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When Science Isn't Enough: The Importance of a New Social Contract for Conservation Communication

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**When Science Isn't Enough: The Importance of a New Social Contract for Conservation
Communication**

A thesis submitted in partial fulfillment of the requirement
for the degree of Bachelor of Art in Government from
The College of William and Mary

by

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When Science Isn't Enough: The Importance of a New Social Contract for Conservation Communication

By: Deborah Kornblut

Invasive species are increasingly harming Alaska's natural resources and communication efforts have been identified as a cost-effective method of preventing their spread. However, current communications are limited in Alaska and communication efforts have not been assessed. Using the theory of a social contract, this study raises the question: "Why have communication efforts not been successful in preventing the spread of invasive species?" This project primarily assesses opinions about invasive species from conference attendees at the Alaska Annual Invasive Species Workshop and local businesses in Alaska. Using semi-structured interviews, insights are gathered into shared value systems, level of knowledge, and degree of concern about invasive species. Answers from the two response groups are compared. Results are discussed.

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Introduction

Alaska is home to a variety of natural features which fuel its economy. Whether along the 6,640 miles of coastline, across 3,000 rivers, or in 3 million lakes throughout the state, Alaska's natural environment provides integral goods and services to both the state's residents and visitors (State of Alaska, 2019). For example, according to the Alaska Outdoor Recreation Economy Report, Alaska's outdoor recreation opportunities accrue about \$7.3 billion and employ 72,000 people (Outdoor Industry Association 2017). In particular, many residents and visitors depend on the state's salmon industry with the 2017 commercial salmon fisheries harvest totaling 224.6 million wild salmon which were priced at \$678.8 million (Bowers 2017). The seeming infinite abundance of the state's natural resources fuels residents confidence in their state's economy. According to a household survey conducted by the University of Alaska (UA) in 2018, about 84% of respondents stated that on a scale of 1-10 with 10 equating to "thriving," their economic household is either a 5 or above (McDowell Group 2018).

The state's natural resources also promote a strong emphasis on a subsistence lifestyle which in turn influences the Alaskan culture. Overall, about 36.9 million pounds of wild foods are harvested by rural subsistence users while residents of urban areas gather about 13.4 million pounds of wild food (Alaska Department of Fish and Game 2019). Whether gathering or processing wild foods, the experience of gathering one's own foods creates a rich plethora of traditions among state residents and indigenous groups in particular. Once again, salmon is a particularly important species in Alaska's subsistence lifestyle and hence culture. Not only are salmon a crucial element of Alaska's ecosystems, but also about 20% of salmon harvested from

Alaskan salmon runs is used for subsistence purposes (Bowers 2017).¹ Culturally, salmon images evoke powerful memories imbued with unique traditions for many state residents (Birdsong 2019). Additionally, king salmon is the official state fish of Alaska and the importance of salmon research permeates Alaska's education system which offers courses such as a "Salmon Culture Semester" through the University of Alaska Southeast.²

However, Alaska's resources, economy, and culture are all under threat due to invasive species. Executive Order 13112 defines invasive species as "introduced species likely to cause harm to the environment, human health, or the economy" (USFWS 2012).³ Invasive species cost about \$1.4 trillion annually worldwide and are the second leading cause of biodiversity loss (Pimentel et al. 2001). Within the U.S., invasive species cause over \$120 billion in damages, leading to the loss/alteration of goods/services, habitat change, nutrient cycling and even fire frequency (Bonanno 2016, USFWS 2012). Until recently, Alaska has remained spared of the burden of invasive species, but due to climate change, changing habitat suitability, and increasing industrial development, Alaska's natural resources are increasingly vulnerable to the spread of invasive species. The presence of invasive species in vulnerable habitats, like rats on Alaska's island communities, threatens the quality and biodiversity of the natural resources (Alaska Department of Fish and Game 2019).⁴ But invasive species are also capable of damaging

¹ As an anadromous fish, salmon travel from freshwater ecosystems to the ocean which in turn transfers nutrients between the otherwise separate ecosystems. Salmon will travel inland to spawn. After spawning, salmon travel upstream during which time their bodies degrade and leave nutrients in the water. The nutrients are then absorbed by surrounding foliage and continue fueling the remaining ecosystem.

² To see more about the program: <http://salmonculturesemester.alaska.edu/>

³ E.O. 13112 was signed by President Clinton in 1999.

⁴ Rats are especially dangerous to native species. In one case, an accidental shipwreck deposited several rats onto an Aleutian island which then experienced a significant decline in seabirds and increase in rats, earning the island the title of "Rat Island" (Alaska Department of Fish and Game "Rats", 2019).

less vulnerable ecosystems in the state as well. For example, the spread of Elodea⁵ in Alaska is estimated to lead to salmon habitat degradation, which in turn can cause between \$100 and \$500 million annually in damages to the state's commercial sockeye industries (Schoewer 2017). Elodea is also a hazard for boaters and floatplane pilots because it catches on rudders and propellers (USFWS 2019). Regardless of how the impact of invasive species manifests, invasive species are a danger to both ecosystems and people.

Recognizing the threats of invasive species, various actors created frameworks for addressing the introduction and spread of invasives. At the international scale, invasive species are identified as a priority in the Arctic Invasive Alien Species (ARIAS) Strategy and Action Plan (Arctic Council 2017). Invasive species are also listed as a concern at the federal level in the U.S. Fish and Wildlife Service's (Service) Fisheries and Aquatic Conservation (FAC) Program. Within the state, individuals from agencies and organizations formed the Alaska Invasive Species Partnership in 2000 in order to collaboratively "work for the statewide management of noxious and invasive pests in Alaska" (UAF 2019). Policies within the state, such as a ban on fibrous materials like felt waders, and later, the state Governor's declaration of an Alaska Invasive Species Awareness Week furthered the state's efforts to combat the spread of invasive species (Alaska Department of Fish and Game 2012, CRWP 2016). Throughout many of the initiatives to address the spread of invasive species, conservation managers are often scientists who focus on eradication and prevention efforts. Little attention is directed to assessing the receptiveness of the Alaskan public to invasive species management priorities (Santo et al.

⁵ Elodea is Alaska's first submerged aquatic plant (Schoewer 2017). It is suspected that Elodea was released into the ecosystem as part of a fish tank that was dumped into various water bodies and was later transported throughout the state via water recreational equipment, such as boats and floatplanes.

2015). Yet, opinion leaders are becoming increasingly concerned about the ability of the Alaskan public to participate in prevention efforts (Nisbet and Scheufele 2009, Santo et al. 2015).

Working within the context of the growing concern about invasive species and the limitations of social understanding, I assess invasive species communication efforts in Alaska. I find that invasive manager-oriented opinion leaders and public-oriented opinion leaders are aligned in their valuation of the state's natural resources at both an individual and an organizational level. However, I also show that current communication efforts have been unsuccessful. While both groups of opinion leaders are biased towards managing invasive plants, the type of invasive species with which they are concerned with is different. Additionally, I show that previous messaging strategies are insufficient in the Alaskan context and many invasive species opinion leaders, while supportive of communication efforts, are unsure of how to best approach communicating with the Alaskan public. Furthermore, I show that invasive species managers inaccurately assume that the Alaskan public simply needs to be educated about the presence of invasive species in the state. I conclude with a framework for how future communication efforts should be revised to address complicated conservation issues like invasive species management.

Section one covers the literature on environmental communication and presents the social contract of science as a guiding theory for this study. In section two, I give an overview of my methodology which is a series of semi structured interviews with panelists at the Annual Alaska Invasive Species Workshop and local bait and tackle shops throughout the state. Section three presents my analysis of responses to the semi structured interviews through graphical representations of responses to the interviews and quotations from respondents. Section five

concludes the paper with a discussion of the findings and a call for the need of a new social contract for science.

Valuing Communication Efforts

Regardless of the method, preventing the spread of invasive species cannot be achieved without public support. An engaged public is identified as potentially the most cost effective and practical method of data collection and implementation of conservation objectives (Dickinson et al. 2011). Additionally, whether the public is positively or negatively engaged with an issue ultimately affects the success of a project or a policy (Melero 2017, Cronin 2015). In the case of invasive species, an engaged public can assist conservation managers by reporting new locations of invasive species manifestations. Unlike in other conservation issues, the public is also at the frontline for containing the spread of invasive species since it only takes one person to spread an invasive specie. Furthermore, invasive species management requires intensive coordination since managers must be able to access private lands in order to eradicate invasive species (Santo et al. 2015). By incorporating human centered designs into invasive species management, conservation managers can build widespread support and encourage coordination among sectors of the public (Santo et al. 2015).

Within the Alaskan context, the engagement of the public is especially crucial for preventing the spread of invasive species. Many invasive species studies are conducted on islands where due to new technologies area size is rarely a hindrance (Santo et al. 2015).⁶ At 663,300 sq. mi. or nearly 2.5 times larger than Texas, Alaska is the largest state in the U.S. and

⁶ An abundance of invasive species studies are conducted in tropical regions or on small island nations. A significantly smaller portion of studies address invasive species management in northern latitudes and in large landmasses. This study helps contribute to this scarcer literature.

about 52% of the state is considered wilderness (Wilderness Connect 2019) Additionally, Alaska is unique because it is a mixture of islands and a large land mass. Both the vast size and abundance of wilderness in Alaska make traditional management of the state's resources challenging, even with advanced technologies. Furthermore, the remoteness of many areas in Alaska causes normal law enforcement to be both daunting and difficult since officials are unable to efficiently monitor most areas in the state. Instead of relying on the limited resources of conservation managers, engaging the Alaskan public ensures that remote areas are monitored for invasive species. The Alaskan public must be engaged in invasive species prevention efforts in order to ensure successful program implementation.

Yet, social challenges inhibit the involvement of the public and hence effective invasive species prevention efforts. Various belief barriers hinder invasive species prevention efforts by limiting the permeation of knowledge and concern about invasive species throughout the public (Prinbeck, Lach, and Chan 2009).⁷ A case study which surveyed Florida residents provides a clear example of the impacts of such belief barriers on public engagement. Although Florida is overrun with invasives, 63% of survey respondents reported being slightly or not knowledgeable about invasive species (Huang and Lamm 2016). When respondents were asked about their knowledge of prevention strategies, 66% of respondents reported they were either slightly or not knowledgeable about how to prevent the spread of invasive species (Huang and Lamm 2016). The presence of belief barriers in Florida contributed to limited public engagement in combating the spread of invasive species, despite the plethora of tangible examples of the negative impacts

⁷ Prinbeck, Lach and Chan identify 6 social barriers: invasives species prevention strategies are perceived as worse than the presence of the invasive species, fighting invasive species is in itself a losing battle, invasive species are a low managerial priority, the general public does not know nor care about the presence of invasive species or effective preventative efforts, and lastly, recommended preventative behaviors are perceived as demanding of the public.

of invasive species. Furthermore, invasive species denialism has increased over the last three decades (Ricciardi and Ryan 2018). Invasive species denialism is a variation of science denialism which is defined as “the use of rhetorical arguments to give the appearance of legitimate debate where there is none, with the ultimate goal of casting doubt on scientific consensus” (Ricciardi and Ryan 2018). When coupled with the belief barriers against invasive species, invasive species denialism not only damages public engagement, but also detracts from effective management overall.

Communication efforts are a strategy to overcome social challenges affecting invasive species management. Such efforts establish a framework through which the public learns how to appropriately respond to situations with which they have little experience (Gamson and Modigliani 1989, Melero 2017). On the other hand, when information is improperly communicated, the public can be discouraged from acting on an issue and denialists or other groups in society are able to step in and shift the public’s perception of the management effort (Warner and Kinslow 2011). Through targeted communication messaging, the public can be empowered to take action regarding the spread of invasive species. However, how communication efforts are structured is an ongoing debate in conservation management.

Traditionally, the scientific community pushed for the need to promote scientific literacy among the public. Scientific literacy is defined as the ability of the public to understand basic scientific concepts and critically evaluate scientific evidence (Laugksch 1999). Rather than focusing on a particular topic, authors argued that the general public should be taught to think analytically (Diethelm and McKee 2009). The foundation for this argument stems from research discussing the public's exposure to fake news, with individuals who consume false news being more susceptible to inaccurate claims (Balmas 2012). This line of argument asserts that by using

critical thinking the public can be taught to discern between un-trustworthy and reputable scientific claims. Although scientific literacy can help develop a toolkit to overcome invasive species denialism, scientific literacy can also result in the reinforcement of false beliefs as the same strategies which can be used to debunk a false finding are utilized to criticize rigorous science as well. Furthermore, in the case of invasive species, the scientific literacy argument is insufficient because it does not account for the existing belief barriers about invasive species. For example, some invasive species prevention efforts are perceived as too complex to even undertake and in other cases certain invasive species are considered desirable (Clavero 2014, Prinbeck, Lach, and Chan 2009). The presence of belief barriers along with the continued rise in invasive species denialism, despite efforts at promoting scientific literacy, indicate that the public's lack of action regarding invasive species management is not due to a lack of critical thinking.

