend will intensify for the foreseeable future. As a result, moist habitats and human water sources are likely to be diminished in dry seasons while flows will intensify in wet seasons. Through their dam/pond systems, beaver have been shown to increase water storage in ponds and surrounding floodplains, thus slowing winter flows, increasing riparian and meadow water availability, and extending stream flow up to six weeks into dry summer seasons. Thus, allowing an increase in historically low beaver populations could provide a low-cost means of addressing both habitat and seasonality concerns. Yet, in Oregon, beaver are absent from the official discourses on adapting human systems and habitats to climate change. Through forty key informant interviews and an analysis of official policy and publications, this study identifies and critically examines five institutional blockages to beaver recolonization. That analysis clarifies the imprint of political pragmatism and institutional sub-cultures upon beaver presence in Oregon today.

*Keywords:* beaver reintroduction, climate adaptation, institutional cultures, Oregon.

OVER THE PAST DECADE in the Western United States, several nongovernment groups and individuals within government agencies have become interested in assisting beaver recolonization. These agents are motivated primarily by concerns with habitat restoration. Research in Oregon and Washington shows that beaver dam/pond systems can significantly enhance habitat for salmonids (Pollock with various co-authors: 2007, 2004, 2003; Burnett et al. 2007) and for fifty of the 115 species identified for special treatment by the Oregon Department of Fish and Wildlife (2006b; see also Müller-Schwarze and Sun 2003). Other actors are also interested in the abil-

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ity of beaver to create wetland habitat as a way to moderate the predicted landscape-scale drying associated with climate change in the Western United States (Pollock et al. 2012; DeVries et al. 2012; Wild 2011; Bird et al. 2011).

Several studies indicate that the observed shift from winter snow toward rain regimes in the West's highlands will strengthen in the coming decades (Westerling 2016; Mote and Salathé 2010; Nolin and Daly 2006). Related studies forecast that currently increasing winter and decreasing summer stream flows will become ever more pronounced (Chang and Jung 2010; Chang and Jones 2010). Beaver could potentially mitigate against that seasonality in a number of ways (Baldwin 2015). In appropriate conditions, beaver can build up to ten dams per channel kilometer (Warren 1926; Baker and Hill 2003), and in low gradient environments with wide valley bottoms, each dam can bank up to 7,400 cubic meters of water in associated ponds and through local aquifer recharge (Westbrook, Cooper, and Baker 2006). One policy conservation specialist (Vickerman 2011) referred to beaver recolonization as "low hanging fruit"—an inexpensive program with tangible benefits.

Yet, in the official discourse of habitat restoration and climate change adaptation in Oregon, beaver are nearly absent; and across Oregon landscapes, there is little evidence of increased beaver presence. This study asks, "Why?"

In an effort to understand these policy and practical absences, this study examines and characterizes the culture of land and wildlife management professionals and policy makers in Oregon. Through forty key informant interviews and a critical review of literature published by state wildlife management and climate change institutions, the study identifies and critically analyzes five institutional obstacles to beaver recolonization and/or reintroduction. The first two of these are legislative: (1) the need for "political neutrality" in climate change adaptation documents and recommendations published by the state, and (2) the statutory listing and treatment of beaver as predators. The latter three pertain to positions shared by many wildlife management specialists that: (3) beaver currently occupy all appropriate habitat, (4) trapping does not affect populations or recolonization, and (5) beaver reintroduction is ineffective.

## **Historical Background**

Our knowledge of current and historic beaver populations and presence in Oregon and in the West generally is incomplete (see Lanman et al. 2013 for review of pre-historic populations in California). Because beaver are not

game animals, the Oregon Department of Fish and Wildlife (ODFW) has not conducted censuses of them.

Because most beaver populations were significantly reduced through commercial trapping prior to 1840, well before the General Land Office Surveys of the West, there is little historical record of beaver presence or effect on Oregon landscapes. Trapping company records give some indication of beaver populations and depredation. For example, between 1831 and 1834, Fort Vancouver received 405,472 pelts primarily from what is now northwestern Oregon and southwestern Washington (Kebbe 1960). Journals of early explorers and trappers describe how now-channelized and arid valley floors across the American West were once difficult to traverse due to multiple channels and broad riparian flood plains covered by dense vegetation. These were landscapes created and maintained in part by beaver (Ogden 1950; Pattie 1831; Work 1945; Seton 1929). On a continental scale, pre-trapping beaver populations are estimated to have been between sixty million and three hundred million (Butler and Malanson 2005; Naiman et al 1988). Today that population is estimated at three to six million, with most of them in Canada and Alaska (*ibid.*). Anecdotal evidence indicates that beaver populations in Oregon are significantly below pre-Euro-American contact levels. The state does not census beaver and no estimate of current populations is available.

