AN ABSTRACT OF THE DISSERTATION OF

Monica L. Hubbard for the degree of Doctor of Philosophy in Environmental Sciences presented on August 20, 2013.
Title: Oregon's Integrated Water Resource Planning: Public Knowledge, Risk Perception, and Civil Society

Abstract approved:

Brent S. Steel

The overall purpose of this research is to assess the Oregon public's capacity to address water resources disturbances through civil society. According to scientists and resource managers, Oregon's water resources are over taxed and at risk, with future projections placing additional stress from climate change and population growth. Oregon's 2009 House Bill 3369 directed the Oregon Water Resources Department to develop a statewide Integrated Water Resource Strategy (IWRS) to address these challenges and meet current and future water needs. Prior to IWRS' implementation it is important to understand if the Oregon public has the capacity to understand and respond to disturbances in water resources as the inability to respond can undermine the state's IWRS implementation. For this study a "disturbance" is a change in Oregon's water quantity, quality and or availability. The ability to respond to a disturbance by the public is associated with the concept of civil society. Civil society is a method where members of Oregon's public can understand and engage in water resource issues in Oregon and has three key components: (a) being informed about a policy issue; (b) interacting with others about the issue; and (c) engaging in a practice to make a policy change. Yet, even with the

conditions in place for a civil society response to a disturbance, management implementation can be inhibited due to low knowledge and inaccurate risk perception. Using a statewide mail survey to 1,563 randomly selected households, this study examined the Oregon public's dimensions of civil society, knowledge, and risk perception concerning Oregon's water resources. Findings suggest the public has the dimensions of civil society in place to respond to a disturbance in Oregon's water resources, as well as sufficient risk perception. However, the public's level of factual and self-assessed knowledge is less than optimal. This low level of knowledge has the potential to inhibit or limit water resource management efforts by the state.

Oregon's Integrated Water Resource Planning: Public Knowledge, Risk Perception, and Civil Society

by
Monica L. Hubbard

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Dean of the Graduate School

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

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Monica L. Hubbard, Author

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1 INTRODUCTION

1.1 INTRODUCTION

Oregon has numerous natural resources and a diverse population. Dense forests cover and the Pacific Ocean nestles western Oregon, while semi-arid deserts and rugged mountain ranges sit in eastern Oregon. The Scenic and Wild Rogue River, and Crater Lake both rest in southern Oregon. The state's urban center, Portland, is in the northern Willamette Valley. One natural resource Oregon is known for is its water. Even with more than 161,000 kilometers of rivers and streams, 580 kilometers of coastline, and more than 1,400 named lakes (Oregon Water Resources Department, 2012), Oregon's water resources are overtaxed and at risk (Bastasch, 2006; Oregon Water Resources Department, 2012). Most surface water is already fully or over allocated during the summer months (Oregon Water Resources Department, 2012), and in the Willamette Valley, an area known for high precipitation levels, twelve groundwater areas have been removed from use due to depletion (Oregon Water Resources Department, 2012). Water quality is also an issue, with 1,861 water bodies in the state listed as "impaired" under the Clean Water Act's 303(d) standards, including more than 30 lakes and 35,400 stream kilometers (Oregon Water Resources Department, 2012). Oregon's water resources may face greater pressures in the future, especially if climate change and population growth projections hold true.

Oregon's state government is aware of the situation, and in 2009 the 75th Legislative Assembly passed House Bill 3369. In this bill, the Legislature directed the Oregon Water Resources Department (OWRD) to develop a statewide, integrated water resources strategy as a planned response to address these challenges and to meet

current and future water needs (Oregon Water Resources Department, 2009a). Based on the strategy's goal, the ODWR describes the vision as:

> …bring[ing] various sectors and interests together to work toward the common purpose of maintaining healthy water resources to meet the needs of Oregonians and Oregon's environment for generations to come (Oregon Water Resources Department, 2009, p. 1).

In 2012, OWRD submitted the final Integrated Water Resources Strategy, hereafter known as either the IWRS or the Strategy. IWRS has short- and long-term management recommendations to address Oregon's water quality and quantity issues, many of which were developed in conjunction with groups of water interests, such as staff from irrigation districts, natural resource agencies, and industry. As the state moves toward the implementation stage, gaining an understanding of how Oregon's public will respond to water resources disturbances is important; their response or responses may impact implementation of one or more of the IWRS management practices. This leads to the following research question: Do Oregonians have the dimensions of civil society in place to understand and help manage disturbances in water resources? Given that civil society can be influenced by knowledge and risk perception, subsequent questions include: (a) what are Oregonians' current self-assessed and factual knowledge about the state's water resources?; and (b) what are their perceptions of risk associated with water resources?

1.2 BACKGROUND

The ability for communities and individuals to understand and respond to information is important for policy implementation. Oregon's general public may be called on to accept and support potentially controversial management practices associated with the IWRS. If the public does not understand the disturbances or changes associated with Oregon's water resources, its support of management practices may be limited. The presence of several dimensions of civil society may well contribute to the public's ability to understand and respond to water resource disturbances. These dimensions include: feeling informed about water resources, talking about water resources, and feeling they have the ability to impact water resource policy. However, Oregon's public may run into limitations or barriers that can undermine the development of civil society; these are conditions or factors that render a response to a disturbance ineffective (Adger et al., 2007), and include a low level of knowledge and inaccurate risk perception about the issue (Adger et al., 2007; Engle, 2012).

The ability to understand and respond to a change or "disturbance" is associated with the concept of civil society. The term "disturbance" is used in both the natural and human dimensions (Gunderson, 2000; Ivey et al., 2004). Within human dimensions, it can be a press or pulse ecological (Janssen & Ostrom, 2006), socioeconomic (Wall & Marzall, 2006), or institutional (Mendis et al., 2003) change that can impact a population. For this study, "disturbances" refer to the changes in Oregon's water resources' quality and/or quantity due to natural (e.g., climate change,

drought) or human (e.g., nonpoint pollution, overuse) stressors. The following sections briefly discuss the concepts of civil society, knowledge, and risk perception used throughout the dissertation, with in-depth literature reviews to follow in the subsequent chapters.

1.2.1 Civil Society

Research has identified multiple determinants for a community or individual to adapt to a disturbance (Yohe & Tol, 2002), including availability and access of financial resources and technology, infrastructure, human networks, education, and civil society. For this study, civil society is a method where members of Oregon's public can understand and engage in water resource issues in Oregon. According to the literature, there are three key components of civil society: (a) being informed about a policy issue; (b) interacting with others about the issue; and (c) engaging in a practice to make a policy change (Dalton, 2009; Klofstad, 2010). If individuals are informed about an issue, they are more likely to interact and talk with others about the issue (Delli Carpini et al., 2004). If individuals talk about an issue with others, they are more likely to engage in activities to influence policy, including joining a nongovernmental agency, or volunteering (Dalton, 2009; Klofstad, 2010). Engagement in these activities can in turn make individuals feel more informed about an issue (Klofstad, 2010), thereby completing the cycle of civil society.

1.2.2 Knowledge

The complexity associated with natural resource and environmental science policy issues can lead to a low level of knowledge about water resources for members of the public. Yet, for members of the public, knowledge about a salient policy issue is often an important and necessary, but not always sufficient, prerequisite for the policy implementation and support (Lazo et al., 2000; Sundblad et al., 2009). Knowledge helps individuals make informed decisions, participate in the policy process, and promote their own self-interest (e.g., Pierce et al.,1989; Robelia & Murphy, 2012). If members of the public are going to accept a water resource management practice recommended by the IWRS, they potentially need knowledge about water resources in Oregon. Limited knowledge can promote misconceptions about an issue and therefore can impact the policy making process; as people rely on assumptions, and possibly disinformation, to form a policy preference, they may lean toward accepting a poor policy and management preference. Essentially, a low level of knowledge about an issue can lead people to believe there is not a problem, so that issue does not require public resources (Pierce et al., 2009). Furthermore, although knowledge does not necessarily lead to pro-environmental behaviors or actions (Kollmuss, 2002), it is an essential component for behavioral changes (Pierce et al., 1989; Robelia & Murphy, 2012; Steel et al., 2005). In summary, as proclaimed by Janicke (1997), without knowledge there is no (perceived) problem, no public awareness, and consequently no policy process.

1.2.3 Perception of Risk

As with knowledge, issue complexity can lead to challenges in risk perception for the public. Early risk perception research focused on potential direct human health impacts, such as nuclear energy and auto accidents (Slovic, 2000), and tried to determine when and why people accept certain personal risks yet reject others. The research matured to indirect (or secondary) risks, including threats to the environment. Understanding how the public perceives a particular risk can help to frame communication and outreach strategies, which may assist with implementation of management practices. If the public perceive a risk inaccurately, or don't perceive an activity as a risk, they may not support a management practice directed at the risk.

1.2.4 Oregon's Integrated Water Resource Strategy (IWRS)

Oregon's IWRS goal is to meet in-stream and out-of-stream[1] needs currently, and in the future (Oregon Water Resources Department, 2009a). The IWRS explicitly states that it will *not* relinquish any existing authorities, nor will it remove or jeopardize any existing water rights, or other local, state, and federal authorizations (Oregon Water Resources Department, 2012). The Strategy, now known as ORS 536.220(2), calls for OWRD to:

[1] Defining the terms "in-stream" and "out-of-stream" uses is a component of the IWRS goal 2. As is, these are generalized as "left in place water" and "diverted water" within the document (Oregon Water Resources Department, 2012, p.B2).

> … formulate a coordinated, integrated state water resources policy and provide means for its enforcement, that plans and programs for the development and enlargement of the water resources of this state be devised and promoted and that other activities designed to encourage, promote and secure the maximum beneficial use and control of such water resources and the development of additional water supplies be carried out by a single state agency (Oregon Water Resources Department, 2009a, p. 1).

The OWRD led development of the IWRS and partnered with Oregon Departments of Environmental Quality (ODEQ) and Fish and Wildlife (ODFW) to ensure water quality and ecological needs were addressed. In addition, the Oregon Department of Agriculture (ODA) participated to ensure that Oregon's agriculture industry was promoted and protected (Oregon Water Resources Department, 2012). More than 15 natural resource and economic development state agencies and 10 federal agencies also provided assistance. To gain the public's input, OWRD hosted 11 open houses, "multiple" government meetings, "dozens" of stakeholder workshops, and "several" rounds of public comment (Oregon Water Resources Department, 2012).

Completed in August 2012, the IWRS covers four "cross-cutting" issues: groundwater, climate change, funding, and institutional coordination (Oregon Water Resources Department, 2012). IWRS lists four primary objectives: (a) understand Oregon's water resources today; (b) understand instream and out-of-stream needs; (c) understand coming pressures that affect Oregon's water needs and supplies; and (d) meet Oregon's instream and out-of-stream needs.

IWRS has a total of 42 recommended management actions, yet as the IWRS acknowledges, due to the "reality of the national, state, and local economic situation" (Oregon Water Resources Department, 2012, p. 121), these can only be recommendations as the resources necessary for implementation are limited. Even so, according to ORS 536.220(2), the strategy must be updated every five years, with 2012-2017 the "implementation" phase. The 2012-2017 years call for "providing essential services and conduct in-basin work, improving Oregon's ability to understand and meet its water needs" (Oregon Water Resources Department, 2012, p. 121). Many of these next steps are awaiting funding authorization from the Oregon Legislature.

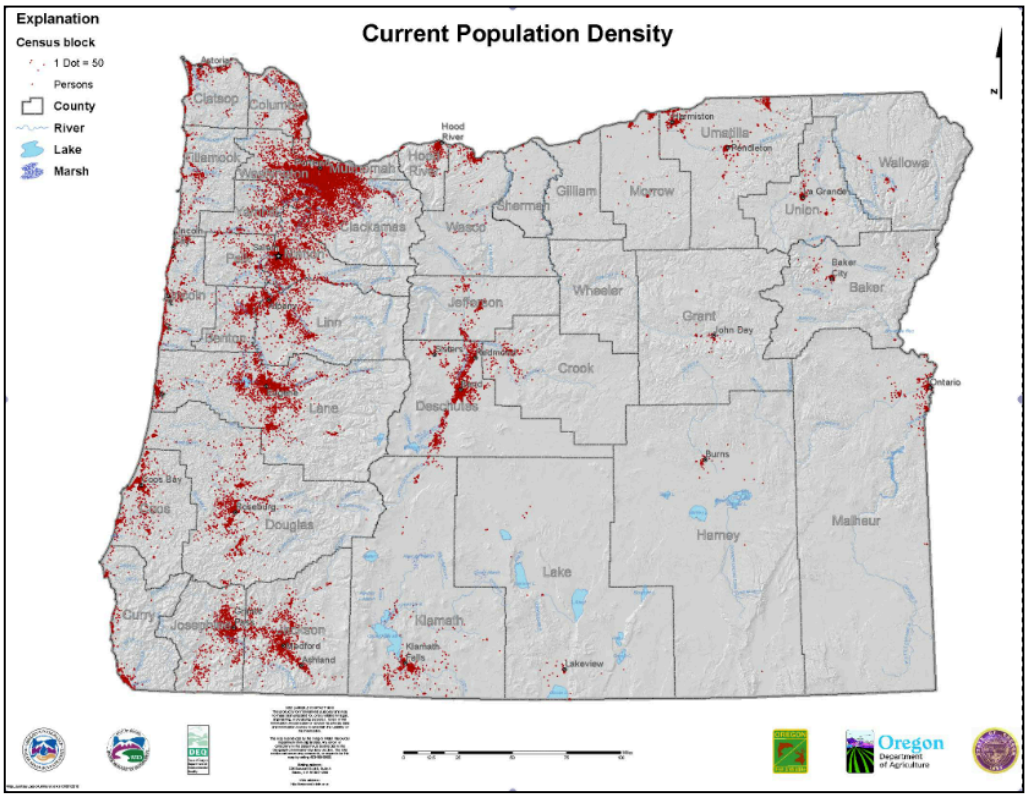
The IWRS is a form of planned adaptation, which is the result of a deliberate policy decision, based on an awareness that conditions have changed or are about to change and that action is required to return to, maintain, or achieve a desired state (Intergovernmental Panel on Climate Change, 2007a). Yet, implementation of IWRS' potential management practices can be impeded if members of the general public do not have the dimensions of civil society in place to understand and respond to disturbances, as well as have the knowledge and risk perception on water resources.

1.3 RESEARCH LOCATION

The state of Oregon is the 27th most populous state in the nation (U.S. Census, 2012) and home to 3,857,625 people (Population Research Center, 2012), with an overall density of 104 people per square kilometer (U.S. Census, 2012). Yet, as

depicted in Figure 1, 69% of the population occupies only 1% of the landmass (U.S. Census, 2011). Using the U.S. Office of Management and Budget definition of "rural," 82% of Oregon's land is rural, with 22% of its population occupying that land (Population Research Center, 2012). The remaining 78% occupy metropolitan counties primarily between the urban centers of Portland and Salem (Population Research Center, 2012).

Figure 1. Oregon 2010 Population Density



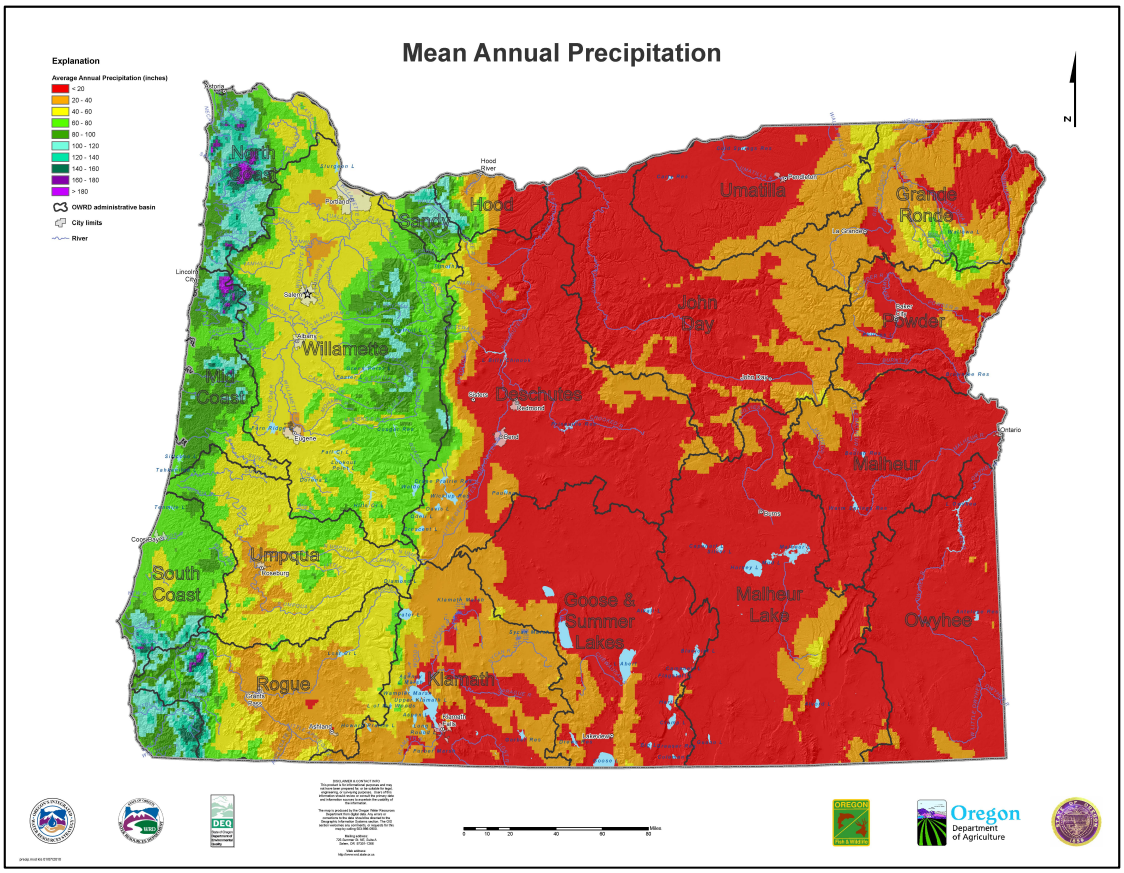
Source: Stahr, 2010c

Population growth in Oregon has been steady, and relatively rapid, with the trend predicted to continue, although there is a disparity in growth between urban and rural areas. Between 1950 and 2010, Oregon's population grew two and a half times to 3,831,074 residents (Population Research Center, 2012) at a rate of 152% over the 60 years. In comparison, the U.S. population increased 104% over the same time period. Most of this growth occurred in the greater Portland area (Office of Economic Analysis, 2004) with relatively little growth in the rural areas. Long-term projections have Oregon's population growing to almost 5.5 million by 2040, or a 132% increase from 2010 (Albrecht, 2008). Among many infrastructure concerns, the projected population growth will exceed current water supplies (Office of Economic Analysis, 2004).

Like Oregon's population, its level of precipitation varies across the state. There are two key features influencing Oregon's precipitation—topography and the Pacific Ocean; together they create vastly different precipitation levels across the state. As displayed in Figure 2, the Willamette Valley receives between 102 and 356 centimeters of rain per year. In contrast, eastern Oregon receives only 25 to 51 centimeters per year (Climate Impacts Group, 2010a). The state average annual rainfall varies from less than 20 centimeters in the drier Plateau Regions to as much as 508 centimeters at points along the upper west slopes of the Coast Range (Bastasch, 2006). The majority of the precipitation falls during the winter months when the jet stream pushes storms from the Pacific Ocean inland causing orographic lifting along the Cascade Range; as the storm moves up the range, the precipitation falls either in

the form of rain or snow, and therefore leaves little precipitation to fall east of the Cascades (Bastasch, 2006).

Figure 2. Oregon Annual Average Precipitation



Source: Stahr, 2010b

Precipitation from these storms often falls as snow and remains on the ground in the form of snowpack. This snowpack accumulation is Oregon's largest water storage "facility" and plays a key role in controlling the timing and amount of stream flow throughout the state (Chang & Jones, 2010). Increased temperatures can substantially affect the snowpack and water availability during the summer months

(Chang & Jones, 2010). In fact, Oregon's great dividing line, the Cascade Range with its transitional snow[1], is particularly vulnerable to temperature changes and fluxes (Nolin & Daly, 2006).

The Pacific Northwest region, Oregon included, is expected to warm about 0.5°F every 10 years for the next few decades (Nolin & Daly, 2006). Climate models project that averaged across the region annual temperatures will be 1.9ºF higher by the 2020s when compared with the 1970-1999 average, and 2.9ºF higher by the 2040s (Washington State Department of Ecology, 2007). These figures are averages, with the full projections spanning a range of 0.7ºF to 3.2ºF for the 2020s and 1.4ºF to 4.6ºF for the 2040s (Western Regional Climate Center, 2013). Although this warming may seem minor to some, even a small increase can act as a catalyst to change in water availability.

Overall, with the exception of slightly more precipitation in the winter months, the amount of precipitation in Oregon is not expected to change dramatically due to climate change (Chang & Jones, 2010; Mote, 2006; Nolin & Daly, 2006). What will change is the form of precipitation, which is projected to be more rain and less snow (Chang & Jones, 2010; Mote, 2006; Nolin & Daly, 2006). Decreased snow with increased rain has several ecological implications, including reduction in mountain glacier recharge, as well as decreased snowpack (Mote, 2006; Nolin & Daly, 2006).

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[1] Snow cover that accumulates at temperatures close to the ice-water phase. Nolin, A. W., & Nolin, A. W., & Daly, C. (2006). Mapping "At Risk" Snow in the Pacific Northwest. *Journal of Hydrometeorology, 7*(5), 1164-1171.