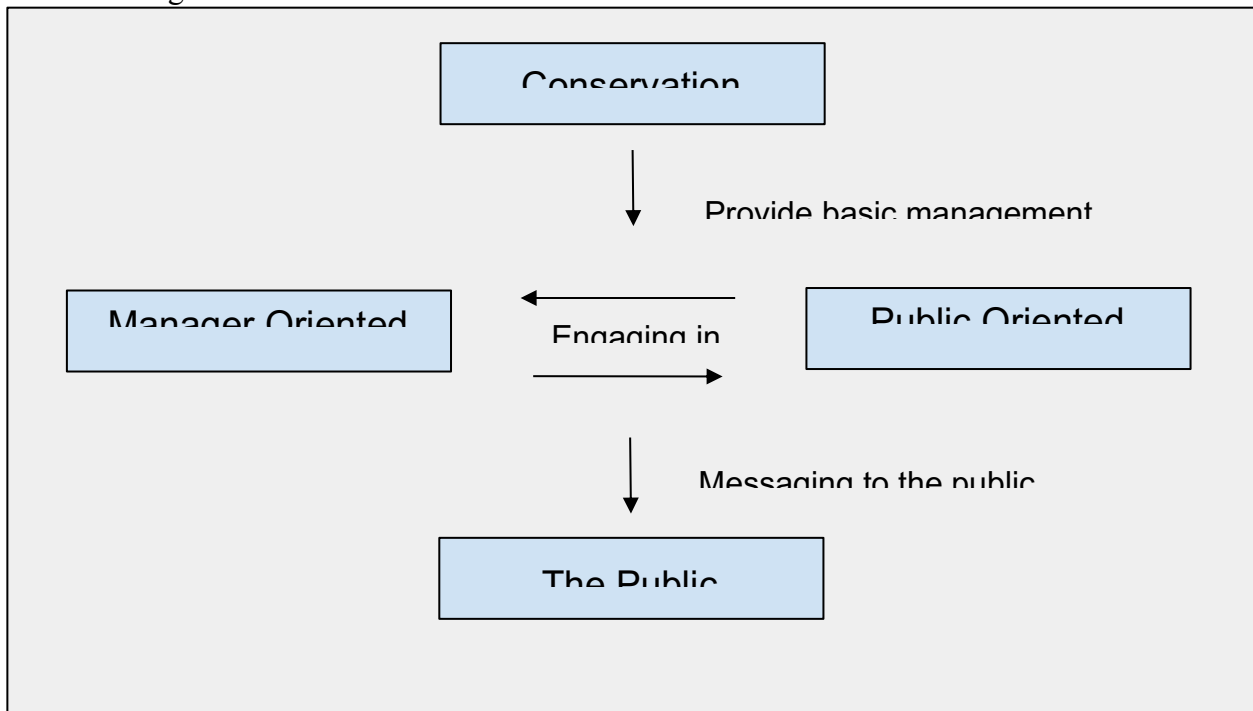
An alternative argument for raising awareness about invasive species incorporates a deficit model. Within the deficit model, the public's rejection of scientific information is driven by a lack of knowledge or understanding of the issue at hand (Wald et al. 2018). Unlike the scientific literacy argument, the deficit model necessitates that conservation managers explain the reasoning behind conservation strategies (Selge, Fischer, and van der Wal 2011, Bremmer and Park 2007, Wald et al. 2018). By explaining the reasoning behind conservation management, conservation managers are able to counteract some of the belief barriers like the perceptions that invasive species are a low management priority or the negative perception of invasive species preventative strategies. Including public input in conservation management also helps individuals with less certainty about management develop more favorable outlooks towards the management approach (Herlan et al. 2012). With better outlooks on invasive species

management, the public becomes inherently less susceptible to invasive species denialist claims since the public is taught to appreciate the need for invasive species prevention.

Another significant difference between the scientific literacy model and the deficit model is the incorporation of personal values into communication messages in the deficit model. Selge, Fischer, and van der Wal argue for conservation managers to understand the drivers behind the public's perceptions or actions (2011). Understanding the public's perceptions and actions further counteracts belief barriers that the public may be harboring, such as the level of existing knowledge and concern among the public about invasive species. Individuals can feel empowered through communication strategies by using "driver models" which directly connect a person's actions with their impact on environment (Hart and Larson 2014). Additionally, communicating through personal values helps contextualize conservation within a community context (Bowen-Jones and Entwistle 2002). For many, empathy, self and community benefits, and a sense of personal responsibility about biodiversity loss are cited as important drivers for action (Melero 2017). Therefore, by contextualizing information about invasive species prevention within a personal context, conservation managers can increase the lay persons level of support for invasive species prevention efforts or attitudes towards prevention efforts. Understanding the value systems of the public therefore becomes an important first step when designing the message for the deficit model.

The Social Contract

Table 1: Diagram of the Social Contract



Using the deficit model to reach every individual in the public is extremely challenging due to cost and time constraints, necessitating the delineation of opinion leaders (Abroms and Maibach 2008, Seekamp et al. 2016). Some information sources and venues are trusted by both the public and conservation managers. These sources and venues are also known as opinion leaders and they are necessary to disseminate information to an audience (Seekamp et al. 2016). Opinion leaders have the potential to influence both their local and transient communities by disseminating information and impacting normative social pressures (Howell, Shaw, and Alvarez 2014). With invasive species, both conservation managers and the public must have opinion leaders to guide the discussion about preventing the spread of invasive species.

Both groups of opinion leaders receive information from conservation managers. Manager-oriented opinion leaders are either groups of individuals or organizations who participate in collaborative efforts to prevent the spread of invasive species. Manager-oriented

opinion leaders do not have to be conservation managers themselves, but are actively involved in processing information to present to the public through research, outreach, policy work, etc. On the other hand, public-oriented opinion leaders are trusted members in local communities who are willing to share messages with their local community. Public-oriented opinion leaders engage in a dialogue with the manager-oriented opinion leaders to provide feedback about the information the manager oriented leaders wish to share with the public. Either group of opinion leaders, manager- or public-oriented, can distribute information to the public. Nonetheless, the presence of opinion leaders to moderate the spread of information creates a social contract for science between the conservation managers and the public.

The social contract for science builds off of the political theories of 18th century philosophers. In the 18th century social contract, people give up rights to a governing body in exchange for protection. The social contract for science operates in similar terms with the public giving something up in exchange for something else from managers, but rather than trading protection for rights, the social contract for science is an exchange of information. In the social contract for science, science makes discoveries and passes them to the public through a principal agent model (Gibbons 1999, Guston 2000). The principals are the conservation managers who create delegation for the agent while the agent is the public which performs the delegated task (Guston 2000). Other authors, such as Lubchenco, called for the social contract for science to be expanded to be ecologically sound, economically feasible and socially just in order to accommodate for environmental and social change (Lubchenco 1998). Lubchenco also calls on scientists to lead the dialogue of scientific priorities, new institutional arrangements, and improved mechanisms (1998). Within this conceptualization of this social contract, society expects science to produce both useful and best science (Lubchenco 1998).

According to the social contract for science, social authority breaks down when the linkages between various groups are inadequately established (Gibbons 1999).⁸ Oftentimes, opinion leaders must balance the conflictual objectives of conservation managers and the public in order to create a successful chain of information to prevent the spread of invasive species (Marris et al. 2006). For example, recreational fisheries worry about control measures for invasive species, but conservation managers tend to express greater interest in the early detection of invasive species in addition to the cost of managing the invasive species (N'Guyen 2015). Furthermore, the presence of belief barriers against managing invasive species contributes to the different perceptions among conservation managers and the public, resulting in a general distrust of managers by the public (Wald et al. 2018). Opinion leaders can combat the disconnect between conservation managers and the public through tailored communication efforts which can help create a shared research foundation (N'Guyen et al. 2015).⁹ Therefore, the theory is as follows:

Conservation managers have a social contract with the public which is moderated by opinion leaders. The linkages between conservation managers, opinion leaders, and the public allows conservation communication initiatives to be executed efficiently.

However, if coordination points in social networks are disregarded, the social contract for science is no longer effective.

⁸ Additional calls for updates to improve the effectiveness of policy have included changing how science is discussed and valued in society in general (Guston 2000).

⁹ Communication is the process of science speaking to the public and the public speaking back (Gibbons 1999).

Hypotheses:

- 1) The social contract for science is ineffective when opinion leaders are misaligned in their value systems.
- 2) Manager-oriented and public-oriented opinion leaders for invasive species will differ based on their level of knowledge and comfort regarding invasive species management due to failed communication efforts.
- 3) The social contract for science is ineffective when managers present information to the public without establishing a social connection.

Methodology

The study consists of a two-part approach. In part one, I assess data gathered at the Annual Invasive Species Workshop. The Annual Invasive Species Workshop is a focal point for various manager-oriented opinion leaders to meet and discuss ongoing developments in invasive species management throughout the state of Alaska. During the weeklong conference, between 100-150 attendees listen to various presentations from conservation managers and fellow opinion leaders on current and emerging invasive species issues facing the state (UAF 2019). External speakers are also invited to present their findings from invasive species preventative efforts in the contiguous U.S.

I create a sample pool for the conference by stratifying the list of 34 presenters at the conference into the following groupings: university, official, federal agency, corporation, tribal organization, state agency, and nongovernmental organization. Using a random number generator, I rank the presenters to determine the order in which I plan to interview them. I follow the list from left to right, ordering the speakers based on the random number and rotating through

the organizations. However, it is important to note that the ranking is a guideline and not a concrete list. Actual interviews are conducted in an approximate manner of the randomized order because each grouping has a different number of presenters and many of the speakers arrive and leave at various points in the conference. Interviews are conducted between panels and before/after events of the week-long the conference.

Part two of the study supplemented the manager-oriented opinion leader data from the conference with public-oriented opinion leader data from bait and tackle shops throughout the state. In the case of Alaska, bait and tackle shops are public-oriented opinion leaders because outdoor recreation vendors in general are identified as opinion leaders (Howell, Shaw, and Alvarez 2014). The bait and tackle shops are particularly effective in disseminating information, and their engagement in conservation practices impacts normative social pressures on the general public (Howell, Shaw, and Alvarez 2014). The shops are able to disseminate information to resource users who are vectors for the spread of invasive species. For example, aquarists, water gardeners, outdoor pond owners are vectors for the spread of invasives (Seekamp et al. 2016). The focus is then further narrowed to local vendors because local vendors in Alaska are often well established, helping to account for the transience of temporary pop-up shops. Furthermore, local vendors are likely to be members of the communities where they own their shops, entailing that they are aware of community issues outside of a store setting.

In order to generate a sample pool of the bait and tackle shops, I begin by creating a comprehensive contact list of various vendors that provide equipment or tours for outdoor recreationists living or visiting Alaska. With assistance from the Fisheries and Ecological Services staff of the U.S. Fish and Wildlife Service, I select a sample of 31 local outdoor recreation vendors was selected. The selected areas focus on major hubs in Interior and

Southcentral Alaska where most of the state's population is located.¹⁰ Surveys are conducted within the following cities/towns: Anchorage; Fairbanks; Seward; Soldotna; Wasilla; and Kodiak. At each location, store managers or owners are interviewed, acting as representatives for the given location.¹¹ Some locations require multiple visits in order to meet with the point of contact.

Similar questionnaires are developed for both parts of the study. For part one, a nine-question interview is utilized to collect manager-oriented opinions on personal and organizational values, management decisions, and prevention efforts. The survey undergoes several revisions and is approved by the College of William & Mary's Student IRB. For part two, a ten-question interview is used to assess vendors' values, knowledge, and level of concern about invasive species. The questions are reviewed by a U.S. Fish and Wildlife Service Information Collection Clearance Officer as well as the agency's Human Dimensions Branch. The second interview is ultimately approved by the U.S. Office of Management and Budget. In both cases, many of the questions allow for multiple responses. Not all participants answer all of the questions and respondents could report multiple answers. Each participant is asked the following series of questions in the order shown in Appendix 2, Figure 1 and Figure 2. In both questionnaires, respondents are asked to think about their personal values and on behalf of their business/organization in order to control for the differences between the two.

Once all of the interviews are conducted, the responses are transcribed and then coded into categories to allow for the emergence of broader themes within both datasets.

¹⁰ See Appendix 1 in order to view a distribution of population data in the state.

¹¹ The terms owners, locations, or businesses are used interchangeably throughout the remainder of the paper.

Results

In part one of the study, interviews were conducted with 28/34 selected presenters. From the “University” category 5/7 presenters were interviewed. From the “Officials” category 1/2 presenters were interviewed. From the “Federal Agencies” category 6/9 people were interviewed.¹² From the “Nongovernmental Organization” category, 3/4 presenters were interviewed. All selected presenters from the “LLC” (2/2), “State Agencies” (6/6), and “Tribal Group” (4/4) were interviewed.¹³ An additional 3 conference attendees were also interviewed because several of the presenters recommended them as reputable manager-oriented opinion leaders regarding invasive species management efforts in the state. Two of the additional interviews were with federal employees and one was with a representative from a nongovernmental organization. Commonalities arose within and across the interviews. Nonetheless, responses from opinion leaders varied by organization. Both quantitative and qualitative results are discussed below.¹⁴ For more information about responses to the following questions, see Appendix 3.¹⁵

¹² Agencies which were represented at the conference included: the US Fish and Wildlife Service, National Oceanic and Atmospheric Administration, US Forest Service, and the US Department of Agriculture.

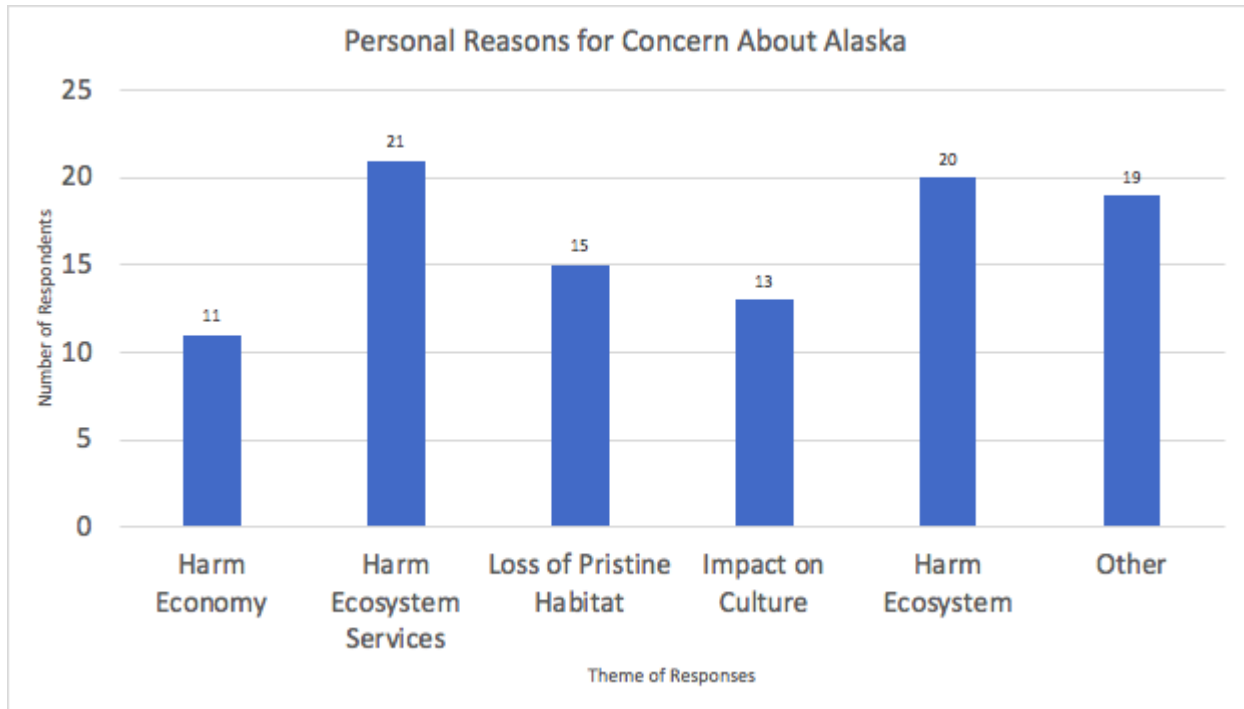
¹³ Respondents are described interchangeably as respondents, representatives, or opinion leaders with a certain background.

