ABSTRACT

In the last decade, scientific research, news stories, and documentaries have highlighted the value that beavers (*Castor canadensis)* can bring to various ecosystems. Beavers build dams that create complex habitats and increase biodiversity. Research has shown that beaver dams dramatically alter streamside vegetation, increase groundwater elevations, augment stream productivity, and provide fish habitat. Due to the vast information available regarding the benefits of using beavers in restoration projects, this study aims to analyze the social challenges to the reintegration of beavers in Ada County and Owyhee County.

In recent years, beaver-related projects have become more popular among restoration and conservation groups in semi-arid and arid regions throughout the United States. Successfully managing beaver populations and resolving conflicts surrounding beaver-related restoration projects involves understanding current beaver population trends and analyzing their correlation to public attitudes. Information on beaver sightings and beaver harvesting reports are used to analyze beaver population trends. Information on approaches to beaver management in Ada County and Owyhee County were also collected. This study aims to identify social constraints landowners, ranchers, land managers, state, city, and federal governments, and other stakeholders may come across when managing beavers. Furthermore, the goal is to foster greater understanding of the opportunities and challenges of using beavers in restoration projects in Ada County and Owyhee County.

INTRODUCTION

Ben Goldfarb's book, *Eager: The Surprising, Secret Life of Beaver and Why the Matter,* writes that before European's settled in North America, beaver populations were estimated to be between 60-400 million individuals. Furbearers, especially beavers, were trapped heavily in the 1500s to obtain pelts to make hats, coats, capes, gloves, and other pieces of clothing in Europe and the eastern United States. Due to the economic opportunities beavers provided, many trappers moved west as the demand for fur continued to increase. By the 1700s, beaver became the newest source for international commerce.[1]

Fur trade continued to grow in the Pacific Northwest through the early 1800s as settlers began to move in. In 1818, the United States and Great Britain signed the Treaty of 1818 that allowed for joint occupation and control in the Oregon territory. At the same time, neither country owned the land. In an effort to keep settlers from moving farther west, The Hudson Bay Fur Company sought to create "fur desert" where they attempted to trap as many animals as possible to take profits away from American trappers.[2] Notably, they had its largest pelt-trading year in 1875 by vending more than 270,000 pelts.[3]

A large amount of trapping lead to the beaver's near extinction in the late 1800s. This triggered laws throughout the west that protected beaver from being hunted or trapped. Even though heavy trapping ceased around 1870, it is estimated that there were only 100,000 beaver left by 1900.[4] Between the 1780s and 1980s, a study by the U.S. Fish and Wildlife Service revealed that the United States had lost 53% of its original wetlands.[5] The loss in wetlands caused an increase in erosion in rivers and creeks, depleted water tables, desertification, and triggered the disappearance of species including

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[1] Nicolaas Bowes et al. "Ecosystem experiment reveals benefits of natural and simulated beaver dams to a threatened population of steelhead (*Oncorhynchus mykiss)*," *Scientific Reports* 6, no. 28581, (2016) doi: 10.1038/srep28581

[2] Joel Schwarz, "Hudson's Bay Company Policies set stage for modern environmental struggles," *University of Washington* (2004), https://www.washington.edu/news/2004/12/13/hudsons-bay-company-policies-set-stage-for-modern-environmental-struggles/

[3] Ben Goldfarb, *Eager: Eager: The Surprising, Secret Life of Beavers and Why the Matter* (White River, VT: Chelsea Green Publishing, 2018), 47.

[4] Valerie Brown, "Welcoming the Beaver," *Columbia Insight Independent Environmental Journalism* (2019), https://columbiainsight.org/welcoming-the-beaver/

[5] Thomas E. Dahl, "Wetlands Losses in the United States 1780's to 1980's," U*.S. Department of the Interior, Fish and Wildlife Service, Washington, D.C.* (1990), 1.

fish, amphibians, insects, and plants.[6] As drastic changes throughout the U.S. landscape became increasingly notable, individuals turned to the original ecosystem engineers to help restore and conserve the landscape: *Castor canadensis,* the North American beaver.

Valerie Brown, journalist with Columbia Insight, writes that the current North American beaver population currently ranges between 12-15 million[7]. While exact beaver population data does not exist, this study analyzes beaver trapping information, nuisance complaints, and beaver-related restoration projects to help provide estimates on beaver population trends throughout the United States. Data is collected by the United States Department of Agriculture (USDA) Wildlife Service (WS) to provide Federal guidance to help resolve conflicts to allow people and wildlife to coexist. A 2018 program data report by the Animal and Plant Health Inspection Service (APHIS), a division of the USDA WS, reported 22,655 beavers had been intentionally killed or euthanized while 65 of them were freed, released, or relocated throughout the United States.[8]

SOCIAL CHALLENGES SURROUNDING BEAVER REINTEGRATION. Public attitudes regarding wildlife and wildlife management have been more diverse in the last 100 years.[9] For example, there have been disagreements on how much conservation is enough and to what levels biologic diversity is required. This is problematic because without a clear understanding of a community's role in biodiversity protection or destruction, conservationists and land managers have difficulty making decisions when it comes to managing wildlife.[10]

Recent work such as Ben Goldfarb's *Eager*, and Sarah Koenigsberg's "Beaver Believers" movie, highlight the benefits that beaver presence can bring to an area. Specifically, beavers provide various ecosystem services to areas where water is a limited or declining resource. While research and media appear to show an increasing trend in using beavers in restoration projects throughout the Western U.S., there should be strong consideration and analysis of the social constraints surrounding potential beaver-integration in geographical areas—especially in urban areas where there is a higher population density. In "Of wood and rivers: bridging the perception gap," Whol argues that since their near extinction, individuals have become unused to seeing beavers in river corridors throughout North America.[11] Due to the minimal exposure to beaver that individuals may have today, many view beavers as "pests" or "nuisance" because of their potential to wreak havoc on personal property. Beaver can take down trees, flood areas if their dams collapse, and build dams in irrigation canals.

Culture can influence the perception that individuals have toward the external world of nature. If individuals perceive beavers negatively, there will be increased public reluctance towards reintegrating beavers in an area. An increase in beaver populations could mean an increase of their presence in urban areas, such as Ada County, Idaho where they have the potential to cause conflict across the urban landscape. As beavers move into areas inhabited by humans and vice-versa, human-beaver conflicts have the potential to become more frequent and more contentious.[12]

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[6] Brown, "Welcoming the Beaver."

[7] Brown, "Welcoming the Beaver."

