AN ABSTRACT OF THE THESIS OF

Zach Pike-Urlacher for the degree of Master of Science in Water Resource Policy and Management presented on June 6, 2019.

Title: Reconciling Working Landscapes on State and Federal Lands with Endangered Species Act Requirements: Emerging Governance Surrounding Beaver-Related Watershed Restoration in Oregon

Abstract approved: _____

Hannah Gosnell

Reconciling working landscapes with Endangered Species Act (ESA) requirements is a vexing challenge playing out in watersheds across the western United States. Beaver-related watershed restoration (BRR) methodologies have the potential to reconcile competing demands for resource extraction and recovery of ESA-listed species by restoring ecosystem functionality more effectively and at a lower cost than other watershed restoration strategies. BRR also provides a compromise between landscape scale, process-based restoration methodologies, such as Stage Zero, and more passive and prescriptive management treatments, such as riparian fencing. The research utilizes a variety of qualitative methods and a case study approach to explore emerging governance surrounding BRR in the Upper Nehalem Watershed

and Upper Klamath Basin, both in Oregon. The case studies are analyzed using a conceptual framework that draws on adaptive governance theory to identify opportunities and barriers associated with efforts to reconcile ESA implementation with working landscapes. The thesis concludes with recommendations for overcoming identified barriers and supporting further experimentation with this novel approach to enhancing the resilience of western watersheds.

Reconciling Working Landscapes on State and Federal Lands with Endangered Species Act Requirements: Emerging Governance Surrounding Beaver-Related Watershed Restoration in Oregon

by

Zach Pike-Urlacher

A THESIS

submitted to

Oregon State University

in partial fulfillment of

the requirements for the

degree of

Master of Science

Presented June 6, 2019

Commencement June 2019

Master of Science thesis of Zach Pike-Urlacher presented on June 6, 2019

APPROVED:

Major Professor, representing Water Resource Policy and Management

---

Director of the Water Resources Program

Dean of the Graduate School

I understand that my thesis will become part of the permanent collection of Oregon State University libraries. My signature below authorizes release of my thesis to any reader upon request.

Zach Pike-Urlacher, Author

ACKNOWLEDGEMENTS

First and foremost, I want to thank my advisor, Hannah Gosnell. Hannah, thank you for standing up for me my first quarter when there were problems with my teaching assistance position, and I didn't know where to turn. Thank you for awarding me the freedom to pursue an over-the-top research project and then helping me switch gears when problems arose with my original thesis. Thank you for helping me navigate the nebulous world that is graduate school, and, most of all, thank you for sticking this project out with me until the end.

I would like to thank my committee members, Aaron Wolf, Jenna Tilt, and Kelly Biedenweg—

Aaron, thank you for the conversation we had before I applied to Oregon State. It is largely because of this conversation that I chose to attend OSU in the first place. Thank you, also, for your presence, and the lessons you gave during the Conflict Transformation seminar. You create space that bridges worlds. This is a blessing.

Jenna, in your Planning, Principles, and Practices class you gave me tools to combine scientific inquiry, firm design principles, and creativity, a framework to bring novel ideas into the world professionally, and the confidence not only to explore big problems but to create big solutions. Thank you.

Kelly, in your Environmental Decisions class you showed me the methods that I ultimately used for this thesis and encouraged me to pilot test them. Because of this, I went into the field with confidence. Thank you.

I would also like to thank the head of the Water Resources Graduate Program, Mary Santelmann. Mary, thank you for letting me confide in you when I wasn't sure about this program, for keeping the metaphorical train on the tracks as I worked through my degree, and so, so, much for the job recommendation. I am thrilled to take what I have learned into the world.

I would like to extend a very big thank you to the many individuals that were interviewed for this thesis. Your work is vital to our world and it does not go unnoticed.

Finally, I would like to thank my family and friends—

I want to acknowledge my parents for loving me, supporting me, and nurturing my love of the natural world and community to the wildest end; my Klamath friends, Shasta friends, and Bellingham friends for being there for me even when my choices didn't appear to make a whole lot of sense; and the dear people I met here at Oregon State. Thank you for blindly paddling into waves, skiing untracked lines, dancing, laughing, crying, and sharing this journey.

TABLE OF CONTENTS

TABLE OF CONTENTS (Continued)

Page

LIST OF FIGURES

Figure Page

LIST OF TABLES

Reconciling Working Landscapes on State and Federal Lands with Endangered Species Act Requirements: Emerging Governance Surrounding Beaver-Related Watershed Restoration in Oregon

1 Introduction:

Reconciling working landscapes with the social demand for aquatic ecosystem integrity and the protection of Endangered Species Act (ESA) listed species is a current challenge throughout the western United States (Cosens et al. 2018). Beaver-related watershed restoration (BRR) methodologies have the potential to reconcile these competing demands by restoring ecosystem functionality at a lower cost than other watershed restoration strategies (Pilliod et al. 2018). However, current governance structure is not optimized to support the use of BRR on state and federal land for a variety of reasons. Because of this, a need for adaptive governance to support reconciliation of production and ecosystem protection and restoration exists on these working landscapes (Cosens, 2013).

This thesis aims to characterize emerging governance structures surrounding the use of BRR on two different landscapes, assess its alignment with adaptive governance principles and its ability to support BRR use, and to make recommendations for improvement.

This research draws from two case studies to explore the emergence of adaptive governance related to BRR. The first is located in northwest Oregon in the Upper Nehalem Watershed. The restoration work here occurred on state forest land and evolved out of a strategic planning process that included multiple federal, state, local, and non-government organizations, civil entrepreneurs, and project funders across institutions and jurisdictions. The restoration project was designed to enhance Coho salmon habitat in order to comply with the ESA, both by amending habitat using beaver dam analogs (BDAs) and by attracting wild beavers to BDA sites.

The second case study is located in southeastern Oregon on Jack Creek, a seasonal creek on the northeast side of the Klamath Basin. This project was housed on federal forest land that is leased as grazing allotments and took place directly upstream from private ranchland. This restoration project was spurred by the listing of the Oregon Spotted Frog (OSF) under the ESA, the identification of OSF critical habitat in the watershed, a lawsuit brought on by a watchdog group related to the National Forest Management Act (NFMA), and the desire to make the habitat amendments necessary under the ESA and NEPA to reopen public and private land to grazing.

Both case studies were motivated by concerns about degraded aquatic species habitat and concerns related to ESA enforcement. Both cases also involved the use of BDAs to alter aquatic ecosystem conditions and attempts to attract live beaver to project sites. The case studies, however, differ in key ways. Organizations working on Jack Creek attempted to translocate live beavers, while this was not attempted in the Upper Nehalem Watershed. The restoration work in the Upper Nehalem took place on state forest land while the project on Jack Creek took place on federal forest land. The Jack Creek project also involved a private landowner while work in the Upper Nehalem was not hampered by this constraint.

This research is guided by a conceptual framework associated with adaptive governance principles (Cosens et al. 2018). The framework includes key factors that have been shown to facilitate the reconciliation of development and nature in natural resource management, dealing specifically with water resources that cross institutional and jurisdictional boundaries (Cosens et al. 2018; Cosens, 2013). In this research, reconciliation is defined as the enhancement of

degraded ecosystems that are past the point of being restored to a "natural" condition, but that can still be improved in terms of their function, in the places that people live, work, and play.

Key concepts in the analytical framework are defined in Table 1 and include: 1) polycentric governance structures nested within traditional government hierarchies that provide structure and stability, 2) adaptive capacity, 3) participatory capacity, 4) social learning, 5) network formation across sectors and scales of government, and 6) bridging organizations capable of facilitating cooperation between network actors (Cosens et al. 2018; Cosens et al 2017).

Adaptive Governance Feature	Definition	Citations
Polycentric governance structure	Governance structure in which multiple centers of power or decision-making authority is divided amongst bodies with overlapping jurisdictions	Bingham, 2009; Cosens et al. 2017; Cosens et al. 2018; Gunderson, 2001; Chaffin et al. 2014
Adaptive capacity	Governance structure in which the social-ecological system of interest can support adaptive management	Smit and Wandel, 2006; Cosens et al. 2018; Ostrom, 2005
Participatory capacity	Ability of local and marginalized groups at the bioregional and landscape scale to participate in decision-making regarding how natural resources will be managed	Cosens et al. 2018; Ostrom, 2005
Social learning	Process by which people, networks, and organizations learn from one another through sustained integration, ongoing deliberation, and the sharing of knowledge	Bandura and Walters, 1977; Cosens et al. 2013; Carlsson and Sandstrom, 2008
Network formation	The process by which actors from public, private, and non-government sectors build relationships with one	Adam and Kriesi, 2007; Ansell and Gash, 2008

	another around shared interests and problems	
Bridging organizations	Groups that help to connect actors within a network across institutional and jurisdictional boundaries as well as across scales of government	Cosens et al. 2018; Scarlett and McKinney, 2016

Table *1.* Key concepts used to assess emergence of adaptive governance associated with BRR

The restoration work in both the Upper Nehalem Watershed and on Jack Creek aimed to reconcile existing and continued development with the need to enhance desired ecosystem characteristics. In both cases, enhancement work was aimed at improving habitat for ESA-listed species, and new governance emerged largely because pre-existing governance surrounding ESA implementation was not suited to accommodate BRR. These factors make the conceptual framework applied in this thesis useful for examining the emerging governance structures in these case studies. Furthermore, this framework helps to exemplify ways in which governance mechanisms facilitating BRR use might better help reconcile development with ecosystem protection and enhancement goals utilizing BRR.

1.1 Research Questions:

1. To what degree do the Upper Nehalem Watershed and Jack Creek case studies provide evidence of a transition toward adaptive governance surrounding beaver related watershed restoration on state and federal lands in Oregon?
2. What governance adjustments are necessary for beaver related watershed restoration to better support watershed restoration goals in Oregon?

3. How might results of this study inform efforts to promote adaptive governance in other watershed restoration contexts?

The following thesis reviews literature on BRR, the idea of beavers playing a role in the reconciliation of working landscapes and ESA requirements, and principles of adaptive governance informing the conceptual framework used for this research. It then describes my research methods, including informal and semi-structured interviews, document analysis, situation mapping, and interview coding. Situation maps are then used to guide a narrative overview of each case study. Results and discussion are organized around the components of the conceptual framework. Finally, recommendations are made for reconciling working landscapes with ESA regulation using BRR. These include recommendations for legal and regulatory reform, project planning and funding, and landowner outreach and education.

2 Literature Review:

2.1 Summary:

The following literature review provides a brief history of beaver extirpation in North America, related land use changes, and effects on watershed processes. It then describes the development of the idea of beavers playing a role in reconciliation, introduces the concepts of reconciliation and adaptive governance, and reviews literature pertaining to each component of the conceptual framework used to evaluate emerging governance surrounding BRR in this research.

2.2 Beaver Extirpation in North America and BRR:

Before European settlement, it is estimated that there were 60-400 million beavers in North America, occupying a geographic range of 15 million square kilometers from the arctic tundra to Northern Mexico (Muller-Schwarze, 2011; Naiman et al. 1988). By the turn of the 20th century, however, beavers in North America were trapped to near extinction for their pelts (Jenkins and Busher, 1979). Because of this fur trapping, along with accompanying land use changes such as the introduction of domesticated grazing animals, deforestation, extirpation of large predator species leading to increased grazing by native ungulates, and the intentional draining of wetlands, at least 45 million acres of wetlands were converted to dry areas in the United States (Shaw and Fredine, 1956). This historical loss of wetland and floodplain area has profoundly changed the North American landscape. While it is difficult to understand exactly how large an influence the removal of beavers had on the watersheds of North America, observation of ecological succession following beaver re-introduction gives an idea of how profound an impact these animals have on the environments they inhabit.

Beavers alter watersheds primarily by impounding stream channels and cutting down trees to build dams and lodges that impound river systems (Green and Westbrook, 2009). Semi-permeable beaver dams—along with providing beavers with protection from predators, expanded habitat, and consistent food sources—expand the wetted area of streams, change the timing and quantity of seasonal flows, decrease current velocities in most systems, generally convert single channel streams into braided or stair-step profiles, expand the area of flooded soils in the riparian zone, increase retention of sediment, increase quantities of organic matter stored in aquatic habitat, alter carbon and nutrient budgets, increase quantities of dissolved oxygen, change the quantity and diversity of the plant and animal species that inhabit aquatic and riparian habitats, generally increase biological diversity, potentially increase connectivity

between surface and ground water in some circumstances, raise water tables in certain geomorphological conditions, cool water temperatures in the summer months and warm them in the winter, increase the ability of aquatic ecosystems to filter pollutants, and increase the heterogeneity of habitats within a watershed (Remillard et al. 1987; Martell, 2006; Hood and Bailey, 2008; Hood and Larson, 2015, Goud et al. 2018; Naiman et al. 1988). While there is much excitement about the seemingly transformative power of beavers, the degree to which these expectations are reasonable and realistic has recently been called into question (Nash et al. in review). The absence of beavers, in combination with other activities that increase flow velocity, reduce in-stream complexity, and destabilize stream banks through the removal of riparian vegetation, tend to have the opposite effect, causing streams to become incised and change to single channel profiles, lose connectivity with their floodplains, warm, concentrate flows during storm and melt events, and develop more homogeneous habitats (Green and Westbrook, 2009; Naiman et al. 1988).

This growing understanding of how watersheds change in the absence of beavers has sparked significant interest in the use of beavers for watershed restoration. Generally, BRR initiatives are designed to address nuisance beavers issues through non-lethal means, increase beaver populations, increase water storage and raise water tables, generate wetland habitat, create habitat for a particular species, and enhance riparian habitat through the promotion of floodplain connectivity and aggradation of incised streams (Pollock et al. 2015; Beechie et al. 2010).

Several BRR methods are used frequently. These include: translocation of live beavers, building of artificial beaver-dams (ABDs) or BDAs meant to both imitate natural beaver dams in terms of

form and function and attract live beavers, providing food to attract beavers, constructing beaver lodging, and planting riparian vegetation (Allen et al. 1983; Barne et al, 1997; Callahan, 2005; Howard, 1985; Jenkins, 1975; Johnston 1990; Macfarlane, 2014; Nolte, 2014; Pollock et al. 2015; Slough and Sadleir 1977). BRR methods sometimes also aim to address problems caused by nuisance beavers non-lethally and use methods such as caging vegetation, fencing culverts, controlling flooding near infrastructure using pond levelers and similar devices, and beaver translocation through non-lethal trapping (Pollock et al. 2015). Additionally, BRR methods are often coupled with landowner education to increase effectiveness. In a number of cases, these methods, used independently and in combination, have been shown to effectively create and maintain deep pools that act as rearing and overwintering habitat for juvenile salmonids, trap sediment in ways that improve water quality measures, aggrade incised channels, increase summer flows, decrease summer stream temperatures, change plant community composition in the riparian zone, and sequester carbon in wetland areas (Gurnell, 1998; Johnston and Naiman 1990; Maret et al. 1987; Nickelson et al. 1992; Pollock et al. 2007; Pollock et al. 2014; Rosell, 2005; Skinner et al. 1984; Westbrook et al. 2006). Questions still remain regarding beaver dams' and artificial beaver dams' ability to store surface water and increase connectivity between surface and ground water (Nash et al. in review).

2.3 Reconciliation of Development and Ecosystems:

Reconciliation can be defined as a means of bringing different systems or ways of thinking into alignment (Cosens et al. 2018). In the context of natural resources, reconciliation acknowledges that many ecological systems have passed the point at which it would have been possible to restore them to 'natural' conditions, and yet they are not beyond the point of improving ecosystem function (Benson and Craig, 2014). Reconciliation is often a non-linear process,

particularly in the context of the accelerated rates of change that characterize our modern era (Steffen et al. 2011; Walker and Salt, 2012). Reconciliation is achieved when individuals and groups learn novel ways of interacting with natural resources that look to establish and maintain new habitats to conserve species diversity in places where people live, work, and play (Moyle, 2014). Reconciliation also considers the hope of aligning multiple ways of viewing nature and the social-ecological interactions required for transformation. Arguably, one of the greatest divides, in terms of the way people view nature, is the weight given to phenomena that are measurable and quantifiable versus the weight given to the intangible, qualitative, and spiritual aspects of nature (Wolf, 2008). In the context of watershed restoration and BRR, conflicting world views arise when some actors wish to enhance watershed functioning due to a desire for intrinsic values inherent in natural ecosystems, while others wish to work with landscapes in ways that produce tangible and quantifiable results. In this respect, reconciliation will largely come about both through the building of new habits and the balancing of quantifiable and non-quantifiable values (Cosens et al. 2018; Wolf, 2008).

2.4 Adaptive Governance Principles Pertaining to Reconciliation and BRR:

Adaptive governance is a form of emergent environmental governance that is being increasingly called upon in the face of complex ecosystem change (Chaffin et al. 2014). In the context of social-ecological systems, adaptive governance can be defined as the forming and reorganizing of relationships between actors, organizations, and institutions within a governance network, particularly when this formation and reorganization occurs around shared goals and problem solving (Cosens et al. 2018; Chaffin et al. 2014).

Adaptive governance can help lead to the realization of reconciliation between development and ecosystem ideals at the bioregional and landscape scale by allowing networks of actors to solve complex problems that develop non-linearly (Cosens et al. 2018). Adaptive governance can also lower institutional roadblocks and barriers by promoting flexibility in implementation of policies and laws (Chaffin et al. 2014). This requires trust and social learning within networks as well as flexibility in the law (Cosens et al. 2017; Craig et al. 2017). There also, however, needs to be stability in the law in order to protect the interests of both those working on the landscape and listed species. These disparate yet ultimately converging needs demand an integrative approach to problem solving that promotes both innovation and experimentation, yet provides stability during these processes (Craig et al. 2017).

Cosens et al. 2018 identifies key building blocks for reconciliation including capacity building within local and marginalized communities, linkages between this capacity and changes to policy and decision making relevant to the landscape in question, governance mechanisms nested within and able to seek resources from a stabilizing government, and the presence of emergent and formally authorized bridging organizations at the bioregional scale. For reconciliation within the social-ecological system to be realized, however, a willingness of network actors to reconcile the ways in which they view nature must also exist through empathy building that leads to desires to respond to these expanded views by forming habits that change the way that individuals and groups interact with developed landscapes (Cosens et al. 2018; Gosnell et al. 2018).

Because law dictates the boundaries, rules, and processes within which government action can take place, it is often a major barrier to adaptation in the context of the social-ecological system

(Cosens et al. 2017). This is not to say, however, that law is incapable of adapting to complex emerging problems and new social norms (Green et al. 2015). Legal processes can evolve within broader adaptive governance systems and may be adjusted in order to facilitate desirable changes (Dietz et al. 2003). If new laws are to be adopted in democratic societies, however, these laws must also enhance legitimacy and justice within the legal system (Lockwood et al. 2010).

Cosens et al. 2017 pose guidelines and a framework for inquiry into of the role of law in adaptive governance, purporting that key areas to consider include the extent to which governance systems are polycentric in the way that they are governed, containing multiple centers of authority that are redundant and nested within higher forms of government. They note that laws are complementary to other centers of authority, in that decisions governed by the law in question should be made at the scale of government closest to the landscape of interest and integrated into sectors of government that influence how decisions governed by that law are made. Laws should be stable in their representation and decision-making frameworks; but there should also be capacity for resources and legal authority to be adaptive and respond to change and allow those that are affected by the law to have a role in decision making. Decisions governed by the law have to be seen as legitimate, as public support of laws is important for resource management. Those affected by the law should have the right to seek review and procedural justice regarding the law in question at the appropriate level. Scientific and interest-based collaborative processes should be used in the creation and enforcement of the law, and resources for monitoring the effects of laws should be present and should consider new and relevant information. Frameworks that balance stability and flexibility in terms of how

decisions governed by the law are made need to be put in place to provide means for dispute resolution (Cosens et al, 2017).

While many of the frameworks considered in this literature review were developed to evaluate emerging governance intended to reconcile development and ecosystem at the scale of transboundary water resources, these frameworks provide a strong conceptual basis for analyzing emerging governance structures surrounding BRR work that crosses institutional and jurisdictional boundaries at the landscape scale (Cosens et al. 2017; Cosens et al. 2018). Assessments of governance structure, degrees of adaptive and participatory capacity and social learning, network formation, and the role of bridging organizations remain relevant at this scale (Cosens et al 2018; Chaffin et al. 2014). The following sections of this thesis aim to utilize these conceptual principles of adaptive governance and reconciliation in order to characterize the emergent governance surrounding BRR on two landscapes.

2.5 Components of Conceptual Framework:

Governance Structure:

The term governance refers to formal and informal ways by which society decides upon collective goals, acts to achieve those goals, and resolves conflicts (Delmas and Young, 2009; Pelling et al. 2007; Rogers and Hall, 2003). Adaptive governance refers to emergent governance structures that can adapt and reorganize during periods of abrupt change or crisis (Folke et al. 2005). In other words, adaptive governance is the social conditions necessary for adaptive management. Within social-ecological systems, this reorganization frequently centers around developing a shared understanding of policies and knowledge of the ecological system of interest that individuals, organizations, agencies, and institutions at multiple sectors and scales of

government draw from as they form networks and share resources (Brunner et al. 2005; Cosens et al. 2018).

Adaptive governance can help lead to the reconciliation of development and ecosystems when polycentric governance structures are present yet nested within larger government hierarchies that provide stability and resources, and actors within these networks actively seek to facilitate desired feedbacks from the biophysical system (Cosens et al. 2018). For this to be achieved, vertical federal, state, and local governance structures need to be coordinated, and horizontal management structures that allow for multiple actors to engage in fragmented aspects of BRR need to be present. This organizational structure is achieved through the empowerment of local actors and the nesting of reconciliatory action within established governance networks at the scale of the system of interest (Bingham, 2009; Cosens et al. 2013; Gunderson, 2001). This governance structure provides a social mechanism that can allow ecosystems to return from an unstable condition to a state where they can maintain their form and function, without severely compromising development, safety, or equity in the system of interest (Cosens et al. 2018; Craig et al. 2017).

Adaptive Capacity:

Adaptive capacity refers to an individual's or group's ability to act in the face of hazards in ways that reduce their vulnerability to those hazards (Smit and Wandel, 2006). Governance structures exemplifying adaptive capacity are flexible, responsive to non-linear environmental change, and, in the context of reconciliation, capable of viewing nature in multiple ways (Cosens et al. 2018). Adaptive capacity can emerge from laws and government that help to distribute knowledge and financial resources through networks and provide institutional checks on power

imbalances (Cosens et al. 2017; Ostrom, 2005; Huitema et al. 2009). Because problems with managing landscapes across institutional and jurisdictional boundaries exist within social-ecological systems, bridging organizations, such as civic entrepreneurs, non-government organizations, and universities often help to build adaptive capacity by enhancing the exchange of information, leveraging financial resources, and dispersing risk (Carlsson and Sandstrom, 2008; Kemmis and McKinney, 2011; Scarlet and McKinney, 2016).