¹⁴ Quotes from respondents are not verbatim. Due to time constraints as well as IRB restrictions, only notes were jotted from interviews.

¹⁵ Not all questions are discussed in the results section.

Results from the Annual Invasive Species Workshop

Conference Survey Question 1: Why do you think invasive species are a concern to Alaska?

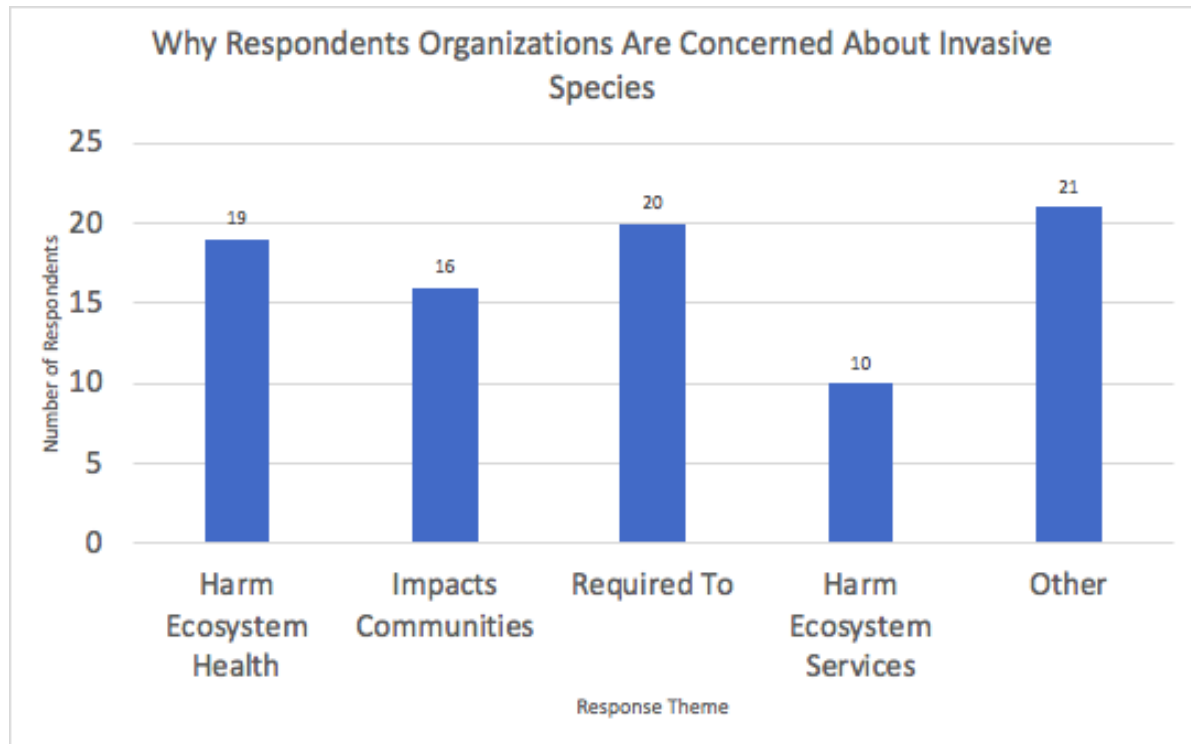


Opinion leaders in invasive species efforts were primarily concerned with the state's ecosystem and its services. Whether as a threat to Alaska's ecosystem services (21 respondents), a threat to Alaska's ecosystem (20 respondents), or as contributing factors to Alaska's pristine habitat (15 respondents), many of the manager-oriented leaders were invested in maintaining the integrity of Alaska's natural resources. The category "Ecosystem Services" differentiated from the category "Harm Ecosystems" because whereas "Ecosystem Services" incorporated responses such as recreation and how the ecosystem can be used, "Harm Ecosystems" encompassed responses which addressed preserving the ecological integrity of the Alaskan ecosystems. Many of the respondents also emphasized that Alaska is one of the few pristine ecosystems that has remained "untouched" and has "too much to lose" if invasive species are allowed to degrade its lands and waters. Although "Loss of Pristine Habitat" may be incorporated into both "Ecosystem Services" and "Ecosystem," these responses received their own category because they captured

sentiments of the intangible benefits of Alaska's wilderness. Unlike the "Ecosystem Services" and "Ecosystems" categories, "Loss of Pristine Habitat" was a phrase imbued with human values. One state respondent captured all three of these sentiments when he noted: "I live in Alaska because of the wildlife, fisheries, and overall undisturbed ecosystems. Invasives threaten all of this. With invasive species in the state, there is only a negative impact and if nothing is done to address their presence then it's only going to get worse."

Another category worth noting was the importance of culture in many of the responses. Overall, 13 respondents expressed concern with invasive species because they "Impact Culture." A university respondent noted that "Alaska depends both literally and emotionally on its natural resources." Several respondents acknowledged that invasive species damage this linkage between culture and natural resources by degrading existing resources and threatening cultural symbols like salmon. Tribal representatives were especially concerned about the threat of invasive species to the cultural values of their respective indigenous communities. One tribal representative discussed the impending reality of invasive species impact on the tribes when she stated that "Invasive species risk recreational activities, wildlife and wilderness, but for the tribes, they are a risk to subsistence resources. Without the resources, the tribe can't continue cultural traditions."

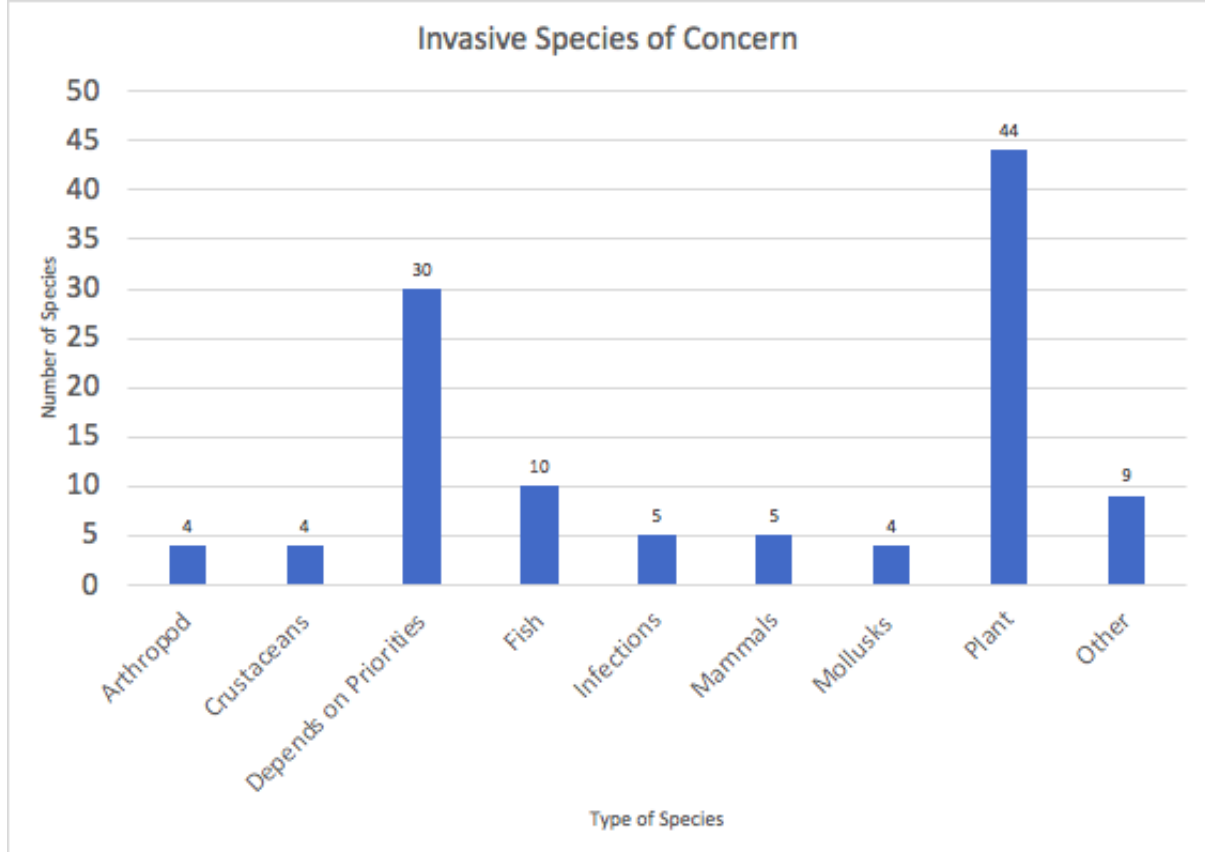
Conference Survey Question 2: Why is your organization concerned with invasive species in Alaska?



Although presenters and their organizations shared similar concerns, the terminology used to describe the concerns differed. Once again, “Harm Ecosystem Services” comprised several responses, but to a lesser extent with only 10 respondents citing it as a concern for their organization. Other categories varied from the first series of responses in the language used to describe them. Rather than stating that invasive species “Harm Ecosystems,” presenters stated that their organizations were concerned with “Ecosystem Health.” Instead of talking about how invasive species “Impact Culture”, respondents stated that their organization is concerned with “Impacted Communities.” Once again, tribal representatives noted the importance of culture in the context of invasive species management. For example, a tribal representative noted that “Subsistence and culture are first and foremost intertwined. The fish are the most important to the tribe and if you compromise the fish, that is problematic. This summer, the runs were bad and by adding stressors like invasive species these aspects add up.”

Another distinction between individuals and their organizations was in the categories of state and federal respondents. All federal representatives and most state agency representatives stated that their organization's interest in invasive species management was because they are required to deal with invasive species through mandates and policies. A federal respondent stated: "As part of my agency, our job is to manage forests. We strive to achieve the greatest good for the greatest number of people and we can't do that if the ecosystem is degraded. By policy, executive orders, and mandates, it's our job to manage invasive species." Between federal and state respondents, state level respondents expressed that their organization had a greater distribution of concerns with some respondents listing concern over ecosystem services and the cost-effectiveness of prevention as justifications for involvement in invasive species management. In contrast to the federal representative, a state representative explained that "Every state is concerned with invasive species because their presence becomes more expensive and we can't predict their impacts. We've also seen what happens when their presence isn't addressed." Federal and state respondents inflated the "Required To" category, which is composed of 20 respondents, but nongovernmental groups also attributed some of their work to their mission statements and other forms of commitments to combating invasive species.

Conference Survey Question 3: Is there a particular invasive species with which you or your organization is concerned with?

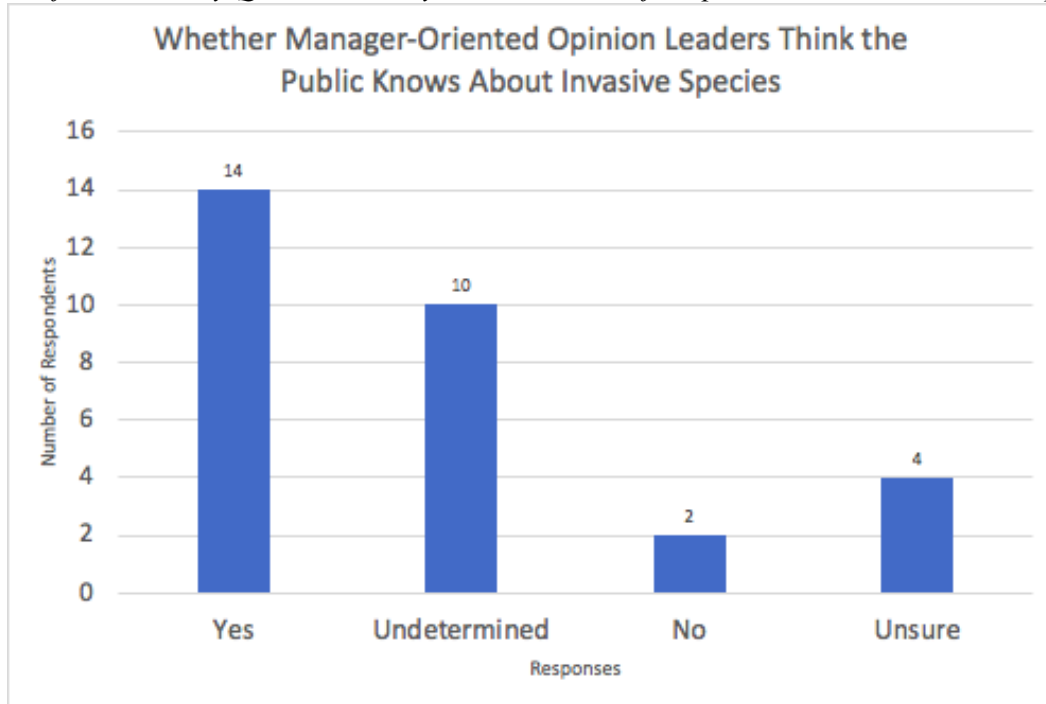


Management-oriented opinion leaders listed a plethora of invasive species with which they were concerned with. Responses to this answer could be mentioned in other questions, but were only coded as once per conversation. Listed species range from Siberian Silk Moths, to European Green Crabs, to Bird Vetch. Nonetheless, plant species dominated conversations with 44 different plant species mentioned during interviews. Among the plant species listed, Elodea was mentioned by 12 respondents. Elodea was also the most commonly cited invasive species of concern overall. The interviewed official stated that “Elodea is our number one priority because we’ve seen how fast it grows and its impacts in Anchorage.” Northern Pike was the second most listed invasive species, having been mentioned by 7 respondents. Hawkweed and Bird Vetch tied for third from among specific invasive species listed, having been mentioned by 6 respondents. Discussion of other invasive species taxa was more dispersed with many species being listed