[8] "Program Data Report G – 2018 Animals Dispersed/Killed or Euthanized/Removed or Destroyed/Freed or Relocated," *United States Department of Agriculture Animal and Plant Health Inspection Service*, accessed February 20, 2020, https://www.aphis.usda.gov/aphis/ourfocus/wildlifedamage/pdr/?file=PDR-G_Report&p=2018:INDEX:.

[9] J.B. Trefethen, "An American crusade for wildlife," (Winchester, New York, New York, USA, 1975), **Cited in** Jonker A. Sandra, et al. "Experiences with Beaver Damage and Attitudes of Massachusetts Residents Toward Beaver," The Wildlife Society, 34 no. 4 (2015). doi: 10.2193/0091- 7648(2006)34[1009:EWBDAA]2.0.CO;2. 1009.

[10] Monique B. Mulder and Peter Coppolillo, *Conservation: Linking Ecology, Economics and Culture* (Princeton, NJ: Princeton University Press, 2005), 166.

[11] Ellen Whol, "Of wood and rivers: bridging the perception gap," *WIREs Water* 2 no. 3 (2015) doi:10.1002/wat2.1076

[12] Jonker A. Sandra, et al. "Experiences with Beaver Damage and Attitudes of Massachusetts Residents Toward Beaver," 1009.

BENEFITS OF USING BEAVERS IN RESTORATION. Beavers provide a wide range of ecosystem services that help improve habitats for plant and animal communities. Beavers build dams that help reduce stream velocity by retaining flow that reduces storm-water run-off by increasing retention.[13] Beaver ponds help create wetlands and aid in recharging groundwater by increasing catchment storage that infiltrates and elevates water table levels that further extends areas of riparian habitat.[14] Moreover, beaver dams help slow and widen streams that reduce erosion potential and increases sediment accumulation that further improves subsurface flow in streams.[15] Sediment trapped behind beaver ponds helps reconnect floodplains and further increases subsurface flow. This helps maintain groundwater levels that aid increase buffers of diverse riparian vegetation structures. Increased surface water, groundwater levels, increases in the diversity of riparian vegetation, and geomorphic changes that beaver dams bring to streams help provide increased availability of water, food, shelter, and other benefits for aquatic species and riparian habitats.[16] The ecosystem services that beavers provide to deteriorated or suffering water systems and habitats provide opportunities for arid landscapes to use in restoration projects. The importance of these services will likely increase in the coming years throughout the western United States as the demands for water, threats to wildlife habitats, warming climates, and frequency of droughts increase.[17]

WHY REINTEGRATE BEAVERS IN IDAHO? In Idaho, beavers provide recreational opportunities, harvest, aesthetic, cultural, and scientific benefits to the State. Understanding beaver ecology provides an excellent opportunity for restoration ecologists, public agencies, and private landowners to use beavers as a tool to help benefit habitat systems and landscapes. In Idaho, water management has become an increasingly integral part of land stewardship due to the State's semi-arid climate. Annual average temperatures in Idaho have increased 1.5^{o}F since data collection began in 1895.[18] While precipitation is expected to increase in Idaho over the 21st century, there is greater potential for increased temperatures to increase and intensify naturally occurring droughts.[19] Increased temperatures and droughts will affect the 880 square miles of surface water area, over 2,000 lakes, 93,000 miles of streams and rivers, and the 3.3 million acres of area being irrigated in the State of Idaho.[20]

The Census Bureau estimates an 11.9% increase in Idaho's population from approximately 1,567,582 in April 2010 to a population of 1,787,065 in July 2019. As the population in Idaho continues to increase, the demand for drinking water will also increase. Groundwater is the source of drinking water for 95% of Idaho's citizens, is a key resource in replenishing streams, rivers, and provides for fresh water for irrigation, industry, and communities throughout the State.[21] Only 4% of the total ground water extracted from the aquifer is used for drinking water and approximately 60% of the total groundwater withdrawn is used for agriculture.[22] The demand for water in agriculture, industrial, and domestic use are examples of the need for proper water and land management practices that will maintain and protect Idaho's groundwater where feasible to support its ongoing beneficial uses.

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[13] David E. Bailey, et al. "Reintegrating the North American beaver (*Castor canadensis)* in the urban landscape," *WIREs* 6 no. 1 (2019). doi: 10.1002/wat2.1323. 2.

[14] Bailey, et al. "Reintegrating the North…" 2.

[15] Bailey, et al. "Reintegrating the North…" 2.

[16] David Pilliod, et al. "Survey of Beaver-related Restoration Practices in Rangeland Streams of Western USA," *Environmental Management* 61 (2017). doi:10.1007/s00267-017-0957-6. 59.

[17] Pilliod, et al. "Survey of Beaver-related…" 59.

[18] J.K Ruke et al. Idaho State Climate Summary. NOAA Technical Report NESDIS 149-ID. https://statesummaries.ncics.org/chapter/id/

[19] Ruke et al. Idaho State Climate…

[20] "Idaho Water Facts." *Idaho Department of Water Resources*, accessed February 23, 2020. https://idwr.idaho.gov/water-data/idaho-water-facts.html

[21] "Groundwater in Idaho," *Idaho Department of Environmental Quality,* accessed February 16, 2020. deq.idaho.gov/water-quality/ground-water.

[22] "Groundwater in Idaho." *Idaho Department of Environmental Quality.*

This study aims to better understand the social constraints to reintroducing beavers by answering the following questions: (1) what are the current trends in beaver populations in Owyhee and Ada County? (2) what is the current public perception of beavers in Ada County and Owyhee County, respectively? Based on the results found for the first two questions, the discussion section will focus on the potential opportunities and challenges in reintegrating beavers in Ada County and Owyhee County. This research can be beneficial to landowners, natural resource managers, public agencies, and private entities an opportunity to consider potential social implications related to future beaver-related restoration projects.

METHODS

Owyhee County and Ada County, Idaho, United States were selected for this study due to being adjacent counties with differing population densities. Owyhee County consists of 4.9 million acres (7,656.25 square miles) of land where over 80% percent of it is public land is managed by the Bureau of Land Management, 7% is state-owned, and 12% is privately owned.[23] A 2018 population estimate of Owyhee County is 11,693 representing a 1.4% increase since 2010.[24] Owyhee County cities include Bruneau, Grand View, Grasmere, Homedale, Marsing, Orena, Riddle, and Silver City. On the other hand, Ada County is comprised of 675,193.6 acres (1,054.99 square miles) of land and includes the City of Boise, Garden City, Meridian, Eagle, Kuna, and Star. Ada County's 2018 population estimate was 469,966, representing a 19.8% increase since 2010.

