Subsistence in the Copper River Basin and Prince William Sound, Alaska: A Statistical Analysis Determining the Effectiveness of Subsistence Resource Management for Sockeye and Chinook Salmon.

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Abstract

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Many of Alaska's salmon fisheries are models of biological success in terms of population size, structure, and stability, utilizing the precautionary principle to promote maximum sustainable yield. At the same time the fisheries include multiple stakeholders with conflicting viewpoints and challenges. The State of Alaska has a statutory priority to ensure subsistence stakeholders receive the harvest they need first, while distributing the opportunity to harvest any abundance of fish thereafter equitably amongst the remaining user groups. Different stakeholders hold different perspectives on how successful the State is at managing these fisheries. I explore the management methods in the Copper River Basin in Prince William Sound (PWS), Alaska, using statistical analyses to establish whether existing sources of information can be used to determine the impact and efficacy of regulations on the State of Alaska's priorities. In PWS the salmon fishery is important to three very different user groups, offering an opportunity to explore how the State manages a high-stakes salmon fishery with multiple stakeholder involvement. Subsistence harvest and users are the primary focus of my inquiry, while I also examine personal use and commercial fisheries. For a period of 34 years from 1979 to 2015, changes in state and federal regulations along with escapement numbers are used to determine relationships between management and harvest in the PWS. The results of my investigation indicate that the State of Alaska is meeting their management goals by sustaining fish populations and keeping harvest levels stable.

Table of Contents

Abbreviations and Definitions

The following abbreviations and definitions are commonly used throughout this thesis. This list is meant to serve as a reference for the reader.

Abbreviation	Definition
ADF&G	Alaska Department of Fish and Game
Subsistence	Defined by the State of Alaska as "the taking of fish, shellfish, or other fisheries resources by Alaska residents for subsistence uses" (AS 16.05.940(31))
Subsistence Uses	Defined by the State of Alaska "customary and traditional uses" of fish and wildlife for "direct personal or family consumption as food, shelter, fuel, clothing, tools, or transportation; for the making and selling of handicraft articles out of non-edible byproducts of fish and wildlife resources taken for personal or family consumption; and for the customary trade, barter, or sharing for personal or family consumption" (AS 16.05.940(32)) (See also C&T)
Subsistence Priority	Defined by the State of Alaska as: "adopting subsistence regulations that provide a reasonable opportunity for subsistence uses **first** before providing for other uses of any harvestable surplus of a fish stock or game population" (AS 16.05.258 (b)) (paraphrased by ADF&G)
Personal Use	Defined by the State of Alaska as "the taking, fishing for, or possession of finfish, shellfish, or other fishery resources, by Alaska residents for personal use and not for sale or barter, with gill or dip net, seine, fish wheel, long line, or other means defined by the Board of Fisheries."
Home pack	Harvest taken home by commercial fishermen from commercial catch, for subsistence purposes.
FBS	Federal Board of Subsistence
C&T	Customary and Traditional. (See also Subsistence uses)
BOF	Board of Fisheries
ANILCA	Alaska National Interest Lands Conservation Act
AAC	Alaska Administrative Code
AS	Alaska Statute
OSM	Office of Subsistence Management (Federal)
AMR	ADF&G, Division of Commercial Fishing Annual Management Report
SPSS	Statistical Package for the Social Science
SLR	Simple Linear Regression
MLR	Multiple Linear Regression
MSY	Maximum Sustainable Yield

List of Figures

List of Tables

Introduction

The State of Alaska is considered to have some of the best managed fisheries in the world.[1] This is usually with reference to the many high-grossing commercial fisheries within the state and its surrounding waters. However, commercial fishing is not what makes Alaska unique. Instead, it is the balance between commercial fishing, which is a multi-billion dollar industry, sport fishing that drives a thriving tourism industry, and subsistence and personal use fishing which have sustained Alaska Natives and other state residents for centuries as a part of their culture and way of life.[2] It is the State's duty to consider subsistence, commercial, sport, and personal use stakeholders when setting regulations.[3] Subsistence is defined in Alaska Statutes as "noncommercial, customary, and traditional uses" for a variety of purposes (AS 16.05.940[32]).[4] Alaska is required under the Subsistence Statute to identify fish stocks that support subsistence and, if there is a harvestable surplus of these stocks, adopt regulations that provide reasonable opportunities for these subsistence uses to take place (AS 16.05.258).[5] The purpose of my investigation is to determine what effect, if any, the regulations mandated by the state and implemented by ADF&G are having on subsistence, personal use, and commercial harvest patterns and amounts.

I have chosen to focus my analysis on the Copper River Basin located in Prince William Sound, Alaska (Figure 1.1). The Copper River Basin falls under the Prince William Sound Management Area (PWS). I chose this area because of its importance to subsistence, commercial, and personal use fisheries.[6] Having to account for multiple fisheries and users is considered one of the most difficult challenges faced by the Board of Fisheries, Alaska Department of Game, and the Federal Subsistence Board when making and updating regulations.[7] PWS is home to the famous Copper River Salmon Fishery, but also houses rural communities that rely on those same "famous" salmon stocks for subsistence and cultural uses. While all 5 species of salmon can be found in PWS, the two most important species for both commercial and subsistence fisheries are Chinook and sockeye, and therefore I restricted my analysis to these two species.[8]

[1] (Luizza et al. 2016; Lonner 1980)
[2] (Barbier 2913; van den Broek, Smith, and Wade 2007, 1; Naves et al. 2015; Kukkonen and Zimpelman 2012; Simeone and Kari 2005)
[3] (*Alaska Statute: Definitions*, n.d.)
[4] (*Alaska Statute: Definitions*, n.d.)
[5] (*Alaska Statute: Subsistence Use and Allocation*, n.d.)
[6] (Roberson 1977; Kari and Tuttle 2005)
[7] (van den Broek, Smith, and Wade 2007, 1)
[8] (Fall et al. 2014, 217)

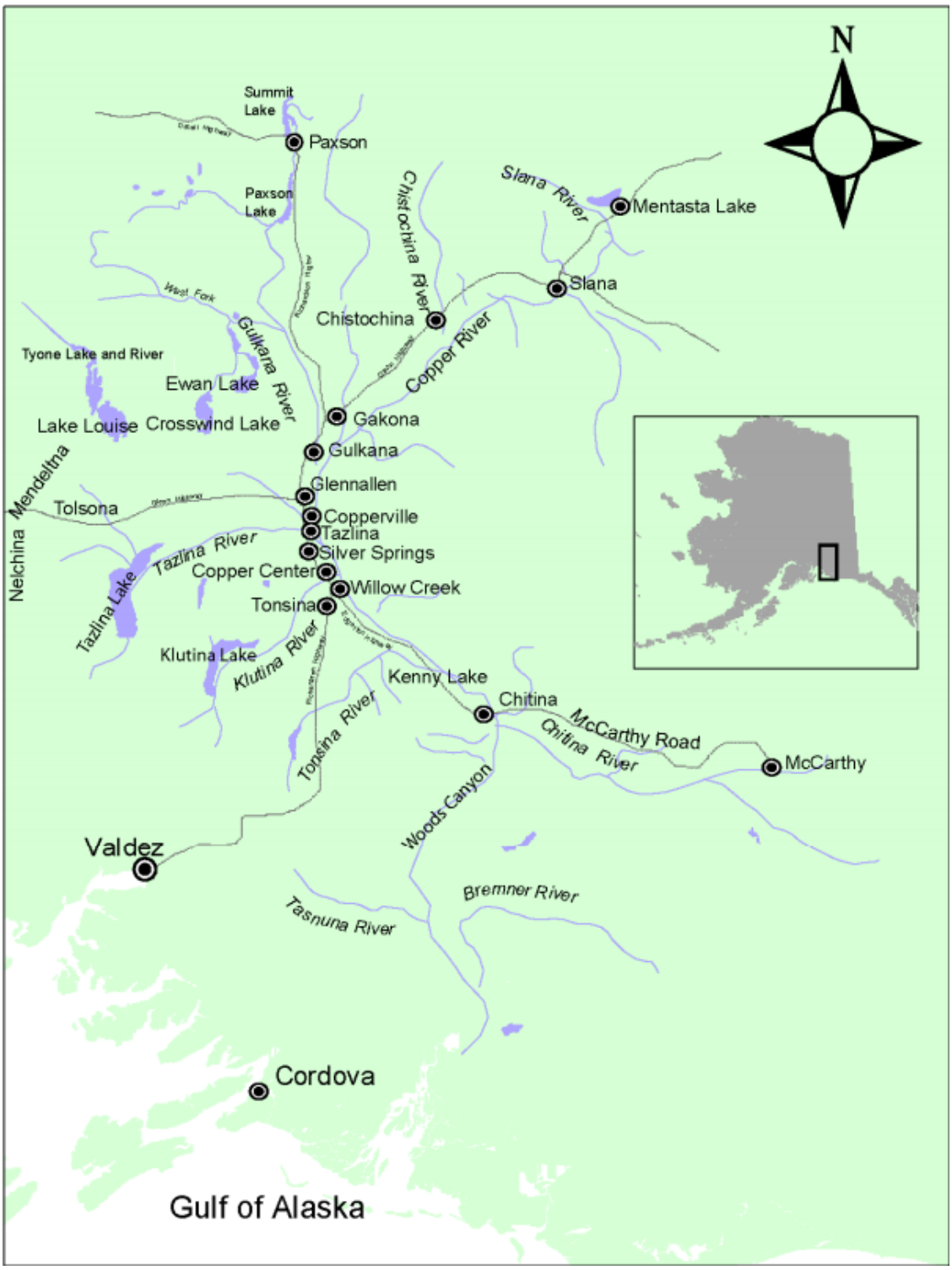

Figure 1.1 Map of Copper River drainage, created by the Division of Subsistence, ADF&G.[9]

[9] (Fall and Simeone 2010, 35)

My analysis focused on compiling state and federal regulations for PWS from 1979 to 2015, using a "less restrictive, more restrictive, no change" coding scheme to determine the annual change in regulation. An important facet of management in PWS is the use of salmon escapement goals as a management tool. The State of Alaska utilizes a management scheme that requires a certain amount of salmon to escape each season ensuring the return of salmon the following year, sustaining the population, and guaranteeing harvest for stakeholders into the future.[10] I used statistical tools to compare changes in regulation and escapement with chinook and sockeye harvest data, to determine whether trends emerged, while also considering outside factors that could have affected regulations and harvest amounts.[11] I formulated recommendations based on the results of this analysis.