Currently, Oregon's snowpack at both transient and higher elevation areas act as water storage and provides stream flow in the dryer late spring and summer months (Nolin & Daly, 2006). Increased temperatures will result in less streamflow in the late spring and early summer, and increased flow in the winter and early spring (Chang & Jones, 2010). Furthermore, summer stream temperatures could increase in response to the increased ambient air temperature and reduced summer flows resulting in water quality impacts (Chang & Jones, 2010). Essentially, if Oregon loses its water storage capacity, it faces a reduction in water supply in the summer months as demand for water increases (Chang & Jones, 2010). Assuming the current rate of demand per capita remains, by 2040 the increased need for water due to climate change impacts will amount to half of the water required to meet the needs of the growing population (Oregon Water Resources Department, 2010d, 2011, 2012).

Changes in Oregon's population and climate change will require changes in the management of Oregon's water. Currently the state manages its water through the Oregon Water Code (Oregon Water Resources Department, 2009a). Unlike most states where the water code is part of the Constitution, Oregon's is a state law (Bastasch, 2006) – Oregon Revised Statutes (ORS) Chapters 63, 536 through 543, 545, 547, 548, 552, 553, and 554. Though officially a hybrid system with the Riparian Doctrine[1], the Water Code is predominantly based on the Prior Appropriation Doctrine (Oregon Water Resources Department, 2010a, 2010b), also commonly known as the

[1] Under the riparian doctrine, a landowner whose property adjoins a water body has the right to make use of the water for a beneficial use as long as that use does not harm downstream users.

"first in Time, first in Right" doctrine. When enacted on February 24, 1909, to provide certainty to the user, water rights went to those who first used the water. These "senior" water right holders were, and continue to be, allocated their full water allotment, whereas "junior" water right holders had to wait and see if there was enough water for them. Later, in an effort to settle and develop the West, the Doctrine was applied to settlers, many of who were farmers and ranchers, as long as the water was for a beneficial use (i.e., agriculture, irrigation, industry). Tribal water rights, also known as "Winters Rights" from a 1908 Supreme Court case adjudicating water rights (Winter's v. United States, 207 US 564), determined water seniority by the date the reservation was created. If a reservation was created before the initial settlers within an area, the Tribe had priority water right status.

Oregon's water code still uses the Prior Appropriation Doctrine as its foundation, with four principles that hold today: (a) water belongs to the public; (b) any right to use water is assigned by the State through a permit system; (c) water use under the permit system follows the Prior Appropriation Doctrine (i.e., first in time, first in right); and (d) permits must be issued for beneficial use and without waste (Bastasch, 2006; Getches, 1997; Oregon Water Resources Department, 2010c). Furthermore, Oregon manages its groundwater-surface water interaction as one, in the form of conjunctive management (Oregon Water Resources Department, 2012), unless

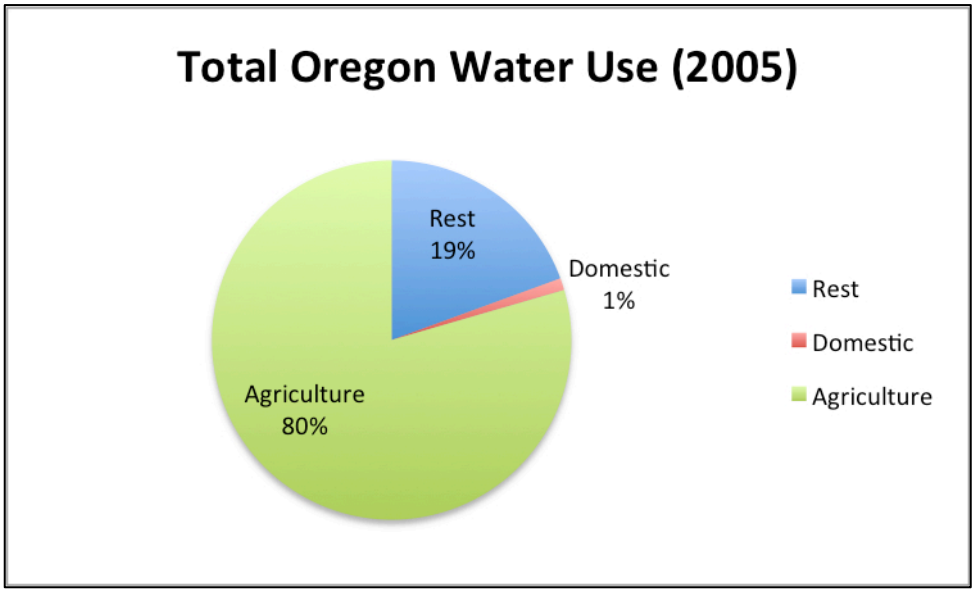
the groundwater comes from an exempt-use well[1] (Oregon Water Resources Department, 2009b).

Oregon water users divert about nine million acre-feet of water each year for out of stream uses, or about 8% of the estimated annual yield (Oregon Water Resources Department, 2012). Like many western states settled with the certainty of the Prior Appropriation Doctrine, the majority of water rights (permits) are issued for agriculture. In fact, contrary to popular belief, as displayed in Figure 3, about 80% of Oregon's water is currently used for agriculture (Kenny et al., 2009), whereas only 1% is used for domestic[2],[2] use.

[1] A well is exempt from needing a water right permit if it is for: group or single domestic use, up to 15,000 gallons per day; irrigation of lawn and/or non-commercial garden up to half an acre or less; single industrial or commercial purpose not to exceed 5,000 gallons per day; irrigation of school property up to 10 acres in critical ground water areas; stock watering; and down-hole heat exchange.

[2] Water used for indoor household purposes such as drinking, food preparation, bathing, washing clothes and dishes, flushing toilets, and outdoor purposes such as watering lawns and gardens. Domestic water use includes water provided to households by a public water supply (domestic deliveries) and self-supplied water.

Figure 3. Oregon Fresh Water Use in 2005



Source: Kenny et al., 2007

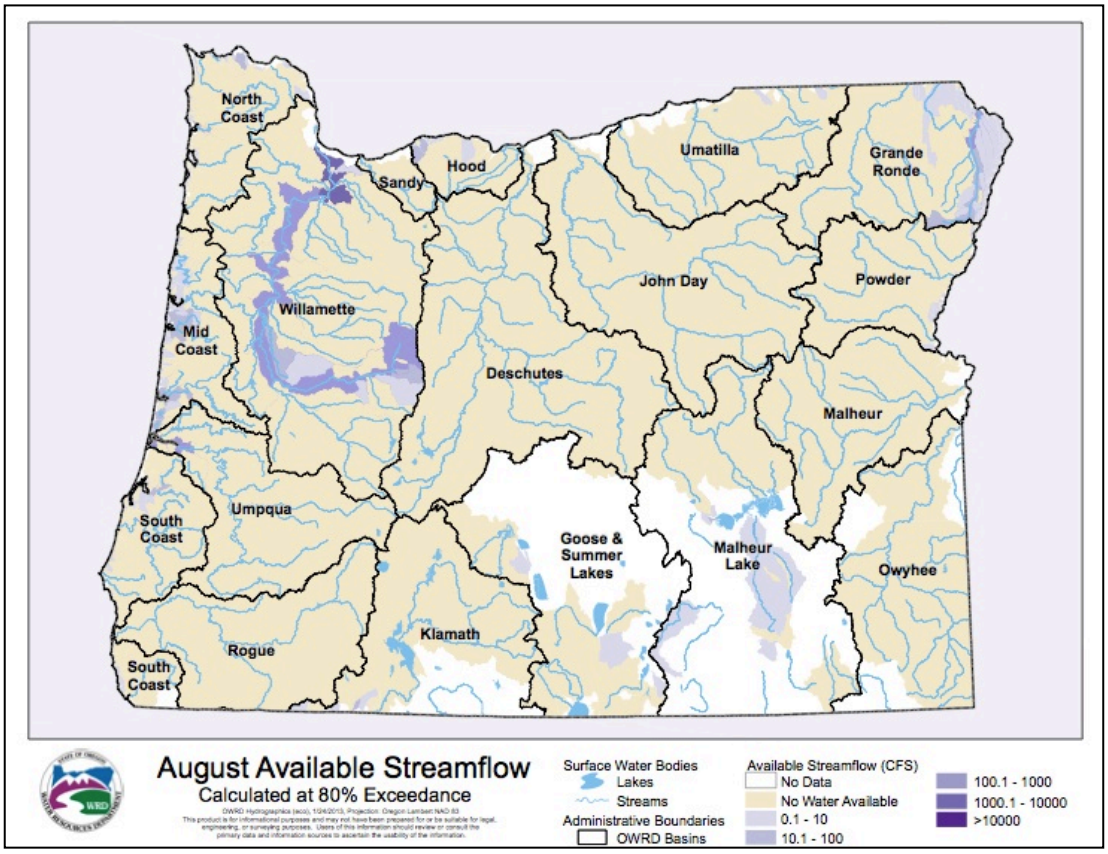
In 2008, the OWRD water demand forecast indicated that agriculture uses about 85% of diverted water, about 5% more than the 2005 estimate provided by the U.S. Geological Survey (USGS) (Kenny et al., 2005). Of the 85% of total water diverted for agriculture, 66% is used in the eastern and southeastern counties of Baker, Crook, Deschutes, Harney, Jefferson, Klamath, Lake, Malheur, Morrow and Umatilla. In 2010, only about 11% of Oregon's population lived in these counties (Population Research Center, 2012). Irrigation occurs on about 1.65 million acres of cropland, about half of Oregon's total cropland (Oregon Water Resources Department, 2012). Irrigation methods vary in Oregon from efficient drip or micro sprinklers, to less efficient flood and furrow irrigation. As of 2008, flood and furrow is the dominant

[1] Rest includes aquaculture, industry, mining and thermoelectric energy generation.

irrigation system used in Oregon, accounting for 41% of irrigated cropland (Oregon Water Resources Department, 2012). This is followed by central pivot systems at 32%, whereas drip or micro sprinklers account for just 5% (Oregon Water Resources Department, 2012). Furthermore, irrigation demands are predicted to increase 10% in the next 40 years (Oregon Water Resources Department, 2010d).

Even with a long-established water code, many of Oregon's waterways are at risk (Oregon Water Resources Department, 2012). Most surface waters are either fully or over allocated in the summer months, during the time when water is needed the most (Figure 4). Furthermore, there are pressures and concerns with ecological impacts of surface-water withdraws and depletion of groundwater supplies (Oregon Water Resources Department, 2012). To mitigate ecological impacts, about 19 million acre-feet of water is protected for in-stream water rights held by Oregon to sustain aquatic species and ecosystems (Oregon Water Resources Department, 2012).

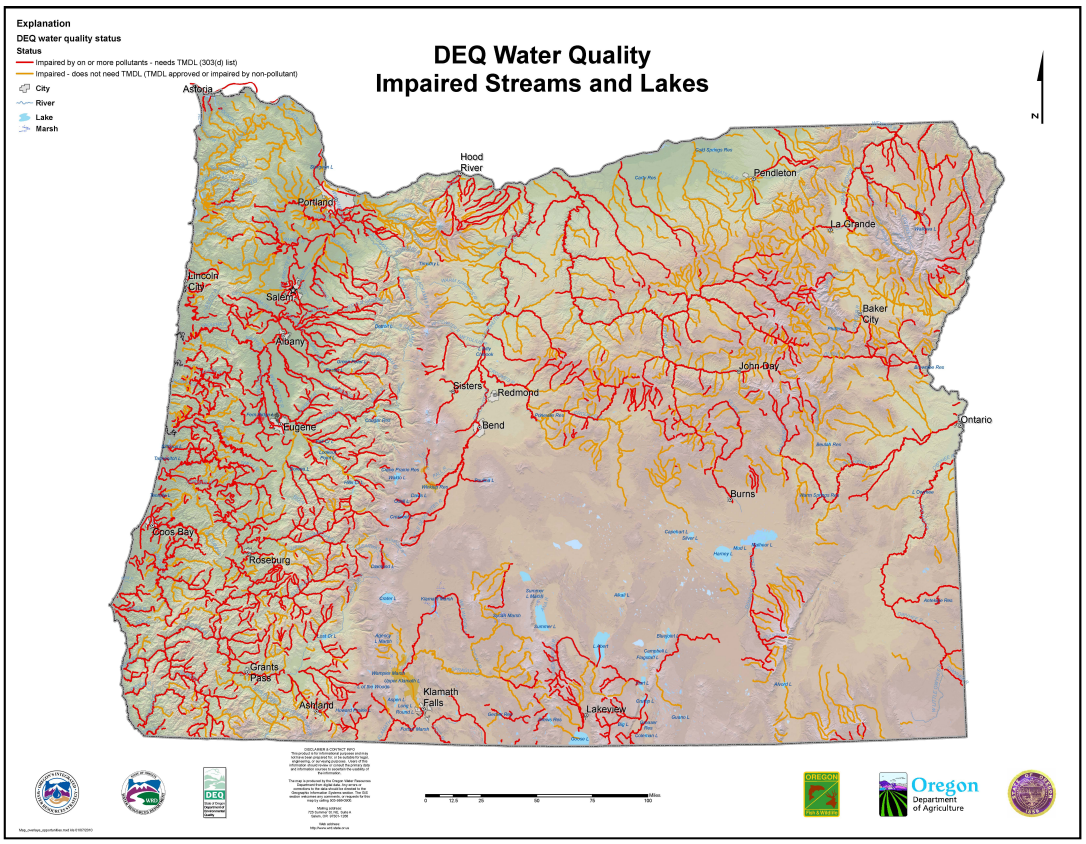
Figure 4. August Available Stream flow



Source: Oost, 2013

Oregon's water quality and quantity are related, and management of water quantity directly impacts the quality. Of Oregon's water bodies, 1,861 are already listed as "impaired" under the Clean Water Act 303(d) standards (Figure 5). This includes more than 30 lakes and 35,400 stream kilometers (Oregon Water Resources Department, 2012). Stressors on Oregon's water quantity, including climate change and increased demand, will impact water quality as reduction in stream flow increases pollution concentrations and increases water temperatures (Chang & Jones, 2010).

Figure 5. Oregon Impaired Waterways



Source: Stahr, 2010a

1.4 CHAPTER DESCRIPTIONS

This dissertation consists of five chapters, three of which are developed as standalone manuscripts that can be submitted for publication in a relevant journal. Since the three papers are standalone similarities exists in the methods, background,

and research location sections. Chapter two, the first paper, examines the question as to whether Oregon's public has relevant dimensions of civil society in place to understand and respond to disturbances in Oregon's water resources. It will further examine various predictors of civil society engagement. Chapter three explores the question of the public's level of self-assessed knowledge, as well as their factual knowledge on Oregon's water resources. Chapter four addresses the question of what is the public's risk perception of Oregon's water resources. Finally, the last chapter provides a synopsis of the research findings in the three papers. Each chapter will provide additional background information, including the operationalization of measured concepts.

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2 OREGON'S WATER RESOURCE MANAGEMENT: ASSESSING THE PUBLIC'S CIVIL SOCIETY TO UNDERSTAND AND ENGAGE IN OREGON'S WATER RESOURCES

2.1 INTRODUCTION

The state of Oregon's water resources are currently over taxed and at risk, with potential climate change and population growth exacerbating the problem (Oregon Water Resources Department, 2010d). These challenges, whether over the short or long term, will impact Oregon's water quantity, quality and availability. In order to understand and engage in water resource issues, including accepting and supporting new water resource management strategies, the Oregon public will need the dimensions associated with civil society in place. These dimensions are necessary, though not always sufficient, for the public to understand and engage in water resources issues as potential barriers may impeded the civil society process.

2.2 BACKGROUND

Oregon does not always have enough water to meet its needs: most surface water is fully or over allocated during the summer months (Oregon Water Resources Department, 2012), and groundwater supplies are increasingly unavailable due to depletion (Oregon Water Resources Department, 2012). Water quality is also impacted with close to 2,000 water bodies already listed as "impaired" under the Clean Water Act 303(d) standards, including more than 30 lakes and 35,400 stream kilometers (Oregon Water Resources Department, 2012).

To address these water challenges, Oregon's 75th Legislative Assembly passed House Bill 3369, which directed the Oregon Water Resources Department (OWRD) to develop a statewide, integrated water resources strategy (OWRD, 2009a). The

legislature's goal is the development of a blueprint for Oregon to meet current and future water needs, for both the in- and out-of-stream uses. The appoach is integrated and examines risk factors tied to water, such as water quality, quantity, and availability; ecosystem services; and social needs. OWRD submitted the final Integrated Water Resources Strategy (IWRS) in 2012 with 42 short and long term recommended actions (OWRD, 2012). With implementation on the horizon, Oregon's public may be called upon to support some of these actions. Yet, implementation can be inhibited if the public does not have the dimensions of civil society in place to understand the disturbances to Oregon's water resources, as well as engage in the related policies.

Civil society is a nongovernmental and commercial aspect of society, and a potentially necessary component for the public's ability to respond to a disturbance. A "disturbance" can be an ecological (Janssen & Ostrom, 2006), socioeconomic (Wall & Marzall, 2006), or institutional (Mendis et al., 2003) change impacting an individual or group. For this study the term "disturbance" refers to the changes in Oregon's water resources due to natural (i.e. climate), or human (i.e., regulatory or policy changes) stressors, and includes changes in water quantity, water quality, and water availability. More specifically, if citizens are informed about the disturbance, interact with other members of the community and society concerning the disturbance, have a sense of efficacy that their participation can lead to policy change, they may be more likely to engage in the policy process. Using a public survey conducted in 2010, this study examines various dimensions of Oregon civil society concerning water

resources, and identifies potential sociodemographic and cultural predictors of these dimensions.

2.3 LITERATURE REVIEW

Civil society is the noncommercial aspect of community life that exists between the individual and government (Ravitch & Viteritti, 2001). It is also referred to as the "third sector" with government and business as the first two sectors (Civil Society International, 2003). There are three main dimensions of civil society examined in this chapter including: (a) being informed about an issue; (b) interacting and transferring information about the issue with others; and (c) participating in activities that potentially lead to policy changes on that issue. Essentially, within civil society individuals engage in activities to influence policy changes, including voting, campaign activities, communal actions (e.g. working with a group or community), and contacting officials (Dalton, 2009). Furthermore by participating in civil society individuals and groups can produce social and organizational skills that are vital for a participatory democracy (Kittilson & Dalton, 2011).

Considered part of one's civic duty, voting is a traditional form of engagement in civil society (Dalton, 2009; McClurg, 2003). However, according to U.S. Census Data, there has been a decline in voter turnout since 1972 (McDonald & Popkin, 2001), which may suggest a decline in civil society. One possible reason for this decline is the individual's perception on voting, which they may view as having

limited political impact (Dalton, 2009), as well as perceiving the government as a waste and ineffective (Ravitch & Viteritti, 2001).

Modernization of society, including the rise in the environmental concern, has transformed the norms of the civil society that influences the actions of citizens (Wagenet & Pfeffer, 2007). The result is a rise in non-traditional civil society activities, and what Dalton (2009) calls the "Engaged Citizen." According to Dalton (2009), there are two forms of citizens: the "Citizen Duty" and the "Engaged Citizen." Duty-based perceptions include traditional norms, such as the importance of voting in elections, serving on a jury, serving in the military, obeying the law, and reporting a crime (Kittilson & Dalton, 2011). Engaged citizenship reflects a more participatory, elite-challenging view of citizenship, such as forming one's own opinion, supporting those who are worse off, being active in politics, and being active in voluntary groups (Kittilson & Dalton, 2011).

The Citizen Duty views political engagement as an obligation and demonstrates this in the form of voting. The Engaged Citizen, on the other hand, may also vote, but participates in a wide array of activities that give them a direct voice affecting life and political impact (Dalton, 2009), such as joining a group or volunteering. Furthermore, the Engaged Citizen also tends to be more interested in social issues, including environmental causes, whereas the Citizen Duty may focus on economic issues.

According to Putman (2000) political knowledge and interest in an issue is a precondition for participation in civil society activities. Issue knowledge often comes

from discourse with other citizens, which involves information exchange between individuals (Delli Carpini et al., 2004). This knowledge, in turn, can increase participation in public discourse and political action, such as joining a group (Milner, 2002). In a panel study of college students, Klofstad (2010) found a relationship between civic talk and participation in civil society, with individuals heavily influenced by their social circle. As individuals participate in communal activities, they further gain knowledge and information that can be transferred to others, and thereby increase civil engagement on the issue.

The characteristics of those who engage in civil society varies, and often dependent on the type of citizen, Citizen Duty or Engaged Citizen, but fall into the categories of socio-economic status and cultural. Socio-economic status (SES) indicators include gender, age, education, and income. Age is predictive as to the type of civic activity an individual engages in; as age increases so does likelihood of voting (Dalton, 2009; McDonald & Popkin, 2001; Milner, 2002; Putnam, 2000), whereas a decrease in age increases the likelihood of engaging in communal activities (Dalton, 2009).

Regarding gender, males were traditionally more likely to engage in voting and other civic activities than females (McDonald & Popkin, 2001), but this trend has started to change. As females increasingly entered the workforce, their participation in voting increased (Dalton, 2009; McDonald & Popkin, 2001). Furthermore, when assessing engagement activities outside voting, gender differences are quiet small with

females more likely to engaged in civil activities such as volunteering than men (Dalton, 2009).

Level of education and household income are both strong predictors of civil society engagement. In fact, education is considered the strongest of the SES predictors (Delli Carpini et al., 2004; McClurg, 2003; Milner, 2002), with the higher educated putting greater emphasis on all modes of engagement, than the less educated. This may be due to the education and cognitive skills required to understand information. Although income is strongly related to education, increased income often lowers civil society activities outside of voting (Dalton, 2009). Putnam (2000) speculates one reason may be due to individuals "voting" with their checkbook (money) instead of engaging in communal activities.