Over the past 115 years, state and federal governments have vacillated between promoting and killing beaver. In 1899, the Oregon legislature empowered the Game Commission to enforce a new ban on trapping. Beaver populations increased as a result (Kebbe 1960). In 1918, the trapping ban was lifted and populations again declined. In 1932, the state re-instituted a ban on killing beaver on lands outside the agriculturally important Willamette Valley. At the same time, the United States Forest Service (USFS), Bureau of Biological Survey and the Oregon State Game Commissioner cooperated in live-trapping beaver where plentiful and reintroduced 962 beaver to areas where humans had extirpated beaver. From 1939 through 1945, the state reintroduced more than three thousand beaver, and populations increased notably (*ibid.*, 4). In 1945 the program enlisted 590 primarily Willamette Valley landowners interested in hosting beaver on their property. By 1950 the number of participants had increased to 1,500. As an increasing number of farmers were learning to work with beaver, others advocated for increased efforts at extirpation. During the same period, the annual number of nuisance removals increased from 3,000 to 6,000 (*ibid.*). Unable to satisfy all requests

for nuisance removals by live-trapping, the state again opened agricultural lands to limited trapping in 1951.

In the 1970s the idea that beaver could be useful in restoring riparian habitat again gained currency among certain public lands managers. Federal and state agencies closed several stream reaches to beaver trapping (ODFW 2010b). In most cases, those reaches are on lands managed by the Bureau of Land Management (BLM) and the USFS. The entire Mt. Hood and much of the Ochoco National Forests, for example, were and remain closed to licensed beaver trapping. In the 1990s the listing of symbolically and economically important salmon species as “endangered” spurred further study of beaver-fish interaction (Mitchell and Cunjak 2007). Several interviewees in the current study reported that fisheries biologists with the ODFW found that in the Oregon Coast Range, the single greatest impediment to coho salmon restoration was a lack of pools that provide refuge from high winter stream flows that flush juveniles to sea prematurely. The proposition that reintroduced beaver could again provide that ecosystem service is discussed widely among ODFW officers.

Today in Oregon, the “Beaver State,” there is no consensus on beaver among the various groups charged with the management of public lands. This study finds that groups and individuals who are against increased beaver presence largely control public policy and its formation, and through legal institutions have made killing beaver largely legal and publicly invisible. The analysis then turns to interviews with professionals practically engaged with beaver management and identifies three cultural institutions that work against support of beaver recolonization in Oregon.

## Methods

This paper is primarily an analysis of discourse, in the broad sense of the term, and includes extant literature, ongoing public discussion, legal, cultural, and political institutions, everyday operations by agents that affect beaver, and the understandings that guide management agendas and actions. The study employs three primary methods to gather information for analysis: (1) a review of thirteen state publications on climate change and adaptation, (2) the discourse and policy produced through meetings held in Oregon in December 2010 and February 2011 by the Oregon Watershed Enhancement Board, the Oregon Sustainability Board, and the Oregon Global Warming Commission, and (3), forty open-ended interviews with thirty-six key informants. Those informants included eight serving officers

of the Oregon Department of Fish and Wildlife (biologists specializing in fish or in wildlife, stream restoration experts, and regional and agency managers). The study also included interviews with representatives of the USFS, the BLM, the Oregon State University Agricultural Extension Service, and the Oregon Climate Change Initiative. Interviews also included representatives from several non-government environmental organizations, including the Climate Leadership Initiative, the Beaver Advocacy Committee, the Defenders of Wildlife, and three watershed councils. Interviewees were selected for their roles as wildlife managers generally, and familiarity with beaver reintroduction and recolonization specifically. Interviews were conducted via telephone and in person from January to August of 2011.

As an inductive study, interviews were semi-structured. Questions addressed four themes: (1) informants' understanding of beaver in Oregon and their organization's position, (2) the basis of those understandings, (3) opinions regarding beaver reintroduction and recolonization, and (4) perceived problems with beaver reintroduction and recolonization. Discussions normally followed the informant's expertise and extended beyond these themes in ways unique to each interviewee.

