

AN ABSTRACT OF THE FINAL REPORT OF

Thomas M. Sheridan for the degree of Master of Science in Fisheries and Wildlife Administration, Department of Fisheries and Wildlife, presented on November 30, 2017.

Title: An Evaluation of Collaborative Salmon Fishery Management in Prince William Sound, Alaska

Primary internship conducted at: Prince William Sound Aquaculture Corporation (PWSAC)
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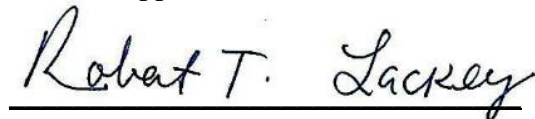
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Collaborative decision-making is often promoted as a means to achieve socially acceptable and enduring solutions to natural resource management issues, and one that holds promise for resolving “wicked” problems. However, success rates for implementation of collaborative recommendations are unknown. This paper explores challenges to collaborative salmon fishery management in Prince William Sound (PWS), Alaska, based on experience made possible through internship service on the Prince William Sound Aquaculture Corporation (PWSAC) Board of Directors, and the Alaska Hatchery Research Project (AHRP) Science Panel. Three constraints to collaborative salmon fishery management in PWS were identified, including: (1) PWS citizens’ mistrust of public managers, (2) recent and ongoing reductions to the State of Alaska’s budget, and (3) a lack of individual and organizational capacity among the area’s prospective collaborators. The paper then identifies several broad lessons to consider when collaborating, including: (1) the importance of selecting participants who possess relevant knowledge and who are willing to compromise, (2) an awareness and acceptance of the significant resources and time that collaborations require, (3) the availability of organizational capacity to support these endeavors, and (4) the availability of individuals with the credibility and skills required to effectively lead collaborations. The paper concludes with some recommendations for PWSAC and AHRP to consider when attempting collaborations in the future, including resorting to a quasi-traditional top-down management approach should their attempts at collaboration fail.

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Prince William Sound, Alaska

by
Thomas M. Sheridan

A FINAL REPORT

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Oregon State University

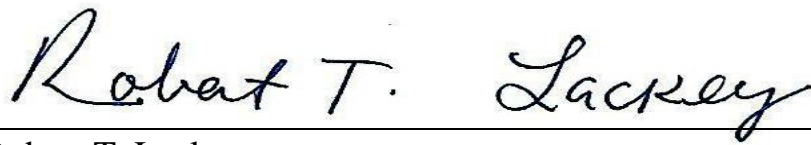
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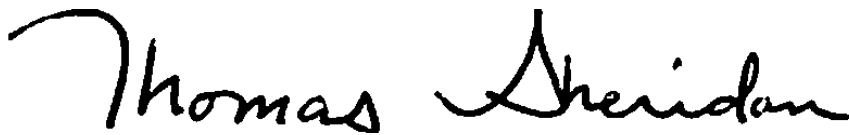
APPROVED:

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Robert T. Lackey

Major Professor, representing Department of Fisheries and Wildlife, Oregon State University

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

A handwritten signature in cursive script that reads "Thomas Sheridan". The signature is written in black ink and is positioned above a horizontal line.

Thomas M. Sheridan, Author

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I am especially thankful for the support of my wife and children, without which I would not have completed this endeavor.

Finally, the views expressed in this document are those of the author and do not necessarily reflect the opinions or policy positions of any organization.

INTRODUCTION

Immediately prior to the commencement of my graduate program in Fisheries and Wildlife Administration in September 2015, I was appointed by the commissioner of Alaska's Department of Fish and Game (ADF&G) to serve as ADF&G's ex officio representative on the Prince William Sound Aquaculture Corporation's (PWSAC) Board of Directors. This volunteer assignment was identified as an ideal candidate for my graduate program's professional internship component, although there were some initial concerns that this assignment alone would fail to meet the internship's standards for time commitment. Soon thereafter, ADF&G's commissioner appointed me to serve on the Alaska Hatchery Research Project's (AHRP) Science Panel. This opportunity was identified as my secondary internship thereby alleviating these concerns and rounding out my graduate program.

The ADF&G ex officio position on PWSAC's Board of Directors is viewed as a gesture of goodwill to restore a past relationship between ADF&G and PWSAC, and to promote better communication and cooperation between these respective organizations. Through my concurrent role as PWS Area Management Biologist with ADF&G, I was initially looked to for insights on fishery management. And, having previously worked for a hatchery organization in southeast Alaska, Northern Southeast Regional Aquaculture Association (NSRAA), my hatchery background was also of benefit to this relationship. As part of my role, the PWSAC board chairman appointed me to serve on the board's Board Development Committee. However, in order to meet my graduate program's expectations that these internship assignments represent a "stretch" from one's normal day-to-day assignments, I worked with PWSAC to ensure that I participated in all committee meetings during the winter 2015/2016 meeting schedule, most of which included my physical attendance. This commitment was beyond the ex officio position's

original expectations, and beyond any commitment that had been achieved by previous ex officio representatives. I served PWSAC in this capacity from their October 9, 2015 general board meeting until my departure from ADF&G in April 2016.

Following reductions in ADF&G's budget and the cancellation of the department's graduate studies program, I was presented with a job opportunity that promised greater flexibility to concentrate on my graduate program. While this position with Silver Bay Seafoods required that I spend most of the summer months away from home, I was able to concentrate on my internships and coursework during the offseason. And, following Silver Bay Seafoods' selection for representation on PWSAC's Board of Directors starting with their October 7, 2016 general board meeting, I was seated on the board and subsequently elected to the board's Executive Committee by board members. Thus, I was able to continue with my graduate program internship with PWSAC in a new and important capacity. According to PWSAC's (2016) bylaws, "The Executive Committee will be responsible to the Board of Directors and will oversee and support management to assure that the goals and plans of the Board of Directors are achieved." Further, these bylaws state that "In the absence of contrary direction from the Board, the Executive Committee shall exercise the full powers of the Board" (PWSAC, 2016). As a member of this committee, I provided significant input on the company's response to a public relations and human resources disaster, and was able to help steer the organization towards a more sustainable and collaborative future. As evidenced by the significant time commitment required during this final year of my PWSAC internship, I believe that the level of responsibilities associated with this service represent a significant "stretch" from that which should be expected as a member of PWSAC's Board of Directors.

The AHRP is a large-scale research project taking place in Alaska exploring interactions between hatchery and wild salmon in PWS and southeast Alaska. Formally conceived in 2011, the project was designed by a Science Panel composed of retired and current scientists from ADF&G, University of Alaska, the state's hatchery operators, and the National Marine Fisheries Service (NMFS). Although data collection for the AHRP is awarded to independent contractors, the Science Panel maintains oversight of the project and its products, drawing from the panel's expertise in salmon fishery enhancement, fishery management, and wild and hatchery interactions (ADF&G, 2012). Given my initial role as ADF&G's fishery manager for the PWS commercial purse seine salmon fishery, it was anticipated that I would contribute local management perspectives. This internship assignment initially qualified as a "stretch" from my day-to-day job due to the fact that there were no other management biologists assigned to the Science Panel. Likewise, following my departure from ADF&G to Silver Bay Seafoods, there were no other industry representatives on the Science Panel. Further, I was and am by far the least experienced member of the panel, which I believe speaks to the potential for learning on my part. Initially, there was some hope that I would assist with meeting operations as part of this internship. However, this proved to be unnecessary given the project facilitator's retirement from his former position with ADF&G and subsequent focus on his role with the project. Instead, my involvement with the AHRP would be to assist when called upon, and to observe experts at work supervising a complex research project. Further, over time I was looked to as a conduit for accessing PWS commercial fishery stakeholders through my involvement on PWSAC's Board of Directors, in addition to my other stakeholder engagement activities.

Altogether, I estimate a time commitment to PWSAC of at least 470 hours, with another 128 hours of service to the AHRP Science Panel through my graduate program internships. For

both internships, a significant amount of time was spent gaining an understanding of issues facing both entities, and the various individuals involved with their processes. Apart from the discrepancy in time commitment, the PWSAC internship was by far the more involved and challenging of the two assignments. As part of this internship, I participated in the planning meetings and day-to-day operations of PWSAC, observing its structure and functioning in the process. Following the departure of the company's top managers, the Executive Committee was charged with recruiting for an interim and permanent General Manager, which serves as PWSAC's chief executive. I and the board's chairman convinced a long-time colleague to take on the former role, and the Executive Committee acquired the services of a recruiting firm to assist with recruiting candidates for a permanent General Manager. Throughout this process, I took on a leadership role beyond that which should be anticipated of a graduate-level intern, culminating with the development and execution of interviews with prospective candidates. The questions and scoring matrix for this process served as my internship's outreach activity, and may be found in this report's appendices.

Both internship assignments involved stakeholder engagement activities, conflict resolution, and attempts at collaboration. Many courses at Oregon State University (OSU) informed my understanding of these activities, especially Ecological Policy (FW 620) and Consensus and Natural Resources (FES 585). Throughout the duration of these internships, several constraints to collaborative salmon fishery management in PWS were identified, including: (1) PWS citizens' mistrust of public managers, (2) recent and ongoing reductions to the State of Alaska's budget, and (3) a lack of individual and organizational capacity among the area's prospective collaborators. Further, several lessons were learned regarding collaborations while participating in these internships, including: (1) the importance of selecting participants

who possess relevant knowledge and who are willing to compromise, (2) an awareness and acceptance of the significant resources and time that collaborations require, (4) the availability of organizational capacity to support these endeavors, and (5) the availability of individuals with the credibility and skills required to effectively lead collaborations. The paper concludes with some recommendations for PWSAC and AHRP to consider when attempting collaborations in the future, including resorting to a quasi-traditional top-down management approach should their attempts at collaboration fail.

Salmon fishery management in PWS

Public management in Prince William Sound (PWS) has a long and rich history that has provided many challenges to management of the area's salmon fishery resources. Following a visit by the U.S. Bureau of Fisheries in 1887, reports of the area's abundant salmon drew immediate interest from places as far away as San Francisco, and by 1889 the construction of PWS's first salmon canneries took place on Orca Inlet near present-day Cordova. With the decimation of sea otter populations in PWS and an influx of Americans to these canneries, Lethcoe and Lethcoe (2001) describe a shift in the Sound's population from the trading posts on Hinchinbrook Island eastward to the canneries on Orca Inlet. Although the cannery owners first refused to hire the area's indigenous residents and instead imported Chinese laborers, this changed somewhat with passage of the Geary Act of 1902, which made it increasingly difficult for the canneries to employ Chinese immigrants (Lethcoe and Lethcoe, 2001). Regardless, very few Native Alaskans were employed in the canneries, and fewer still were employed as fishermen on the grounds. Most of the area's indigenous population was engaged in subsistence fishing activities during the summer months to provide salmon for their winter food supplies, leaving Cordova's white population to enjoy most economic gains from the area's developing

salmon fishery. And as the canneries grew in number, so too did Cordova's population, which grew from zero to an estimated population of 1,293 residents by 1910 (Lethcoe and Lethcoe, 2001).

During the early-1900s, the commercial fishing industry dominated Alaska's economy, at times contributing as much as 85% to the territory's economy. According to Lethcoe and Lethcoe (2001), the territory's salmon fishery alone was worth twice the value of ore extracted from Alaskan mines. During World War I, significant U.S. government military spending on Alaskan salmon products to feed Allied troops further expanded the Alaskan salmon canning industry. Salmon prices crashed soon thereafter, leading the industry to harvest more fish to turn a profit. More than eleven million pink salmon (*Oncorhynchus gorbuscha*) were harvested in PWS during the 1926 fishing season, serving as the peak pink salmon harvest in PWS for many years to come (Clark et al., 2006). However, overharvest and poor management practices are commonly blamed for a subsequent decline in salmon abundance throughout Alaska starting in the late 1930s.

The number of fish traps in operation statewide peaked in 1927 prior to a reduction by the federal Bureau of Fisheries in 1928 (Colt, 1999). Clark et al. (2006) estimate that fewer than 10% of the 434 fish traps licensed in the state in 1948 were owned by Alaskan residents. The prevailing sentiment among many Alaskans at the time was that fish traps with out-of-state owners were contributing to salmon declines. Common among most Alaskans was a perception that the federal government was mismanaging the territory's salmon fishery resource from afar, due in large part to lobbying efforts by commercial salmon fishing industry representatives in Washington, D.C. The lack of self-rule in Alaskan salmon management and the influence that industry had on federal salmon managers are believed to be primary forces for the Alaskan

statehood movement (Clark et al., 2006). In testimony before the U.S. Senate, R. R. Warren, an Alaskan resident and commercial fisher stated: “We Alaskans charge emphatically and can prove that the fish trap is a menace to a continued successful operation of fisheries in Alaska.” Opponents of fish traps prevailed in this instance, and when Alaska achieved statehood in 1959, the abolishment of fish traps was soon to follow (Clark et al., 2006).

As momentum grew towards Alaska gaining statehood, its fisheries were important enough to be featured in the state’s constitution. Article VIII, Section 4 of the Alaska Constitution reads: “Fish, forests, wildlife, grasslands, and all other replenishable resources belonging to the state shall be utilized, developed and maintained on the sustained yield principle, subject to preferences among beneficial uses.” Harrison (2002) asserts that the phrase “subject to preferences among beneficial uses” denotes recognition among delegates of the Alaskan Constitutional Convention that not all demands made of the resource could be satisfied, and that prudent resource management based on modern conservation principles would require the prioritization of competing uses.

By the time that Alaska was granted statehood, it was acknowledged that significant damage had been done to the state’s salmon fishery resource. When first addressing the Joint Assembly of the First Alaska State Legislature in 1960, governor William Egan began his speech by stating, “On January 1 of this year, Alaska’s Department of Fish and Game was handed the depleted remnants of what was once a rich and prolific fishery...on these ruins of a once great resource, the department must rebuild.” Similarly, in a speech to the U.S. Senate in 1960, Alaskan senator Ernest Gruening stated, “Had it not been for the federal government’s neglecting and permitting the abuse of the salmon fishery resource of Alaska, they would today constitute a great and rich heritage for this and future generations” (Harrison, 2002). Sentiments such as

these provide important historical context, as they speak to the environment that would lead to the design of Alaskan salmon fishery management institutions, most of which are still relevant today.

Although salmon populations in some areas of the state experienced increases in abundance during the 1960s, subsequent declines in statewide abundance and harvests reached all-time lows by the early-1970s. Statewide, annual salmon harvests of approximately 22 million fish in 1973 and 1974 rank among the state's lowest catches since 1900 (Stopha, 2017). Clark et al. (2006) suggest that the period of decline in Alaskan salmon abundance from the late 1940s through the late 1970s is due to a myriad of factors, including poor salmon management from an absentee federal management system, and increases in international high seas fisheries targeting Alaskan salmon. Mantua et al. (1997) further attribute the pronounced decline in Alaskan salmon production during this time frame to a dramatic shift in broad scale climatological phenomena starting in 1947. This shift resulted in conditions that were unfavorable to Alaskan salmon production, which persisted until a subsequent shift to more favorable conditions in 1977 (Mantua et al., 1997).