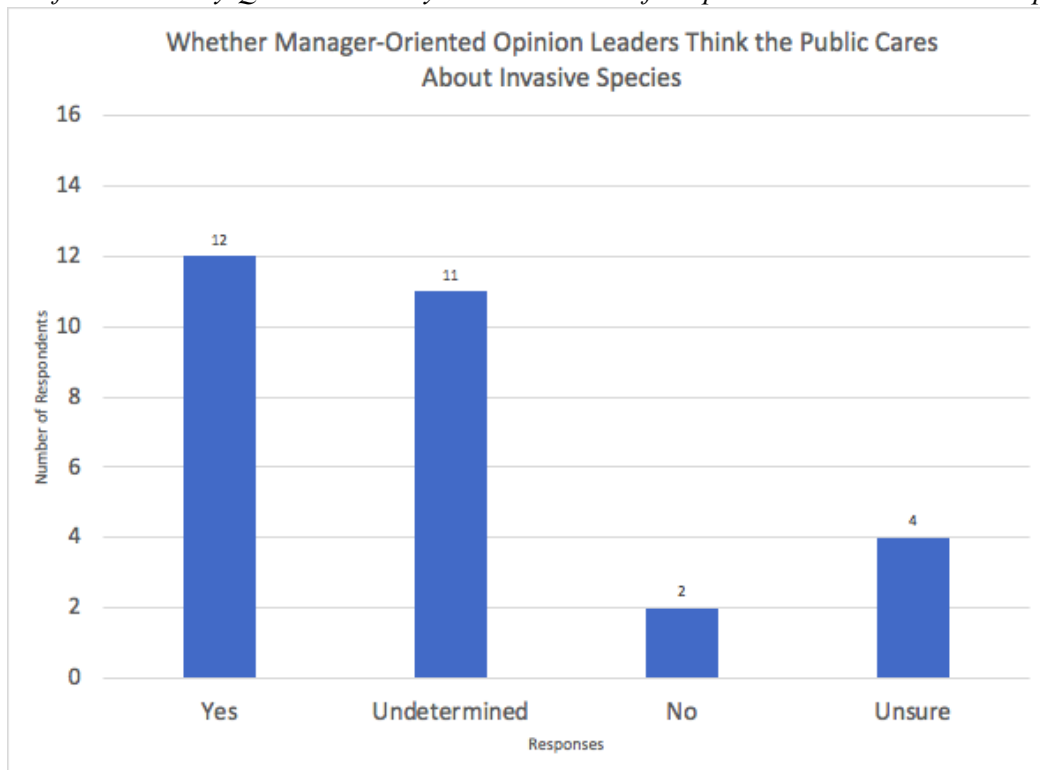
only once or twice. Different groups at the conference also differed in the number of invasive species they listed as part of their responses. Tribal representatives tended to focus on single invasive species with which they had management experiences whereas university respondents tended to list a variety of species of concern.

The category “Depends on Priorities” was mentioned 30 times when asked about invasive species of concern. Priorities were based on circumstances and regions, as well as ranking systems like the Alaska Center for Conservation Science and internal priority lists for organizations. A university representative explained that “Prioritizing which invasive species to address is tricky because in some cases we’ve lost the war. We use priority lists to eradicate and contain invasive species. Which invasive species you’re managing also depends on where you are in the state.” A state representative also discussed their organizations use of a ranking system in addressing invasive species invasions. He stated: “We use a top 50 list at the Council. We’re looking at dreissenid mussels, feral swine, northern pike, diseases such as whirling, and so on. The top fifty are chosen from a matrix and expert panels assess the invasive species level of risk and their manageability.”

Conference Survey Question 4: Do you think sectors of the public **know** about invasive species?



Conference Survey Question 5: Do you think sectors of the public **care** about invasive species?



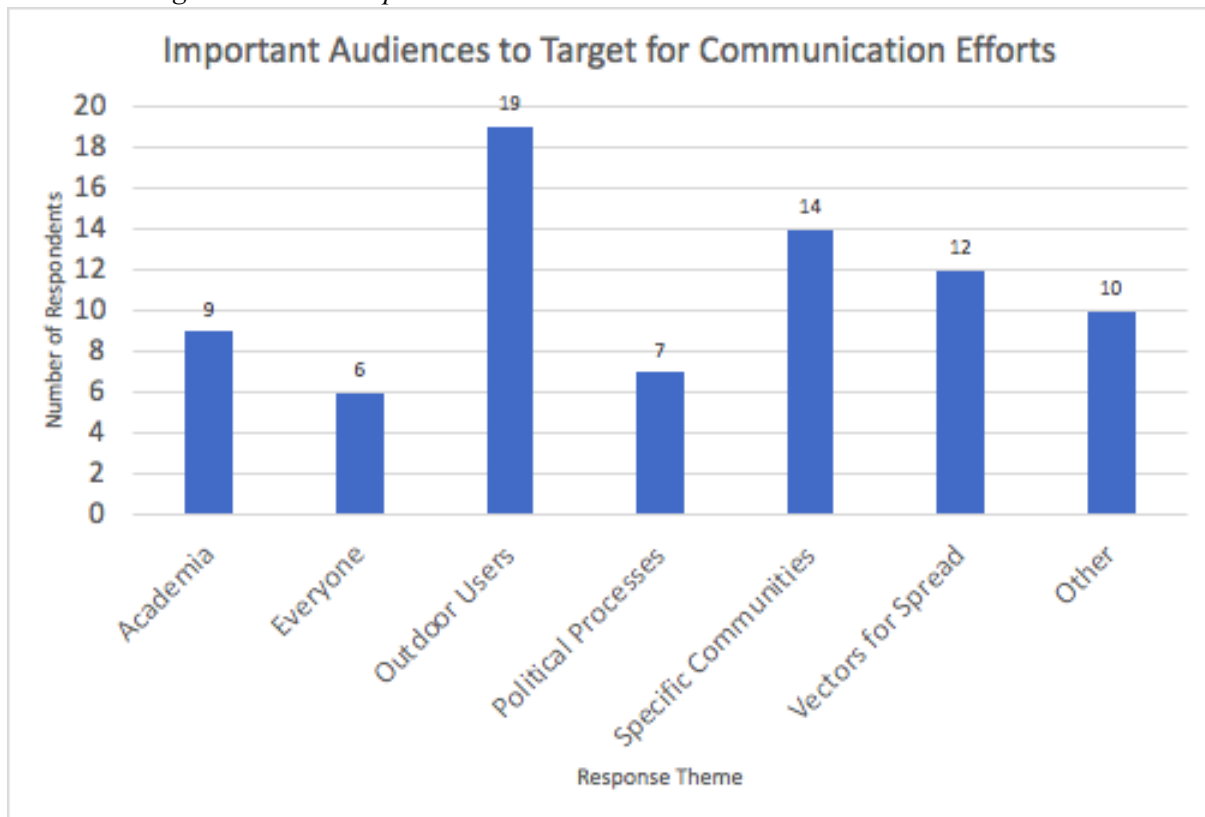
Questions 4 and 5 had similar responses, with a majority of conference presenters thinking that sectors of the public both know and care about invasive species. Only two responses were “No” for both questions and both were from federal employees. Within the “Undetermined” category, the respondents exhibited concern over the level of knowledge available to sectors of the public as well as the public's familiarity with the impacts of invasive species. Many seemed to think that if the knowledge is presented to the public then the public will respond accordingly. As an LLC representative described the predicament: “Very little of the public knows about invasive species. There’s a lack of common knowledge...They don’t care because they don’t know, but if they had the education then they would.” A respondent from one of the tribes also commented that “The public is clueless about invasive species. They know the basic concept of weeds. Besides us, the biologists, the public is not well informed.” Another respondent later added that “If everyone knew about the impact of invasive species, then they would likely care. These actions aren’t done maliciously, but out of ignorance.” University respondents were the most optimistic about sectors of the public knowing and caring about invasive species. Only four respondents were unsure about whether sectors of the public know or care about invasive species.

For both questions, respondents also noted that their responses were species and area dependent. Species-wise, terrestrial invasive species were assumed to be less well known by the public than aquatic invasive species. Other cases demonstrated that level of knowledge also varied by area with representatives from island communities explaining that invasive species prevention efforts in their communities are distinct from the broader state of Alaska. A tribal representative from an island community described that “Yes we know a lot about crayfish in Kodiak because we’re eating them and orange hawkweed too, but even then many don’t know

that hawkweed is invasive because it's pretty. The general public probably knows less, especially in bigger areas like Anchorage. We're a small town so we read signs." A second tribal representative also illustrated the distinction between the general Alaskan public and her island community: "On the island community people definitely know about invasive species. In the broader state of Alaska, they don't, but even being here at the conference, I'm here to learn and I feel like I know nothing now."

Several other trends should also be noted in responses to both of these questions. A common trend throughout several of the opinion leaders are comments of "hope so." Similarly, some respondents noted that some sectors know about invasive species, but the number of people who know is trivial. A federal respondent captured this sentiment when he said "Yes, some sectors know, but they're a small percentage of sectors and an even smaller percentage within them." Additionally, some respondents wavered in their confidence of whether the public both knows and cares about invasive species. The federal respondent directly stated that no the public does not know, but yes some sectors care. Other respondents fluctuated more in their responses. For example, one state representative answered "Yes" that the public knows about invasive species, but when asked about whether sectors of the public care about invasive species, the same respondent answered "Some". The media attention given to invasive species in the lower 48, with Florida in particular, was also cited as the antithesis of the pristineness of Alaska's resources and therefore an informative example for Alaska's public about the dangers of invasive species. A respondent from a nongovernmental organization stated: "We're seeing more and more people know about invasive species as snowbirds come from areas riddled with invasive species, like Florida." Another recurring trend among responses for these questions was mentions of the lack of funding to engage in research to assess public opinion.

Conference Survey Question 6: In your opinion, who is the most important audience to target when communicating about invasive species?

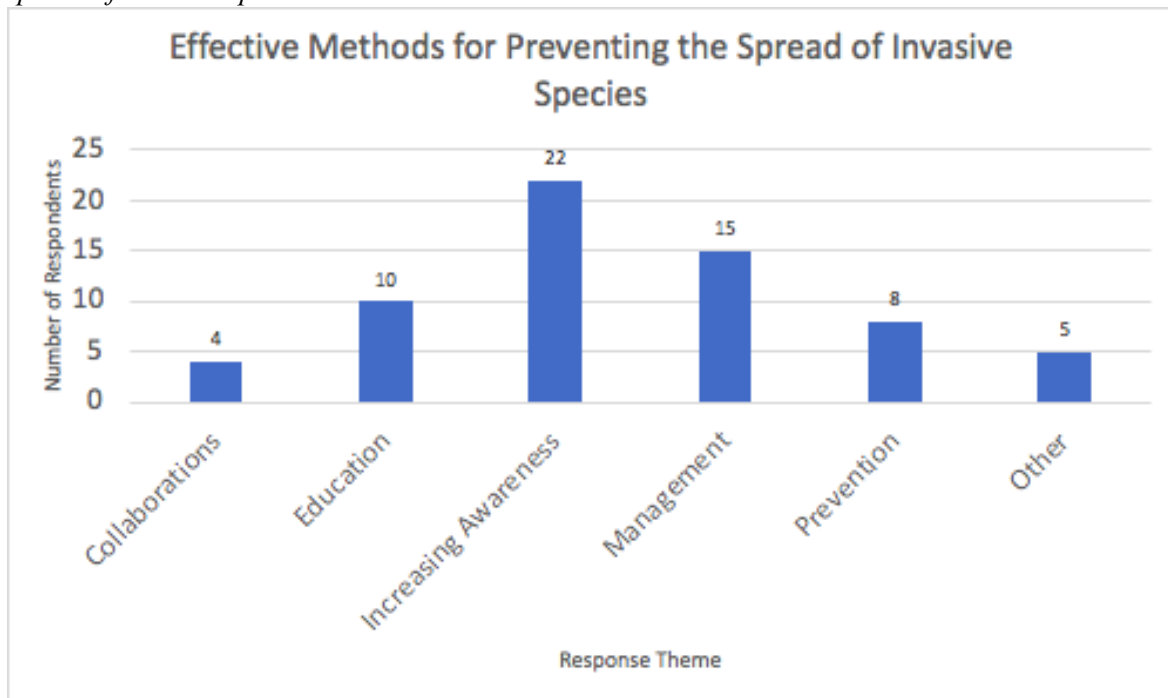


When asked about who is the most important audience to target regarding invasive species, “Outdoor Users” comprised the largest portion of responses (19 respondents), but otherwise the responses were relatively mixed. “Outdoor Users” included hikers, fishermen, hunters, subsistence communities etc. Before being condensed into broader themes, the category “Outdoor Recreationists” comprised the largest identified target group with 9 respondents stating that outdoor recreationists are an important audience to target. While many respondents within the “Everyone” category (comprised of 6 respondents) simply stated everyone should be targeted for communication efforts, one respondent also described the need to target everyone but delineate sectors within the broader mass. The state representative described how “We need to communicate to everyone. We have to identify those who can move invasive species, those

who are impacted by invasive species, those who care about invasive species, and the negative impact of invasive species. Then we need to split them apart and target specific groups.”