Accordingly, adaptive capacity, in the context of the social-ecological system, usually displays as the presence of knowledge and financial resources within a network at the scale of the landscape of interest (Cosens et al. 2013). When a system is adaptive, the availability of these resources will often transcend sectors and scales of government and allow actors to facilitate desired feedbacks from the biophysical system of interest and monitor and respond to these feedbacks in a timely, effective, and nimble manner as change occurs non-linearly (Cosens et al, 2018). Capacity building between network actors, and the nesting of this capacity within governance mechanisms that provide stability, help to link local actors to policy and decision-making changes relevant to the landscape in question (Cosens et al. 2014). This provides a mechanism by which development and ecosystems can be reconciled at the landscape scale.

Participatory Capacity:

In the context of the social-ecological system, participatory capacity refers to the capacity of local and marginalized groups at the bioregional and landscape scale to participate in decision making regarding how natural resources will be managed (Cosens et al. 2018). This capacity stems largely from the acknowledgement of past wrongs by network actors and acceptance of different worldviews, particularly those that pertain to how nature is perceived and acted upon

(Cosens et al. 2018; Wolf, 2008). In the context of watershed restoration, differing worldviews often arise when actors' intrinsic values surrounding the natural functioning of a watershed conflict with others' values regarding desires to work with watersheds in ways that produce tangible and quantifiable results. Past wrongs, in this context, are largely acknowledged when actors accept a worldview that is not their own as valid.

Participatory capacity in landscapes that cross institutional and jurisdictional boundaries is often facilitated by bridging organizations which connect local actors to resources at higher levels of government (Cosens et al. 2013; Ostrom 2005; Huitema et al. 2009). Participatory capacity can lead to reconciliation when local people seek to facilitate desired feedback from the biophysical system in question and can do so within established government frameworks (Cosens et al. 2018). Given that local people generally have some of the largest stakes both in how development occurs and how desirable feedbacks are facilitated from the biophysical system, participatory capacity is not only an essential mechanism for reaching reconciliation but is also critical to equity and inclusion more broadly (Cosens et al. 2018; Craig et al. 2017). The concept of 'local' is a tricky one when restoration projects are on state or federal lands. Because both federal and state lands are public, anyone with interest in those lands, regardless of their physical residence, should be able to participate in decision making regarding how those landscapes are used. This said, however, some public lands are used more heavily by some users than others. For example, certain timber operations operate in certain state forests, individual ranchers lease particular federal forest grazing allotments, and watershed councils operate in specific watersheds. In this way, for there to be participatory capacity on state and federal lands, the public must be allowed to participate in decision making, and the specific agencies and

actors that frequently use that landscape must be included in decisions regarding how that landscape is used.

Social Learning:

Social learning refers to the way in which people learn from one another through observation, imitation, and modeling (Bandura and Walters, 1977). In the context of the social-ecological system, social learning focuses on ways in which actors within a network learn from one another about a variety of phenomena that affect a landscape of interest and then build habits that lead them to interact with that landscape differently (Cosens et al. 2013; Carlsson and Sandstrom, 2008). The development of habits that facilitate feedback from the biophysical system and allow actors to respond to these feedbacks in a timely, effective, and nimble manner, allowing for the enhancement of desired ecosystem characteristics in developed areas, is at the heart of the idea of reconciliation (Cosens et al. 2018).

Social learning in the social-ecological system can be about both ways of altering ecosystem processes to facilitate desired feedbacks and about alternative ways of implementing laws and rules surrounding natural resource use in order to do so (Bingham, 2009; Cosens et al. 2013; Scarlett and McKinney, 2016). This learning also fundamentally includes learning about alternative ways of viewing nature and the means for balancing multiple world views through double and triple loop learning (Wolf, 2008).

Network Formation:

Network formation is the process by which actors from public, private, and non-government sectors build relationships with one another around shared interests and problems (Adam and

Kriesi, 2007). Emerging governance that leads to the formation of polycentric networks, nested within governance structures that provide stability and resources, can lead to reconciliation when paired with a desire to facilitate desired feedbacks from the biophysical system in landscapes that people frequently interact with (Cosens et al. 2018).

Networks can be formal and officially organized or informal and emergent in response to shared interests or problems (Ansell and Gash, 2008; Kettl, 2006). The formation of both formal and informal networks in the context of social-ecological systems, is generally driven by relationship building between key network actors (Adam and Kriesi, 2007). As previously stated, network structures that are polycentric in nature yet nested within governance structures that provide resources and stability are largely conducive to reaching reconciliation on landscapes in which actors wish to facilitate desired feedbacks from the biophysical system in the places that they live, work, and play (Cosens et al. 2018; Carlsson and Sandstrom, 2008; Scarlett and McKinney, 2016). Furthermore, bridging organizations often play a disproportionate role in helping these kinds of networks emerge, due to their ability to connect local actors to governance structures that provide stability and resources (Cosens et al. 2018; Scarlett and McKinney, 2016).

Bridging Organizations and Entities:

Bridging organizations are groups that help to connect actors within a network across institutional and jurisdictional boundaries as well as across scales of government (Cosens et al. 2018; Scarlett and McKinney, 2016). Bridging organizations, such as civic entrepreneurs, non-government organizations, and universities, do not replace emerging governance structures, but instead facilitate their formation in ways that help build capacity by enhancing the exchange of information, leveraging financial resources, and dispersing risk (Carlsson and Sandstrom, 2008;

Kemmis and McKinney, 2011; Scarlet and McKinney, 2016). Bridging organizations can be picked out of a network of governance actors when organizations are observed helping to connect local actors to both financial and knowledge resources at higher scales of government (Cosens et al. 2018; Scarlett and McKinney, 2016). These organizations are often civic entrepreneurs, non-government organizations, and universities at the bioregional and landscape scales (Cosens et al. 2018; Carlsson and Sandstrom, 2008).

Bridging organizations help reconciliation be realized by helping polycentric governance structures to nest within governance structures that provide stability in the face of non-linear change to the landscape of interest (Cosens et al. 2018; Carlsson and Sandstrom, 2008). Bridging organizations are particularly effective when they specifically link local communities to capacity that leads directly to changes in policy and decision-making frameworks (Scarlett and McKinney, 2016; Wheatley and Frieze, 2009). In this way, bridging organizations, while not a prerequisite for reconciliation, provide support and capacity building which often help reconciliation be achieved (Cosens et al. 2018).

3 Methods:

To answer the research questions outlined in the introduction of this thesis, several research methods were used. These include: informal interviews, semi-structured interviews, document and discourse analysis, situation mapping, and thematic interview coding. The following section outlines each of these methodologies as they were used to conduct this research.

Figure 1. A visual representation of methods used for research

3.1 Informal Interviews:

Informal interviews were conducted with individuals who participated in BRR restoration projects in the Upper Nehalem Watershed and on Jack Creek as well as with other individuals knowledgeable about various aspects of BRR and watershed restoration governance (Bernard, 2017). There were three primary goals associated with these informal interviews. The first was to better understand the scope of BRR occurring in the western United States and draw on the knowledge of experts in the field in order to ask pertinent research questions. The second was to identify the case studies which were ultimately used in this thesis. This step was essential as case studies for this research needed to be both current and accessible. The third primary goal associated with conducting informal interviews was to identify individuals that could serve as key informants, build rapport with these informants, and in doing so, gain access to other interviewees with knowledge pertinent to this research (Bernard, 2017; Blomberg, 2017).

Sampling for informal interviews was done purposively in alignment with the Internal Review Board (IRB) authorization received for this project. Interviewees were contacted by both phone and email and asked an array of questions centered around the goals of identifying relevant research questions, identifying relevant case studies, identifying key informants who could render access to those case studies, and building rapport with them (Bernard, 2017).

3.2 Semi-Structured Interviews:

Semi-structured interviews were the primary methodology used for this research (Bernard, 2017). Sampling for these interviews was initially purposive, drawing from connections made during the informal interview process. During these initial interviews with key informants, interviewees were asked to identify other individuals involved in the Nehalem and Jack Creek BDA restoration projects. Individuals identified were then contacted for interviews and those that were interviewed were then also asked to identify other potential interview candidates in order to achieve a snowball sample (Bernard, 2017). For each case study, this process was repeated until interviewees did not produce any new interview candidates (Bernard, 2017; Salganik, 2004) Because both case studies examine restoration projects involving a small number of key individuals, sample sizes for this study are relatively small. While the validity of small sample sizes has been debated in the qualitative methods literature, this research relies heavily on theory-based design, and utilizes informed expert interviews. This style of research is considered valid when the majority of the expert population in a sample is interviewed, even when that population is too small to produce results that would be considered statistically relevant in other study designs (Trotter, 2012). In both case studies, the majority of the entire population was sampled. Furthermore, interview data was tested for validity by 1) testing for redundancy by comparing interviewee responses and confirming that the same information was repeated by multiple interviewees and was not contradictory, 2) triangulating information by comparing interviewee responses to pertinent documents as well as to one another, and 3) by showing select study results to key informants and asking them to confirm the validity of the information presented (Trotter, 2012; Bernard, 2017).

An interview guide (Appendix A) was developed to elicit answers to the questions posed in the introduction of this thesis. Interviews dealt with the general theme of beaver-based restoration as well as BDA governance more specifically.

Most interviews were conducted in person and recorded using the Apple iPhone application iTalk; however, several interviews were conducted over the phone and recorded using the application Tape-a-Call. All interviews were then transcribed using the application oTranscribe and stored in accordance with the IRB approval obtained for this project. The method for analyzing these interviews as well as other documents relevant to this study is described in subsequent sections.

3.3 Document and Discourse Analysis:

During the interview process many interviewees provided access to formal and informal documents pertaining to each case study. These documents were also used for analysis in a process described below.

3.4 Situation Mapping:

Situation maps are a representation of complex systems that can be used to visualize and infer relationships about systems structure and the relationship between system components (Clarke, 2005; Lanzara, 1985). They are useful for understanding complex governance structures. In this research, situation maps were created to explore the governance structure regarding BDA installation for both the Upper Nehalem and Jack Creek case studies. Situation maps were created for each case study by coding interviews and documents provided by interviewees for key terms and then organizing these key terms into logical groupings. A term was considered

key if it was representative of an individual or group acting directly or indirectly on BDA installation; a formal agreement between actors; a formal law or regulation; a stated project goal, funding source, restoration or governance tool; or representative of another important aspect of BDA installation governance. Once all interview transcripts and other documents were coded for key terms, situation maps were produced using SmartArt applications within Microsoft Word. Situation map validity was checked by showing the situation maps to key informants from each case study and asking them to validate the accuracy of the maps both in terms of the completeness of key terms listed and organizational accuracy.

3.5 Interview Coding:

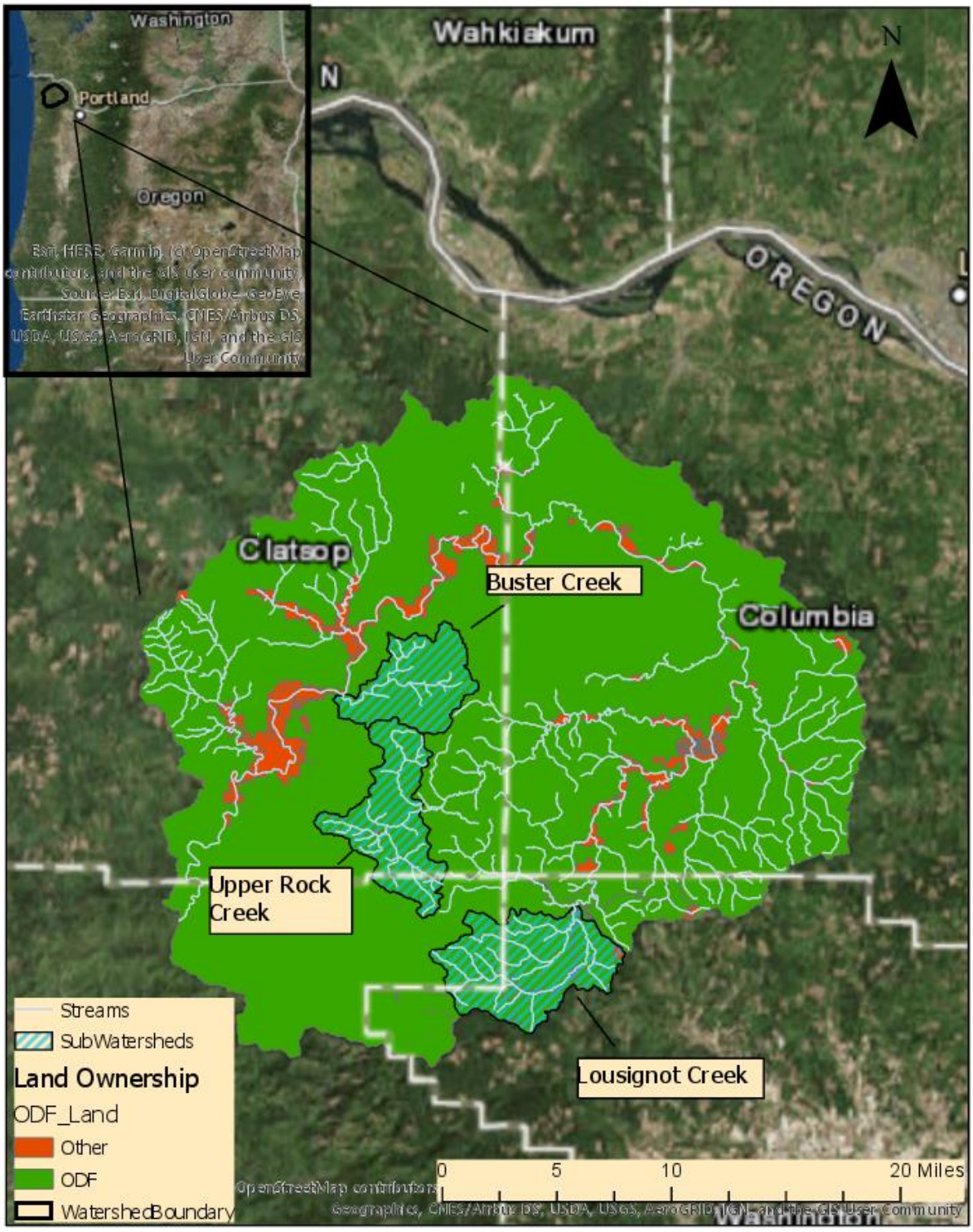
Interviews were coded in a manner meant to answer the questions posed in the introduction section of this thesis. A coding framework based on adaptive governance principles was designed to answer questions regarding the adequacy of current governance mechanisms to facilitate BDA installation (see Appendix B). Themes directly related to governance mechanisms surrounding BDAs were also coded for with the goal of answering questions regarding the emergence and evolution of governance mechanisms.

All interviews were coded using NVivo qualitative data analysis software, and data were stored in a manner in accordance with the IRB approval received for this project. Coded interviews were used as primary tools to guide the writing of the case studies, results and discussion, and conclusion sections of this document.

4 Introduction to Case Studies:

4.1 Upper Nehalem Watershed:

The Upper Nehalem Watershed is located in the northwest corner of Oregon (Map 1). The watershed has a high density of headwater and low order streams flowing from the Coast Range into the Nehalem River, which was once one of the most prolific Coho producing rivers in the Coast Range (Interview WSC Staff, 2018). Following the ESA listing of Coho in 2008 by NOAA Fisheries , several state and federal plans were created to address the decline of Coho salmon in the Upper Nehalem Watershed and more broadly throughout the state (Interview WSC and UNWC Staff, 2018). Due largely to the availability of data on Coho populations and habitat quality in the Upper Nehalem, the opportunity to leverage funding, and the historical size of Coho runs in the Nehalem River and their cultural significance, the Wild Salmon Center (WSC) designated the Upper Nehalem as a Pilot Watershed Project (PWP) and worked with a variety of partners to plan and initiate the BRR project in the watershed (Interviews with WSC and UNWC Staff, 2018). BRR was chosen as a primary methodology for restoration in this watershed after site surveys and modeling efforts showed that the presence of beaver dams was highly correlated with the presence of both adult and juvenile Coho salmon in the sub-watersheds of interest. Individuals involved in the Upper Nehalem Watershed restoration were familiar with BRR and felt comfortable with the methodology after the strong connection between beaver and Coho habitat was established early in the restoration planning process (Interview with UNWC, staff).



Map 1. Map depicting the Upper Nehalem Watershed, sub-basins housing BRR projects, and land ownership (GIS data downloaded from Oregon Spatial Library and National Hydrography Dataset, 2019)

Image 1. BDA in Upper Nehalem Watershed (Image by author, 2019)

Image 2. Coho Salmon spawning in Upper Nehalem Watershed (WSC, 2018)

After the PWP was established, the Nehalem Strategic Action Plan (NSAP) was developed (Interview with WSC staff, 2019; Oregon Coast Coho Business Plan, WSC). The development of this plan was facilitated by the WSC, but multiple agencies and stakeholders in the Upper Nehalem Watershed, termed the Steering Committee, ultimately provided input as to what the plan should include and how tasks should be carried out. The NSAP ultimately outlined the plans for BRR in the Upper Nehalem, along with several large wood placements, and monitoring projects throughout the watershed. It was decided that BRR would be used as a primary restoration methodology after it was found that beaver dams provided excellent Coho salmon habitat in areas that were described as poor Coho habitat in a GIS model (Interview with WSC Staff, 2018). In the process of ground-truthing this GIS model, it was found that the model accurately described Coho salmon habitat quality except in places where there were natural beaver dams in the watershed. The GIS model looked at factors such as stream slope, valley width, and stream width-to-depth ratios, but did not account for the ways that beaver dams alter stream velocity and other habitat conditions, which caused the model to inaccurately predict the habitat quality of areas in the watershed containing beaver dams. This led the steering committee to feel strongly that BRR could be a viable method for Coho habitat restoration. Once the connection between beaver dam presence and quality Coho habitat was made, project goals for the NSAP were finalized to include attracting wild beavers to BDA sites, the creating of pools and complex habitats that could serve as refuges for juvenile Coho and migrating adults, both through habitat amendment using BDAs and attracting of wild beavers, the improving of water quantity, and the further testing of BRR as a salmon habitat restoration methodology through a ten-year monitoring program (Interviews with WSC and UNWC staff, 2018).

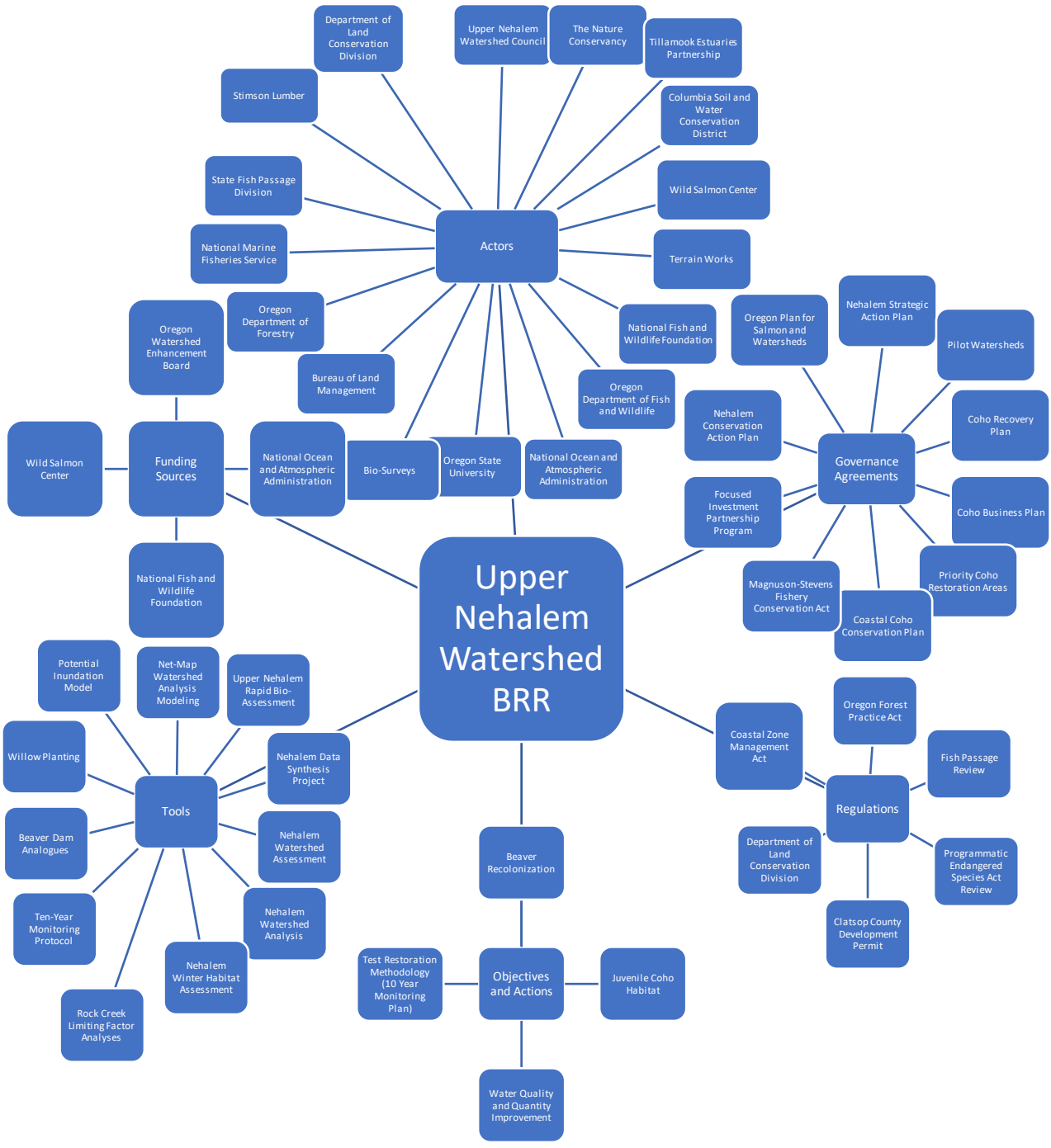


Figure 2. Situation map of factors related to BRR in the Upper Nehalem Watershed

After goals under the NSAP were established, several datasets that preceded the NSAP were compiled and novel tools were created to help guide the process of deciding where to place restoration sites at the sub-basin and reach scale. Prior to the NSAP, the group Terrain Works used an optimization model, termed the Watershed Analysis Model, to help identify priority restoration reaches in the Upper Nehalem based on a variety of geomorphological and ecological factors (Interview with UNWC staff, 2018). A ground truth project, termed the Upper Nehalem Rapid Bio-Assessment, accompanied the Watershed Analysis Model. It was developed by Bio-Surveys as a system for ground-truthing potential restoration sites to assure that the model accurately predicted intended environmental characteristics. The Nehalem Data Synthesis was an effort by the Steering Committee to compile data from the Nehalem Watershed Assessment and Rapid Bio-Assessment, with other available datasets and literature to comprehensively select the most effective sites for BDA construction. Once restoration sites were selected, a Potential Inundation Model was created to model the hydrologic effects of beaver colonizing each BDA site at different stage heights.