One year following the first successful large-scale extraction of oil from the Atlantic Richfield site in Alaska's Prudhoe Bay, the State of Alaska held an auction for land leases to support the development of the state's oil fields, which resulted in the state collecting \$900 million in a single day. This, according to Anderson (2002), occurred at a time when the state's total annual budget was just over \$100 million. The resulting financial windfall sent the state into a public spending frenzy, which would include a focus on capital projects and increased capacity for the Alaska's public agencies. A wide range of activities geared towards rehabilitating the state's salmon fishery resource followed soon thereafter, including the establishment of a

Division of Fisheries Rehabilitation, Enhancement and Development (FRED) within ADF&G (Stopha, 2017). Alaskan voters subsequently amended the state's constitution to allow for the development of a statewide hatchery program. The overarching goal of the program was to enhance salmon fisheries while minimizing adverse impacts on wild stock production. Implementing language from the Alaska legislature stated that "The program shall be operated without adversely affecting natural stocks of fish in the state and under a policy of management which allows reasonable segregation of returning hatchery-reared salmon from naturally occurring stocks" (Snow, 1991). With substantial financial resources now available to the agency, ADF&G and its FRED division embarked on a period highlighted by the development of salmon hatchery capacity in the state, including the construction of 18 state hatcheries between 1969 and 1983 (Stopha, 2017). Concurrently, there were also significant developments in supporting state regulations and policies, the likes of which further institutionalized the state's hatchery program.

Alaska's salmon hatchery program

Central to the development of Alaska's hatchery program was the creation by regulation of regional aquaculture associations (RAAs) for many of the state's salmon planning regions. Where RAAs operate hatcheries in the state, they also organize as a private nonprofit (PNP) corporation governed by a board of directors whose membership includes commercial salmon fishing permit holders, and representatives of other stakeholder groups, including commercial seafood processors, city officials, sport fishing interests, and subsistence harvesters, among others (Stopha, 2017). To fund operations of an RAA, commercial salmon fishing permit holders may choose to impose a salmon enhancement tax on the sale of salmon harvested in their area (Stopha, 2017). RAAs and independently operated PNPs may also contract with seafood

processors to harvest hatchery salmon in designated areas to pay for hatchery operations, a process which is referred to as “cost recovery fisheries.” To put these institutions into perspective, the PWS RAA, PWSAC, required approximately \$10 million in fish sales and another million dollars in salmon enhancement tax revenues to balance its budget in 2016 (PWSAC, 2017).

Salmon fishery enhancement efforts for each planning region are guided by comprehensive salmon plans as developed by regional planning teams (RPT). RPTs are most commonly comprised of six voting members, with three members appointed by the RAA’s board of directors, and three memberships held by ADF&G staff. Hatchery planning is conducted in a public process based on the desires of fishery user groups and the region’s communities (Stopha, 2017). Although members of the public are encouraged to attend, and RPT meetings are open to the public, voting on issues of relevance to the RPT is limited to team members. The RPT reviews hatchery permit applications within their region, along with hatchery annual management plans, ultimately making recommendations to the ADF&G commissioner for his/her final ruling. I believe that this decision-making structure includes both a bottom-up and top-down management approach given the involvement of local stakeholders and the role of ADF&G’s commissioner in the final ruling on these recommendations. For the PWS area, the Prince William Sound/Copper River (PWS/CR) RPT is the local body responsible for hatchery planning. Although not included as part of my PWSAC internship, I have served as chair of the PWS/CR RPT since spring of 2015.

Permitting for Alaskan hatcheries is an elaborate and intensive process requiring consideration of a wide range of factors, including: hatchery production goals; hatchery siting information, including water flow, water chemistry data, land ownership, and water rights;

hatchery design; additional biocriteria, including the selection of local broodstocks for seeding hatcheries; and a financial plan. Oversight for permitting of Alaskan hatcheries is through ADF&G, with interagency collaboration involving local, regional, and headquarters staff. Numerous policies enacted as state regulation also govern Alaskan hatchery operations, including the ADF&G Genetics Policy, the Alaska Fish Health and Disease Control Policy, the Alaska Policy for the Management of Sustainable Salmon Fisheries, the Salmon Escapement Goal Policy, and local fishery management plans (Stopha, 2017). These regulations require fishery managers to consider the interactions of hatchery and wild salmon stocks when reviewing hatchery permits and planning, although consideration of such interactions has been slow to develop due in part to the inherent difficulty in assessing ecosystem indicators, their causes, and their impacts.

Salmon hatchery production in PWS

Of the 29 hatcheries in operation in Alaska in 2016, six contribute to PWS area fisheries, five of which are operated by PWSAC. Gulkana Hatchery (GH), which is located near Paxson in the Alaskan interior, augments production of sockeye salmon (*Oncorhynchus nerka*) returning to the Copper River; Cannery Creek Hatchery (CCH), which is situated in a fjord in northcentral PWS, produces pink salmon; Armin F. Koernig Hatchery (AFK) in southwestern PWS produces pink and chum salmon (*Oncorhynchus keta*); Wally Noerenberg Hatchery (WNH) in northwestern PWS produces pink, chum, and coho salmon (*Oncorhynchus kisutch*); and Main Bay Hatchery (MBH) in western PWS produces sockeye salmon. Valdez Fisheries Development Association (VFDA) operates Solomon Gulch Hatchery (SGH) in Port Valdez, and produces pink and coho salmon (Stopha, 2017). PWSAC, VFDA, and ADF&G also collaborate on the release of relatively small numbers of juvenile coho and Chinook salmon (*Oncorhynchus*

tshawytscha) in and/or near the communities of Chenega, Cordova, Tatitlek, Valdez, and Whittier (Stopha, 2017). Modest hatchery releases near the Native villages of Chenega and Tatitlek comprise the only hatchery releases in PWS intended primarily for subsistence fishers.

In response to poor salmon returns to PWS during the late 1960s and early 1970s, which can be tied in part to losses in productivity stemming from the 1964 Great Alaskan Earthquake, PWSAC was formed to develop hatcheries in the area, and to stabilize pink and chum salmon runs at levels similar to those which occurred from 1920–1950 (Stopha, 2013b). According to Stopha (2013b), PWSAC’s founders also viewed salmon hatcheries as safeguards against potential impacts from oil development in the region, including the construction of the Trans-Alaska Pipeline System (TAPS) terminus in Port Valdez. The State of Alaska commenced PWS hatchery construction in the mid-1970s at CCH, with PWSAC building its first hatchery in 1979 at a former cannery site in Port San Juan in southwestern PWS. Later renamed the AFK Hatchery, higher than anticipated construction costs led some early PWSAC board members to make considerable donations of their own time and money to complete the facility (personal communication with Bill Webber, Sr., PWSAC Founder). The PWSAC Board of Directors currently has 45 members, including 27 PWS commercial salmon fishing permit holders, who are elected by PWS salmon permit holders; and an additional 18 seats appointed by the board representing local municipalities, Alaska Native organizations, salmon processing companies, sport fishing interests, personal use fishery participants, and subsistence fishery interests. CCH permitted capacity has grown from just over four million pink salmon eggs in 1978 to 187 million pink salmon eggs in recent years (Stopha, 2013c). AFK Hatchery has experienced similar growth in its production capacity, growing from the collection of just under 6.3 million pink salmon eggs in 1975 to its current permitted capacity of 190 million pink salmon eggs (Stopha,

2013b). PWSAC's overall production has followed this pattern, with PWS hatchery egg takes totaling more than 693 million coho, chum, pink, and sockeye salmon eggs in 2017 (PWSAC, 2017).

Salmon hatcheries as economic drivers for rural Alaska

In terms of adult returns, hatchery production in Alaska is generally considered to be a success, resulting in increasing harvests of salmon over time. In 2013, a record 283 million salmon were harvested in Alaskan commercial fisheries, including 176 million wild fish, and 107 million hatchery fish (Stopha, 2016). In PWS alone, a record 76 million hatchery-produced pink salmon were harvested in 2013 by common property fisheries and hatchery operators (Vercessi, 2015). By comparison, the estimated wild pink salmon total run to PWS in 2013 was approximately 31 million fish, which was the largest wild stock return since statehood and exceeded the previous high of 25.8 million fish in 1984 (Sheridan et al., 2014). Statewide, the second largest harvest on record occurred in 2015, with a 263 million fish commercial harvest that included the third largest catch for wild stocks (170 million fish), and the second largest catch for hatchery stocks (93 million) (Stopha, 2016). For PWS, a new record wild pink salmon total run of 63.5 million fish in 2015 was more than double the previous record from 2013 (Knudsen et al., 2016).

With large hatchery returns have come significant economic benefits for the region's industry and communities. From 2007 until 2011, PWS commercial fisheries harvested PWSAC salmon in commercial common property fisheries worth a total \$264 million in ex-vessel value (McDowell, 2012). During this time frame, PWSAC operations and salmon production generated an additional annual average of \$51 million in labor income for approximately 2,500 workers, including commercial fishers, processing workers, PWSAC employees, and other supporting

jobs (McDowell, 2012). From 2008 until 2012, VFDA generated an annual average of \$80.1 million in economic output (McDowell, 2013). VFDA production from 2008 through 2012 led to the creation of jobs for 824 workers, resulting in total annual average earnings of \$21.5 million per year in labor income, and other related effects (McDowell, 2013).

Significant Alaskan hatchery production also takes place outside of PWS, including large programs in Cook Inlet, Kodiak Island, and southeast Alaska. In 2013, Vercessi (2014) reports that an estimated 97 million salmon, or 36% of the state's total commercial common property salmon harvest, were produced by Alaskan salmon hatcheries. The return of these hatchery salmon provided an estimated ex-vessel value of \$182 million in 2013, or 25% of the state's total commercial common property salmon harvest value (Vercessi, 2014). In 2015, the share of Alaskan hatchery fish harvested in commercial common property fisheries increased to 30% of the statewide harvest value, with the first wholesale value of the commercial hatchery harvest nearing \$350 million (Stopha, 2016). It is widely accepted that these hatchery programs have outperformed their original expectations. Members of the Alaska commercial salmon fishing industry have encouraged the state to allow for increases in hatchery production, although state fishery managers remain cautious about such increases (Stopha, 2013a).

Alaskan hatchery controversy

However economically successful these hatcheries may be, the scale of hatchery production in Alaska has led many to question its impacts and potentially negative ecosystem-wide consequences for wild salmonids, forage fish species, marine mammals, and seabird populations. This is especially true in PWS, where upwards of 600 million juvenile salmon are released each spring (ADF&G, 2012). In PWS, concerns have been raised regarding the impacts that these hatchery releases could have on wild salmon and herring through competition for

limited prey resources, or through predation by returning hatchery-origin salmon (Ward et al., 2017). According to Ward et al. (2017), pink salmon consume a wide range of prey items, including zooplankton, herring, and other fish. As pink salmon comprise the largest component of hatchery releases in PWS, Brenner et al. (2012) recommend that a precautionary approach be applied when managing hatchery salmon production. Although Pearsons (2008) also recommends such an approach to this management issue, he further asserts that more concerted efforts need to be made to clearly identify policy and technical arguments regarding the issue of hatchery production, and separate wild and hatchery fish where appropriate. By doing so, Pearsons (2008) argues that only then will the management of ecological interactions associated with hatcheries allow for improvements in ecosystem benefits.

However, it has been argued by some that a precautionary approach is already embedded in the design and evolution of Alaska's salmon hatchery program. As defined by Garcia (1995), the precautionary approach is "A set of agreed cost-effective measures and actions, including future courses of action, which ensures prudent foresight, reduces or avoids risk to the resources, the environment, and the people, to the extent possible, taking explicitly into account existing uncertainties and the potential consequences of being wrong." Along with ADF&G biologists, a broad consortium of experts from other regulatory agencies, the University of Alaska, and fisherman's associations collaborated to formulate guidelines and policies for the development of Alaska's modern hatchery program throughout the 1970s and 1980s. Above all else, this consortium was charged with the development of a program that intended to supplement and not replace wild salmon fisheries (McGee, 2004). Policies and regulations were enacted to specifically protect wild stocks from potential negative effects of hatchery activities. According to McGee (2004), the protection of wild salmon stocks in Alaska is accomplished through (1) a

rigorous hatchery permitting process that includes review by experts in the fields of genetics, fish pathology, and fishery management; (2) policies that require the placement of hatcheries away from significant wild stocks; (3) use of local broodstocks; (4) legal mandates requiring wild stock prioritization in fishery management; (5) requirements for the tagging and marking of hatchery-produced fish; and (6) requirements for special studies on interactions between hatchery and wild fish, as necessary. According to McGee (2004), these policies and procedures were subsequently followed by the Hatchery Scientific Review Group during a hatchery reform project in the state of Washington some 20 years following their implementation in Alaska.

Despite these policies, as pink salmon production at PWS hatcheries expanded, there has been increasing concern that hatchery salmon could be having a negative impact on wild fish (ADF&G, 2012). Recent studies in PWS and southeast Alaska have documented the presence of hatchery-produced “stray” salmon in local streams (Brenner et al., 2012; Piston and Heinl, 2012). Concerns exist regarding potentially negative genetic and ecological interactions between hatchery and wild stocks of salmon, and complications with escapement estimates which could result from the presence of large numbers of hatchery strays in local streams. Many studies have identified potential risks to natural salmon populations posed by hatchery production, including genetic interactions. However, there have been relatively few field studies of these kinds conducted in Alaska, nor have many of these studies included pink or chum salmon, which are the focus of Alaska’s hatchery program.

Alaska Hatchery Research Project (AHRP)

Considering how much has been invested in Alaskan fisheries over time, there are many stakeholders involved, including government agencies, commercial fishers, noncommercial stakeholders, and environmental groups. Alaskan fisheries managers and policymakers continue

to be under increased pressure to ensure that hatchery practices are managed responsibly and do not greatly interfere with wild salmon populations. To address these issues, a research project was developed, titled “Interactions of Wild and Hatchery Pink and Chum Salmon in Prince William Sound and Southeast Alaska” (ADF&G, 2012). The project’s research program (hereafter referred to as the Alaska Hatchery Research Project, or AHRP) seeks to address many of the concerns that exist regarding hatchery production in PWS, and will likely produce results with implications for hatchery management in PWS and beyond (ADF&G, 2012). The primary goals for this research project are to estimate the proportion of the annual runs of pink salmon in PWS that are comprised of first-generation offspring of hatchery salmon, determine the annual variation and extent of hatchery pink salmon straying in PWS, and assess the impact on fitness (productivity) of wild pink salmon stocks due to straying of hatchery salmon (ADF&G, 2012).