Cultural and worldview indicators may include environmental beliefs, political ideology, and religiosity. Regarding partisanship, those with ties to the Republican Political Party are more likely to engage in Civic Duty activities (i.e., voting), whereas those affiliated with the Democratic Political Party are typically Engaged Citizens (Dalton, 2009). Although political party identification and political ideology are not the same, this suggests that as political ideology becomes more liberal, people are more likely to engage in communal activities.

A cultural indicator associated with civil society is engagement with nongovernmental organizations (Kittilson & Dalton, 2011). According to Dalton (2009) those who are more bicoentric are more likely to engage in communal civil society activities than those who are anthropocentric. This suggests that those who

engage in environmental organizations may have a more biocentric environmental belief. One of the most common measures of environmental belief is through the use of the New Environmental Paradigm (NEP). Dunlap, VanLiere, and colleagues developed the NEP in the late 1970s as a way of measuring a paradigm shift at the time (Dunlap et al., 2000). In the 1970s the United States was moving from the Dominant Social Paradigm (DSM) to a New Environmental Paradigm (NEP); individuals who believe in the DSM were more anthropocentric, whereas those who believe in the NEP were more bicoentric. According to Dalton (2009) those who are more bicoentric are more likely to engage in communal civil society activities than those who are anthropocentric. Yet, in their examination of environmental belief and involvement in voluntary organizations, Schuett and Ostergren (2003) found that the level of environmental belief, as measured with the NEP, and involvement in organizations differ for those who are in specific outdoor activities. For example, they found that those who are involved in a "consumptive" (e.g., hunting, fishing) activity associations are more anthroprocentric than those who engage in "appreciative" outdoor activities (e.g., hiking) associations. This suggests that environmental belief as measured by the NEP may have conflicting predictive power for different groups involved in natural resources.

Individuals are not automatically equipped to participate in civil society; instead they require resources (i.e., knowledge) and psychological motivations (i.e., civic engagement) to participate (Klofstad, 2010). Therefore, an individual requires resources in the form of human and social capital to understand information as they

engage with other individuals and networks to receive and transmit the information. According to Putnam (2000), social capital is the, "features of social life – networks, norms and trust – that enable participants to act together more effectively to pursue shared objectives" (p. 12). A subsequent definition is, "the mutual relations, interactions, and networks that emerge among human groups, as well as the level of trust found within a particular group or community" (Mendis et al., 2003, p. 38). Essentially, social capital provides the bonds formed between individuals through friendship and memberships of organizations, and are essential for civil society, and coping with disturbances. Related to social capital is human capital, which is "the skills, education, experiences and general abilities of individuals combined with the availability of productive individuals" (Wall & Marzall, 2006, p. 379). It is what a group or individual needs to understand information, including the education and knowledge on a disturbance or event. This information, in turn, needs to be transmitted throughout the community through the use of social capital and the dimensions of civil society.

2.3.1 Opportunities and Limitations to Civil Society

Whereas a group or individuals may have the dimensions of civil society in place to understand disturbance or support a management practice, it may not be sufficient; lack of knowledge and inaccurate risk perception may act as barriers to civil society. Barriers are conditions or factors that render adaptation ineffective to a response to a disturbance (Adger et al., 2007; Rudberg et al., 2012). Social and

cultural barriers refer to the way a group or individual perceives a risk, which is often dictated by cultural and worldview influences (Adger et al., 2007). Possibly the most prevalent barriers to the support of water resource management practices are information and knowledge about a disturbance (Engle, 2012). Knowledge and awareness of a disturbance are important factors in mitigating barriers, and necessary to conditions for behavioral or policy changes (Adger et al., 2007; Engle, 2012). If a community or individual is able to identify a barrier or problem, through the dimensions of civil society, they can gain information on the problem, and then transfer that information to others, thereby making the barrier an opportunity.

2.3.2 Civil Society and Water Resources

In regard to water resources, available research shows a paradigm shift in water resource management is taking place that could be increasing civil society activities (Engle, 2012; Wagenet & Pfeffer, 2007). One reason for this shift may be related to the focus on nonpoint source pollution that all but demands the "third sector" of civil society to be involved (Wagenet & Pfeffer, 2007), leading governmental agencies at all levels to increase citizen participation on environmental management. On an issue not related to nonpoint source pollution, Wagenet and Pfeffer's (2007) comparative study on civic engagement found that by adhering to its model of civic participation on the Hudson River dredging project, the U.S. Environmental Protection Agency (EPA) overcame much of the resistance to the project from area residents. On the other hand, a litigious atmosphere was created

when Onodaga County made few attempts at civic participation on the project. The EPA's efforts are an example where a problem was identified and through the use of civil society turned into an opportunity.

In a study evaluating the adaptive capacity in water planning within large urban community water systems in Arizona and Georgia, Engle (2012) found the main barriers to management activities were financial, regulatory, staffing and personal, trust and confidence, and perception of the public. The public felt the "job (drought management) has been finished," (Engle, 2012, p. 1145) which inhibited implementation of the new management approach. Arizona water managers reported that the general public did not perceive drought as a risk until it became an emergency, which precluded the public from taking an active participatory role in water planning. In Georgia, individuals also missed the opportunity to participate in the water planning process, as they believed drought management was the state's responsibility to plan for future water management, negating their own need and responsibility in implementing certain management approaches.

Having various dimensions of civil society in place may well help the Oregon public understand disturbances to water resources, and engage in proactive behaviors. As the EPA found, by engaging with the public through the civil society process its management of the Hudson River dredging project was more efficient than Onodaga County, which did not engage with the public on the same project. Oregon's water management agencies may need to engage the public on management activities identified in the IWRS. This leads to the question, what is the status of the public's

three dimensions of civil society on water resources? Specifically, are important necessary, but not always sufficient conditions, in place to encourage a civil society response to these changes? Furthermore, what are the SES and cultural predictors of the three dimensions? Based on the literature, education is predicted to be the strongest SES predictor of civil society. Furthermore six hypotheses on civil society will be tested:

> H_1: The more Oregonians talk about water resources, the more likely they are to feel informed about water resources.
>
> H_2: The more Oregonians talk about water resources with others, the more likely they are to feel they have an impact on water resource policy.
>
> H_3: The more likely Oregonians feel they have an impact on water resource policy, the more likely they are to feel informed about water resources.
>
> H_4: The more biocentric Oregonians are, the more likely they will consider themselves informed about water resources.
>
> H_5: The more biocentric Oregonians are, the more likely they will talk about water resources.
>
> H_6: The more biocentric Oregonians are, the more likely they will belief they can have an impact on water resource policy issues.

2.4 METHODS

Data utilized in this study are collected from a mail questionnaire distributed by the U.S. Postal Service to a random sample of Oregon households in the spring of 2010. The questionnaire was mailed to 2,000 randomly selected households, with 1,563 going to valid addresses. The sample was supplied by a private sampling company. Accounting for an estimated 30% bad addresses and a potential 30%

response rate, it was expected the original sample size of 2,000 would provide 400 valid responses, leading to a 95% confidence level and 5% confidence interval for the results. Using a modified version of Dillman's (1978) Total Design Method, three waves were distributed to the households, with each asking to have a member 18 years or older to fill out the questionnaire. The first wave consisted of a post-card informing the household to expect the questionnaire, and the purpose of the questionnaire. The second wave included the questionnaire, a letter informing respondents the nature of the questionnaire as well as the ability to refuse participation, and a business reply mailer with postage. The third wave was a reminder, with the same items included in the second wave. Taking into account the 437 bad addresses, the final response rate was 51%, or 799 completed questionnaires. The 799 questionnaire responses provide a 95 percent confidence level and a 4% confidence interval.

The questionnaire was developed from information collected though stakeholder interviews conducted for the Oregon Water Resources Department (OWRD) and previous research. It included three sections: (a) self-assessed level of knowledge and perception of risk; (b) level of environmental belief; and (c) socio-economic information. Testing of the questionnaire took place on three separate occasions; the first to three graduate students not engaged in the project, the second and third time to a research methods undergraduate class of 29. Question wording, refusals, and other difficulties encountered in the implementation of the surveys can result in some measurement error or unintended bias in responses.

2.5 RESEARCH LOCATION

Research for this study occurs within the State of Oregon, which lies in the northwest corner of the United States. The state is one that exists at odds with itself: it is progressive and conservative, rural and urban, desert and rainforest. Yet, like its neighbors Washington and California, it is changing. Oregon has a population of 3,857,625 (Population Research Center, 2012), with most of it (69%) occupying only 1% of the landmass (U.S. Census, 2011). This may change with projections putting Oregon's population to almost 5.5 million by 2040, resulting in a 132% increase from 2010 (Albrecht, 2008). Not only will this population increase change density, and lead to greater competition for resources, it will place stress on Oregon's water infrastructure, including exceeding current water supplies (Office of Economic Analysis, 2004).

Oregon's precipitation levels vary across the state. The average annual rainfall ranges from less than 20 centimeters in the drier Plateau Regions to as much as 500 centimeters at points long the upper west slopes of the coast Range (Bastasch, 2006). Much of this precipitation falls during the winter months in the form of snow along the Cascade Mountain range. Oregon's snow produces snowpack that acts as the state's largest water storage facility. Moving one step further, the snowpack dictates Oregon's water supply, determining the timing and amount of streamflow throughout the state. According to the Climate Impacts Group (2010b) at the University of Washington, 50% of Oregon water users are located in areas of the state dependent on snowpack to meet their water needs. This snowpack and summer water supply is at

risk to potential warming associated with climate change (Chang & Jones, 2010). Essentially, if Oregon loses its water storage capacity, it faces a water supply shortage in the summer months as demand increases. Furthermore, irrigation demands are projected to increase by 10% with a one degree Celsius rise in temperature (Oregon Water Resources Department, 2012).

The State of Oregon manages its water through the Oregon Water Code, which was enacted on February 24, 1909 (Oregon Water Resources Department, 2009a). The Code is officially a hybrid with the Riparian Doctrine, but predominantly uses the Prior Appropriation Doctrine as its foundation (Oregon Water Resources Department, 2010d). The Prior Appropriation Doctrine is commonly referred to as "First in Time, First in Right." With the Doctrine, and to provide certainty, the best water rights go to those who used it first, and, like many western states, these were typically farmers and ranchers. The Doctrine states that if the water is available, these "senior" water right holders are allocated their full water allotment, whereas "junior" water right holders must wait and see if there is enough water for them. Tribes were also allotted water rights, known as "Winters Rights," with a priority date set at the establishment of the tribal reservation. Oregon's Water Code, therefore, is designed to protect senior water right holders for the beneficial use of all Oregonians. Today, as in the past, the majority of Oregon's water rights (permits) are issued for agriculture, with 79% of Oregon's water currently used for agriculture and irrigation (U.S. Geological Survey,

2009), and if aquaculture[1] is included it increases to 89% (U.S. Geological Survey, 2009). Meanwhile, the domestic[2] water use accounts for a little over 1% of Oregon's water use (U.S. Geological Survey, 2009).

2.6 ANALYSIS

The survey respondents' basic characteristics are presented in Table 1 along with Oregon's 2011 population estimates of those 18 years and older. At a mean of 56 years, the survey population is six years older on average than Oregon's 18 years and older population of 50 (U.S. Census, 2011). To compensate for the bias, the survey data is weighted by age with the U.S. Census Bureau (2011) Community Data (Table 8 in appendix). For the survey the 18-19 age category had no responses, and there were only eight responses in the 20-24 age category. Therefore, the 20-24 and 25-34 age categories were collapsed into a 20 – 34 age category.

1. Water use associated with the farming of organisms that live in water (such as finfish and shellfish) and offstream water use associated with fish hatcheries.

2. Water used for indoor household purposes such as drinking, food preparation, bathing, washing clothes and dishes, flushing toilets, and outdoor purposes such as watering lawns and gardens. Domestic water use includes water provided to households by a public water supply (domestic deliveries) self-supplied water.

Table 1. Survey Response Bias

Demographic Variable	Survey Response Bias	Census Estimates (2010) [1]
Mean Age (Over 18)	56	50
Median Household Income	$50,000 - $74,999 (survey category)	$49,260 (2006 – 2010 adjusted average)
Gender (over 18)	50% Male, 50% Female	49% Male, 51% Female
Some College or Higher (over 25)	79%	64%

1. Source: U.S. Census. (2011). *2010 Census Demographic Profile Summary File*. Retrieved from http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=DEC_10_DP_DPDP1.

Within this study three dependent variables are used to assess the dimensions of civil society: (a) feeling informed about water resources; (b) talking about water resources; and (c) impact on water resources policies. Table 2 displays the variables' phrasing in the questionnaire, and the weighted descriptive data. Analyzing the three dependent variables on civic engagement dimensions, the majority of the respondents felt they were "somewhat informed" about water resource issues (mean = 2.06); "sometimes" talk about water resource issues (mean = 2.53); and have a "small impact" on water policy in Oregon (mean = 2.52). The process of creating a single civil society measurement with the three dependent variables proved unreliable with a Cronbach's alpha of .53.

Table 2. Civil Society Weighted Dependent Variables

Variable Name	Variable Description	Options	%	Mean (S.D)
Inform	*In general, how well informed would you consider yourself to be concerning water issues in the state of Oregon?*	1. Not informed 2. Somewhat informed 3. Informed 4. Very Well informed	18% 60% 19% 3%	2.06 (.69) *n* = 769
Talk	*How often do you talk about issues related to water with your family, friends, or other acquaintances?*	1.Never 2. Hardly ever 3. Sometimes 4. Often	11% 35% 45% 9%	2.53 (.80) *n* = 771
Impact	*Overall, how much impact do you think people like you can have in making Oregon's water policy?*	1. No impact at all 2. A small impact 3. A moderate impact 4. A big Impact	16% 50% 29% 5%	2.42 (.78) *n* = 772

The six independent variables examined as predictors of the three dimensions of civil society include four socio-economic status (SES) and two cultural variables (Table 3). The four SES variables are age, income, education, and gender. Gender was recoded into a dummy variable, where 1 = male and 0 = female Income was recoded by collapsing all income categories from $50,000 and more into a dummy variable where 1 = households that make $50,000 or more a year and 0 = else. Education responses were also collapsed creating a dummy variable where 1 = "some college or more" and 0 = else.

Cultural variables include self-identified political ideology, which is a measure of traditional political culture (Pierce et al., 2009); and the New Environmental Paradigm (NEP) index, which is an indicator of environmental belief. To measure

political ideology, respondents were asked on domestic policy issues what they consider themselves to be and provided with a range of one "very liberal" to five "very conservative." For the analysis this was reverse coded so 1 = "very conservative and 5 = "very liberal." The NEP is an additive index created from six selected variables. Participants were asked whether or not they agreed or disagreed with six statements, three anthropocentric and three bicoentric, related to the environment. They were provided with a scale ranging from one through five, with 1 = "Strongly Disagree" and 5 = "Strongly Agree." The three anthropocentric variables ("Humans have the right to modify the natural environment to suit their needs," "The so-called 'ecological crisis' facing humankind has been greatly exaggerated," "Humans were meant to rule over the rest of nature") were reverse coded to ensure the direction of the responses corresponded with the other items in the index. For example, the statement "humans have the right to modify the natural environment to suit their needs," was reverse coded from 1 = "Strongly Disagree" and 5 = "Strongly Agree" to 1 = "Strongly Agree" to 5 = "Strongly Disagree." The six variables were compiled into an additive index ranging from six through 30. Those with a composite of six are deemed to be in full support of the Dominant Social Paradigm, or anthropocentric, while those with a composite of 30 are deemed to be in full support of the New Environmental Paradigm, or bicoentric. The overall reliability of the NEP index was reliable with Cronbach's alpha of 0.78 (Table 4).

The six independent variables used as predictors of civil society are displayed in Table 3. On average, the weighted sample is 47% female and 53% male. For

education, 80% have some college or more, while 55% make $50,000 or more in household annual income. The respondents are on average "moderate" (mean = 3.09) for political ideology. On a scale of six through 30, with 30 bicoentric, on average the respondents are more bicoentric than anthropocentric (mean=22.49).

Table 3. Civil Society Weighted Independent Variables

Variable Name	Variable Description	Public
		Mean (SD)
Age	Respondent Age in Years	48.9/(16.75) n =772
Gender	*Dummy variable for gender* (0=female; 1=male)	.465 *n* = 768
Educ	*Formal educational attainment* (0 – grades school through vocational school; 1 - some college or more)	.801 n =770
Income	*Household income (before taxes) in 2009* (0 = Less than $50,000; 1 - $50,000 or more)	.548/(2.18) 738
NEP	*New Environmental Paradigm index* (6=low support for environmental protection to 30=high support for environmental protection)	22.49/(5.30) n =754
Ideology	*Self-identified political ideological orientation* (1 = very conservative to 5 = very liberal)	3.09/(.983) n =740

Table 4. NEP Reliability Analysis

	Means	Standard Deviation	Item Total Correlation	Alpha if Item Deleted	Cronbach Alpha
New Environmental Paradigm Index					.78
The balance of nature is very delicate and easily upset by human activities[1]	3.98	1.12	.53	.74	
Humans have the right to modify the natural environment to suit their needs[2]	3.47	1.21	.43	.76	
We are approaching the limit of people the earth can support[1]	3.51	1.34	.51	.74	
The so-called "ecological crisis" facing humankind has been greatly exaggerated[2]	3.55	1.39	.59	.72	
Plants and animals have as much right as humans to exist[1]	4.02	1.25	.53	.74	
Humans were meant to rule over the rest of nature[2]	3.71	1.41	.54	.74	

1. Variables coded on a 5-point scale from "Strongly Disagree" (1) to "Strongly Agree" (5).
2. Variables coded on a 5-point scale from "Strongly Agree" (1) to "Strongly Disagree" (5).
3. $n = 753$

Bivariate and multivariate tests are used to analyze the data. The bivariate analyses consists of two steps, the first evaluates the relationships between the three civil society variables through a series of Pearson's correlations. The use of Kendall's Tau b correlation was explored, and produced similar results as Pearson's. The second step, also through the use of Pearson's correlations, explores the relationships between the three dependent variables against the four SES and two cultural independent variables. Multivariate analyses consist of OLS regression models to examine the effects of the SES and cultural variables on the three dependent variables.

2.7 RESULTS

Table 5 presents the relationships between the three dependent variables; some items show high correlation whereas others exhibit little correlation. Examination of the relationships between the three civil society dimensions supports the hypotheses of positive relationships among all three. The strongest relationship is between talking about water resources and feeling informed about water resources; as talking about water resources increases, feeling informed about water resources increases. This is statistically significant positive relationship ($r = .490$, $p \leq .001$) and can be categorized as "large" using guidelines from Cohen (1988). As the second hypothesis predicted, there is a statistically significant positive relationship ($r = .121$, $p \leq .001$) between talking about water resources and belief in making an impact on policy; as talking about water resources increases, belief in having impact on water resources policy increases. The relationship can be categorized as "small" (Cohen, 1988). The

third hypothesis is also supported with a statistically significant positive relationship (r = 228, $p \leq$ .001); as belief in having an impact on water resources policy increases, talking about water resources increases. This relationship is categorized as "medium" (Cohen, 1988).

Table 5. Correlations Among the Dimensions of Civil Society

	Informed	Talk	Impact
Informed	___		
Talk	.490***	___	
Impact	.121***	.228***	___

*** $p < .001$ level.

The relationships between the SES and cultural variables with the three civil society variables are presented in Table 6. Environmental belief, as measured with the NEP, is predicted to be the strongest variable correlated with the civil society dimension being informed about water resources, since respondents who have strong biocentric beliefs are thought to be more informed about environmental issues (Dalton, 2009; Wagenet & Pfeffer, 2007). Hypothesis four predicts a positive relationship between the NEP and feeling informed about water resources; the more biocentric respondents are, the more informed they feel about water resources increases. There was a positive relationship (r = .027), but it was not statistically

significant ($p > .05$) therefore this does not support the hypothesis. Hypothesis 5 is supported, with a statistically significant positive ($r = .191$, $p \leq .01$) relationship between the NEP and talking about water resources; as environmental belief becomes bicoentric, talking about water resources increases. This is categorized as a "small to medium" relationship (Cohen, 1988). They last hypothesis predicts a positive relationship between the NEP and belief in having an impact on water resource policy. The correlation substantiates the hypothesis with a statistically significant positive ($r = .161$, $p \leq .01$) relationship; the higher the level of biocentric belief, the more likely respondents believe they can have an impact on water policy. This is categorized as a "small" relationship (Cohen, 1988).

Age is also a consistent statistically significant predictor with all three civil society variables. As age increases, feeling informed about water resources increases ($r = .130$, $p \leq .01$). In addition, as age increases, talking about water resources increases ($r = .082$, $p \leq .05$). The last variable, belief in making an impact on water resource policy produces a negative relationship; as age increases, belief in making an impact on water resource policy decreases ($r = -.107$, $p \leq .01$). It should be noted, that all three relationships with age are categorized as "small" (Cohen, 1988).

Table 6. Correlations Among Study Variables

	Inform	Talk	Impact	Age	Gender	Educ	Income	Ideology	NEP
Inform	___								
Talk	.490**	___							
Impact	.121**	.228**	___						
Age	.130**	.082*	-.107**	___					
Gender	.184**	-.015	-.072*	.121**	___				
Education	-.012	.089**	.150**	-.082*	-.104*	___			
Income	.100*	.017	-.020	-.046	.254**	.237**	___		
Ideology	-.050	.065	.185**	-.170**	-.235**	.234**	.054	___	
NEP	.027	.191**	.161**	-.121**	-.252**	.117**	-.086*	.592**	___

*$p \leq .05$; **$p \leq .01$ level

Table 7 presents the results of the three OLS regression models that assess the impact of SES and cultural predictors on the three civil society variables. Based on previous research, education is predicted to be the strongest SES predictor for all three civil society variables (Dalton, 2009; Milner, 2002), and the NEP the strongest predictor of the cultural variables (Dalton, 2009; Wagenet & Pfeffer, 2007).