Once the steering committee decided upon BRR as a primary methodology, and restoration site plans were established, several permits were obtained. Historically, all restoration work in the Nehalem that fell on ODF land was permitted under the Oregon Forest Practices Act (Interview with ODF staff, 2018; Oregon Forest Practices Act, ODF). For the BRR project, however, which utilized 27 BDA structures, a Fish Passage Review (FPR) was received through ODFW State Fish Passage Division (SFPD), a Programmatic ESA Review was received through NOAA, a Clatsop County Development Permit was obtained through Clatsop County, and the project

was reviewed by the DLCD under the Coastal Zone Management Act (Interviews with ODFW, NOAA, WSC, and UNWC Staff, 2018).

Once sites were selected and permits were obtained, BDAs were installed, and willows were planted to attract beaver. A ten-year monitoring plan was established as part of the NSAP to assess the long-term effectiveness of the project in terms of Coho and beaver recolonization and water quality measures, although this aspect of the project is only partially funded (Interview with NOAA staff, 2018). All aspects of the NSAP were funded by the Oregon Watershed Enhancement Board, NOAA, NFWF, and matching funds from the WSC (Interviews with WSC, UNWC, and NOAA staff, 2018).

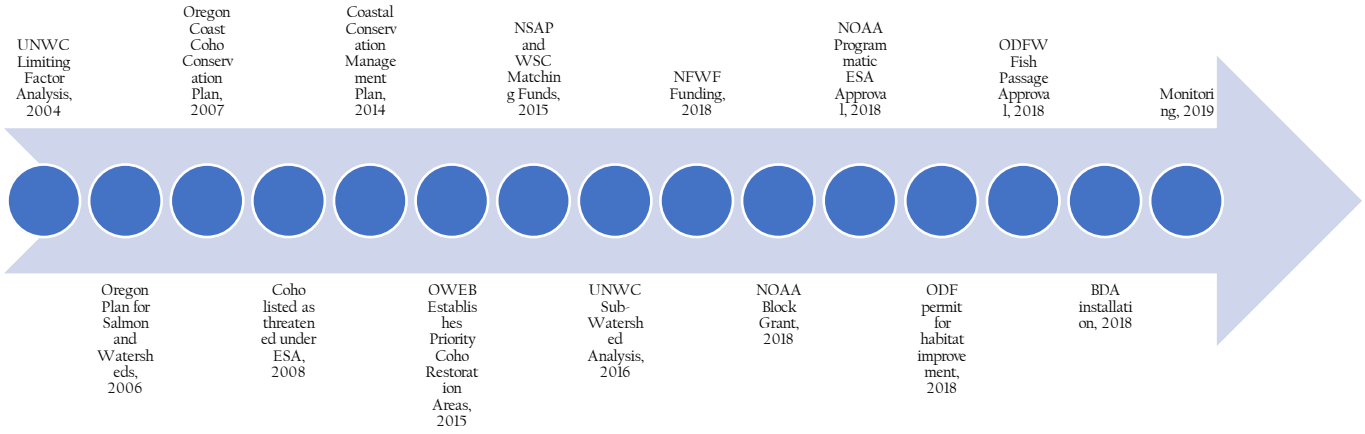


Figure 3. Timeline of events leading to BRR in the Upper Nehalem Watershed

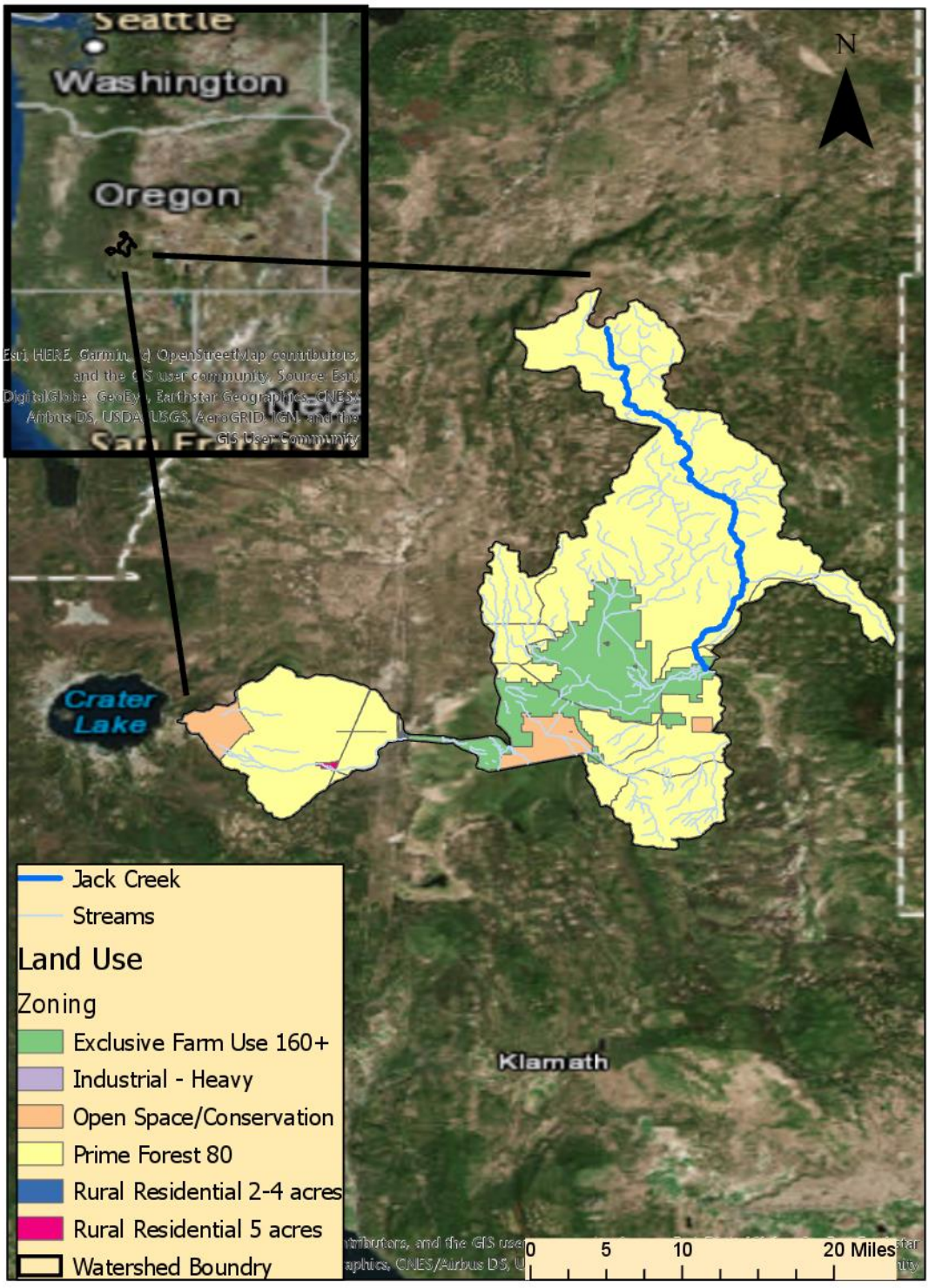
4.2 Jack Creek:

Jack Creek, located on the Fremont-Winema National Forest in the Williamson River Watershed, is one of several headwater streams in the Upper Klamath Basin (Map 2). BRR was initiated on Jack Creek following a history of litigation, land-management changes, and disagreements about how best to amend the landscape to allow grazing authorizations to be issued by the USFS while protecting critical habitat for the Oregon spotted frog (OSF) and complying with the National Environmental Policy Act (NEPA), National Forest Management Act (NFMA), and ESA (Concerned Friends of the Winema v. U.S. Forest Service, 2017).

The first grazing authorization for Chemult Pasture, a 68,000-acre livestock pasture that Jack Creek runs through, was issued at the turn of the century. This pasture has been grazed by a

private landowner and his family, who also owns private ranchland on Jack Creek, since this time. OSF were discovered on Jack Creek in 1996 and listed as a sensitive species in 2004. In 2008, a local watchdog group, the Friends of the Winema (FOW), along with the Center for Biological Diversity (CBD) and other plaintiffs brought an action claiming that grazing harmed sensitive species in Jack Creek (Concerned Friends of the Winema v. U.S. Forest Service, 2017). After this case was filed the USFS built a "frog fence" around the riparian areas of Jack Creek in order to have NFMA claims dismissed by the court. In 2010, another motion was filed challenging the USFS grazing authorization and the court found that the USFS violated NFMA, by failing to review the effects of annual grazing on the Chemult Pasture on sensitive species, and NEPA by failing to do supplemental environmental analysis after critical OSF habitat was found on Jack Creek (Concerned Friends of the Winema v. U.S. Forest Service, 2017). The USFS responded to these rulings by issuing a permit violation to the cattle user and restricting both the number of cattle allowed to graze on the Chemult Pasture and the time period in which grazing was allowed. In 2014, OSF were designated as threatened under the ESA, and the USFS issued a new Environmental Impact Statement (EIS) in order to update grazing authorizations. In 2015, the United States Fish and Wildlife Service (USFWS) consulted with the USFS and issued a Biological Opinion (BiOp) for the updated grazing authorizations. In 2017, the court ruled that the grazing authorization for Chemult Pasture violated NFMA and ruled that the BiOp for Jack Creek should be remanded. The court ordered a new environmental review, halting any further grazing until the USFS and USFWS could demonstrate that this activity would not harm OSF (Concerned Friends of the Winema v. U.S. Forest Service, 2017). After both fencing and exclusion of cattle failed to improve OSF habitat, the USFS and USFWS were forced to rethink their approach and improve ecosystem conditions on Jack Creek in order to address the root of the OSF critical habitat problem.

Increasing frog numbers through habitat improvement (namely by creating ephemeral pools and arresting head-cutting) was presented by the court as a path forward that could allow for grazing permits to again be issued by creating a buffer against "non-lethal take" caused by grazing (Concerned Friends of the Winema v. U.S. Forest Service, 2017). Initially, the Forest Service planned to address the degraded habitat on Jack Creek by doing a Stage Zero restoration, a method that involves filling an incised channel with substrate and letting the channel reform naturally (Interview with TU staff, 2018). However, opposition to this method from both the FOW and the private landowner eventually led those involved to decide upon BRR as a restoration methodology (Interview with TU Staff, 2018). Initial opposition to Stage Zero restoration stemmed from concerns that the method would lead to increased sedimentation, particularly in the event of flooding leading to a "blow out", which could harm existing OSF and degrade grazing pastures (Interview Trout Unlimited staff, 2018). Although a process of social learning needed to occur for BRR to be accepted as a viable methodology, 11 BDAs were eventual installed on Jack Creek to address head-cutting and enhance OSF habitat. Live beaver translocation was also attempted prior to the installation of these BDAs, however, neither live beaver nor beaver activity have been observed on Jack Creek since this translocation attempt (Interview with KWP staff, 2018).



Map 2. Williamson River watershed containing Jack Creek BRR, streams, and land use (GIS data downloaded from Oregon Spatial Library and National Hydrography Dataset, 2019)

Image 3. BDA installation on Jack Creek (Image by North West Youth Corps, 2018)

Image 4. OSF in Jack Creek (Image by USGS, 2018)

Several actors were involved in the BRR on Jack Creek, including the USFS, a private ranch owner, the Department of State Lands, the FOW, CBD, Klamath-Siskiyou Wildlands Center (KSWC), Western Watershed Project (WWP), Oregon Wild (OW) Trout Unlimited (TU), the

Klamath Watershed Partnership (KWP), the OSF Working Group (OSFWG), BLM, Three Lakes Construction, the North-West Youth Corps (NWYC), the United States Army Corps of Engineers (USACE), and the Oregon Water Resources Department (OWRD).

The non-profit group TU took on the lead role of design and implementation of the BDA project (Interview with TU Staff, 2018). TU was contacted by USFWS environmental scientists following the lawsuit by the FOW and decision to abandon the Stage Zero restoration plans. TU proposed using BDAs for the project, due to the experience of individuals at the organization with the methodology and the appropriateness of Jack Creek's morphology.

TU worked with the OSFWG, along with the USFS and USFWS who provided consultation on the BDA project throughout the planning and implementation stages in order to make sure the project met NEPA, NFMA, and ESA requirements (Interviews with KWP and TU staff, 2018). This mainly involved oversight to make sure that project plans addressed the issues of stream incision and head cutting and that the implementation of the project did not disturb known OSF habitat.

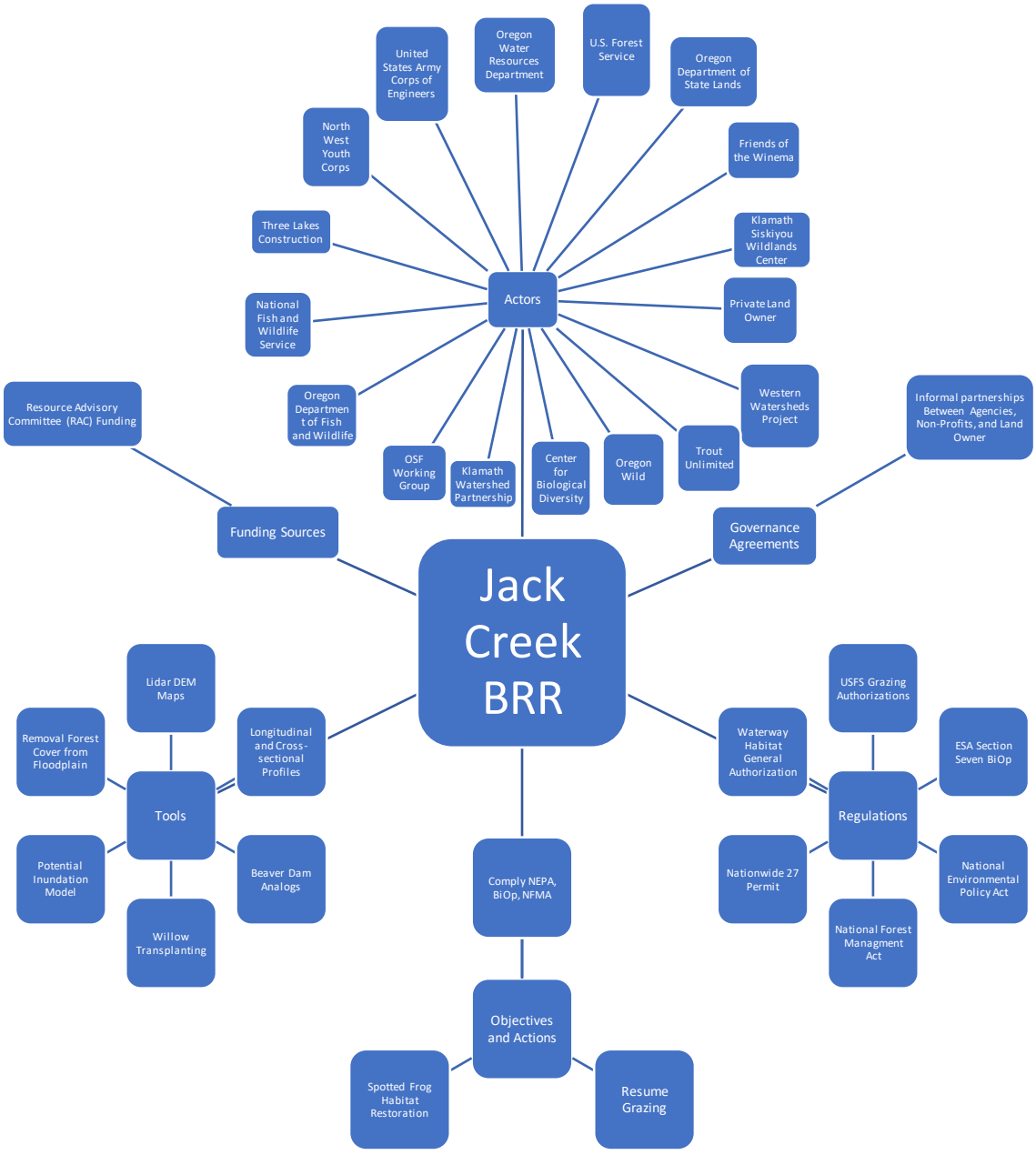


Figure 4. Situation map of factors related to BRR on Jack Creek

To meet the objectives of restoring OSF habitat, resuming grazing, and meeting NEPA, NFMA, and ESA requirements, several tools were used to optimize the BRR planning process and streamline decision making. Although only a handful of BDAs would have been required to arrest the head cutting on Jack Creek, an environmental scientist with the USFWS recommended that the project be designed to incorporate as many pools as possible, because year-round pools generally make for optimal OSF habitat (Interview TU staff, 2018). To plan where BDAs would be placed, LIDAR-produced digital elevation models along with longitudinal and cross-sectional stream profiles were used to understand the stream's morphology and make decisions regarding BDA placement. Once these placements were agreed upon, a potential inundation model was created in order to show the impact that the newly implemented BDAs would have on the riparian area at different stage heights (Interview with TU Staff, 2018).

Once restoration site plans were established, permitting for the BDA installation was obtained through the Oregon Department of State Lands (ODSL) who issued a Waterway Habitat General Authorization permit (Interview with ODSL staff, 2018). This General Authorization does not call out BDAs specifically, but allows for an expedited permitting process for grade control projects that use materials which mimic natural substrates, do not create fish passage barriers, and are limited to 100 cubic yards of fill per mile of waterway. This shortened permitting process typically takes less than 30 days and does not require a public comment period. A Nationwide 27 general permit was also obtained through the USACE. This is a general permit that permits water quality considerations for habitat restoration activities under section

404 of the Clean Water Act (Nationwide 27 Permit, Army Corps of Engineers). This permit covers restoration work that produces net increases in aquatic resource function. OWRD was also contacted by TU regarding permitting (Interview with TU staff, 2018). Although the project does amend the way that water is stored in Jack Creek, no water storage permits were necessary due to the remoteness of Jack Creek, the fact that there are no diversions on the channel, and the relatively low amount of water that would potentially be stored by each BDA, given these other factors (Interview with TU staff, 2018).

To implement the BDA project on-the-ground, TU worked with the KWP, NWYC, and Three Lakes Construction (Interviews with KWP, NWYC, and TU staff, 2018). The KWP provided logistical support and supplies for the project. NWYC volunteers physically built BDAs, transplanted willows, and removed lodgepole pine in the riparian zone. NWYC is a non-profit organization that provides skill building and job training programs for high school graduates and partners with a variety of organizations to support a wide array of projects (Interview Northwest Youth Corps staff, 2018). NWYC had partnered with TU previously and reached out to TU before the restoration season to ask if there were projects for their crews to get involved in (Interview with NWYC staff, 2018). Three Lakes Construction amended the access road required to move materials into Jack Creek and helped move the equipment necessary to implement the project.

Along with the building of BDAs, willows were planted both in the riparian zone of Jack Creek and directly into the BDA structures to anchor the banks, increase habitat complexity within

the stream, and potentially attract wild beaver to the area (although interviewees were not optimistic about this prospect) (Interview with TU staff, 2018).

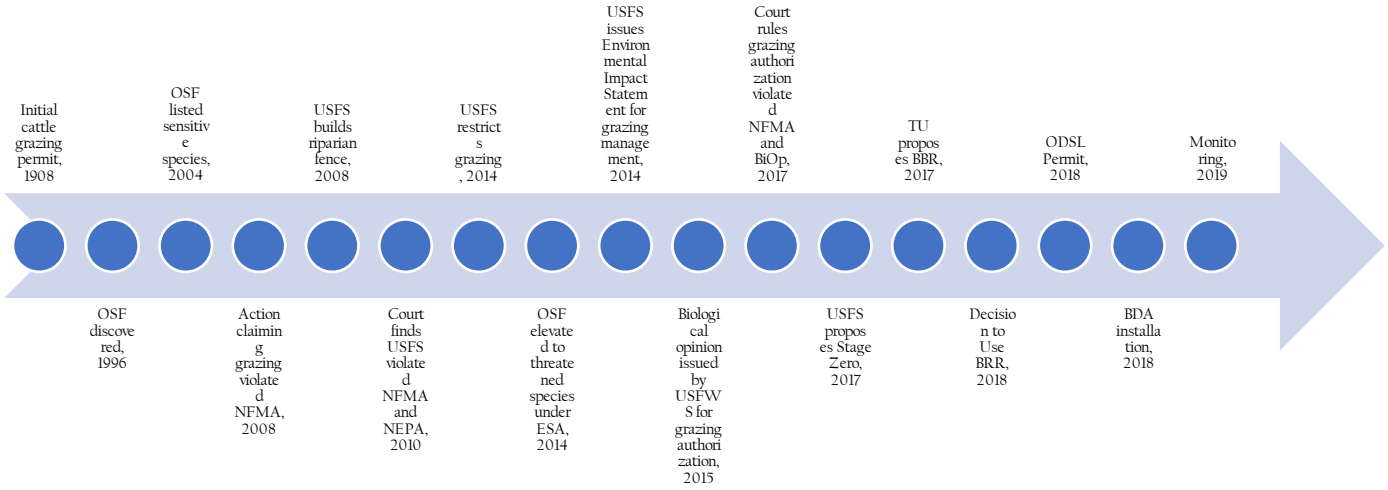


Figure 5. Timeline of events leading to BRR in Jack Creek

5 Results and Discussion:

5.1 Overview:

This results and discussion section compares key principles of adaptive governance to the emergent governance observed in the Upper Nehalem Watershed and Jack Creek. For each of the six principles used in the framework of this research, commonalities and differences between the two case studies are explored, and key insights are highlighted. Below, Table 2 summarizes major findings.

	Upper Nehalem Watershed	Jack Creek
Governance Structure	• Conflicting interpretations of OFPA • Gaps in governance: inadequate FPR process, lack of technical BDA definition, and lack of protection for beaver to accompany BDA structures. • New forms of governance including multi-method strategic plans, and emergence of new permitting processes • Largely polycentric network structures nested within government hierarchy	• ODFW rules made beaver relocation difficult, paving way for BDA use • General permits that do not specifically call out BDA use represent gaps in governance • Interviewees expressed need for general permits through Forest Service/BLM and state legislature • Restoration driven by federal regulation, but spurred by grass roots activism
Adaptive Capacity	• Restoration site selection intended to maximize feedback from biophysical system • Presence of financial resources: OWEB, WSC, NFWF, NOAA block grant • Ability to integrate local watershed knowledge into NGO, state, and federal strategic plans • Ten-year monitoring plan with adaptive management protocols • Programmatic BiOp streamlining ESA section 7	• Presence of financial resources from Forest Service RAC funding and labor resources through NWYC • Presence of local knowledge resources through TU and KWP • Adaptive management principles aimed at facilitating feedback from the biophysical system
Participatory Capacity	• ODF willingness to house BDA projects promoted by WSC	• Restoration design ultimately driven by

	and UNWC, despite uncertainty of outcomes • State agencies allowing local NGOs and contractors to lead decision making process, while providing support/stability	local NGOs and private land owner • NGOs provided checks on federally driven plans not adapted to local conditions • Willingness of government agencies, NGOs, and private landowner to amend plans for sake of collaboration
Social Learning	• Strong understanding of restoration goals and BDA function amongst interviewees • Explicit connections between local watershed knowledge and restoration planning • Strong understanding of ecological role of beaver and connection to fisheries health amongst interviewees • Learning involving new ways of navigating FPR despite loosely defined process • Learning about how to do non-extractive work under OFPA	• Punctuated learning about historical beaver presence and role of BDAs on landscape • Strong general knowledge of common permits needed for restoration work amongst interviewees • Multiple references to potential Forest Service and state general permits • Information exchange with other BRR projects in American West
Network Formation	• Fragmented governance structure nested in government hierarchy • Familiarity between actors based on past work • Local actors' knowledge of watershed facilitated	• Strong relationships between fragmented actors from past work • TU connection to BDA pioneers • Good working relationships between local NGOs and state and federal agencies

	informal network formation • Good working relationships facilitated willingness to collaborate despite uncertainty of outcomes	• TU past work with NWYC • Restoration process potentially slowed by conflict of interest
Bridging Organizations	• WSC and UNWC primary bridging organizations facilitating cooperation between actors at multiple scales of government • Bio-Surveys connected organizations at multiple scales of government to knowledge resources, allowing funding to be used strategically	• TU, KWP, and FOW primary bridging organizations facilitating communication between actors at multiple scales of government

Table 2: Table comparing adaptive governance principles to emergent governance in the Upper Nehalem Watershed and Jack Creek

5.2 Governance Structure:

Upper Nehalem Watershed:

In this research, governance structure was examined by coding interviews for themes including: conflicting laws and policies; gaps in governance; new forms of government; signs of polycentricity, or the making of decisions at multiple scales of government; and signs of subsidiarity, or the making of decisions at the smallest feasible scale of government (Cosens, 2017; Chaffin et al. 2014).