Description of Study Area

Prince William Sound includes all waters of Alaska between the longitude of Cape Fairfield and the longitude of Cape Suckling (5 AAC 24.100) south of the Yukon-Area described in Alaska Administrative Code (5 AAC 05.100), and all waters of the Upper Susitna River drainage upstream of the Susitna River's confluence with the Osthena River.[12] The PWS management area has a total land area of 38,000 square miles and its main geographical features include the Copper River, its tributaries, and Prince William Sound.[13] According to ADF&G, the Prince William Sound Management Area is broken into several districts. The Eastern, Southwestern, and Copper River districts all have their own subsistence regulations; all other districts fall under the General District regulations (Figure 1.2). The Copper River is 300 miles long and empties into the Gulf of Alaska.[14] The Copper River flows through the Copper Basin which is located in South Central Alaska and is home to 20 communities totaling approximately 3,000 people.[15] The Ahtna, an Athabascan speaking people, have inhabited the area for at least a millennium.[16] This District is broken into three sub-districts: the Glennallen and Chitina subdistricts, and the area around the former village of Batzulnetas. A subsistence fishery takes place in the Glennallen Subdistrict and within the Batzulnetas area, while the Chitina Subdistrict is currently classified as a personal use fishery under state regulations[17]

[10] (Alaska Department of Fish and Game 2016)
[11] (Lonner 1980)
[12] (State of Alaska, n.d.)
[13] (Fall et al. 2014, 217)
[14] (van den Broek, Smith, and Wade 2007, 3)
[15] (Fall et al. 2014, 118)
[16] (Simeone and Fall 2003; Simeone and Kari 2005)
[17] (State of Alaska, n.d.)

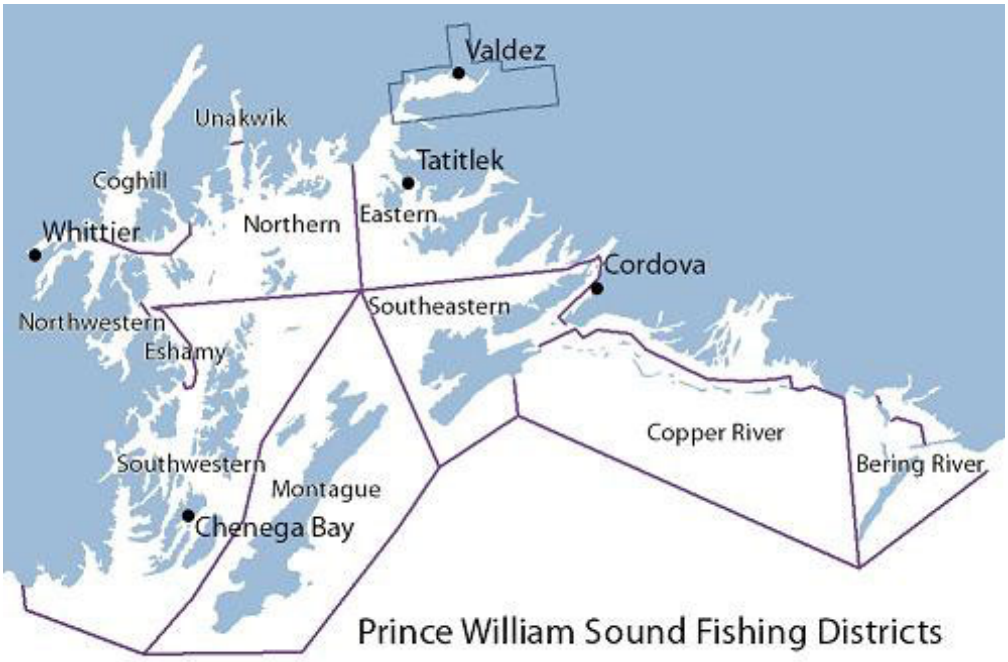

Figure 1.2 PWS Fishing Districts. Retrieved from Division of Subsistence, ADF&G.[18]

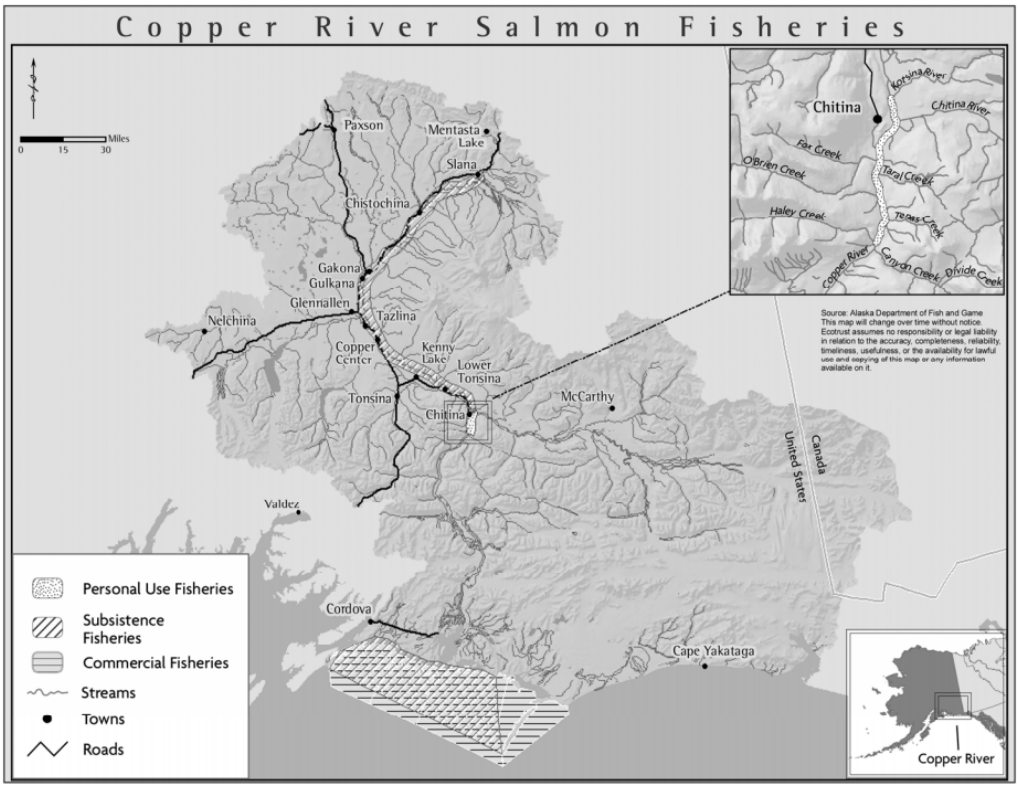

Figure 1.3 Map of Copper River Basin, showing personal use, subsistence, and commercial fishing areas. Retrieved from Division of Subsistence, ADF&G.[19]

[18] (Alaska Department of Fish and Game n.d.)
[19] (Simeone et al. 2011, 12)

Historical context

The history of Prince William Sound and associated state and federal regulations provides important context for my analysis. Table 1.1 summarizes some key changes to state and federal regulations and actions that may have affected the PWS area.

Year	Change or action
1959	Alaska attains Statehood
1960	Subsistence permit required
1964	Copper River and its tributaries closed to subsistence fishing
1960s	Seasonal limits based on income and household size adopted. For incomes under the limitation set by regulation, salmon allocations are 200 for an individuals and 500 for a family. For incomes over the limit, salmon allocations are 20 for an individual and 40 for a family.
1977	BOF created Chitina and Glennallen subdistricts.
1978	• Division of Subsistence is created within the Alaska Department of Fish and Game • First subsistence law adopted; C&T finding instated
1980	Subsistence permits created in the Copper River Management Plan using “classes”, based on age, income, residency, household size, wage employment, and history of participation in the fishery.
1981	Salmon seasonal limit increased to 30 salmon for an individual, 60 for a household of 2 persons, and 10 for each additional household member.
1984	• Separation of subsistence and personal use fishery • Positive C&T finding for Glennallen Subdistrict • Negative C&T finding for the Chitina Subdistrict • Subsistence permit eligibility limited to Copper Basin and Tanana residents • Low income requirement dropped for higher seasonal limit
1985	*Madison* decision passes, opening up subsistence fisheries to all residents of Alaska rather than just those local to the fishing district.
1986	New State subsistence statute: *Madison* decision reversed.
1988	Establishment of Batzulnetas Fishery.
1989	Exxon Valdez Oil Spill
1990	• *Madison* decision reinstated following the *McDowell* decision. • Dual management of subsistence resources between State and Federal agencies begins.
1993	Positive C&T finding for Chitina Subdistrict

1996	Negative C&T finding for Chitina Subdistrict
1997	Establishment of Village Fish Wheels
1999	Positive C&T finding for Chitina Subdistrict
2003	Negative C&T finding for Chitina Subdistrict
2005	BOF determined no significant information was available to warrant review of C&T finding of Chitina salmon stocks
2008	BOF determined no significant information was available to warrant review of C&T finding of Chitina salmon stocks
2009	Following the *Alaska Fish and Wildlife Conservation Fund v. State* case, BOF is directed to adopt a definition of "Subsistence way of life" and reconsidered C&T finding for Chitina salmon stocks.
2010-present	BOF determined no significant information was available to warrant review of C&T finding of Chitina salmon stocks

Table 1.1 PWS Management Area Timeline. Adapted from ADF&G, Division of Subsistence. [20]

A key management change occurred in 1978 when the Division of Subsistence within ADF&G was created.[21] This was concurrent with the adoption of the first subsistence law and the beginning of consistent and reliable harvest information in the area.[22] Prior to 1978, subsistence fishing was defined in (AS 16.05.940(17)) as fishing for "personal use and not for sale or barter".[23] After the Subsistence Division was created and the subsistence law put into place, "customary and traditional uses", referred to as C&T from here on out, were identified. C&T uses of resources include "direct personal or family consumption as food, shelter, fuel, clothing, tools, or transportation; for the making and selling of handicraft articles out of non-edible byproducts of fish and wildlife resources taken for personal or family consumption; and for the customary trade, barter, or sharing for personal or family consumption" (AS 16.05.940[32]).[24] A fisheries stock or stocks must have a positive C&T finding in order to be open for subsistence fishing and harvesting.[25] This law has had a large impact on the Copper River District within PWS, with C&T findings for its sub-districts changing a handful of times, thus altering subsistence opportunities over the years. One of the more impactful C&T changes occurred in 1984, when BOF ruled that salmon stocks in the Glennallen District were found to have a positive finding while salmon stocks in the Chitina District had a negative finding. Following the closure of the Chitina District to subsistence fishing, a personal use fishery was authorized. This represented a large shift in management,