I received considerable cooperation from interviewees. Perhaps because I have trained very broadly as a geographer of human-environment relations, interviewees seemed at ease discussing diverse matters from policy formation to geomorphic stream response and habitat restoration. As a native of the area, I could discuss places and issues of concern with a familiarity that may have encouraged interviewees to be forthcoming with detail and opinion. Respondents are treated confidentially, as information provided could affect professional relationships. Officers of the ODFW were especially generous with their time and candid in their responses—suggesting a relatively healthy intra-institutional environment.

## **Political Obstacles to Beaver Reintroduction**

### *Obstacle #1: Political Neutrality*

The publication of reports by the State of Oregon is a political process. In order to be published, reports must not raise objections from the legislators and lobbyists who approve and fund them. This need for what informants called “political neutrality” shapes reports on climate change in important ways.

Between 2008 and 2017, nine agencies and state-mandated workgroups published thirteen studies addressing climate change and wildlife and land adaptation (see Table 1). Reports such as these play a central role in state policy and practice. And even though the potential benefits of beaver re-colonization are both acknowledged in peer-reviewed (Hood and Bayley 2007; Collen and Gibson 2001) and grey literature (Bird et al. 2011; Wild 2011; Tippie 2010), there is no mention of beaver in any of these reports. This study sought to understand this absence through an analysis of the reports and the report writing and publication process.

Publishing Group	Title	Published
Oregon Climate Change Research Institute	<i>The Third Oregon Climate Assessment Report</i>	2017
Oregon Department of Fish and Wildlife	<i>Oregon Conservation Strategy</i>	2016
Department of Land Conservation and Development	<i>Strategic Plan 2014-2022</i>	2014
Oregon Water Resources Department	<i>Oregon's Integrated Water Resource Strategy</i>	2012
Oregon Global Warming Commission	<i>Report to the Legislature: 2011</i>	2011
	<i>Interim roadmap to 2020</i>	2010
Oregon Water Resource Commission	<i>Preparing Oregon's watersheds for climate change</i>	2010
	<i>Prioritization framework: Improvement priorities at basin and watershed scales (draft)</i>	2010
Adaptation Framework Work Group	<i>The Oregon climate change adaptation framework</i>	2010
Oregon Climate Change Research Institute	<i>Oregon climate assessment report</i>	2010
Department of Land Conservation and Development	<i>Climate ready communities: A strategy for adapting to impacts of climate change on the Oregon Coast</i>	2009
Oregon Climate Change Integration Group	<i>A framework for addressing climate change</i>	2008
Oregon Department of Fish and Wildlife	<i>Preparing Oregon's fish, wildlife, and habitats for future climate change: A guide for State adaptation efforts</i>	2008

Table 1.—Recent publications by State of Oregon agencies and workgroups reviewed for this section.

In Oregon's official response to climate change, two work groups are prominent. The Oregon Climate Change Research Institute (OCCRI), a collaborative group of more than eighty authors, leads efforts to characterize ongoing and expected effects of climate change. In its first full report (2010), OCCRI identified four key environmental changes: increases in temperature of about 0.2-1°F per decade, warmer and drier summers, some evidence of increased extreme winter precipitation events, and sea-level rise aggravated by greater wave heights during storm events. Each of these projected trends is already evident in environmental records.

The second group, the Adaptation Framework Work Group (AFWG), is charged with creating an institutional framework to guide and enable state agencies in their efforts to mitigate and adapt to climate change. The AFWG (2010) translated the four primary changes identified in the OC-CRI report into eleven risks likely to affect Oregon landscapes in significant ways. Those risks and their relative probability of occurrence are listed in Table 2. Of the risks identified by the AFWG, numbers 2, 3, 5, 7, 8, 9, and 10 all result from an increased seasonality in hydrologic regimes. All are exacerbated by decreasing storage of water in landscapes in the form of snow. Though a literature addressing the ability of beaver to help adapt to these effects of climate change is newly emerging (see Bird et al. 2011; Wild 2011), knowledge of the role beaver play in decreasing hydrologic seasonality at local scales has circulated for some time (Naiman et al. 1988; Baker and Hill 2003). Yet, the in publications listed in Table 1, beaver are completely excluded from the texts; though a beaver is prominently pictured on page 5 of the ODFW's *Preparing Oregon's Fish, Wildlife, and Habitats for Future Climate Change* (2008).