Knudsen et al. (2015a) report that the proportion of pink salmon entering PWS in 2013 were 67.9% hatchery and 32.1% wild stock pink salmon. Stream sampling in 2013 resulted in an estimated region-wide hatchery fraction in spawning streams of 4.3% (Knudsen et al., 2015a). For the 2014 field season, Knudsen et al. (2015b) report that the proportions of pink salmon entering PWS were 86% hatchery and 14% wild stocks. Stream sampling in 2014 resulted in an estimated region-wide hatchery fraction in spawning streams of 15% (Knudsen et al., 2015b). In 2015, Knudsen et al. (2016) report that the proportion of pink salmon entering PWS was 55% hatchery, and 45% wild stocks. The estimated Sound-wide pink salmon hatchery fraction in spawning streams was 10% in 2015, according to Knudsen et al. (2016). The stray rates resulting from the AHRP will be of interest to managers and policy makers, as it has generally been held that a 2% incidence of pre-spawning hatchery strays in a neighboring wild stock population could serve as a trigger point for action, and for consideration of hatchery reform to reduce

straying. This “2% rule” is based on the theoretical rate of loss of alleles in a wild salmon population as described by Withler (1997). According to Withler’s (1997) research, at a 1.5% influx of hatchery genes in each generation, the replacement of 50% of alleles in a wild population could occur in 25 generations. It is proposed by some that this replacement of alleles would accompany a decrease in population fitness and a resulting decrease in productivity of the wild population. Withler’s (1997) numbers assume that there is no selection pressure acting to slow the rate of allele replacement. Conversely, in the absence of relevant applied research, it is possible that allele replacement could increase genetic fitness due to selective pressure. Further, Tallman and Healey (1994) compared the incidence of enhanced chum salmon carcasses in three British Columbia wild populations using a biochemical genetic analysis available at the time. They found that actual gene flow was an order of magnitude less than the observed rate of straying: in one population, there was a 46% observed stray rate, whereas the actual gene flow from hatchery to wild fish was estimated at less than 5% (Tallman and Healy, 1994). Regardless, the pairing of contemporary genetic technologies and analyses with Alaskan pink and chum salmon populations and observed stray rates resulting from the AHRP will provide the scientific community with an unprecedented opportunity.

Ecosystem Approach to Fishery Management (EAFM)

In recent decades, the concept of sustainable fisheries has evolved to include consideration for a wide range of potential ecological impacts on marine ecosystems, such as the importance of habitat, consideration of food web and predator-prey interactions, and the unintended harvest of non-target species, among other ecosystem components and interactions. Starting in the 1990s, a variety of advisory panels recommended that ecosystem components be given broad consideration in fisheries management (Frampton, 1996). By the late 1990s, this

changing paradigm, hereafter referred to as an ecosystem approach to fisheries management (EAFM), had increasingly taken hold in many natural resource management arenas, including freshwater and marine environments. Bengston et al. (2001) assert that ecosystem management was widely accepted by the American public as early as the late 1990s, as interpreted by an analysis of media stories from 1992 through 1998 which found that 78% of all attitudes portrayed regarding ecosystem management had been favorable.

By the turn of the twentieth century, EAFM was in the implementation stage or had already been implemented at several federal natural resource management agencies across the U.S. (Imperial, 1999). Olander et al. (2015) assert that a more recent explosion of interest in incorporating ecosystem considerations into natural resource management is due to changes in public awareness, changes in natural and social sciences, and changes in public policy, including impact assessments under the Endangered Species Act (ESA). Although public environmental concerns and interest in natural resource management are nothing new, Olander et al. (2015) argue that there is an increasing awareness of the ways that management of interconnected ecosystems affect businesses, households, and communities. As understanding and measurement of ecological systems by environmental and research communities evolves, a similar increase in the research of human dimensions of fishery and wildlife management has also begun to highlight the broad social benefits of EAFM beyond the protection of purely ecological considerations. For example, in 2008 the American Farm Bill called on U.S. federal agencies to explore ecosystem services and their potential application in environmental markets (Olander et al., 2015). In 2015, U.S. government leaders released a policy memorandum making a similar request for consideration of ecosystem services in all federal decision-making activities. This increased prioritization can be seen in the increase in numbers of peer-reviewed articles

addressing EAFM and similar concepts, where between 1995 and 2003 Dolan et al. (2016) report that there were between 0 and 2 articles published per year with the term EAFM in the topic subjects, with that number increasing to more than 30 such publications in recent years.

However, despite widespread and growing support for EAFM, controversy over how it should be implemented remains for the various disciplines involved with fisheries management endeavors, including the fields of ecology, fisheries science, economics and other social science disciplines. According to Fulton et al. (2014), this conflict stems in part from a tendency to seek simple solutions to inherently complex fishery management problems, with each discipline prescribing its own “silver bullet” solution guaranteed to solve all management issues. Fulton et al. (2014) assert that reviews of the performance for each discipline’s preferred approach reveal that no single solution performs well for all species in all circumstances. The resulting adversarial tone, Fulton et al. (2014) argue, leaves fishery managers scrambling to find which measures or combination thereof will best meet the multiple and often conflicting goals of EAFM.

Given differing interpretations of this concept, Imperial (1999) highlights several obstacles to the implementation of EAFM, including an inconsistency of related policies across and between levels of government. Imperial (1999) advocates for collaborative decision-making due to the many agencies necessary for the implementation of EAFM on such a broad scale. Gray (1985) defines collaboration as “the pooling of appreciations and/or tangible resources, e.g., information, money, labor, etc., by two or more stakeholders to solve a set of problems which neither can solve individually.” According to Gray (1985), collaboration implies a joint decision-making approach to problem resolution where power is shared and stakeholders take collective responsibility for their actions and subsequent outcomes from those actions. Although

EAFM and collaborative decision-making may lead to improvements in natural resource management, Imperial (1999) asserts that a wide range of administrative and institutional challenges should be addressed before EAFM can be broadly incorporated into governmental processes. However, Imperial (1999) notes several themes common to both EAFM and collaborative decision making, including: (1) approaching problems from an integrated or systems perspective; (2) improving institutional performance; (3) improving the integration of government policies; (4) enhancing the coordination of governmental and non-governmental organizations; (5) ensuring broad public participation; (6) involving key stakeholders in government decision making; and, (7) having a strong scientific basis behind government policies.

Through my internships with both PWSAC and AHRP, I note some institutional activities that embody the principles of EAFM and collaborative decision making as described in Imperial (1999). Alaska's hatchery operators outside of PWSAC have been effective at approaching their relationship with state managers from a systems perspective, as represented by the AHRP's multi-agency approach towards collaboration through its Science Panel. I believe that my appointment to the AHRP Science Panel represents an attempt to better engage PWSAC in the AHRP. Further, my participation in PWSAC activities, and especially my outreach products (appendices), represent efforts by stakeholders to improve institutional performance at PWSAC. ADF&G service on PWSAC's Board of Directors through its ex officio position promises to enhance the coordination of governmental and non-governmental actors, while ensuring broader participation. And although PWSAC's board is likely too large, I believe that the original intent for its design reflected similar considerations for broad participation. Finally, I

believe that the AHRP embodies Imperial's (1999) interpretation that EAFM includes a scientific foundation to government policies regarding hatchery production in Alaska.

Implications for fishery certification

The Alaskan commercial salmon fishery has long been touted as a model for sustainable fishery management, and was the first large-volume commercial fishery to be certified by the Marine Stewardship Council (MSC) in 2000 (Foley and Hébert, 2013). According to Foley and Hébert (2013), MSC performs third-party certification of fisheries using "credible standards for sustainable fishing and seafood traceability that seek to increase the availability of certified sustainable seafood." The MSC certification and labeling regime is a voluntary agreement sought out by "client" groups, most commonly commercial fishery participants (Foley and Hébert, 2013). In the case of the Alaskan commercial salmon fishery, ADF&G served as the client group for MSC's initial certifications. Foley and Hébert (2013) describe the MSC certification and labeling regime as a technical, scientific and social process that results in new economic and organizational relationships. Businesses that wish to use or sell MSC-certified seafood products must enter into a licensing agreement with MSC, and pay MSC a royalty fee based on the volume of the product that they sell with this ecolabel (Foley and Hébert, 2013).

Under the MSC program, the process for assessing a fishery is performed by a third-party team who assigns numerical scores between 0 and 100 for established fishery performance indicators (Chaffee et al., 2007). According to Chaffee et al. (2007), this process requires that these team members discuss and evaluate the information that they have been provided for a given performance indicator, and reach a consensus decision on scores. A fishery must receive scores of 80 or above on various indicators relating to three MSC principles to be recommended for certification: MSC Principle 1 states that a fishery must be conducted in a manner that does

not lead to over-fishing or depletion of the exploited populations and, for those populations that are depleted, the fishery must be conducted in a manner that demonstrably leads to their recovery; MSC Principle 2 states that fishing operations should allow for the maintenance of the structure, productivity, function and diversity of the ecosystem on which the fishery depends; and, MSC Principle 3 states that the fishery is subject to an effective management system that respects local, national and international laws and standards, and incorporates institutional and operational frameworks that require use of the resource to be responsible and sustainable (Chaffee, et al., 2007). Should any indicators related to these principles receive a score below 80, a “condition” is established that, when met, would bring the fishery’s indicator score to a level representative of a well-managed fishery.

According to Foley and Hébert (2013), MSC has gained global prominence in setting environmental standards for certifying harvests from capture fisheries and labeling products from those fisheries determined to meet the MSC’s criteria for certification. Bush et al. (2013) assert that MSC’s market dominance is due to its scientific basis, which is further supported by recognized attributes of market-based forms of environmental governance, including transparency, consistency, inclusiveness, and impartiality. Foley and Hébert (2013) assert that MSC, formally established in 1997, held a virtual monopoly in setting widely adopted standards for responsible capture fisheries by the 2000s, and was successful in persuading key European and U.S. markets to commit to buying only MSC-certified seafood. This was highlighted, argue Foley and Hébert (2013), by Wal-Mart’s 2006 announcement to source only MSC-certified seafood products by 2011.

Foley and Hébert (2013) report that although the Alaskan salmon fishery maintained compliance with the MSC certification program, opposition to this process by Alaskan interests

was apparent by 2005. According to Foley and Hébert (2013), Alaskan salmon fishery stakeholders had become increasingly frustrated with three aspects of MSC's certification program, including increasing fisheries certification costs, related ecolabel fees, and ecolabel marketing. At the time, Alaskan crab and pollock fisheries had experienced significant challenges in obtaining MSC certification, resulting in lengthy and expensive assessments. As most salmon processors in Alaska were also involved with these fisheries, this experience colored Alaskan salmon processors' opinions on recertification of the Alaskan salmon fishery (Foley and Hébert, 2013). Foley and Hébert (2013) assert that industry insiders increasingly complained that the MSC ecolabel demanded royalty fees at each level of sale, leading many industry leaders to judge the program as a costly "racket." Further, many key Alaskan interests increasingly favored the collective territorial brand identity of "Alaskan seafood" over the MSC ecolabel. According to interviews conducted by Foley and Hébert (2013), these leaders had concluded that Alaskan seafoods' well-established and historic reputation of sustainability could be communicated to consumers without the MSC ecolabel. Finally, ADF&G officials reportedly viewed MSC reassessment and its annual auditing as time-consuming and redundant given the fact that they were forced to compile detailed accounts of activities that they would be doing irrespective of Alaskan fisheries' participation in the MSC program (Foley and Hébert, 2013).

Concerns regarding the potential impacts of large-scale hatchery production had been raised as early as MSC's first certification of the Alaskan salmon fishery in 2000. Chaffee (2000) recommended that ADF&G "identify long-range research to assess the magnitude of the interaction of hatchery programs on the wild stock gene pool and the effect on the reproductive fitness of those stocks." Further, ADF&G was charged with documenting the programs, policies, regulations and actions taken to ensure that Alaska's hatchery program was consistent with the

department's Genetics Policy (Chaffee, 2000). As part of their 2007 recertification of the Alaskan salmon fishery, Chaffee et al. (2007) assigned specific conditions to be met regarding hatchery production in the state as a prerequisite for recertification. Soon thereafter, ADF&G announced that it would no longer act as the client for MSC certification, instead transferring this role to the state's public-private seafood marketing group, Alaska Seafood Marketing Institute (ASMI). As part of their findings from the first surveillance of the fishery following its 2007 recertification, Knapman et al. (2009) concluded that there was insufficient information provided by ADF&G to determine whether goals for wild PWS salmon were being met consistently. Further, the assessment team concluded that the data and analyses available to them were inadequate to determine if enhanced fish in PWS were having an adverse impact on any component of the area's wild salmon (Knapman et al., 2009). As a result, PWS salmon failed to meet the threshold for certification, and would remain in assessment status until conditions were met that would result in a score greater than 80 (Knapman et al., 2009).

Although some components of the Alaska salmon fishery would maintain certification status with MSC in some capacity, most Alaskan salmon processors and the State of Alaska withdrew from MSC certification and embarked on a series of alternative certification programs, most notably the Alaska Responsible Fisheries Management (RFM) Certification program, which was created in 2010. The pending decline in supply of MSC-certified salmon from global markets prompted MSC to send a letter to major buyers of Alaskan salmon asking them to pressure their suppliers into supporting fishery recertification with MSC (Foley and Hébert, 2013). Foley and Hébert (2013) allege that Wal-Mart subsequently told ASMI that it intended to maintain its previous commitment to sourcing only MSC-certified salmon, even if most of the state's salmon did not become recertified. Following several years of heated negotiations among

Alaskan industry representatives, the state's political leaders, and Wal-Mart, the retailer announced in 2014 that it considered the Alaska RFM program as having met the requirements of the retailer's sustainable seafood policy (Foley and Havice, 2016).

PWSAC and other stakeholders coordinated MSC's first site visit to PWS in 2015, in an attempt to reengage the certification body and provide some local perspectives on the area's salmon fishery. Following this visit, PWS salmon were included in the pre-existing Alaska salmon MSC certificate, and entered into reassessment for potential recertification in 2016. As part of my PWSAC and AHRP internships, I participated in discussions with MSC's assessment team regarding some of their concerns and questions about PWS salmon. According to a MSC press release, the entirety of the Alaska salmon fishery, including PWS salmon fisheries, was again recertified to the MSC standard in 2017 (MSC, May 16, 2017). Based upon the findings as quantified by the AHRP, the MSC certification assessment team determined that the impacts of wild and hatchery salmon interactions are low, and meet the certification body's sustainability requirements.

CONSTRAINTS TO COLLABORATION IN PWS

Any attempt to review the literature for evidence of barriers to effective natural resource management is bound to result in a wide range of answers, from a wide range of perspectives. However, similarities may be found within, and a few of these barriers resonate with my own personal experiences. In order to overcome the barriers to the development and implementation of successful EAFM, Berkes (2012) recommends altogether new governance approaches to address fisheries problems. According to Berkes (2012), creativity in handling the inherent divisiveness of natural resource management is a prerequisite to successfully addressing the many uncertainties inherent to complex social-ecological systems such as fisheries, which

inevitably involve the selection of policy winners and losers. Rather than working to grow EAFM concepts which are currently applied towards the pursuit of marine ecosystem sustainability, Berkes (2012) advocates for a revolution involving multiple disciplines with multiple objectives, which he believes is necessary to deal with “wicked” problems that have become technically unresolvable. Collaboration, Berkes (2012) argues, will be required to come to an understanding of these problems, and to move towards their solution.