[20] (Fall and Simeone 2010; Simeone et al. 2011; State of Alaska, n.d.; D. Holen 2002; Fall and Stratton 1984; Roberson 1977; Stratton 1982)
[21] (Roberson 1977)
[22] (Fall and Simeone 2010, 1; Fall and Stratton 1984; Stratton 1982)
[23] (*Alaska Statute: Definitions*, n.d.)
[24] (*Alaska Statute: Definitions*, n.d.)
[25] (Fall and Simeone 2002, 4)

allowing non-subsistence fishing in the area for the first time since the new definition of subsistence was put into place.[26]

Prior to 1985, only residents local to the Copper River district could apply for subsistence permits.[27] However, the *Madison Decision,* which focused on fisheries in the Cook Inlet Management Area to the southwest of the Copper River, removed this stipulation and made all Alaskans eligible to participate in subsistence fisheries.[28] Preceding *Madison v. Alaska Department of Fish and Game,* the Alaska BOF had put criterion into place used to determine whether a community or person was eligible under C&T for subsistence fishing. [29] (Please refer to Appendix D for an example of the criterion.) Only 3 communities in the Cook Inlet area satisfied this criterion, leaving a majority of subsistence users in the area unprotected and without subsistence resources and opportunities.[30] This case led to the *Madison Decision* and resulted in subsistence permits statewide being opened to all residents of Alaska, no matter where they reside permanently.[31]

In 1980 the Alaska National Interest Lands Conservation Act (ANILCA) was passed.[32] Title VIII of this act stated a priority for subsistence use of fish and wildlife on federal lands within Alaska, which cover about 60 percent of the state.[33] ANILCA gave authority to manage subsistence use of fish and wildlife to the State of Alaska, as long as the State managed with consistency to federal law. However, in 1989 the Alaska Supreme court found in the *McDowell Decision*[34]*,* that the "residency criterion used in the act which conclusively excludes all urban residents from subsistence hunting and fishing regardless of their individual characteristics to be unconstitutional," and that "there are...substantial numbers of Alaskans living in areas designated as urban who have legitimate claims as subsistence users. Likewise there are substantial numbers of Alaskans living in areas designated as rural who have no such claims."[35]. Due to this decision, the State could no longer implement regulations that were compatible with Federal law. Thus, in 1990 Alaska was found by the Department of the Interior to be out of compliance with ANILCA, and dual management of subsistence resources began. This change meant that residents of the PWS had to adhere to both state and federal regulations from that time forward, creating a more complicated management regime for the area.[36]

Cultural Context

The Glennallen Subdistrict is one of the very few subsistence salmon fisheries connected by the road system and consequently is the most easily accessible subsistence fishery in Alaska.[37] It is located approximately 6-7 hours by car from the

[26] (Fall and Simeone 2002)
[27] (State of Alaska, n.d.)
[28] (Madison v. The Alaska Department of Fish and Game 1985)
[29] (Fall and Simeone 2010, 108)
[30] (Simeone and Kari 2005)
[31] (State of Alaska, n.d.)
[32] (*H.R. 39-96th Congress: Alaska National Interests Lands Conservation Act* 1980)
[33] (Strong 2013, 30:1:82)
[34] (McDowell v. State of Alaska 1989)
[35] (Strong 2013)
[36] (Naves et al. 2015, 213)
[37] (Roberson 1977, 13)

state's two largest population centers, Anchorage and Fairbanks. Subsistence, personal use, and commercial fishing are intrinsically reliant on salmon fisheries in the PWS region.[38]

A large portion of those intrinsically reliant on subsistence salmon fishing in the Copper River Basin and PWS are the Ahtna, an Alaskan Native Athabascan-speaking people indigenous to the area.[40] Modern-day Ahtna communities participate in a mixed cash-subsistence economy. Their lifestyle and culture are largely based on their customary and traditional uses of fish and wildlife.[41] Salmon play the largest role in their subsistence diets and culture, but they also make use of other wildlife, plants, and berries in the area.[42] Throughout the centuries the Ahtna have developed sophisticated ways of harvesting and processing salmon, created protocols for self-governing the amount of salmon harvest, and created and kept an oral tradition for salmon in the Copper River Basin.[43] However, due the accessibility of the Copper River Area, the Ahtna are faced with increasing competition for salmon from other stakeholders. This competition was fueled by the addition of a major road system connecting the area to most of Alaska's urban population, the change in eligibility for subsistence permits from only locals to all Alaskan residents, and environmental changes in the area.[44]

Commercial fishing has also played a long role in the culture of the PWS and Copper River Basin. Commercial fishing began in the region in 1969, and since then it has been the main source of income in Cordova, AK, one of the biggest population centers within the PWS Management Area.[45] According to the 2010 U.S. Census, almost half of Cordova's households had at least one member working in the commercial harvesting or processing sector. The local earnings in the area were about $21 million.[46] The high permit numbers and earnings indicate how important commercial salmon is to the people and culture in PWS. However, in 1989 Cordova and the rest of PWS were sharply affected by the Exxon Valdez Oil Spill (EVOS). The spill took a huge toll on the commercial fishing based economy and culture of PWS.[47] EVOS and the current competition from farmed salmon has had a lasting effect on the economy of the area.[48]

There exists a statutory requirement that the BOF and ADF&G "must adopt subsistence regulations that provide a reasonable opportunity for subsistence uses **first** before providing for other uses of any harvestable surplus of a fish stock or game population" (AS 16.05.258 (b)).[49] This is referred to as the "subsistence priority." Therefore, it should be a priority of the State to determine whether or not the regulations established by the Board of Fisheries are having an impact on the subsistence users in the region first, before considering other stakeholders. Anecdotally, many subsistence users believe that those in the commercial fishing industry enjoy an advantage in terms

[38] (Naves et al. 2015, 212)
[40] (Naves et al. 2015, 212)
[41] (D. Holen 2002, 57; Naves et al. 2015, 212)
[42] (Kukkonen and Zimpelman 2012, 3)
[43] (Simeone and Kari 2005)(Naves et al. 2015, 212)
[44] (Simeone et al. 2011; Simeone and Kari 2005; Fall and Simeone 2010)
[45] (Naves et al. 2015, 212)
[46] (Alaska Commercial Fisheries Entry Commission 2016)
[47] (Ward et al. 2017; Fall et al. 2001)
[48] (Fall et al. 2001)
[49] (*Alaska Statute: Definitions*, n.d.; Alaska Department of Fish and Game n.d.)

of harvest timing and regulations[50] and that the commercial industry is not only favored by state regulations, but that the commercial industry takes so much of the harvest that subsistence users not able to catch what they need.[51] It is easy to see how management of PWS salmon fisheries may be challenging when keeping both of these important stakeholders in mind. Environmental concerns such as the EVOS and ocean warming further exacerbate the problem of resource allocation, forcing the State of Alaska to make difficult decisions when it comes to resource management and allocation.

Materials and Methods

Data

I gathered regional data on regulations, harvest, and escapement between 1975 and 2015 as described below. This represents the time period for which ADF&G has both reliable and up-to-date harvest and regulation data for the PWS Management Area. Three sets of regulations directly affect subsistence users in the PWS Management Area: State Finfish Subsistence Regulations, State Finfish Personal Use Regulations, and Federal Subsistence Regulations. State regulations are established by the Alaska Board of Fisheries as reported in the Alaska Administrative Code, using best available science.[52] Federal regulations are established by the Federal Subsistence Board.[54] (Please refer to Appendices A, B, and C for the most recent example of these regulations.) Information pertaining to all regulations was coded using the year, area (whether state or federal), regulation number, title of the regulation section, section number, table reference if available, and verbatim text from the original regulation. (Please refer to Appendix D, for an example of this coding.)

I compiled State and Federal Finfish Subsistence and Personal Use Regulations for the PWS Management area from 1979-2015. PWS Subsistence Finfish Regulations can be found in Chapter 12 and Personal Use Regulations can be found in Chapter 77 under Title V of the Alaska Administrative Code.[55] Historic paper copies of these AAC regulations were obtained from the Division of Subsistence in Anchorage, Alaska. Federal Subsistence Regulations were obtained from historic paper copies from the Federal Office of Subsistence Management (OSM).

Yearly data for salmon harvests are available through various historical publications of the Alaska Department of Fish and Game. I obtained records of subsistence harvest, personal use harvest, and commercial harvest over the period 1979-2015. Figures 2.1 and 2.2 show the total number of sockeye and chinook harvested in the PWS from the three stakeholders focused on in this analysis (subsistence, personal use, and commercial harvests).

[50] (Wolfe 2004)
[51] (Simeone and Kari 2005; D. L. Holen 2004; D. Holen 2002)
[52] (State of Alaska, n.d.)
[54] (Department of the Interior 2016)
[55] (State of Alaska, n.d.)

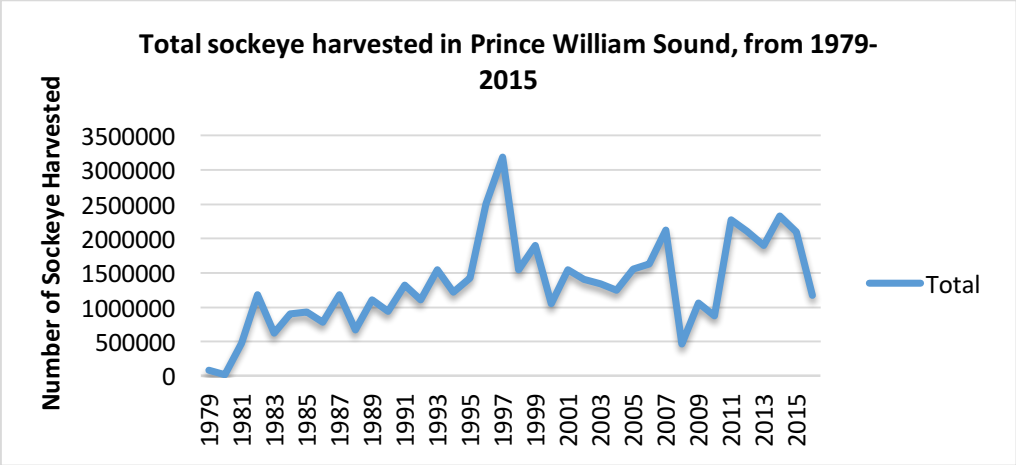

Figure 2.1 Total Number of sockeye Harvested in PWS, including Subsistence, Personal Use, and Commercial Harvests, from 1979-2015. Gathered from ADF&G published salmon harvest data.