The “Vectors” category was differentiated from other categories because although most of the other groups can be identified as vectors for the spread of invasive species, the “Vectors” category specifically concerned individuals and organizations spreading invasive species such as recreationists in infested areas. A university respondent explained that “We need to target rural Alaskan communities and off the road systems. Youth are important too. Also, we should focus on people bringing people.”

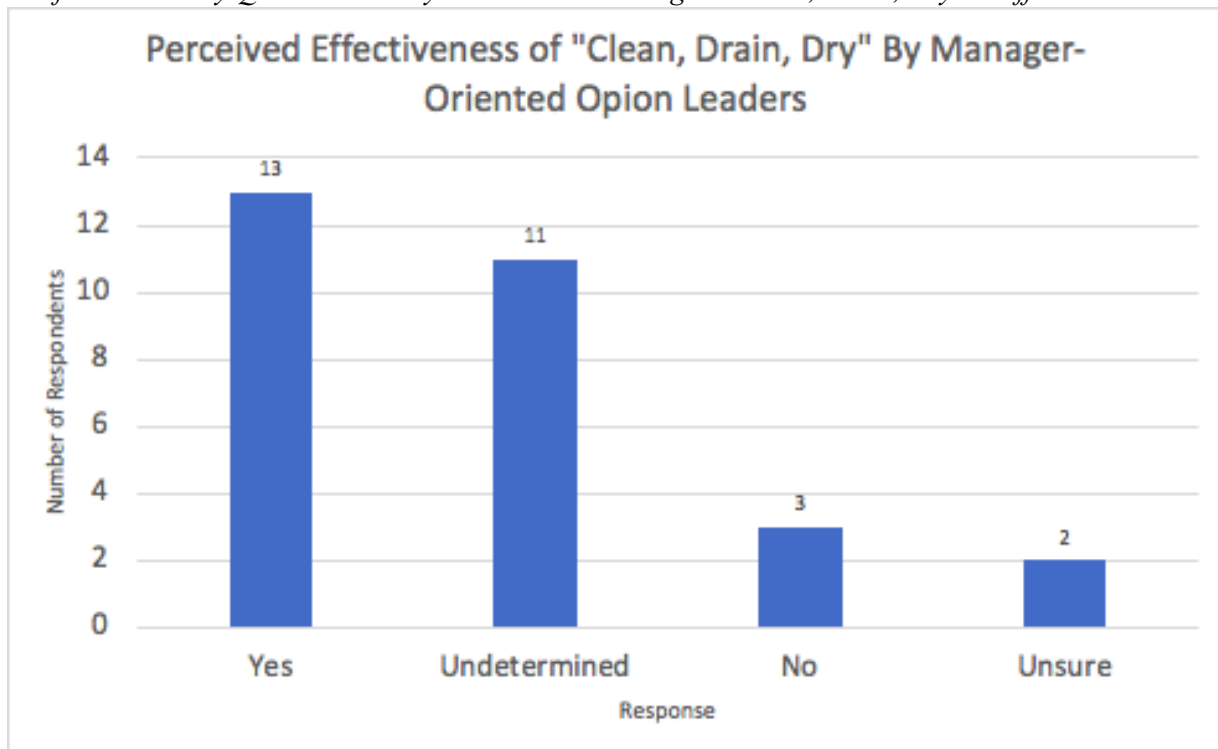
Conference Survey Question 7: In your opinion, what’s the most effective method of preventing the spread of invasive species?



Although many respondents stated that effective strategies vary by sector and vector, “Increasing Awareness” (22 respondents) was listed as the most effective method of preventing the spread of invasive species. Aspects of awareness included inreach and outreach. Although recognizing that inreach and outreach are important mediums, a state representative noted: “I’m

a biologist. I don't know how to communicate information in the best ways." An NGO representative who was interviewed at the same time agreed. The second most popular approach to preventing the spread of invasive species, mentioned by 15 respondents, was identified as "Management." For the "Education" category, several respondents listed only education as an effective method of preventing the spread of invasive species.

Conference Survey Question 9: Do you think that the slogan "Clean, Drain, Dry" is effective?



Opinion leaders were asked to provide their opinion on the effectiveness of the "Stop Aquatic Hitchhikers Campaign!"¹⁶ For this question, only one response was coded for each respondent to minimize the conflation between the "Yes" and "Undetermined" categories. Many of the responses, 13 of the respondents, expressed support for the effectiveness of "Clean, Drain,

¹⁶ "Stop Aquatic Hitchhikers" is one of the most well recognized messaging campaigns for limiting the spread of aquatic invasive species. Its byline is "Clean, Drain, Dry." Since Alaska is dependent on its water bodies, I chose to focus on this campaign rather than other well known invasive species prevention slogans (eg: the "Don't Move Firewood" campaign).

Dry.” Some of the respondents briefly elaborated on why they believed “Clean, Drain, Dry” to be effective, describing the slogan with phrases such as “direct and obvious”, “saturated”, and “action oriented.” The interviewed official stated that “I do think it’s effective. It’s like when you hear something seven times. We have to mimic the level of the campaign by saturating it at every opportunity.” However, many of the “yes’s” were hesitant or conditional. For example, one respondent from a state agency noted that “We love to have it, but I don’t know the studies. The slogan seems to be effective but we don’t have the resources. We’ve done a study with “Don’t Move Firewood.” We hope so, yeah.” Some of the respondents who said “Yes” also admitted that although they like to think that it is an effective slogan, they recognized the bias of their response as people working in the field of invasive prevention. Every respondent from a state agency said “Yes,” whereas respondents who were federal employees were split with about half saying “Yes Clean, Drain, Dry is effective” and others stating that its effectiveness is undetermined.

The “Undetermined” category (11 respondents) included features such as the need for fines for “Clean, Drain, Dry” to be effective or the condition that the slogan has to be sufficiently disseminated throughout the state. Additionally, several respondents noted the presence of a “gut feeling” when discussing the effectiveness of “Clean, Drain, Dry”. Yet, others and sometimes the same respondents, noted that the slogan may be effective in the “lower 48,” but was not practical in the state of Alaska. Cordova was a commonly cited place in Alaska where the effectiveness of the slogan comes under question. Due to abundant rainfall, the “Dry” aspect of “Clean, Drain, Dry” becomes impractical.¹⁷ When asked about the “Clean, Drain, Dry”, a respondent from the university discussed his hesitancy about the effectiveness of the slogan, citing his personal

¹⁷ According to U.S. Climate Data, Cordova experiences an average annual precipitation in rainfall of 148.37 inches.

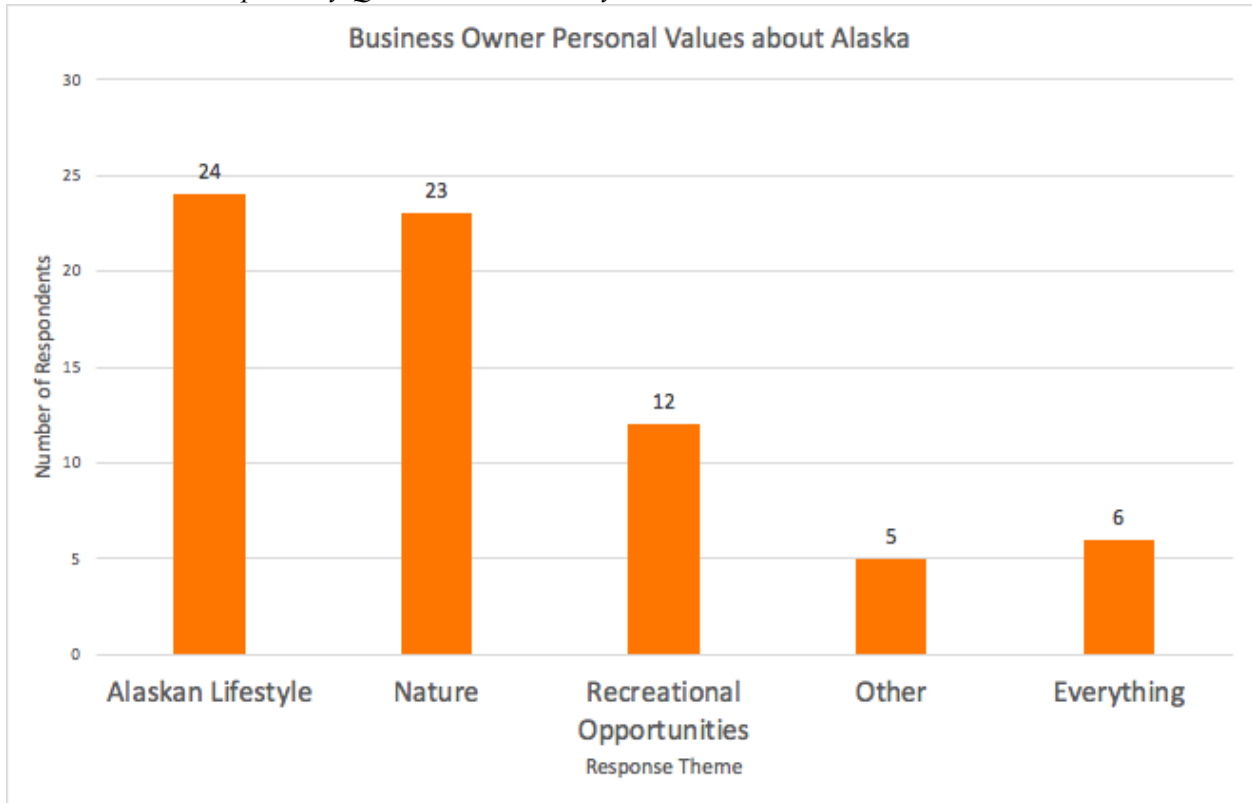
experiences as evidence. He said “As a boater without a garage, I try to do these steps, but when it isn’t dry, it’s not always possible. The slogan can be effective if it hits everyone, but we need to make it practical and make it hit home. It’s not that bad, but it’s not long enough.”

Results from the Bait and Tackle Shops

In part two of the study, interviews were conducted with 24/31 selected locations. As the largest city in the state, there were nine stores selected from Anchorage and all were interviewed. In Fairbanks, 5/7 locations were interviewed. In Seward, only one location was selected, but the owners declined to participate. In Soldotna, 2/5 locations were interviewed and although one location declined to participate, the owner did contribute insights. In Wasilla, 3/3 locations were interviewed. Lastly, in Kodiak, 5/6 locations were interviewed. Commonalities arose within and across the interviews. Nonetheless, responses from businesses tended to vary by geographic locations. Both quantitative and qualitative results are discussed below.¹⁸ For more information, see Appendix 4.

¹⁸ Similarly to the opinion leader surveys, quotes from respondents are not verbatim. Due to time constraints as well as IRB restrictions, only notes were jotted from interviews.

Bait and Tackle Shop Survey Question 1: What do you value most about Alaska?

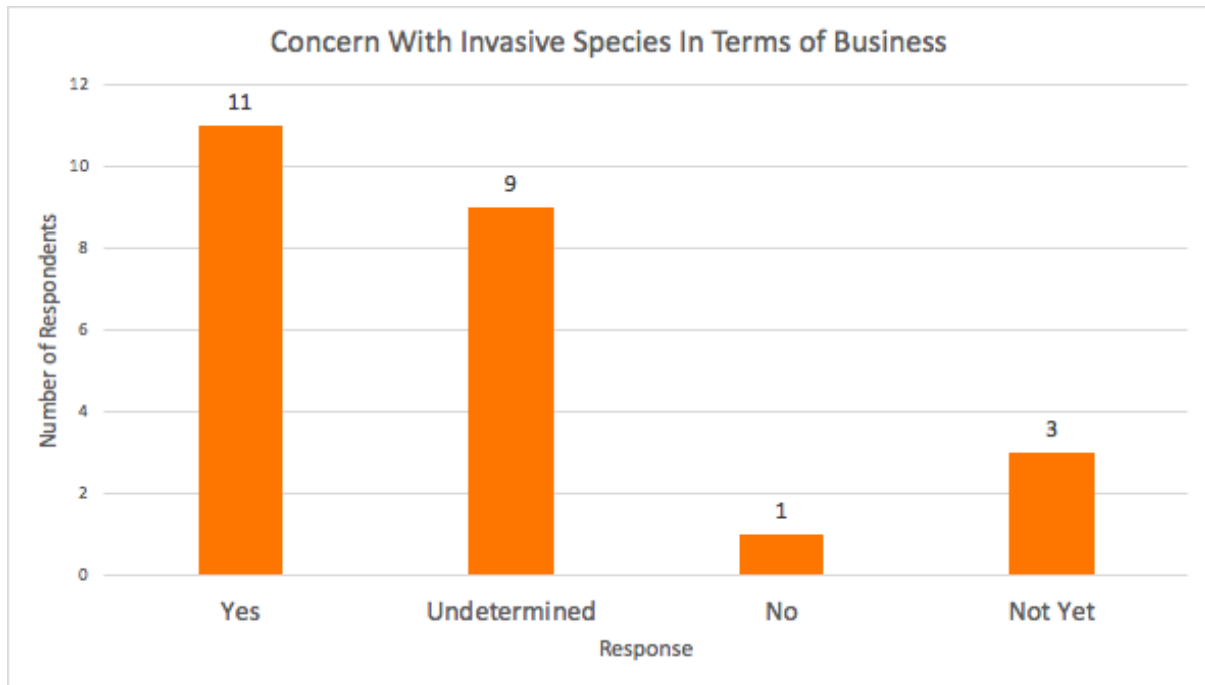


Rather than begin with conversations about invasive species, bait and tackle shops were first asked about their value systems. When asked about their personal values, shop managers or owners were often surprised and made comments similar to “Phew, there’s a lot.” Of the locations surveyed, 6 explicitly said they valued “Everything” about the state. When asked to narrow those values, many tended to focus on aspects of the state which fell in the “Alaska Lifestyle” category which was comprised of 24 respondents. Within the “Alaska Lifestyle” category, many respondents pointed to the lack of people in the state, the opportunity to live a subsistence lifestyle, and the greater degree of privacy they felt by living in the state. A store in Fairbanks stated “There’s a difference between here and there in the sense that you can go 10 minutes in a direction and there might be civilization at some points but in another spot it’s the wilderness.” Another store in Wasilla expressed similar sentiments “I value everything about the

state, but especially the laid back lifestyle. It's not like the lower 48." The "Alaska Lifestyle" category was also commonly tied to the "Nature" category, which was composed of 23 respondents. Throughout the state, the importance of the Alaskan lifestyle and its connection to nature was represented consistently, regardless of the area's population size. A respondent from a bait and tackle shop in Anchorage stated: "I value the lifestyle the most. It affords people to have a connection with the outdoors so that people are able to cohabitate the landscape with nature." A respondent from a bait and tackle shop in Kodiak echoed the sentiment, stating that "Alaska's sustainable resources allow us to live off the land."