The absence of any mention of beaver or beaver recolonization is part of a wider pattern revealed in an analysis of the reports. Generally, the reports avoid calls to make *any* material changes. Instead they recommend: increasing environmental monitoring, increasing education in public schools, identifying new funding sources for related programs, reviewing and developing state policy, and investing in building state agency capacity. The reports also call for increasing capacity for "adaptability" and/or "resilience," though the meanings of these terms are not elaborated, except to suggest greater empowerment of local-scale agencies and projects.

The document that comes closest to specific calls to action is the ODFW's *Preparing Oregon's Fish, Wildlife, and Habitats for Future Climate Change* (2008). There, the agency recommends investing in implementation of the *Oregon Conservation Strategy* (2006b), a far-sighted document directing the ODFW to address critical issues, including threatened species. My review of that document suggests that more beaver ponds could benefit eleven of the sixty-two birds, two of the five reptiles, seventeen of the eighteen amphibians, and twenty of the thirty fish species listed for special treatment (compiled from pages 320–349). And even though every ODFW officer interviewed for this study had a well-defined opinion regarding beaver, the animal is completely excluded from the report.

Rank	Risk	Likelihood	Beaver mitigation
1	Increase in average annual air temperature and likelihood of extreme heat events	Very likely	
2	Changes in hydrology and water supply; reduced snowpack and water availability in some basins; changes in water quality and timing of water availability	Very likely	Direct
3	Increase in wildfire frequency and intensity	Likely	Indirect
4	Increase in ocean temperatures with potential for changes in ocean chemistry and increased ocean acidification	Likely	
5	Increased incidence of drought	Likely	Direct
6	Increased coastal erosion and risk of inundation from increasing sea levels and increasing wave heights and storm surges	Likely	
7	Changes in abundance and geographical distributions of plant species and habitats for aquatic and terrestrial wildlife	Likely	Indirect
8	Increase in diseases, invasive species and insect, animal and plant pests	Likely	Indirect
9	Loss of wetland ecosystems and services	Likely	Direct
10	Increase incidence and magnitude of damaging floods and frequency of extreme precipitation events	More likely than not	Direct
11	Increased incidence of landslides	More likely than not	D23

Table 2.—Ranked list of likely risks posed by climate change in Oregon (AFWG 2010, 5).

In order to understand this absence, I attended three state board meetings. I interviewed six board members; several of these explained independently that report acceptance and publication is a primary goal of boards. Several respondents also related that because reports must be approved by legislative committees, they must not include content that might raise objections from variously interested politicians. Informants referred to this quality as “political neutrality.” Several board members indicated that the boards concerned were particularly “risk averse,” i.e., concerned with continued funding and conscious of the need for political neutrality. Interviewees also reported that, as a result, reports are also somewhat “action neutral.”

Responses regarding beaver specifically were consistent with this wider pattern. At meetings of the Oregon Watershed Enhancement Board and a joint meeting of the Oregon Sustainability Board and the Oregon Global Warming Commission, two board members and one agency expert independently indicated that there has been informal consideration of using beaver to mitigate wetland loss. Due to the low cost of beaver recolonization, informants characterized it as especially attractive, given the currently constrained financial capacity of state agencies. At another meeting, two board members commented that representatives from the Department of Agriculture (DOAg) have, on several occasions, expressed “strenuous objection” to including any language suggesting that beaver should be encouraged as a strategy to mitigate or adapt to the effects of climate change. Thus, beaver are not politically neutral; their inclusion threatens the acceptance and publication of agency reports representing weeks and months of effort.

### *Obstacle #2: The Statutory Classification of Beaver as Predators*

In Oregon, two bodies of law regulate beaver taking. The ODFW defines beaver as fur-bearing animals and regulates trapping accordingly. Under that regime, all beaver taking must be licensed. In order to obtain a license, the ODFW requires that applicants take a course on allowable practices, and at the end of each season, trappers must submit a harvest report card in order to obtain a license in subsequent years. Under the ODFW regime, property owners are required to file for a damage permit before they may legally kill a beaver on their land. Thus, the ODFW has the ability to regulate and accurately track human taking of beaver (ODFW 2010b). My analysis