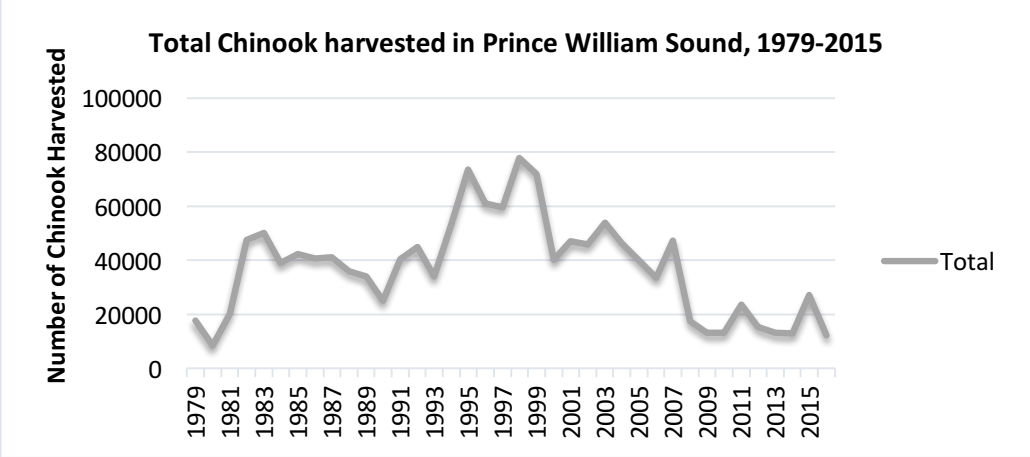

Figure 2.2 Total Number of Chinook Harvested in PWS, including Subsistence, Personal Use, and Commercial Harvest, from 1979-2015. Gathered from ADF&G published salmon harvest data.

The subsistence and personal use harvest data were obtained from the Alaska Salmon Fisheries Database (ASFDB).[56] Figures 2.3 through 2.6 show the subsistence and personal use, of both chinook and sockeye harvest in PWS from 1979-2015.

I obtained PWS commercial harvest data from the Division of Commercial Fisheries' Annual Management Reports for the period 1979-2016[57] Harvest data are reported to the ADF&G Commercial Fisheries Division by commercial fishery permit holders during each season. Figures 2.7 and 2.8, show the commercial sockeye and Chinook harvest from 1979-2016.

[56] (Alaska Salmon Fisheries Database, n.d.)
[57] (Alaska Department of Fish and Game 2016)

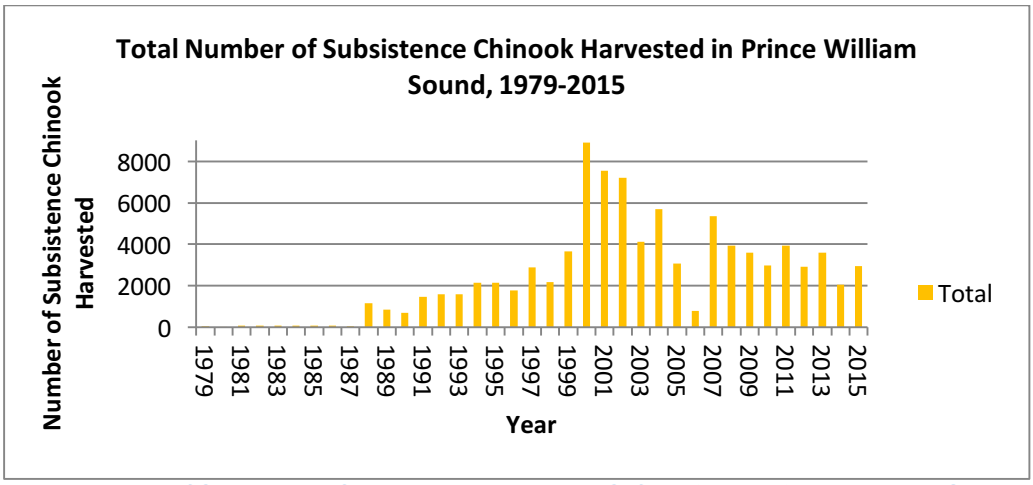

Figure 2.3 Total Number of Subsistence Chinook harvested in PWS, from 1979-2015. Using Data Gathered from the ADF&G published salmon harvest data.

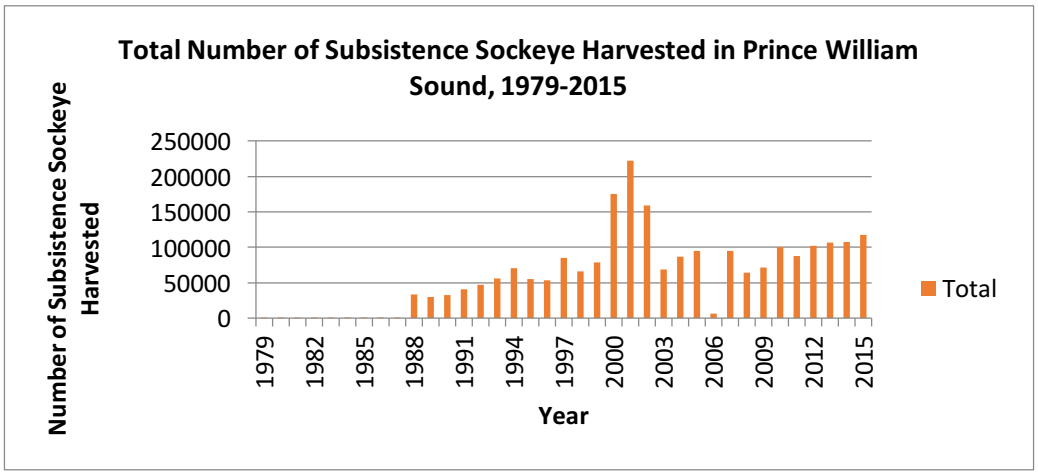

Figure 2.4 Total Number of Subsistence sockeye harvested in PWS, from 1979-2015. Using data gathered from the ADF&G published salmon harvest data.

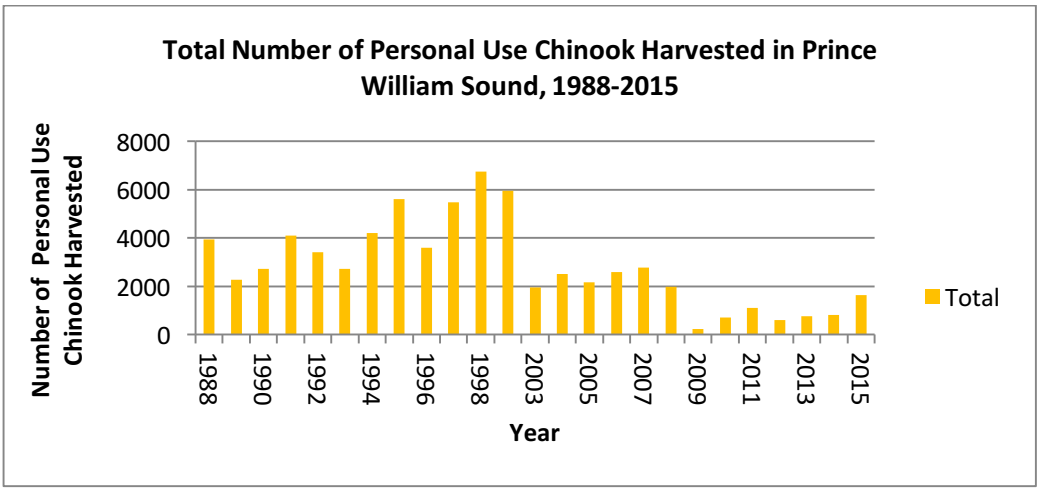

Figure 2.5 Total Number of Personal Use Chinook harvested in PWS, from 1988-2015. Using data gathered from the ADF&G published salmon harvest data.

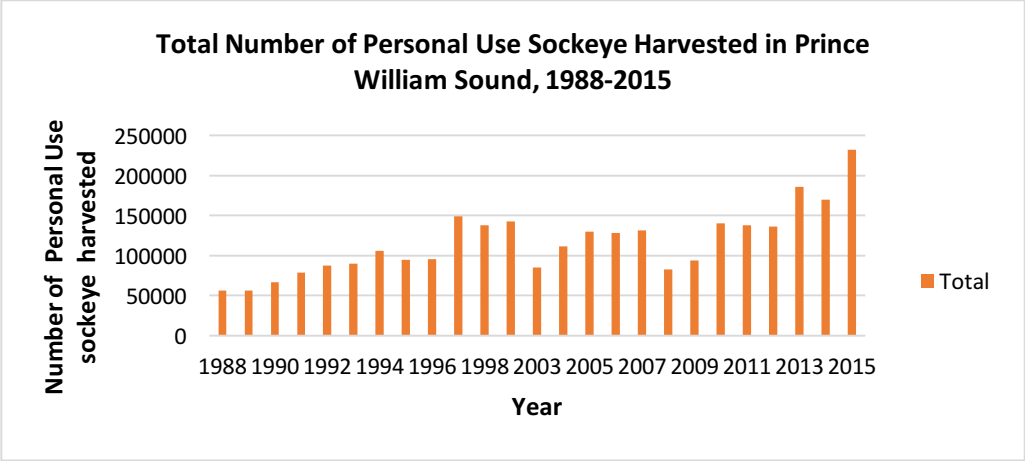

Figure 2.6 Total Number of Personal Use sockeye harvested in PWS, from 1988-2015. Using data gathered from the ADF&G published salmon harvest data.