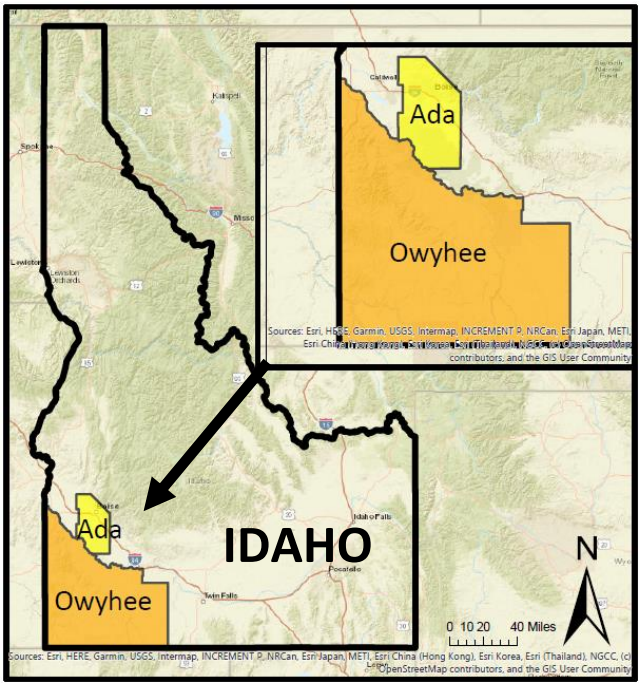

FIG. 1: STUDY AREA INCLUDES OWYHEE AND ADA COUNTY, IDAHO

This study focuses on the last ten years (2010 – 2020). Information on beaver observances and harvesting trends from the last decade will provide the most relative and current trends for land managers, landowners, local governments, conservation groups, and students to use when in urban development or beaver-related restoration projects. To assess the first research question regarding beaver population trends, statistical data regarding beavers, such as information on relocating, trapping, and killing was collected from the Idaho Fish and Game (IDFG). Data that was collected from IDFG's Statewide Furbearer Report for fiscal years (FY) 2010 through 2018 include historical trends in beaver ranking based on their pelt value compared to other furbearers, number of beavers harvested in the State of Idaho, number of beavers harvested in Ada County and Owyhee County, and beaver price per pelt. In addition to assessing beaver harvesting and trapping trends, information was obtained to generate a map on where beavers have been observed in Ada County and Owyhee County. Beavers observances reported by the general public and published on to IDFG's

[23] Jesse Abrams et al. "Beaver-Related Restoration in Owyhee County, Idaho: Opportunities and Challenges." *United States Department of Agriculture, Forest Service, Pacific Northwest Research Station* (2019). https://www.fs.fed.us/pnw/pubs/pnw_rp611.pdf. 3.

[24] "QuickFacts Ada County Idaho; Owyhee County, Idaho," *United States Census Bureau*, accessed March 4, 2020. https://www.census.gov/quickfacts/fact/table/adacountyidaho,owyheecountyidaho/PST045219

website was collected to find the distribution of beaver sightings in Ada County and Owyhee County.[25] Observations submitted by the public provide an excellent resource for wildlife managers to population data on several species.

Beaver observance data from IDFG was combined with the field notes obtained by the Idaho Department of Environmental Quality's (DEQ) Beneficial Use Reconnaissance Program (BURP) on beaver and beaver complex observances made by field scientists. The BURP program combines biological monitoring and habitat assessment to determine the quality of Idaho's waters to ensure Idaho is meeting the requirements of the Clean Water Act.[26] Determining sampling sites is part of the BURP program's site verification process and is often completed prior to BURP field sampling activities. The BURP Field Manual for Sampling Streams lists beaver complexes as criteria that make sites unsuitable for sampling.[27] BURP field data obtained for this study includes site sample dates and site locations that were unable to be sampled due to the presence of beaver and beaver complexes to better understand their presence in Ada County and Owyhee County.

Lastly, to obtain information on public attitudes toward beaver, a literature review was conducted on scientific literature (i.e. scholarly and peer-reviewed journals) and documents (i.e., non-peer-reviewed reports such as news articles) surrounding the use of beavers in restoration projects. Literature and news article searches were performed through Boise State University's Albertsons Library and Google search using terms such as "beaver", "beaver nuisance", "beaver benefits", and "beaver challenges." To try to better understand attitudes toward beaver in Ada County, mentions of "beaver" were searched within Ada County municipal government websites. This provides an opportunity to understand what type of language is used when mentioning beaver in public hearings and gives perspective on how Ada County's urban landscape is managing beaver. Lastly, the U.S. Department of Agriculture, Forest Service, Pacific Northwest Station published a study in 2019 titled "Beaver-related restoration in Owyhee County, Idaho: Opportunities and Challenges," was used as a primary source in understanding public attitudes toward beaver in Owyhee County.

RESULTS

WHAT ARE THE CURRENT TRENDS IN BEAVER POPULATIONS IN OWYHEE AND ADA COUNTY?

Currently, IDFG classifies beaver populations as globally widespread, abundant, and secure. In Idaho, the conservation ranking for *Castor canadensis* is "S4," meaning they are longer as rare as they used to be and even though they appear to be secure, they are is still of long-term concern[28]. While there is very little information on beaver populations within Idaho, there is evidence showing that beaver trapping is decreasing.

BURP data regarding water quality surveys conducted between January 1, 2010 and January 1, 2020 by DEQ's Boise Regional Office BURP field scientists were obtained to better understand where beaver sightings or complexes have been found. The location information for each beaver observance collected from IDFG and DEQ were combined and used in ArcGIS Pro to generate a map of where beavers or beaver dam complexes have been observed. The map that was does not give exact numbers of beaver populations or their locations, rather it provides a visual representation of where beavers have been seen the last ten years (Figure 2). There is a presence of beaver in both counties. Observances in Ada County have been near and within the City of Boise. Beaver are also found near Ada County in the surrounding mountain region. In Owyhee County, beavers have been found more sparsely,

[25] Note: The public can share information on their beaver observances at: https://idfg.idaho.gov/species/observations/add#speciesid-15973.

[26] "Beneficial Use Reconnaissance Program." *Idaho Department of Environmental Quality.* https://www.deq.idaho.gov/burp

[27] Note: Beaver complexes are areas where streams are submerged under a lake or pond due to beaver dam impoundment and are listed as criteria that would make a site nonsampleable for DEQ BURP field crew.

[28] "American Beaver: *Castor canadensis*," Idaho Fish and Game, accessed February 16, 2020, https://idfg.idaho.gov/species/taxa/15973

but also along streams. This is expected since beavers live near rivers, streams, ponds, small lakes, and marshes where they build their dams.