According to Weber et al. (2017), wicked problems are unstructured, cross-cutting, and relentless. According to the first of these three primary characteristics, the causes and effects of these problems are extremely difficult to identify, thus adding uncertainty and complexity, resulting in conflict due to lack of consensus on the problem or its solution. Wicked problems are cross-cutting in that they cut across organizational structure, policy domains, administrative and political jurisdictions, and political interests. Third, wicked problems are not going to be solved indefinitely, and efforts to solve them will inevitably have consequences for other policy arenas. Weber et al. (2017) argue that the uncertainty, contestedness, and complexity of wicked problems necessitate the involvement of multiple citizens and groups, or stakeholders. Further, Weber et al. (2017) introduce a “post-normal” approach to science in the policy process as a means for more effectively addressing and resolving wicked problems. Weber et al. (2017) assert that the key to the post-normal approach is an extended peer community that intentionally involves a broad representation of stakeholders to increase public understanding and literacy through participation, represent different viewpoints in the decisions about how problems are defined, and democratize knowledge production and its application to wicked problem decisions.

Weber et al. (2017) introduce collaborative governance arrangements as a means to give people a voice in decisions, reduce conflict and litigation, and produce more durable policy

outcomes by creating trust and providing mutually beneficial solutions. Collaborative governance is defined by Ansel and Gash (2007) as a “...governing arrangement where one or more public agencies directly engage non-state stakeholders in a collective decision-making process that is formal, consensus-oriented, and deliberative and that aims to make or implement public policy or manage public programs or assets.” In their review of collaborative governance arrangements, Weber et al. (2017) describe their understandings and applications as holding the potential to successfully address wicked problems, where uncertainty, disputed values, and high stakes go hand in hand. The widespread move to collaboration among Western democracies’ deliberations on natural resource issues seeks out the involvement of science, local knowledge, and communities in policy-making. Networks established between involved organizations, individuals and groups are defined by their enduring relationships of exchange. Although a network could involve a simplistic arrangement between two government agencies, more often they involve a complex combination of connections across a variety of sectors.

According to Weber and Khademian (2008), networks may evolve to govern or address an issue, they may be initiated through regulatory mandate, or they may be created by entrepreneurial managers to accomplish resource sharing and/or to enhance program performance. For the latter, Weber and Khademian (2008) describe the role that collaborative capacity-builders (CCBs) play in fostering the transfer, receipt, and integration of knowledge across the network, which can build long-term collaborative problem-solving capacity strong enough to address complex public, or wicked, problems.

In his review of progress in EAFM implementation, Cochrane (2017) identified two interrelated obstacles to Berkes’s (2012) optimistic vision, including an unlikelihood that stakeholder groups will buy into integrated approaches to management if they feel that their

interests are better served by a pre-existing approach. Cochrane (2017) asserts that these self-serving tendencies apply to scientists as well, whom he asserts share a common trait of being pre-occupied with their own disciplines, interests and theories. Lachapelle et al. (2003) assert that a lack of agreement on goals, rigidity in process and design, and a lack of trust confounds effective natural resource planning, especially when dealing with wicked or messy issues. Armitage (2005) suggests that community-based natural resource management faces significant political, technical, and financial barriers, including a limited number of organizations and individuals with the skills necessary to overcome entrenched top-down planning processes. In his review of adaptive management, Walters (2007) argues that failures in implementation can be traced to three institutional problems: a lack of management resources necessary to monitor large-scale experiments, an unwillingness by decision makers to allow for uncertainty in policy choices, and a lack of leadership required for the planning and implementation of new and complex management plans.

Through my own experiences, including coursework completed as part of my graduate program, and especially through my experiences as an intern with PWSAC and AHRP, I have settled on three overarching barriers which I believe are limiting effective collaborative management of PWS salmon fishery resources, including: (1) lack of trust, (2) inadequate funding, and (3) limited organizational and individual capacity. Although a brief description of lessons learned through my internships will follow, I sought to seek out, implement, and otherwise understand potential solutions to each of these barriers through my service on PWSAC's Board of Directors and the AHRP Science Panel.

Barrier #1: PWS citizens' mistrust of public managers

There are long-standing barriers to effective collaborations between commercial fishery stakeholders and natural resource managers in PWS which predate current conflicts, and which should be given some consideration when attempting to collaborate in PWS. For starters, there are still elders alive within the community of Cordova who recall being excluded from participation in local commercial fisheries under federal management as described by Clark et al. (2006), and these individuals' stories undoubtedly have planted the seeds of doubt in state-sponsored fisheries management for many years. Further, several formerly productive fisheries once prosecuted in the area have since collapsed due to perceived mismanagement by state officials, including those targeting Tanner crab (*Chionoecetes bairdi*), spot shrimp (*Pandalus platyceros*), Dungeness crab (*Cancer magister*), and Pacific herring (*Clupea pallasii*) (Rumble et al., 2014; Wessel et al., 2015; Wessel et al., 2012; and, Thorne and Thomas, 2008). Overharvest has been implicated for the aforementioned shellfish species, whereas impacts from the Exxon Valdez Oil Spill of 1989 (EVOS) have been the focus of much research into the subsequent collapse of PWS's herring population, and a failure for this species' population to recover to its former abundance in the decades since the spill.

Given its profound impact on the area's ecology, economy, and psyche, I believe that additional discussion of EVOS is warranted. Ott (2008) asserts that corporate interests and their political allies oppressed resistance by PWS citizens to the construction of the terminus of the trans-Alaska crude oil pipeline in Port Valdez, which she characterized as an unjust and cruel use of power. In 1970, Senator Ted Stevens assured local commercial fishers and Alaska Native villages in the proposed pipeline's corridor (including PWS) that "not one drop" of oil would touch the waters of PWS. In response to their resistance, Governor Bill Egan threatened Cordova

fisherman during a 1970 teleconference: “You don’t want oil? Then I won’t give you any *[expletive deleted]* oil! I’ll block off all shipments into Cordova! See how far your fishing boats will get!” (Ott, 2008). The ecological and social disaster that befell PWS following EVOS has been well documented in peer-reviewed literature, and I would argue that it contributes to an environment of mistrust that still exists between many Cordova residents and the state’s managers and political leaders.

Shindler et al. (2002) assert that public mistrust of natural resource agencies is widespread – and I would argue that this is especially true for policy losers – often leading to a lack of support for their decisions or the way those decisions are made. The authors report that barriers between resource management institutions and the public centering on issues of trust have led to a level of frustration with bureaucracies perceived to be politically driven, where many Americans are suspicious of these institutions and their processes (Shindler et al., 2002). To combat these tendencies, Davenport et al. (2007) found widespread agreement within scientific literature that collaborative processes exemplifying fairness and emphasizing relationship building promote trust. The key to building trust, the authors found, was consistent and honest communication between the public and natural resource managers, meaningful and sincere collaboration, and the joint implementation of actions. In order to effectively engage with a community, public managers must motivate its members to become involved in all phases of the management process, all the while clearly communicating avenues for their involvement. Davenport et al. (2007) recommend that these activities be held at times deemed to be convenient for community members, with all activities receiving significant coverage in local media.

Davenport et al. (2007) argue that trust is a key factor in implementing natural resource management policy, and is especially hard to come by in “local communities.” In describing

challenges to federal natural resource management, Davenport et al. (2007) contrast values held by a national public with symbolic interests in far-away protected places against “local community” stakeholders who have a more complex dependence on, interest in, and vulnerability to natural resource management decisions impacting their own backyard. Similar conflicts are at play in the PWS natural resource management arena, given differences of opinion on salmon fishery management practices held by local industry stakeholders relative to individuals with broader, national perspectives, including those in academia, environmental non-governmental organizations (ENGOS) such as MSC, and some within ADF&G. I believe that this is especially true when it comes to the debate over the sustainability of large-scale salmon hatchery production in PWS. According to a press release from ADF&G’s commissioner commemorating the establishment of August 10th of each year as Alaska Wild Salmon Day, ADF&G’s highest priority is to manage Alaska’s prized wild salmon populations (Sam Cotten, personal communication, August 10, 2016). However, in most years, the majority of salmon harvests in PWS are hatchery fish, including 72% of a record harvest of 103.5 million salmon in 2015 (Stopha, 2016; Haught et al., 2017). I believe that ADF&G’s wild fish priority often conflicts with the reality of PWS’s salmon fishery, thereby meeting the definition of a wicked problem inasmuch as the debate is likely a technically unresolvable problem where uncertainty, disputed values, and high stakes tend to go hand in hand. According to Shindler et al. (2002), wicked problems require new ways of thinking, where trust and credibility in resource agencies requires public managers to engage with citizens through means which are deemed to be genuine and trustworthy. In these situations, Shindler et al. (2002) argue that managers’ credibility is tied to their concern and care, openness, and honesty, in addition to their knowledge and expertise.

Often lost in these discussions, and which I believe should be incorporated into any discussion of natural resource management decisions, is the acknowledgement of outcome winners and losers. As Lackey (2006) asserts, for every policy choice, there will be those who benefit, or “win,” there will be those who are harmed, or “lose,” and there will be some for whom the consequences are uncertain. Further, Lackey (2006) asserts, it is the potential losers who tend to be more vocal and assertive than potential winners, and who have a disproportionately greater influence on decision making processes. Managers who fail to anticipate this outcome, or who promote an unattainable “win-win” scenario, ultimately run the risk of losing credibility with stakeholders.

Relevant internship experience: ADF&G ex officio service on PWSAC Board of Directors

In response to conflict between ADF&G staff in the Cordova area office and PWSAC staff, and assertions of ongoing problems associated with PWSAC operations and/or permit compliance issues, ADF&G staff recommended a departmental internal review of PWSAC operations in 2006 (Craig Farrington, personal communication, April 4, 2006). Although this memo to PWSAC resulted in additional conflict between the two organizations, ADF&G staff continued with their review, and subsequently submitted a memo to ADF&G’s commissioner which served to summarize “PWSAC’s inadequate hatchery operations and makes recommendations of possible corrective measures to help PWSAC improve their respective operations” (Craig Farrington, personal communication, November 8, 2006). ADF&G’s commissioner subsequently forwarded a copy of this memo to the entirety of PWSAC’s Board of Directors, and thus ensued what is arguably the most contentious period in the organizations’ relationship. For many close to the conflict, including some local ADF&G staff, it was and still is believed that much of this interagency conflict was due largely to clashes of personality and

unprofessional behavior on the part of both organizations. For many at PWSAC and ADF&G, it was believed that more constructive dialogue should have resulted in a less public airing of grievances. PWSAC's trust in ADF&G and its staff was lost as a result of these encounters, and this sentiment radiated throughout the community of Cordova and elsewhere amongst many PWS commercial salmon fishery stakeholders.

One constructive resolution to this issue was PWSAC's adoption of a new bylaw creating an ex officio position on the PWSAC board for the commissioner of ADF&G or his/her designee. According to an October 31, 2007 memo (George Covell, personal communication) from PWSAC to ADF&G's commissioner, the PWSAC board created this position as a gesture of goodwill, and to restore a prior relationship where ADF&G staff once had a participatory role on the board. It was hoped that ADF&G's ex officio member would participate in both board and committee meetings, and would serve as a liaison between the board and ADF&G. Although I was not an active participant in these early interactions, I was present soon after the publication of ADF&G's "2006 Internal Review of Prince William Sound Aquaculture Corporation" (ADF&G, 2009), and believe that the position was no longer fulfilling its original intent. Further, ADF&G's 2009 publication of such a contentious document several years after PWSAC and ADF&G had reached agreement on most of the contested issues opened old wounds, and left some on PWSAC's board questioning the relevance of ADF&G's ex officio position altogether.

Several years later, following what could be characterized as a period of time involving relatively cordial and constructive relationships between ADF&G and PWSAC, the ADF&G commissioner recommended that I serve on PWSAC's board as ADF&G's ex officio representative. Although my appointment to the board's Board Development Committee met the position's original expectations, I was able to take this relationship to a new level through my

internship, and participated in every PWSAC committee meeting during the 2015/2016 winter meeting season, most of which involved in-person attendance. As ADF&G's liaison to PWSAC, I was able to present on issues of importance to the organizations and to PWS's commercial salmon fishery stakeholders. Further, given my concurrent appointment to the AHRP Science Panel, I was able to serve as a liaison between the PWSAC board and a research project of significant importance to the organization. I believe that my service as ADF&G's ex officio representative on PWSAC's board developed trust between the two organizations, and contributed to my own expertise regarding public natural resource management processes, and to my credibility with stakeholders as well.

Lesson #1: individual conflicts of personality often impede collaboration, and their impacts can be long-lasting

Although I brought strong communication skills into my graduate program internships, my own credibility in PWS salmon fishery circles had been years in the making, not all of which was my own doing. Given my predecessors' struggles in maintaining relationships with fishery stakeholders, and PWSAC in particular, there was nowhere to go but up when I joined ADF&G's Cordova area office in 2010. And, having previously worked in hatcheries in southeast Alaska, this experience gave me credibility in an area that I otherwise knew very little about. During my first season managing PWS's commercial purse seine salmon fishery in 2011, pink and chum salmon stream escapements were above average, which allowed for a relatively liberal and extremely popular fishery management approach. Following the 2011 fishing season, ADF&G research biologists determined that PWS pink salmon escapement goals had been set too high during the 2002 Board of Fisheries process, leading to foregone opportunity during much of the 2000s, along with fishery congestion and conflict between commercial fishermen

and ADF&G fishery managers. Starting with the 2012 season, PWS purse seine salmon fishery management benefitted from these reduced escapement goals, and from record wild stock returns in both 2013 and 2015. In some fishers' eyes, I was doing an exemplary job. And so, although I do believe that I possess strong communication skills, including an ability to compromise and to listen emphatically, sometimes it helps to get a little lucky.

Despite this luck and apparent goodwill, there remained some mistrust on the part of PWSAC and ADF&G during my tenure, with familiar dysfunction returning to the forefront in the wake of my departure from the latter. Stern and Baird (2015) describe such a situation as “affinitive” distrust arising from a previous interpersonal argument or betrayal. Although this form of distrust largely disappeared in PWS following the departure of my predecessors, thereby contributing to my own credibility, I believe that it has since returned following my departure. In such an example, Stern and Baird (2015) argue, an emphasis on interpersonal trust and insufficient systems-based trust has compromised the resiliency of these institutions' relationship in the face of personnel turnover. This has been exacerbated in my opinion by the promotion of an individual seen as being anti-PWSAC into a leadership position at ADF&G. Stern and Baird (2015) suggest that systems-based trust can be developed through transparency in decision-making, power sharing, an equitable distribution of benefits and risks, and joint procedural development.

Relevant internship experience: appointment of PWS stakeholder to AHRP Science Panel

Although all records of ADF&G's 2006 internal review of PWSAC (ADF&G, 2009) have been removed from the state's web site, the document's recommendations included consideration for ADF&G “straying evaluations” in response to ADF&G findings which indicated the presence of hatchery chum salmon in PWS streams. According to ADF&G (2009),

the PWS/CR Phase 3 Comprehensive Salmon Plan (PWS/CR RPT, 1994) states that PWSAC should be responsible for funding “all additional evaluations.” Given funding mechanisms available to PWSAC, it is most likely that cost recovery fishery revenues would pay for such research, ultimately resulting in fewer fish available to commercial common property fisheries, and participating stakeholders. As the PWSAC board is overwhelmingly comprised of commercial fishermen, the promise of funding large-scale research projects with cost recovery fish that could otherwise end up in their nets did not go over well then, and remains a controversial subject to this day.