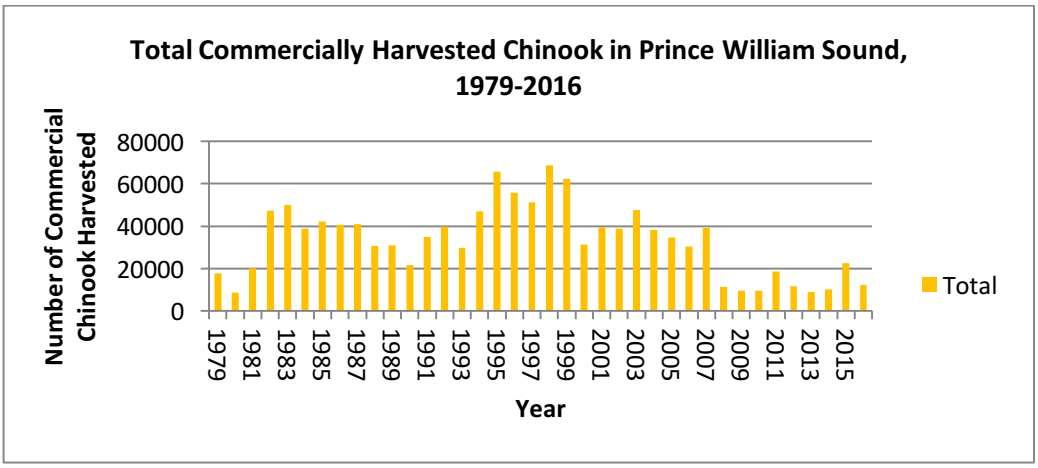

Figure 2.7 Total Number of Commercially Harvested Chinook in PWS, from 1979-2016. Using data gathered from the ADF&G published salmon harvest data.

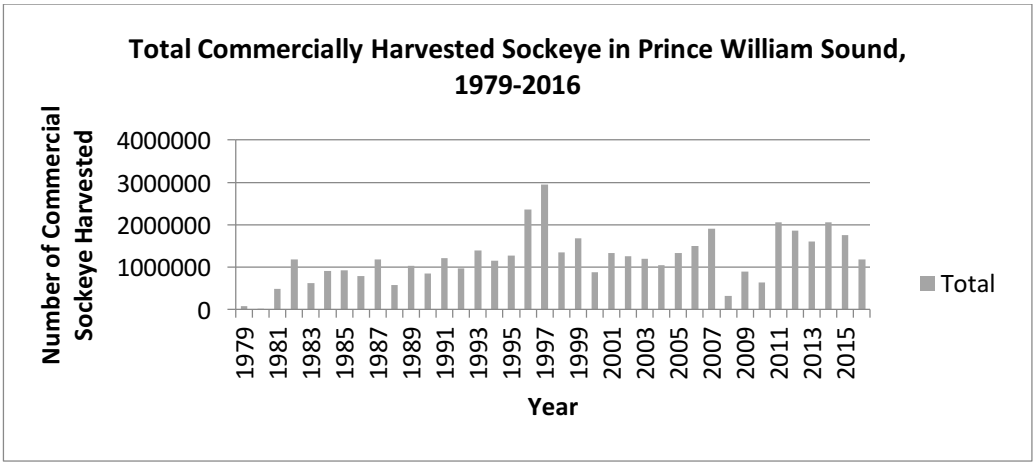

Figure 2.8 Total Number of Commercially Harvested Chinook in PWS, from 1979-2016. Using data gathered from the ADF&G published salmon harvest data.

Escapement is a driving factor of harvest in PWS.[58] I obtained data pertaining to escapement from ADF&G Commercial Fish Annual Management Reports.[59] Figures 2.9 and 2.10 show the total and commercial Chinook and sockeye harvest along with the escapement numbers for PWS, from 1979-2015.

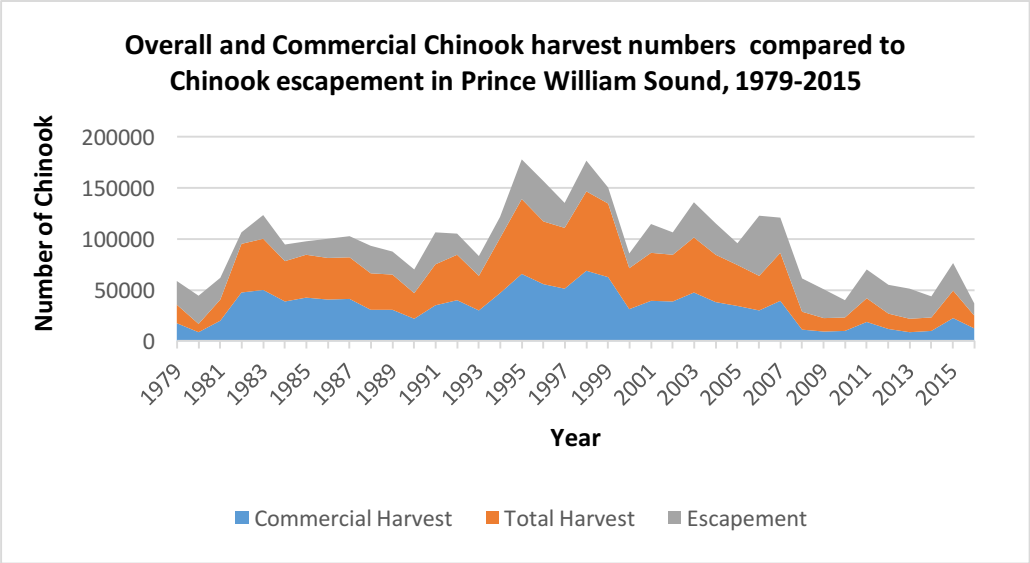

Figure 2.9 PWS Chinook total (subsistence, personal, and commercial) and commercial harvest numbers compared to PWS Chinook escapement numbers, 1979-2015. Data gathered from published ADF&G salmon harvest and escapement numbers.

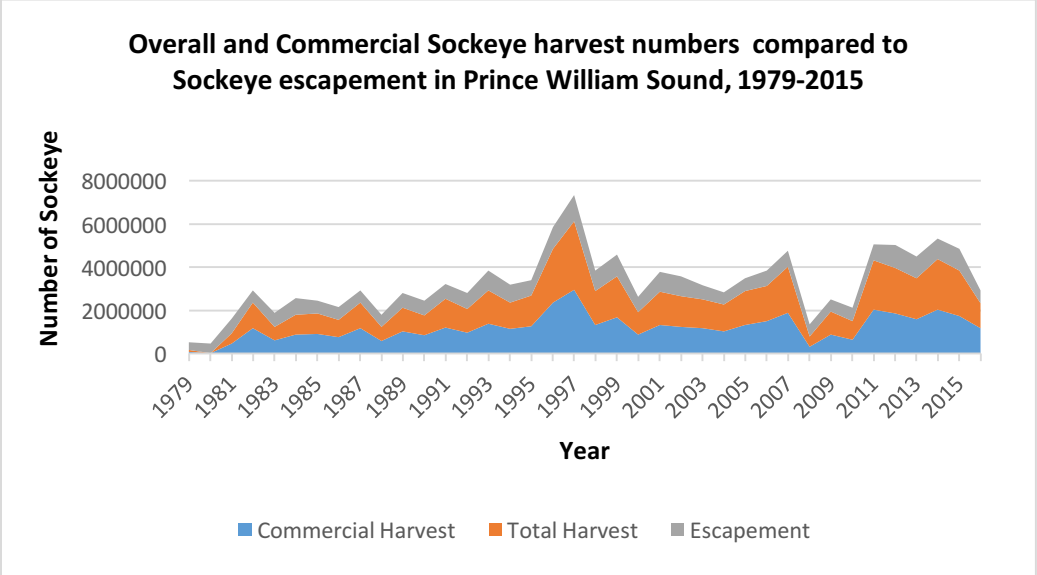

Figure 2.10 PWS sockeye total (subsistence, personal, and commercial) and commercial harvest numbers compared to PWS sockeye escapement numbers, 1979-2015. Data gathered from published ADF&G salmon harvest and escapement numbers

[58] (van den Broek and Smith 2012)
[59] (Alaska Department of Fish and Game 2016)

Coding and Statistical Analysis

My analysis included both quantitative and qualitative data. To allow comparison between qualitative regulation data and quantitative harvest data, I developed a coding method based on examples from Auerbach and Silverstein[60]. I coded regulations as "less restrictive, no change, and more restrictive" with respect to regulations that were in place the year prior (Table 2.1). I recorded the overall change (both species combined), as well as the change for each species independent of the other. Examples of coding outcomes are provided in Appendix D. In the event that a new regulation was put into place that did not exist the year before, best professional judgement was used to determine whether the new regulation had a more liberal or more strict effect on that year's regulations as a whole.

Code	Change in Regulation Compared to the Year Prior
-1	More restrictive than the year prior
0	No change from the year prior
+1	Less restrictive than the year prior

Table 2.1 Coding Scheme for Changes in PWS Regulations, adapted from Auerbach and Silverstein.

I then considered combined annual changes in regulations. I summed the positive and negative changes across regulations for each year to determine an overall score for that year. Figure 2.11 shows the distribution of overall regulatory changes from 1979-2016.

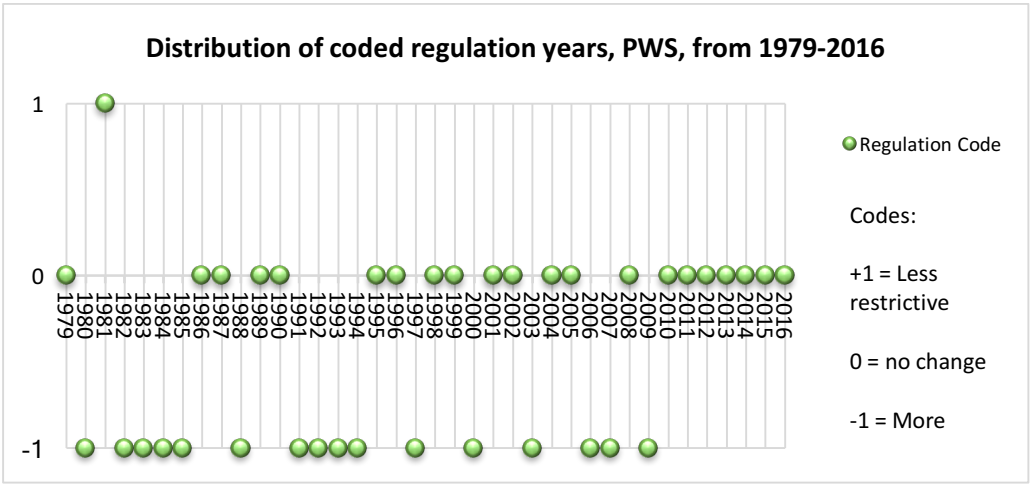

Figure 2.11 Distribution of coded combined annual changes in PWS subsistence and personal use regulations, from 1979-2016. Using a more restrictive, less restrictive, and no change coding scheme.