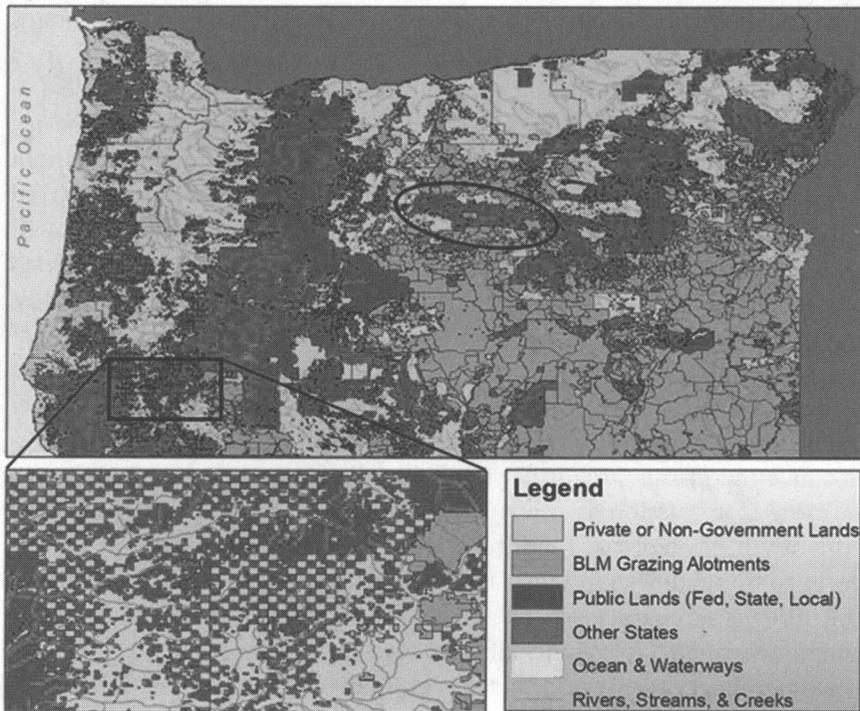


Figure 1.—Mapping human predation regimes in Oregon. Oregon statutes allow unregulated beaver predation on all private and leased public lands. Trapping is regulated by permit only on non-leased public lands. The oval indicates where Ochoco National Forest is. Inset map illustrates range fragmentation in terms of predation regime.

of data provided by the ODFW indicates that from 1998 to 2010, the mean average annual trapping take was 2,971 beaver.

However, under the advocacy of the Oregon Department of Agriculture (DOAg), a second body of law has also been applied to beaver “control.” Oregon Statute 610.002 defines predatory animals as “feral swine . . . , coyotes, rabbits, rodents [beaver] and birds that are or may be destructive to agricultural crops, products and activities, but excluding game birds and other birds determined by the State Fish and Wildlife Commission to be in need of protection. [1959].” The statute enables land holders to remove such animals at their discretion. The ODFW asked the Oregon Department of Justice (DOJ) for clarification regarding the two regulatory regimes. The DOJ

opinion found no conflict in these two regimes in relation to the Endangered Species Act, and so let the statutes stand (Arnold 1984).

It is important to note that the Oregon DOAg also represents the timber industry. Long the center of the Oregon economy, logging companies have invested many tens of millions of dollars in extensive road networks with thousands of stream contacts. Because beaver may block road culverts or otherwise incorporate road grades in their dam projects, beaver activity can lead to road failure. Thus, the industry has significant interests in the right to “control” beaver on its lands. About forty-five percent of the state is privately owned, and so falls under this statute.

As Figure 1 illustrates, the area under the “beaver as predator” regime is significantly expanded by ORS 610.105. That statute states, “Any person owning, leasing, occupying, possessing or having charge of or dominion over any land, place, building, structure, wharf, pier or dock” may “immediately and continue in good faith to control” any listed predator. About thirty percent of Oregon lands are public lands held in lease, primarily by grazing and logging operators. Thus, across seventy-five percent of Oregon lands, beaver may be killed without record or regulation.

Further, the Predator Statute also forbids all state agencies from requesting any information regarding killing of listed animals. As a result, all evidence of beaver extirpation under the Predator Statute can only be anecdotal, and therefore may be dismissed as such.

### **Institutional Obstacles within the ODFW**

Through interviews, the officers of the ODFW and several other experts expressed considerable difference in their understandings of and opinions about beaver in Oregon. In the following discussion, I identify three commonly held positions that work against beaver recolonization and reintroduction. After describing each, I critically analyze the discourse supporting these positions.