Several interviewees in the Upper Nehalem Watershed expressed confusion as to which permits are required to install BDA structures on State Forest land. At the heart of this confusion was the OFPA, and if and how BDAs are permitted under the act or permitted through ODSL as

county development permits when they are not directly tied to a productivist activity (Interview with ODF staff, 2018). An UNWC staff member expressed feelings of uncertainty regarding permitting and the OFPA, stating that

> At one point we had to send it [BDA permitting procedures] to Clatsop County Plan Development Services. I was a little worried…because at that point I was like, why do I even have to get a development permit, because isn't this covered under the Oregon Forest Practices Act? –UNWC Staff, 2018

An ODF employee involved in the Nehalem BDA project weighed in on the issue stating

> That [the OFPA] is the interesting part, because technically it [BDA work] is not permitted under the Forest Practices Act, so um, it is hard to say whether we did everything exactly right. One of the things I've found out through this project, um, cause I had always assumed that under Forest Practices we have, I don't want to say license, we have authorization to go do some of these things—put wood in the streams—but what I found out is that under Forest Practices it [restoration work] has to be connected and tied to another operation, so you either have to be doing road work, harvesting, doing something, and then you can do, you can also include this work as part of that. –ODF staff, 2018

A NOAA employee, however, interpreted the OFPA differently while explaining her agency's logic behind choosing the permitting path for the project. She stated that

> We didn't feel like they [restoration practitioners] were dredging and filling…if they were then we would have [gotten a permit] but because it is covered under the Forest Practices Act they don't actually have to get a DSL permit for it, even if there was dredging and filling happening, so it doesn't, this particular project didn't need an Army Corps permit or DSL permit. NOAA staff, 2018

Along with instances in which participants felt confused about the best way to permit BDA projects, several interviewees in the Upper Nehalem Watershed talked about situations where they felt there were gaps in governance surrounding BDAs. An ODFW staff expressed his hesitations giving out Fish Passage permits for BDA projects given the newness of BDA use in Oregon. He stated,

> I think that there is a time and a place for a BDA, and I think folks that are putting these on the landscape don't have, maybe, the experience and knowledge as to maybe when is the right or the wrong time and place.—ODFW staff, 2018

The same interviewee then talked about the impact that removing wood from streams had on fish passage in Oregon during the 1960s and '70s. He expressed concern that BDAs could have the same effect on fish passage if mechanisms are not created to ensure that implementations are done properly. He referred to BDAs a "shiny new tool", stating,

> I am hoping, while this is maybe not a surrogate for that story line, in terms of large wood removal, I am concerned that there are a lot of folks that are jumping on board with these structures without really knowing what the goal is. Folks follow money right, and even to some degree some watershed councils. And OWEB has been free to subsidize some of these, I shouldn't say free, but they have been apportioning funds for beaver dam analogs for the past 5 years. —ODFW staff, 2018

This quote speaks to the need for ongoing experimentation and monitoring regarding BBR to address these uncertainties. Because uncertainty existed regarding how BDAs would effect fish passage, the 10 year monitoring plan played a large role in assuaging ODFW's concerns (Interview with ODFW staff, 2018).

One individual responsible for permitting BDAs at NOAA also spoke to the newness of BDAs as a restoration methodology, and the presence of gaps in the way the structures are governed as a result of this. She explained that

> In our NEPA document we analyze the effects of very similar projects and I don't even know how it [BDAs] didn't make it in there because it is in our programmatic biological opinion, so I don't really know how the right words didn't get into our EIS, but they didn't.—NOAA staff, 2018

NOAA's EIS provides a mechanism for permitting certain kinds of restoration activities in a streamlined manor. Because wording calling out BDAs specifically did not make it into this document, it makes permitting BDA projects more time consuming than other types of

restoration activities that are called out in the EIS. Had BDAs been in the EIS the permitting for the project may have progressed more quickly.

The same interviewee then explained how there is not a complete "road map" for how to install and permit a BDA and how some folks at the NOAA science center are working on an implementation manual, which she feels will help answer a variety of permitting gray areas by better defining what a BDA is and how it should best be used. An individual from the WSC talked about how he felt that general permits would help streamline restoration work. He explained that

> The Freshwater Trust has been pushing for a long time to sort of streamline the permitting process and have different permits for restoration work so that they wouldn't have to meet the same thresholds as development projects…The state is following suit.—WSC staff, 2018

Finally, one watershed council staff member pointed out that in order to meet the process-based restoration goal of attracting beaver to BDA sites, that beavers need protection from hunting, trapping, and poaching. She summed up her thoughts by saying,

> The beavers are amazing. They will do all the work. We just need to back off. But they need protection, the problem is they need protection, they are not protected, they are subject to poaching and trapping and you know they don't have the type of protection that they need to do the job, because if we just step back the beaver would do a lot of the restoration for us. –UNWC staff, 2018

Interviewees in the Upper Nehalem Watershed referenced what could be considered new forms of governance required to facilitate the use of BDA structures. These new forms of governance can generally be put into three categories: 1) strategic plans specifically drafted to detail the use of BRR and mechanisms required to facilitate its use, 2) new agency and state general permits, and 3) alternative applications of existing laws and rules.

While strategic planning is by no means a new mechanism for organizing groups, several mechanisms utilized in the NSAP are novel and somewhat specific to the use of BRR aimed at salmon population recovery. The Net-Map Watershed Analysis, Rock Creek Limiting Factor Analysis, and Rapid Bio-Assessment methods in combination provided a creative way to develop both current beaver and salmon habitat suitability rating for habitat within the Upper Nehalem Watershed, and also to assess suitability for habitat improvement based on a variety of biophysical and land use factors. While watershed analysis, limiting factor analysis, and biological assessment methods are not novel methodologies when employed independently, their combination provides an example of how strategic planning can facilitate productive collaboration between multiple network actors (Ansell and Gash, 2008).

While the use of BDA structures for habitat restoration has not yet been adopted into either US Forest Service, US Fish and Wildlife Service, or state general permits, the prevalence with which interviewees referenced the potential of these permits existing in the near future speaks to the idea that new forms of governance are being created to facilitate the use of BDA structures (Interviews with WSC and NOAA staff, 2008). While it is evident that new forms of governance are forming around BDA use, these new methodologies will certainly not be adopted overnight. When asked what the greatest challenge of using BDAs was in the Nehalem, a NOAA employee answered by saying,

> I think the newness [of BDA use], and it has been going on for a while now, but I think that people still don't fully have their heads wrapped around it, so just trying to build something as you are doing it. That is probably the biggest challenge because you don't have a complete road map for what the process looks like. –NOAA staff, 2018

In this way, the NOAA employee spoke both to the idea that new governance mechanisms are forming in response to increased desire to use BDAs as a restoration methodology, as well as an

awareness that it will take some time to develop and adopt these new governance mechanisms due to the complexity of doing restoration work.

Interviewees in the Upper Nehalem Watershed made statements that suggest organizational structures surrounding the governance of BDAs exhibited signs of polycentricity and subsidiarity. While the project was nested within the Strategic Action Plan and facilitated by the WSC, project actors were networked throughout scales of government, from local to national levels (Interviews with WSC and NOAA staff, 2018). Interviewees' statements suggest that decisions were made at each scale of government and that communication between sectors and scales was relatively prevalent (Cosens et al. 2018). A watershed council staff described this organizational structure, stating that

> The Wild Salmon Center was given the project management role, and then they are partnered with the Oregon Watershed Enhancement Board, ODFW, NOAA, and then the National Fish and Wildlife Foundation, so those five are, more or less, the main agencies. They developed the whole framework for how they were going to proceed, and they worked with advisors from OSU…and then there were others, there was a whole room full of others, we were down there to work out a common framework. –UNWC staff, 2018

A NOAA employee also described the multi-tiered decision-making process that occurred once funding was secured through the Strategic Action Plan, stating that

> When we fund something we are on the hook for them providing technical assistance to try and make it a better project if we can, and also dealing with environmental compliance and making sure all the compliance pieces are in place, especially the things that the federal government are on the hook for, like ESA, and section 106, the cultural resource stuff. –NOAA staff, 2018

Together, these two statements speak to an environment in which decisions were made at multiple scales of government with communication about these decisions occurring across institutional and jurisdictional boundaries.

A combination of conflicting interpretations of laws and rules, perceptions of gaps in governance, the emergence of new forms of governance, and network structures suggest a polycentric governance structure. However, these governance structures are not neatly nested within traditional government hierarchies (Cosens et al. 2018). The local plans (PWP) are not neatly nested under state and federal law. Gaps and confusion about jurisdiction exist. However, the fact that decisions were made in multiple sectors and scales of government and across institutional and jurisdictional boundaries speaks to emergant adaptive governance (Cosens et al. 2017; Chaffin et al. 2014; Weber 2008).

Jack Creek:

When asked about conflicting laws and policies, interviewees involved in the Jack Creek case study did not explicitly reference laws that they saw as conflicting, but instead primarily spoke about specific aspects of management surrounding BRR that they felt were lacking or missing. Regarding these gaps in governance, one interviewee who works with TU explained how he felt that current laws and policies made it difficult for live beaver catch and release, a strategy that was attempted by the KWP prior to BDA installation on Jack Creek. The interviewee stated,

> At the time that KWP started this [a live beaver relocation program] that [best practices for catch and release] wasn't really known very well. And then also ODFW regulations at the time had a time limit for how long you can hold these animals [beavers]…To get permitting with ODFW you can't hold these animals for more than 24 hours and sometimes it takes a week to trap a family unit. –TU staff, 2018

This sentiment about difficulty holding beavers was echoed in an early informal interview with a KWP staff who felt that ODFW regulations requiring beavers to be held for short periods of time and accompanying laws dictating when and how beavers can be released made it difficult to relocate beavers to restoration sites (Interview with KWP staff, 2018). While the individual stated that the KWP wanted to continue the nuisance beaver relocation program, given that the

group had already invested in the infrastructure required to catch, hold, and release beaver, and felt that the program was having a positive impact on landowner relations and education, he felt that this was not possible given the ODFW regulations, which made it too difficult to catch, hold, and release beavers in a way that led to successful relocation of the animals.

Regarding BDAs specifically, an individual with the ODSL explained the current pathway through which most BDAs are being permitted in eastern Oregon on Forest Service and BLM land, stating that,

> Currently we process most of them [BDAs] under what's called a Waterway Habitat General Authorization. And so the expedited process that covers, and it's not specifically called out, doesn't specifically call out BDAs, but it calls out grade control and so we know if they can fall under certain caveats, and that's usually volume thresholds, they'll fall under the grade control, and...they have to be constructed of materials that mimic natural substrate, so the BDAs do that, be sized appropriately for the stream, don't create a fish passage barrier, and then activity is limited to 100 cubic yards for every one half mile of waterway. So, if they can fit that then we put them through that expedited process, if they can't they go into a full individual permit process. –ODSL staff, 2018

While this current permitting path is sufficient for permitting BDAs, when asked about the efficiency of the permitting process for BDA structures, in comparison to other restoration techniques with similar levels of impact to aquatic habitat, the interviewee with ODSL brought up that the Forest Service and Oregon legislature are proposing amendments to a general permit and considering new draft rules respectively. These general permits would specifically call out BDA use. The interviewee stated that

> the Forest Service actually wants to include BDAs...They have, they have some very specific activities that they're allowed under a general permit, which is a very specific tailored permit to Forest Service/BLM for a host of restoration activities that they've requested of us. So, they want to do, their current permit is up in 2020, and they want to add BDAs on to their next permit. –ODSL staff, 2018

If BDAs were included in the USFS general permit, this would streamline the way that they are permitted on National Forest Land (NFL) by creating a generic pathway through which all

BDAs could be permitted. ODSL permits are still required on NFL land in Oregon to assure that projects meet the requirements of the state (Interview with ODSL, staff). When asked what would be required for BDAs to be included in the Forest Service's general permit in 2020, the interviewee stated,

> Our number one criterion is need. Is there a need? So, in specific, general permits are for activities that are repeated and repeatable and have minimal impact. And so, I think our definition for general permit is that it has to be predictable, have predictable outcomes with minimal impact regarding activity. So, we have to make sure it meets that vision. It's necessary to meet it. It's something they are doing a lot of, you know. It's been done enough where we know the impacts will be minimal and here I would think flooding would be something we need to talk about…So, they'll probably do a request and then work with our policy and planning and really just present the need, how many they are doing a year, you know, what the volume thresholds are, and demonstrate how it has predictable outcomes and minimal impacts….We just have to decide if this activity goes along with our definition of general permit, and I don't see how, you know, I really don't see that we would find otherwise. I think it's there, except for the flooding risk. –ODSL staff, 2018

The same interviewee with ODSL also talked about the drafting of general permits for BDA projects, not specific to Forest Service/BLM, through the state legislature, and some of the controversy surrounding these new draft rules (Interview ODSL staff, 2018). She stated,

> These projects have triggered a lot of different draft rules…We actually had draft rules for BDAs specifically. They haven't gone anywhere. I guess a group named the Coastal Caucus specifically requested us not to put these in, to not make a final rule, but we did have a State General Permit for certain activities promoting waterway-floodplain connectivity with it and in the area we call out restoration check dams and beaver dam analogs. So, we had all these draft rules put out and there is a lot of opposition and I don't exactly know why but my guess is flooding again, going back to that, I would imagine people are nervous about that. –ODSL staff, 2018

After identifying these gaps in governance, the ODSL employee explained some of the rationale behind creating general permits for BDAs through the Forest Service/BLM as well as through the state. When asked how often BDA projects are rejected by State Lands, she first described that

> We don't turn down a lot, however, they may not be appropriate for this expedited [Waterway Habitat General Authorization] permit process so they might have a volume

> that exceeds 100 cubic yards for every half mile of waterway in which case we change it to an individual permit application. So, we don't really deny it, we change it, and then we, you know, we look at it through that scope. –ODSL staff, 2018

When asked about the individual permitting process, the ODSL employee explained how the time restraints can be burdensome on some small restoration groups, stating that

> Compared to the general authorization it's a slightly longer permit application. I don't think it's that, you know, terrible, but I guess I have looked at them enough. It is a longer permit application. It's a longer process. It can be up to a six-month process and it has a 30-day public review. Still a lot of people in the restoration community look at this and kind of balk at it because it does take, you know, a long time if they just got funding from OWEB and their in-water work period is, you know, three weeks from now, and they have limited, you know, they could find a contractor but he's only available for one week out of that three weeks, you know, they're in a pinch and so I think that's the real, I don't think it's the application that people are nervous about I, I think it's the time. –ODSL staff, 2018

When asked about difficulties with permitting, the lead on the Jack Creek project with TU explained that he did not have problems permitting the BDA project once the project plans were drafted; however, he did mention that the project took a long time to implement due to disagreements about how Jack Creek should best be restored to meet ESA requirements (Interview with TU staff, 2018). The interviewee referenced the Waterway General Habitat Authorization and Nationwide 27 permit which covered the permitting for the project through ODSL and the Army Corps of Engineers respectively. Even though permitting went relatively smoothly for the Jack Creek project once restoration methodologies were agreed upon, the interviewee with TU did mention how he felt that a general permit for BDAs and similar projects would be beneficial to his line of work. He also referenced the state draft rules on BDAs specifically when talking about the permit pathway for the Jack Creek BDA project, stating that,

> The GA [general authorization] kind of got the kibosh. And most of the pushback on that [the draft rules] came from western slopes Coastal Range agricultural interests…At least in my case [we] asked well what are we doing instead, and do I have to do a whole joint permit or not? And they [ODSL] said no on the east side, on the west side, yes. If you're over there you've got to go through a full joint permit application which requires

> notifying landowners and a 30-day public notice period, et cetera, et cetera. –TU staff, 2018

Along with the issue of general permits for BDA projects, the interviewee with TU brought up water storage, which he felt would likely be a concern related to BDA use in the future (Interview with TU staff, 2018). He stated,

> One other thing that I'll mention, it didn't end up being a problem for me, but is probably the biggest can of worms with this [BDA use]. Technically, if you think about these [BDAs] you're building water storage. Oregon Department of Water Resources, OWRD, potentially has issues with this as well as downstream water users. –TU staff, 2018

In Western Water Law a structure that stores water of any size must obtain a water right from the state. While BDAs are semi-permeable and allow water to pass through them, they do expand the wetted width of streams, create pools, and ultimately store water. Other authors have echoed the statement of the TU staff (Pilliod et al. 2015).

This collection of statements regarding a lack of state and federal agency general permits for BDA use, inefficiencies created by using regular individual applications to permit BDAs given the time constraints that most restoration groups work within, the adoption of other expedited permitting processes not necessarily tailored for permitting restoration projects, and moves by the Oregon legislature and state agencies to create general permits for BDAs, speaks to the idea that there are existing gaps in governance surrounding BDA use in eastern Oregon and that new governance mechanisms are emerging to fill these gaps (Cosens et al. 2017). Based on interviewee responses, it appears that moves to create new governance mechanisms surrounding BDAs are happening within government. Much of this change is being driven by the desire of grassroots organizations to use BRR, and the relationship between restoration practitioners and state and federal agency officials (Cosens et al. 2018). In terms of governance structure, this speaks to a situation that is networked and nested within existing government structures. In

terms of the Jack Creek project specifically, the impetus for the restoration work came largely from top-down regulatory action, compelled by litigation initiated by the whistle blower group, FOW. While the choice to utilize BDAs was somewhat of a networked decision, the way in which the project was permitted was also largely driven by state and federal government (Interviews with TU and ODSL staff, 2018).

Like in the Upper Nehalem, the Jack Creek case study exemplifies a situation in which restoration was done within a fragmented governance structure; however, in the case of Jack Creek, drivers of restoration came primarily from within government organizations (Interview with TU staff, 2018). A project lead with TU described the outcome of the restoration project, stating,

> The update [to Forest Service grazing allotments] has been done but it hasn't been approved. They haven't been able to get their clearance. And like I said they got sued and so they kind of went back to ground zero and re-established and redid some things to kind of deal with the parameters of the lawsuit and the judgments of the lawsuit. So, one of those things is he [the private ranch landowner] can't go back in there until there's something on this head-cut that is deemed acceptable by the Fish and Wildlife Service and the Forest Service as a solution to the head-cut problem. And so, my work there is that part of that. There are other conditions he has to meet, and I don't know where he is on meeting those, but this seems to be the biggest hang up. So anyway, he liked the idea that it was pretty quick and cheap, painless, and resilient. It wasn't going to be a blow out potential for his property downstream and it was going to get him back into his grazing, which, you know, he really wanted to do. So, he got onboard with it and, you know, Fish and Wildlife Service approved our BA for this project…And, I mean, we went forward. –TU staff, 2018

Like in the Upper Nehalem Watershed, the Jack Creek case study exemplifies a situation in which fragmented actors worked within a polycentric governance structure nested within traditional governance hierarchies to reach restoration goals (Cosens et al. 2018). While the network surrounding the Jack Creek restoration was markedly smaller, due to the size and location of the restoration project, the governance style observed in this case study fits within

adaptive governance principles. The idea of reconciliation is also evident in interviewee quotes. While summing up the goals of the Jack Creek restoration project, a project lead with TU said,

> So, the Forest Service kind of had to redo grazing plans up there with this guy, dealt with the landowner, with the cattle user. And that sort of spurred all this other stuff. It was like, well how are we going to allow this grazing, how are we going to do the work to make sure that the channel and the habitat stays intact? How can we restore habitat that's been degraded? And so that's sort of like the setup for this and that was the starting point, kind of in the early 2000s. –TU staff, 2018

This statement speaks strongly to the idea that, in the face of federal regulation, a degree of reconciliation emerged in individuals' desires to create better OSF habitat, respond to ESA regulations, and reopen private and public grazing allotments to grazing (Cosens et al. 2018).

Commonalities and Difference:

While the Upper Nehalem Watershed and Jack Creek case studies took different pathways to implementing BRR, many key similarities exist between the governance structures utilized for each project. In the Upper Nehalem Watershed, precedence for Coho salmon restoration was largely present due to the existence of previous state and federal strategic plans aimed at Coho salmon recovery. These plans helped build relationships between Nehalem actors before the beginning of the Nehalem BRR project, building strong rapport between individuals in the network. This created a situation ripe for the grass roots organizing facilitated by the WSC and UNWC. These organizations acted as bridging organizations and helped connect local actors in the Upper Nehalem to state and federal government organizations, who then helped secure resources for the project. This led to the ability of fragmented actors to do work within a governance network that was nested within stabilizing government structure, ultimately leading to a situation conducive to restoration work. Within this structure, the time individuals spent building relationships with one another, particularly considering that many of these

individuals came from different sectors and scales of government, as well as ideological backgrounds, should not be deemphasized (Adam and Kriesi, 2007; Cosens et al. 2018).

In Jack Creek, the grassroots whistle blowing organization FOW spurred regulatory action by the federal government under the ESA following litigation. When federal restoration plans failed to take local preferences into account, particularly from the ranching community, the local branch of TU was contacted to aid in restoration design (Interview with TU staff, 2018). Social learning needed to occur before government agencies were ready to get on board with design plans proposed by TU; however, ultimately TU, along with the KWP, were able to act as bridging organizations, connecting federal agencies with resources to the local knowledge needed to implement a successful project (Cosens et al. 2018).

While BRR in the Upper Nehalem Watershed and Jack Creek took different paths, both projects relied heavily on fragmented networks and bridging organizations to manage resources and ultimately implement restoration projects. In both cases, BDAs were also chosen as a primary restoration strategy 1) because actors felt that this methodology could best achieve species restoration goals, and 2) because the methodology was accepted by actors concerned with both ecosystem resilience and development (Cosens et al. 2018). Furthermore, the methodology was seen by many actors as preferable to methods that directly sought to bolster beaver populations, as these methods were made difficult by ODFW rules and stakeholder opposition (Interview with KWP staff, 2018).