Independent Means T-Test

I first tested the null hypothesis that stated changes in regulation had no effect on harvest. I used the independent means t-test in SPSS to determine whether there was a statistically significant difference in salmon harvest numbers across the three types of

[60] (Auerbach and Silverstein 2003)

fisheries, between years with no regulation change and years with a more restrictive regulation change. Years with less restrictive regulation changes were not analyzed because this circumstance only occurred in one year of the study. The independent variable was change in regulation and the dependent variable was salmon harvest. I used an independent means T-test to test whether there was a statistically significant lag time between harvest and changes in regulations. For example, did it take one year for regulation changes to affect harvest patterns? Two years? I did this by shifting the harvest numbers by one year, while holding the changes in regulation constant, and then performed a T-test. Both tests used a 95% confidence interval.

Simple Linear Regression and Pearson's Correlation Coefficient

Using a simple linear regression model I tested for a correlation between salmon escapement and salmon harvest. I used the Pearson correlation coefficient because the data are collected on an annual basis.

The method of least squares was used to determine a linear model that best describes the data, as follows:

$$Y_i = (b_0 + b_1 x_i) + e_i$$

Where Y_i is the harvest amount, x_i is the *ith* year's harvest number on the predictor variable, b_1 is the gradient of the straight line fitted to the data, b_0 is the intercept of that line, and e_i represents the difference between the harvest predicted by the lines for year i and the actual harvest obtained in year i.[61] Assumptions of the model (linear relationship between the independent and dependent variable,s multivariate normality, no or little multicollinearity, no auto-correlation, and homoscedasticity present) all were met.

Multiple Linear Regression

I used multiple linear regression (MLR) to test the effects of escapement and change in regulation on harvest simultaneously, according to the following equation:

$$Y_i = (b_0 + b_1 x_1 + b_2 x_2 + \ldots + b_n x_n) + e_i$$

Assumptions of the model (predictor variables either quantitative or categorical, and outcome variable quantitative, continuous and unbound; predictor variables display non-zero variance; no perfect multicollinearity; homoscedasticity present; all values of the outcome variable independent; errors independent and normally distributed; and predictors are uncorrelated with external variables) all were met.

Using the hierarchical method, I used escapement as the first variable in the equation because the results of the T-test and SLR showed that escapement had a greater effect on harvest than regulation changes. The changes in regulation comprised the second predictor variable and were recoded using a dummy variable.

Results

On average, overall and commercial sockeye harvests were lower one year after a negative change in regulation, compared with one year after no change in regulations (Table 3.1). These were one the only significant associations detected by the

[61] (Field 2005, 145)

independent means t-test. The complete results from the independent means t-test for both the un-lagged changes in regulation and the changes in regulations lagged by one year can be found in Appendix E.

While not statistically significant, differences in the mean subsistence harvest rate for both species were larger during the year that changes in regulation were put in place. Whereas in contrast, differences in the mean personal and commercial harvest rate for of both species were larger in the year *after* regulatory changes were put in place. This suggests that regulations may have a detectable impact on subsistence harvest in the year a regulation is put into place, whereas other fisheries experience a detectable impact a year succeeding a regulation change. On average, subsistence sockeye and chinook harvest were lower in the year a negative (less restrictive) change was put into place, than in a year with no regulation change (Table 3.1).

Test Type	*Fishery*	*Species*	*Mean*	*SE*	*df*	*t*	*p (2-tailed)*
Independent Means T- test with lag time	Commercial	Sockeye	No change: 1,431,177 More Restrictive: 991,249	No change: 675,416 More restrictive: 441,300	33	2.232*	.033
Independent Means T- test with lag time	Overall (subsistence, personal, and commercial)	Sockeye	No change: 1,605,319 More Restrictive: 1,164,479	No change: 169,004 More restrictive: 103,578	33	2.124*	.041
Independent Means T- test	Subsistence	Sockeye	No change: 81,684 More Restrictive: 47,871	No change: 12,146 More restrictive: 12,598	34	1.900	.066
Independent Means T- test	Subsistence	Chinook	No change: 3,418 More Restrictive: 2,404	No change: 577 More restrictive: 684	34	1.142	.262

* Indicates t value significant at t(33)= 2.03, p<.05.

Table 3.1 The mean, standard error (SE), degrees of freedom (df), t-value, and p-value for PWS Chinook and sockeye Salmon harvests, for the year of and year after a negative regulation was put into place, from 1979-2015. Using an Independent Means t-test with a 95% CI and statistically significant p-value <.05*.

The association between harvest and escapement was significant for sockeye salmon in all fisheries (Table 3.2). No significant association between harvest and escapement was found for Chinook. The full results of the SLR, including the Chinook results, can be found in Appendix E. Figure 3.1 displays scatterplots showing the relationship between sockeye escapement and sockeye harvest for all PWS fisheries.

Sockeye Fishery	*F*	*p/sig*	*R^2*	*Pearson*	*Equation*
Subsistence	11.986	.001	.255	.505	*Harvest = -42,684.083+ .142(escapement)*
Personal Use	12.014	.002	.353	.594	*Harvest = 13,932.461 + .131(escapement)*
Commercial	63.167	.000	.643	.802	*Harvest = -70,0791.663 + 2.560(escapement)*
All	69.101	.000	.664	.815	*Harvest = 80,0836.625 + 2.881(escapement)*

Table 3.2 The F statistic, p-value, R^2, Pearson coefficient, and regression equations for PWS sockeye salmon harvest and escapement numbers, from 1979-2015. Using a Simple Linear Regression with a significant p-value < 0.02.

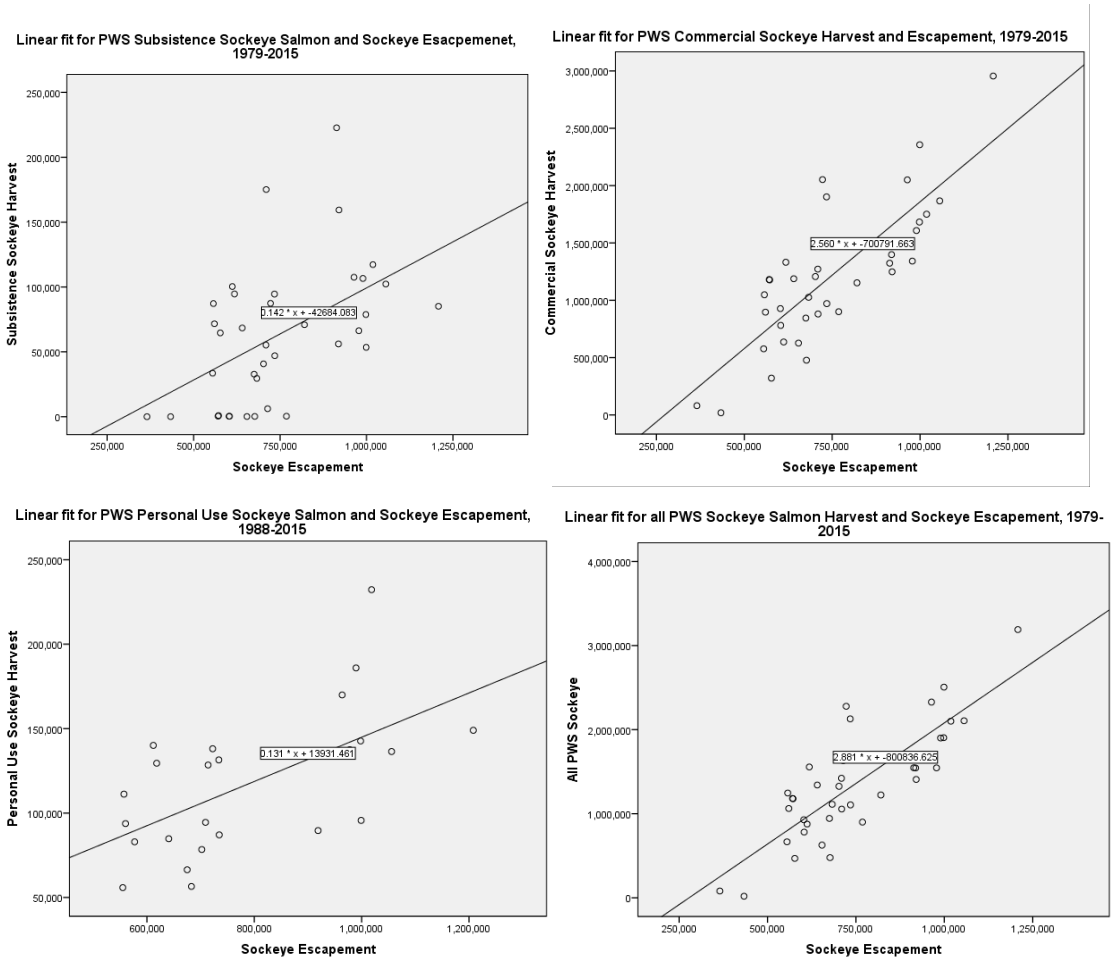

Figure 3.1 Scatterplots of subsistence, personal use, commercial, and overall PWS sockeye harvest and sockeye escapement from 1979-2015. Including the linear equation found from the SLR, with a 95% CI and p-value < 0.02.

MLR returned the same results as SLR. That is, a significant association between harvest and escapement was found for sockeye in all fisheries, but no such association was found for Chinook. A summary table of the sockeye salmon results is provided in Table 3.3. The full results of the MLR, including the hinook results, can be found in Appendix E. 3-D scatterplots showing the relationship between sockeye escapement, changes in regulations, and sockeye harvest for all PWS fisheries is shown in Figure 3.2.