#### *Obstacle #3: The Position that Human Predation Does not Decrease Populations*

Within the ODFW, officers hold a wide range of positions regarding the effect of human predation on beaver populations. Many interviewees, both within and especially from outside the ODFW, believe that human predation inhibits beaver presence and recolonization. Five ODFW officers reported that they understood that fisheries specialists in particular felt that beaver

taking was problematic. Alternatively, four officers disagreed for a variety of reasons.

Notably, few people trap beaver by permit in Oregon. From 2000 to 2009, the number of licensed trappers averaged 184. Two interviewees indicated that this contingency, though small, had been “very effectively” represented in the legislature through the Oregon Trappers Association (OTA), and that the OTA maintains close ties with Oregon’s still powerful logging industry. Two interviewees stated that in early 2011, the ODFW was working to rebuild apparently strained relations with the OTA, explicitly including the association in trapping policy discussions. Several of the interviewees also characterized beaver trappers as good stewards of beaver populations, indicating their understanding that beaver populations need to be actively checked.

More importantly, these reported trappings do not reflect “removal” under the predator statute, as discussed above. Anecdotal evidence from a number of sources indicating that beaver extirpation is ongoing was supported by a public statement from a JWTR Timber Company spokesperson (KWP 2011). Even though JWTR owns 950 square miles of forestland, (approximately sixteen percent of Klamath County, and much of that county’s forested area), their spokesman stated that they have had only one nuisance beaver on their land (time period was unspecified), they have fewer beaver than in surrounding National Forest lands, and that he did not know why there were not more. He also stated that people were removing beaver without explicit permission of JWTR, thus acknowledging their tacit approval of the practice. Needham and Morzillo’s study provides further indirect evidence of beaver killing. It found that twenty-four percent of rural respondents indicated that they “do not want beaver on my property or on my neighbors’ property,” and twelve percent have either contracted to have beaver killed or done so themselves (2011, 17). Confirming this result, residents attending a related workshop in Chiloquin, adjacent to JWTR lands, reported frequent encounters with beaver carcasses marked by bullet wounds.

Thus, there are indications that human predation may significantly decrease beaver presence. The Predator Statute prohibits research into the scale of non-permitted taking.

#### *Obstacle #4: The Position that Current Range is Appropriate and Maximal*

Several of the ODFW officers interviewed asserted that beaver already occupy their appropriate range, and therefore efforts to allow or encourage range expansion are inappropriate. Much of what follows in this subsection is an analysis of the origins and accuracy of these assertions.

Interviewees offered several lines of evidence to support this claim. The most common argument offered against further efforts to expand beaver range—and this was offered in a very matter-of-fact manner, independently by three Wildlife Division officers—is that where there have been trapping closures, in some areas for up to forty years, beaver populations have not increased. The consensus within this subculture is that if the habitat is appropriate, beaver are already there. Several interviewees added that there is good connectivity along stream reaches, and that when two-year-old beaver leave the family, they often establish new pond systems; thus, populations are believed to be diffusing normally. Several interviewees also referred to an internal study that concluded that beaver populations were never great in Oregon.

The following discussion identifies four counters to these assertions. First, as noted above, the ODFW does not census beaver and has no data on populations, so statements regarding populations and range are not drawn from quantitative analysis. Second, as an ODFW wildlife biologist who has studied beaver relocation in the Cascade Range suggested, it is unknown how far beaver will travel to find good habitat, or what constitutes friction in that search. He has radio tracked a newly released beaver travelling up to eight miles in one night. However, that occurred immediately after a release, and travel was downstream, while recolonization is often a more difficult upstream journey.

A third counterpoint echoes the second. In support of the earlier assertion, several interviewees referred to the paucity of beaver in the Ochoco National Forest (ONF), even though trapping has been suspended for decades. However, as Figure 1 indicates, the ONF is essentially an island surrounded by private and leased public lands, where beaver may be killed without license or record. Further, while trapping has been suspended, “removal” under the Predator Statute has remained very much in place upon any leased land, up to 95.6 percent of the 344,000 ha forest. Additionally, as the inset map in Figure 1 illustrates, streams across much of Oregon seldom

offer continuous conduits that are safe from human predation. Risk of animal predation during migration has also increased over the past thirty years as predator populations have rebounded (ODFW 2006a). A beaver without a den to shelter in during daylight hours is very easy prey for cougar, coyote, and bear. Thus, assertions of effective habitat connectivity are problematic.