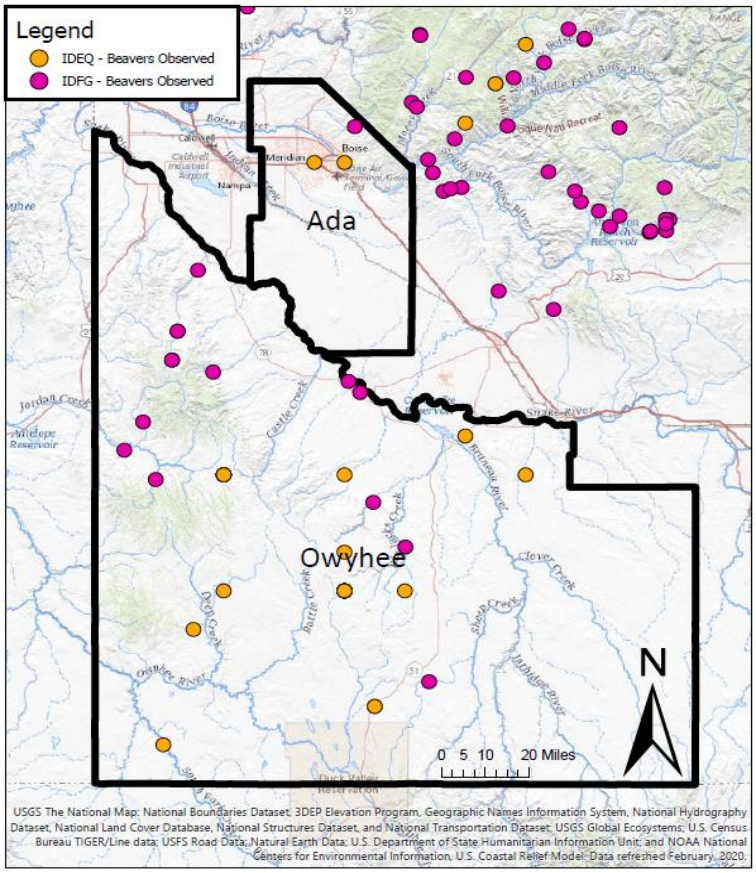

FIGURE 2: **MAP OF BEAVER OBSERVANCES REPORTED BY THE IDFG AND IDEQ FROM 2010 TO 2018**. Each dot represents a beaver sighting report by the public to IDFG or by field scientists with IDEQ. IDFG allows for the public to submit beaver observances through their website. IDEQ requires BURP field scientists to note streams that contain beaver dam complexes and or beavers. Both data are valuable in providing an idea of where beavers are found within and around Ada County and Owyhee County.

IDFG is the primary agency in the State of Idaho in managing beaver populations to ensure their surrounding wildlife populations continue to benefit as well as provide a long-term return to humans. Each year, IDFG publishes a Statewide Furbearer Report to gather furbearer population estimates, outline the market value of the state's furbearer harvest, study hunter and trapper attitudes surrounding the State's furbearer program and help inform trappers/hunters about furbearers.

Bobcat, coyote, muskrat, marten, and beaver have been the top five most frequently harvested species from 2010 – 2018 (Table 1). Each year, the IDFG State Furbearer report ranks species based on the total dollar value of pelts sold. For example, in 2010, Bobcat ranked first place because pelts sold for $245.07 while beaver pelts that same year were $17.35 per pelt. Overall, beaver have ranked fifth place based on their average total dollar value. The Idaho Trappers Association reports that beaver pelts were sold at $16.63 per pelt in January 2019 and $16.58 in January of 2020.29 Comparing these numbers to the ranking of beaver in IDFG's Furbearer Report could indicate that beaver price per pelts and popularity among trappers for economic revenue may be decreasing in the coming years as pelt values for other species continue to surpass beaver pelt value.

[29] Fur Sale Reports, Idaho Trappers Association, accessed March 12, 2020, https://www.idahotrappersassociation.com/fur-sale-results.html

SEASON	BOBCAT	COYOTE	MUSKRAT	MARTEN	BEAVER
2010	1	3	2	5	4
2011	1	3	2	5	4
2012	1	3	2	4	5
2013	1	4	2	3	5
2014	1	3	2	4	5
2015	2	1	3	4	5
2016	2	1	5	6	4
2017	2	1	3	4	6
2018	2	3	14	5	7
AVERAGE RANKING	1.4	2.4	3.9	4.4	5.0

TABLE 1: STATEWIDE RANK BY DOLLAR VALUE FROM 2010 – 2018 BASED ON THE TOTAL DOLLAR VALUE OF PELTS SOLD. Bobcat, coyote, muskrat, and marten were included in this table for being the top five frequently harvested species as seen in their average ranking in the last ten years. Other species assessed in IDFG's Furbearer Report statewide ranking include badger, mink, otter, raccoon, red fox, skunk, weasel, and wolves. Source: Idaho Department of Fish and Game, Statewide Furbearer Reports from FY2010 – FY2018.

While on average beaver have been among the top five most harvested species, there has been a decrease in the number of beavers harvested in the last ten years in Idaho (Figure 3). The number of beavers harvested reached its highest point in 2013 with a total 3,550 reported to have been trapped. There was a 53.61% decrease in the number of beavers harvested from 2013 to 2018, where 1,647 beavers were trapped.