Sockeye Fishery	*F*	*p/sig*	R^2	*Pearson*	*Equation*
Subsistence	6.826	.003	.286	.535	Harvest = 28118.671-19201.783(regulation change) + .133(escapement)
Personal Use	7.333	.004	.411	.641	Harvest = 28159 - 20950.630(regulation change) + .123(escapement)
Commercial	30.952	.000	.643	.803	Harvest = -742794.103 + 55372.397(regulation change) + 2.584(escapement)
All	33.574	.000	.664	.815	Harvest = -809674.506 + 11651.101(regulation change) + 2.886 (escapement)

Table 3.3 The F statistic, p-value, R^2, Pearson coefficient, and regression equations for PWS sockeye Salmon harvest, escapement numbers, and changes in regulation from 1979-2015. Using a Multiple Linear Regression with a significant p-value < 0.04.

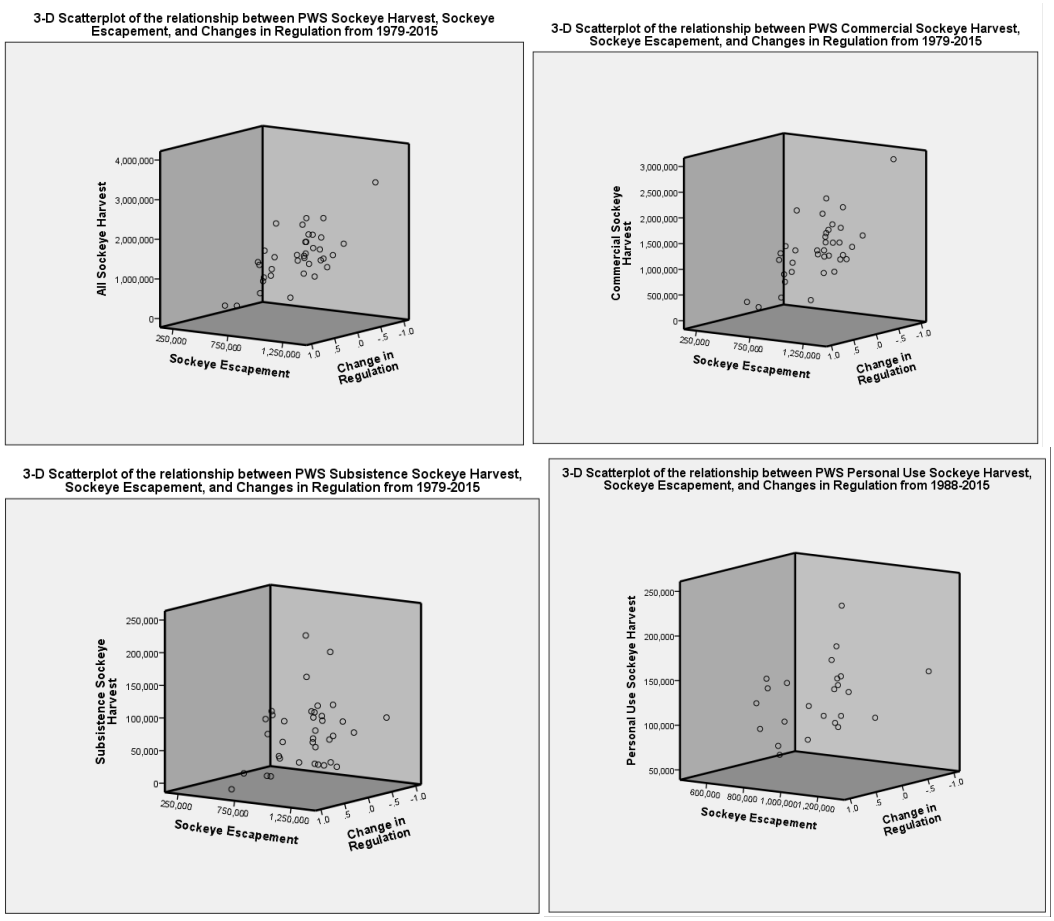

Figure 3.2 3-D Scatterplots of subsistence, personal use, commercial, and overall PWS sockeye harvest and sockeye escapement, from 1979-2015, with a 95% CI and p-value < 0.04.

I used multiple Linear Regression to determine whether both variables (escapement and changes in regulation) were a better predictor of harvest than either variable alone. Table 3.4 summarizes the difference in results between the SLR and MLR analyses. Considering the fisheries individually, the MLR did improve the ability to predict harvest by a very small amount for subsistence and personal use. However, it is important to note that there was no significant change in the ability to predict overall

sockeye harvest and an almost negligible increase in the ability to predict commercial sockeye harvest when using MLR.

ΔSockeye Fishery	*ΔF*	*Δp/sig*	*ΔR²*	*ΔPearson*	*% change in Correlation*
Subsistence	-5.16	-.002	+.031	+.030	+3%
Personal Use	-4.681	-.002	+.058	+.047	+4.7%
Commercial	-32.215	No Δ	+.002	+.001	+.1%
All	-35.527	No Δ	No Δ	No Δ	0%

Table 3.4 Reported changes from the MLR results and SLR results for the F statistic, p-value, R^2, Pearson coefficient, and regression equations for PWS sockeye salmon harvest and escapement, from 1979-2015. Determining if the addition of the third variable (changes in regulations) had a significant impact on the ability to predict PWS sockeye harvest.

Issues concerning causality must be acknowledged. First, it's probable that not all variation is captured by the two variables used, and there is likely another, unmeasured, variable influencing escapement and harvest.[62] Second, the direction of casualty is important to consider. Correlation coefficients tell us nothing about which variable causes the other to change.[63] It is possible that harvest levels might be influencing escapement, instead of escapement predicting harvest levels. Moreover, influential cases and sample size should be kept in mind when considering the results of the MLR.[64] In some cases data that could be considered outliers, were not excluded. Instead the adjusted r^2 was used to account for possible influential cases. With only 34 cases (years) in this study, I was working with a very small dataset. A small sample size can make it hard to predict the effect of the predictor variables and can decrease the generalizability of the outcomes.[65] Consequently, it is important that we interpret these results in terms of correlation and not causality and do not generalize the results outside of PWS.

Discussion

The bulk of my analysis suggests that regulations and their varying changes, overall, do not have a significant impact on harvest levels in most of the fisheries I considered. This suggests that the regulations enacted by the State of Alaska are doing what they are meant to do, that is, protecting the abundance of the species while keeping harvest levels relatively stable.[66]

Despite this finding, the results of the SLR analysis reveal a significant change in overall and commercial sockeye salmon harvests in the year following a negative change in regulations. One potential explanation of this finding is that, owing to the state's statutory commitment to prioritize subsistence harvests, commercial users were negatively affected by regulatory changes. Continued monitoring could help clarify whether commercial stakeholders are indeed receiving less harvest per capita in order to meet the subsistence priority and help determine how the remaining allocation could

[62] (Field 2005, 127)
[63] (Field 2005, 130)
[64] (Field 2005, 144)
[65] (Field 2005, 174)
[66] (Naves et al. 2015, 213)

be equitably distributed between commercial and personal use stakeholders in the future.

The SLR also provided evidence that subsistence fisheries were the only case that had a stronger relationship with regulations the year they were put into place. This poses a unique situation for subsistence harvest and users. They are the first of the user groups to feel an impact from changes in regulation. This puts them at a disadvantage compared to other user groups because they potentially have little or no time to adjust or prepare for a change in harvest amounts.[68] Although the difference in harvest means was not significant for subsistence users between years with and without a regulation change, it was very close to being so. To better understand this and establish whether or not this has a significant impact on subsistence users, more research and continuous monitoring would need to be conducted by the State of Alaska over time.

The results from the SLR confirm that the null hypothesis was rejected for sockeye salmon but not for Chinook. The difference for Chinook salmon is likely due to outside variables such as environmental change and what is commonly referred to as the "Chinook Disaster" in the surrounding areas. [69] Overall, due to the results I would suggest that escapement is a good predictor of sockeye salmon harvest for all fisheries analyzed.

Notably, a number of variables outside the scope of this project likely affect salmon stocks and stakeholders in PWS. For instance, environmental and biological variables play a substantial role in salmon reproduction and survival. Things such as water temperature and pH, competition, and suitable spawning grounds can influence how many salmon are able to spawn, survive, and return to PWS.[70] These factors could explain some of the variance that is unexplained by the regulations and escapement.[71] Social variables such as economic changes, cultural shifts, and technology advances could also influence harvest numbers.[72] These variables were outside the scope of this analysis.

Policy Implications

With regard to subsistence and personal use regulations in PWS, it appears that overall the State of Alaska is meeting its primary objectives. This is supported by the fact that changes in regulations are for the most part not having a significant effect on harvest. However, this result is non-informative regarding the impact of timing of regulatory changes on subsistence stakeholders. If indeed subsistence users are impacted by negative regulatory changes more heavily or earlier than other stakeholders, the State would not be meeting its statutory subsistence priority and would need to reevaluate current management strategies.[73]

Evaluation of the impacts of regulatory changes could be improved by extending data collection, for example by collecting data for 2-3 years following a regulatory

[68] (Novak Colwell et al. 2017; Simeone and McCall-Valentine 2007)
[69] (Wood et al. 2017; Wolfe 2004)
[70] Chaloner et al., "Variation in Responses to Spawning Pacific Salmon among Three Southeastern Alaska Streams."
[71] (Shanley and Albert 2014)
[72] (Forbes 1984; Frink 2009; Lonner 1980)
[73] (*Alaska Statute: Subsistence Use and Allocation*, n.d.)

change. Such an extension would allow identification of time lags in response that could exist. The results of my analysis also indicated that under conditions of a shrinking resource base and growing number of users, there could be uneven harvest distribution, in which stakeholders are differentially impacted by the loss in harvestable fish per capita.[74] Understanding differential impacts among users is important for ensuring that the subsistence priority is met, while equitably distributing the remaining abundance of harvest.

Finally, it is clear from my results that regulations and escapement are both important to the management of PWS salmon stocks. It is necessary to point out that the current fisheries management methods, while successful, are purely reactive. The State is maintaining stock and harvest numbers, but is not actively increasing either. This is an area where there is room for management improvement, recognizing that funding for new science to meet this need may not be immediately available. The available evidence suggests that PWS sockeye and chinook fisheries are being managed in a way that is consistent with the State's resources and management goals.