A fourth counter regards the understanding that, based upon historic accounts, contemporary beaver populations in Oregon's Coast Range resemble pre-contact levels. Without exception, each of the four interviewees who made this assertion referred to an internal report by R. E. Rainbolt (1999), which concluded that historically "Beavers were *common* in the Coast Range, but not *abundant*" (ibid., 12, emphasis in original, terms not defined).

There are several exceptions to the Rainbolt report. First, most of the primary sources cited pertain to the estuary of the Columbia River. The report notes that there, both Captain Gray in 1792 and Lewis and Clark in 1805 (Lewis 1903) wrote that local peoples traded beaver pelts and on occasion produced several hundred pelts for trade. Lacking any "record or estimate of historic beaver populations in the Coast Range" (ibid., 3), Rainbolt reviewed logs recorded by expeditions dispatched by the Hudson Bay Company to the "Coast Range." In fact, the 1826 expedition featured in the report did not venture beyond coastal estuaries, "due to channel obstruction by woody debris" (Davies in ibid., 5). According to Davies' log, natives along the central coast reported that "in the interior there were plenty" (ibid.) of beaver, and the expedition reported seeing many "beaver vestiges." Further south, on the Rogue River, the same expedition reported signs of beaver on every stream.

In further support of his assertion that beaver were not abundant, Rainbolt cites several sources that suggest that in the 1820s, local peoples, even in the Columbia estuary, were disinterested in hunting beaver. He concludes from this that either the local people were very "indolent" and/or that beaver were not plentiful enough to support a native trapping economy (ibid., 7–8).

However, Rainbolt fails to consider that those native peoples were suffering a demographic collapse as a result of exposures to European diseases. Boyd (1999) reports that by 1801 the Chinook, Tillamook, Alsean, Siuslawan, Coosan, and Tututni peoples had all suffered at least one smallpox epidemic, and in 1824 the groups at the north and south end of this range were known to have suffered an additional smallpox/measles epidemic. As a result, a pre-contact native coastal population estimated at about 11,300 people was reduced to 1,030 individuals at the time of treaty signings between 1853 and

1874. This could certainly explain the observed lack of interest in trapping among native peoples.

One additional point bears explication. In a 1988 review of this same historic literature, Guthrie and Sedell concluded that beaver were *plentiful* in the coast range in the first half of the nineteenth century. The authors highlight a 1854 account of traversing a slough near the Coquille River on the central coast. There, Esther Lockhart reported that boatmen had to stop at least every few hundred feet to break a beaver dam to allow the boat to pass, and that the dams would be back in place the next day. The authors suggest that the Coast Range was not heavily trapped because the mountain men of the time eschewed the soaking rains of Oregon's Coast Range.

Though it may seem a fine distinction, *plentiful* and *common* have very different meanings. *Common* implies present, as beaver are today. *Plentiful* connotes so many as to be easily gotten. By attending to Rainbolt's interpretation, and dismissing Guthrie and Sedell's, wildlife officers support a no-management policy, which is consistent with their institutional capacity. The ODFW does not have the financial resources to live-manage beaver. Interestingly, the Guthrie and Sedell study has been effectively excluded from institutional memory; none of the interviewees mentioned the study.

#### *Obstacle #5: The Position that Reintroduction Is Ineffective*

A majority of interviewed ODFW officers suggested that beaver reintroduction is ineffective—this despite the notable success of the state's reintroduction efforts in the 1940s discussed above. Several officers referred to a pilot reintroduction effort sponsored in part by the Beaver Workgroup (an association of interested parties organized by the ODFW). An ODFW field biologist closely involved with the project reported that thirty-four adult beaver were live-trapped along the lower reaches of the Umpqua River, fitted with radio transmitters, and released at thirteen sites along three reaches of tributaries to the Umpqua River. Seventeen of the transplants are known to have died: nine by predation, four by vehicle collision, and four through other accidents. Of the remaining, ten transmitters have either fallen off or are no longer being tracked. Seven adults were still being tracked at the time of the interview. From this, one may reach two very different conclusions: a focus on confirmed living beaver yields a survival rate of twenty-one percent, while a focus on confirmed dead implies a survival rate of up to fifty-three percent. None of the officers referring to the program cited the latter figure.