	Upper Nehalem Watershed	Jack Creek
Permitting Path/Policy Stream	• Priority Designation/Strategic Planning • ODFW Fish Passage • NOAA Programmatic ESA review • DLCD review under Coastal Zone Mgmt. Act • Clatsop County Development Permit • OFPA	• National Forest Management Act • Lawsuit • Biological Opinion, ESA Section 7 • NEPA • ODSL • Waterway Habitat General Authorization • Nationwide 27 • ESA review, NFWS
Initial Driver of Restoration	• ESA requirement to recover listed species? • Priority Watershed Designation • Grassroots salmon restoration	• Regulation under ESA and NEPA • Litigation re: NFMA, NEPA, ESA by local whistleblower group

		• Grassroots organization involvement
Land Use	• ODF State Forest	• U.S. Forest Service • *Upstream private ranchland
Relative Project Size	• Large (watershed scale restoration)	• Small (reach scale restoration)
Other Landscape Characteristics	• Perennial Streams • Salmon/Trout Bearing • Westside of Cascades	• Annual Stream • Non-Salmon/Trout Bearing • Eastside of Cascades
Funding Sources	• OWEB • NOAA • NFWF • WSC	• RAC Funding, U.S. Forest Service
Installation Work	• Bio-Surveys • Subcontractors	• TU • NWYC • Subcontractors

Table 3. Table comparing key factors affecting governance structure surrounding BRR in the Upper Nehalem Watershed and Jack Creek

Emerging Insights:

- The use of BDA structures and accompanying in-stream BRR work is not technically permitted under the OFPA unless it is tied to another operation such as road building or timber harvest. This will need to be addressed in order to use BRR for reconciliation on state forest land.
- The lack of technical definition for BDA structures and accompanying technical installation guides makes them difficult to incorporate into agency and state general permits. In order to be incorporated into such permits, what a BDA is in a technical sense will need to be better defined with factors such as volume thresholds, water storage, and flooding potential specifically addressed.
- Lack of knowledge of BDAs effects on acute fish passage will limit ODFW's willingness to permit the structures. Along with better technical definition of what a BDA is, research regarding acute fish passage specifically will help define how BDA effectiveness can be optimized.
- The designation of beavers as predatory animals, which allows the animals to be lethally controlled with minimal state oversight, has made restoration practitioners wary of revealing the locations of restoration projects and has brought into question how effective BRR can be in Oregon without awarding beavers more protection at the state level.
- New BRR governance mechanisms are emerging through multi-stakeholder strategic planning processes, the creation of decision-making tools specific to BRR at the

landscape scale, the adaptation of existing laws and policies for BRR, and the starting of processes to amend current laws to fill gaps in governance and incorporate BRR. These mechanisms can be considered adaptive due to their networked nature. However, for reconciliation to be realized, these emerging forms of governance will need to be capable of working with agricultural, ranching, and forestry communities. This thesis demonstrates that this kind of co-production is possible, however, some agricultural and timber interests have been opposed to agency general permits as well as state legislation intended to promote BRR (Interviews ODSL and WSC staff, 2018)

- Demand to improve endangered species habitat in degraded ecosystems is a major driver of the interest in BRR methods and, in federal contexts requiring consideration of Section 7 of the ESA, is often manifest in litigation associated with NFMA, NEPA, and the ESA.

  Water storage may prove to be an obstacle to BRR in heavily allocated systems. The effects of BDAs on water storage will need to be addressed, and mechanisms for permitting water storage for the structures will need to be worked out.

5.3 Adaptive Capacity:

Upper Nehalem Watershed:

For this research, adaptive capacity was assessed by coding for themes related to mechanisms to facilitate feedback from the biophysical system, the presence of financial resources, and the presence of knowledge resources.

BRR as a tool generally provides a mechanism that facilitates feedback from the biophysical system. If implemented well, BRR methodologies should be process based, targeting degraded areas of a watershed and transforming them over time in an iterative, adaptive way that is amenable to resource management and ecosystem enhancement goals (Pilliod et al. 2017). Interviewees in the Upper Nehalem Watershed spoke specifically about actions they took to facilitate these feedback mechanisms. A WSC project manager talked about a situation that occurred while ground-truthing potential project sites after creating a suitability model and finding that areas that were not considered to be good salmon habitat in their model turned out, in reality, to be ideal salmon habitat in areas where natural beaver dams were present. He described these findings, saying that

> This gets into the beaver thing, because what it did is it told us…beaver are capable of modifying, even in places where you don't have ideal geomorphic conditions, you don't have good channel gradient, you may not have a lot of lateral connectivity with your floodplain, you may not have sufficient gravel but you get beavers in there and all of the sudden they sort of, they change the habitat. –WSC staff, 2018

A watershed council staff spoke specifically about how restoration sites were chosen in order to maximize feedback from the biophysical system, stating that

> Within each sub-basin we know where the anchor habitat most likely is and then across the Nehalem…we chose depending on how much anchor habitat there is…and then rate them accordingly, and then we are focusing the restoration work that we are doing right now on the ground in those high priority areas. –UNWC staff, 2018

An employee with ODFW spoke to educational components of the project, which are another way to facilitate feedback from the biophysical system by broadening individuals' relationships to that system and changing their interactions with it (Cosens et al. 2018). He stated,

> I am hoping we can educate folks how vital beaver are to a healthy functional ecosystem and instead of just wanting to completely eradicate, just understanding how important beaver are on the landscape and how we can live with beaver more effectively by not just simply eradicating trapping ext. So, I am hoping that these BDAs will help tell that

> story, help folks connect the dots and be a little bit more tolerant and lenient. –ODFW staff, 2018

Financial, labor, and knowledge resources were all present in the Upper Nehalem Watershed. Their role in facilitating the project is evident. A watershed council staff explained that

> The WSC is the one who funded and facilitated the Strategic Action Plan with each of the pilot groups, the Nehalem being one of them. OWEB [also] funded it, and the National Fish and Wildlife, and then NOAA has added more funding in. –UNWC staff, 2018

Along with speaking to the role of financial resources, the same watershed council staff also talked about the importance of knowledge resources for facilitating the Nehalem restoration project. She stated that

> Having the consultant, that was key to the whole process because the man worked for the department of Fish and Wildlife in his youth, he developed his own protocols and consulting business and his son does the restoration construction, they work as a team and have several companies and they have a good track record. They are easy to work with, they are fair, they are hardworking, they do the job that they said they were going to do, it is defendable. And, of course, the Watershed Council is key because we have over 20 plus years of experience too, and in our case, I know other watershed councils have had a lot of turn over with their executive coordinator people, we haven't. I have been here a long time and I think that there is some value in that, depending on how you look at it, so we can stay consistent. –UNWC staff, 2018

When asked specifically about the factors that made the Upper Nehalem Restoration project possible, a WSC staff stated,

> You know I would say having enough technical expertise in the room. And again, it goes back to capacity. I would say that we have enough capacity to pull this off and that has a few, um, I don't know a few tentacles on it. We had the person who understood river dynamics well enough and Coho biology and ecology that they could say we need beavers and here is how we get them. So, there is one, just the on the ground technical capacity. Um and then you know the modeling capacity. NOAA restoration center has done all our modeling for us doing all the GIS and running all the net map and determining where all the BDAs should go. So, another sort of form of technical capacity and you know I would include myself in the fundraising capacity. –WSC staff, 2018

This statement speaks to both the importance of financial and knowledge resources present in the Upper Nehalem, their role in facilitating the restoration process, and the ability of multiple actors within the network of actors to utilize these resources (Cosens et al. 2018).

The elements of the NSAP that looked to optimize BRR by identifying the areas in the watershed most appropriate for BDA construction, along with the plan to monitor the project for ten years and make future watershed amendments based on the findings of this monitoring protocol, speak to adaptive governance (Chaffin et al. 2014). Overarchingly polycentric governance structures combined with explicit plans for local actors to work within a government system to react to changes to the biophysical system speak to adaptation (Cosens et al. 2018). The existence of financial and knowledge resources, and local actors' ability to access this capital, also speaks to the adaptive capacity observed in the Upper Nehalem Watershed and were likely integral to the project's success.

Jack Creek:

For the Jack Creek BRR project, financial resources were leveraged by the Forest Service. One interviewee with TU explained the process, stating,

> So, the way it came about is this, this head cut reach was identified as one of the big problems if it continues to erode. It's going to be a problem. So, the Forest Service themselves applied for RAC [Resource Advisory Council] funding, which is like a Forest Service type funding. –TU staff, 2018

While this RAC funding financed the BDA project, other free datasets and labor services were integral to the implementation of BDAs on Jack Creek. A KWP staff described the importance of publicly available data for the restoration project, and how this data helped to drive decision making during the restoration planning process. He stated,

> They [the Forest Service] are basically providing this free flight [LIDAR] service for natural resource management. So, we had representatives from the Fish and Wildlife Service, U.S. Forest Service looking at these areas [Jack Creek]. These locations obviously one time had beaver populations that we know are no longer there. –KWP staff, 2018

This data was integral to the planning process of BDA implementation, which required creating flow accumulation, sediment transport, and flood models, all of which require high quality digital elevation models. These models helped to predict the kinds of impacts that BDA installation would likely have on the landscape, allowing stakeholders to make decisions in the presence of best available information (McKinney and Kemmis, 2011).

In terms of on the ground installation of BDA structures, a large amount of labor was provided by the non-profit organization NWYC as well as by project subcontractors. A project lead with NWYC explained how her relationship with TU ultimately drove her crew's participation in the restoration process. When asked how the partnership between NWYC and TU began, she stated,

> So really, what it was is a couple years ago we reached out to Trout Unlimited because I was interested in these restoration efforts. Our crews can definitely be utilized to do these projects, and when you need a large group of people to do them it's hard to rely on the current groups that are doing these things, volunteers and such. So, we reached out to Trout Unlimited in 2016 and we did a revegetation project with them. So, we had a relationship and it all kind of comes down sometimes to what funding makes sense for the program. And so how we got involved was our programs are something that our partners are really invested in because of the youth and young adult engagement component of our projects. We are taking people and we are putting them in a work development program, teaching them the skills that they need to further their success. We're showing them how to work, going to crew with eight other people and do all these hard skills while they're learning soft skills at the same time, and then totally turning around and going back into that workforce to work for our partners…They can leave our program with industry recognized certifications and then they have those credentials. They move on to the next job they say, 'Oh, I know how to do a beaver dam analog, ok, I worked on that. I also know how to fell a tree. I worked on that. Oh, I'm familiar with Trout Unlimited, I worked on this project with them.' And then it connects them in three different ways to a future job. –NWYC staff, 2018

This statement not only speaks to the labor resources that NWYC provided to the restoration project, but also to a mechanism for social learning stemming from the kinds of relationships described in the above statement (Ansell and Gash, 2008).

A TU staff spoke about the presence of resources generally and the impact that this had on the project environment, stating,

> We are in the great position of having money and time to spend it next year so we can go in and see what we had done and can we do more, should we do more? Is what we are doing working? Do we need to modify? And so that's sort of the plan for next year. –TU staff, 2018

This statement not only outlines the existence of financial resources, but also implicitly speaks to how these resources are being used to bring adaptive management principles into the restoration project, by providing capacity to evaluate the effects of the project over time and make amendments as necessary (Cosens et al. 2018; Craig et al. 2017).

The knowledge resources needed to design a BDA restoration capable of meeting the goals of reconnecting Jack Creek to its floodplain, arresting head cutting, and reducing sedimentation, and successfully navigating the permitting process required to install the structures legally were largely present in the Jack Creek case study, despite the fact that it took a considerable amount of time to begin on the ground restoration work following the identification of critical OSF habitat (Ansell and Gash, 2008). This time period between the initial desire to make site amendments aligning with the regulatory mandates under the ESA and taking action to do so occurred largely due to conflicting views as to which restoration methodology should be used to restore Jack Creek. This disagreement between the Forest Service and the FOW considerably

slowed the restoration process; however, opposition to original restoration plans likely created a situation that was more amenable to all stakeholders (Interview with TU staff, 2018).

Once BDAs were proposed as a restoration methodology, a degree of social learning had to occur between the involved agencies for individuals to feel comfortable using the methodology on Jack Creek. A project lead with TU who initially proposed using BDAs on Jack Creek described his thought process, stating,

> I worked for the Klamath Tribes in Chiloquin and I had been to a few beaver training sessions with Joe Wheaton out in Logan and I think I'd done a field trip down the Scott River as well...Those guys were really pioneering this stuff in California. And so, I had a lot of background and some trainings and really Jack Creek to me, when I thought, when I knew that we couldn't do whatever the original project was, this looks like a great place for a beaver dam analog, because you know the concerns are, you know, disconnected floodplain head cutting, you know, incised stream, like all of the things that, you know, a lot of what these have been used for originally. –TU staff, 2018

The same interviewee then described the pushback he got when he presented the idea to his colleagues,

> So, I brought up the subject of that [BDAs] and I had very minimal support initially. And in part because it was a new technique. People were not very, you know, were not very sold on the potential of this technique...There had also been Friends of the Winema who had sued the Forest Service over the grazing in this area [Jack Creek] and over this project [proposed Stage Zero restoration]...I don't know if they were officially partnering but some of the people involved with Friends of Winema were also involved with another restoration group down here [KWP], and they've been trapping nuisance beavers in the Wood River Valley and taking them up here to Jack Creek and relocating up to Jack Creek ...And so that was happening, and I think that's part of the reason why I got so much pushback is when I was like, 'well let's build these beaver dams.' Because you know beaver and the people who were suing them were sort of intertwined. I think I also got some pushback because of that thinking that, you know. I don't know what the thinking was. I definitely got a lot of pushback. I presented this idea at the OSFWG for the Klamath Basin with the Forest Service, the BLM, Fish and Wildlife Service, you know, kind of all the big players. Then I got a lot of pushback on it. I kind of shelved the idea because it was honestly one of my lower priorities at the time. There were a lot of other projects that were needing my attention. So, we sat on the idea. TU staff, 2018

The interviewee then described how social learning occurred, stating,

> I came back to it the next year and found a lot of support. So, and I think what it mainly happened in that time was a lot of other people had, you know, from either my initial idea or from their own sort of reading had started to learn about BDAs as a technique and realized that I had a lot to offer. You know the original concerns were 'it's too steep there.' There was a lot of concerns and then all of a sudden it kind of seemed like people have gotten a little more educated about it. And all of a sudden, they like the idea. And so that was late, it was like 2017. And then I kind of got the green light and worked through with the Forest Service to develop their, to do their NEPA and their ESA and I developed some designs and put together the project and we went out and executed the project this August. –TU staff, 2018

The process described in these statements speaks not only to the need for knowledge resources, but also to the importance of social learning and open discourse. If projects containing multiple interdependent goals are to be implemented successfully, it is important that there be space for ideas to be heard, considered, and openly discussed (Cosens et al. 2018; Wolf, 2008). While it took some time, this environment was present in the Jack Creek case study. Along with the learning about BDA restoration done by the TU staff, this environment, which allowed for open discourse, likely played a large role in choosing BDAs as a primary restoration methodology (Cosens et al. 2018; Chaffin, 2008).

Several key factors speak to ways in which the Jack Creek restoration project was designed to facilitate feedback from the biophysical system. The adaptive management strategies discussed above, in which the project was designed in such a way that it will be examined at regular intervals and updated if desired project goals are not met, might be considered an especially important piece of the project design in terms of the project's ability to facilitate feedback from the biophysical system (Cosens et al. 2018; Scarlett and McKinney, 2016).

Equally important might be the careful planning surrounding the design work of the project and the collaboration between TU project planners and OSF biologists (Interview with TU staff,

2018). The project designer with TU described the process of collaborating with USFWS biologists, stating,

> So, she's like, 'give me as many pools as you can.' So, I did. And we put in you know 11 in the main stem and then a few upstream, like I said, to kind of move flow around to divert it from going to the primary head cuts. And so, yeah. I basically just stair stepped this thing all the way down to the bottom where, you know, if these things build up to dam crest, which I know that they're not, but if they filled up to dam crest like there would be no more than like a foot or a foot and a half of drop from one dam crest to the next pool, and they would pretty much all just back it up. So I, you know, if I if you looked at it and it filled up to its potential it would just be a pond, a twelve hundred foot pond with different elevations but that's not going to happen, but that's how it was designed to potentially function. It's going to break down a lot of the energy. You know like almost all of our drop came in the head cuts in the very top of the head cuts you know. It dropped three to five feet almost immediately and then after that it really mellowed out. But you know trying to catch that water from other dams and things of that nature and just like maximize our pool volume and surface area we just we just sewed up this whole primary channel. –TU staff, 2018

This interviewee went on to explain how designing the project in this way would maximize the potential OSF habitat in Jack Creek while minimizing the risk of flooding to the private pastures downstream of the project. This represents thinking that actively seeks to garner feedback from the biophysical system in desirable ways and reconcile ecosystem and development (Cosens et al. 2018; Chaffin et al. 2014).

When asked about the potential of the BDA structures to bring beaver back into the Jack Creek system, the project lead with TU said,

> I think historically it [Jack Creek] probably was [good beaver habitat] because historically there were probably beaver packed into this basin. It's just great man, like there's so much wide, flat-wide floodplains and low grade, and tons of willow. There are a million little micro channels in there, beavers can just go to town on this thing. But, like I said, they were trapped out, worked out by the cattle and their habitat was degraded and so, like I said, there's very few of them left. KWP, like I said, had their sort of beaver reintroduction program. I don't know the official stats on that but I I'm pretty sure they almost all died. Everything that they relocated up there did not make it in large part because there wasn't water. Then they were, they were learning some stuff about like they were transporting like and translocating, relocating like one or maybe two animals and the science is really telling us now that you need like the whole family. And,

> yeah, I think you know if it's successful that it creates some good habitat and then that there is a colonization happening already from natural populations either up or downstream making their way around then you may see that it's like, that this ends up being a really good spot for them the land. But, right now, I don't think it's going to happen, in the foreseeable future. TU staff, 2018

While this statement speaks to the realistic idea that the biophysical system of Jack Creek has been altered significantly enough by land use changes that it is unlikely that beaver will return to this system in the near future, it also speaks to the idea of reconciliation by showing how BDAs might act to facilitate feedback from the biophysical system in ways that do not restore the area to a historical ecological baseline, but instead look to preserve and enhance key ecosystem functions while allowing valuable land uses to continue (Cosens et al. 2018; Benson and Craig, 2018).

Commonalities and Difference:

Both the projects in the Upper Nehalem Watershed and Jack Creek exemplified aspects of adaptive capacity. Actors in both cases, ultimately, chose to utilize restoration strategies aimed at facilitating feedback from the biophysical system by employing restoration methods meant to move each respective system towards a more ecologically resilient baseline over time (Cosens et al. 2018; Chaffin et al. 2016). Along with these biophysical treatments, actors in both case studies integrated adaptive management protocols into their monitoring plans that called for regular checks to structures, with systems in place for making amendments to restoration sites if necessary and recording findings to inform future projects. Furthermore, financial resources, leveraged both from public and private organizations, were present in enough quantity to fund restoration work and monitoring, while knowledge resources that helped actors optimize restoration design were also present. In the case of both the Upper Nehalem Watershed and Jack Creek, bridging organizations were integral in connecting actors with intimate local

knowledge and to the financial resources necessary to do restoration work (Cosens et al. 2018).

It is important to note, however, that it took some time for the Jack Creek case study to reach a place where it might be considered adaptive (Chaffin et al. 2014). This is largely the case because initial restoration techniques proposed by the Forest Service were rejected, as they did not take considerations of local stakeholders sufficiently into account and were ultimately opposed by local actors (Interview with TU, 2018).

Emerging Insights:

- Mechanisms are emerging surrounding BRR to ensure that the restoration work facilitates desired feedbacks from the biophysical system over time. Namely, data driven exploration of ecosystem processes and the integration of adaptive management principles into design plans are fueling this adaptation.
- Financial resources are being made available for BRR activities through OWEB, NFWF, NOAA, the U.S. Forest Service, and non-government groups.
- Systems are in place, such as watershed councils and non-government organizations, that seek to garner local input on BRR projects.
- Various initiatives are emerging to educate lay people on the importance of beavers on the landscape.
- Local, regional, and national networks are emerging to understand how BRR can be optimized in different locations and at different scales. However, BRR is largely still becoming normalized in many areas.

5.4 Participatory Capacity:

Upper Nehalem Watershed:

Several quotes by actors in the Upper Nehalem Watershed speak to the ability of actors at multiple scales of government to participate in resource management activities. These statements also provide insight into ways that habitat enhancement work aimed at Coho salmon fisheries recovery is being reconciled with development centered land uses, primarily timber harvest (Interview with ODF staff, 2018). One ODF employee stated, while talking about his organization's role in the BDA project, that

> At this point I am not going to necessarily say that ODF is in full support of this concept [BDA use]. It is obviously something new to the west side. I think that there has been some effort by a lot of folks to actually make, it appears as though some people have pushed this, kind of like this, as the solution kind of thing. So, I am not sure we necessarily agree with that, but where we are with this as a landowner is, we are supportive of this trial, because how are you going to know anything unless you try. And we are the logical people, because we are willing, and we have the sites that can accommodate them [BDAs]. And, certainly the sites they picked, there was no conflict. It fits in with our objectives. We're always getting pressure from the environmental side of the world, so we are always trying to find ways to work and make things better, because, I mean, that is a big deal. We are being, right now we are being sued over Coho and so doing something to help the Coho can't hurt. ODF staff, 2018

These statements speak to a willingness to reconcile differing land use goals by allowing restoration work to occur in areas that were historically used primarily for timber harvest, while also acknowledging the dissonance that still exists between Coho restoration and timber harvest. A watershed council staff reiterated these sentiments, stating that

> Right now, all of our projects, with the exception of one reach, are on ODF land. So, we started out with the public land and the ODF have been fabulous, they are completely on board, completely ecstatic, completely go for it. –UNWC staff, 2018

Interviewees also spoke to the ability of local actors to participate in project planning and the process of government in facilitating this process. A watershed council staff described her organization's role as a local actor stating that the project was in part successful because

> We have been in business for a long time and we know how to do restoration and we have a solid partnership base, and then all of our partners are on board. –UNWC staff, 2018

The same watershed council staff also spoke to ways in which the project was facilitated by government organizations. Speaking about her work with NOAA, she stated,

> They did actually present the idea [using BDAs]. We had talked about beaver and had done some analyses about where they are and where they could be, and we are certainly in favor of it. There were not any rejectors to that. So basically, we said that we would like to do BDAs and then it turns out that one of our consultants…had done some BDAs already and knew how to do them…so they helped develop the protocol. –NOAA staff, 2018

An ODF employee also spoke about collaborating with both local actors as well as other government agencies at the state and federal level. He stated that

> They have really helped [NOAA and WSC] to have that connection for us because especially when we don't always have a lot of money to do this kind of stuff. It helped that we could work with them, [and] the watershed council…If somebody can help fund some of it, it makes it easier to do when things are tough, when finances are tight. But you keep going, so that was a big help. So, yeah, we try to support them [the Watershed Council] as much as we can. We have done a lot of stuff with them. ODF staff, 2018

The above statements, while acknowledging that disagreements between salmon recovery and timber harvest goals still exist, speak to an environment in which local organizations who are invested in either or both land uses can participate in the decision-making process surrounding restoration projects (Rosenzweig, 2003; Moyle, 2014). While specific past wrongs were not explicitly highlighted by study participants, stakeholders' willingness to collaborate, and even promote each other's work in some instances, speaks to a degree of reconciliation occurring in the Upper Nehalem Watershed (Cosens et al. 2018). Interviewees' statements also suggest that government organizations at both the state and federal level aided in facilitating this participatory capacity by providing funding and technical support, while deferring to local knowledge of watershed process when appropriate.