Although the AHRP Science Panel is comprised of individuals with excellent expertise in Alaskan salmon fishery enhancement, hatchery management, and interactions between wild and hatchery fish, the original group lacked much of a contemporary connection to PWS. Whereas two regional aquaculture associations (RAAs) from southeast Alaska are represented on the AHRP Science Panel, no such representation from PWS existed until my appointment to the panel in 2015. Although this appointment was not predicated on its inclusion in my graduate program, the panel expressed support of its inclusion as one of my graduate internship assignments. At the time of my original assignment, I did not expect that my PWSAC ex officio position alone would meet my graduate program’s time commitment requirement, making it necessary to seek out a secondary internship to meet program standards.

Over time, my connections to PWS commercial fishery stakeholders have proven to be of benefit to the AHRP. In October of 2015, I was tasked by the AHRP Science Panel to reach out to commercial fishery stakeholders in the PWS region and beyond for their support of AHRP’s grant applications with North Pacific Research Board (NPRB) and NOAA’s Saltonstall-Kennedy (S-K) grant program, including: PWSAC (<http://pwsac.com/>), Valdez Fisheries Development

Association (VFDA, <https://www.valdezfisheries.org/>), Cordova District Fishermen United (CDFU, <http://cdfu.org/>), Copper River/Prince William Sound Marketing Association (CR/PWS MA, <http://www.copperrivermarketing.org/home>), Northwest & Alaska Seiners Association, and United Fishermen of Alaska (UFA, <http://www.ufafish.org/>). UFA posted their letter of support of the AHRP to the UFA website: <http://www.ufafish.org/wp-content/uploads/2015/11/UFA-support-SK-Hatchery-Wild-Study-Proposal-110515.pdf>

The AHRP grant applications were successful, and members of the project's leadership team suggested to me that this was due in part to such strong support of the project from commercial fishery stakeholders. Oftentimes, such stakeholders are skeptical of research projects, especially those which could result in production declines for their fisheries. Over the years, I believe that I have earned and built considerable trust within these organizations, which translated into support for the AHRP grant applications. Altogether, the NPRB and S-K grants resulted in an additional \$539,000 for the AHRP budget.

Also, as part of my role as ADF&G ex officio representative on PWSAC's Board of Directors, there had been increasing discussions regarding PWSAC's financial support of AHRP. In response to the State of Alaska's budget crisis, Alaskan hatchery operators had been asked to contribute financially to the AHRP. For their March 4, 2016 board meeting, a representative from the AHRP's finance committee (and member of the AHRP Science Panel) presented to the PWSAC board requesting \$100,000 annually in PWSAC funds for the AHRP, which would bring the annual contributions of the state's private nonprofit hatchery operators to \$350,000 per year. Given the project's disproportionate focus on potential interactions between hatchery and wild salmon in PWS, and the large scale of PWSAC's hatchery programs, it was argued by this AHRP representative that a pro-rated level of funding for PWSAC could be justified to exceed

\$140,000 per year, and that PWSAC was getting a good deal relative to some other hatchery operators. Despite the compelling nature of this argument, I was surprised when PWSAC voted instead to limit their contribution to \$50,000 per year, following some discussion of this issue off the record in executive session. I was unable to participate in this executive session. I believe that this action spoke to the work that still needed to be done in generating PWS commercial stakeholder support for the project. Otherwise, throughout my time on PWSAC's board as ADF&G's ex officio representative, I was often asked to provide a summary of AHRP activities, and I believe that these interactions provided for my own professional development, while enhancing my roles as ADF&G's ex officio board member and as a member of AHRP's Science Panel.

My role as liaison between PWSAC and the AHRP Science Panel was arguably enhanced given my election to PWSAC's Executive Committee in 2016, resulting in my frequent summary of project activities to the board. Following a request by the AHRP finance committee in September 2017, I was asked to represent the group's renewed request that PWSAC fund the project to the full \$100,000 annually, as was originally proposed. These activities included conversations both on the record and off with PWSAC board members, culminating with a presentation to the PWSAC board at their October 6, 2017 meeting. Immediately following my presentation, the PWSAC board voted unanimously to increase their annual funding of the AHRP from \$50,000 to \$100,000 per year.

In summary, I believe that my assignment to the AHRP Science Panel led to increased trust in the project's research endeavors, and support of the project from commercial fishery stakeholders in PWS. Further, my representation of the AHRP to local stakeholders, and my ability to garner support for the project likely enhanced my credibility in some Alaskan scientific

circles. Despite my departure from ADF&G, I believe that my subsequent advocacy for the department's role in the AHRP and for support of ADF&G's involvement with the project has helped to enhance my own credibility with ADF&G leadership.

Lesson #2: selection of participants who possess relevant knowledge and who are willing to compromise can have long-lasting positive impacts

Whereas previous selections of staff who were unwilling to compromise had impeded collaboration between PWSAC and ADF&G, my appointment to the ex officio position and the AHRP Science Panel brought more positive outcomes to all organizations involved. In hindsight, I believe that ADF&G's political leadership knew what they were doing when they appointed me to both ADF&G's ex officio seat on PWSAC's board and the AHRP Science Panel simultaneously in 2015. As previously described, I had earned PWS commercial fishery stakeholders' trust during my years as the ADF&G PWS commercial purse seine salmon fishery manager, and significant credibility with other stakeholders as well. Over the years, my experience and perspectives were sought out for presentation to executives from Wal-Mart, Costco, and Whole Foods, among others, all of whom wanted to ensure that the salmon products they were purchasing from PWS were derived from sustainably managed fisheries. Increasingly, these experiences grew to include participation in broader discussions regarding Alaskan salmon fishery certification, culminating with the coordination of MSC's first site visit to Cordova in 2015. Following MSC's visit in 2015, I would be asked to give presentations on PWS salmon fishery management to several fishery certification teams, both as an employee of ADF&G and Silver Bay Seafoods. And so, although I do not share the technical expertise of the other AHRP Science Panel members, I had undoubtedly developed a relevant skill set of my own. I further believe that ADF&G and AHRP leadership saw the writing on the wall regarding the State of

Alaska's looming budget crisis, and the group's need to bring PWS commercial fishery stakeholders into the tent, so to speak. I believe it was and still is of the utmost importance that PWSAC be engaged with AHRP, and fully informed of its process, findings, and potential outcomes. Given my involvement with both entities through my graduate program internships, I was able to serve as a bridge between the two organizations. In closing, and especially when contrasting my own experiences against those of my predecessors in their many conflicts with PWSAC staff, I believe they speak to the need for improved staff selection and training to ensure that more successful interactions occur, as was recommended by Stankey and Shindler (1997).

Barrier #2: State of Alaska budget cuts

Although the state's \$900 million oil revenue windfall in 1968 would help to create the state's hatchery system, proceeds from the initial Prudhoe Bay land sales were exhausted by the state's fiscal year 1976 budget (Anderson, 2002). Oil revenues would continue to fund state operations, however, and once oil started flowing through TAPS in 1980, the Alaskan state legislature repealed the state's income tax, further solidifying Alaska's dependence on oil. Since then, Alaska's state government has been almost entirely supported by a combination of tax revenues from oil and gas production, along with federal receipts (Wright and Hazelton, 2016).

Early on, funding for the operation of the state's salmon enhancement program and related project construction, operation, and maintenance was largely provided through state bonds and general fund appropriations to ADF&G's FRED division (Snow, 1991). According to Snow (1991), from 1972 until 1992, funding for the FRED division exceeded \$210 million, most of which was dedicated to salmon fishery enhancement activities. An additional \$56.2 million in bond issues were authorized by the Alaskan legislature in 1976 and 1978 for Alaskan salmon fishery enhancement activities, with overwhelming voter support (Snow, 1991). And, by 1992,

state capital appropriations nearing \$25 million were dedicated to the construction of FRED division facilities. Finally, following its ratification in 1985, the Pacific Salmon Treaty resulted in the U.S. federal government providing an additional \$20 million to produce new salmon through hatchery production to mitigate losses to Alaskan fishermen resulting from treaty catch quotas (Snow, 1991). Although state and federal funds continue to support the maintenance and improvement of existing facilities, most of the state's salmon fishery enhancement system infrastructure was in place 20 years after its inception, and more than 20 years ago.

Alaskan oil production has been in decline since 1988, although consistently high oil prices have kept state tax revenues high for most years until recently, with some notable exceptions. Between 1985 and 1988, low global oil prices led to dramatic reductions in Alaskan state government revenues, resulting in widespread layoffs, and efforts to divest the state of some of its responsibility for the operation of commercial production hatcheries. Accordingly, the Alaskan legislature passed an act in 1988 that allowed state hatcheries to be operated by PNP hatchery corporations (Stopha, 2017). Since that time, all (14) state-owned commercial production hatcheries still in operation have been contracted to PNP hatchery operators, including three PWSAC hatcheries, with CCH transferring operations in 1988, MBH in 1991, and GH in 1993 (Stopha, 2017). An additional ten state-constructed hatcheries have been closed statewide since the inception of the FRED Division, and the division itself was dissolved and merged with the ADF&G Division of Commercial Fisheries in 1993 following years of budget cuts and the state hatcheries' "privatization program" (McNair and Holland, 1993).

Global oil prices began a steady decline in 2014 due to increased production from shale oil and fracking, increased pumping in the Middle East, and a decreased demand for energy (Wright and Hazelton, 2016). Wright and Hazelton (2016) assert that this has been the largest

sustained decline in the price of Alaskan oil since TAPS began producing in the early 1980s. The result has been an annual budget deficit for the State of Alaska that could soon exceed \$4 billion despite an overall reduction in state spending of 44 percent over the past five years, with over \$1.9 billion in cuts to the state's operating budget since fiscal year 2015 (State of Alaska, 2017a). Further, Alaska's capital budget for fiscal year 2018 is the smallest enacted in the state since 2000, according to a recent press release (SOA, 2017a). Of greatest relevance to PWS salmon fishery management, ADF&G's budget has been reduced by \$29 million, or 37 percent, with 182 positions being eliminated since fiscal year 2015 (SOA, 2017b). Local department representatives have cited budget cuts as having impeded their ability to fulfill their responsibilities as public managers, resulting in travel restrictions to participate in stakeholder engagement activities, elimination of projects deemed essential for fishery management, and elimination of positions in the Cordova area office.

In his seminal work on adaptive management of renewable resources, Walters (1986) suggests that management activities as large as those in place in PWS could be viewed as adaptive processes, where managers learn the potential of natural populations to sustain management activities through experience with these activities themselves and not solely through other research or theory. In his introduction, Walters (1986) uses harvesting activities to describe management, although I would argue that hatchery production in PWS also fits the author's description of experimental management activities. Early on, Walters (1986) recognized the challenge that funding such large-scale experiments and the monitoring required to evaluate them would likely serve as a barrier to the implementation of adaptive management.

More recently, Walters (2007) has come to a similar conclusion, asserting that there is inadequate funding available for the increased ecological and economic monitoring needed to

successfully compare the outcomes of management experimentations. Part of the problem, Walters (2007) suggests, is that most management agencies rely on in-house data collection completed by highly educated staff. He describes how fisheries scientists with advanced degrees routinely partake in the collection of simple data that could otherwise be collected by others with far less training, at far less of a cost. Walters (2007) describes how many large-scale management experiments have included consideration for developing collaborative monitoring programs where resource users collect most of the monitoring data at relatively low costs. I believe that both of my internship assignments exhibit ways in which stakeholders have responded creatively to address the state's budget crisis. However, despite these stopgaps, I believe that financial barriers remain an impediment to effective collaborative salmon fishery management in PWS.

Relevant internship experience: advocacy for innovation on PWSAC Board of Directors

Soon after my appointment to serve on PWSAC's Board of Directors as ADF&G's ex officio representative, the State of Alaska announced that it would be cutting its funding of the Coghill River Weir. This weir is located in northwestern PWS, and is operated to manage for returns of wild stock sockeye salmon returning to Coghill Lake. This lake is remote from PWSAC hatcheries, although returning (wild) adults are presumed to travel through hatchery fisheries, resulting in their harvest in fisheries targeting hatchery returns. In response to this cut in funding, ADF&G requested that PWSAC pay for the project, which they had deemed to be essential for the management of wild sockeye salmon returning to Coghill Lake. Although PWSAC had been asked by the state to operate its hatcheries in previous decades, PWSAC has since typically drawn a line in the sand on funding projects that cannot be proven to have demonstrable impacts on hatchery production and resulting returns. It was the opinion of many

PWSAC board members that although such operations (Coghill River Weir) are undoubtedly central to ADF&G's mission to prioritize and manage for wild stock sustainability, operation or funding of the weir wasn't necessarily consistent with PWSAC's mission. This issue was discussed at many committee meetings, and as ADF&G's ex officio representative on the PWSAC board I was looked to for information regarding this project. Ultimately, PWSAC voted to fund the weir for the 2016 season, although ADF&G staff would continue staffing the project, and manage its operations to previous standards. Over the course of the following winter, PWSAC lobbied Alaskan political leaders in Juneau to include this project in the governor's budget, and state funding of this project was returned for the 2017 season. I believe that both actions by PWSAC spoke to their desire for collaboration with ADF&G. Further, I believe that my involvement through service on PWSAC's board was helpful in this process.

Described elsewhere in this paper, PWSAC's funding of the AHRP warrants reinforcing here, as this is not the only ADF&G research endeavor to which PWSAC contributes financially. PWSAC also contributes \$100,000 annually to the operation of an ADF&G otolith laboratory in Cordova through a cooperative agreement between the two organizations. Considering recent ADF&G budget cuts, PWSAC has frequently discussed how it could likely get more out of this project if it were to develop an otolith laboratory of its own, much like several southeast Alaska hatchery operators have done. It is presumed that PWSAC would have lower operating costs than ADF&G for similar operations. For example, Douglas Island Pink and Chum (DIPAC) operates a large otolith laboratory in Juneau, and is a subcontractor with ADF&G on related projects. Likewise, Southern Southeast Regional Aquaculture Association (SSRAA) operates a similar facility in Ketchikan, and also collects and processes otolith samples for ADF&G. Northern Southeast Regional Aquaculture Association (NSRAA) in Sitka has a much smaller

otolith lab for in-house evaluation programs, although it should be noted that the Sitka Sound Science Center (SSSC) is a subcontractor for AHRP field work, and receives funding from NSRAA for their research activities. As an NSRAA employee, I developed and operated their otolith laboratory in the 2000s, and so bring some relevant experience for the PWSAC board to consider when discussing such endeavors.

Lesson #3: financial limitations amongst collaborators will limit effective collaborations

The largest budget cut in Alaska's fiscal year 2017 budget was a \$100 million unallocated line item that the Senate referred to as a "placeholder" for future reductions (Wright and Hazelton, 2016). Wright and Hazelton (2016) suggest that this placeholder represents Alaskan political leaders' desire to force the state's executives into making difficult choices about future budget reductions. Although Wright and Hazelton (2016) assert that the state will not be able to cut its way to a balanced budget, state lawmakers continue to balk on seeking additional sources of revenue, such as statewide sales or income taxes. Looking forward, Munisteri et al. (2017) predict that Alaska North Slope oil production will decrease from 490,000 barrels of oil per day in fiscal year 2017 to just over 331,000 barrels per day in fiscal year 2026. In the absence of dramatic price increases for oil, it is clear that future state budgets will be constrained by their reliance upon oil revenues, and that funding of state services, including fishery management, will suffer as a result.