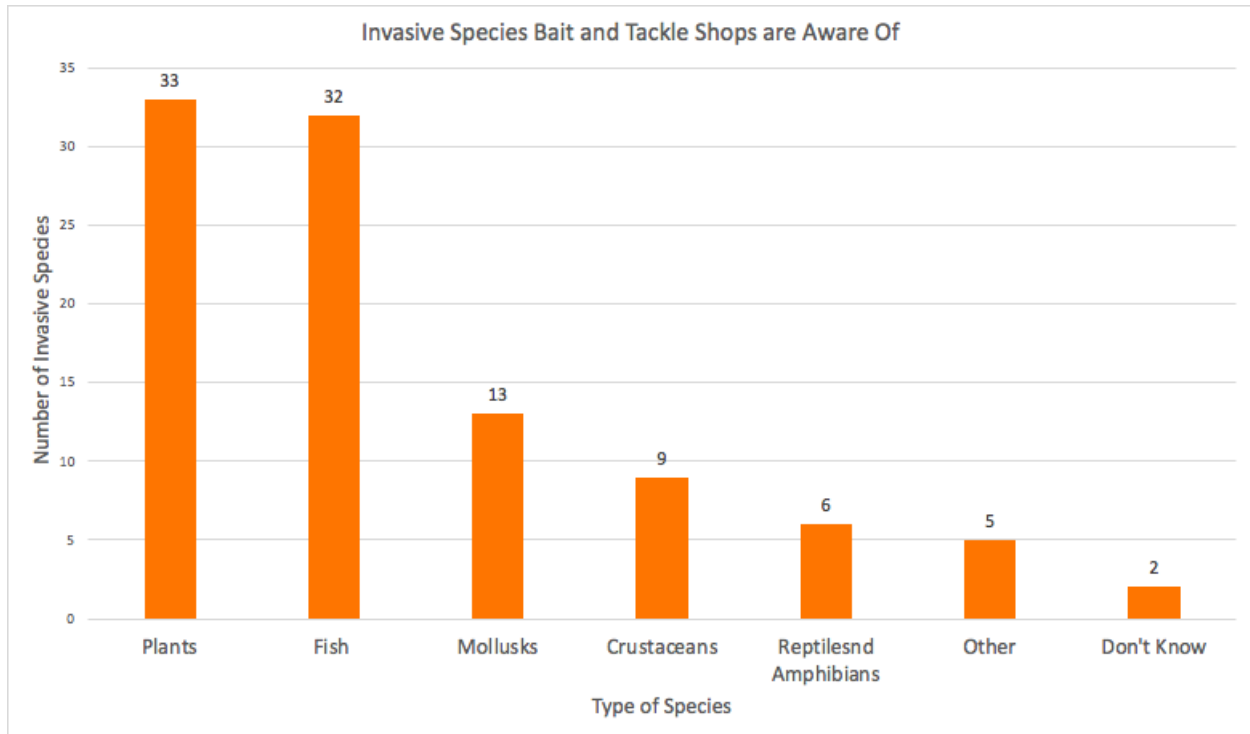
Although the bait and tackle shop businesses were centered around recreation, few locations discussed their value of recreational opportunities in the state or explicitly stated recreational activities they engage in. The "Recreation" category, composed of "hunting" and "fishing", comprised only 12 of responses. Nonetheless, respondents were passionate about their natural resources and their services. As a location in Wasilla said "Gotta protect it at all costs."

Bait and Tackle Shop Survey Question 4: Do invasive species concern you in terms of your business?



When asked about whether invasive species were of concern to individual businesses, responses were mixed. While 11 locations explicitly expressed concern about invasive species, 9 locations were only somewhat concerned and 3 acknowledged they were unconcerned currently but could be at a later date. A business in Anchorage summarized the reasoning behind their response of being concerned at a later time: “Invasive species are a concern although they are not a major concern. My major concern is to pay my people and the rent. It could develop into a major concern where if the fisheries are messed up then there’s an impact on the economy and my income.” Only one location explicitly said that it was not concerned about aquatic invasive species and was instead willing to spread them. The owner of the store said “I’d be happy to introduce invasive species myself. We should bring in all of them, crayfish, frogs, and pike. It’d be a just revenge.”

Bait and Tackle Shop Survey Question 3: Would you say that aquatic invasive species are in Alaska? Y/N If yes, can you name a few? If yes, do you know where they've been sighted?



Question 2 tied into question 3. In response to question 2 (“Do you know what aquatic invasive species are?”), every location answered yes, except for one location in Kodiak. When asked to elaborate on what invasive species are, locations provided various responses. A common definition used to describe invasive species was “Anything that’s not supposed to be there.”¹⁹ Rather than list concrete definitions, many respondents discussed specific invasive species and noted the impacts of said species. Even the one location in Kodiak which said they did not know what invasive species were was able to provide an example of a local invasive species. The Kodiak business said “No, not besides crayfish. I first saw them at a boil and they’ve been ordered from Anchorage. Are we allowed to kill them?”²⁰

¹⁹ This specific quote was from a business in Fairbanks, but other locations also used this definition.

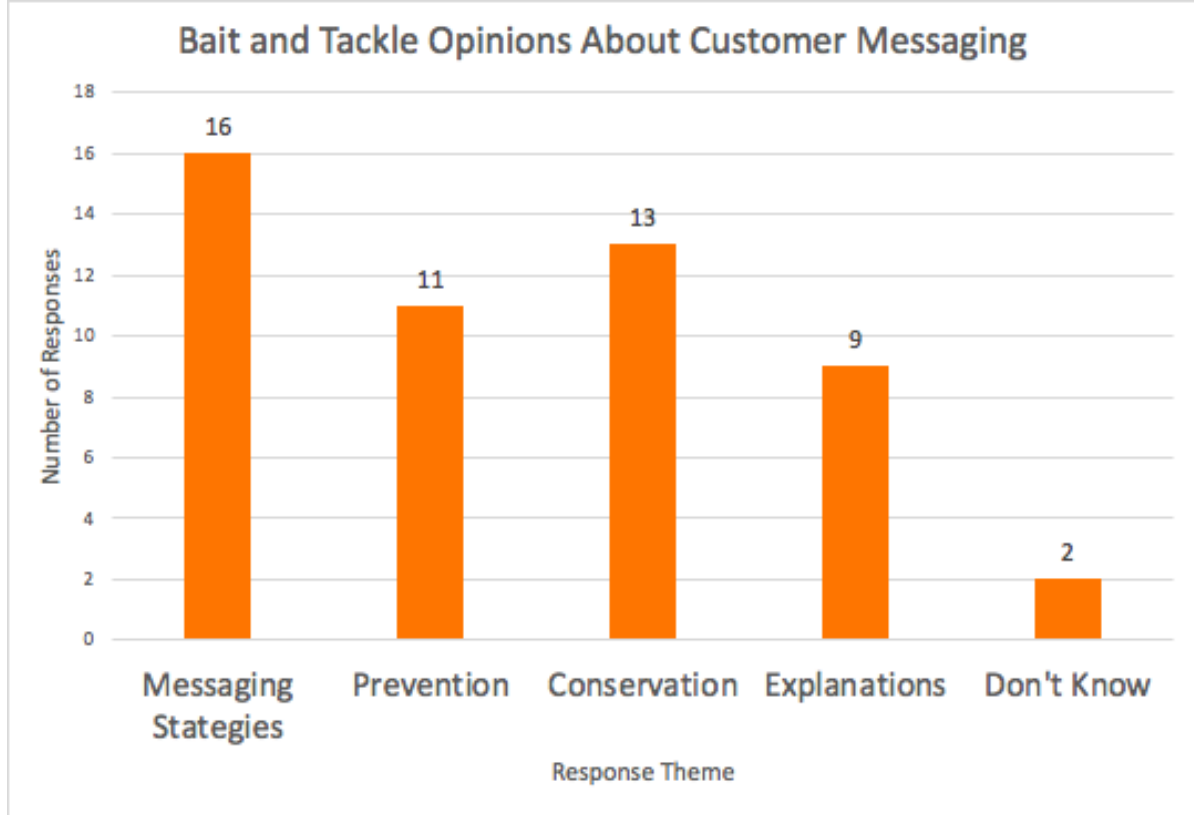
²⁰ Killing and eating crayfish is encouraged in Kodiak. Many residents are excited about the presence of crayfish on the island to the point that some are interested in perpetuating their spread into other water bodies as well. For example, during an interview, a business manager mentioned his neighbor is

Overall, respondents recognized 100 different things as an invasive species. Familiarity with the type of invasive species ranged from broad terms such as “Plants” to specific species such as “Northern Pike.” Northern Pike is both native and invasive in AK, but nonetheless 17 businesses were able to correctly recognize Northern Pike as an invasive species for Southeast Alaska. Pike was also the most well recognized specific invasive species. Whereas “Plants” were recognized by 11 locations, specific plants received less recognition. For example, Elodea was only recognized by 7 locations. Also, not all recognized invasive species recognized by the businesses were of concern to Alaska. For example, some locations listed pythons or dandelions as invasive species; pythons being invasive in warmer climates and dandelions being a noxious weed. Only two locations were unable to list any invasive species in the state or otherwise.

Among the regions surveyed, Kodiak had the most distinct results. Most of the responses in the “Crustaceans” category were because of responses in Kodiak, where all five respondents were able to identify Crayfish as an invasive species in the state. Only one location outside of Kodiak was able to identify Crayfish as an invasive species. Although all locations surveyed in Kodiak could identify crayfish as an invasive species, they were unable to identify other invasive species in the state and had the lowest amount of knowledge about how to prevent the spread of invasive species overall. Yet, the importance of fisheries was more pronounced in Kodiak. For example, one location noted that they would close their store if they experienced another season of poor salmon runs.

interested in moving some of the crayfish from Buskin Lake (the only known site of their infestation) to their backyard in order to have a consistent supply of crayfish.

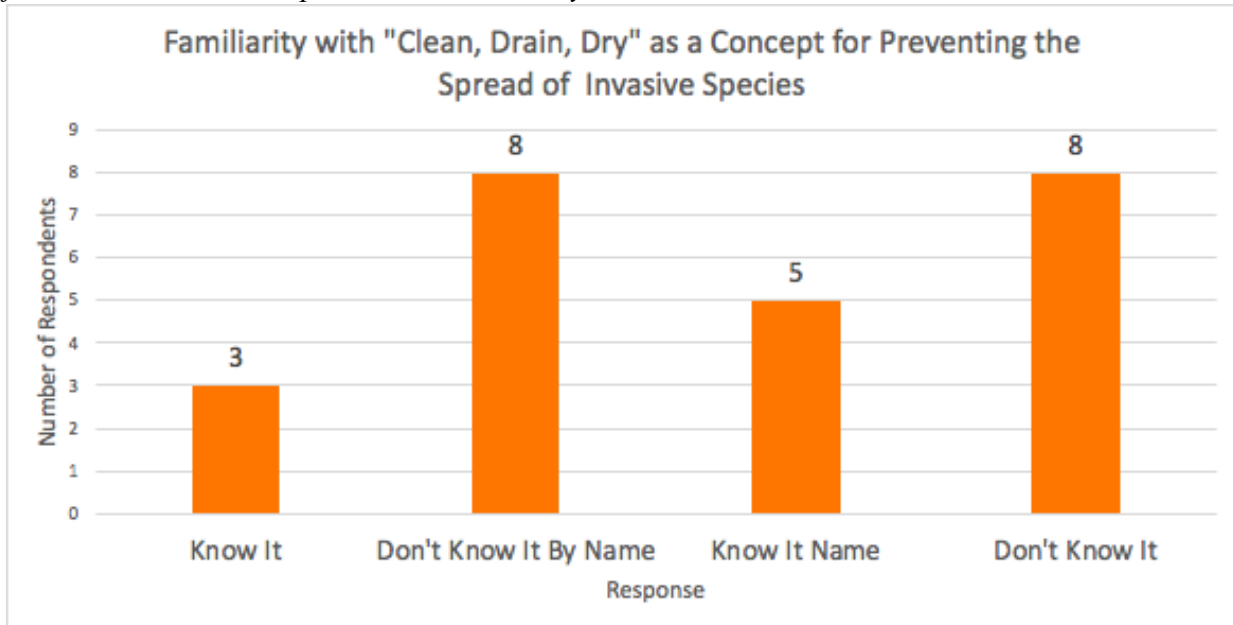
Bait and Tackle Shop Survey Question 8: In your opinion, what is the most important message for communicating with your customers about AIS?



Of the 24 responses, 16 focused on various messaging strategies such as making the material eye-catching or simple. Additionally, several respondents noted that they thought an effective strategy would be to assign values to the resources by making them “yours.” As one location in Fairbanks said “Attach value to the material to show that it’s “your” Alaska and the impacts are on “your” salmon. Show that Alaskans and salmon are connected especially in the case of Elodea but since we don't know what other aquatic plants would do, show that there might be even worse consequences. Don’t tell people what to do.” The same respondent from Fairbanks also noted that “Fairbanks is about 20 years behind Anchorage and Anchorage is behind the lower 48. We learn from the lower 48.” Thirteen locations said that they thought conservation was an important message to incorporate into messaging strategies. From responses, 9 locations thought that explanations about the invasive species already in the state or

how to act in response to invasive species were important messages to use when communicating with their customers. A respondent in Wasilla explained this approach “This may be vulgar, but you have to show that if people don’t care then everything will go away. People need to take care of the land and show responsibility.” Only 2 of responses said they could not identify a message for communicating with their customers.