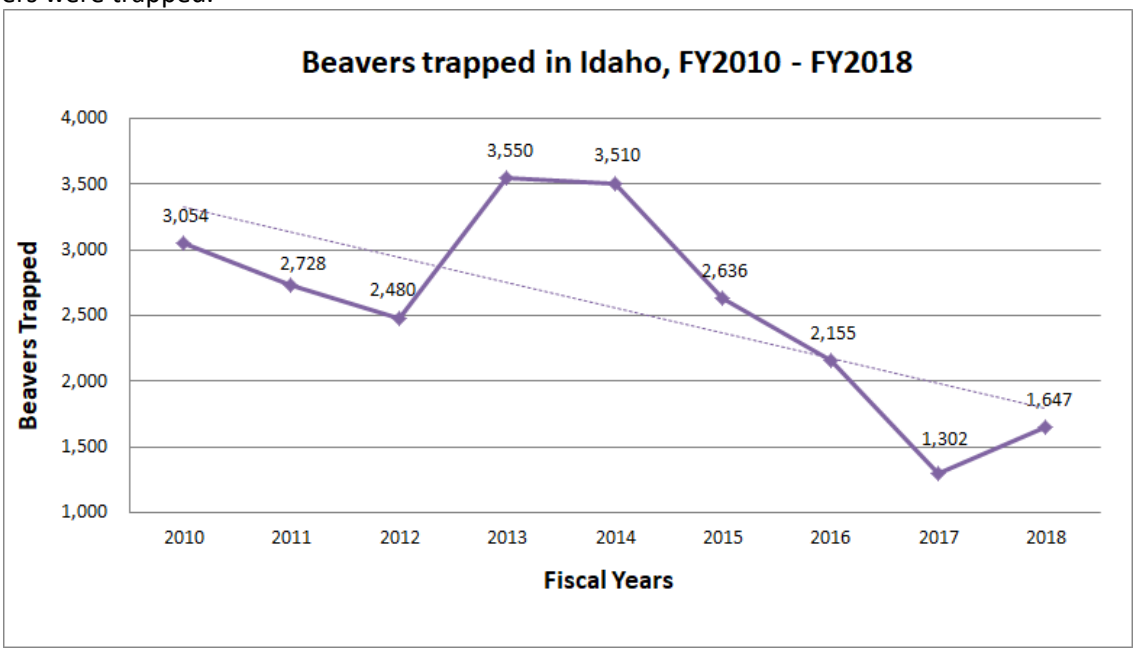

FIGURE 3: NUMBER OF BEAVERS TRAPPED IN IDAHO BASED ON TRAPPERS WHO REPORTED THEY TRAPPED BETWEEN FY2009 – FY2018. Fiscal years are from July 1st through June 30th. Source: Idaho Department of Fish and Game, FY2010 – FY2018 Statewide Furbearer Reports.

The decrease in the number of beavers harvested in recent years could be influenced by the number of trappers and the price per pelt. 2013, the year with the highest number of beavers trapped and second highest in the number of trappers that reported. That year, 505 trappers reported 3,550 beavers harvested (Table 2). That same year, the price per pelt was at the highest at $23.21 per beaver pelt. In contrast, the lowest amount of beavers harvested occurred in 2017 where 253 trappers reported 1,302 harvested beavers. Additionally, the price per pelt was $16.45, the fourth lowest in recent years.

FISCAL YEAR	TRAPPERS REPORTING A HARVEST	TOTAL BEAVERS HARVESTED	ANIMALS SOLD	PERCENTAGE SOLD	PRICE PER PELT
2010	378	3,054	1222	40%	$ 17.35
2011	363	2,728	1421	52%	$ 14.90
2012	389	2,480	1157	47%	$21.95
2013	505	3,550	1796	51%	$ 23.21
2014	557	3,510	1262	36%	$ 20.48
2015	471	2,636	773	29%	$ 15.77
2016	382	2,155	431	20%	$ 14.26
2017	253	1,302	261	20%	$ 16.45
2018	304	1,647	434	26%	$ 16.47

TABLE 2: BEAVER PELT VALUE BASED ON THE NUMBER OF TRAPPERS WHO REPORTED BETWEEN FY2009 – FY2018.
Source: Idaho Department of Fish and Game, FY2010 – FY2018, Statewide Furbearer Reports.

Understanding the Statewide beaver population trends and how they are influenced by the number of trappers or the price per pelt can provide a baseline to compare Ada County and Owyhee County beaver population trends. Furthermore, the species harvested within a county could be indicative of areas with higher beaver populations and of where furbearers live or trap. Data collected from the IDFG Statewide Furbearer Reports reveals a decreasing trend in the number of beavers harvested Ada County in since 2010 (Figure 4). The highest number of beavers harvested in Ada County was in 2011 where 131 beavers were harvested. The lowest number occurred in 2015 where 64 beavers were harvested. Notably, number of beavers harvested in 2018 has been 46.6% less than the number of beavers harvested in 2011.

Owyhee County's data on the number of beavers harvested since 2010 does not appear to be following a specific trend. However, the mean average of beavers harvested between 2010 and 2018 is 68.2 beavers. Comparatively, the mean average in beavers harvested was 93.3 in Ada County. This means that 36.8% more beavers were harvested in Ada County than in Owyhee County in the last ten years.

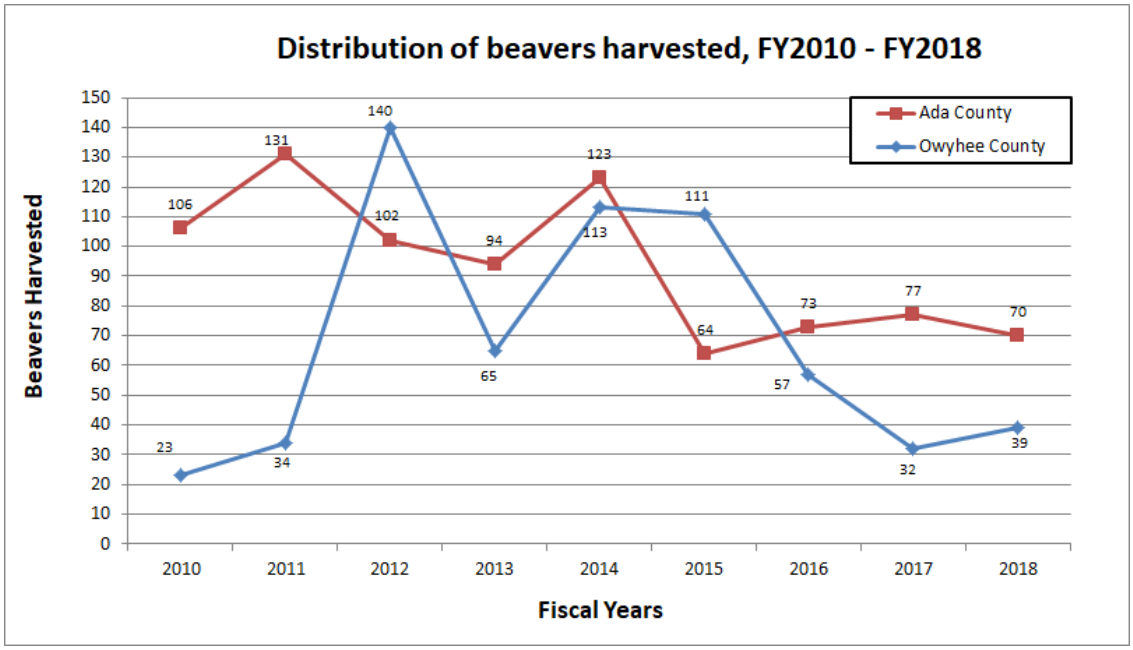

FIGURE 4: DISTRIBUTION OF BEAVERS HARVESTED, AS REPORTED TO IDFG BY TRAPPERS FROM FY2010 – FY2018.
Source: Idaho Department of Fish and Game, Statewide Furbearer Reports from FY2010 – FY2018.