Effective collaborative salmon fishery management endeavors exist elsewhere in the state between ADF&G and regional industry stakeholders, most notably in Bristol Bay through the Bristol Bay Science and Research Institute (BBSRI). In response to the state's fiscal crisis, a "grass-roots initiative developed by stakeholders" with assistance from ADF&G led to the formation of a Bristol Bay Fisheries Collaborative (BBFC) to "shore up the Bay's commercial

fisheries management program and stem further cuts, to the extent possible” (Link and Regnart, 2016). According to its founding documents, BBFC represents the fishery monitoring and staffing needs to protect the capacity of ADF&G to manage the area’s fishery that achieves the department’s biological mandates while maximizing economic benefits. BBFC stakeholders include ADF&G, BBSRI, drift and setnet fishermen, processors, municipalities, villages, support industries, and other stakeholders. Funding for BBFC in 2017 was made possible through financial support from 27 organizations, with BBSRI matching all such funds dollar for dollar. According to Link and Regnart (2016), the State of Alaska contributes approximately \$2.1 million annually towards a core program of research and management activities in Bristol Bay that cost \$3.4 million each year (Link and Regnart, 2016). In 2017, it was estimated that total BBSRI and matching stakeholder contributions totaled \$1.25 million.

According to Link and Regnart (2016), BBSRI and its staff have extensive experience with Bristol Bay’s fisheries, and regularly contract fisheries scientists, biologists, technicians, economists, and computer scientists to conduct research and monitoring projects in Bristol Bay. It should be noted that BBSRI is a subsidiary of the Bristol Bay Economic Development Corporation (BBEDC). BBEDC is a large organization in the region with a mission of promoting economic growth and opportunities of its member communities through sustainable use of the Bering Sea resources. According to BBEDC (2017), the organization had approximately \$238 million in assets in 2016, with approximately \$14.4 million in total unrestricted revenues, gains, and losses. There is no organization specific to the PWS area with similar financial standing.

Without similar collaboration, I believe that it will be difficult for ADF&G to maintain the level of monitoring necessary for the management of the PWS salmon fishery to its former standards. For an area whose commercial fishery management infrastructure was essentially set

based on contemporary harvests averaging 3.1 million salmon in the ten years prior to Alaskan statehood, it's debatable as to whether the area office's resources were sufficient to manage 2015's record harvest of over 103 million salmon (Botz et al., 2012; Haught et al., 2017). Whereas comparable salmon harvests in southeast Alaska have been managed through five area ADF&G offices, with multiple managers in each office, Cordova's is PWS's only area office, with relatively limited staffing. I believe that the Cordova ADF&G area office is especially vulnerable to the state's budget cuts that have taken place since 2014, the likes of which ultimately contributed to my departure from ADF&G in 2016. If industry truly desires fishery management similar to that which existed prior to these cuts in PWS, I believe that additional collaborations between ADF&G and industry stakeholders will need to take place in the future.

Relevant internship experience: collaborative research and monitoring through AHRP

In its internal review of PWSAC, ADF&G criticized a lack of collaboration between the two organizations on monitoring programs, including evaluations of hatchery straying in PWS, and otolith mark recovery procedures. Although large-scale hatchery straying has been identified as having the potential for negative effects on PWS salmon, the fallout stemming from ADF&G's approach to this issue in the 2000s led to political opposition from many PWS industry stakeholders, including PWSAC. Although past collaborations between ADF&G staff and hatchery operators had proven to be both constructive and fruitful in southeast Alaska, I believe that the AHRP gave some consideration to the mistrust between researchers and industry stakeholders in the design and presentation of their research program. In my opinion, the AHRP sought to develop clearly defined research questions that were relevant to issues concerning hatchery production in Alaska, and to do so in such a way that met Shindler et al.'s (2002) definition of social acceptability. Although cuts in funding have since limited the AHRPs

effectiveness with stakeholder engagement, I believe that the project's founding Science Panel had a goal consistent with the Forest Ecosystem Management Assessment Team's (FEMAT) 1993 quote, which Shindler et al. (2002) cite: "people will not support what they do not understand and cannot understand that in which they are not involved." I believe that the group's ability to secure initial funding support from Alaskan salmon processors, hatchery operators, and the State of Alaska speaks to their ability to sell their original vision to a broad group of Alaskan stakeholders. Further, I believe that my appointment to the AHRP Science Panel has provided the project with an additional connection to PWS stakeholders, hopefully to the benefit of their understanding of the project.

The initial AHRP budget anticipated just under \$16.6 million in expenses for the years 2012 through 2023, with anticipated revenues totaling \$14.9 million (Ron Josephson, personal communication, September 17, 2015). The project's anticipated use of contractors for the project's data collection rather than ADF&G staff was expected to result in significant cost savings. The project's anticipated revenues included \$2 million from fishery enhancement organizations (hatchery operators) and \$3.5 million in State of Alaska capital funds for project initiation, an initial pledge for \$2.5 million in matching funds from salmon processors for the first five years of the project, and an expectation for \$3.9 million of in kind work from various state entities. Thus, this original budget anticipated a shortfall of nearly \$4.2 million over the life of the project, which the Science Panel hoped to secure through grant funding and additional state appropriations. Due to recent statewide budget cuts, however, in kind support from ADF&G for the project is in jeopardy, and future financial contributions from the state are unlikely to meet original expectations. As a result, the AHRP has formed a finance committee to address its budget shortfall, comprised of staff from ADF&G's aquaculture section,

representatives of ADF&G's commissioner's office, a processor representative, and hatchery operators (Josephson, 2017). According to Josephson (2017), this team has focused its attention on a pared down program primarily directed at the project's original questions regarding genetic fitness.

As part of my involvement as an intern for both PWSAC and AHRP, I have successfully lobbied for project funding through NOAA's Saltonstall-Kennedy (S-K) Grant Program (\$250,000), the North Pacific Research Board (NPRB, \$289,000), and PWSAC's Board of Directors (\$150,000 total thus far, with an expectation for continued annual support of \$100,000). Although salmon processors had initially committed to five years of support, the AHRP is lobbying for processor contributions for the remainder of the project. Likewise, continued contributions for the remainder of the project is expected to be provided by fishermen through their hatchery organizations via additional cost recovery harvests (Josephson, 2017). Although my internships will come to an end, my involvement with PWSAC will continue as a member of the board's Executive Committee, and I suspect that my appointment to the AHRP Science Panel will grow through my role as a processor representative. I believe that these relationships speak to my efforts at stimulating collaboration between public managers and industry stakeholders in a complex research endeavor, which I hope will continue beyond the scope of my internships, and will grow into a broader participation in Alaskan salmon fishery policy discussions in the future.

Lesson #4: relatively high costs associated with monitoring of hatchery-wild fish interactions will confound achieving effective collaborative salmon fishery management

Walters (2007) asserts that minimal implementation of adaptive management has been due to a lack of resources necessary to monitor large-scale experiments, and a lack of willingness

to experiment with management approaches. The former comes to mind when reflecting on my AHRP Science Panel internship. As represented by the AHRP's large budget, evaluating interactions between wild and hatchery salmon in PWS is an expensive endeavor. In response to cuts in state funding for the project, the AHRP's original research program has been scaled back. Although it has been impressive to behold the support that AHRP has received from industry stakeholders who were engaged with the project early and often by project leaders, a reduction in project objectives will likely be viewed negatively by other fishery stakeholders. And though there have undoubtedly been skeptics and critics of the project and its association with the processing industry, I believe that this relationship will be essential to the project's completion. Given the State of Alaska's dependence on oil for revenues and prospects for continued declines in production, the AHRP stands out to me as an example of the need for collaboration between management and industry.

Barrier #3: lack of organizational and/or individual capacity at PWSAC, ADF&G, and AHRP

According to Feldman and Khademian (2007), modern public program management has come to increasingly involve and require the support of a wide range of perspectives, and especially those of politicians, technical experts, and individuals with local knowledge. The authors promote public managers as an essential component to effective governance, asserting that they and their programs' successes are largely dependent upon an ability to bring about inclusion. Inclusive management, Feldman and Khademian (2007) argue, is predicated on bringing together different perspectives, resulting in the creation of communities of participation that are necessary for the resolution of public management problems.

In order to create effective communities of participation, Feldman and Khademian (2007) argue that inclusive managers must engage in both informational and relational work, which assigns public managers to three roles to help participants see and know the perspectives of others: broker, translator, and synthesizer. Feldman and Khademian (2007) assert that through these roles, a public manager can and should effectively identify and disseminate information about differing ways to understand policy problems, translate ideas for and among participants, and promote and synthesize new ways of understanding such problems. Feldman and Khademian (2007) argue that each of these roles is important in creating an inclusive community of participation, although not all such work will directly address the substance of a policy problem. Instead, the authors argue, some informational work focuses on understanding and developing the capacity of participants, which is crucial in developing effective communities of participation.

Relational work, on the other hand, is aimed at creating connections between the people who need to work together in communities of participation, and developing the potential for empathy amongst the group. Feldman and Khademian (2007) argue that connections between people based on feelings are crucial in legitimizing different perspectives and for building trust, a recognition of which has transformed notions of the role of public managers in governance, and the role of organizations in these processes as well. Successful inclusive managers, the authors argue, work to develop a sense among participants that they belong to a community in which their perspectives are valued, and work to use the group's differences to enhance the community's ability to solve problems.

Feldman and Khademian (2007) introduce boundary objects and boundary experiences as tools that help public managers conduct informational and relational work in such a manner as to

promote inclusive communities of participation. Boundary objects can include pictures, prototypes, graphs, or text, all of which can facilitate a process whereby individuals collectively transform their knowledge. Examples of boundary objects relevant to PWSAC and ADF&G are hatchery annual management plans, which identify fishery management strategies and hatchery production goals for a given year at PWSAC hatcheries. Boundary experiences, according to Feldman and Khademian (2007), are defined as shared or joint activities that create a sense of community while simultaneously transcending perceived boundaries between community participants. An example of a boundary experience that PWSAC and ADF&G participate in is the PWS Salmon Harvest Task Force (SHTF), which is described elsewhere in this report. Although both tools often bring people together to acquire and share information, the latter doesn't always intend to connect people, nor do these boundary experiences always enable people to care about or trust one another. Regardless, when used properly, boundary objects and boundary experiences can shape processes to build connections among participants, and to transform their collective understanding of problems in order to effectively address them.

Relevant internship experience: PWSAC and ADF&G cooperation with stakeholder engagement

ADF&G's ex officio position on PWSAC's Board of Directors arguably qualifies as both relational work and a boundary experience, in my opinion. The ADF&G ex officio position holds great promise for the professional development of the seat holder, and for the development of ADF&G's relationship with PWSAC. However, for purposes of this report section, I have chosen a local PWS institution as a pseudo-boundary experience requiring relational work for both PWSAC and ADF&G staff, based loosely on Feldman and Khademian's (2007) definitions: the PWS SHTF. Formed in the aftermath of EVOS in the early-1990s, the PWS SHTF was

created to provide a collaborative forum to discuss area fishery management issues, and to make formal recommendations to ADF&G on fisheries management plans. The PWS SHTF has no regulatory authority of its own, but is recognized by the commercial salmon fishing industry and by ADF&G as a strong body representing industry interests in the PWS and Copper River salmon management area. The PWS SHTF has at least 14 longstanding seats, including advocacy organizations representing commercial fishing gear groups, several seafood processing companies, two local hatchery operations (including PWSAC), and representatives from ADF&G, Alaska's Department of Environmental Conservation (ADEC), and the Alaska Seafood Marketing Institute (ASMI). The PWS SHTF's bylaws recognize that new seats may be added to the group at the discretion of its membership, as new organizations and interest groups develop in relation to PWS salmon fisheries (SHTF, 1991).

During the 1990s, there were a great many issues impacting the PWS area's commercial salmon fisheries, including impacts from EVOS, a precipitous crash in salmon prices, and the development of new fishery management strategies in the presence of large scale hatchery returns that had only recently begun. For many years, the PWS SHTF would meet regularly throughout the year, and was instrumental in fostering a community of participation and a reliable means of communication between industry stakeholders and relevant public managers. Several management strategies developed collaboratively and with the approval of fishery managers have stood the test of time, and are still in use over 20 years following their development by the PWS SHTF. Over time, ADF&G and PWSAC managers would come to serve this process in a variety of ways, with several gaining valuable experience and notoriety for their ability to engage with and facilitate public participation in the area's salmon fishery management process.

As the EVOS crisis passed, and several influential founders of and longtime participants in the PWS SHTF began to withdraw from prominent roles in industry advocacy, the effectiveness of the process began to wane. Managers within ADF&G cite the task force's bylaws as having a further influence over the organization's fall from favor with industry and ADF&G. These include a bylaw which states that "all recommendations adopted by the task force will be by unanimous consensus of the membership present provided a majority of the recognized members are present." It has been argued by some that the organization failed to meet this standard for consensus over the course of several meetings, ultimately leading some members to disengage from subsequent participation. Further, ADF&G managers for several years have proclaimed the need for the next PWS SHTF meeting to follow bylaws pertaining to the "Protocol for calling special SHTF meetings," which states that "an individual or organization that wishes to call a special meeting of the SHTF must identify the need for a meeting and obtain the consensus of a majority of the members." Regardless of many procedural arguments that have endured behind the scenes over the years, the PWS SHTF had failed to officially convene for several years prior to 2017, and local engagement between industry stakeholders and public managers has often been quite poor.

In spring of 2017, PWS commercial fishers strongly believed that they had been excluded from local fishery management decisions, and demanded through a variety of avenues that the PWS SHTF reconvene as an opportunity for additional dialogue with ADF&G. At this meeting, the group acted to lessen their recommendations' standards for unanimous consensus. Whereas previous PWS SHTF recommendations to the ADF&G commissioner required 100% consensus amongst its membership, future recommendations will now require a supermajority qualified at 75% of the membership present, if the group's quorum requirements have been met. The PWS

SHTF bylaws state that 75% of the group's membership must be present at any given meeting before any actions can be taken by the group. However, the PWS SHTF failed to act on adding new members at their spring 2017 meeting, including Silver Bay Seafoods. Further, the group pledged to meet again in October 2017. Prior to the fall PWS SHTF meeting, I encouraged PWSAC's engagement with and leadership in this process, the results of which were such that PWSAC's interim general manager gave a professional and organized presentation at the group's October meeting, thereby setting a higher standard for future PWSAC and ADF&G staff to follow.