The OLS regression model produced four statistically significant predictors on being informed about water issues. The model suggests that being male is the strongest predictor ($\beta = .169, p \leq .001$), while having an income of $50,000 or more is the weakest ($\beta = .106, p \leq .01$) predictor. Age ($\beta = .150, p \leq .001$), and the NEP ($\beta = .141, p \leq .01$) are also statistically significant predictors. The influence of education ($\beta = .004, p > .05$) and political ideology ($\beta = .088, p > .05$) were not significant. Seven percent ($R^2 = .071$) of the variance is explained by the model.

The OLS regression model on talking about water resource issues produced two statistically significant predictors. The stronger of the two predictors is the NEP ($\beta = .250, p \leq .001$), with age the second significant predictor ($\beta = .120, p \leq .01$). Gender ($\beta = .004, p > .05$), education ($\beta = .056, p > .05$), income ($\beta = .040, p > .05$), nor political ideology are significant predictors. The overall model explains 5% ($R^2 = .050$) of the variance.

The model explaining the impact on Oregon's water policy dependent variable produced only one statistically significant predictor. Education, defined as having "some college or more" ($\beta = .119, p \leq .01$), is statistically significant. The remaining

five variables are not significant predictors. The model explains 5% (R^2 = .045) of the variance.

Table 7. OLS Regression Estimates for Civil Society

Variables	Civil Society Variables		
	Informed about water issues Coefficient (S.E.)	Talk about water resource issues Coefficient (S.E.)	Impact on Oregon's water policy Coefficient (S.E.)
Age	.150***	.120**	-.069
	(.002)	(.002)	(.002)
Male	.169***	.004	-.034
	(.055)	(.064)	(.063)
Education	.004	.056	.119**
	(.069)	(.080)	(.079)
Income	.106**	.040	-.037
	(.055)	(.064)	(.063)
Ideology	.088	.078	-.081
	(.033)	(.039)	(.038)
NEP	.141**	.250***	.070
	(.006)	(.007)	(.007)
F-Test =	9.766	7.100	6.455
Adjusted R^2 =	.071	.050	.045
N =	691	693	693
p =	.001	.001	.001

*$p \leq .05$; **$p \leq .01$; ***$p \leq .001$;

2.8 DISCUSSION AND CONCLUSION

This purpose of this study was to examine the presence of several dimensions of civil society in Oregon related to water resources policy, as well as identify socio-

economic status (SES) and cultural predictors of these civil society variables. The findings from this study suggest that there is indeed evidence of civil society attributes in Oregon that could help make water resource management policy changes successful. For example, those who feel informed about water resources are more likely to talk about water resources, and more likely to feel they have an impact on water resources. As is consistent with previous research (Klofstad, 2010; Milner, 2002), individuals that feel informed about an issue can be important in the communication of policy relevant information to others. Being informed can lead to discussion about the issue (Dalton, 2009; Milner, 2002; Putnam, 2000), which can lead to civil engagement on influencing policy. This is further highlighted by Klofstad (2010) who, in his panel study of college students, found civic talk provided individuals with the motivation and resources (information) to participate in communal civic activities.

There are findings in this study that diverge from the literature. The first is the role of education as a predictor of civil society activities. Previous research suggests education is the strongest SES predictor civil society engagement, in particular with being informed about an issue (Delli Carpini et al., 2004; McClurg, 2003; Milner, 2002). For Oregon's public age 18 years and older, education is a statistically significant predictor for one dimension of civil society, belief in making an impact on water policy ($\beta = .119$, $p \leq .01$), and not significant predictor for being informed about water resources or talking about water resources.

The most consistent SES predictor of civil society is age. According to Dalton (2009) as age increases likelihood of engaging in communal activities decreases. This is not fully the case in this study. Of the three dimensions, it was a statistically significant predictor for two: feeling informed ($\beta = .150$, $p \leq .001$), and talking ($\beta = .120$, $p \leq .01$), about water resources. Yet, when reviewing the correlations between age and the three civil society dimensions, age was statistically significant for all three, producing positive relationships between feeling informed and talking about water resources, and producing a negative relationship with belief in having an impact on water resource policy. Thus, as age increases, belief in making an impact decreases ($r = -.107$, $p \leq .01$). It is unclear why the relationship between age and belief in making an impact is negative, while positive for the other two dimensions. Previous research found that as age increases, so does likelihood of voting (McDonald & Popkin, 2001; Milner, 2002; Putnam, 2000). However, some researchers suggest the public may view voting as having limited political impact (Dalton, 2009), as well as perceiving the government as a waste and ineffective (Ravitch & Viteritti, 2001). This suggests that as people age they may vote out of civic duty, thus engage in civil society, but feel their vote has limited political impact.

The two cultural variables used in this study were self-identified political ideology and environmental belief, as measured with the NEP. Dalton (2009) found that those affiliated with the Democratic political party are more likely to engage in civil society activities, which suggests as engagement increases political ideology

becomes more liberal. This study found that political ideology had a statistically significant relationship between one civil society dimensions, belief in making an impact on water resource policy ($r = .185$, $p \leq .01$). Yet, political ideology was not a significant predictor of any of the three civil society dimensions.

The NEP proved to be a better cultural predictor than political ideology. It was a statistically significant predictor for the civil society dimensions of being informed about water resources ($\beta = .141$, $p \leq .001$), and talking about water resources ($\beta = .250$, $p \leq .0001$). In addition, it produced statistically significant correlations among the variables talking about water resources ($r = .191$, $p \leq .01$), and belief in making an impact on water resource policy ($r = .161$, $p \leq .01$). The strength of the relationships, however, were "small" to "medium" (Cohen, 1988). One possible reason for the small relationships, and the inconsistency in the NEP's prediction ability, may be the type of civil society associations the Oregon public engages in. Perhaps, as Schuette and Ostergren (2003) found, some individuals are engaged in associations where the membership is more anthropocentric centered than bicoentric.

Findings from this study have management implications for water resource managers as they implement the IWRS. First, if they engage the public on water resource management activities, the dimensions of civil society are in place for Oregon's public to understand information on and engage in water resource activities. Yet by doing so they should understand that their efforts might only reach a subset of Oregon's population. Second, while being informed is not the same as having

knowledge, knowledge about an issue is a prerequisite for policy support (Sundblad et al., 2009). With only 22% of the Oregon public who state they feel "informed" or "very well informed" suggests there may be a knowledge gap concerning Oregon's water resources. As Engle (2012) implies from the study in Georgia and Arizona, a low level of knowledge can act as a barrier to water management implementation. Lastly, this study suggests, the traditional predictor of civil society engagement – education – does not translate to water resources in Oregon, and therefore water resource managers can not assume formal education is a predictor of engagement.

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2.10 APPENDIX

Table 8. Survey Sample Weighting

	U.S. Census		Survey Sample		
Age Category	Population Estimate	%	Survey responses	%	Weight
18 & 19	102575	3	0	0	1.00
20 to 34	793474	26	87	11	2.42
35 to 44	501136	17	106	13	1.26
45 to 54	530263	18	167	21	0.84
55 to 59	272858	9	101	13	0.72
60 to 64	256412	9	103	13	0.66
65 to 74	305988	10	135	17	0.60
75 to 84	168506	6	73	9	0.61
85 and over	78627	3	27	3	0.77

3 WATER RESOURCES KNOWLEDGE: ANALYSIS OF THE OREGON PUBLIC'S SELF-ASSESSED AND FACTUAL KNOWLEDGE

Hubbard, M.L.

3.1 INTRODUCTION

Oregon's water resources are currently at risk from various factors, including nonpoint source pollutants, and overuse (Oregon Water Resources Department [OWRD], 2010c). During the month of August most surface water is fully or over allocated (OWRD, 2010d). Groundwater areas in Oregon's have been removed from use due to depletion (OWRD, 2012). Almost 2,000 water bodies in the state are listed as "impaired" due to water quality issues (OWRD, 2012). Future projected water resource stressors include climate change and population growth (OWRD, 2012).

Recognizing that Oregon's water resources are at risk, Oregon's 75th Legislative Assembly passed House Bill 3369 for the development of a statewide, integrated water resources strategy (OWRD, 2009a). The Legislature's intent is to develop a plan to meet current and future water needs, for both instream and out-of-stream uses, such as aquatic species, irrigation, and drinking water. In August 2012, the Oregon Water Resources Department submitted the final Integrated Water Resources Strategy (IWRS) with short- and long-term recommended actions for water resources management. With implementation on the horizon, Oregon's general public may be called upon to accept and support potentially contentious management practices. Keeping in mind knowledge on water resources is insufficient to influence behavioral changes (e.g., Finger, 1994; Willis et al., 2011), a low level of knowledge can limit or create a barrier to implementation of management practices (Adger et al.,

2007; Engle, 2012). This study will explore the Oregon public's self-assessed and factual knowledge concerning Oregon's water resources, as well as the predictors of this knowledge.

3.2 BACKGROUND AND LITERATURE REVIEW

With many natural resource and environmental issues, complexity of the problem makes them especially vulnerable to myths and misconceptions (Robelia & Murphy, 2012), which can lead to a low level of public knowledge about the issue (Pierce et al., 2000). Oregon's water resources may be no different, in particular when uncertainty around climate change and population dynamics are incorporated. Yet, for several key reasons, public knowledge about a salient policy issue is a prerequisite, although not necessarily sufficient, for a policy's implementation and support (Sundblad et al., 2009). For example, Lazo and colleagues (2000) found that knowledge of the complex issue of climate change among citizens increases policy support.

Therefore it is important for water resource managers to gauge and understand the public's knowledge on Oregon's water resource in order to promote acceptance of management practices identified in the IWRS as well as to promote behavioral changes. For this study, "knowledge" refers to the level of information or facts the public believes it possesses about Oregon's water resources. Knowledge, as defined by Engel et al. (1990) is "the information stored within the memory" (p. 281). The term

"information" is defined as "an objective (mind independent) entity. It can be generated or carried by messages (words, sentences) or other products of cognizers (interpreters)" (Floridi, 2005, p. 352).

A second definition of "information" is "knowledge acquired through experiences or study" (Information, n.d., p.,n.p). According to previous research (Flynn & Goldsmith, 1999; Raju, 1995) there are two main types of knowledge: objective (factual or actual) and subjective (self-assessed or self-perceived). Subjective knowledge (self-assessed) and objective (factual) knowledge are two different things, although they are both partially the result of experience, and they have different effects on behavior (Flynn & Goldsmith, 1999). In addition, comparisons of objective knowledge and subjective knowledge have been shown to be moderately to strongly correlated (Flynn & Goldsmith, 1999). Subjective (self-assessed) knowledge is the combination of knowledge and self-confidence (Raju, 1995), with the public often focusing on personal experience as a source of their knowledge (White & Hall, 2006).

Knowledge is an important component for the public to make informed decisions, participate in the policy process, and to promote their own self-interest (Pierce et al., 1989; Pierce et al., 2009; Robelia & Murphy, 2012). According to Pierce et al. (1989) "policy-relevant knowledge refers to the information democratic publics have that will help them understand policy disputes and implications" (p. 1). Knowledge can help the public accept policies, as misconceptions about an issue can

impact the policy making process. A low level of knowledge can potentially lead to poor citizen participation in policy development and acceptance (Pierce et al., 1989). In addition, if an individual has confidence in their own (self-assessed) knowledge they may be more likely to use simple decision rules when formatting choices (Radecki & Jaccard, 1995). As people rely on assumptions, or possibly disinformation to form a policy preference, there can be potential to prefer a poor policy and management preference. And, in some cases, a low level of knowledge about an issue can even lead people to believe there is no problem, therefore that issue may not require public support or resources (Pierce et al., 2009). Though knowledge does not necessarily lead to pro-environmental behaviors or actions (Kollmuss, 2002), it does appear to be a necessary component for behavioral changes (Robelia & Murphy, 2012; Steel et al., 2005). Basically, as laid out by Janicke (1997) "without knowledge (about an issue) there is no (perceived) problem, no public awareness, and consequently no policy process" (p. 7).

The public's level of knowledge concerning environmental issues varies and can be issue specific. In their study of the National Environmental Education Foundation (NEETF) surveys, Robelia and Murphy (2012) found that Americans possess a substantial amount of knowledge about some environmental issues - including waste disposal, hazardous waste, and species extinction - yet lack knowledge on issues such as energy production, climate change, and water quality. In addition, they found that some environmental myths are still prevalent among the

United States (U.S.) public's understanding of environmental issues (Robelia & Murphy, 2012). This theme is substantiated with Salt Lake County's (2010) phone survey of residents' attitudes, knowledge, and behaviors related to water and recreation. The county found that only 13% of residents believe they live in a watershed, and only 7% were able to name the watershed they live in (Salt Lake County, 2010).

3.2.1 Predictors of Knowledge

Previous research suggests common predictors, or influencers, of knowledge are socioeconomic status (SES) (Pierce et al., 1989; Steel et al., 2005), cultural and worldview indicators (Pierce et al., 2000; Steel et al., 2005), and exposure to information sources (Culbertson & Stempel, 1986; Steel et al., 2005; Vaske, 2001).

3.2.1.1 Socioeconomic Status (SES)

Socio-economic status (SES) predictors of environmental knowledge include age, education, gender, and income. Typically, as income increases, so does the level of knowledge on environmental issues. According to Pierce et al. (1989) who studied the public's claimed knowledge about environmental issues, individuals with higher income levels have the resources required to gain knowledge, including access to education. Education, on the other hand, provides the tools necessary to process information, as well as the ability to prevent the over-simplication of an issue, and identifying false or misleading information (Pierce et al., 1989). Using the National

Environmental Education Training Foundation (NEETF) surveys on environmental knowledge, attitudes, and behavior, Robelia and Murphy (2012) found that within the limits of their study, "the most significant single factor in the level of environmental knowledge appears to be people's level of education" (p. 311).

Like education, gender is a predictor of environmental knowledge. In the NEETF surveys, females scored lower than males on environmental knowledge questions (Robelia & Murphy, 2012). In the comparative study between U.S. and Russian cities making nuclear weapons, Pierce (2000) found males were more likely to claim knowledge on environmental terms than females. More recently, in a 2009 study on renewable energy knowledge, males had a higher level of subjective (self-assessed) and objective (factual) knowledge than females (Pierce et al., 2009). Time may be closing the gap between males and females though. The survey conducted by Salt Lake County (2010) to assess the effectiveness of education and outreach efforts by the Watershed Planning and Restoration program found that females were slightly more knowledgeable than males on water issues.

Age may be a stronger predictor of environmental knowledge than gender. On policy issues as a whole, young people tend to exhibit lower levels of knowledge than the older demographic (Pierce et al., 1989; Pierce et al., 2009; Steel et al., 2005). However, with environmental policy issues, there is often an interaction effect between age and gender; young females tend to have a higher level of environmental knowledge than older females (Pierce et al., 1989; Steel et al., 2005). Generally

speaking, as measured by the NEETF surveys, males, middle-aged adults and those with college degrees are the more likely to have higher levels of environmental knowledge than females and younger adults with less than college degrees (Robelia & Murphy, 2012).

3.2.1.2 Culture and Worldview

In addition to socioeconomic status (SES), some researchers view cultural or worldview variables as strong predictors of environmental knowledge (e.g., Pierce et al., 1989; Robelia & Murphy, 2012; Steel et al., 2005), and can explain gaps in knowledge between two different groups (Kwak, 1999). Furthermore, cultural variables can exhibit independent effects from SES variables for individuals with a particular stake or motivation, whether direct or ideological, in a policy outcome (Kwak, 1999; Pierce et al., 2009). Two examples of cultural or worldview predictors of environmental knowledge are environmental belief and political ideology. Previous research on political ideology and environmental knowledge shows that ideology can influence perception a policy issue (Casey & Scott, 2006). On renewable energy knowledge, ideology was a statistically significant predictor of factual knowledge, with ideology becoming more liberal as knowledge increased (Pierce et al., 2009).

Environmental belief is a worldview that can correlate with environmental knowledge. One method to measure environmental belief is through the use of the New Environmental Paradigm (NEP) index. Developed by Dunlap and Van Liere in

1978, when major environmental issues received attention, the NEP was a worldview emerging within society that contrasted sharply with the existing Dominant Social Paradigm (DSP). Support of the DSP represents adherence to seeing nature as a resource for humans, that people should control nature, and that science and technology will resolve environmental problems (Dunlap & Van Liere, 1978). Those who are on one end of the NEP index are more biocentric, whereas those who are on the other end are anthropocentric.

A study assessing environmental knowledge in both the U.S. and Japan found a weak to moderate relationship between knowledge and environmental belief in both the two countries (Pierce et al., 1989). This is substantiated by Pierce and collogues (2009) in their study on renewable energy, which found a weak, positive relationship between the NEP and objective (factual) and subjective (self-assessed) knowledge (Pierce et al., 2009). Steel et al. (2005) in their study on the Oregon public's knowledge concerning ocean fisheries found the NEP was a statistically significant predictor of both objective (factual) and subjective (self-assessed) knowledge. Yet there is a question as to whether those with a biocentric policy preference have a stronger motivation to aquire information and thus become more knowledgable, or do those with a higher level of knowledge move toward being more biocentric? This further leads to the question as to where individuals gain their policy-relevant water information.

3.2.1.3 Information Sources

Past research suggests that the public uses various information sources to gain environmental information (e.g., Steel et al., 2005; Robelia & Murphy, 2012). The general idea is that increased media coverage will lead to the desired depth and breadth of public understanding and knowledge (Culbertson & Stempel, 1986; Kollmuss, 2002; Kwak, 1999; Robelia & Murphy, 2012). Yet, there is a difference between commonly used information sources, and effective information sources. An information source may be utilized a great deal, but not lead to increased knowledge levels, while another source may be used little and increase issue knowledge.

Using the NEETF surveys, Robelia and Murphy (2012) found that nationwide adults most often used mass media to acquire environmental information. In their comparative study of U.S. and Russian cities that produced nuclear weapons, Pierce, Lovrich & Dalton (2000) found residents in the U.S. cities had a higher claimed level of knowledge on nuclear production than residents in the Russian cities, and theorize this is due to the relative freedom in the flow of communication.

Although television (TV) is the most used media source of environmental knowledge (Sundblad et al., 2009), its use can lead to conflicting results. In their study evaluating use and reliance on knowledge, Culbertson and Stempel (1986) found that focused TV use (using it to gain information on a certain topic) lead to higher political knowledge than just general TV use. Other studies found that although TV may be the

most frequent source of information about the environment, there may be a negative relationship between TV use and environmental knowledge, which is associated with increased ideological programming (Pierce et al., 2009). In a study evaluating knowledge and support for renewable energy policy, researchers found a negative correlation between both subjective (self-assessed) and objective (factual) knowledge and TV use (Pierce et al., 2009): as TV use increased, self-assessed (subjective) and factual (objective) knowledge on renewable energy decreased. In the study concerning ocean fisheries knowledge, there was a negative relationship between TV use and objective (self-assessed) and objective (factual) knowledge; as TV use increased, knowledge concerning ocean fisheries decreased (Steel et al., 2005).

In contrast, research shows that those who frequently read newspapers are more likely to have a greater level of environmental knowledge than those who do not read as frequently (Pierce et al., 2009). On political knowledge as a whole, Culbertson and Stemple (1986) found that both focused and general newspaper use increased political knowledge. This could be due to a reciprocal relationship – the more knowledgeable the individual, the more likely the individual will read newspapers on environmental issues. Radio as an information source, on the other hand, produces weak correlations. In the study on knowledge and renewable energy, use of radio produced a positive correlation on subjective knowledge, but a negative correlation on objective knowledge (Pierce et al., 2009); as radio use increased, factual (objective) knowledge decreased and self-assessed (subjective) knowledge increased.

The use of information dissemination by a governmental agency and nongovernmental organization can influence environmental knowledge. In a study examining hunters' and non-hunters' information sources and knowledge about chronic wasting disease[1] (CWD), Vaske et al., (2009) found that many traditional sources (e.g., radio, TV) were ineffective at improving Wisconsin hunters' knowledge on CWD. While the effective sources at improving knowledge were the Department of Natural Resources (WDNR) website and secretary column, and local newspapers. Steel et al., (2005) found that the use of the organization Sea Grant's material was a strong predictor of self-assessed (subjective) knowledge and factual (objective) knowledge concerning ocean fisheries, yet only a small portion of the study population used the Sea Grant material.

More recently, the use of the Internet as an information source is growing with the U.S. public. Individuals seeking knowledge can use the Internet, or if using the Internet makes individuals have a higher self-assessed level of knowledge. Steel et al. (2005) found that the use of the Internet was a statistically significant predictor of self-assessed knowledge, but it was not a significant predictor of factual knowledge. On renewable energy knowledge, Pierce et al. (2009) did not find the Internet to be a statistically significant predictor of either self-assessed or factual knowledge.

1. Disease of deer (Odocoileus spp.), elk (Cervus *ela- phus),* and moose (Alces *alces)* that has been found in free-ranging herds in 11 states (Vaske et al., 2006).