Beavers are not only being trapped for recreational purposes or for economic gain, but they are also being trapped to address damage complaints.[30] When economically feasible, IDFG live-trap and translocate beavers to other areas to help improve riparian habitats or increase beaver populations.[31] When this is not possible, the Department issues Furbearer Depredation Control Permits to allow individuals to handle beaver or other furbearer damage complaints. Depredation permits are often issued to landowners who are ultimately responsible for killing and depredating animals.[32] The language used in the FY2018 Statewide Furbearer Report on the issuance of these permits is described as a "quick" and "efficient" way of handling damage complaints. Since January 1995, IDFG has maintained records of the number of permits issued and the number of animals subject to removal each year. Since these permits have been issued, beavers have been the most common species in which kill permits have been issued, followed by muskrat and racoon.[33]

Data obtained from IDFG on the number of depredation permits issued reveal that more permits are issued to individuals in Ada County than Owyhee County (Figure 5). Between 2010 and 2019, there were ten times more depredation permits issued to people in Ada County than Owyhee County. Gaps in data may be present for instances where individuals kill, trap, or remove beaver without notifying IDFG.

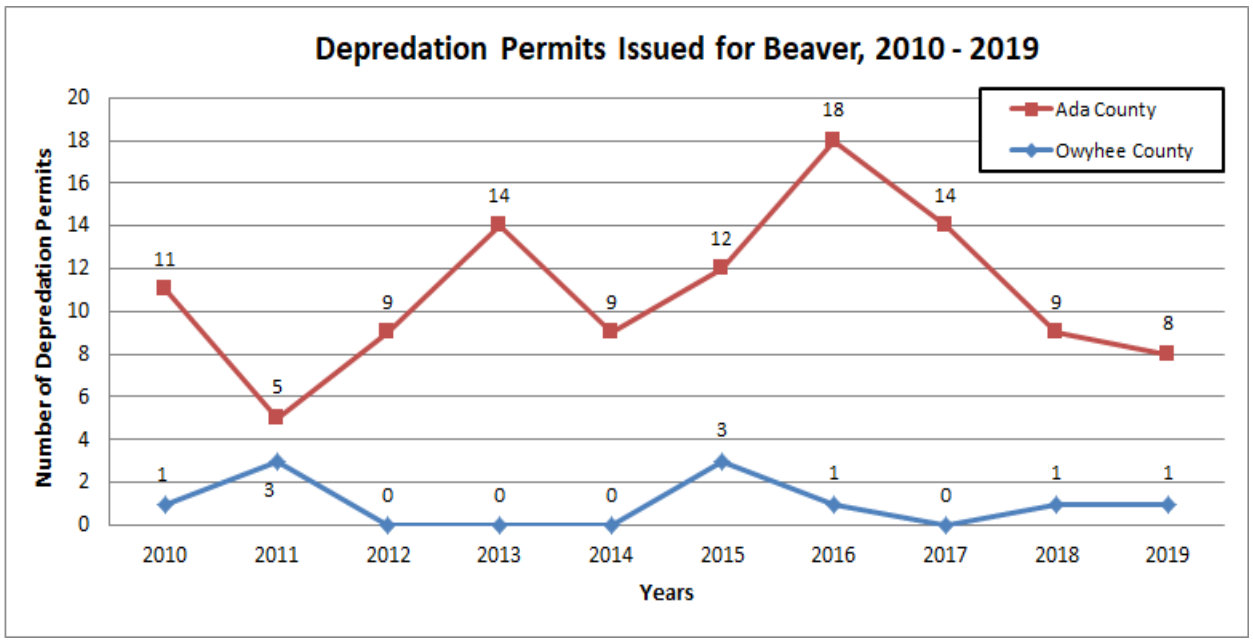

FIGURE 5: DEPREDATION PERMITS ISSUED BY IDFG FOR BEAVERS FROM 2010 – 2019.
Source: Idaho Department of Fish and Game

IDFG issues depredation permits for a specified length of time and notes the approximate amount of beaver that are subject to removal for each permit issued. Analyzing the number of individual permits issued and comparing the number of beavers subject to removal for each permit provides an opportunity to analyze at what rate beavers are being removed in each county. Between 2010 and 2019, 109 depredation permits were issued to individuals in Ada County. From those permits, 485 beaver were

[30] Cory Mosby, FY2018 Statewide Furbearer Report, *Idaho Department of Fish and Game* (2018). 5.
[31] Mosby, FY2018 Statewide Furbearer. 5.
[32] "A Landowner's Guide to Preventing Big Game Damage and Filing Damage Claims" *Idaho Fish and Game* (2018). https://idfg.idaho.gov/sites/default/files/2018_idfg_wildlife_depredation_handbook.pdf
[33] Mosby, FY2018 Statewide Furbearer. 5.

subject to removal (Table 3). In Owyhee County, 10 depredation permits were issued where 61 beaver were subject to removal. Lastly, IDFG issued 6 depredation permits between 2010 and 2011 to individuals in Ada County that allowed for an unlimited amount of beaver removal.[34] During this same period, no similar permits were issued to individuals in Owyhee County. Overall, the information collected on depredation permits shows that more depredation permits and the number of beaver subject to removal were higher in Ada County than Owyhee County.

	ADA COUNTY		OWYHEE COUNTY	
YEAR	**PERMITS ISSUED**	**BEAVERS SUBJECT TO REMOVAL**	**PERMITS ISSUED**	**BEAVERS SUBJECT TO REMOVAL**
2010	11	28	1	1
2011	5	26	3	27
2012	9	31	0	0
2013	14	69	0	0
2014	9	40	0	0
2015	12	55	3	16
2016	18	102	1	3
2017	14	62	0	0
2018	9	32	1	4
2019	8	40	1	10
TOTAL	109	485	10	61

TABLE 3: TOTAL NUMBER OF BEAVERS SUBJECT TO REMOVAL UNDER DEPREDATION PERMITS ISSUED IN ADA COUNTY AND OWYHEE COUNTY. IDFG issues individual depredation permits that are valid for a specific length of time, and for a certain number of animals. Source: Idaho Fish and Game.

WHAT IS THE CURRENT PUBLIC PERCEPTION OF BEAVERS IN ADA COUNTY AND OWYHEE COUNTY?