The Beaver Workgroup has made efforts to increase the efficacy of beaver reintroduction. The Department has published a protocol for beaver reintroduction (2010a), and now maintains a Web page on live management. The biologist in charge of the Umpqua relocation project reported that much was learned and that subsequent projects could have a better success rate. The nongovernmental Beaver Advocacy Committee, led by Stanley Petrowski and Leonard and Lois Houston from the South Umpqua River, has had better success in relocation efforts in the same watershed, and is critical of the slow pace of the Beaver Workgroup. They assert that much of the Workgroup's research agenda has already been explored and is in the literature. In response, one ODFW officer suggested that those studies are often not particular to Oregon. Because the ODFW is responsible for any problems caused by relocation, caution on their part is understandable.

And, as one board member explained, historically, rural lawmakers' reactions to constituent complaints about beaver damage can be "swift and violent."

### **Discussion: Where to Go from Here?**

Beaver recolonization faces a number of obstacles. Very real environmental obstacles inhibit beaver recolonization and reintroduction in Oregon. Several interviewees indicated that habitat conditions across much of their former range are unsuitable, following decades of vegetative denudation, stream channelization, and removal of large woody debris—all leading to more-rapid drainage and dam-destroying increases in stream power. Interviewees indicated that the cost of preparing a site for successful reintroduction can be quite high.

The institutional obstacles identified here also pose obstacles to beaver recolonization and reintroduction. However, as discursive constructs, these may be moderated through education. The need for political neutrality in committee reports might be blunted by changing the public's perception of beaver. Needham and Morzillo's (2011) study—published by ODFW—found that fifty-seven percent of rural landowners surveyed expressed interest in having beaver live on or near their property. The study also found that twenty-four percent of rural respondents did not want beaver nearby. Pro-beaver activists, such as Heidi Perryman of Worth a Dam in Martinez, California, have found success in changing anti-beaver attitudes through public education, particularly with children. Whether timber-land manag-

ers and others at risk of damage from beaver will be willing to voluntarily engage in damage mediation measures also seems questionable.

Nearly all interviewees who mentioned the statutory classification of beaver as predators also stated their belief that the designation has diminished beaver populations. Those interested in increasing beaver presence felt that de-listing beaver as predators would lead to significantly higher beaver populations. Although the ODFW could appeal the original DOJ opinion, consistent with ORS 610.002, the department might also move administratively to define beaver as “in need of protection,” thus effectively de-listing them. Before any of these alternatives can be effective, the state will have to build institutional capacity to manage beaver populations and limit damage to roads. Oregon State University’s Agricultural Extension Service, for example, is charged generally with educating rural landowners; however, that agency has only one wildlife specialist for the entire state (Sanchez 2011). Several ODFW officers similarly stated that the department does not currently have the human resources to respond to beaver nuisance complaints.

Reintroduction poses its own problems. Though many of the particulars of keeping beaver alive through the trapping and transportation process have been addressed (e.g., Tippie 2010; ODFW 2011), release site selection remains an issue. Wildlife managers have promoted the use of habitat suitability indices (or models) to identify optimum release sites (see Buckley et al. 2011; Wild 2011). However, those models are problematic in their assumption that beaver presence and absence are reliable indicators of habitat quality (Baldwin 2013). In so doing, they overlook the role of human predation in creating absence and so may mischaracterize habitat preferences and suitability (Carpenedo 2011).

## Conclusions

While the policies and practices of wildlife- and land-managing institutions are, to an extent, science-based, they are also socially and culturally influenced. In an effort to understand the ways various institutions in Oregon have either failed to promote and/or have actively worked to inhibit beaver recolonization and reintroduction, inductive interviews with relevant experts and other agents provide certain insights. This study identifies specific cultural forms among wildlife and lands managers that work against allowing beaver recolonization and support the dismissal of possibility, and several of these beliefs are not well-founded. From a political economy perspective, powerful agricultural interests drive the need for political neutrality

among state agencies and have worked to make beaver killing very possible and nearly invisible.

Evidence suggests that beaver could help human and non-human communities adapt to ongoing and projected effects of climate change in the Pacific West (see Baldwin 2015), and do so at relatively low cost. Whole critical literatures address why enlisting non-human beings is philosophically difficult (e.g., Plumwood 2002; and Baldwin 2016, 2006). Pragmatically, as keystone species, beaver produce their own spatial architectures that may conflict with land-owners' and -managers' intentions. On the other hand, beaver can also be managed in nonlethal ways to work cooperatively with land managers interested in cultivating a moister, and so a livelier, landscape in the face of anthropogenic climate change (Lundquist and Doleman 2016; Pollock et al. 2007; OWIC 1993).

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