3.2.1.4 Policy Issue Interest

Individuals with a high level of knowledge may be those who seek a certain policy outcome (Steel et al., 1990) when compared to those who do not have an interest in the policy issue (Raju, 1995). Radecki and Iaccard's (1995) research on perceived (self-assessed) knowledge found that the more important a topic is to an individual, the more likely it is they will view themselves as knowledgeable about the topic area. Kwak (1999), who reviewed existing research on gaps in policy knowledge, found that a person's degree of concern, issue interest, and issue involvement be strongly related to knowledge acquisition. Therefore, an individual or expert with a stake in water resources management may have a stronger motivation to learn about Oregon's IWRS and thus a higher level of water resource knowledge, than those without a stake.

This study will explore the area of water resources in Oregon and the level of self-assessed knowledge among Oregon's general public age 18 years and older. Furthermore, it will use a water resource knowledge question to evaluate factual knowledge. Another aspect of the study will examine the predictors of self-assessed and factual knowledge. Based on the literature, the following hypotheses will be tested:

> H_1: Oregonians with some college or more will have a higher level of self-assessed knowledge than those with no college.
>
> H_2: Oregonians who earn $50,000 or more a year will have a higher level of self-assessed knowledge than those who make less than $50,000 a year.

H_3: Females are more likely to have higher levels of self-assessed knowledge when compared to males on water resource issues.

H_4: Use of television, Internet and radio for information will not be statistically significant predictors of self-assessed or factual knowledge.

H_5: Use of watershed councils, and OWRD will be statistically significant predictors of self-assessed knowledge.

H_6: The use of local newspapers and the Oregonian will be statistically significant predictors of self-assessed knowledge.

H_7: Oregonians with biocentric orientations will have higher levels of knowledge when compared to those with anthropocentric orientations.

3.3 METHODS

Data utilized in this study are collected from a questionnaire developed to assess the Oregon public's level of knowledge, and beliefs on water resources. The questionnaire was developed from information collected though stakeholder interviews conducted for the Oregon Water Resources Department (OWRD) and existing research. The questionnaire included three sections: (a) self-assessed level of knowledge and perception of risk; (b) level of environmental belief; and (c) socio-economic information.

The mail questionnaire was distributed to the Oregon public by mail via the U.S. Postal Service in the spring of 2010. Distribution used the Dillman (1978) Total Design Method where three waves were mailed to the households. The first wave consisted of a post-card informing the household to expect the questionnaire, and its purpose. Wave two included the questionnaire, a letter informing respondents the nature of the questionnaire as well as the ability to refuse participation, and a business

reply mailer with postage. Wave three included a reminder letter, with the same items included in the second wave. The second and third waves instructed the household to have a member age 18 years and older to fill out the questionnaire.

The questionnaire was sent to 2,000 randomly selected households, with 1,563 going to valid addresses. A private sampling company provided the sample with names and addresses. After accounting for an estimated 30% bad addresses and a potential 30% response rate, it was expected the original sample size of 2,000 would provide 400 valid responses, leading to a 95% confidence level and 5% confidence interval. With the 437 bad addresses and 799 completed surveys there was a final response rate of 51%. This provided a 95 percent confidence level and a 4% confidence interval of the results.

3.4 RESEARCH LOCATION

The state of Oregon is the focus of this research. As of July 1, 2011 Oregon had a population of 3,857,625 (Population Research Center, 2012), with 69% occupying only 1% of the landmass (U.S. Census, 2011). Long-term projections have Oregon's population growing to almost 5.5 million by 2040, or a 132% increase from 2010 (Albrecht, 2008). Among many infrastructure concerns, the projected population growth will exceed current water supplies (Office of Economic Analysis, 2004).

The Willamette Valley, where about two-thirds of Oregon's public resides, receives between 100 to 355 centimeters of rain a year. In contrast, sparsely populated

eastern Oregon receives only 25 to 51 centimeters a year (Climate Impacts Group, 2010a). Throughout the state the average annual rainfall varies from less than 20 centimeters in the drier Plateau Regions to more than 500 centimeters at points along the upper west slopes of the Coast Range (Bastasch, 2006). The majority of precipitation falls during the winter months, much of it in the form of snow in the Cascade and other mountain ranges, which act as Oregon's largest water storage facility. This snow pack plays a key role in the water supply, especially in determining the timing and amount of stream flow throughout the state (Mote, 2006).

A changing climate in the Pacific Northwest likely will reduce the amount of precipitation in the form of snow, affecting Oregon's snow pack and thereby water availability during the summer months (Nolin & Daly, 2006). According to climate models, the Pacific Northwest region is expected to warm about 0.5°F every 10 years for the next few decades (Nolin & Daly, 2006). Climate models project that, averaged across the region, annual temperatures will be 1.9ºF higher by the 2020s when compared with the 1970-1999 average, and 2.9ºF higher by the 2040s (Western Regional Climate Center, 2013). These figures are averages, with the full projections spanning a range of 0.7ºF to 3.2ºF for the 2020s and 1.4ºF to 4.6ºF for the 2040s (Western Regional Climate Center, 2013).

If Oregon loses its snow pack storage capacity, it may face an increasing water supply shortage in the summer months as demand increases from population growth, agriculture and other water uses. Even as these challenges mount, Oregon, at the time

of this study, was one of two western states without a formal water management strategy, as well as one of many without an integrated strategy that takes into account water quantity, water quality, and ecosystem services.

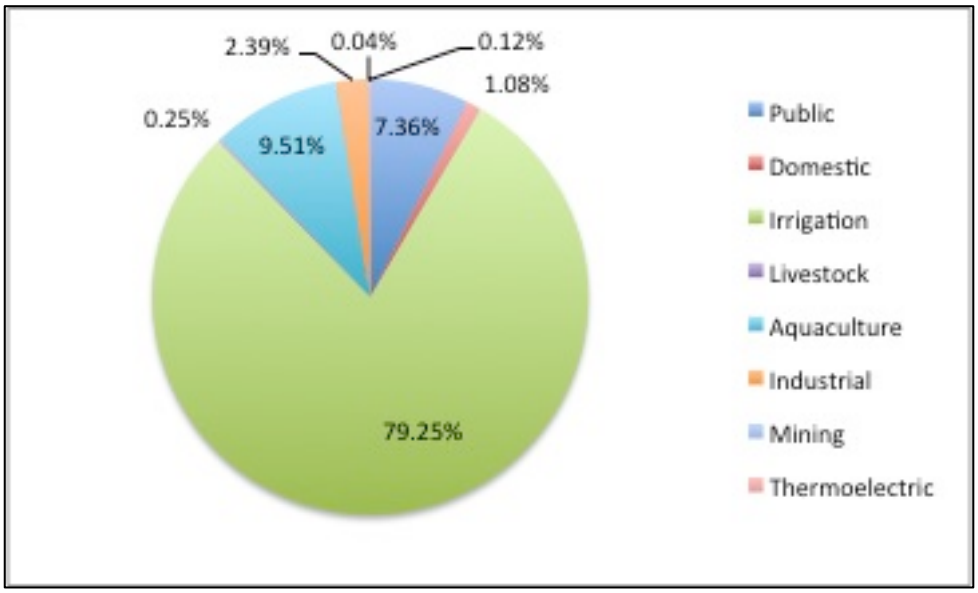
The State of Oregon manages its water through the Oregon Water Code that was enacted on February 24, 1909 (Oregon Water Resources Department, 2009a). Though officially a hybrid system with the Riparian Doctrine[1], the water code is predominantly based on the Prior Appropriation Doctrine (Oregon Water Resources Department, 2010a, 2010b), also commonly called the "First in Time, First in Right" doctrine. To provide certainty of water availability as an incentive to early settlers, the best water rights were awarded to those who used it first. If water is available, these "senior" water right holders are allocated their full water allotment, whereas "junior" water right holders must wait and see if there is enough water for them. Like many western states settled with the Prior Appropriation Doctrine, the majority of senior water rights are used for agriculture. Figure 1 shows that 79% of Oregon's water is currently used for agriculture and irrigation (U.S. Geological Survey, 2009). In addition, aquaculture[2] uses 10% of Oregon's freshwater (U.S. Geological Survey,

1. Under the riparian doctrine, a landowner whose property adjoins a water body has the right to make use of the water for a beneficial use as long as that use does not harm downstream users.

2. Water use associated with the farming of organisms that live in water (such as finfish and shellfish) and off stream water use associated with fish hatcheries.

2009). Meanwhile, domestic[1] water use accounts for a little over 1% (U.S. Geological Survey, 2009) of freshwater use.

Figure 1. Oregon Fresh Water Use 2005



Source: U.S. Geological Survey, 2009

3.5 ANALYSIS AND RESULTS

The survey respondents' basic characteristics are presented in Table 1 along with Oregon's 2011 population estimates of those 18 years and older. Keeping in mind the survey only went to respondents age 18 years and older, a demographic characteristic that may have a potential bias is age. At a mean of 56 years, the survey

1. Water used for indoor household purposes such as drinking, food preparation, bathing, washing clothes and dishes, flushing toilets, and outdoor purposes such as watering lawns and gardens. Domestic water use includes water provided to households by a public water supply (domestic deliveries) and self-supplied water.

population is six years older on average than Oregon's 18 years and older population of 50 (U.S. Census, 2011). To compensate for the bias the survey data are weighted by age with the U.S. Census Bureau (2011) Community Data (Table 9 in appendix). There were no survey responses in the 18-19 age category, and only eight responses in the 20-24 age category. Therefore, the 20-24 and 25-34 age categories were collapsed into a 20 – 34 age category.

Table 1. Survey Response Bias

Demographic Variable	Survey Response Bias	Census Estimates (2010) [1]
Mean Age (Over 18)	56	50
Median Household Income	$50,000 - $74,999 (survey category)	$49,260 (2006 – 2010 adjusted average)
Gender (over 18)	50% Male, 50% Female	49% Male, 51% Female
Some College or Higher (over 25)	79%	64%

1. Source: U.S. Census. (2011). *2010 Census Demographic Profile Summary File*. Retrieved from http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=DEC_10_DP_DPDP1.

3.5.1 Knowledge on Water Issues

The goal of this study is to assess Oregon public's level of knowledge on Oregon's water resources. For this study, "water resource knowledge is the level of self-assessed and factual knowledge concerning Oregon's water quantity and quality."

In order to measure the Oregon public's level of self-assessed knowledge on water resources an additive index was created. Respondents were asked to rate their own knowledge on 13 water terms - six policy and seven technical (Table 2). The 13 terms were selected from interviews with OWRD and previous research on water resources. The items ranged from common water resource terms, including "watershed" to very technical terms, such as "hyporheic flow." The survey prompted respondents to "indicate if you know what the term means; have heard of the term but do not know its meaning; or have not heard of the term at all." The 13 knowledge variables were recoded into dummy variables of either 1 = "know the term" and 0 = "do not know the term" (don't know the meaning and have not heard of the term). The 13 dummy variables were then combined into a single additive index, ranging from 0 to 13, with 13 being a high level of self-assessed knowledge on water resources and 0 being the lowest. The Oregon public on average were familiar with about 5 terms (mean = 5.38) (see Table 2).

The frequency distributions for the Oregon public's self-assessed water resources knowledge level on the 13 terms are displayed in Table 2. The majority of the public (50% or more) indicate they know five of the 13 terms. A high percentage of the public assess themselves as knowing the terms "watershed" and "water right," whereas the term "Prior Appropriation Doctrine" has the lowest percentage at 9%. It should be noted that 20% of the public know the term "nonpoint source pollution."

Table 2. Familiarity with Water Resource Terms

Term	(%)	Mean / (SD)
Water Resource Term[1]		
Watershed	83 *n*= 769	
Water right	71 *n*= 768	
Clean Water Act	61 *n*= 760	
Greywater	60 *n*= 766	
Snow water equivalent	53 *n*= 766	
Safe Drinking Water Act	49 *n*= 766	
Aquifer storage and recovery	47 *n*= 762	
Catchment	29 *n*= 763	
Evapotranspiration	27 *n*= 766	
Exempt well	23 *n*= 760	
Nonpoint Source Pollution	19 *n*= 760	
Hyporheic flow	10 *n*= 761	
Prior Appropriation Doctrine	9 *n*= 761	
Self-Assessed Knowledge Index[2]		5.38 / (3.19) *n* = 736

1. For the following terms, respondents were asked to indicate if they: 1 = know what the term means; 2 = have heard of the term, but don't know it's meaning; or 3 = have not heard of the term at all. Results show the percentages of those who "know what the term means."
2. Variable coded on a 13 -point scale from "no knowledge" (0) to "high knowledge" (13).

To assess factual water resources knowledge, the questionnaire asked respondents, "In your opinion, what sector uses the most water in the state of Oregon?" and provided six options: municipal (drinking water, lawn watering, etc…); agriculture/irrigation; industry; energy production; fish and wildlife; and other. The responses were recoded into a dummy variable, where 1 = know the correct answer, and 0 = do not know the correct answer. The frequency results, as displayed in Table 3, show that 29% of the public knew that agriculture uses the most water. At 38% the majority of the respondents selected stated municipal as the largest use of Oregon's water.

Table 3. Public Factual Water Knowledge[1]

Water Use	(%)
Municipal	38
Agriculture - Irrigation	29
Industry	19
Energy Production	10
Fish and Wildlife	2
Other	1
n	752

1. Respondents were asked "In your opinion, what sector uses the most water in the state of Oregon?" Results show percentages.

3.5.2 Factors Affecting Water Knowledge

Three groups of independent variables used as predictors of self-assessed and factual knowledge are SES, cultural, and information sources (Tables 4a and 4b). The five SES variables are age, income, education, gender and an age/gender interaction. Gender was recoded into a dummy variable, where 1 = "male" and 0 = "female." Income was collapsed into a dummy variable where 1 = "households that make $50,000 or more a year" and 0 = "households that make less than $50,000 a year." Education was collapsed to create a dummy variable where 1 = "some college or more" and 0 = "vocational school, high school diploma and less." The frequency analyses show the respondents are 46% male, with 80% or more having some college or more, and 55% making $50,000 or more a year.

Cultural variables include self-identified political ideology and the New Environmental Paradigm (NEP) index. To measure political ideology, respondents were asked on domestic policy issues what they consider themselves to be and provided with a range of one "very liberal" to five "very conservative." For the analysis this was reverse coded so 1 = "very conservative and 5 = "very liberal." The NEP is an additive index created from six selected variables. Participants were asked whether or not they agreed or disagreed with six statements, three anthropocentric and three biocentric, related to the environment. They were provided with options ranging from one through five, with 1 = "strongly disagree" and 5 = "strongly agree." The three anthropocentric variables ("Humans have the right to modify the natural

environment to suit their needs," "The so-called 'ecological crisis' facing humankind has been greatly exaggerated," and "Humans were meant to rule over the rest of nature") were reverse coded to ensure the direction of the responses corresponded with the other items in the index. The six variables were compiled into an additive index ranging from six through 30. Those with a composite of six are deemed to be in full support of the Dominant Social Paradigm, or anthropocentric, while those with a composite of 30 are deemed to be in full support of the New Environmental Paradigm, or biocentric. With all six variables included the overall reliability of the NEP index was reliable with Cronbach's alpha of 0.78 (Table 5). The frequencies show that for political ideology on average the Oregon public 18-years and older assess themselves as "moderate" (mean = 3.09), while on average they are more biocentric than anthropocentric (mean = 22.49).

The information sources consists of 12 items where respondents were asked in the questionnaire the frequency of use for each of the 12 information sources. They were provided a range from 1 = "never" to 4 = "very frequently." TV was the most used source with the public using it "frequently" (mean = 2.60), followed by OPB (mean = 2.53). Watershed councils were used the least at "never" to "infrequently" (mean = 1.49), with elected officials second to last (mean = 1.61).

Table 4a. Predictors of Water Knowledge

Variable Name	Variable Description	Mean (SD)
Age	Respondents Age In years	48.9 (16.75) *n* = 772
Gender	Dummy variable for gender (0=female; 1=male)	.465 *n* = 768
GenAge	Gender age interaction variable	23.75 (27.65) *n*=768
Educ	Formal educational attainment (0 – grade school through vocational school; 1 -some college or more)	.801 *n* =770
Income	Household income (before taxes) in 2009 (0 = Less than $50,000; 1 - $50,000 or more)	.548 (2.18) 738
NEP	New Environmental Paradigm index (6=low support for environmental protection to 30=high support for environmental protection)	22.49 (5.30) *n* =754
Ideol	Self-identified political ideological orientation (1 = very conservative to 5 = very liberal)	3.09 (.983) *n* =740
TV	Frequency of use of television for information about Oregon water (1 = never to 4 = Very frequently)	2.60 (.895) *n* = 763
OPB	Frequency of use of Oregon Public Broadcasting for information about Oregon water (1 = never to 4 = Very frequently)	2.53 (.996) *n* =766
Radio	Frequency of use of radio for information about Oregon water (1 = never to 4 = Very frequently)	2.12 (.940) n=756

Table 4b. Predictors of Water Knowledge (cont.)

Variable Name	Variable Description	Mean (SD)
Oregon	Frequency of use of the Oregonian for information about Oregon water (1 = never to 4 = Very frequently)	2.02 (1.005) *n*=762
News	Frequency of use of local newspapers for information about Oregon water (1 = never to 4 = Very frequently)	2.23 (.980) *n* = 759
Water	Frequency of use of watershed councils for information about Oregon water (1 = never to 4 = Very frequently)	1.49 (.718) *n*=755
Elected	Frequency of use of elected officials for information about Oregon water (1 = never to 4 = Very frequently)	1.61 (.758) *n*=757
Rec	Frequency of use of recreation groups for information about Oregon water (1 = never to 4 = Very frequently)	1.81 (.846) *n* =757
Academ	Frequency of use of universities and colleges for information about Oregon water (1 = never to 4 = Very frequently)	1.88 (.903) *n*=758
OWRD	Frequency of use of Oregon Water Resources Department for information about Oregon water (1 = never to 4 = Very frequently)	1.80 (.840) *n*=752
Environ	Frequency of use of environmental groups for information about Oregon water (1 = never to 4 = Very frequently)	2.03 (.9108) *n* =760
Internet	Frequency of use of the Internet for information about Oregon water (1 = never to 4 = Very frequently)	2.39 (.957) *n* = 758

Table 5. NEP Reliability Analysis[3]

	Means	Standard Deviation	Item Total Correlation	Alpha if Item Deleted	Cronbach Alpha
New Environmental Paradigm Index					.78
The balance of nature is very delicate and easily upset by human activities[1]	3.98	1.12	.53	.74	
Humans have the right to modify the natural environment to suit their needs[2]	3.47	1.21	.43	.76	
We are approaching the limit of people the earth can support[1]	3.51	1.34	.51	.74	
The so-called "ecological crisis" facing humankind has been greatly exaggerated[2]	3.55	1.39	.59	.72	
Plants and animals have as much right as humans to exist[1]	4.02	1.25	.53	.74	
Humans were meant to rule over the rest of nature[2]	3.71	1.41	.54	.74	

1. Variables coded on a 5-point scale from "Strongly Disagree" (1) to "Strongly Agree" (5).
2. Variables coded on a 5-point scale from "Strongly Agree" (1) to "Strongly Disagree" (5).
3. $n = 753$

3.5.3 Bivariate Analysis

An analysis of variance (ANOVA) was used to test hypotheses one through four (Table 6) on the dependent variable of self-assessed knowledge. All three independent variables were statistically significant. The public with "some college or more" (mean = 5.57, $p < .001$) had a higher level of self-assessed knowledge than those with vocational school and less education (mean = 4.57). This supports hypothesis 1. The second hypothesis also was supported as the public who makes $50,000 or more a year (mean = 5.86, $p < .001$) self-assessed their knowledge higher than those who make less than $50,000 a year (mean = 4.73). The results do not substantiate the third hypothesis; females' self-assessed knowledge (mean = 4.84, $p < .001$) was lower than the males (mean = 6.03).

Table 6. Self-Assessed Knowledge by Demographic Variables

	Sample		Dependent Variable: Self-assessed knowledge index[1]			
Demographics	*n*	%	Mean	Standard deviation	*F*-value	*p*-value
Gender[2]					26.40	< .001
Male	341	47	6.03	3.09		
Female	392	53	4.84	3.18		
Education[2]					11.30	< .001
≥ Some college or more	593	81	5.57	3.17		
≤ High school diploma or vocational school	141	19	4.57	3.16		
Income[2]					22.43	< .001
< $50,000	309	44	4.73	3.05		
≥ $50,000	397	56	5.86	3.21		

1. Variable coded on a 13 -point scale from "no knowledge " to (1) to "high knowledge" (13).

2. For the bivariate analyses, this predictor variable was recoded into a dummy variable.

A series of four OLS regression models were used to evaluate the ability of the independent variables to predict the self-assessed level of knowledge (Table 7). Self-assessed knowledge is measured with an index ranging from 0 = no knowledge to 13 = high knowledge. The first step involved running three individual OLS regression models to determine statistically significant variables for inclusion into a full model. Model one included four SES variables as well as the age/gender interaction variable. Of the five variables income, education, and age were statistically significant and included in the full model. The second model used the cultural variables NEP and political ideology, which were not statistically significant and therefore not included in

the full model; this does not support hypothesis 7. The last model examined the 12 information sources. Of the 12 TV, OPB, watershed councils, elected officials and OWRD were statistically significant and included in the full model. Hypothesis 6 is not substantiated; use of local newspapers and the Oregonian were not statistically significant.

The full model had eight independent variables, three SES and five information sources. Age ($\beta = .129$, $p \leq .001$) and income ($\beta = .120$, $p \leq .001$) were statistically significant predictors of self-assessed knowledge; as age and income increased, self-assessed knowledge increased. TV use was a statistically significant predictor of knowledge ($\beta = -.127$, $p \leq .001$) but had a negative relationship; as TV use increased, level of self-assessed knowledge decreased. While radio and Internet were not significant predictors, TV was and therefore does not support hypothesis 4. Both watershed councils ($\beta = .276$, $p \leq .001$), and OWRD ($\beta = .128$, $p \leq .01$) were statistically significant predictors; as use of watershed councils and OWRD increased, self-assessed knowledge increased. This substantiates hypothesis 5. Use of elected officials ($\beta = .109$, $p \leq .01$), and OPB ($\beta = .194$, $p \leq .001$), also were statistically significant predictors in the full model. The full model explained 32% ($R^2 = .316$) of the variation in self-assessed knowledge.