ADA COUNTY: In 2012, Boise Parks and Recreation Commissioners discussed amending City of Boise ordinance to allow park personnel to trap beaver that were causing "extreme damage" in city parks. [35] Legal counsel suggested that the ordinance be amended to allow trapping by the Boise Parks and Recreation Department or by a licensed trapper. Tom Governale, Superintendent of Parks, added that beavers were one of the top pests in the State of Idaho and that without trapping, the City of Boise has had as much as 80% of vegetation destroyed.[36]

In a City of Eagle council meeting on August 22, 2017, former councilmember, Naomi Peterson proposed a discussion surrounding city ordinance on protecting landscape from beavers be considered as an agenda item for future meetings.[37] She explained that some residents in the Laguna Pointe Subdivision, located next to the Boise River in Eagle, Idaho, were trapping and killing beaver who were damaging their landscaping. Residents resisted wrapping their trees with wire to prevent beaver damage because it was not aesthetically pleasing. To combat trapping and killing in Eagle, Peterson suggested collaborating with IDFG to relocate beaver or provide educational opportunities to help landowners improve their relationship with nature and learn how to coexist with their natural environment.

She also proposed that the City enact an ordinance that would require landowners to take other measures to protect their landscaping other than trapping and killing. Other council members

[34] Note: IDFG does not provide specific information on the 6 depredation permits issued between 2010 and 2011 because they contain confidential permit holder information. In a discussion with IDFG on March 2, 2020, officials confirmed one depredation permit with an unspecified issue date between 2010-2019, was issued without an expiration date and with permissions to remove an unlimited amount of beaver to a company with reoccurring problems with beavers in irrigation canals.

[35] Boise Parks and Recreation Commissioner's Meeting Minutes, March 15, 2012, *City of Boise.* http://boisecityid.iqm2.com/Citizens/FileOpen.aspx?Type=12&ID=2500&highlightTerms=beaver.

[36] Boise Parks and Recreation Commissioner's Meeting Minutes, March 15, 2012.

[37] City of Eagle Meeting Minutes, August 22, 2017, video, 02:43:16 – 02:53:38, https://eagle-id.granicus.com/player/clip/627?.

questioned how a measure would be enforced. Due to the already existing negative perception on beaver in the City of Eagle, some council members believed there would be a strong pushback from residents if an ordinance required them to wrap their trees. To this, Peterson immediately responded: "could you imagine the pushback if…we were at a town hall meeting and I say…'citizens of Eagle, do you know that we are…trapping [and] we're killing beavers? We drown them. We drown them in the subdivisions because people don't want to wrap their trees.' Do you think we would get a pushback from that?"[38]

In 2016, local citizens contacted Garden city expressing concern over beavers damaging trees along the Boise River to the extent of them falling onto the Boise Greenbelt. City workers at the time attempted to wrap trees with chicken wire to help deter beavers. Garden City Mayor John Evans explained the importance of balancing the aesthetic component along the river and protecting trees to maintain the stability of the bank next to the river.[39]

Beaver are mentioned in the City of Star's 2018 and 2019 Comprehensive Plans. In each plan, the City of Star recognizes that beaver have specific habitat needs, including their need for basic food, cover, shelter, and space.[40] Overall, the City emphasizes that future development within the city should be conducted in a manner that protects local wildlife while meeting the needs of the human population.[41]

The previous examples of how Boise, Eagle, Garden City, and Star are not representative of Ada County's sentiment toward beaver but do provide a general idea of how different municipalities approach beaver population management. The information found on mentions of beaver in Star signal that their city government views them positively and consider the natural environment as an important consideration for future city development projects to maintain coexistence. In contrast, residents and city officials in areas like Eagle, Star, and Boise appear to view beaver as pests, nuisances, and "critters" that primarily damage public and private land. Overall, the negative perception of beaver in these cities could be correlated to the high amount of depredation permits issued in Ada County compared to Owyhee County.

OWYHEE COUNTY: The USDA Northwest Climate Hub conducted a study to understand the opportunities and challenges associated with beaver-related restoration throughout Owyhee County rangeland systems and to improve understanding of what is needed to implement restoration projects from a social and regulatory standpoint. [42] The study focused on landowners' and ranchers' perspectives surrounding beaver-related restoration since these projects would more than likely occur on private ranches or on public lands where ranchers have grazing allotments.[43]

Researchers interviewed 19 Owyhee County landowners, ranchers, and key stakeholders to help identify specific opportunities surrounding beaver-related restoration projects in the area. Interviews with ranchers, landowners, land managers, and other stakeholders revealed various opportunities for integrating beavers and beaver-related structures in watershed restoration projects in Owyhee County.[44] Overall, the interviewed stakeholders had a neutral to favorable perspectives of beaver. Many of them recognized the potential of beaver as ecosystem engineers, whose dam structures bring habitat benefits for sensitive species, such as the Columbia spotted frog. Additional benefits from the presence

[38] City of Eagle Meeting Minutes, August 22, 2017, video, 02:47:47-02:48:02, https://eagle-id.granicus.com/player/clip/627?.

[39] "Beavers causing headache for Garden City," *Kivitv.com*, 6 On Your Side, last modified March 10, 2016, https://www.kivitv.com/news/garden-city-looks-on-how-to-reduce-damage-to-trees-from-busy-beavers.

[40] "City of Star Comprehensive Plan," City of Star (2019), https://www.staridaho.org/vertical/sites/%7BBABF7977-2C81-44F3-A8BC-95C5171109E7%7D/uploads/COMP_PLAN_FINAL_042519(1).pdf. 73.

[41] "Beavers causing headache." *Kivitv.com*

[42] Abrams, et al."Beaver-Related Restoration." 1.

[43] Abrams, et al. "Beaver-Related Restoration." 3.

[44] Abrams, et al. "Beaver-Related Restoration." 6.

of beaver that ranchers and landowners observed were the creation of wet meadows, increased retention of water in streams later in the summer, increased stream velocity, and the reduction of erosion potential.[45] Interviewees also observed beaver populations to be abundant within the broader landscape and their ability to recolonize on their own.[46] One interviewee noted that, "beaver were starting to make their comeback big time," near Stoneman Creek where a beaver dam was reconstructed and beaver had been translocated.[47] Other interviewees observed that beaver were recolonizing naturally after the installation of artificial beaver ponds had been installed on their properties.[48] After noticing the benefits these landowners received, other landowners expressed interest in installing artificial structures to increase natural beaver recolonization.[49]

Few of the stakeholders interviewed in this study had negative perceptions on the presence of beaver. Challenges in the reintegration of beaver included landowner concerns on the impacts beaver can have on irrigation infrastructure and livestock operations, damages and alterations beavers may have on landscapes, liability issues surrounding restoring habitat for sensitive or threatened species on private lands, unsuitable environmental conditions for translocated beaver, and regulatory or permitting issues surrounding beaver-related restoration projects.