Jack Creek:

The roles that TU and the KWP took in designing and facilitating the implementation of the BRR project speak, to a certain extent, to the ability of local organizations to participate in decision-making processes surrounding the BRR (Interview with KWP staff, 2018). The fact that the downstream landowner was also part of the decision-making process also speaks to participatory capacity. The project lead from TU touched on this while talking about some of the drivers of restoration and his role in the restoration project, stating,

> So anyway, he [private land owner] liked the idea that it was pretty quick and cheap, painless, and resilient; so it wasn't going to be a blow out potential for his property downstream and it was going to get him back into his grazing which you know he really wanted to do. TU staff, 2018

In some ways, this participatory capacity was facilitated by the FOW. The group's opposition to the Forest Service's original restoration plan forced alternatives for habitat restoration to be considered, but also created space for the private landowner to weigh in on what he wanted the restoration project to look like (Interview with TU Staff, 2018). This action, while likely slowing the pace of restoration, put a check on the state and federal agencies, facilitated participation, was likely one of the reasons that TU was contacted for the project, and created a situation in which the downstream landowner had more say in how the restoration project was planned and implemented (Scarlett and McKinney, 2003).

While past wrongs were not explicitly mentioned by most interviewees, the implicit acknowledgment of past wrongs can be seen in the process by which the private landowner agreed to make grazing amendments, the Forest Service yielded their initial restoration plans, and the KWP agreed to move away from live beaver relocation and towards BDA use (Cosens et

al. 2018). A KWP staffer spoke about the organization's move away from live beaver relocation, stating that

> We were assessing habitat potential, assessing where the best habitat was, where we could move beaver and assure that they would succeed once we moved them there. Because of that work, you know, you have drought conditions some years, here is where it gets complex when you talk about the ecology of a beaver and a high mountain stream…some just needed more flow or needed to slow that flow down. These are places that had meadows that, as we had less water being held up there, we had pine forests encroaching on those meadows. The hope was to bring those back to their natural condition. Because of the nature of beavers themselves, you cannot guarantee that they will not come up on a low water year, or you almost know that they will not. In that sense we have moved to beaver dam analogs. As I mentioned one of our big partners or I should say one of our big stakeholders, has been Green Diamond, and, they have suffered, you know, they say they spend about a hundred thousand dollars per year dealing with beaver damage, you know, culverts, roads, they are trying to take care of that, so, you know, they were not excited about more beavers being in those areas. You know Green Diamond is fairly new to this conversation, you know. KWP staff, 2018

This statement implicitly shows how KWP acknowledged some of their past wrongs, while seeking solutions that could be beneficial both to ecosystem process and development (Cosens et al. 2018).

Government organizations helped to facilitate the capacity of local entities, including TU, the KWP, and the private landowner downstream of the Jack Creek restoration project to participate in restoration planning by providing funding, knowledge resources such as high quality digital elevation model data and expertise about OSF habitat, and guidance as to requirements necessary to fulfill mandated amendments under the ESA (Weber, 2008). Although much of the process that ultimately produced the decision to use BDAs on Jack Creek might be described as tedious, participation by local entities in decision making, the willingness of actors to let go of some of their original land management preferences and in doing so implicitly acknowledge their past wrongs, restoration planning that includes monitoring and the ability to amend site conditions if necessary, and the state and federal agencies' roles in

facilitating the process of designing restoration that met both federal regulatory and local land use goals, speaks strongly to the idea of reconciliation (Cosens et al. 2018).

Commonalities and Differences:

Both the Upper Nehalem Watershed and Jack Creek case studies exemplified varying degrees of participatory capacity. In both cases, local actors were ultimately allowed to participate in the process of planning the restoration process, although it took the Jack Creek restoration project longer to reach a place where this kind of participation occurred. Past wrongs were arguably acknowledged to a greater degree in the Upper Nehalem Watershed than in Jack Creek (Cosens, 2018). In the Nehalem, actors responded to interview questions in ways that suggest a willingness to view nature both through the lenses of ecosystem resilience and development. While these views were present amongst some individuals involved in the Jack Creek project, individuals entered the situation without the option to not alter management surrounding Jack Creek, if they wished to return to grazing. This created a situation in which some individuals' primary interest was to simply do what was necessary to return to ranching, while others more directly sought to reconcile this development with ecosystem values. However, all individuals interviewed did express interest in doing restoration work as was necessary to enhance OSF habitat to a degree that would lift the grazing ban. This represents a desire for reconciliation (Cosens et al. 2018).

Emerging Insights:

- Because BRR crosses institutional and jurisdictional boundaries, local entities, particularly non-government agencies and civic entrepreneurs, have taken leading roles

in many BRR projects. These local leaders, however, have nested their work in higher levels of government, which is largely necessary for providing support and stability, including funding, the issuing of permits intended to promote safety and equity, and providing technical support.

- State and federal landowners are showing willingness to incorporate BRR methods into developed landscapes and have allowed local entities to participate in project planning.

5.5 Social Learning:

Upper Nehalem Watershed:

Interviewees made statements suggesting that social learning, regarding both alternative interpretations of the law and about ecosystem processes, occurred amongst actors in the Upper Nehalem Watershed. These statements also suggest that this learning was largely driven by peer to peer interactions amongst individuals at different sectors and scales of government (Cosens et al. 2018). A Department of Forestry individual stated that,

> I mean obviously it [BDAs] is natural. We are not building a dam. We are just setting up an opportunity for beavers to do it on their own. –ODF staff, 2018

This statement was made during a discussion about permitting in which the interviewee shared that he was concerned that permitting could be a problem for other groups attempting to use BDAs, if agencies misinterpret the functionality of the structures and view them as small dams (Interview with DOF staff, 2018). Given that this project was the first instance that the interviewee worked with BDAs, the wording of his response suggests a strong understanding of the ways in which BDAs are meant to facilitate feedback from the biophysical system. This understanding of the restoration process was largely shared by other participants interviewed for this research (Interviews with UNWC and WSC staff, 2018).

Several interviewees also referenced instances in which they specifically learned new details about the ecological functioning of their watershed and how that functioning could be better enhanced and managed. A watershed council staff explained how BDAs were placed

> Where we know there were beaver colonies that blew out for whatever reason and haven't been able to reestablish…we give them that foothold, because once the stream entrenches, it is hard for them to get it back up. They have got to start with some base level, so this gives them a foundation to a get start on. We also went in and planted willows first, so that they would have a food source. –UNWC staff, 2018

These statements suggest that strong feedbacks between information gathered about the watershed through habitat modeling, ground-truthing, and local knowledge acquired from the watershed councils' numerous years of working in the watershed were present in the Upper Nehalem and that participants shared a strong understanding of why the restoration project took the directions that it did (Cosens et al. 2018; Chaffin et al. 2014).

Several interviewees also stated that the process of doing the BDA restoration brought up larger conversations about the presence of beaver in the Upper Nehalem and how this population should best be managed. An ODFW employee spoke about how he hoped that BDAs might help educate people about the importance of beavers for watershed health, stating,

> I think we have got to do a better job of educating folks. These [BDAs] are easy to install, cost effective, low cost I should say, and, you know, folks who have no restoration experience can get out and frankly build these, they are that easy, as I think you probably know. So, I think going more into the purpose and need of these structures, why are they helpful, helping educate the layman, the landowner, the non-Fish and Wildlife community about the importance of beaver. I guess I would love to see if folks can really connect the dots to how critical beaver are on the landscape. Not too far from Salem, walking with a local entity in a county park, with the landowners, and they have beaver issues and they have a long history of killing beaver on their property, which in this state they can do given the predatory status of beaver. Um, I am hoping we can educate folks how vital beaver are to a healthy functional ecosystem and instead of just wanting to completely eradicate, just understanding how important beaver are on the landscape and how we can live with beaver more effectively by not just simply eradicating, trapping, etc. So, I am hoping that these BDAs will help tell that

> story, help folks connect the dots and be a little bit more tolerant and lenient. –ODFW staff, 2018

A watershed council staff expressed a similar sentiment, stating,

> There are larger issue with beaver, you know, we are only going to be able to take snapshots of what is happening with the beaver whether they are present or not and if they are present what do they do and what is the result and, you know, how many juvenile salmon are hanging out in the pools that they create and things like that…but they need some protection and they need their designation at the state level to be changed. They are not vermin, they are not predators, I think they are completely misunderstood on the books. –UNWC staff, 2018

Interviewees also talked about learning about alternative interpretation of the law as it applies to BDA governance. A NOAA employee spoke to the need to approach ODFW fish passage differently than they were used to doing for better established dam and culvert projects, stating that,

> I think there was a little bit of probably a leap of faith that ODFW had to take on this one, because we said it is a pilot, and we are going to go in, and we had an adaptive management plan and monitoring that we were going to do and it was sort of phased like we were going to see what works…we just had to work hard to keep the communication open with them…they do not have a really well developed process for how to permit these sorts of things or how to improve fish passage because it is a different thing than a culvert or a dam removal. –NOAA staff, 2018

These comments speak to learning that occurred about alternate pathways through FPR, and the ability of individuals to communicate inter-agency to share this information (Cosens et al. 2018).

An ODF employee also spoke to learning about alternative ways to do BDA work on State Forest land that is not explicitly covered under the OFPA. He stated,

> It is an interesting challenge. If the beavers build a dam and flood it and all the trees die that is natural. But if we put these in, and they were going to do a couple things: One, they were talking about some of the sites they were going to fall all the alder so that it would, well the light would get in, but mostly it was to give the willow an opportunity

> to grow. They were also going to girdle some. They were going to try some things and then see and some they were going to do nothing and just leave them. But doing something with those trees or even, because you are not harvesting them, it is not technically forest practices, so technically you are back under the county ordinance. –ODF staff, 2018

Although the issue of how BDAs can best be governed under the OFPA has not entirely been resolved, this statement provides an example of actors working within established governance frameworks in order to carry out restoration practices (Cosens et al. 2018).

Regarding adaptive governance, the social learning about ecosystem function and alternative interpretation of law, exemplified by interviewees' statements above, speaks both to the sharing of information within formal and informal networks, and to the ability of network actors to seek resources from government at a higher scale within a nested system (Cosens et al. 2018; Chaffin et al. 2016). This information sharing is critical to actors' ability to coordinate restoration activities and for participatory capacity, as it is not possible to participate in decision making in the absence of relevant information. Interviewees' familiarity with the permitting process speaks to the strength of networks as they form between scales of government (Weber and Khademian, 2008).

Jack Creek:

Arguably the most important learning that took place about ecosystem processes, in the context of the Jack Creek restoration project, was that individuals at the state agencies learned about how BDAs alter watershed and ecosystem processes on the landscape (Interview with TU staff, 2018). These individuals had significant influence in deciding upon restoration design, and their learning about BDA function largely paved the way for the restoration work to take the path that it did. Comments by interviewees suggest that knowledge gained about the historical

presence of beaver in the Klamath Basin and their importance in ecosystem function historically may have played a role in the learning that took place amongst the natural resource managers (Interview with KWP staff, 2018).

A KWP staff talked about a collaborative effort in the basin to better understand what beaver populations might have looked like under historical conditions. He stated that

> We had some of that information available through the Forest Service and ODFW. And there have been numbers that have been talked about, um, I've heard the number in the Upper Basin, 3000 beavers, well I'm not certain that those numbers are currently accurate, but with some of the initial funding they did some light-halk flights…They are basically providing this free flight surface for natural resource management. So, we had representatives from the Fish and Wildlife Service, U.S. Forest Service looking at these areas [Jack Creek]. There obviously are locations that one time had beaver populations that we know are no longer there, although that is a hard assessment to make. Historically, we do not know how many beavers may have used those areas. You know a few diligent beavers can create a network that is pretty strong. –KWP staff, 2018

A staff with TU explained the relationship between historical beaver population decline, landscape scale changes, punctuated disturbance events, stream incision, and habitat degradation, stating,

> What you've got out there is you've got this historic grazing. It's been hammered pretty hard and what also is missing from this system is beaver. There historically were beaver in there. I've found old dams walking around in there and there are no beaver there now, or very few. I think there are some up there, they are kind of, the further north you go, the higher up you get, it's a little more perennial. And, there is supposedly still some beavers floating around out there…And so the story from the landowner goes, you know, this is, that there were beaver all up and in this section, they were being trapped, and then the '64 flood, the '62 or '64, I think, the big flood of record in most of the Pacific Northwest hit the Klamath Basin really hard as well. And so, you have, you know, heavily impacted banks and wetlands from cattle grazing, reduced or eliminated beaver populations, and then…the story goes that the '64 flood came in there and really wanked that out and it went from probably three or four historic, really you know we're talking like a foot, foot and a half deep, two feet wide, you know, channels; like a series of those kind of which were supported by beaver, and there was probably cattle trailing in there as well, and a big disturbance event likely the '64 flood. I've seen some old aerials from around that time and it looks like that might have been what happened. –TU staff, 2018

All of these processes described by the interviewees from TU and the KWP represent social learning about ecosystem processes that provided precedents for BDA use (Scarlett and McKinney, 2016). Given that it is likely that this knowledge became normalized amongst the resource management community during the course of the Jack Creek project, this learning is likely the primary contributing factor that allowed individuals from state and federal agencies to become more comfortable with the idea of using BDAs to arrest the head cut on Jack Creek in order to meet a variety of land management goals.

Most interviewees who participated in the Jack Creek restoration project had at least some previous experience doing restoration work and many of them showed a high degree of familiarity with the permits required to do restoration work in their region. Two topics that came up repeatedly, however, were 1) excitement about the ability to use the Nationwide 27 permit and Waterway Habitat General Authorization, and 2) anticipation of general permits that might streamline the way that BDA projects are permitted in the future (Interviews with TU and KWP staff, 2018).

An interviewee with the ODSL explained how the Waterway Habitat General Authorization

> Doesn't specifically call out BDAs but it calls out grade control and so we know if they can fall under certain caveats, and that's usually volume thresholds, they'll fall under the grade control. ODSL staff, 2018

This quote provides an example of one way that the law has been interpreted in order to permit BDAs in a somewhat efficient manner (Cosens, 2017). Interviewees also brought up the potential for general permits that would make implementing BDAs easier on Forest Service and BLM land. Overall, interviewees in Jack Creek discussed learning about ecosystem processes in much

greater detail then learning about alternative interpretations of the law. This indicates 1) that permitting was not the limiting factor in the implementation of this project and 2) that, in this region, current permitting practices are sufficient for facilitating the use of BDAs as long as fewer than 100 cubic yards of fill are used, which is likely for most BDA projects (Interview with ODSL staff, 2018).

The social learning observed in the Jack Creek case study can be considered adaptive, particularly the learning about mechanisms to facilitate feedback from the biophysical system in ways that are both conducive to ecosystem function and cattle grazing (Chaffin et al. 2014). This is particularly true given that learning occurred in a way that helped people to understand ecosystem processes in ways that allowed them to align multiple ways of viewing ecosystems in the context of project goals (Cosens et al. 2018).

Commonalities and Differences:

The kinds of social learning that occurred in the Upper Nehalem Watershed and Jack Creek looked fairly different. In the Upper Nehalem Watershed, most actors entered the restoration process with a strong understanding of beavers' role on the landscape and how BDAs could be used to facilitate salmon habitat restoration, and those who did not were able to quickly learn from their peers. Much of the new learning that occurred in the Upper Nehalem centered around how to permit non-extractive work on state forest land under the OFPA, and how to navigate ODFW FPR, while knowledge about how BDAs affect acute fish passage is still questionable. While these questions were not necessarily answered, the project was able to move forward by being designated a pilot project. This designation was largely assigned to help assess the question of fish passage, which will help to better define the permitting process for

BDAs under FPR (Interview with ODFW staff, 2018). The question of how best to permit BDAs under the OFPA represents a question posed by this restoration project but left unanswered (Interview with ODF staff, 2018). The subject will likely come up again in subsequent BRR projects.

In Jack Creek, social learning centered around understanding both the historical presence of beaver, in order to set precedents for the use of BDAs, and the conveyance of what BDAs are and how they affect the landscape to state and federal actors with decision making power. This learning was essential for the project to move forward and accounted for a fair amount of time and energy in the development of restoration design (Interview with TU staff, 2018). Once BDAs were decided upon as a restoration methodology, permitting was relatively straightforward (Interview with ODSL staff, 2018).

Emerging Insights:

- There is growing familiarity with BRR methods amongst non-government organizations and local, state, and federal agencies involved with resource management in Oregon. This is in part due to the strong network of BRR practitioners and advocates throughout North America and the growing number of BRR projects.
- Non-government organizations and civic entrepreneurs often play leading roles in helping local watershed knowledge be incorporated into BRR projects that cross institutional and jurisdictional boundaries.
- Knowledge regarding effects of BRR on the landscape is actively being sought and mechanisms are being put in place to integrate this knowledge into agency strategies at

the state level. This is particularly apparent in ODFW's approach to FPR for BDA structures.

- Groups involved in BRR are learning to use established laws and rules in ways that are conducive to BRR. Some examples are the permitting of BDA structures under the OFPA, Waterway Habitat General Authorization, and Nationwide 27 general permits, even though the structures are not called out explicitly.

5.6 Network Formation:

Upper Nehalem Watershed:

The network formation process in the Upper Nehalem Watershed is largely a product of relationships between key organizations and network actors. The WSC, the UNWC, NOAA, ODF, ODFW, OWEB, NFWF, and the consulting company Bio-Surveys were all referenced frequently by nearly all interviewees as key organizations, although these organizations were not the only actors involved in the Upper Nehalem restoration project (Interviews with UNWC and WSC Staff, 2018). Of these organizations, the WSC and UNWC could be considered central nodes in a network of actors, with relationships and resources organized around these entities. Several factors likely led to the partnerships between these organizations and the restoration framework that was created as a product of these relationships. These factors include: 1) A precedence for Coho restoration set forth by numerous state and federally sanctioned conservation plans that provided the WSC with means of justifying the designation of the Upper Nehalem Watershed as a PWP, in turn helping to garner support for the project and leverage funding, 2) the wealth of watershed process knowledge available in the Upper Nehalem, stemming from state and federal conservation plans and the work of local actors with long histories of professional data collection practices, and 3) a history of formal and informal

relationships between network actors that provided a basis by which cooperation could occur, financial and knowledge resources could be accessed, and novel regulatory situations could be surmounted (Cosens et al. 2017; Chaffin et al. 2016).

A Watershed Council staff touched on how the stage was set for successful collaboration between network actors by previous conservation plans. She stated that

> There were three stream/watershed councils that were chosen for the pilot project, which is part of the Coho Business Plan that goes way back. It is modeled after the National Fish and Wildlife Business Plan, and then the Oregon Watershed Enhancement Board went across the state and developed priorities, target priorities, and Coho restoration is one of the targets, and then NOAA has been a driver in all of that. –UNWC staff, 2018

The existence of the numerous conservation plans mentioned by this interviewee, and the active role of state and federal government organizations in facilitating participatory action from local entities through these plans, speaks to the importance of these conservation plans and the past relationships that formed, in part, as a product of them. These plans likely aided the formation of formal and informal networks surrounding the restoration project in the Nehalem and the work that stemmed from these relationships. These plans may also have played a role in laying the foundation for productive group process. Because these past conservation plans required input from multiple stakeholder groups in the Upper Nehalem Watershed, they likely helped individuals to build familiarity with one another, and gain trust that they were able to bring to the BDA project in the Nehalem before it even started (Weber and Khademian, 2008).

The availability of knowledge resources in the Upper Nehalem stemming both from the presence of these past conservation planning projects and the work of local organizations also helped to facilitate network formation surrounding restoration in the Upper Nehalem Watershed. A WSC staff described how

> One of the priorities for all of us in developing these Strategic Action Plans is to leave the local partners with some reach specific priorities and most plans don't do this. –WSC staff, 2018

The interviewee went on to describe how the planning

> Is a fairly standard conservation planning process that we go through. The first thing you sort of do is pull all of your data together, do your lit review, get a sense of what has been done before, identify where there are data gaps and that rolls into a period of assessment where we talk to the partners about, well, what is going on in this watershed and where are the primary limiting factors. It was deemed a very high priority to bring beavers back into the system. –WSC staff, 2018

These statements speak to the idea that the WSC acted as a bridging organization between project stakeholders at different sectors and scales of government and gives the impression that the availability of specific local watershed knowledge was critical to this collaborative process (Cosens et al. 2018; Ansell and Gash, 2008). A NOAA employee reiterated this sentiment, stating,

> I actually think it [the decision to use BDAs] was kind of a group effort and discussion. We did want to see this sort of project piloted on the coast. But [name of local consultant] and the Watershed Council were the ones that kind of agreed to take it on and I think [name of local consultant] is definitely interested in doing these types of projects in the right place. –NOAA staff, 2018

Other interviewees later went onto explain how this decision to use BDAs largely came about due to the wealth of watershed data available in the Upper Nehalem. While the collaboration and working relationships described in these statements cannot be entirely attributed to the existence of previous conservation plans, good data, and financial and knowledge resources, it is likely that these plans, and the resources they provided, played a large role in providing the framework in which networks were able to form around the Nehalem restoration project (McKinney and Kemmis, 2011).

Finally, the presence of formal and informal relationships was critical to network formation surrounding the BDA restoration project in the Nehalem (Interview with UNWC staff, 2018). These relationships and the capacity they created within the restoration network provided a means by which funding was leveraged, restoration planning was accomplished, and novel regulatory situations were surmounted (Cosens et al. 2018; McKinney and Kemmis, 2011). While the formation of these relationships can partially be attributed to the presence of past conservation planning initiatives and the prevalence of knowledge and financial resources, many of the relationships in the Upper Nehalem Watershed can be attributed to the character of individuals, their willingness to collaborate around shared values, and the trust that frequently accompanies a history of collaboration and good working relationships (LeBaron, 2002).

The WSC was primarily connected with organizations that helped to fund the restoration project and provided the additional capacity needed to synthesize a large amount of data into a Strategic Action Plan, while the UNWC was primarily connected to individuals and local organizations that could provide site-specific information required to carry out restoration and aid in navigating the regulatory landscape (Interview with UNWC, 2018). A NOAA employee explained how she worked with the WSC informally on a funding proposal before they officially partnered on the project. She stated that

> They got to a point where the Strategic Action Plan was kind of far enough along so they could come in as a group of different populations that are working under this Coho Business Plan process. They had enough of a strategy at that point, they were not all done, but they could come in for our funding with a competitive proposal. So, the WSC developed a proposal with the help of these entities to get project implementation dollars from us. –NOAA staff, 2018

The WSC's role as a bridging organization which connected local restoration organizations to funders at the state and federal level was likely integral in facilitating the successful implementation of BDAs in the Nehalem (Cosens et al. 2017; Chaffin et al. 2016).