Table 7. OLS Regression Estimates on Self-Assessed Knowledge

	Self-Assessed Knowledge[1]			
Variables	Model 1 Coefficient/ (S.E.)	Model 2 Coefficient/ (S.E.)	Model 3 Coefficient/ (S.E.)	Full Model Coefficient/ (S.E.)
Age	.170***/(.010)			.129***/(.007)
Gender	.205/(.770)			
Educ	.120**/(.308)			.027/(.272)
AgeGen	-.070/(.015)			
Income	.117**/(.055)			.120***/(.211)
Ideol		-.035/(.152)		
NEP		.046/(.028)		
TV			-.108**/(.121)	-.127***/(.121)
OPB			.171***/(.119)	.194***/(.110)
Radio			.047/(.120)	
Oregon			.019/(.106)	
News			.040/(110)	
Water			.213***/(.191)	.276***/(.178)
Elected			.087*/(.165)	.109**/(.154)
Rec			.069/(.161)	
Academ			.027/(.149)	
OWRD			.152***/(.166)	.128**/(.154)
Environ			,061/(.138)	
Internet			-.030/(.115)	
F-Test	13.474	1.817	24.801	38.915
R^2	.088	.005	.303	.316
n	702	692	699	682

1. Self-assessed knowledge ranges from 0 = no knowledge to 13 = high knowledge.

*$p \leq .05$; **$p \leq .01$; ***$p \leq .001$

Table 8 shows the results from the logistic regressions with factual knowledge on water use as the dependent variable. Factual knowledge is a coded as a dummy variable, with 0 = do not know the right answer, and 1 = know the correct answer that agriculture is the largest user of water. A series of four logistic regression models were used to evaluate the ability of the independent variables to predict the factual knowledge with the statistically significant variables from the first three models included into the full model. Neither of the SES variables were significant predictors and therefore were not included in the full model. The two cultural variables were also not significant and therefore not included in the full model. Of the 12 information sources the statistically significant variables included in the full model were TV, OPB, Internet, and environmental groups. In the full model the use of TV and Internet were statistically significant predictors of factual knowledge; as use of these sources increased, the less likely the respondents were to know the largest use of Oregon's water. The use of OPB as an information source was also a statistically significant variable; as use of OPB increased, the more likely respondents were to know the largest use of Oregon's water. The Nagelkerke R^2 for the full model was .054, which indicates the model does not explain most of the variation.

Table 8. Logistic Regression Estimates of Factual Water Knowledge

Variable	Factual Knowledge[1]			
	Model 1 Coefficient (S.E.)/ Exp(B)	Model 2 Coefficient (S.E.)/ Exp(B)	Model 3 Coefficient (S.E.)/ Exp(B)	Full Model Coefficient (S.E.)/ Exp(B)
Age	.013 (.007)/1.013			
Gender	.137 (.550)/1.147			
Educ	.254 (.224)/1.289			
Age/Gen	.005 (.010)/1.005			
Income	.224 (.182)/1.251			
Ideol		-.302 (.106)/.739		
NEP		.014 (.020)/.986		
TV			-.328*** (.103)/.720	-.289** (.097)/.749
OPB			.322*** (.100)/1.380	.347*** (.092)/1.415
Radio			.067 (.100)/1.070	
Oregon			.120/(.087) 1.128	
News			.129 (092)/1.137	
Water			.036 (.158)/1.037	
Elected			.246 (.141)/1.279	
Rec			-.084 (.135)/.920	
Academ			.085 (.125)/1.089	
OWRD			-.183/(.142) .833	

Environ			,051** (.114)/1.052	.073 (.090)/.773
Internet			-.272** (.098)/.762	-.258** (.090)/.773
Chi-square	9.26	18.38	41.72	28.45
Nagelkerke R^2	.035	.020	.081	.054
n	716	730	722	753

1. Factual knowledge coded with 1 = knows the biggest of Oregon's water, and 0 = does not know the biggest use of Oregon's water.

*$p \leq .05$; **$p \leq .01$; ***$p \leq .001$

3.6 DISCUSSION AND CONCLUSION

The purpose of this study was to assess the Oregon public's self-assessed and factual knowledge on water resources, as well as the predictors of that knowledge Overall, in reviewing the individual self-assessed knowledge terms, there were only five terms where at least half of the respondents said they "know" – two policy and three scientific. And, there is only one term where 75% or more of Oregon's public "knows" – "Watershed." At just 19% a term little of the Oregon public knows is "nonpoint source pollution." The general public, particularly in urban areas, is considered a key source of nonpoint source pollution and often targeted by water resource managers for water quality enhancement options, such as Household Hazardous Waste (HHW) collection events and storm water protection. Yet, relatively few Oregonians know what the term means. Although one could hope this is due to a lack of knowledge about the term itself and the residents are aware of individual

nonpoint source activities, previous research in Oregon posited this might not be the case. In their study of residents in the Tualatin Oregon watershed, researchers found little awareness by respondents about how their own personal behaviors may impact and pollute water quality (Davis, Hibbitts & McCaig, 2002).

One area to note is the placement of the terms "water right" and "Prior Appropriation Doctrine" among the 13 terms. The term "water right" was the second most known term at 71%, whereas "Prior Appropriation Doctrine" was the least known at 9%. In fact, fewer respondents know the term "Prior Appropriation Doctrine" than the scientific term "hyporheic flow." The discrepancy between the two terms is interesting as the two are linked; the basic tenant of the Prior Appropriation Doctrine is the water right. The Prior Appropriation Doctrine is the foundation of Oregon water law; it dictates how, where, when, and how much water is used. Yet, the self-assessed knowledge on the term is low, which leads to the question of whether the self-assessed knowledge on the Prior Appropriation Doctrine is low as respondents don't really understand what the term means or do people know the general idea around the Prior Appropriation Doctrine and simply do not recognize the term?

The results of the SES variables against the self-assessed knowledge was consistent with the literature. Those with some college or more, as well as those who make $50,000 or more were more knowledgeable. The literature has demonstrated that males traditionally score higher on environmental knowledge than females (Pierce, 2000; Robelia & Murphy, 2012). However, studies have identified an interaction

effect, with younger females having a higher level of environmental knowledge than older males (Steel et al., 2005), and where females scored higher (Salt Lake County, 2010). This study predicted in the case of Oregon's water resources knowledge, females would have a higher level of knowledge, but results showed that males assess themselves as having a higher level of knowledge.

Evaluating the influence of information sources on self-assessed knowledge suggests the sources used the most often are not necessarily the most effective. TV is the most used source for water resources information (mean = 2.60), yet its produces a statistically negative relationship with self-assessed knowledge, and factual knowledge. This is consistent with the findings on general knowledge found by Culbertson and Stempel (1986) as well as environmental knowledge (Pierce et al., 2009). In contrast, OPB was the second most used information sources (mean = 2.53) and had a positive relationship for both self-assessed and factual knowledge. The most effective sources of self-assessed knowledge are OPB, watershed councils, elected officials and the OWRD. Yet, on average these sources are used anywhere between "never" to "infrequently." For example, the use of watershed councils is only between "never" to "infrequently" (mean = 1.49) used, but produces a statistically significant relationship with self-assessed knowledge. This indicates that, with the exception of OPB, the most *effective* used sources of information are also some of the least *utilized* information sources.

Then there is the question as the influence of the predictors, or background variables, on water resource factual and self-assessed knowledge. According to previous research, typically males, middle-aged adults and those with college degrees are more likely to have higher levels of environmental knowledge (Robelia & Murphy, 2012) than females, younger adults, and those without a college degree. This study found that in regard to self-assessed water knowledge in Oregon, of the socio-economic status (age, gender, income, education, age/gender interaction) variables only age and income were statistically significant predictors. The fact education was not a significant predictor of self-assessed knowledge is interesting in that previous research (e.g., Robelia & Murphy, 2012; Steel et al., 2005) found it to be a consistent significant predictor of environmental knowledge. Furthermore, the gender and age/gender variables were not significant, which is also counter to previous research (e.g., Robelia & Murphy, 2012; Steel et al., 2005). This leads to the question of culture's effect on water resource knowledge, specifically environmental belief.

Previous research has demonstrated that issue knowledge is higher with those who have a stake in the issue (Pierce et al., 2009), or motivation to learn about the issue (Kwak, 1999). Radecki and Iaccard (1995) found that the more important a topic is to an individual the more likely it is they will view themselves as knowledgeable about the topic area. Oregon water resources has made international news (BBC News, 2004), and led to environmental conflict, such as the 2001 Klamath Water War, or the push for removal of the Snake River Dams. As such, one may

assume there is a relationship between water resource knowledge and environmental beliefs. The results from this study demonstrate that environmental belief was not a statistically significant predictor of self-assessed or factual knowledge. This leads to the question as to why? While conjecture, is it possible that water resources alone is not an environmental issue, but only in the context of another issue, such as endangered fish species?

These findings have implications for water resource management and for future research. First, from this author's perspective, the overall knowledge is low for the Oregon public, which as Engle (2012) suggests can act as a barrier in implementing water management practices. For example, most of Oregon's public, 38% in fact, believe that the majority of Oregon's water is used for domestic use, when it is only 1% and agriculture accounts for 80%. While this belief may assist water resource managers in promoting water conservation by the general public, it may lead to low public support if water conservation management practices are directed at agriculture. A second implication is the low level of knowledge on the term "nonpoint source pollution;" does this finding imply that the public really does not know what nonpoint source pollution activities (i.e., changing oil in the street, flushing pharmaceuticals in the toilet) are, or do they know the concept and simply not the term associated with it? Third, by understanding the influence of commonly used and effective information sources on water resource knowledge may assist water resource managers educate the public on IWRS management practice. The results show that the

most used information source (TV) does not lead to an increased knowledge, while the most effective sources (OWRD, watershed councils) are infrequently used. The one exception is OPB, which is the second most used source, and had a positive impact on knowledge.

This study produced some interesting findings, but also raises questions for future research. Some questions are due to the study's limitations, whereas others are in response to the study's findings. Within this study there is a question as to whether there is a lack of knowledge on a term and what the term means, or if respondents know the term's concept and simply do not recognize it by name. For example, do people know the concept of "First in Time, First in Right" but not know the name behind it – "Prior Appropriation Doctrine?" To address this, a future study into the self-assessed and factual levels of knowledge should include a more substantial water resources management quiz (e.g., true / false questions) to help assess factual knowledge. Lastly, a study should explore the cultural aspect of water; the results suggest that when viewed alone and out of context of other issues, water is not an environmental issue.

3.7 APPENDIX

Table 9. Survey Sample Weighting

	U.S. Census		Survey Sample		
Age Category	Population Estimate	%	Survey responses	%	Weight
18 & 19	102575	3	0	0	1.00
20 to 34	793474	26	87	11	2.42
35 to 44	501136	17	106	13	1.26
45 to 54	530263	18	167	21	0.84
55 to 59	272858	9	101	13	0.72
60 to 64	256412	9	103	13	0.66
65 to 74	305988	10	135	17	0.60
75 to 84	168506	6	73	9	0.61
85 and over	78627	3	27	3	0.77

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4 RISK PERCEPTIONS CONCERNING OREGON'S WATER RESOURCES: AN ANALYSIS OF OREGON'S GENERAL PUBLIC

Hubbard, M.L.

4.1 INTRODUCTION

The state of Oregon has water resource challenges. According to an Oregon Water Resources Department (OWRD) 2001 report:

> Put very simply, there is not enough water where it is needed, when it is needed, to satisfy both existing and future water users. The situation jeopardizes the high level of livability that Oregonians enjoy. It seriously limits the ability of Oregon's economy to grow, and threatens existing users' water supplies and the sustainability of the natural systems on which our economy relies (p.6).

In addition to water scarcity and availability, Oregon's water quantity is at risk with thousands of stream kilometers and numerous lakes listed as "impaired" (Oregon Water Resources Department, 2012). Potentially exasperating these challenges are the stressors of climate change and population growth (Oregon Water Resources Department [OWRD], 2012).

Oregon's Legislature passed House Bill 3369 to address the water resource issues by directing the OWRD to develop a statewide, integrated water resources strategy (OWRD, 2009a). As directed by HB 3369, the OWRD is to use an integrated approach to develop a plan that allows the state to, "maintain healthy water resources to meet the needs of Oregonians and Oregon's environment for generations to come" (Oregon Water Resources Department, 2009, p. 1).

In August 2012, the OWRD submitted the final Integrated Water Resources Strategy (IWRS) with short- and long-term recommendations and management strategies to address current and potential risks to Oregon's water resources. With

implementation on the horizon it is important to understand how Oregon's general public will perceive risks concerning Oregon's water resources. Public perceptions of risks have been found to compel the priorities and legislative agendas of regulatory bodies (Kunreuther & Slovic, 1996). Inaccurate risk perception by the public also can create barriers to water resource management implementation (Engle, 2012). If groups define and perceive risks differently, this can lead to conflict (Sjöberg, 1998), potentially limiting management practices. If a risk is perceived as low probability, groups or individuals may be less willing to accept or support a management strategy directed at that risk, whereas the opposite may be true if they view the risk as high. In addition, perceiving risk as low in controllability may lead to inaction or low support for management options (Sjöberg, 1998). Essentially, if a management agency does not know how the public perceives a particular risk then it cannot predict how they will respond to the risk or the risk's management prescription (i.e., IWRS implementation). However, understanding how the public perceives a particular risk can create an opportunity for water management agencies as they frame communication and outreach strategies.

Before Oregon can move forward, the question arises: How does the general public perceive risks to Oregon's water resources, specifically water quality and quantity? In addition, what are the predictors of risk perception for the Oregon's general public? For this study, "risks" are activities known to negatively affect

Oregon's water quantity and quality, and "risk perception" is the subjective judgment that Oregonians make about these activities.

4.2 BACKGROUND AND LITERATURE REVIEW

The perception of risk early research focused on risks with direct human health impacts, such as nuclear energy and auto accidents (Slovic, 2000). With a focus on technical issues, this research used risk as the unit of analysis (Slimak & Dietz, 2006) and tried to determine when and why people accept certain personal risks, yet disregard others. Starting in the late 1960s, as threats and impacts on the environment reached the public's attention, research focused on nature and environmental (O'Conner, Bord, & Fisher, 1999).

Since the initiation of risk perception research, models have been developed to assess why people perceive risks as they do. According to Sjoberg (2000), risk perception is "a phenomenon in search of an explanation" (p. 1), and he proposes that these perceptions are shaped by the characteristics of the risks themselves. For example, in the case of nuclear power, a risk characteristic might be possibility of a nuclear meltdown. This model, known as the psychometric model (Slovic, 2000), tries to explain differences in how the characteristics of the *risks* are perceived rather than how the differences in *individuals* influence the risk perception (Slimak & Dietz, 2006). Within the psychometric model, people make judgments about the current and desired riskiness of diverse hazards and the desired level of regulation of each (Slovic,

1987). Again, using the risk as the unit of analysis, not the individual, the model uses the aggregates of individuals on risks characteristics, but does not take into account the differences of the individuals themselves. Use of the psychometric model has produced high levels of explanatory efficiency when the perceived risk was related to the psychometric factors (Sjöberg, 1999; Slimak & Dietz, 2006), but this finding was mostly due to the fact that aggregated data were analyzed. When raw data are analyzed with the individual as the unit of analysis, only about 20% of the variance in risk perception can be explained (Sjöberg, 1999).

The psychometric model is effective at explaining risk perception directed at a technical issue (e.g., nuclear energy, automobile accidents), however, environmental conflict results not so much from differences in perceptions across the *risks* themselves, but in differences in perceptions across *individuals* (Slimak & Dietz, 2006). This suggests that individuals base their risk perception on bounded rationality – meaning they must form an opinion with limited knowledge and time, and thus are susceptible to values and beliefs. Therefore, a model evaluating the perception of risk on an ecological issue may need to include characteristics of the individual. In their survey of the lay public and U.S. Environmental Protection Agency risk professionals, Slimak and Dietz (2006) applied the value-belief-norm theory for risk perception on various environmental issues, including climate change and commercial fishing. They found belief in the new ecological paradigm and Schwartz's altruism explained

anywhere from 19 to 46 percent of the variance in the risk rankings (Slimak & Dietz, 2006).

4.2.1 Predictors of Risk Perception

Previous research has demonstrated there are underlying factors that help to explain variability in risk perception. These include, but are not limited to, knowledge, exposure, worldview, and sociodemographic (socioeconomic status) factors (McDaniels et al., 1997; McDaniels et al.,1995; Rowe & Wright, 2001; Slovic, 1987; Wildavsky & Dake, 1990).

4.2.1.1 Socioeconomic Status (SES)

SES factors related to risk perception are gender, education, race, income, and age. Of these, only gender seems to be a consistent predictor with males typically perceiving risk smaller and less problematic than females (Rowe & Wright, 2001; Sjöberg, 1999; Slovic, 2000). According to Slovic (2000), this may be due to gender roles, where men typically work in areas that may be viewed as risky by those not working in the field. In a national mail survey examining the relationship between risk perception and willingness to address climate change, O'Conner, Bord, and Fisher (1999) found females were more likely to believe than males that the world is at risk from climate change.

In addition to gender, the SES variables of age, income, and education are related to ecological risk perception. Typically, risk is inversely correlated with

education and income; as income and or education increases, perception of risk decreases. For example, in O'Conner et al. (1999), as education increased the risk perception of climate change decreased. Age is also correlated with risk (Lazo et al., 2000), with risk perception increasing as age increases. O'Conner's (1999) study suggests a similar relationship, yet the relationship between age and risk perception was weak and not statistically significant. In Slimak and Dietz's (2006) study, age, gender (females), and political liberalism positively correlated with risk perception, whereas education and income were negatively correlated.

4.2.1.2 Culture and Worldview

In addition to sociodemographic factors, cultural and worldview are consistent predictors of risk perception (Rowe & Wright, 2001). Worldview, which is defined as general attitudes toward the world and its social organization, helps people determine whether something is a risk or not (Slovic, 2000). One aspect of cultural is environmental belief, with the New Environmental Paradigm a widely used measure of environmental belief (Slimak & Dietz, 2006; Stern et al.,1999). The NEP was created by Dunlap, VanLiere and colleagues as a way to measure the paradigm shift in the 1970s (Dunlap et al., 2000). At the time, individuals in the United States were moving from an anthropocentric paradigm, which Dunlap et al., (2000) refer to as the Dominant Social Paradigm (DSM), to a biocentric paradigm known as the New Environmental Paradigm (NEP). Yet, the ability of the NEP to predict risk perception varies. For example, when using four different risk scales – ecological, chemical,

global, and biological – Slimak and Dietz (2006) found that, when all other factors were controlled, the NEP accounted for anywhere between 9% and 42% of the variance.

In a study assessing risk perception on nuclear energy, Slovic (2000) found that those who observe a certain hierarchical social order with varying levels of authority and structure tend to have a lower perception of risk. Furthermore, if a group can possibly benefit from the potential risk, then their perception of risk declines or they may downplay a risk as a way to either control the risk activity or benefit from it (Slovic, 2000). On the other hand, a group also may emphasize a risk if it will further their cause (Slovic, 1987). This suggests that those who stand to benefit from the extraction of Oregon's water resources will perceive the risk on water quality, quantity and availability to be lower than those who won't benefit from extraction.

4.2.1.3 Knowledge

Knowledge, whether self-assessed or factual, of a risk activity can influence an individual's risk perception. For example, using an existing pro-risk index, Wildavsky and Drake (1990) found those who self-assessed their knowledge as high on technology tended to percieve greater benefits from the technology and less risk than those who rated themselves with low knowledge. In their review of previous risk perception research, Rowe and Wright (2001) suggest one reason for the differences

between experts and the laymen is knowledge on an issue, with the experts having greater knowledge, and lower risk perception than the public.

4.2.2 Oregon Water Resources

According to state water managers and scientists, Oregon's water resources are presently at risk (OWRD, 2011) with climate change and population growth potentially aggravating the issue (OWRD, 2012). There is little available data on the Oregon's public's risk perception concerning water resources. One exception is a 2002 (Davis Hibbitts & McCaig, 2002) survey conducted on Washington County residents on values, beliefs and risk perception of the waterways within the Tualatin Basin. Of the threats to the waterways, residents ranked industrial pollution as the most serious risk, followed by development. However, urban nonpoint source pollution activities were ranked low with researchers finding that there is a "notable absence of perceived threats to the river and streams related to personal behavior, including lawn fertilizers, run-off from garden chemicals and residue from car repair" (p. 13).

As highlighted in the Washington County study, the Oregon public may not always have the same risk perception as the respective management agencies, which can constitute a barrier or an opportunity. When a management agency does not understand how a risk is perceived by their constituents, they are more likely to develop management strategies and practices that are counter to the public than when they understand how the public understands risks (Slovic, 2000).

Using the Washington County survey findings and prior scholarly research, four hypotheses were developed:

> H_1: Members of the public with some college or more will have a lower level of risk perception than those with no college.
>
> H_2: Members of the public who earn $50,000 or more a year will have a lower level of risk perception than those who make less than $50,000 a year.
>
> H_3: Females will have a higher level of risk perception concerning water resources than males.
>
> H_4: Members of the public with higher levels of self-assessed water resource knowledge will have higher levels of risk perception than those with lower levels of knowledge.