These perspectives on beaver and beaver-related restoration shared by respondents are not representative of Owyhee County. The study conducted by Abrams, et al. was based on literature review and interviews of 19 Owyhee County stakeholders, including ranchers, landowners, state, federal, and NGO representatives. The views expressed by these stakeholders are not representative of Owyhee County because they were not selected by random; rather, they were chosen for potentially have experience with beaver or riparian restoration activities. However, they do show that ranchers and landowners in Owyhee County have positive associations with beaver and few of them feel that grazing operation would be negatively affected by beaver. Lastly, observations made by stakeholders on beaver recolonization supports the potential increase in beaver population trends discussed in earlier in this study.

DISCUSSION

The first key finding in analyzing beaver population trends is that there is a presence of beaver in Ada County and Owyhee County (Figure 2). Second, while beaver are among the top five most frequently harvested furbearers in the State of Idaho (Table 1), there is a notable decrease in the number of beavers being trapped (Figure 3) and decrease in their pelt value (Table 2), based on information retrieved for the last ten years. Third, on average, 36.8% more beavers are harvested in Ada County than in Owyhee County (Figure 4). Lastly, more depredation permits to mitigate problem beaver are issued to residents in Ada County than in Owyhee County (Figure 5). Overall, these findings reveal that the number of beavers being trapped has gone down in recent years and that more beavers are being harvested for recreational and economic purposes as well as to remove nuisance beaver in Ada County than in Owyhee County.

Findings on public attitudes toward beaver reveal that many cities and residents in Ada County appear to view beaver as a nuisance or pest. The negative perception of beavers in Ada County could be directly correlated with the higher amount of depredation permits issued compared to those issued in Owyhee County. In contrast, landowners and ranchers in Owyhee County had a positive perception of beaver and some were interested in integrating them in restoration projects on their private land.

[45] Abrams, et al. "Beaver-Related Restoration." 6.
[46] Abrams, et al. "Beaver-Related Restoration." 6.
[47] Abrams, et al. "Beaver-Related Restoration." 6.
[48] Abrams, et al. "Beaver-Related Restoration." 6.
[49] Abrams, et al. "Beaver-Related Restoration." 6.

These findings will be used to lead a discussion in the potential opportunities and challenges in reintegrating beavers in Ada County and Owyhee County. The decrease in beavers being harvested by trappers could allow beaver populations to thrive as they begin to recolonize areas. Increases in beaver populations will greatly influence public attitudes, and subsequently, beaver management strategies, in two distinct ways in Ada County's urban landscape than they would in Owyhee County's rural landscape. The perception that humans have on the effects beaver have across landscapes is commonly influenced on whether the outcome of a beaver's presence has a negative, neutral, or positive effect on a site's ecologic trajectory and design goals.[50]

In Ada County, an increased beaver population would be minimally tolerated. Current attempts to trap and remove beaver are a temporary solution. A continued or increased presence of beaver within Ada County and its surrounding areas will mean that despite their removal, there will be repeated colonization of beaver. If this is the case, urban settings like Ada County, should consider redesign or modify sites to accommodate beaver.[51] A combination of trapping, public education on ecosystem engineers and their benefits, management, and modifications to sites can result in high costs in some areas.[52] Incorporating beavers in urban planning, as the City of Star did in their Comprehensive Plan, can offer amenities such as aesthetics and opportunities for the public to be more connected with nature. Studies show that incorporating beaver in project designs result in comparatively lower maintenance costs than those that did not anticipate beaver colonization in their management plans.[53]

In Owyhee County, an increase in beaver populations would be more tolerated because the effects of beaver are viewed as beneficial. Even though they are perceived positively, beaver should be more actively managed in Owyhee County to avoid the unfavorable effects of beaver, such as damages to irrigation canals, that could contract the original goals of the initial reintegration of beaver. Active beaver management that utilizes an adaptive approach can ensure that beaver colonies remain in their intended place for beavers to provide increased ecosystem services and ecological functions to rangelands.[54]

The use of beaver in restoration has the potential to promote ranching resilience to droughts by improving streamflow and increasing forage production.[55] The interest and willingness to integrate beaver that landowners and ranchers in Owyhee County have expressed provides an opportunity for collaboration between municipalities in Ada County experiencing problems with beaver colonization in urban areas. IDFG should serve as a primary intermediary in guiding or creating a compatibility agreement between both counties and providing guidance on the legal aspects surrounding beaver trapping or relocation.

IDFG and cities in Ada County should collaborate to create and provide education and outreach targeting landowners on how properly protect their landscape from unwanted beaver damage. Outreach should focus on showing landowners the benefits beavers bring to a landscape. As shown in interviews with Owyhee County stakeholders, an increased understanding of ecosystem engineers results in greater acceptance of colonization. Public education should include how relocating beaver can help drought areas in Owyhee County. Through this, public attitudes in Ada County toward beaver can be transformed from being viewed as "pests" to tools for conservation.

[50] Bailey, et al. "Reintegrating the North." 9.
[51] Bailey, et al. "Reintegrating the North." 9.
[52] Bailey, et al. "Reintegrating the North." 9.
[53] Bailey, et al. "Reintegrating the North." 10.
[54] Bailey, et al. "Reintegrating the North." 10.
[55] Abrams, et al. "Beaver-Related Restoration." 5.

CONCLUSION

As temperature and the frequency and intensity of droughts increase, there will be a greater need for effective land and water management strategies in the State of Idaho. Understanding beaver ecology and human-beaver relationships provides an excellent opportunity for restoration ecologists, public agencies, and private landowners interested in using beavers as a tool to help benefit habitat systems and landscapes to address the social challenges that may be encountered when planning and executing conservation strategies.

Assessing public attitudes toward beaver can provide a better understanding in evaluating the success of a restoration project and in planning future projects. Findings in this study show a decrease in beaver trapping and harvesting trends as well as higher amounts of depredation permits issued to Ada County compared to Owyhee County. A decrease in beaver trapping could lead to an increased presence of beaver in both counties. For this reason, future development in Ada County should allow flexibility to accommodate beaver colonization. Urban planners and local governments will further be presented with opportunities to either reintegrate beaver in Ada County's urban landscape or collaborate with local governments in Owyhee County to relocate beaver in areas where they can benefit specific sites. Lastly, there is an ongoing need for additional educational outreach opportunities in Ada County targeted toward landowners that highlight the positive effects beavers have in restoring and creating habitats and on how to protect their private land from unwanted beaver alterations. This can create a culture of coexistence between humans and beavers in urban settings.

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