Similarly, the Watershed Council acted as an intermediary that helped work with state organizations to navigate the permitting for the project. An ODFW employee talked about how prior to the Nehalem project his organization was working to "get the message out" to restoration groups that BDA structures require FPR and oversite from ODFW. This interviewee then stated, while talking about the Nehalem project, that

> The reason now, why in this case, the Upper Nehalem watershed, [name of watershed council staff], who I had a good relationship with called me and said 'look we are planning to do some beaver dam restoration work in the Upper Nehalem Watershed and we are proposing a pilot project to evaluate different types of beaver dam analog configurations and we want to coordinate with Oregon Fish and Wildlife because we know fish passage is an issue,' and so this started a lot of this discussion prior to implementation. –UNWC staff, 2018

The informal relationship between the ODFW employee and Watershed Council staff that this statement inherently speaks to suggests the importance of informal relationships in helping to navigate regulatory uncertainty. In the case of fish passage, because relatively few BDA structures have gone through the FPR process, uncertainty exists about how BDAs might affect acute fish passage, and because Fish Passage is ultimately reviewed by a relatively small number of individuals, it is likely that early communication helped to address some degree of uncertainty surrounding BDAs (LeBaron, 2002). This inclusion in the planning process likely helped individuals at ODFW to feel justified in permitting a PWP.

This designation of the Upper Nehalem as a PWP was also likely a major factor contributing to the successful installation of the restoration project in the Upper Nehalem. The presence of polycentric yet networked governance structures that are nested within a stabilizing government body capable of seeking resources from a higher scale of government is an important component of the reconciliation (Cosens et al. 2018). Within these governance structures, bridging organizations that are both emergent and formally authorized to act at the regional scale are important components of network structure that allows for nesting within a stable government (Scarlett and McKinney, 2016).

Interviewee comments suggest a governance structure that is both polycentric and highly networked (Adam and Kriesi, 2007; Ansell and Gash, 2008). It is apparent, based on formal documents and interviewee responses, that each actor working on the BRR restoration project in the Upper Nehalem had the power, to varying degrees, to make independent decisions about components of the restoration project within their jurisdiction (Interviews with WSC, NOAA, and UNWC staff, 2018). Within this governance structure, however, based on interviewee responses, it is apparent that many collaborative decisions were made within a networked governance structure (Adam and Krisi, 2007; Weber and Khademian, 2008). The presence of the WSC, the UNWC, and, to a lesser extent, NOAA as bridging organizations, largely helped to facilitate the cooperation exemplified in the Nehalem and to nest the goals of local entities within formal government structures (Cosens et al. 2018). The presence of these components, along with decision-making hierarchies that facilitated feedback from the biophysical system, speaks strongly to the presence of adaptive governance (Chaffin et al. 2014).

Jack Creek:

The key organizations and network actors that contributed to and influenced the BDA restoration project on Jack Creek were TU, the USFS, the ODFW, the ODSL, the NWYC, the private landowner downstream of the project site, the KWP, and the FOW (Interview with TU staff, 2018). TU took on the role of project lead on the BDA project after opposition from the FOW and the private landowner to the Stage Zero restoration proposed by the Forest Service. The Forest Service owned the land on which the project was implemented, provided funding for the restoration work, and was largely on the hook for making amendments to the head cutting on Jack Creek in response to ESA regulation brought on by the litigation by the FOW (Interview with TU staff, 2018). ODFW provided spotted frog biologists who consulted on the project and were ultimately responsible for deciding whether the project acted as a reasonable alternative under the ESA (Interview with TU staff, 2018). The ODSL handled the permitting for the project (Interview with ODSL staff, 2018). The NWYC provided labor that cut back on expenses for the project (Interview with NWYC staff, 2018). The private landowner's influence also helped to push the decision to use BDAs instead of a Stage Zero restoration methodology (Interview with TU staff, 2018). The KWP helped to compile publicly available data and engaged in discourse regarding project design (Interview with KWP staff, 2018). Some members of KWP are also involved with FOW (Interview with TU staff, 2018). Finally, the FOW were major drivers of change, filing the lawsuit that both spurred the initial regulation and providing opposition that steered the project away from Stage Zero restoration methodology. This action both caused TU to become involved in the project and ultimately led to the decision to use BDAs for restoration (Interview with TU staff, 2018).

Several key relationships leading to the creation of both formal and informal networks should be noted. First, the TU project lead's connection to some of the BDA mavericks in the Western

United States, and his participation in BDA workshops, likely provided the initial knowledge base that allowed him to identify Jack Creek as an appropriate BDA site (Interview with TU staff, 2018). This individual's reputation in the resource management community in the Klamath Basin was also likely important, causing TU to be contacted after the Forest Service's plan to do a Stage Zero restoration was forgone. TU's relationship to the KWP also likely aided in decision making surrounding the use of BDAs on Jack Creek, as the KWP was already active in this area and had collected the information showing that beaver had likely once been prolific in the area, creating further precedence for using BDAs to amend the head cut on Jack Creek. The individual who permitted the BDAs on Jack Creek also revealed that she knew the TU project lead personally (Interview with ODSL staff, 2018). This informal relationship likely helped the ODSL feel comfortable working with TU given their past relationship. TU's past relationship with the NWYC along with a positive relationship with the private landowner likely helped the project go smoothly once stakeholders within state and federal agencies got on board with the idea of using BDAs on Jack Creek (Interview with TU staff, 2018).

One of the more interesting informal relationships present in the network surrounding the Jack Creek restoration is the relationship between the KWP and the FOW. The TU project lead explained how it might have affected the course of the restoration due to the fact that some of the same people who were advocating for beaver restoration were involved in lawsuits in opposition of the proposed Stage Zero restoration methodology in the same area where they were doing beaver relocation at the time. The interviewee, while describing the relationship, stated,

> I think that's part of the reason why I got so much pushback is when I was like, 'well let's build these beaver dams.' Because you know beaver and the people who were suing them were sort of intertwined. –TU staff, 2018

The same interviewee did state, however, that he was not exactly sure why he got so much pushback against using BDAs originally, and felt primarily that people at first did not like the methodology because it was new (Interview with TU staff, 2018).

Overall, a polycentric network existed surrounding the Jack Creek BRR (Cosens et al. 2018; Ansell and Gash, 2008). Actors in this network spread out over space and time and those that might be considered key network actors changed as the project evolved over time (Interview with TU staff, 2018). While project design included fewer actors than in the Upper Nehalem Watershed, largely due to the difference in project size, multiple checks and balances were present in the Jack Creek case study and occurred within different sectors and scales of government. Ultimately, local, state, and federal actors were involved in the project, and after a somewhat rocky legal road was traveled, a project that aimed to reconcile two competing land uses was implemented with plans to check the project regularly and amend it as needed in order to facilitate feedbacks from the biophysical system (Cosens et al. 2018; Cosens et al. 2017).

Commonalities and Differences:

Networks surrounding restoration projects in both the Upper Nehalem Watershed and Jack Creek were largely fragmented but nested within government hierarchies (Ansell and Gash, 2008; Cosens et al. 2018). In the Nehalem, networks largely formed around past relationships that were already established from past salmon restoration efforts, as well as around the presence of financial and knowledge resources. In Jack Creek, networks also formed around past relationships and knowledge resources in the basin. In both cases, bridging organizations played predominant roles in facilitating network formation (Cosens et al. 2018). In the Nehalem, the

WSC actively worked to contact individuals with knowledge resources and ties to funding resources that could be leveraged for the project. In Jack Creek, individuals responsible for managing the federal forest land surrounding Jack Creek were on the hook for the project following litigation. TU became involved once the proposed Stage Zero restoration was rejected and helped to pull in a network of local actors with knowledge pertinent to the project (Interview with TU staff, 2018).

Emerging Insights:

- Fragmented governance networks are forming around BRR projects that cross institutional and jurisdictional boundaries. Bridging organizations help these networks form by connecting local actors to government resources.
- Relationships between network actors across institutions and jurisdictions help networks solve problems in the face of novel situations and uncertainty.
- Key network actors with local watershed knowledge, connections to other network actors, and/or financial resources are critical for administering successful projects and garnering support from government organizations.

5.7 Bridging Organizations:

Upper Nehalem Watershed:

Several interviewee responses specifically speak to the existence of bridging organizations (Interviews with WSC, 2018). Primarily, the WSC and UNWC acted as bridging organizations that worked to nest polycentric governance networks within a stabilizing governance hierarchy (Cosens et al. 2018; Adam and Kriesi, 2007). The consulting company and civic entrepreneur, Bio-surveys also acted as a bridging organization helping to disseminate knowledge to the WSC

and UNWC, as well as to the government organizations involved in the BRR project (Interviews with UNWC and WSC staff, 2018).

A watershed council staff described the WSC's role as a bridging organization, touching on how the organization helped to connect network actors to government agencies, stating that

> The Wild Salmon Center is key cause they, they stick in there, and they hang in there, and then they check in on us and they help keep us accountable to NOAA in a manner that makes them feel confident, and then that goes to Washington DC, and they bring more money into the pool. –UNWC staff, 2018

This statement speaks to the importance of bridging organizations and their ability to help connect actors to government entities at multiple scales of government and, in doing so, leverage resources necessary to meet restoration goals (Cosens et al. 2018; Scarlett and McKinney, 2016). It also exemplifies the role of both the WSC and UNWC as bridging organizations. A WSC staff echoed this sentiment, stating,

> My role has been, and the WSC's role has been, first and foremost, to facilitate the strategic planning process and to develop the strategic action plan and then, along with that, also to go out and see if we can raise public and private money to implement the highest priority projects. –WSC staff, 2018

This statement again speaks to the organization around project goals that the WSC, as a bridging organization, helped to facilitate (Cosens et al. 2018).

A NOAA employee touched on the importance of the consulting company Bio-Surveys, who acted as a local entity with intimate knowledge of watershed process in the Upper Nehalem. She described the process of choosing priority restoration locations throughout the Nehalem, stating that

> The other part of this is that we did, you know, we did that [selecting priority restoration sites] using the net map model…our GIS analyst, she did a lot of that, kind of using the Beaver Restoration Guide Book and the parameters in there to kind of see where it made sense, and then we looked at all the locations were there were historic beaver dams, because [name of consultant] had done that when he was doing his rapid bio assessment work. He documented the locations. –NOAA staff, 2018

This statement exemplifies both how local knowledge became nested within government structures in the Upper Nehalem and the importance of this knowledge to the success of these types of projects generally (Adam and Kriesi, 2007; Cosens et al. 2018).

In the Upper Nehalem, non-government organizations including the WSC and the UNWC, the civic entrepreneur Bio-Surveys, and OSU were all present as bridging organizations, and, to varying degrees, helped to coordinate actors within a network, bridging sectors and scales of government at the resource level (Cosens et al. 2018; Scarlett and McKinney, 2016). Based on Cosens et al.'s definition of the term, this speaks strongly to the idea that some degree of reconciliation was capable of being reached surrounding the implementation of BDAs in the Upper Nehalem Watershed. This idea is further reinforced given that bridging organizations existed within the context of polycentric and networked governance structures, a demonstrated capacity for social learning, participation, and adaptation within a restoration that actively sought to restore ecosystem function in areas which are also heavily used for resource development (Cosens et al. 2018).

Jack Creek:

In the Jack Creek case study, TU was the consummate bridging organization. They acted both as a bridge between local watershed knowledge, knowledge of pertinent BDA restoration methodologies, and the needs of the state and federal agencies and the private landowner

(Interview with TU staff, 2018). The presence of TU as a bridging organization is likely the largest factor that helped the emergent governance structures surrounding the Jack Creek case study to be somewhat adaptive (Cosens et al. 2018). This largely occurred due to TU's ability to connect local and regional knowledge about watershed processes and restoration methodology to a government that provided resources for the project (Cosens et al. 2018; Gunderson, 2002). This led to a restoration strategy that simultaneously kept the interests of the ranching community and spotted frog habitat enhancement goals at heart. A TU project lead described the process of getting tapped on the shoulder to help with the Jack Creek project after the decision not to go forward with the proposed Stage Zero restoration. The interviewee stated that

> That technique [Stage Zero restoration], that method, kind of was rejected and when that happened the Forest Service still had this money and they were running out of time to do anything with it. So, they reached out to our organization, which we were not currently, we weren't TU back then, we were a different small nonprofit just locally based in Klamath. –TU staff, 2018

This statement speaks to the evolution of the project on Jack Creek, and the importance of TU's involvement in the project (Adam and Kriesi, 2008).

The KWP also worked as a bridging organization during the Jack Creek restoration project. The KWP helped compile publicly available data that was used for the design work on the Jack Creek project, and perhaps more importantly, facilitated much of the work aimed at quantifying the historical size of beaver populations in the Klamath Basin, which helped to provide precedents for the use of BDAs on Jack Creek (Interview with KWP staff, 2018). The KWP in project planning meetings also likely helped push for restoration strategies capable of reconciling the desire to both do habitat restoration and continue using the land surrounding

Jack Creek for grazing. The mission of the organization, to enhance and restore natural resources while helping to assure long term regional economic sustainability, along with the organization's close relationships to TU, long term relationships with prominent landowners throughout the Klamath Basin, including the landowner on Jack Creek, and with the state and federal agencies active in the basin, speaks strongly to the idea that the organization's presence helped to bridge divergent project goals and promote solutions aimed at reconciling differences and working toward mutually agreeable solutions (Interview with KWP staff, 2018). Members of KWP involved with FOW also likely helped drive the direction of restoration. While interviewees were clear that it was TU that proposed using BDAs, individuals affiliated with both KWP and FOW may have been more in tune with landowner concerns from their experience with KWP, which may have helped to encourage the FOW to oppose the Forest Service initial Stage Zero restoration methodology (Interview with TU staff, 2018).

Finally, the FOW, in a way, acted as a bridging organization by bringing the habitat degradation along Jack Creek to the attention of the federal government (Interview with TU staff, 2018). This grassroots action triggered mechanisms within the federal government including court proceedings which called for management changes under the ESA and the completion of a spotted frog management plan for Jack Creek under NEPA. Furthermore, by opposing the Forest Service's initial restoration plans along with the private landowner downstream of the project, the FOW also created space for local organizations to get involved, who ultimately proposed solutions that appear to better reconcile land uses than the initial proposed Stage Zero restoration plan (Cosens et al. 2018). In this way, the contributions of TU, the KWP, and the FOW to the Jack Creek restoration project largely helped the project to capture the hope of aligning multiple ways of viewing nature and social-ecological interaction (Cosens et al. 2018).

Commonalities and Differences:

In both cases, bridging organizations played leading roles in network formation (Cosens et al. 2018). In the Nehalem this was done intentionally by the WSC. Network formation was similarly facilitated by TU in Jack Creek, after the organization was asked to help with the restoration project. However, the networks that formed around BRR in Jack Creek were predominantly informal.

Emerging Insights:

- Bridging organizations are playing important roles in BRR projects that cross institutional and jurisdictional boundaries by helping to focus knowledge resources and leverage funding. Knowledge of watershed process and methods for altering it with BRR are particularly important, as these resources both help increase project effectiveness and leverage funding by outlining specific deliverables in grant applications.
- Non-profit organizations and civic entrepreneurs are revealing themselves as particularly important bridging organizations for BRR projects. This is largely the case due to their relationships with both local and government actors, their ability to condense knowledge across institutional and jurisdictional boundaries and design BRR strategically based on this knowledge, and leverage funding from multiple sources.

6 Conclusions:

This thesis sought to characterize emerging governance structures surrounding BRR on two different landscapes in Oregon, assess its alignment with adaptive governance principles, and its

ability to support BRR in other geographic and watershed restoration contexts. Generally, BRR appears to be a promising approach for reconciling ESA issues on working landscapes and provides a methodological compromise between landscape scale restoration techniques such as Stage Zero restoration and more prescriptive approaches such as grazing exclusion or riparian fencing. Based off the conceptual framework used for this research and current conceptualizations in scholarship, it is apparent that governance structures forming in response to BRR are somewhat adaptive, although barriers to adaptation still exist and will need to be addressed if BRR is to be used to broadly to reconcile ESA issues with working landscapes. Furthermore, observation of beaver colonization, pool formation, and sediment aggradation in field sites in the Upper Nehalem Watershed speak to a promising outlook for the restoration efforts in this watershed (Interview with UNWC staff, 2019). The Jack Creek project site received heavy snow this winter and has not yet been revisited (Interview with TU staff, 2019).

6.1 Emerging Adaptive Governance Surrounding BRR:

Several emerging governance structures were observed in the Upper Nehalem Watershed and Jack Creek case studies. These include multi-stakeholder strategic planning processes, the creation of decision-making tools specific to BRR at the landscape scale, the adaptation of existing laws and policies for BRR, and the starting of processes to amend current laws and rules to fill gaps in governance. In both the Upper Nehalem Watershed and Jack Creek, networks formed around the respective BRR projects. In the Upper Nehalem, this process was formally driven by the WSC following pilot watershed designation (Interview with WSC staff, 2018). In Jack Creek it was informally driven by TU after the USFS asked the group to help with

the project (Interview with TU staff, 2018). In both cases, social learning about BRR was required for stakeholders to view the methodology as an appropriate response to ESA issues. In the Upper Nehalem, social learning was driven by the dissemination of reach and sub-watershed scale knowledge by the WSC, UNWC, and Bio-Surveys (Interviews with WSC and UNWC staff, 2018). In Jack Creek, actors in federal agencies needed time to become familiar with BRR as a methodology, after pressure from regional environmental groups and private ranchers forced the USFS to abandon their Stage Zero restoration plans. Familiarity with BRR was largely gained through exposure to case studies throughout the western United States (Interview with TU staff, 2018). In both cases, bridging organizations facilitated social learning. In the Nehalem, the WSC consolidated watershed knowledge dispersed amongst multiple actors, and worked with NOAA and Bio-Surveys to do novel GIS modeling and survey work (Interview with NOAA staff, 2018). In Jack Creek, TU introduced the idea of BRR as a possible remedy to the endangered species concerns on Jack Creek (Interview TU staff, 2018). Although it took some time for the idea of BRR to become normalized, TU's ability to connect federal actors to BRR case studies throughout the American West was integral to the decision to use BRR on Jack Creek.

In both case studies, the work of bridging organizations also led to increased adaptive and participatory capacities within the emergent governance structures that formed. In the Upper Nehalem, the WSC's pilot watershed designation played a major role in disseminating local watershed information throughout a network of actors that span multiple jurisdictions and institutions and leveraging funding for strategic planning. The NSAP included monitoring and mechanisms to amend actions based off the finding of this monitoring (Interview with WSC, 2018). These adaptive management principles written into this strategic plan helped individuals

both at ODF and ODFW feel more comfortable with BRR as a methodology (Interviews ODF and ODFW staff, 2018). By surmounting these obstacles, local interests including the UNWC and WSC gained the ability to participate in decisions regarding decisions on ODF land. In Jack Creek, the acceptance of BRR opened the possibility to facilitate desired feedbacks from the bio-physical landscape in ways that show promise of helping OSF populations recover and creating a situation in which the USFS can again issue grazing authorizations under NEPA, NFMA, and the ESA (Concerned Friends of the Winema v. U.S. Forest Service, 2017). The fact that local watchdog groups, private ranchers, and the KWP participated in this process following the move to BRR speaks to the emergence of participatory capacity. Finally, along with the presence of bridging organizations who helped facilitate social learning, participatory capacity, and adaptive capacity in both case studies, the presence of these factors within polycentric governance structures speaks largely to the adaptive nature of the governance emerging to support BBR efforts (Cosens et al. 2018; Chaffin et al. 2014).

Within these networks novel decision-making tools specific to BRR, adaptations to exciting laws and policies, and the starting of processes to amend current laws and rules and create new laws specific to BRR occurred. In the Upper Nehalem, the NSAP utilized a combination of GIS modeling, ground truth methods, and "back-cast" interpolation at the sub-watershed and reach scales that constituted a novel methodology for identifying limiting factors to Coho populations and then finding specific reaches were these factors could be effectively ameliorated (Interview with WSC staff, 2018). In order to implement these methodologies, however, Fish Passage review had to be received from ODFW. ODFW staff spoke to their discomfort permitting BDAs because of a lack of knowledge of acute fish passage for the structures, but stated that they felt comfortable permitting the project in the Nehalem due to the inclusion of monitoring and

contingencies to alter project sites should they prove to create a fish passage problem (Interview with ODFW staff, 2018). ODF staff also expressed uncertainty regarding how best to permit BDAs under the OFPA, but also felt comfortable allowing BDAs to be built on their land given the experimental nature of the project (Interview with ODF staff, 2018). Interviewees in the Nehalem also mentioned that the Forest Service and BLM are looking to amend there agency rules to allow BDAs to be installed on Forest Service and BLM land under a general permit, and that draft rules were created in the Oregon legislature that would specifically provide a stream-lined permitting path for BDAs (Interviews with WSC, UNWC, and ODF staff, 2018). Interviewees, however, mentioned that these efforts have been stalled due to opposition from agricultural and timber interests. A NOAA employee weighed in by saying that a better technical definition of 'BDA' and accompanying implementation manuals, would be necessary for their agency to add BDAs to their general permits (Interview NOAA staff, 2018). In Jack Creek general permits specifically calling out grade control were used to permit BDAs under section 404 of the Clean Water Act (Interview ODSL staff, 2018). Because these permits are not intended for BDA use, this provides an example of current laws and rules being adapted for BRR (Chaffin et al, 2014). Interviewees involved with Jack Creek reiterated the attempts at amending Forest Service and BLM general permits to stream-line BDA permitting, attempt to pass draft rules into law, and opposition from agricultural and timber interests (Interviews with TU and ODSL staff, 2018).

6.2 Barriers to BRR and Recommendations:

While the nature of the emerging governance surrounding BRR in the Upper Nehalem Watershed and Jack Creek can be viewed as adaptive based on the conceptual framework used in this research and current conceptualizations of adaptive governance in scholarship, some barriers to BRR exist and will need to be addressed before BRR can be used in other geographic and watershed restoration settings intending to reconcile ESA concerns with working landscapes. In the Nehalem, interviewees pointed out that BDA installation is not technically permitted under the OFPA unless it is tied to another land use such as road building or timber harvest (Interview with ODF staff, 2018). Because the Nehalem project was a pilot watershed project, actors aware of this rule felt justified in forgoing this technicality due to the projects somewhat experimental nature (Interviews with ODF and NOAA staff, 2018). For future projects on state forest lands, however, mechanisms will need to be created for legal BDA permitting that is not tied to other land uses. The most straight forward way to do this would be to include BDAs within the scope of work of the OFPA when it is next updated. For this to occur, however, collaboration between timber interests and those wishing to improve aquatic habitat conditions will need to occur for opposition of BRR to be surmounted and reconciliation reached. An ODF staff talked about how he felt that both ODF and timber interests wished to do work to enhance Coho fisheries in order to avoid lawsuits stemming from ESA and NEPA violations (Interview with ODF staff, 2018). This mutual desire to both enhance watershed function and provide a buffer against non-lethal take which would allow for timber operations to continue unhindered, is likely a good place to begin this dialog (Wolf, 2012).