4.3 METHODS

This study used data from a questionnaire developed to assess the risk perception, belief and values on Oregon's water resources of Oregon's general public. Development of the questionnaire stemmed from information collected though stakeholder interviews conducted for the Oregon Water Resources Department (OWRD) as well as examination of previous research. There were three sections of the questionnaire: (a) self-assessed level of knowledge and perception of risk; (b) level of environmental belief; and (c) socio-economic information. There were three tests of the questionnaire before finalization.

Using a modified version of Dillman's (1978) Total Design Method, the questionnaire was sent to the Oregon public by mail via the U.S. Postal Service during

spring 2010. Three waves were sent to the households, with each asking a member 18 years or older to fill out the questionnaire. A postcard informing the household the purpose of the questionnaire as well as when to expect it consisted of the first wave. The second wave consisted of a packet that included the questionnaire, a letter informing respondents the nature of the questionnaire as well as the ability to refuse participation, and a business reply mailer with postage. The last wave included a reminder letter, questionnaire, and business reply mailer with postage.

In all, the questionnaire was sent to 2,000 randomly selected households. There were 437 bad addresses and 1,563 valid addresses. The sample was provided by a private sampling company and included names and addresses. With an estimated 30% bad addresses and 30% response rate, it was calculated the original sample size of 2,000 would provide 400 valid responses, leading to a 95% confidence level and 5% confidence interval for the results. Taking into account the 437 bad addresses, the final response rate was 51%, or 799 completed questionnaires, which provided a 95 percent confidence level and a 4% confidence interval.

4.4 RESEARCH LOCATION

The focus of this research is the state of Oregon. It contains a diverse landscape, with the Columbia and Snake Rivers delineating the north and east borders, and the Pacific Ocean on its west. Its elevation ranges from sea level to 11,249 feet at

the summit of Mount Hood at (U.S. National Geodetic Survey, 2013). The ecosystems range from tempered rainforests throughout the west, to high desert in the east.

Oregon's population of 3,857,625 (Population Research Center, 2012) makes it the 27th most populace in the nation (U.S. Census, 2012). With a land area of 249,000 square kilometers, there are on average 104 people per square kilometer (U.S. Census, 2010), yet 69% of the population occupies only 1% of the land mass (U.S. Census, 2011). This may change with long term projections having Oregon's population growing to almost 5.5 million by 2040, or a 132% increase from 2010 (Albrecht, 2008). Among many infrastructure concerns is that the projected population growth will exceed current water supplies (Office of Economic Analysis, 2004).

The majority of Oregonians reside in the Willamette Valley which receives between 100 to 355 centimeters of rain a year (Bastasch, 2006). Eastern Oregon is lightly populated and receives between 25 to 50 centimeters a year (Climate Impacts Group, 2010a). The average annual rainfall throughout the state varies from less than 20 centimeters in the drier Plateau Regions to as much as 500 centimeters along the coast range (Bastasch, 2006). Snow in the winter months along the Cascade Mountain range is Oregon's main source of precipitation. This is Oregon's largest storage facility (Mote, 2006) and its associated snow melt is the key driver in Oregon's water availability. Snow not only determines the quantity of water provided for stream flow and use, but when the water will be provided (Chang & Jones, 2010).

Climate change impacts, primarily in the form of increased temperatures, can significantly affect Oregon's snowpack (Mote, 2006; Nolin & Daly, 2006). Climate models predict the Pacific Northwest region is expected to warm on average of 0.5°F every 10 years for the next few decades (Western Regional Climate Center, 2013). Full warming projections span a range of 0.7ºF to 3.2ºF for the 2020s and 1.4ºF to 4.6ºF for the 2040s (Western Regional Climate Center, 2013).

The quantity and seasonality of water supply is projected to shift as the distribution of precipitation changes and the temperatures increase with climate change (Chang & Jones, 2010). More rain and less snow could lead to a reduction in snowpack accumulation. A higher rate of snow melt associated with climate change also is expected to lead to earlier peak annual stream flow, and thereby reduced flows in the summer months (Chang & Jones, 2010; Nolin & Daly, 2006). In addition to the impacts on Oregon's snowpack, warmer air temperatures and a reduction of precipitation in the summer months are projected to increase evapotranspiration and further reduce summer stream flows as well as impact water quality (Chang & Jones, 2010). Essentially, the projected shift to the quantity and seasonality of Oregon's water could reduce the supply in summer months (Chang & Jones, 2010) when the demand is greatest (Oregon Water Resources Department, 2012). Furthermore, a rise in temperatures is expected to increase the demand for water (Oregon Water Resources Department, 2012).

Oregon's water is managed through the Oregon Water Code, which is technically a hybrid of the Riparian[1] and Prior Appropriation Doctrines, yet its foundation stems from the Prior Appropriation Doctrine (Oregon Water Resources Department, 2010a, 2010b). Often referred to as "First in Time, First in Right," the Prior Appropriation Doctrine was initially designed to ensure certainty by providing the best water rights to those who use the water first, also known as "senior" water right holders. On the other hand, those with permits after the senior water right holders have to wait and see if there is enough water for them. Essentially, "senior" water right holders are always permitted their full water amount before their "junior" water right holders are allotted any water. As such, Oregon's Water Code is designed to protect senior water right holders for the "beneficial use" of all Oregonians. Like most western states, the majority of water permits (right) are for agriculture; in fact, as Figure 1 displays, the U.S. Geological Survey estimates about 79% of Oregon's water is used for agriculture and irrigation (Kenny et al., 2009).

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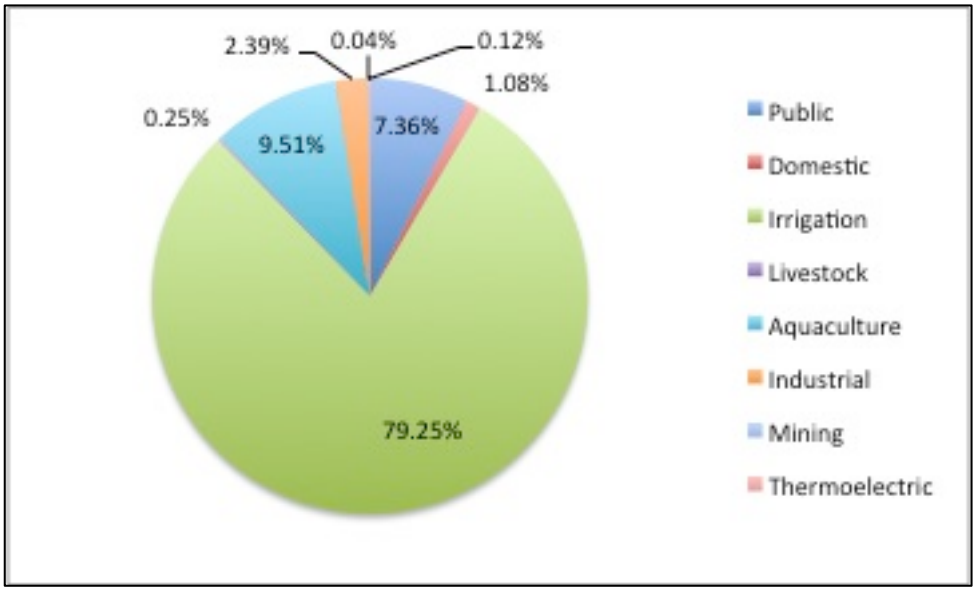
1 Under the riparian doctrine, a landowner whose property adjoins a water body has the right to make use of the water for a beneficial use as long as that use does not harm downstream users.

Figure 1. Oregon Fresh Water Use 2005



Source: Kenny et al., 2009

4.5 ANALYSIS AND RESULTS

Table 1 presents the basic survey characteristics of the survey respondents. For comparison, the U.S. Census Bureau's 2011 population estimates for Oregon are included. Evaluation of the two populations – Oregon's population age 18 years and older, and the survey population age 18 years and older – shows that on average the survey population is 56, whereas the Oregon population is six years younger at 50. This age difference can lead to potential biases in the results, therefore the survey data are weighted by age with the U.S. Census Bureau (2011) Community Data (Table 8 in appendix). For the weighting, there were no survey responses in the 18-19 age category, and only eight respondents in the 20-24 age category. Therefore, the 20-24 and 25-34 age categories were collapsed into the 20 – 34 age category.

Table 1. Survey Response Bias

Demographic Variable	Survey Response Bias	Census Estimates (2010) [1]
Mean Age (Over 18)	56	50
Median Household Income	$50,000 - $74,999 (survey category)	$49,260 (2006 – 2010 adjusted average)
Gender (over 18)	50% Male, 50% Female	49% Male, 51% Female
Some College or Higher (over 25)	79%	64%

1 Source: U.S. Census. (2011). *2010 Census Demographic Profile Summary File*. Retrieved from http://factfinder2.census.gov/faces/tableservices/jsf/pages/productview.xhtml?pid=DEC_10_DP_DPDP1.

The premise of this study was to assess the Oregon public's risk perception concerning Oregon's water resources. For this study "risks" are the activities known to impact Oregon's water quantity and quality, and "risk perception" is the subjective judgment that Oregonians make about these activities, and operationalized with the creation of an additive risk index. To create the index ten questions related to risk activities on water resources were used. The ten activities were pulled from interviews with OWRD personal and OWRD (2010) issues papers. For each risk activity, respondents were asked, "how much risk does the activity pose to Oregon's water quality and quantity?" They were provided with four options 1 = "no risk;" 2 = "minor risk;" 3 = "moderate risk;" and 4 = "serious risk." The ten variables were combined into an additive index ranging from 10 to 40, with 10 = "no risk" and 40 = "serious risk." The index proved to be reliable with a Crobach's Alpha of .88 (Table 2).

Table 2. Risk Perception Reliability Analysis

	Means	Standard Deviation	Item Total Correlation	Alpha if Item Deleted	Cronbach Alpha
Perception of Risk Index[1] [2]					.88
Ag practices	3.43	.73	.66	.86	
Forestry practices	3.30	.81	.67	.86	
Hydro dams	2.61	.93	.59	.87	
Drought	3.26	.82	.62	.86	
Climate Change	3.02	.95	.67	.87	
Population growth	3.09	.76	.54	.86	
Irrigation for agriculture lands	2.76	.81	.63	.86	
Water privatization	2.97	.93	.56	.87	
Industry	3.23	.80	.64	.86	
Private wells	2.11	.86	.46	.88	

1. Variables coded on a 4-point scale "No Risk" (1), "Minor Risk" (2), "Moderate Risk" (3), and "Serious Risk" (4).
2. $n = 607$

Evaluation of the Oregon public's risk perception on the ten individual risk activities is presented in Table 3. On average, the Oregon public perceives "agricultural practices" (mean = 3.41) as the greatest of the ten risk items followed by "forestry practices" (mean = 3.27). The lowest risk activity was "private wells" with the public perceiving it as a "minor risk" (mean = 2.09). Using the additive risk index,

on average, the Oregon public perceived the state's water quantity and quality at a "moderate risk" (mean = 29.77).

Table 3. Individual Risk Perception Activities Means

Risk Activity[1]	Mean / (SD)
Agricultural practices	3.41 / (.740) *n* = 768
Forestry Practices	3.27 / (.827) *n* = 760
Hydro dams	2.56 / (.931) *n* = 725
Drought	3.26 / (.804) *n* = 745
Climate Change	3.03 / (.929) *n* = 751
Population growth	3.13 / (.739) *n* = 762
Irrigation for agriculture lands	2.74 / (.820) *n* = 737
Water privatization	2.98 / (.932) *n* = 760
Industry	3.26 / (.781) *n* = 738
Private wells	2.09 / (.864) *n* = 768
Total Risk Index[2]	29.77 / (5.80) *n* = 744

1. Variables coded on a 4-point scale from "No Risk" (1) to "Serious Risk" (4).
2. Risk index coded on a 30-point scale from "No Risk" (10) to "Serious Risk" (40).

To assess the predictors of risk perception concerning Oregon's water resources three groups of independent variables were used: information sources, cultural, and water resource knowledge, and socio-economic status (SES). Tables 4a and 4b present the variables. For the information sources variables, the questionnaire asked respondents which information sources they use to get information on water resources and how frequently they use them. The public was provided 12 options and directed to choose between a range of 1 = "never" to 4 = "very frequently." On average, TV was the most frequently used source (mean = 2.60) followed by OPB (mean = 2.53). Watershed councils (mean = 1.49) and elected officials (mean = 1.61) were used the least.

Four SES variables and one interaction variable were used as risk perception predictor variables: age, income, education, gender and gender/age. Income was collapsed into a dummy variable where 1 = households that make $50,000 or more a year and 0 = households that make less than $50,000 a year. Gender was recoded into a dummy variable, where 1 = male and 0 = female. The education variable was collapsed to create a dummy variable where 1 = some college or more and 0 = vocational school, high school diploma and less. The frequency analyses show the respondents are 46% male, with 80% or more having some college or more, and 55% making $50,000 or more a year.

Cultural and knowledge variables used as predictors were self-identified political ideology, the New Environmental Paradigm index, and the self-assessed

knowledge concerning Oregon's water resources. The NEP is an additive index created from six selected variables. Participants were asked whether or not they agreed or disagreed with six statements, three anthropocentric and three biocentric, related to the environment. They were provided with options ranging from one through five, with 1 = "strongly disagree" and 5 = "strongly agree." The three anthropocentric variables ("Humans have the right to modify the natural environment to suit their needs," "The so-called 'ecological crisis' facing humankind has been greatly exaggerated," and "Humans were meant to rule over the rest of nature") were reverse coded to ensure the direction of the responses corresponded with the other items in the index. The six variables were compiled into an additive index ranging from 6 through 30. Those with a composite of six are deemed to be in full support of the Dominant Social Paradigm, or anthropocentric, while those with a composite of 30 are deemed to be in full support of the New Environmental Paradigm, or biocentric. With all six variables included, the NEP index was reliable with a Cronbach's alpha of 0.78 (Table 5). To measure political ideology, respondents were asked on domestic policy issues what they consider themselves to be and provided with a range of one "very liberal" to five "very conservative." For the analysis this was reverse coded so 1 = "very conservative and 5 = "very liberal." On average, the Oregon public 18-years-and-older assess themselves as more biocentric than anthropocentric (mean = 22.49) and "moderate" (mean = 3.09) on political ideology.

Knowledge is operationalized with a self-assessed knowledge additive index, which was created by asking survey respondents to rate their knowledge on 13 water terms. The survey prompted respondents to "indicate if you know what the term means; have heard of the term but do not know its meaning; or have not heard of the term at all." The 13 variables were recoded into dummy variables of either 1 = "know the term" and 0 = "do not know the term" (don't know the meaning and have not heard of the term). These were combined into a single additive index, ranging from 0 to 13, with 13 being a high level of self-assessed knowledge on water resources. On the scale of 0 to 13, the Oregon general public self-assess themselves to have score of 5.38 (Table 4a).

Table 4a. Predictors of Risk Perception

Variable Name	Variable Description	Mean (SD)
Age	Respondents Age In years	48.9 (16.75) *n* = 772
Gender	Dummy variable for gender (0=female; 1=male)	.465 *n* = 768
GenAge	Gender age interaction variable	23.75 (27.65) *n*=768
Educ	Formal educational attainment (0 – grade school through vocational school; 1 - some college or more)	.801 *n* =770
Income	Household income (before taxes) in 2009 (0 = Less than $50,000; 1 - $50,000 or more)	.548 (2.18) 738
NEP	New Environmental Paradigm index (6=low support for environmental protection to 30=high support for environmental protection)	22.49 (5.30) *n* =754
Ideol	Self-identified political ideological orientation (1 = very conservative to 5 = very liberal)	3.09 (.983) *n* =740
Know	Self-assessed level of knowledge concerning Oregon's water resources (0 = no knowledge to 13 = high knowledge)	5.38 (3.19) *n* = 736
TV	Frequency of use of television for information about Oregon water (1 = never to 4 = Very frequently)	2.60 (.895) *n* = 763
OPB	Frequency of use of Oregon Public Broadcasting for information about Oregon water (1 = never to 4 = Very frequently)	2.53 (.996) *n* =766

Table 4b. Predictors of Risk Perception (cont.)

Variable Name	Variable Description	Mean (SD)
Radio	Frequency of use of radio for information about Oregon water (1 = never to 4 = Very frequently)	2.12 (.940) *n*=756
Oregon	Frequency of use of the Oregonian for information about Oregon water (1 = never to 4 = Very frequently)	2.02 (1.005) *n*=762
News	Frequency of use of local newspapers for information about Oregon water (1 = never to 4 = Very frequently)	2.23 (.980) *n* = 759
Water	Frequency of use of watershed councils for information about Oregon water (1 = never to 4 = Very frequently)	1.49 (.718) *n*=755
Elected	Frequency of use of elected officials for information about Oregon water (1 = never to 4 = Very frequently)	1.61 (.758) *n*=757
Rec	Frequency of use of recreation groups for information about Oregon water (1 = never to 4 = Very frequently)	1.81 (.846) *n* =757
Academ	Frequency of use of universities and colleges for information about Oregon water (1 = never to 4 = Very frequently)	1.88 (.903) *n*=758
OWRD	Frequency of use of Oregon Water Resources Department for information about Oregon water (1 = never to 4 = Very frequently)	1.80 (.840) *n*=752
Environ	Frequency of use of environmental groups for information about Oregon water (1 = never to 4 = Very frequently)	2.03 (.9108) *n* =760
Internet	Frequency of use of the Internet for information about Oregon water (1 = never to 4 = Very frequently)	2.39 (.957) *n* = 758

Table 5. NEP Reliability Analysis

	Means	Standard Deviation	Item Total Correlation	Alpha if Item Deleted	Cronbach Alpha
New Environmental Paradigm Index					.78
The balance of nature is very delicate and easily upset by human activities[1]	3.98	1.12	.53	.74	
Humans have the right to modify the natural environment to suit their needs[2]	3.47	1.21	.43	.76	
We are approaching the limit of people the earth can support[1]	3.51	1.34	.51	.74	
The so-called "ecological crisis" facing humankind has been greatly exaggerated[2]	3.55	1.39	.59	.72	
Plants and animals have as much right as humans to exist[1]	4.02	1.25	.53	.74	
Humans were meant to rule over the rest of nature[2]	3.71	1.41	.54	.74	

1. Variables coded on a 5-point scale from "Strongly Disagree" (1) to "Strongly Agree" (5).
2. Variables coded on a 5-point scale from "Strongly Agree" (1) to "Strongly Disagree" (5).
3. $n = 753$

Table 6 displays the results from the analysis of variance (ANOVA) used to examine the differences between the four SES variables against the dependent additive risk index. The first hypothesis predicted the public with "some college or more" will have a lower risk perception than those without college. This was not substantiated, as those with "some college or more" had a higher risk perception (mean = 30.26, $p <$ .001) than those with no college (mean = 27.68). Hypothesis 2 was also not substantiated; not only do the cohort who earns $50,000 or more a year have a higher risk perception (mean = 30.26, $p = .33$), but the test was not statistically significant. Females in the study had a higher risk perception (mean = 31.22, $p < .001$) than males (mean = 28.45), which substantiates hypothesis 3.

Table 6. Risk Perception by Demographic Variables

	Sample		Dependent Variable: Risk Perception index[1]			
Demographics	*n*	%	Mean	Standard Deviation	*F*-value	*p*-value
Gender[2]					42.22	< .001
Male	297	46	28.45	5.99		
Female	308	54	31.22	5.24		
Education[2]					19.18	< .001
≥ Some college or more	490	80	30.26	5.48		
≤ High school diploma or vocational school	116	20	27.68	6.64		
Income[2]					4.57	.33
< $50,000	256	45	30.39	5.64		
≥ $50,000	330	55	29.37	5.83		

1. Risk index coded on a 30-point scale from "No Risk" (10) to "Serious Risk" (40).
2. For the bivariate analyses, this predictor variable was recoded into a dummy variable.

To assess the predictors of risk perception concerning water resources a series of four OLS regression models were used (Table 7). The dependent variables was the risk perception index that ranged from 10 = "no risk" to 40 = "serious risk." The first three regression analyses were sub-models, with statistically significant variables ($p \leq .05$) included in the full model. The first model consisted of four SES variables – age, gender, income, and education – and the gender/age interaction variable. Of the five, education was included in the full model. The cultural and knowledge variables NEP, political ideology, and knowledge index were evaluated in the second model. All three were statistically significant and included in the full model. The third model evaluated

the 12 information sources predictors. Of these TV, radio, local newspapers, OPB, elected officials, Internet, and environmental groups were included in the full model.

The full model included 12 independent variables: two SES, two cultural, knowledge, and seven information sources. Of these, four were statistically significant. Gender was the one statistically significant SES variable ($\beta = -.096$, $p \leq .01$). Of the two cultural variables, the NEP was statistically significant ($\beta = .451$, $p \leq .001$); as biocentrism increased, risk perception increased. The knowledge index was predicted to be an indicator of risk perception, yet it was not statistically significant ($\beta = .214$, $p > .05$), therefore hypothesis 5 is not substantiated. Two of the seven information sources in the full model were statistically significant – use of OPB, and environmental groups for water resource information. Of the two, use of environmental groups was the strongest information source predictor ($\beta = .260$, $p \leq .001$); as use of environmental sources as an information source increased, risk perception increased. Use of OPB is the second strongest information source predictor ($\beta = .209$, $p \leq .001$); as use of OPB for water resource information increased, risk perception increased. The full model explained 54% ($R^2 = .537$) of the variation of Oregon's public risk perception concerning water resources.