Based on my own observations, I believe that budget cuts at ADF&G have resulted in the promotion of inexperienced individuals into prominent management positions statewide, which has had negative impacts on ADF&G's ability to effectively engage with stakeholders. Further, state financial resources available to support such activities are undoubtedly limited. With regard to the former shortcoming, it may be difficult for ADF&G to fund training activities, such as related coursework. As of 2015, ADF&G's budget supporting graduate studies was eliminated, and opportunities for cross training with more experienced managers elsewhere in the state have been discontinued. However, experience interacting with local stakeholders should be easier to achieve, especially with some outside influence and support. With regard to funding for the PWS SHTF, were Silver Bay Seafoods to be added to the group's membership, I believe that I would be able to secure financial support for group functions, and I suspect that other processors on the task force would follow suit with their own contributions. Likewise, through my position on the City of Cordova's Fisheries Development Committee, I will continue to advocate for the city's support of PWS SHTF activities, such as in-kind donation of facilities and staff assistance. Finally, whereas chairmanship of the PWS SHTF was once limited to ADF&G employees, the

task force's bylaws allow for others to serve in this capacity. For my own part, I will advocate for PWSAC's General Manager to serve in such a capacity in the future. Although such advocacy is outside the purview of my internship(s), I believe that my service on PWSAC's Board of Directors has been a positive influence over the development of the PWS SHTF, and the development of PWSAC's role in this process.

Lesson #5: an inability and/or unwillingness to engage with stakeholders will prevent effective collaborations

Although I have and will continue to advocate for the development of ADF&G staff, I have concluded that there are relatively few barriers to developing the capacity of PWSAC and its staff. I believe that future innovations in PWS fishery management will need to come from PWSAC and other industry stakeholders. In PWS, unfortunately, the challenge is often getting the public managers to the table. While with ADF&G and since, I have often heard managers bemoan the perceived lack of progress on some issues. However, as I learned from Shindler et al. (2002), "For public agencies, the real product of planning is not the plan, but an enduring relationship with the agency's constituents, clients, and customers. Properly done, the benefits of public management will continue long after a plan is complete or the decision is made." It is my hope to work with PWSAC's board to develop its staff in such a manner as to mitigate for the inevitable conflict that will arise between PWSAC and ADF&G, while at the same time persuading ADF&G's leaders of the value inherent to stakeholder engagement. As I have come to know the "legendary" managers of years gone by, invariably their careers involved significant exercises in stakeholder engagement, such as the PWS SHTF, and the development of salmon fishery management plans elsewhere in the state. Hopefully, such a process can be renewed in PWS.

Lesson #6: PWSAC's reliance on inadequately trained volunteers for critical organizational functions and direction will confound effective collaborative salmon fishery management in PWS

It should be noted here that during the course of my internship, PWSAC dealt with significant adversity in the form of criminal charges against the organization and three of its employees. During this time, two of the organization's top employees retired from service, leaving PWSAC with significant holes to fill at the top of its organizational chart. I believe that I was influential in PWSAC selecting its interim general manager, and was heavily involved with the recruitment and interview of permanent general manager candidates. Throughout this experience, I was shocked at the time commitment required of volunteer board members, and a general lack of sophistication amongst the board to address such complex processes. In my opinion, the board and organization were pushed to the brink of disaster following these management departures. The time commitment logged for my PWSAC internship speaks to my involvement with this process, which included: working with board members to recruit for general manager candidates through an outside firm, working with board members to develop our candidate screening process, developing the interview process for PWSAC's general manager candidates based on my previous experiences, leading the interview process with prospective general manager candidates, and working with board members to select our preferred candidate. The design and implementation of this process served as my internship outreach product, and may be found detailed in this paper's appendices. Throughout this process, I was struck by the general lack of capacity amongst PWSAC's board to successfully navigate this process, and further note PWSAC's reliance on significant commitments from volunteer board members to survive this ordeal. I question the sustainability of these arrangements, and

hope to work with PWSAC staff and board members to ensure that PWSAC is better equipped to deal with such matters should a similar emergency occur in the future.

Lesson #7: PWSAC's organizational structure and corporate culture have prevented effective collaborative salmon fishery management in PWS

During the course of my internship with PWSAC, I observed significant conflict between the organization and the State of Alaska. Given the inherent complexity of co-managing mixed stock fisheries in PWS, there will likely always be some tension between ADF&G and PWSAC as they work to achieve their organizations' respective goals, which I argue should overlap. However, as detailed in a press release from the state's Department of Law (Carole Holley, personal communication, November 3, 2017), the state filed criminal charges against three of PWSAC's most senior employees on September 26, 2016, alleging that these employees failed to report a hazardous substance discharge at CCH, resulting in oil pollution at the hatchery. ADEC staff further asserted that the spill resulted from negligence on the part of PWSAC through its employees, and that these three employees provided false information to ADEC investigators. Ultimately, the state entered into a global civil settlement agreement with PWSAC and its employees, thus resolving criminal charges against PWSAC and its employees. However, in the year that passed following the initial charges, PWSAC's board, and especially its Executive Committee, were deeply involved with a review of the related criminal case, overseeing mitigation for the underlying event, and recruiting for new leadership for the company as previously described in my graduate program journal and elsewhere in this document.

As part of this process, PWSAC's Executive Committee reviewed the organization's structure, and concluded that its leadership structure is excessively vertical. Authority at PWSAC rests almost entirely with its general manager position, with relatively few middle managers

overseeing a company with 45 full-time employees and up to 75 seasonal employees. As detailed throughout peer-reviewed literature, vertical organizational structure can have several disadvantages, which I believe have contributed to conflict between PWSAC and the state, including: lack of employee empowerment and well-being, and an associated lack of innovation; relatively little inter- and intraorganizational communication, often leading to conflict, and employee turnover; and a bureaucracy that is often slow to respond to and/or inflexible to change (Plunkett et al., 1997). Pearce and Sims (2002) assert that many organizations are moving away from traditional vertical leadership, and present research suggesting that shared leadership can result in more effective management teams. As PWSAC's Executive Committee works with the organization's new general manager, I hope to share these and other perspectives to help guide the organization towards a more effective and collaborative future.

Relevant internship experience: AHRP collaborative capacity builder

The AHRP Science Panel is currently engaged with a complex public problem, or wicked problem as referred to in Weber and Khademian (2008). In order to build long-term collaborative problem-solving capacity, Weber and Khademian (2008) argue, it is necessary for public and private governing institutions to develop sustainable networks that allow for the transfer, receipt, and integration of knowledge across the network. My AHRP internship coordinator was the project's original facilitator, and is generally recognized as the embodiment of Weber's and Khademian's (2008) definition of a "collaborative capacity builder" (CCB). Although he was and is considered to be a leader in Alaskan salmon fisheries management, he has recently retired from state service and his future role with the AHRP is unclear.

Following the retirement of the AHRP's original facilitator from ADF&G, I believe that the group has struggled to find leadership with similar collaborative skills and experience. Thus

far, they've made do with ADF&G staff and leadership from within the hatchery and processing sectors. However, with regard to the former, state budget cuts have stretched ADF&G staff thin and limited their ability to serve the project in a similar capacity. Most other members of the AHRP Science Panel members are retired or are nearing retirement. Given the project's anticipated end date of 2023, I believe that the group's future effectiveness is vulnerable pending likely turnover of project leadership.

Stern and Baird (2015) predict that such turnover in personnel can lead to a loss of trust among remaining collaborators, and trust in the collaboration's effectiveness from peripheral participants. In order to buffer collaborations from these disturbances, Stern and Baird (2015) recommend a greater reliance on systems-based trust through the implementation of fair and transparent procedures. The authors argue that this can allow new participants to focus on building relationships rather than expending energy understanding or reinventing a process. Stern and Baird (2015) suggest that these procedures could include specific practices for developing relationships with new participants. I recommend that the AHRP continue to develop, implement and reinforce its procedures with an eye for fairness and transparency. Further, given the project's three-tiered focus of collaboration among ADF&G staff, representatives of hatchery operators, and salmon processor representatives, I would recommend that AHRP leadership seek out individuals and opportunities from each area for inclusion and development with an eye for the project's final phase.

Lesson #8: in order to be most effective, collaborative endeavors must be committed to developing current and future collaborative capacity builders

Weber and Khademian (2008) define a CCB as someone who has been assigned a lead role in a network's problem-solving activities through the individual's legal authority, whose

expertise is valued within the network, and who has a reputation as an honest broker. Although public managers are almost always involved with such networks, Weber and Khademian (2008) contend that CCBs do not always need to be public managers. Based on my own observations and experience, I believe that the AHRP is lacking with regard to participants who possess strong skills and experience with collaborative endeavors, and who can be expected to remain with the project through its conclusion in 2023. Given the challenges that ADF&G staff face due to state budget cuts which are expected to persist into the future, I recommend that the AHRP consider looking outside of ADF&G for future project facilitation, and instead look within the ranks of its industry partners for such a leader.

Although there are many examples of effective and credible research collaborations with industry available in peer-reviewed literature, AHRP leadership can anticipate some challenges should they explore project facilitation by an industry representative. Perkmann and Walsh (2007) describe how collaboration with industrial partners in academic research projects has become increasingly important to government and highlight several trends indicating a growing involvement of universities with industry, including an increasing occurrence of patenting by universities, increasing university revenues through licensing fees, an increasing number of university researchers engaged in academic entrepreneurship, an increased share of industry funding in university income, a diffusion of technology transfer offices, and the prevalence of industry collaboration support offices and science parks (Perkmann and Walsh, 2007). Resnik (2014), on the other hand, summarizes research which contends that many scholars are concerned about such financial interests and their potential threats to the scientific community's adherence to methodological and ethical norms, such as honesty, objectivity, openness, and social responsibility. Resnik (2014) argues that the best approach to dealing with financial

interests in research is to implement policies designed to minimize or mitigate their potential impact on scientific integrity, including disclosure of financial interests to institutions, government agencies, journals, and all other parties who need to know about them; management of individual and institutional financial interest related to research; scrutinizing contracts to ensure that they do not include provisions to prevent the publication of research results; and requiring researchers to make supporting data and methods available as a condition of publication.

LOOKING FORWARD

Recommendations for PWSAC

Through my service on the PWSAC Board of Directors, I have also concluded that the board's structure could be reviewed, and possibly reduced in size. I would not be the first to suggest such a review, as PWSAC contracted with The Foraker Group in 2006 to review the organization's board size and structure. In their research findings, Foraker notes that PWSAC's board is the largest of all regional aquaculture associations in the state, and recommended that the PWSAC board be reduced from 45 members to 15 (ADF&G, 2009). According to Foraker (ADF&G, 2009) decreasing the size of PWSAC's board would provide the organization with the following benefits: creation of opportunities to engage all board members rather than delegating all significant decision making to the board's Executive Committee; cost reductions associated with meeting travel, and possibly allowing for meetings to be held throughout the region; increased communication and trust among board members due to more frequent and meaningful interactions; enhancement of the board's non-fisherman representation; improved opportunities for use of task force committees to better engage with interested public; increased compatibility

with strategic planning processes; and creation of separate opportunities for stakeholder networking outside of board service, such as conferences.

There is research which suggests that larger boards may be less effective than smaller boards (Coles et al., 2004), and that a chief executive's influence is negatively related to a large board's independence. Boone et al. (2004) present a hypothesis which states that chief executives who generate surpluses for their firms wield influence with some of their directors, and that this influence is often used to place sympathetic individuals in open board positions. In this scenario, board composition is one component of the chief executive's compensation, often limiting a board's ability to ratify and monitor senior managers' decisions and leading to entrenched chief executives. Based on my review of the literature, and my own personal experience with PWSAC's board and the organization's management over the years, I agree with Foraker's recommendation for reducing its board size, although I suspect that the board would be more amenable to a number that lies somewhere between 15 and 45 members.

Other recommendations for PWSAC that have been addressed elsewhere in this report include the development of PWSAC's General Manager to become a more collaborative leader for the organization and with external collaborators, revision of PWSAC's organizational structure, improvements in the retention and development of the organization's staff, and development of board member capacity. Finally, I recommend that the organization become more engaged with external agencies, the broader scientific community in Alaska and beyond, within the community of Cordova and throughout the PWS region.

Recommendations for AHRP

Alaska's budget crisis is limiting the AHRP's ability to engage with stakeholders, and its ability to innovate in this regard. I argue that this is due to the AHRP's reliance on ADF&G staff

to fill the project's facilitator role, and the assignment of project oversight to ADF&G. A growing body of research has pointed to the prevalence of external sources of innovation, the likes of which have led many organizations to engage in "open innovation" through relationships between industry and universities (Perkmann and Walsh, 2007). Whereas it was originally expected that the State of Alaska would contribute significantly to the funding of AHRP, it is becoming apparent that industry will be looked to for funding of much of the project's remaining work. Further, given the recent retirement of AHRP's facilitator, I believe the group needs some assistance in this regard. In the future, I recommend that responsibilities for project oversight be increasingly delegated to the chairman for AHRP's finance committee, and that industry stakeholder engagement be assigned to an individual with ties to both the AHRP and the salmon processing community. I also recommend that the group's industry sponsors consider tying support for stakeholder engagement activities to their own contributions so as to achieve the project's original aspirations.

Final analysis and interpretation of project results will likely be left to Science Panel members, although it is questionable if many of these individuals will remain engaged with the project in 2023. I believe that this jeopardizes the project's future relevance and ultimate success, and should be addressed soon. Industry-university collaboration in this regard could be a viable option, in my opinion. However, the University of Alaska system has also been significantly impacted due to state budget cuts. According to a recent University of Alaska press release, the university's budget has been cut by 38% over the past four years, or \$145 million, resulting in 1,183 fewer employees, and 50 fewer degree and certificate programs (Roberta Graham, personal communication, November 6, 2017). As such, I would encourage the consideration of industry funding for an established entity, such as that which exists through the Pollock

Conservation Cooperative Research Center (PCCRC). Established in 2000 to improve knowledge about the North Pacific Ocean through education and research, the PCCRC focuses on the commercial fisheries of the Bering Sea and Aleutian Islands. The PCCRC funds investigators and students conducting research on pollock, salmon, and other groundfish species, as well as the fishing of and fisheries for these species. In addition, the PCCRC funds research on ecosystems and habitat associated with these species, along with research on marine mammals, resource utilization, marine resource economics, fishery management, and policy. The PCCRC has invested over \$20 million into marine education and research at University of Alaska Fairbanks (UAF) through 2014, and is the largest philanthropic contributor to marine research at the University of Alaska. However, should Alaska's fiscal environment prevent such efforts with or through the UA system, I would recommend developing a relationship with outside entities, such as OSU's Policy Analysis Laboratory (OPAL) to assist with a review of the project's penultimate phase and recommendations to policy makers.

CONCLUSIONS

Although many of the lessons drawn from my internship experiences are specific to ADF&G, the AHRP, and PWSAC, I believe that there are broad lessons for professionals to consider in any collaborative endeavor. First, the proper selection of individual participants who are capable of collaborating is essential. Poor selection can lead to conflict, and can have long-lasting and deleterious effects on attempts at future collaborations. Conversely, selection of adequately skilled and qualified stakeholder participants can also have long-lasting impacts on collaborative endeavors, albeit positive ones. Second, financial limitations among prospective collaborators can and will limit effective collaboration. This is especially true for high-cost research, monitoring, and management activities, which are most effective and enduring when

achieved through collaborative means. Third, an inability or unwillingness to engage with stakeholders will undoubtedly prevent effective collaborations. This can be due to individual shortcomings, or organizational failures, such as poorly trained leadership, and poor organizational structure. Finally, I believe that collaborative endeavors must be vigilant in identifying, developing, and promoting individuals who possess those skills as previously described which lend themselves to the leadership of effective collaborative endeavors. I encourage any such endeavor to work continuously to develop its “bench” to ensure continuity of high-quality leadership should there be turnover during the lifetime of the endeavor. All of these lessons are especially relevant and important to consider when attempting to resolve wicked problems through collaboration.