Bait and Tackle Shop Survey Questions 5 and 6: If you were in an area with aquatic invasive species, how would you prevent the spread of aquatic invasive species from that area? Are you familiar with the concept “Clean, Drain, Dry”?



In order to test the saturation of the “Stop Aquatic Hitchhikers” campaign among outdoor recreationists in Alaska, businesses were asked about their familiarity with preventing the spread of invasive species as well as familiarity with the “Clean, Drain, Dry” slogan. Question 5 tested whether respondents were familiar with general strategies for preventing the spread of invasive species²¹ while Question 6 supplemented responses to Question 5 by indicating respondents

²¹ These strategies include the very steps within the slogan: cleaning equipment, drying equipment, and draining equipment in order to prevent the spread of invasive species.

familiarity with current invasive species communication efforts. The latter question (question 6) was a potential answer to the former (question 5). Respondents either knew the slogan informally, meaning they were able to describe the steps within the slogan, or formally, meaning they were able to accurately connotate the slogan as a preventative strategy part of a broader campaign.

Business familiarity with preventative strategies was low and even lower with the “Clean, Drain, Dry” slogan. Only three locations were able to recognize “Clean, Drain, Dry” both formally and informally and these respondents were dispersed throughout Alaska. A location in Anchorage responded to question five with “In regards to boating, I would pull the boat from an area, dry it, clean it, and flush the bilge pumps in the water.” Then, when asked about “Clean, Drain, Dry” in question 6, the same respondent said: “Yes. I heard about it from “Kids Don’t Float.” It’s the same as in the previous question in that you clean it, drain, then dry to kill things off. If something grows in water then it will die on land.” However, almost half of the locations were not able to recognize “Clean, Drain, and Dry” by name. Nonetheless, many were still able to recognize the steps involved in the process. For example, another location in Anchorage answered question 5 with “Don’t be irresponsible. Don’t dump your fish tank. Become educating on how invasive species are spread, use preventative methods and don’t be stupid.” When asked about familiarity with “Clean, Drain, Dry” the same respondent answered “No. The company doesn’t know where our clients take their rentals. When the rental is returned it is soaked down which is done to primarily check for leaks, then it is rinsed off with fresh tap water, then it is left to dry. We don’t always have the time to go through proper procedures because there can be a fast turnaround on the boats.” Eight locations had no familiarity with preventative strategies or the slogan. Locations in Kodiak had the lowest familiarity with prevention strategies, with 5

surveyed locations being unable to describe preventative strategies in general or recognizing the “Clean, Drain, Dry” slogan.

Discussion

Shared Value Systems

Except for one business in Soldotna, all opinion leaders (conference attendees and bait and tackle shops) were concerned with invasive species in some capacity.²² Not only were almost all opinion leaders concerned with invasive species, but they also expressed a shared foundation of values. Across the board, respondents highlighted similar values to incorporate into targeted invasive species communication efforts. Two trends in particular developed from responses: the interconnectedness of Alaska’s environment with its people and the distinction of Alaska from the remainder of the U.S.

While the terminology varied between conference attendees and bait and tackle shops, the significance of protecting nature and culture from invasive species in Alaska was pervasive. Although conference attendees used more technical terms, the bulk of responses about why people in Alaska should be concerned with invasive species was due to the quality of Alaska’s natural resources. Conference attendees discussed their values using terms like “ecosystem” and “ecosystem services” and the bait and tackle shops expressed similar concepts but using the words “nature” and “recreational opportunities.” The belief that nature is intertwined with culture was also present among all respondents. Among the conference attendees culture was expressed in sentiments regarding the impact of invasive species on culture in Alaska while

²² The business which said it was not concerned with invasive species and was in fact willing to spread invasive species was an outlier in the sample pool.

among the bait and tackle shops culture in Alaska is encapsulated within the category “Alaska Lifestyle.” In particular, the term “subsistence” was constantly coupled with “lifestyle” and the need to protect this unique feature of Alaska’s society from invasive species. The recurring mention of culture in interviews reinforces the significance of preserving natural resources for both ecological and cultural reasons. Values of nature, culture, and the opportunities provided by the state’s resources persisted across personal values and the values of the businesses/organizations the individuals were representing, demonstrating a consistency in the value systems which underlie conservation management in the state.

The importance of capitalizing on Alaska’s uniqueness also manifested itself in recurring comparisons of Alaska to the “lower 48.” Often noted as an example to learn from, references to the spread and impacts of invasive species in the lower 48 were used as a case and point for why invasive species should not be allowed to spread throughout Alaska. Respondents may have focused on invasive species in the lower 48 because they had either moved from or traveled through states where they were exposed to the threat of invasive species (such as the Great Lakes region). Yet, the redundancy of references to Florida implies that comparisons of Alaska to the lower 48 were based on more than just personal experiences. A stronger explanation is that communication efforts of invasive species in Florida were successful. Mentions of lionfish, pythons, and the red wave²³ among respondents demonstrated that media efforts had had an impact. References to the lower 48 ultimately indicate an awareness of the cross-national efforts to combat invasive species which is in turn important because it shows that common belief barriers about the futility of invasive species management are less developed in Alaska.

²³ All of these invasive species are present in Florida and had received significant national media attention through a variety of news sources, ranging from Facebook to a featured story in National Geographic.

Additionally, the distinction between Alaska and the remainder of the U.S. accentuates the notion of Alaska as a unique place. Unlike in the rest of the U.S., respondents indicated that Alaska's uniqueness is an empowering feature for invasive species communication efforts to capitalize on. Both groups also recognized the importance of creating a framework of resource ownership within communication strategies about invasive species to further the notion that Alaska is different.

The consistency in the values discussed by all respondents demonstrate that manager-oriented (the conference attendees) and public-oriented (bait and tackle shops) opinion leaders are in fact aligned in their value systems which does not confirm hypothesis one. Since hypothesis one is not confirmed, the first component of the social contract within the deficit model can be assumed to work in Alaska. Therefore, communication messages can utilize the shared foundation between conservation managers and the public to standardize the public's understanding of invasive species. Careful communication efforts can in turn strengthen the prioritization of invasive species prevention efforts in the public's mind.

Differences in Knowledge

Unlike with the case of shared value systems, knowledge foundations differed among opinion leaders. The dissemination of knowledge from management-oriented opinion leaders did not uniformly reach public-oriented opinion leaders. In particular, opinion leaders differed in their familiarity with specific invasive species and with strategies to prevent the spread of invasive species.

Across respondents, there was a general familiarity with various forms of invasive species, but the level of comfort respondents had with invasive species was variable among both conference attendees and bait and tackle shops. Invasive plants were the most identified invasive

species taxa by both groups. Among conference attendees, the bias towards plants can be explained by the origin of the organization hosting the conference. Formerly known as the Committee for Noxious and Invasive Plant Management (CNIPM), the organization only recently shifted to an all taxa agenda by changing its name to the Alaska Invasive Species Partnership during the Fall 2018 conference.²⁴ Conference attendees focused on specific plant species like Hawkweed, Elodea, and Bird Vetch. Unlike the conference attendees, the bait and tackle shops discussions of invasive plant species was typically generalized. Rather than list specific plant species, the bait and tackle shops would mention invasive species by the generalized term of “Plants.” Elodea was a particularly clear example of the distinction in knowledge between conference attendees and bait and tackle shops. Whereas conference attendees listed Elodea as a priority invasive species, few bait and tackle shops were able to recognize the invasive plant by name. On the other hand, invasive species like Northern Pike and Signal Crayfish were the most commonly noticed invasive species among bait and tackle shops. Among the conference attendees, Northern Pike and Signal Crayfish were only mentioned by conference attendees who had worked on prevention/eradication efforts for these species.

Opinion leaders also differed in their familiarity with preventative strategies; in particular, the effectiveness of the “Clean, Drain, Dry” slogan. Many conference attendees described strategies for raising awareness as the most effective method of preventing the spread of invasive species. Yet, the same attendees were hesitant about how to actually engage the public and several conference attendees explicitly admitted to being unsure of how to structure communication efforts. Additionally, many bait and tackle locations requested more information about how to identify invasive species in the state as well as how to prevent their spread. The

²⁴ Whether the name change will actually have an impact on the agenda of the partnership can only be evaluated at a later time.

willingness of locations to learn the type of invasive species in the state as well as the appropriate responses is a reassuring result because it indicates a willingness among businesses to engage with the issue but also demonstrates that current invasive species efforts have not been successfully disseminated. The limited saturation of the “Clean, Drain, Dry” slogan bolsters the indication that current communication efforts are ineffective. Conference attendees tended to cite the “Clean, Drain, Dry” slogan as a well-known, concise, and overall effective for communicating preventative tactics regarding the spread of invasive species. However, the bait and tackle shops indicated that they had little or mixed experiences with “Clean, Drain, Dry.” In one case, a bait and tackle shop frustratedly discussed the abundance of invasive species pamphlets in their shop, yet was unable to identify the “Clean, Drain, Dry” slogan. Instead, the location manager stated that more education about preventative tactics is necessary, all while holding up a pamphlet about “Clean, Drain, Dry.”

The ability of the bait and tackle shops to accurately identify invasive species and general preventative strategies in Alaska demonstrates that information has reached the public-oriented opinion leaders. However, the information known by the public-oriented opinion leaders does not align with the information discussed by the management-oriented opinion leaders. On one hand, the bait and tackle shops awareness of these invasive species demonstrates that some communication efforts about invasive species have worked. But, the communication efforts are clearly limited. These findings confirm hypothesis two, with failed communication efforts accounting for the distinction in knowledge among opinion leaders.

Lacking Established Connections

Manager-oriented opinion leaders have the intuition to involve public-oriented opinion leaders in invasive species communication efforts, but have not yet actually engaged public-

oriented opinion leaders in communications. Rather, the manager-oriented opinion leaders continue to single-handedly structure communication efforts and present information to the public-oriented opinion leaders without establishing social connections. The result is the development of disengaged public-oriented opinion leaders and hence an ineffective social contract.

Conference attendees highlighted using increased public awareness as a method of preventing the spread of invasive species by targeting invasive species communications to outdoor users. Yet, there was little, if any, representation from bait and tackle shops or other public-oriented opinion leaders at the conference. Furthermore, a common thought process among conference attendees was that the public's level of knowledge and concern is limited primarily by the availability of information. However, as presented in the previous section, the ability of public-opinion leaders to engage in informed conversations about invasive species demonstrates that the issue with raising awareness about invasive species is not about simply educating target audiences. Under this approach, the management-oriented opinion leaders are simply presenting information which they perceive as important in a seemingly meaningful format, but without developing the relationships needed for a strong social contract.

Accustomed to the traditional method of being treated only as receivers of information, bait and tackle shop owners anticipate management-oriented opinion leaders to provide information and leave. For example, at a location in Fairbanks, several attempts had to be made before a manager agreed to be interviewed because he thought that I had brought outreach material the location could passively put up in their venue. Other locations also anticipated to be presented with posters, flyers, etc. A location in Anchorage described the outreach material as

“Something for the customers to read while they wait in line.” These findings support hypothesis three.

A New Social Contract

Throughout this study, I have shown that management-oriented opinion leaders in Alaska are relying on an ineffective social contract. Although the management-oriented opinion leaders recognize the importance of involving public-oriented opinion leaders to increase public engagement with preventing the spread of invasive species, they have not yet engaged these communities. Without an effective social contract for science, public-oriented opinion leaders lack the knowledge and social networks needed for effective communications, despite the shared foundation of values between the groups of opinion leaders.

In order to improve the “old” social contract for science, manager-oriented opinion leaders need to encourage active dialogue between themselves and public-oriented opinion leaders. Therefore a “new” social contract is necessary which incorporates contextualization when working within the deficit model. The new social contract must be realistic and context specific in order to achieve sustainability of conservation efforts (DeFries et al 2012). Contextualization and contextualized knowledge will in turn exhibit a stronger impact on information in the modern interrelation of science and society (Gibbons 1999). Not only must scientists and conservation managers disclose the basis and priorities of their research, but they should foster networks in order to obtain compliance with their policy recommendations (N’Guyen et al. 2015, Seekamp et al. 2015). The valuation of opinion leaders for both managers and the public fosters such networks. Scientists have always been expected to provide reliable information, but in the new social contract science must be “socially robust, transparent and

participative” in order to legitimize the proposed management (Gibbons 1999). Unlike in the old social contract, in the new social contract, scientists, or in the case of this study, manager-oriented opinion leaders are not the only ones guiding the discussion.

By understanding bait and tackle shop perceptions of the issue, future outreach efforts will have additional insights into this aspect of industry. By learning more about peoples attitudes and beliefs, policy planning and implementation will be more likely to be successful (Prinbeck, Lach, and Chan 2009). By connecting conservation priorities with existing knowledge, communication allows for the development of a joint research paradigm (N’Guyen et al. 2015). Science must therefore be socially robust, which according to Gibbons involves being valid inside and outside the lab, validity through a variety of experts and lay experts, indicating that such knowledge will be less likely contested (Gibbons 1999). Decisions have to be both at the individual and global scales which then engages various communities to achieve societal benefits and reduce negative outcomes for ecosystems (DeFries et al. 2012). Future communication efforts for invasive species must incorporate social networks in order to minimize costs and effectively prevent the spread of invasives throughout the state.

Other conservation issues can also benefit from incorporating a social contract for science into communication efforts. For example, climate change efforts experience similar roadblocks to invasive species management when garnering public support through communication efforts. Like invasive species management, climate change management is complex and affected audiences are often impacted by belief barriers and influenced by denialism. Incorporating a social contract for science to develop relationships between managers and the public through manager-oriented and public-oriented opinion leaders can help mediate the conflicts which have

evolved between conservation managers and the public. Later studies should test this assumption as well as continue refining what makes an effective social contract for science.