Table 7. OLS Regression Estimates for Risk Perception

	Risk Perception			
Variables	Model 1 Coefficient (S.E.)	Model 2 Coefficient (S.E.)	Model 3 Coefficient (S.E.)	Full Model Coefficient (S.E.)
Age	-.050 (.020)			
Gen	-.318* (1.516)			-.096** (.369)
Educ	.176*** (.605)			-.037 (.478)
GenAge	.110 (.030)			
Income	-.074 (.501)			
Ideol		-.103** (.229)		-.034 (.223)
NEP		.572*** (.042)		.451*** (.041)
Know		.129*** (.057)		.040 (.061)
TV			-.074* (.243)	-.051 (.211)
OPB			.296*** (.234)	.209*** (.212)
Radio			1.133*** (.233)	-.040 (.180)
Oregon			.062 (.207)	
News			-.078* (.210)	-.040 (.180)
Water			.009 (.367)	
Elected			-.083* (.313)	-028 (.245)
Rec			.038 (.303)	
Academ			-.017 (.285)	

OWRD			-.004	
			(.315)	
Environ			.408***	.260***
			(.263)	(.223)
Internet			.092*	-.023
			(.219)	(.193)
F-Test =	12.851	148.206	25.376	58.704
R^2 =	.100	.439	.334	.537
n =	581	566	583	549

*$p \leq .05$; **$p \leq .01$; ***$p \leq .001$;

4.6 DISCUSSION AND CONCLUSION

Oregon's Integrated Water Resources Strategy identifies specific risk activities associated with Oregon's water resources, as well as potential management actions to address these risks. As the state moves to implementation of IWRS, the Oregon general public may be called upon to accept and support management practices addressing the risks. If the public has low risk perceptions, this can create a barrier in the implementation of IWRS. For example, in a comparative study evaluating the adaptive capacity in water planning within large urban community water systems in Arizona and Georgia, Engle (2012) found a main adaptation barrier for the public was perception; the public felt the "job (drought management) has been finished" (p. 1145), which inhibited implementation of the new management approach. In addition, Arizona water managers reported the general public did not perceive drought as a risk until it became an emergency, which precluded the public from taking an active participatory role in water planning (Engle, 2012). Essentially, if Oregon's water

management agencies do not know how a group or individual will perceive a particular risk, then it may not be able to predict how they will respond to the risk or the management prescription of the risk. However, understanding how a risk is perceived can create an opportunity for water management agencies as they frame communication and outreach strategies.

The goal of this study was to assess the Oregon public's risk perception concerning Oregon's water resources. Overall, using the risk index which ran from 10 = "no risk" to 40 = "serious risk," Oregon's public perceived the risk to Oregon's water resources as "moderate" (mean = 9.77). Of the ten risk activities, the public viewed "agricultural practices" (mean = 3.41), "forestry practices" (mean = 3.27), "drought" (mean = 3.26), and "industry" (mean = 3.26) as greater than moderate risks. Three of the four are listed by the IWRS process as risks to Oregon's water quantity and quality (OWRD, 2010) – drought, agriculture, and forestry, whereas industry is not. Industry uses 2% of Oregon's freshwater a year (Kenny, 2009). Regarding water quality, the Clean Water Act's (CWA) National Pollutant Discharge Elimination System (NPDES) permit requirements has led to a reduction of industry's pollution and therefore mitigated industry's risk on water quality. Yet the public views it a greater risk than climate change (mean = 3.03), population growth (mean = 3.13) and hydroelectric dams (mean = 2.56).

When comparing SES variables against the risk perception index, some of the results supported the stated hypotheses and some did not. Males, as predicted, had a

lower risk perception than females. Yet, according to previous research, risk should have a negative relationship with education and income (O'Conner et al., 1999) – as income and education increase, risk perception decreases. In the case of this study, Oregonians with some college or more (mean = 30.26) had a higher risk perception than Oregonians with no college (mean = 27.69). Income, however, was not a significant predictor of risk perception.

As with the SES variables, the cultural variables had mixed results and were not entirely consistent with previous research. There were four notable exceptions – education, NEP, political ideology, and knowledge. Typically, risk is inversely correlated with education and income; as income and or education increases, perception of risk decreases. For example, in O'Conner et al. (1999), as education increased the risk perception of climate change decreased. In the SES partial model, education was a positive predictor of risk perception ($\beta = .175$, $p \leq .001$), yet in the full model it was a negative predictor, and not significant ($\beta = -.037$, $p \leq .05$). The second notable exception is the significance of political ideology; previous research (Rowe & Wright, 2001) found that political ideology is a significant influence on ecological risk perception, but it was not a significant variable in the full model. Third, is the strength of the NEP as a predictor of water – the NEP is the strongest predictor of all the variables ($\beta = .451$, $p \leq .001$); as biocentrism increased, risk perception increased. It explains 54% of the model variance. This is consistent with previous ecological risk research, including Slimak and Dietz (2006), who found the NEP

accounted for up to 42 percent of the variance explaining the global environmental risk index. Finally, is the use of knowledge in the full model; Wildavsky and Drake (1990) found those who self-assessed their knowledge as high on an issue, had lower risk perception. In this study however knowledge was not a significant predictor in the model.

The remaining two significant predictors in the full model were the use of environmental groups and OPB for information concerning Oregon's water resources. Use of environmetal group information was the strongest predictor of the two (β = .260), yet the public's overall use of environmental group information was "infrequent" (mean = 2.03). In fact, the two strongest predictors of water resource risk perception for the Oregon public were environmentally focused – NEP and use of environmental groups for information.

These findings have implications for Oregon's water resource managers as well as for future research. First, based on this study' results, risk perception on Oregon's water resources is not consistent with previous research. In some cases, activities the Oregon public perceives as risks is inconsistent with risk activities identified with IWRS. For example, the public perceives industry as a greater risk than climate change and population growth. Why this is the case could have something to do with the probability and controllability of the risk – industry has high controllability, and the public knows it has been a risk in the past (i.e., Love Canal), while climate change and population growth are projected risks, and therefore their

probability and controllability are uncertain. A challenge for managers is if Oregon's public perceives a risk as low probability and low in controllability, they may be less willing to accept or support a management strategy directed at that risk (Sjöberg, 1998).

Future research should examine some of these issues, as well as take into account the limitations within this study. First is the role of trust in risk perception; trust is the "confidence and belief that people have in the ability of the assigned agencies and officials to control and minimize hazard, technology, and/or activity related risk" (Flynn et al., 1992, p. 418). According to previous research, trust in a management agency, in this case Oregon's water resource management agencies (e.g., OWRD and ODEQ), influences risk perception (Sjöberg, 1999), as well as trust in the institution or ideology (Wildavsky & Dake, 1990). Second, future research should assess the risk sensitivity of Oregon's public: Are they risk sensitive and therefore perceive most activities as a "high" risk or are they risk-takers and perceive activities as "low" risk? Third, this study did not assess the risk perception of nonpoint source pollution activities; how does Oregon's public perceive their own activities as a risk, such as changing oil in the street or flushing their pharmaceutical drugs in the toilet? Lastly, the majority of Oregon's water is used in rural Oregon (OWRD, 2012), which leads to the question as to whether there is a difference in risk perception between Oregon's rural and urban populations.

4.7 APPENDIX

Table 8. Survey Sample Weighting

	U.S. Census		Survey Sample		
Age Category	Population Estimate	%	Survey responses	%	Weight
18 & 19	102575	3	0	0	1.00
20 to 34	793474	26	87	11	2.42
35 to 44	501136	17	106	13	1.26
45 to 54	530263	18	167	21	0.84
55 to 59	272858	9	101	13	0.72
60 to 64	256412	9	103	13	0.66
65 to 74	305988	10	135	17	0.60
75 to 84	168506	6	73	9	0.61
85 and over	78627	3	27	3	0.77

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5 CONCLUSION

Hubbard, M.L.

5.1 CONCLUSION

According to scientists and Oregon's water managers, Oregon's water resources are overtaxed and at risk. The state is addressing these issues with the development of an Integrated Water Resources Strategy (IWRS). Presented in three stand-alone papers, the goal of this dissertation was to assess whether Oregon's public has the dimensions of civil society in place to understand and respond to these risks, in addition to examining the public's self-assessed and factual knowledge, and risk perception concerning water resources.

The first paper focused on the concept of civil society. Specifically, are important components, but not necessarily sufficient, conditions in place to encourage a civil society response to disturbances in Oregon's water resources? Civil society is the noncommercial aspect of community life that exists between the individual and government (Ravitch & Viteritti, 2001), and has three main dimensions: (a) being informed on an issue; (b) interacting and transferring information about the issue with others; and (c) engaging in a practice that potentially leads to a policy change. Using a public survey conducted in 2010, the study examined the presence of civil society attributes on Oregon's water resources, and identified potential socio-economic status (SES) and cultural predictors of those attributes. Using Pearson's correlations, the results showed positive relationships between all three dimensions of civil society, suggesting Oregonians have the capacity to understand and respond to disturbances in water resources. However, while the relationships were positive, the segment of Oregon's public that engages in the civil society activities was low. For example, only

22% feel they are “informed” or “very well informed” on water resources while 25% feel they have an effect on water resource policy.

The second paper explored the previously unaddressed question of the public’s knowledge concerning Oregon’s water resources. Knowledge about an issue will not necessarily lead to environmental behavioral changes (e.g., Finger, 1994; Willis et al., 2011), but has been found to be important for behavioral modification. Furthermore, as Oregon moves to the implementation stage of the IWRS, a low level of knowledge by the public can limit or create a barrier to implementation of management practices (Adger et al., 2007; Engle, 2012). However, a high level of knowledge can be an opportunity if it is transferred to others via the civil society process. Using the 2010 survey data the study assessed the public’s level of self-assessed knowledge concerning Oregon water resources, as well as their factual knowledge on water use. Last, it explored the SES, cultural, and information sources predictors of water resources knowledge. The study found that on a scale of 0 to 13, with 13 a high level of knowledge, the Oregon public had a self-assessed knowledge of 5.38, and 29% knew that agriculture is the largest use of water in Oregon. This suggests that the Oregon public has a lower than optimal level of water resource knowledge. In addition, contrary to the hypothesis, environmental belief as measured with the New Environmental Paradigm (NEP) was not a statistically significant predictor of knowledge.

The final paper examined the Oregon public’s risk perception on water resources. As with a low level of knowledge, inaccurate risk perception by the public

can create a barrier to management implementation (Engle, 2012). Specifically, if the public perceives a risk as a low probability they may be less willing to accept or support a management strategy directed at that risk, whereas the opposite may be true if they view the risk as high. In addition, perceiving a risk as low in controllability may lead to inaction or low support for management options (Sjöberg, 1998). On a scale of 10 to 40, with 40 as high risk perception, the public perceived Oregon's water to be at "moderate risk" (mean = 29.77). Of the ten risk activities, agricultural practices, forestry practices, and industry were perceived to be highest risks activities, whereas private wells, and irrigation for agricultural lands were the lowest. Environmental belief was the strongest predictor of risk perception, whereas self-assessed knowledge was not a significant predictor as hypothesized.

As a whole, the findings of the three papers suggest that through various dimensions of civil society Oregonians possess the foundation to respond to disturbances in water resources. And, by perceiving Oregon's water resources to be at risk, Oregon's public has the potential to avoid a barrier that can negatively impact management implementation. However, this study suggests the public's low level of water resource knowledge can limit the implementation of IWRS management activities.

The study produced three key findings that may help guide management practices as well as future research. First, counter to previous research that suggests education to be the strongest predictor of civil society engagement (Delli Carpini et al., 2004; Milner, 2002), education was not a significant predictor for two civil society

dimensions: feeling informed about water resources, and talking about water resources. Secondly, environmental belief was not a significant predictor of water resource knowledge. As discussed in the second paper, this led to the question as to whether water alone, outside the context of other natural resource issues (e.g., endangered fish), is considered an environmental issue for the Oregon's public? Yet, the results of the third paper found that the NEP is strongest predictor of risk perception ($\beta = .451$, $p \leq .001$). Does this counter the hypothesis that water is not an environmental issue? Perhaps the public with strong environmental beliefs were consistent in their responses on risk perception, while the remaining public were inconsistent in their responses. Lastly, the hypothesized relationship between water resource knowledge and risk perception was neither significant nor negative. In fact, a one-tailed Pearson's correlation found a "small" to "medium" (Cohen, 1988) positive ($r = .205$, $p \leq .01$) relationship between self-assessed knowledge and risk perception; as knowledge increased, risk perception increased. Taken together, the three papers demonstrate that public perceptions and understanding about water resources in Oregon are not always consistent with previous research on civil society, self-assessed environmental knowledge, and risk perception.

The three papers individually suggest some future research opportunities. First, it should explore the influence of trust on risk perception. Oregon's water resource departments, including OWRD and the Department of Environmental Quality (DEQ) will implement IWRS recommendations, but the question remains: does the public

trust them to do so? A low level of trust may reduce support for implementation efforts, whereas a high level of trust may increase public support and resources.

The results from this survey answered the stated research questions, as well as provided interesting findings. However, the methodology resulted in redundancies, including the independent variables used for analyses in each paper. Yet, findings from this study can direct future research, including the formation of a theoretical structural equation model to evaluate the multivariable relationships between the concepts. This might provide a more in-depth perspective of Oregon's public and water resources.

This study has implications for Oregon's water resource management, and implementation of the IWRS. The key issue is the public's overall level of knowledge. While this can be a barrier, identification of this knowledge level can represent an opportunity for Oregon's water resource management agencies in the form of outreach and education. This is not to say Oregon doesn't already engage in outreach, in fact, according to the IWRS it does. Within the IWRS there are two areas of outreach: Oregon's Environmental Literacy Plan, and the "Extensive network of community -based organizations that offer assistance and knowledge on water issues" (Oregon Water Resources Department, 2012, p. 75). The Environmental Literacy Plan, which is part of *No Child Left Inside Act*, is aimed at kindergarten through high school (K -12) and calls for educating students on being lifelong stewards of Oregon's environment. The Environmental Literacy Plan was finalized in 2010, and if it is indeed successful, the results would not show up in this study as survey respondents

are 18 years or older. The community-based organizations IWRS refers to are the 45 soil and water conservation districts, and about 85 watershed councils. These are all great organizations, and based on the results in the second paper, effective for the individuals who use them. Yet, watershed councils, on a scale of 1 = “never” and 4 = “very frequently,” are used “never” to “infrequently” (mean = 1.49) by the public. The findings suggest Oregon’s water resource management agencies should increase outreach through additional outlets, including OPB as it was the second most used information source in the study, as well as being a significant predictor of knowledge.

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6 APPENDIX

6.1 SURVEY INSTRUMENT

Oregon Water Policy Survey

Please return surveys to:

Oregon Water Policy Survey
Master of Public Policy Program
311 Gilkey Hall
Oregon State University
Corvallis, Oregon 97331-6206
541-737-2811

ID # _____
[for mailing purposes only]

SECTION 1

In this first section of the survey, we would like to ask you some questions regarding your knowledge of water issues in the state of Oregon. Please circle the number that most closely represents your view.

Q-1 In general, how well informed would you consider yourself to be concerning water issues in the state of Oregon?

1. Not informed 2. Somewhat informed 3. Informed 4. Very well informed

Q-2 How often do you talk about issues related to water with your family, friends, or other acquaintances?

1. Never 2. Hardly ever 3. Sometimes 4. Often

Q-3 Overall, how much impact do you think people like you can have in making Oregon's water policy?

1. No impact at all 2. A small impact 3. A moderate impact 4. A big impact

Q-4 *Currently*, I believe Oregon will have enough water for human and ecological needs.

1. Strongly disagree 2. Disagree 3. Uncertain 4. Agree 5. Strongly agree

Q-5 *In ten years,* I believe Oregon will have enough water for human and ecological needs.

1. Strongly disagree 2. Disagree 3. Uncertain 4. Agree 5. Strongly agree

Q-6 Listed below are a number of factors that potentially pose a risk to Oregon's water quality and quantity. On the left side of the page, please indicate if you believe the listed factor poses a serious risk, a moderate risk, a minor risk, or no risk at all to Oregon water. On the right hand side, indicate to what extent you believe these risks can be managed by humans. If you are uncertain about your response, please leave the item unmarked.

How much risk does the activity pose to Oregon's water quality and quantity? 1. No risk 2. Minor risk 3. Moderate risk 4. Serious risk					To what extent can these risk be managed by humans? 1. Not at all 2. Slightly 3. Moderately 4. A great deal			
1	2	3	4	**a.** Agricultural practices including use of pesticides, fertilizers and habitat destruction.	1	2	3	4
1	2	3	4	**b.** Forestry practices including use of herbicides, fertilizers and habitat destruction.	1	2	3	4
1	2	3	4	**c.** Hydro-electric dams	1	2	3	4
1	2	3	4	**d.** Drought conditions decreasing flows and increasing temperatures in rivers.	1	2	3	4
1	2	3	4	**e.** Climate change	1	2	3	4
1	2	3	4	**f.** Oregon population growth	1	2	3	4
1	2	3	4	**g.** Irrigation of agricultural lands	1	2	3	4
1	2	3	4	**h.** Water privatization	1	2	3	4
1	2	3	4	**i.** Industry	1	2	3	4
1	2	3	4	**j.** Private wells	1	2	3	4
1	2	3	4	**k.** Other? _____ (please list)	1	2	3	4

Q-7 We would like to know which of the following information sources you currently use or would use to learn more about Oregon's water situation and policy. Please circle the number of the frequency of your use.

		Never	Infrequently	Frequently	Very Frequently
a.	Television news programs and specials	1	2	3	4
b.	Oregon Public Broadcasting	1	2	3	4
c.	Radio programs	1	2	3	4
d.	The *Oregonian* newspaper	1	2	3	4
e.	Other local newspapers	1	2	3	4
f.	Watershed Councils	1	2	3	4
g.	Elected Officials	1	2	3	4
h.	Recreation Groups	1	2	3	4
i.	Universities and colleges	1	2	3	4
j.	Oregon Water Resources Department	1	2	3	4
k.	Environmental groups	1	2	3	4
l.	Information available on the Internet	1	2	3	4

Q-8 In your opinion, what sector uses the most water in the state of Oregon? Please circle one.

1. Municipal (drinking water, lawn watering, etc…)
2. Agriculture/Irrigation
3. Industry
4. Energy production
5. Fish and wildlife
6. Other _____

Q- 9 For the following terms, please indicate if you know what the term means, have heard of the term but don't know its meaning, or have not heard of the term at all.

		Have not heard of the term at all	Have heard of the term but don't know its meaning	Know what the term means
a.	Watershed	1	2	3
b.	Water right	1	2	3
c.	Clean Water Act	1	2	3
d.	Nonpoint Source Pollution	1	2	3
e.	Prior Appropriation Doctrine	1	2	3
f.	Exempt well	1	2	3
g.	Greywater	1	2	3
h.	Hyporheic flow	1	2	3
i.	Snow water equivalent	1	2	3
j.	Aquifer Storage and recovery	1	2	3
k.	Evapotranspiration	1	2	3
l.	Safe Drinking Water Act	1	2	3
m.	Catchment	1	2	3

Q-10 From what you've read and heard, is there solid evidence that the average temperature on earth has been getting warmer over the past few decades, or not?

1. Yes (go to Q-11)
2. No (go to Q-12)
3. Don't know (go to Q-12)

Q-11 Do you believe that the earth is getting warmer…?

1. Mostly because of human activity such as burning fossil fuels.
2. Mostly because of natural patterns in the earth's environment.
3. Don't know

Q-12 On domestic policy issues, would you consider yourself to be?

1. Very Liberal 2. Liberal 3. Moderate 4. Conservative 5. Very Conservative

SECTION 2

This section of the survey concerns your attitudes toward the environment and politics. Please circle the number that most closely represents your view.

Q-13 Listed below are statements about the relationship between humans and the environment. For each, please indicate your level of agreement.

		Strongly Disagree	Mildly Disagree	Neutral	Mildly Agree	Strongly Agree
a.	The balance of nature is very delicate and easily upset by human activities.	1	2	3	4	5
b.	Humans have the right to modify the natural environment to suit their needs.	1	2	3	4	5
c.	We are approaching the limit of people the earth can support.	1	2	3	4	5
d.	The so-called "ecological crisis" facing humankind has been greatly exaggerated.	1	2	3	4	5
e.	Plants and animals have as much right as humans to exist.	1	2	3	4	5
f.	Humans were meant to rule over the rest of nature.	1	2	3	4	5

Q-14 In Oregon, which sectors should receive priority use for water? Please circle the top three.

1. Drinking water
2. Energy production
3. Agriculture/Irrigation
4. Fish and wildlife
5. Industry
6. Recreation

SECTION 3

We now have a few concluding questions to check to see if our survey is representative of all types of people. We also have included a couple of questions concerning politics. Please remember that all answers are completely confidential.

Q-15 What is your current age in years?_____

Q-16 Please indicate your gender? 1. Female 2. Male

Q-17 What level of education have you completed?

1. Grade School	2. Middle or junior high school	3. High school	4. Vocational school
5. Some college	6. College graduate	7. Graduate school	8. Other_____

Q-18 How long have you lived in Oregon? _____ (in years)

Q-19 Which of the following best describes your current work situation?

1. Employed full time	2. Employed part time	3. Not employed outside the home
4. Unemployed	5. Retired	6. Student
7. Other_____		

Q-20 Which category best describes your household income (before taxes) in 2009?

1. Less than $10,000	2. $10,000 - $14,999
3. $15,000 - $24,999	4. $25,000 - $34,999
5. $35,000 - $49,999	6. $50,000 - $74,999
7. $75,000 - $99,999	8. $100,000 - $149,999
9. $150,000 - $199,999	10. $200,000 or more

Those are all the questions we have. If you have any additional comments, please include those on a separate piece of paper. Thank you for your time.