Shindler et al. (2002) assert that public acceptance of management and research activities and outcomes is essential to every resource management decision that public agencies make. Through their analysis, the authors conclude that acceptability of management decisions should be viewed by public agencies as a process rather than as a final product (Shindler et al., 2002). Moving forward, I recommend to PWSAC and AHRP that they take Shindler et al.’s (2002) recommendations to heart so that their activities and outcomes are more socially accepted, and consider integrated solutions to associated conflicts. These recommendations include: treat social acceptability as a process, develop the capacity within their organizations to respond to public concerns, approach trust-building as the central long-term goal of effective public processes, provide leadership to develop a shared understanding of environmental conditions and practices, and focus on the contextual conditions of the impacted ecosystems and the communities that depend on them. Although my internship could not provide me with opportunities to explore each of Shindler et al.’s (2002) recommendations, I believe that my observations and conclusions

regarding barriers facing PWSAC and AHRP are relevant, and worthy of consideration by each organization.

However, care should be taken to avoid promises of ‘win-win’ results from collaborative endeavors. As with any decision-making process, collaborations will ultimately result in both winners and losers, depending upon the process outcome. Drawing from my own experience as chair of the PWS/CR RPT, I believe that a combination of both top-down and bottom-up management approaches ensures that decisions will be made should collaborations fail to produce definitive policy recommendations. Although the structure of RPTs are highly regulated, Alaskan law allows individual RPTs a significant amount of flexibility on who can vote on issues relating to hatchery production in each management area. Further, there are no limitations on inclusion of stakeholders in the RPT process, and there are explicit expectations for public involvement in the groups’ decision-making. In the case of PWS, stalemates over decisions regarding hatchery production have resulted in ADF&G’s commissioner ruling in favor of ADF&G staff recommendations over industry stakeholders’ wishes, and vice versa. Although there are many potential benefits to collaboration outside of an actual decision, action, or recommendation, I believe that management of salmon hatchery production in PWS should maintain its top-down component. So long as the collaborative interactions allow for the development of relationships amongst participants, I believe that trust will endure regardless of decision outcomes.

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APPENDIX 1: PWSAC GENERAL MANAGER INTERVIEW OVERVIEW

PWSAC GENERAL MANAGER INTERVIEW OVERVIEW

Introduction

PWSAC is a large corporation directly employing 45 full-time permanent employees and up to 75 temporary summer employees with a total budget (operating and capital) of over \$12 million. The General Manager's primary duties are to oversee and manage the administrative functions for four remote hatcheries in Prince William Sound, one non-remote hatchery in interior Alaska, a distribution center in Anchorage, and a headquarters office in Cordova. This interview will be structured in such a way to discern your experience and talents as they relate to the many demands of this position, starting first with several questions which are administrative and/or managerial in nature. Questions for these individual sections will be asked by different members of the Prince William Sound Aquaculture Corporation Board of Directors' Executive Committee. As members of this interview committee will be taking notes on your answers, please allow for some delays between questions. Also, it is expected that some redundancies will develop during the interview. Please do your best to stick to the questions at hand, although given the complex nature of the questions it is understood if your answers share some overlap throughout the interview.

Section 1: Administration *(25 points possible for this section = ~17% of total possible points)*

1. How would you describe your management style? (5 points possible)
 2. Drawing from your past experience, how have you developed, implemented, and managed a budget through its cycle? (5 points possible)
 3. Please describe successful techniques for establishing and implementing long-range and short-range goals for an organization such as ours. (5 points possible)
 4. What skills do you think are most important in facilitating the flow of ideas, information and understanding between individuals? (5 points possible)
 5. In your past experience, what problems do you believe are most stressful for managers, i.e., problem subordinates, community members, elected Board members or agencies from outside of the organization or the community? (5 points possible)
-

Section 2: Personnel Management *(25 points possible for this section = ~17% of total possible points)*

PWSAC employs a great many employees from a wide range of backgrounds, including finance and administration, maintenance and engineering, and fish culture, among others. As such, PWSAC's General Manager is tasked with taking a leadership role in developing and maintaining a positive workplace culture to accommodate and empower PWSAC's diverse workforce. With this in mind, please answer the following questions to the best of your abilities:

1. How do you develop trust and loyalty in your employees? (5 points possible)

Again, acknowledging that you are not familiar with PWSAC's personnel policies, we would like to have you address the following scenario based on your own experience managing personnel: *[begin scenario]* it has been brought to your attention that one of your employees is often late to work. To ensure that they are paid for a full 8 hours, the employee has arranged to have another employee log them into the timeclock at the assigned starting time.

2. How would you address this issue to ensure accountability in the future? (5 points possible)
 3. Describe a time when you had to intervene to solve a conflict in a workplace situation. (5 points possible)
 - a. What other alternatives did you consider? (5 points possible)
 - b. Why did you handle it the way that you did? (5 points possible)
-

Section 3: Board Interactions (20 points possible for this section = ~14% of total possible points)

PWSAC's General Manager works under the direction of a large and diverse Board of Directors in a unique endeavor relating to salmon fisheries, and salmon fishery enhancement. PWSAC's 45-member Board of Directors includes ten directors representing the drift gillnet user group, ten directors representing the purse seine user group, six dual gear group permit holders (individuals who fish both drift gillnet and purse seine permits), one set gillnet permit holder, and up to eighteen additional seats representing salmon processing corporations, municipalities, sport fishing interests, subsistence users, and the scientific community. Together with this large Board of Directors, the PWSAC General Manager is tasked with working to achieve the organization's mission, which is:

"To ethically and professionally optimize salmon production in Area E for the long term well-being of all user groups."

Please answer the following questions specific to working with a Board of Directors engaged with fisheries- and hatchery-related endeavors to the best of your abilities.

1. Do you have any experience working under the direct supervision of a Board of Directors? (5 points possible)
 - a. If so, please describe your experience(s). (5 points possible)
 - OR....
 - b. If not, how do you see yourself working within such a relationship? (5 points possible)
 2. What is your experience with and understanding of salmon fisheries? (5 points possible)
 3. What is your experience with and understanding of hatchery production? (5 points possible)
-

Section 4: Fisheries (25 points possible for this section = ~17% of total possible points)

Given the importance of fisheries to PWSAC's operations and mission statement, we are going to present a scenario to you. We realize you may not be familiar with all of PWSAC's policies and procedures but based on your experience how would you handle the following situation:

Your job requires that you work closely with Alaska's Department of Fish and Game (ADF&G) on managing salmon returning to our hatcheries. During this hypothetical scenario, it becomes apparent that fish are not returning in adequate numbers to ensure that PWSAC's egg take goals will be met. At the same time, ADF&G has strongly indicated that they intend to open fishing for commercial fishermen that would harvest significant hatchery fish. PWSAC's position is that they are opposed to these openings. How would you approach ADF&G to address this situation?

Section 5: Cordova *(15 points possible for this section = 10% of total possible points)*

From PWSAC's web site: "The town of Cordova is a small, picturesque, and semi-remote commercial fishing community. Home to about 2,500 people in the winter, Cordova doubles in population 5,000 in the summer. Only accessible by boat or plane, Cordova is pristine, safe, and boasts abundant outdoor recreational opportunities." However, the reality of living and working in Cordova can be far more challenging than this introduction might suggest. Weather in Cordova can truly be a force of nature, where rainfall events totaling 100 inches of precipitation in a given month are not unheard of. Also, given its size, amenities such as retail and restaurant options are extremely limited when compared to larger towns on a road system.

Please answer the following questions to the best of your abilities:

1. Have you ever lived and worked in a small, remote community? (5 points possible)
 2. Working and living in Cordova will require an individual who is fully aware of the nature of living in a rural Alaskan community and who genuinely wants to participate in the community and enjoys the lifestyle. How would you describe your compatibility with the community of Cordova? (5 points possible)
 3. If offered this position, would you prefer to relocate to Cordova full-time, or do you see yourself living in Anchorage and commuting to Cordova for the duration of the summer fishing season and for offseason meetings? (5 points possible)
 4. IF THE CANDIDATE ANSWERS CORDOVA SEASONAL...PWSAC has not planned to provide seasonal housing – how do you anticipate accommodating this situation? (5 points possible)
-

Section 6: Career Goals/Parting Questions *(25 points possible for this section = ~17% of total possible points)*

Given the complexity of PWSAC and its General Manager position, this is often a role that is grown into over time.

1. How long do foresee yourself in this role with PWSAC as a career path? (5 points possible)

2. What do you see as your strengths as they relate to this position? (5 points possible)
 3. Do you anticipate any weaknesses that you would need assistance with, whether it be additional training, mentorship, or delegation of duties? (10 points possible)
 4. The previous questions may not have given you the opportunity to explain to us all the things we should know about your qualifications and attributes. Tell us, why it would be in our best interest to select you for the General Manager position. (5 points possible)
-

Section 7: Overall Impression (*up to 10 points possible = ~7% of total possible points*)

We have asked you quite a few questions. Do you have any additional questions for us?

Total points possible = 145 points total

APPENDIX 2: PWSAC GENERAL MANAGER INTERVIEW SCORECARD

PWSAC General Manager Interview Matrix

Candidate:

Interviewer:

Section 1: Administration

1. How would you describe your management style?

Score (circle choice):

1

2

3

4

5

Bad

OK

Neutral

Good

Great

Notes:

2. Drawing from your past experience, how have you developed, implemented, and managed a budget through its cycle?

Score (circle choice):

1

2

3

4

5

Bad

OK

Neutral

Good

Great

Notes:

PWSAC General Manager Interview Matrix

Candidate:

Interviewer:

3. Please describe successful techniques for establishing and implementing long-range and short-range goals for an organization such as ours.

Score (circle choice):

1

2

3

4

5

Bad

OK

Neutral

Good

Great

Notes:

4. What skills do you think are most important in facilitating the flow of ideas, information and understanding between individuals?

Score (circle choice):

1

2

3

4

5

Bad

OK

Neutral

Good

Great

Notes:

PWSAC General Manager Interview Matrix

Candidate:

Interviewer:

5. In your past experience, what problems do you believe are most stressful for managers, i.e., problem subordinates, community members, elected Board members or agencies from outside of the organization or the community?

Score (circle choice): 1 2 3 4 5
Bad OK Neutral Good Great

Notes:

Section 2: Personnel Management

1. How do you develop trust and loyalty in your employees?

Score (circle choice): 1 2 3 4 5
Bad OK Neutral Good Great

Notes:

PWSAC General Manager Interview Matrix

Candidate:

Interviewer:

2. GIVEN THE PROVIDED SCENARIO, how would you address this issue to ensure accountability in the future?

Score (circle choice):	1	2	3	4	5
	Bad	OK	Neutral	Good	Great

Notes:

3. Describe a time when you had to intervene to solve a conflict in a workplace situation.

Score (circle choice):	1	2	3	4	5
	Bad	OK	Neutral	Good	Great

Notes:

PWSAC General Manager Interview Matrix

Candidate:

Interviewer:

3a. What other alternatives did you consider?

Score (circle choice):

1

2

3

4

5

Bad

OK

Neutral

Good

Great

Notes:

3b. Why did you handle it the way that you did?

Score (circle choice):

1

2

3

4

5

Bad

OK

Neutral

Good

Great

Notes:

PWSAC General Manager Interview Matrix

Candidate:

Interviewer:

Section 3: Board Interactions

1. Do you have any experience working under the direct supervision of a Board of Directors?

Score (circle choice):

0

5

No

Yes

Notes:

- 1a. IF YES, please describe your experience(s).

Score (circle choice):

1

2

3

4

5

Bad

OK

Neutral

Good

Great

Notes:

PWSAC General Manager Interview Matrix

Candidate:

Interviewer:

1b. IF NOT, how do you see yourself working within such a relationship?

Score (circle choice):

1

2

3

4

5

Bad

OK

Neutral

Good

Great

Notes:

2. What is your experience with and understanding of salmon fisheries?

Score (circle choice):

1

2

3

4

5

Bad

OK

Neutral

Good

Great

Notes:

PWSAC General Manager Interview Matrix

Candidate:

Interviewer:

3. What is your relationship with and understanding of hatchery production?

Score (circle choice):

1

2

3

4

5

Bad

OK

Neutral

Good

Great

Notes:

Section 4: Fisheries

1. Please read hypothetical fisheries management scenario.

Score (circle choice):

0

5

10

15

20

25

Bad

Not good

Neutral

OK

Good

Great

Notes:

PWSAC General Manager Interview Matrix

Candidate:

Interviewer:

Section 5: Cordova

1. Have you ever lived and worked in a small, remote community? If so, please describe.

Score (circle choice):	0	1	2	3	4	5
	No	Bad	OK	Neutral	Good	Great (highly relevant to Cordova)

Notes:

2. Working and living in Cordova will require an individual who is fully aware of the nature of living in a rural Alaskan community and who genuinely wants to participate in the community and enjoys the lifestyle. How would you describe your compatibility with the community of Cordova?

Score (circle choice):	1	2	3	4	5
	Bad	OK	Neutral	Good	Great

Notes:

PWSAC General Manager Interview Matrix

Candidate:

Interviewer:

3. If offered this position, would you prefer to relocate to Cordova full-time, or do you see yourself living in Anchorage and commuting to Cordova for the duration of the summer fishing season and for offseason meetings?

Score (circle choice):

0

5

Cordova seasonal

Cordova full-time

Notes:

4. IF THE CANDIDATE ANSWERS CORDOVA SEASONAL...PWSAC has not planned to provide seasonal housing – how do you anticipate accommodating this situation?

Score (circle choice):

1

2

3

4

5

Bad

OK

Neutral

Good

Great

Notes:

PWSAC General Manager Interview Matrix

Candidate:

Interviewer:

Section 6: Career Goals/Parting Questions

1. How long do foresee yourself in this role with PWSAC as a career path?

Score (circle choice):

1

2

3

4

5

Bad

OK

Neutral

Good

Great

Notes:

2. What do you see as your strengths as they relate to this position?

Score (circle choice):

1

2

3

4

5

Bad

OK

Neutral

Good

Great

Notes:

Interviewer:

10

Perfect

5

Great

12

PWSAC General Manager Interview Matrix

Candidate:

Interviewer:

Section 7: Overall Impression

1. This question gives the scorer an opportunity to rate their overall impression of the interviewee, and their fit for the position.

Score (circle choice):

1

2

3

4

5

6

7

8

9

10

Poor fit



Neutral



Perfect fit

Notes:

END OF SCORING SECTIONS

PWSAC General Manager Interview Matrix

Candidate:

Interviewer:

We have asked you quite a few questions. Do you have any additional questions for us? (NO SCORE!)

Notes:

SECT 1 Admin (0-25pts) = _____ SECT 2 Personnel (0-25pts) = _____

SECT 3 BOD Interact (0-20pts) = _____ SECT 4 Fisheries (0-25pts) = _____

SECT 5 Cordova (0-15pts) = _____ SECT 6 Career & ? (0-25pts) = _____

SECT 7 Overall Eval (0-10pts) = _____ TOTAL SCORE (ALL SECTIONS) = _____