Several constraints must be noted when considering this study. The primary constraint was sampling. Creating a comprehensive list for bait and tackle shops without having local contacts in all of the targeted regions was challenging because not every location had a web page. Furthermore, for both surveys, the number of respondents that participated varied. During several of the interviews, multiple people would answer the questions, those being surveyed would switch with someone else midway through the survey, or bystanders would begin participating in the surveys. Another constraint of this study was the timing of the project. In part one of the study, there was insufficient time to ask follow up questions or delve into more thorough conversations with presenters. For part two of the study, which was conducted during the summer, many of the bait and tackle shop locations were either very busy or the owners were on vacation themselves. This meant that accessing the shop owners or managers time was difficult without impeding on their business. Personal time constraints also limited the ability to follow up with presenters and stores at some of the locations.

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Appendixes

Appendix 1

Figure 1. *Population Distribution in Alaska*



Appendix 2

Figure 1. *Questionnaire for Annual Alaska Invasive Species Conferences Panelists*

1. Why do you think invasive species are a concern to Alaska?
2. Why is your organization concerned with invasive species in Alaska?
3. Is there a particular invasive species with which you or your organization is concerned with?
4. Do you think sectors of the public know about invasive species?
5. Do you think sectors of the public care about invasive species?
6. In your opinion, who is the most important audience to target when communicating about invasive species?
7. In your opinion, what's the most effective method of preventing the spread of invasive species?
8. In your opinion, what are the most effective communication strategies for talking about invasives?
9. Do you think that the slogan "Clean, Drain, Dry" is effective?

Figure 2. *Questionnaire for bait and tackle shops*

1. What do you value most about Alaska?
2. Do you know what aquatic invasive species are?
3. Would you say that aquatic invasive species are in Alaska? Y/N
 - a. If yes, can you name a few?
 - b. If yes, do you know where they've been sighted?
4. Do AIS concern you in terms of your business?
5. If you were in an area with AIS, how would you prevent the spread of AIS from that area?
6. Are you familiar with the concept "Clean, Drain, Dry"?
 - a. If yes, briefly explain.
7. Would you be willing to share information with your customers about AIS?
 - a. If so, how? When would you be willing to participate (if it is an activity)?
 - b. Not willing, why?
8. In your opinion, what is the most important message for communicating with your customers about AIS?
9. Would you want to be involved in the creation of the outreach material on AIS for your location? Y/N

Appendix 3

Figure 1: *Why do you think invasive species are a concern to Alaska?*

<u>New Category</u>	<u>Old Category</u>	<u>Tally</u>
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Harm Economy	Harm Economy	11
Harm Ecosystem	Harm Ecosystem	20
Harm Ecosystem Services	Harm Ecosystem Services	21
Impacts Culture	Impact Culture	13
Lose Pristine Habitat	Lose Pristine Habitat	15
Other	Lot to Lose	2
Other	Expensive	2
Other	Responsibility	2
Other	Seen Impact in Lower 48	2
Other	Can Prevent Spread	3
Other	Don't Like Change	1
Other	Response Difficult	6
Other	Impacts Everyone	1

Figure 2: Why is your organization concerned with invasive species in Alaska?

<u>New Category</u>	<u>Old Category</u>	<u>Tally</u>
Harm Ecosystem Health	Harm Ecosystem Health	13
Harm Ecosystem Health	Biological Integrity	6
Harm Ecosystem Services	Harm Ecosystem Services	10
Impacts Communities	Constituents	5
Impacts Communities	Subsistence	3
Impacts Communities	Harms Community/Culture	8
Required To	Management	8
Required To	Mission	3
Required To	Necessitaated By Policy	9
Other	Research	4
Other	Education	2
Other	Outreach/Collaboration	2
Other	Available Opportunity	2
Other	Public Safety	2

Other	Expensive to Manage	3
Other	Harm Economy	6

Figure 3: Is there a particular invasive species with which you or your organization is concerned with?

New Category	Old Category	<u>Tally</u>
Arthropod	Asian Longhorn Beetle	1
Arthropod	Gypsy Moth	1
Arthropod	Asian Gypsy Moth	1
Arthropod	Siberian Silk Moth	1
Crustaceans	European Green Crab	2
Crustaceans	Crayfish	2
Depends on How The Species is Prioritized	Ranking System	8
Depends on How The Species is Prioritized	Based on Impact	6
Depends on How The Species is Prioritized	Varies by Circumstance	6
Depends on How The Species is Prioritized	Aquatic	3
Depends on How The Species is Prioritized	Terrestrial	1
Depends on How The Species is Prioritized	Watch List	2

Depends on How The Species is Prioritized	Lot	4
Fish	Atlantic Salmon	1
Fish	Asian Carp	1
Fish	Northern Pike	7
Fish	Bass	1
Infections	Virus	1
Infections	Diseases	2
Infections	Whirling Disease	1
Infections	White Nose Syndrome	1
Mammals	Feral Swine	1
Mammals	Rats	1
Mammals	Cats	1
Mammals	Humans	2
Mollusks	Zebra and Quagga	4
Other	Fungus	2
Other	Pointless for Some	1
Other	Parasites	1
Other	Sea Vomit	4
Other	Rot	1
Plant	Bohemian Knotweed	1
Plant	Bird Cherry	4
Plant	Bird Vetch	6
Plant	Hawkweed	6
Plant	Butter and Eggs	1
Plant	White Sweet Clover	3
Plant	Reed Canary Grass	5
Plant	Crepis	1

Plant	Panua	1
Plant	Foxtail Barley	1
Plant	Elodea	12
Plant	Canada Thistle	2
Plant	Weeds	1

Figure 4: Do you think sectors of the public know about invasive species?

New Category	Old Category	Tally
Maybe	If Impacted	2
Maybe	Do More	1
Maybe	Conditional	5
Maybe	Lack Common Knowledge	1
Maybe	Still Learning How To Do This	1
No	No	2
Unsure	Unsure	4
Yes	Yes	14

Figure 5: Do you think sectors of the public care about invasive species?

New Category	Old Category	Tally
No	No	2
Undetermined	Less With Costs	2
Undetermined	Link to Interests	3
Undetermined	Show Them Why	2
Undetermined	Conditional	2
Undetermined	Need Knowledge	1
Undetermined	Need Regulation	1
Unsure	Harder Sell	1
Unsure	Mixed	2

Unsure	Only Takes One	1
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Figure 6: In your opinion, who is the most important audience to target when communicating about invasive species?

New Category	Old Category	<u>Tally</u>
Academia	Youth	5
Academia	Schools	4
Everyone	The Public	1
Everyone	Everyone	5
Other	Varies	3
Other	Home Gardeners	2
Other	Master Gardeners	2
Other	Rotary	1
Other	Fairs and Events	1
Other	Unsure	1
Outdoor Users	Outdoor Users	9
Outdoor Users	Subsistence	1
Outdoor Users	Berry Pickers	2
Outdoor Users	Outdoor Enthusiasts	2
Outdoor Users	Fisherment	1
Outdoor Users	Hunters	1
Outdoor Users	Hikers	3
Political Processes	Congress	2
Political Processes	Financial Allocators	1
Political Processes	Government Agencies	1
Political Processes	Voters	2
Political Processes	Tribal Councils	1

Specific Communities	Impacted Communities	5
Specific Communities	Rural Communities	4
Specific Communities	City Dwellers	2
Specific Communities	Internal Audiences	1
Specific Communities	Native Communities	1
Specific Communities	Agricultural Communities	1
Vectors for Invasive Species	Industry	4
Vectors for Invasive Species	Go to Frontlines	1
Vectors for Invasive Species	Transportation	1
Vectors for Invasive Species	People Bringing People	2
Vectors for Invasive Species	Identify Vectors	2
Vectors for Invasive Species	Ports	1
Vectors for Invasive Species	Horticulturalists	1

Figure 7: In your opinion, whats; the most effective method of preventing the spread of invasive species?

New Category	Old Category	<u>Tally</u>
Collaborations	Collaborations	2
Collaborations	Reaching Industry	1
Collaborations	Conferences	1
Education	Education	10
Increasing Awareness	Awareness	4

Increasing Awareness	Conversations	2
Increasing Awareness	Communication	3
Increasing Awareness	Outreach	8
Increasing Awareness	Community Involvement	2
Increasing Awareness	Facebook	1
Increasing Awareness	Inreach	2
Management	Regulations	5
Management	Enforcement	3
Management	Pressure Agencies	1
Management	Provide Alternatives	2
Management	Quarantine Lists	3
Management	Treating Infestations	1
Prevention	Identifying Pathways	1
Prevention	Alerts	1
Prevention	Citizen Monitoring	1
Prevention	Prevention	5
Other	Unsure	2
Other	Varies	3

Figure 8: In your opinion, what are the most effective communication strategies for talking about invasives?

New Category	Old Category	<u>Tally</u>
Education	Indicate Response for People	5
Education	Where to Report	1
Education	Available Resources	1
Education	Outreach	3
Education	Show Pathways	3

Education	Info Sharing	3
Events and Activities	Presentations	2
Events and Activities	Hands On Activities	3
Events and Activities	Events	3
Events and Activities	Face to Face	1
Messaging Strategies	Personal Connection	4
Messaging Strategies	Show Impact of Invasive	9
Messaging Strategies	Show It Matters	3
Messaging Strategies	Salmon	2
Messaging Strategies	Imagery	2
Messaging Strategies	Damages What We Care About	2
Messaging Strategies	Specific Messaging	6
Other	Unsure	4
Other	Food	1
Other	Varies	4
Other	Opportunistic	3
Social Media	Youtube	1
Social Media	Social Media	5
Traditional Outlets	Newspaper	1
Traditional Outlets	Radio	2
Traditional Outlets	Signage	2
Traditional Outlets	Call	1
Traditional Outlets	Newsletter	1

Figure 9: Do you think that the slogan “Clean, Drain, Dry” is effective?

<u>New Category</u>	<u>Old Category</u>	<u>Tally</u>
Maybe	Not Always Possible	5
Maybe	Can Be	4
Maybe	Yes in the Lower 48	4
Maybe	Not Enough Advertising	3
No	No	4
Unsure	Unsure	2

Yes	Yes	13
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Appendix 4

Figure 1: What do you value most about Alaska?

<u>New Category</u>	<u>Old Category</u>	<u>Tally</u>
Alaskan Lifestyle	Lack of People	8
Alaskan Lifestyle	Subsistence	7
Alaskan Lifestyle	Kids	1
Alaskan Lifestyle	Alaskan Lifestyle	4
Alaskan Lifestyle	Openness	3
Alaskan Lifestyle	Privacy	2
Everything	Everything	6
Nature	Alaska's Wilderness	5
Nature	Alaska's Public Lands	1
Nature	Alaska's Resources	7
Nature	Beauty	3
Nature	The Outdoors	9
Other	Freedom	3
Other	Sustainability	1
Other	Adventure	1
Recreational Opportunities	Hunt	4
Recreational Opportunities	Fish	8

Figure 2: Would you say that aquatic invasive species are in Alaska? Y/N If yes, can you name a few? If yes, do you know where they've been sighted?

<u>New Category</u>	<u>Old Category</u>	<u>Tally</u>
Amphibians and Reptiles	Frogs	2

Amphibians and Reptiles	Turtles	2
Amphibians and Reptiles	Pythons	2
Crustaceans	Crayfish	8
Crustaceans	Crustaceans	1
Don't Know	Don't Know	2
Fish	Northern Pike	17
Fish	Lionfish	4
Fish	Atlantic Salmon	2
Fish	Fish	2
Fish	Perch	1
Fish	Walleye	1
Fish	Silver Carp	1
Fish	Blackfish	1
Fish	Snakehead	1
Fish	Sticklebacks	1
Fish	Asian Carp	1
Mollusks	Snails	4
Mollusks	Zebra Mussels	4
Mollusks	Slugs	2
Mollusks	Diddy Mo	1
Mollusks	Clams	1
Mollusks	Mollusks	1
Other	Bugs	1
Other	Bacteria	1
Other	Shellfish	1
Other	Urchins	1
Other	Slime	1
Plants	Plant	11
Plants	Elodea	7
Plants	Bird Vetch	3
Plants	Dandelions	2

Plants	Hawkweed	1
Plants	Butter and Eggs	1
Plants	Milfoyle	1
Plants	Reed Canarygrass	1
Plants	Purple Loosestrife	1
Plants	Kudzo	1
Plants	Ash Weed	1
Plants	Chinese Elms	1
Plants	Blue Spruce	1
Plants	Kat Sui	1

Figure 3: Do AIS concern you in terms of your business?

<u>New Category</u>	<u>Old Category</u>	<u>Tally</u>
No	No	1
Not Yet	Not Yet	3
Undetermined	Partially	4
Undetermined	Unsure	5
Yes	Yes	11

Figure 4: If you were in an area with AIS, how would you prevent the spread of AIS from that area? Are you familiar with the concept “Clean, Drain, Dry”?

<u>Clean, Drain, Dry</u>	<u>Tally</u>
Know It	3
Don't Know It By Name	8
Know It Name	5
Don't Know It	8

Figure 5: Would you be willing to share information with your customers about AIS? If so, how? When would you be willing to participate (if it is an activity)?

<u>New Category</u>	<u>Old Category</u>	<u>Tally</u>
Complementary Efforts	Other agency's information outlets	5

In Person	Workshop/Presentation	3
In Person	Conversations	1
Passive Mediums	Signage (poster, sticker)	19
Passive Mediums	Paper Handouts (flyer, pamphlet, brochure, bag stuffer)	19
Passive Mediums	Items (floaties/FOB tags)	1
Passive Mediums	Video	4
Social Media	Social Media	11
Social Media	Radio	1

Figure 6: In your opinion, what is the most important message for communicating with your customers about AIS?

<u>New Category</u>	<u>Old Category</u>	<u>Tally</u>
Conservation	Impact on Fishing/Salmon	7
Conservation	Conservation	5
Conservation	Alaskan Lifestyle	1
Don't Know	Don't Know	2
Explanations	Explanations (species, how it happens, what to do)	7
Explanations	Report It	2
Messaging	Must Be Eye-catching (scare tactics, beautiful)	8
Messaging	Simple	3
Messaging	Positive	1
Messaging	Attach Value ("yours")	3
Messaging	Learn From Lower 48	1
Prevention	Prevention	6
Prevention	Clean, Drain, Dry	5