ODFW Fish Passage Review also poses a potential barrier to BRR. An ODFW staff specializing in Fish Passage said that ODFW feels uncomfortable permitting BDA structures, because acute fish passage studies have not been done on the structures (Interview with ODFW staff, 2018).

This obstacle can be surmounted by both conducting these acute fish passage studies in a variety of environments, and making necessary changes to BRR methods based upon study results.

Perhaps the largest elephant in the BRR restoration room is the state of Oregon's designation of beaver as predators. This designation allows beavers to be lethal removed and killed without a permit on private land. An UNWC staff also expressed concerns about revealing the location of restoration sites due to the prevalence of both legal and illegal trapping that occurs in her watershed (Interview UNWC staff, 2018). If BRR that seeks to either attract wild beaver or translocate beaver to project sites is to be successful, a greater level of protection for beavers, and accompanying enforcement will need to be awarded at the state level. This kind of legislative change will require both general education efforts regarding the importance of beaver on the landscape, and intentional outreach to groups that have historically been opposed to beaver recovery efforts. Framing beaver recovery in a way that can be viewed as beneficial to these groups will likely determine the success of this outreach (Wolf, 2012). Talking about the ways in which beaver on the landscape can help to provide a buffer against non-lethal take may be an appropriate place to enter this dialog.

Interviewees in both the Upper Nehalem Watershed and Jack Creek spoke about how water storage could be "the biggest can of worms" surrounding BRR. Because BDAs change the quantity and timing of water delivery, they technically constitute water storage and will need to be governed by OWRD (Interviews with TU and NOAA staff, 2018). This will present a major hurdle for BRR if the methodology is moved to more heavily allocated systems. Current transactional processes for issuing storage permits and conducting water rights transfers will need to be adopted to account for the fact that BDAs and BRR projects generally change over

time. As a tradeoff, this barrier speaks to the idea that, although BRR is likely more appropriate than some landscape scale restoration practices such as Stage Zero in some working landscapes, it may be less appropriate than more prescriptive approaches such as natural channel design in heavily developed and allocated systems.

Individuals who worked specifically to do beaver translocation with KWP, expressed feelings that ODFW rules for handling, holding, and transporting beavers do not align well with what they feel are best practices for working with the animals in order to assure successful translocation (Interview with KWP staff, 2018). ODFW should work with the growing number of experts in beaver translocation to adopt up to date beaver translocation practices into their beaver relocation policies.

Finally, general permits for both Forest Service/BLM and state general permits could help increase small restoration groups capacity to use BRR as a restoration methodology (Interviews with TU and ODSL staff, 2018). However, the largest barrier to these permits being drafted into law is opposition from agricultural and timber interests with political influence. Perhaps the best way to surmount this obstacle would be to work with these groups to rethink how such permits could be drafted in order to help reconcile ESA issues with working landscapes. Again, reframing the issue to talk about buffering against non-lethal take and regulatory oversight may be a good strategy for creating these permits in a way that is acceptable to timber and agricultural interests, and is capable of leading to reconciliation.

6.3 Current State of BRR:

In conclusion, BRR provides a promising means for reconciling ESA issues with working landscapes and some preliminary successful implementation of the methodology has created excitement around the technique. Adaptive governance structures are emerging in order to implement BRR in situations that cross institutional and jurisdictional boundaries, involving ESA issues on working landscapes. However, this is currently occurring in largely ideal situations and on landscapes that are predominantly rural, sparsely developed, unallocated, and occupied by few users. For BRR to be capable of reconciling ESA issues with working landscapes in less ideal conditions, the barriers identified earlier in this section will need to be addressed for the methodology to be capable of reconciling ESA issues with working landscapes. While a great deal of excitement currently surrounds the promise of BRR, the future of the methodology hangs in the balance. How the technique is used to address ESA issues on working landscapes, and the types of governance that multiple actors employ to facilitate this work will largely decide whether BRR is a passing fad or a mechanism capable of significantly changing the relationship between ESA issues and working landscapes in the American West.

7 Works Cited:

Adam, S., and Kriesi, H. (2007). The network approach. *Theories of the policy process*, *2*, 189-220.

Allen, A. W., Energy, W., and Team, L. U. (1983). *Habitat suitability index models: beaver* (Vol. 82). Fort Collins: Western Energy and Land Use Team, Division of Biological Service, Research and Development, Fish and Wildlife Service, US Department of the Interior.

Ansell, C., and Gash, A. (2008). Collaborative governance in theory and practice. *Journal of public administration research and theory*, *18*(4), 543-571.

Bandura, A., and Walters, R. H. (1977). *Social learning theory*(Vol. 1). Englewood Cliffs, NJ: Prentice-hall.

Barnes, D. M., and Mallik, A. U. (1997). Habitat factors influencing beaver dam establishment in a northern Ontario watershed. *The Journal of wildlife management*, 1371-1377.

Beechie, T. J., Sear, D. A., Olden, J. D., Pess, G. R., Buffington, J. M., Moir, H., ... and Pollock, M. M. (2010). Process-based principles for restoring river ecosystems. *BioScience*, *60*(3), 209-222.

Benson, M. H., and Craig, R. K. (2014). The end of sustainability. *Society and Natural Resources*, *27*(7), 777-782.

Bernard, H. R. (2017). *Research methods in anthropology: Qualitative and quantitative approaches*. Rowman and Littlefield.

Bingham, L. B. (2009). Collaborative governance: emerging practices and the incomplete legal framework for public and stakeholder voice. *J. Disp. Resol.*, 269.Blomberg, J., Giacomi, J., Mosher, A., and Swenton-Wall, P. (2017). Ethnographic field methods and their relation to design. In *Participatory Design* (pp. 123-155). CRC Press.

Blomberg, J., Giacomi, J., Mosher, A., and Swenton-Wall, P. (2017). Ethnographic field methods and their relation to design. In *Participatory Design* (pp. 123-155). CRC Press.

Brunner, R. D., Steelman, T. A., Coe-Juell, L., Cromley, C. M., Tucker, D. W., and Edwards, C. M. (2005). *Adaptive governance: integrating science, policy, and decision making*. Columbia University Press.

Callahan, M. (2005). Best management practices for beaver problems. *Association of Massachusetts Wetland Scientists (AMWS) Newsletter*, *53*, 12-14.

Carlsson, L., and Sandström, A. (2008). Network governance of the commons. *International Journal of the Commons*, *2*(1), 33-54.Clarke, A., and Clarke, A. (2005). Doing situational maps and analysis. *Situational analysis: Grounded theory after the postmodern turn*, 83-144.

Chaffin, B., Gosnell, H., and Cosens, B. A. (2014). A decade of adaptive governance scholarship: synthesis and future directions. *Chaffin BC, Gosnell H, Cosens BA*.

Clarke, A. E. (2003). Situational analyses: Grounded theory mapping after the postmodern turn. *Symbolic interaction*, *26*(4), 553-576.
Cosens, B. (2013). Legitimacy, adaptation, and resilience in ecosystem management. *Ecology and Society*, *18*(1).

Concerned Friends of the Winema; Klamath-Siskiyou Wildland Center; Western Watersheds Project; Oregon Wild; and Center for Biological Diversity v. U.S. Forest Service, and U.S. Fish & Wildlife Service, and Iverson Management Limited Partnership (United States District Court for the District of Oregon Medford Division January 18, 2017)

Cosens, B. A., Craig, R. K., Hirsch, S. L., Arnold, C. A. T., Benson, M. H., DeCaro, D. A., ... and Schlager, E. (2017). The role of law in adaptive governance. *Ecology and society: a journal of integrative science for resilience and sustainability*, *22*(1), 1.

Cosens, B., McKinney, M., Paisley, R., and Wolf, A. T. (2018). Reconciliation of development and ecosystems: the ecology of governance in the International Columbia River Basin. *Regional environmental change*, *18*(6), 1679-1692.

Craig, R. K., Garmestani, A. S., Allen, C. R., Arnold, C. A. T., Birgé, H., DeCaro, D. A., ... and Schlager, E. (2017). Balancing stability and flexibility in adaptive governance: an analysis of tools available in US environmental law. *Ecology and society: a journal of integrative science for resilience and sustainability*, *22*(2), 1.

Dietz, T., Ostrom, E., and Stern, P. C. (2003). The struggle to govern the commons. *science*, *302*(5652), 1907-1912.

Delmas, M. A., and Young, O. R. (Eds.). (2009). *Governance for the environment: New perspectives*. Cambridge University Press.

Folke, C., Hahn, T., Olsson, P., and Norberg, J. (2005). Adaptive governance of social-ecological systems. *Annu. Rev. Environ. Resour.*, *30*, 441-473.

Gosnell, H., Chaffin, B. C., Ruhl, J. B., Arnold, C. A. T., Craig, R. K., Benson, M. H., and Devenish, A. (2018). Finding Flexibility in Section 7 of the Endangered Species Act Through Adaptive Governance. In *Practical Panarchy for Adaptive Water Governance* (pp. 183-202). Springer, Cham.

Goud, E. M., Watt, C., and Moore, T. R. (2018). Plant community composition along a peatland margin follows alternate successional pathways after hydrologic disturbance. *Acta Oecologica*, *91*, 65-72.

Green, O. O., Garmestani, A. S., Allen, C. R., Gunderson, L. H., Ruhl, J. B., Arnold, C. A., ... and Holling, C. S. (2015). Barriers and bridges to the integration of social–ecological resilience and law. *Frontiers in Ecology and the Environment*, *13*(6), 332-337.

Green, K. C., and Westbrook, C. J. (2009). Changes in riparian area structure, channel hydraulics, and sediment yield following loss of beaver dams. *Journal of Ecosystems and Management*, *10*(1).

Gunderson, L. H. (2001). *Panarchy: understanding transformations in human and natural systems*. Island press.

Gurnell, A. M. (1998). The hydrogeomorphological effects of beaver dam-building activity. *Progress in Physical Geography*, *22*(2), 167-189.
Hood, G. A., and Bayley, S. E. (2008). Beaver (Castor canadensis) mitigate the effects of climate on the area of open water in boreal wetlands in western Canada. *Biological Conservation*, *141*(2), 556-567.

Hood, G. A., and Larson, D. G. (2015). Ecological engineering and aquatic connectivity: a new perspective from beaver-modified wetlands. *Freshwater Biology*, *60*(1), 198-208.

Huitema, D., Mostert, E., Egas, W., Moellenkamp, S., Pahl-Wostl, C., and Yalcin, R. (2009). Adaptive water governance: assessing the institutional prescriptions of adaptive (co-) management from a governance perspective and defining a research agenda. *Ecology and society*, *14*(1), 26.

Jenkins, S. H., and Busher, P. E. (1979). Castor canadensis. *Mammalian species*, (120), 1-8.

Johnston, C. A., and Naiman, R. J. (1990). The use of a geographic information system to analyze long-term landscape alteration by beaver. *Landscape Ecology*, *4*(1), 5-19.

Kemmis, D., and McKinney, M. (2011). Collaboration and the ecology of democracy. *Sustainable Dev. L. and Pol'y*, *12*, 46.

Kettl, D. F. (2006). Managing boundaries in American administration: The collaboration imperative. *Public Administration Review*, *66*, 10-19.

Lanzara, G. F., and Mathiassen, L. (1985). Mapping situations within a system development project. *Information and Management*, *8*(1), 3-20.

LeBaron, M. (2002). *Bridging troubled waters: Conflict resolution from the heart*. John Wiley and Sons.

Lockwood, M., Davidson, J., Curtis, A., Stratford, E., and Griffith, R. (2010). Governance principles for natural resource management. *Society and natural resources*, *23*(10), 986-1001.

Maret, T. J., Parker, M., and Fannin, T. E. (1987). *The effect of beaver ponds on the nonpoint source water quality of a stream in southwestern Wyoming*. Wyoming Water Research Center.

Martell, K. A., Foote, A. L., and Cumming, S. G. (2006). Riparian disturbance due to beavers (Castor canadensis) in Alberta's boreal mixedwood forests: implications for forest management. *Ecoscience*, *13*(2), 164-171.

McKinney, M., and Kemmis, D. (2011). Collaboration and the Ecology of Democracy. *Human Dimensions of Wildlife*, *16*(4), 273-285.

Moyle, P. B. (2014). Novel aquatic ecosystems: the new reality for streams in California and other Mediterranean climate regions. *River Research and Applications*, *30*(10), 1335-1344.

Muller-Schwarze, D. (2011). *The beaver: its life and impact*. Cornell University Press.

Naiman, R. J., Johnston, C. A., and Kelley, J. C. (1988). Alteration of North American streams by beaver. *BioScience*, *38*(11), 753-762.

Nickelson, T. E., Rodgers, J. D., Johnson, S. L., and Solazzi, M. F. (1992). Seasonal changes in habitat use by juvenile coho salmon (Oncorhynchus kisutch) in Oregon coastal streams. *Canadian Journal of Fisheries and Aquatic Sciences*, *49*(4), 783-789.

Ostrom, E. (2009). *Understanding institutional diversity*. Princeton university press.

Pelling, M., High, C., Dearing, J., and Smith, D. (2008). Shadow spaces for social learning: a relational understanding of adaptive capacity to climate change within organisations. *Environment and Planning A*, *40*(4), 867-884.

Pilliod, D. S., Rohde, A. T., Charnley, S., Davee, R. R., Dunham, J. B., Gosnell, H., ... and Nash, C. (2018). Survey of beaver-related restoration practices in rangeland streams of the western USA. *Environmental management*, *61*(1), 58-68.

Pollock, M. M., Beechie, T. J., and Jordan, C. E. (2007). Geomorphic changes upstream of beaver dams in Bridge Creek, an incised stream channel in the interior Columbia River basin, eastern Oregon. *Earth Surface Processes and Landforms*, *32*(8), 1174-1185.

Pollock, M. M., Beechie, T. J., Wheaton, J. M., Jordan, C. E., Bouwes, N., Weber, N., and Volk, C. (2014). Using beaver dams to restore incised stream ecosystems. *Bioscience*, *64*(4), 279-290.

Remillard, M. M., Gruendling, G. K., and Bogucki, D. J. (1987). Disturbance by beaver (Castor canadensis Kuhl) and increased landscape heterogeneity. In *Landscape heterogeneity and disturbance* (pp. 103-122). Springer, New York, NY.

Rogers, P., and Hall, A. W. (2003). *Effective water governance*(Vol. 7). Stockholm: Global water partnership.

Rosenzweig, M. L. (2003). *Win-win ecology: how the earth's species can survive in the midst of human enterprise*. Oxford University Press on Demand.

Salganik, M. J., and Heckathorn, D. D. (2004). Sampling and estimation in hidden populations using respondent-driven sampling. *Sociological methodology*, *34*(1), 193-240.

Scarlett, L., and McKinney, M. (2016). Connecting people and places: the emerging role of network governance in large landscape conservation. *Frontiers in Ecology and the Environment*, *14*(3), 116-125.

Skinner, Q. D., Speck Jr, J. E., Smith, M., and Adams, J. C. (1984). Stream water quality as influenced by beaver within grazing systems in Wyoming. *Journal of Range Management*, 142-146.
Slough, B. G., and Sadleir, R. M. F. S. (1977). A land capability classification system for beaver (Castor canadensis Kuhl). *Canadian Journal of Zoology*, *55*(8), 1324-1335.

Smit, B., and Wandel, J. (2006). Adaptation, adaptive capacity and vulnerability. *Global environmental change*, *16*(3), 282-292.

Steffen, W., Persson, Å., Deutsch, L., Zalasiewicz, J., Williams, M., Richardson, K., ... and Molina, M. (2011). The Anthropocene: From global change to planetary stewardship. *Ambio*, *40*(7), 73

Stern, P. C., Dietz, T., Abel, T., Guagnano, G. A., and Kalof, L. (1999). A value-belief-norm theory of support for social movements: The case of environmentalism. *Human ecology review*, 81-97.

Walker, B., and Salt, D. (2012). *Resilience thinking: sustaining ecosystems and people in a changing world*. Island press

Trotter II, R. T. (2012). Qualitative research sample design and sample size: Resolving and unresolved issues and inferential imperatives. *Preventive medicine*, *55*(5), 398-400.

Weber, E. P., and Khademian, A. M. (2008). Wicked problems, knowledge challenges, and collaborative capacity builders in network settings. *Public administration review*, *68*(2), 334-349.

Westbrook, C. J., Cooper, D. J., and Baker, B. W. (2006). Beaver dams and overbank floods influence groundwater–surface water interactions of a Rocky Mountain riparian area. *Water Resources Research*, *42*(6).

Wheatley, M., and Frieze, D. (2009). Taking social innovation to scale. *Oxford Leadership Journal*, *1*(1), 1-5.

Wolf, A. T. (2008). Healing the enlightenment rift: Rationality, spirituality and shared waters. *Journal of International Affairs*, 51-73.

Wolf, A. T. (2012). Spiritual understandings of conflict and transformation and their contribution to water dialogue. *Water Policy*, *14*(S1), 73-88.

8 Appendices:

8.1 Appendix A: Semi-Structured Interview Guide:

Name of Interviewee:

- What is your role in beaver-based watershed restoration?
    - How long have you worked in this position?
- How did beaver-based watershed restoration begin in this area?
    - What is the history of beavers in this watershed?
    - Why is there a need for beaver-based watershed restoration now?
    - How does beaver-based restoration contribute to other watershed enhancement projects in this basin?
- What are the goals of this beaver-based restoration project?
    - Ecological
    - Regulatory
    - Social
    - Economic
    - Adaptation to climate/regulatory change
    - Other
- What are the watershed conditions in this basin currently?
    - Physical
    - Social
    - Institutional
    - What are the major causes of watershed degradation?
- Scope of practice→what beaver-based watershed restoration activities are being carried out?
    - Live capture
    - Reintroduction
    - BDA/other structures
    - Geographic scope (can we look at a map?)
        - Pub land (what kind/where?)
        - Private land (what kind/where?)
    - Other practices
- What agencies are involved in beaver-based watershed restoration in this basin?
    - Each agencies role?
    - Relationships agencies with one-another?
    - Relationship agencies and landowners?
- What major non-agency stakeholders are involved in/affect beaver-based watershed restoration in this basin?
    - Relationship with the agencies involved?
    - Relationship with each other in the context of beaver restoration?
    - What effect do these stakeholders have on the process of beaver-based watershed restoration?
    - What effects do beaver-based watershed restoration have on these stakeholders?
    - Generally, how would you describe this community's perceptions of beaver-based watershed restoration?

- Can you describe the regulatory landscape governing beaver-based watershed restoration?
    - What permits are required?
    - What are the benefits of beaver-based restoration compared to other kinds of watershed restoration from a regulatory standpoint?
    - What are the challenges of beaver-based restoration compared to other kinds of watershed restoration from a regulatory standpoint?
- What has been successful with this beaver project?
    - Ecological
    - Regulatory
    - Social
    - Economic
    - Other
- Can you summarize the things that have helped with this success?
    - Goals
    - Facilities
    - Agencies
    - Stakeholders
    - Individuals
    - Specific Practices
    - Regulations
    - Types of funding
    - Other
- What have been some major challenges of this beaver project?
    - Ecological
    - Regulatory
    - Social
    - Economic
    - Other
- Can you summarize the things that have led to these challenges?
    - Goals
    - Facilities
    - Agencies
    - Stakeholders
    - Individuals
    - Specific Practices
    - Regulations
    - Types of funding
    - Other
- What would you need to more successfully meet your watershed restoration goals?
- How do you see beaver restoration effecting larger land-use/water-resource issues in your watershed?
    - Irrigation
    - Fisheries
    - Other ecosystem enhancements
    - Wildfire

    - Recreation
- Anything else that you would like to tell me?
- Who else should I talk to?

8.2 Appendix B: Interview Coding Framework:

- Laws related to BDAs
    - Federal
        - Endangered Species Act
            - Section 7
            - Reasonable Prudent Alternatives
        - National Environmental Protection Act
            - US Forest Service Grazing Allotments
            - Other NEPA applications
        - Magnusson-Stevenson Fisheries and Conservation and Management Act
        - Army Corps of Engineers
            - Dredge and Fill permit
                - Nationwide 27 permit
                - Waterway Habitat General Authorization
    - State
        - Oregon Department of State Lands
            - Development permit
        - Oregon Forest Practice Act
        - Oregon State Fish Passage Review
        - Department of Land Conservation District
        - Coastal Zone Management Act
    - Local
        - County Development Permits
- Governance Structure
    - Signs of governance fragmentation
        - Conflicting laws/policies/rules
        - Gaps in governance
    - Signs of polycentricity – decisions made at multiple scales
    - Signs of subsidiarity – decisions made at the smallest scale feasible
    - "New" forms of governance
- Adaptive Capacity
    - Role of financial/labor resources
    - Role of knowledge resources
    - Mechanisms/connections to facilitate feedback from biophysical system
- Participatory Capacity
    - Capacity of local/marginalized to participate in decision making
        - Power dynamics
        - Social justice issues
    - Acknowledgement of past wrongs, different views
    - Role of govt in facilitating participatory capacity
        - Federal

        - State
        - Local
- Social Learning
    - About alternative implementation of laws
    - About ecosystem processes
    - Peer to peer learning
- Network Formation
    - Formal networks
        - Federal
        - State
        - Local
    - Informal networks
    - Key network actors
    - Key relationships
    - Key organizations
- Bridging Organizations and Entities
    - Civic entrepreneurs
    - NGOs
    - Universities

8.3 Appendix C: List of Acronyms:

Acronym	Term
ABD	Artificial Beaver Dam
BDA	Beaver Dam Analog
BiOp	Biological Opinion
BRR	Beaver Related Watershed Restoration
BLM	Bureau of Land Management
CBD	Center for Biological Diversity
DLCD	Department of Land Conservation Division
EIS	Environmental Impact Statement
ESA	Endangered Species Act
FPR	Fish Passage Review
FOW	Friends of the Winema
KWP	Klamath Watershed Partnership
KSWC	Klamath Siskiyou Wildlands Center
NEPA	National Environmental Protection Act
NFMA	National Forest Management Act
NFWF	National Fish and Wildlife Foundation
NFWS	National Fish and Wildlife Service
NMFS	National Marine Fisheries Service

NOAA	National Ocean and Atmospheric Administration
NSAP	Nehalem Strategic Action Plan
NWYC	North West Youth Corps
ODFW	Oregon Department of Fish and Wildlife
ODF	Oregon Department of Forestry
ODSL	Oregon Department of State Lands
OFPA	Oregon Forest Practices Act
OSFWG	OSF Working Group
OSF	Oregon Spotted Frog
OSU	Oregon State University
OW	Oregon Wild
OWRD	Oregon Water Resources Department
PWP	Pilot Watershed Project
RAC	Resource Advisory Committee
SFPD	State Fish Passage Division
TNC	The Nature Conservancy
TU	Trout Unlimited
USACE	United States Army Corps of Engineers
USFS	United States Forest Service
UNWC	Upper Nehalem Watershed Council
WSC	Wild Salmon Center
WWP	Western Watersheds Project