Acknowledgements

The Alaska Department of Fish and Game, Division of Subsistence provided funding for this project in the form of a graduate student internship. This work benefited greatly from the guidance of Dave Koster and Jim Fall. Data was gathered from ADF&G databases and historical records.

[74] (Wood et al. 2017; Simeone 2005)

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Appendix A: PWS Subsistence Finfish Regulations, 2017-2018

(ii) gillnets may be used in fresh and salt water;

(iii) repealed 5/14/93;

(iv) no gillnet fished in salt water may exceed 50 feet in length and two inches in mesh size;

(v) no gillnet fished in fresh water may exceed 20 feet in length and two inches in mesh size; and

(vi) repealed 6/7/95;

(D) repealed 5/6/94;

(E) only outside the boundary of the nonsubsistence area described in 5 AAC 99.015(a)(3);

(3) each gillnet must be attended by the fisherman at all times when it is being used to take fish.

Article 12. Prince William Sound Area.

5 AAC 01.600. Description of Prince William Sound Area. The Prince William Sound Area includes all waters of Alaska between the longitude of Cape Fairfield and the longitude of Cape Suckling south of the Yukon Area described in 5 AAC 05.100, and all waters of the Upper Susitna River drainage upstream of the Susitna River's confluence with the Oshetna River.

5 AAC 01.605. Description of districts and subdistricts. (a) The Upper Copper River District consists of all waters of the mainstem Copper River from the mouth of the Slana River downstream to an east-west line crossing the Copper River approximately 200 yards upstream of Haley Creek as designated by ADF&G regulatory markers.

(1) **The Chitina Subdistrict** consists of all waters of the Upper Copper River District downstream of the downstream edge of the Chitina-McCarthy Road Bridge.

(2) **The Glennallen Subdistrict** consists of all remaining waters of the Upper Copper River District.

(b) Except as specified in (a) of this section, districts are as described in 5 AAC 24.200.

5 AAC 01.610. Fishing seasons. (a) Except in the nonsubsistence area described in 5 AAC 99.015(a)(5) and unless restricted in this section and 5 AAC 01.625, or unless restricted under the terms of a subsistence fishing permit, fish, other than rainbow trout and steelhead trout, may be taken at any time in the Prince William Sound Area.

(b) Salmon may be taken in the Upper Copper River District only as follows:

(1) in the Glennallen Subdistrict, from June 1 through September 30;

(2) repealed 6/12/2003;

(3) when the Copper River subsistence fishery is closed or restricted because of an inadequate escapement of sockeye or king salmon, the fishery may be reopened September 1 for the taking of coho salmon, which constitute the majority of the salmon at that time.

(c) Repealed 6/30/83.

(d) Herring spawn on kelp may be taken for subsistence purposes as follows:

(1) above water from March 15 through June 15;

(2) underwater using dive gear only during open periods for the wild herring

spawn-on-kelp commercial fishery.

(e) Rainbow trout and steelhead trout taken incidentally by fish wheel or subsistence finfish net gear, except dip net gear, are lawfully taken and may be retained for subsistence purposes. Rainbow trout and steelhead trout taken by dip net gear must be released immediately and returned to the water unharmed.

(f) Lingcod may be taken for subsistence purposes only from July 1 through December 31.

(g) Salmon may be taken in the districts described in 5 AAC 01.605(b), only from May 15 through October 31, during fishing periods as follows:

(1) from May 15 until two days before the commercial opening of that salmon district, seven days per week;

(2) during the commercial salmon season, only during open commercial salmon fishing periods in that district;

(3) from two days following the closure of the commercial salmon fishing season in that district through October 31, seven days a week.

5 AAC 01.616. Customary and traditional subsistence uses of fish stocks and amounts necessary for subsistence uses. (a) The Alaska Board of Fisheries finds that salmon stocks are customarily and traditionally taken or used for subsistence in the following locations:

(1) the Glennallen Subdistrict of the Upper Copper River District described in 5 AAC 01.605(2) and the waters of the Copper River described in 5 AAC 01.647(i)(3);

(2) the Southwestern District described in 5 AAC 24.200(i) and the waters along the northwestern shore of Green Island from the westernmost tip of the island to the northernmost tip of the island;

(3) the waters north of a line from Porcupine Point to Granite Point and south of a line from Point Lowe to Tongue Point;

(4) the Copper River District described in 5 AAC 24.200(a);

(5) repealed 6/12/2003;

(6) the Coghill, Northwestern, Eshamy, Unakwik, Southeastern, and Bering River Districts and those portions of the Northern, Montague, and Eastern Districts not included in (2) and (3) of this subsection, excluding those portions within the Valdez Nonsubsistence Area as described in 5 AAC 99.015(a)(5).

(b) The board finds that the following amounts of salmon are reasonably necessary for subsistence uses in the following locations:

(1) Glennallen Subdistrict of the Upper Copper River District:

(A) in that portion from the southern boundary of the subdistrict at the downstream edge of the Chitina-McCarthy Road Bridge to the mouth of the Tonsina River: 25,500 – 39,000 salmon;

(B) in that portion from the mouth of the Tonsina River upstream to the mouth of the Gakona River: 23,500 – 31,000 salmon;

(C) in that portion from the mouth of the Gakona River upstream to the mouth of the Slana River, and the waters of the Copper River as described in 5 AAC 01.647(i)(3): 12,000 – 12,500 salmon;

(2) in the Copper River District as described in 5 AAC 24.200(a):

(A) in a year when there is a harvestable surplus that allows for a commercial fishery: 3,000 – 5,000 salmon;

(B) in a year when there is no commercial fishery: 19,000 – 32,000 salmon;

(3) the Southwestern District as described in 5 AAC 24.200(i) and the waters along the northwestern shore of Green Island from the westernmost tip of the island to the northernmost tip of the island: 2,100 – 3,500 salmon;

(4) the waters north of a line from Porcupine Point to Granite Point and south of a line from Point Lowe to Tongue Point: 1,800 – 3,000 salmon.

(5) the waters described in (a)(6) of this section: 115 – 200 salmon.

(c) The board finds that groundfish, herring, herring spawn on kelp, and smelt in those portions of the Prince William Sound Area that are outside the boundaries of the nonsubsistence area described in 5 AAC 99.015(a)(5) are customarily and traditionally taken or used for subsistence.

(d) The board finds that the following amounts of fish, other than salmon, are reasonably necessary for subsistence uses in the Prince William Sound Area:

(1) 1,000 – 1,500 lingcod;

(2) 7,500 – 12,500 rockfish;

(3) 16,000 – 24,000 pounds of groundfish, other than rockfish and lingcod;

(4) 12,000 – 18,000 pounds of herring;

(5) 4,000 – 6,000 pounds of herring spawn on kelp.

(e) The board finds that freshwater finfish, other than salmon, in the Prince William Sound Area are customarily and traditionally taken or used for subsistence.

(f) The board finds that 25,000 – 42,000 usable pounds of freshwater finfish, other than salmon, are reasonably necessary for subsistence uses in the Prince William Sound Area.

5 AAC 01.620. Lawful gear and gear specifications. (a) Fish may be taken by gear listed in 5 AAC 01.010(a) unless restricted in this section or under the terms of a subsistence fishing permit.

(b) Salmon may be taken only by the following types of gear:

(1) in the Glennallen Subdistrict by fish wheels or dip nets;

(2) repealed 4/30/91;

(3) in salt water by a gillnet or seine, in a district as specified in 5 AAC 24.330, and as follows:

(A) by a gillnet as described in 5 AAC 01.010(c);

(B) by a seine that is not longer than 50 fathoms in length and 100 meshes in depth with a maximum mesh size of four inches;

(4) repealed 6/12/2003.

(c) Fish wheels used for subsistence fishing may be operated only as follows:

(1) the owner of a fish wheel shall register that fish wheel with the department; the department shall issue a registration number for the fish wheel; that registration number, and

either the owner's name and address or the owner's permanent identification number from a valid Alaska driver's license or a state identification card, must be permanently affixed and plainly visible on the fish wheel on a wood, metal, or plastic plate that is at least 12 inches high by 12 inches wide, in letters and numerals at least one inch high, when the fish wheel is in the water; only the registration number from the current year may be affixed to the fish wheel; any other registration number must be removed from the fish wheel;

(2) the owner of a fish wheel registered under (1) of this subsection is responsible for the fish wheel when the fish wheel is in the water;

(3) when the permit holder is a person other than the owner of the fish wheel, in addition to the requirements of (1) of this subsection, an additional plate of wood, metal, or plastic, that is at least 12 inches high by 12 inches wide bearing the permit holder's name and address in letters and numerals at least one inch high must be attached to each fish wheel so that the name and address are plainly visible;

(4) a permit holder may operate only one fish wheel at a time and a fish wheel may be operated only by one permit holder at a time; that permit holder must

(A) have the fish wheel marked as specified in this subsection during fishing operations; and

(B) check the fish wheel at least once every 10 hours and remove all fish caught by the fish wheel;

(5) a person may not set or operate a fish wheel within 75 feet of another fish wheel;

(6) a fish wheel

(A) may not have more than two baskets;

(B) must be removed from the water at the end of the permit period; and

(C) may not be rented, leased, or otherwise used for personal gain.

(d) Halibut may be taken only by a single hand-held line with not more than two hooks attached to it.

(e) The permit holder must personally operate the fish wheel or dip net. A subsistence fish wheel or dip net permit may not be loaned or transferred except as permitted under 5 AAC 01.011.

(f) Herring spawn on kelp may be taken only by a hand-held unpowered blade-cutting device. Kelp plant blades must be cut at least four inches above the stipe (stem). The provisions of this subsection do not apply to Fucus species.

(g) Repealed 5/24/97.

(h) Groundfish may be taken only by a single hand troll, single hand-held line, or a single longline, none of which may have more than five hooks attached to it, except that

(1) lingcod taken incidentally during a subsistence finfish fishery are lawfully taken and may be retained for subsistence purposes subject to the limitations described in 5 AAC 01.610(f) and 5 AAC 01.645(d);

(2) rockfish taken incidentally during a subsistence finfish fishery are lawfully taken and may be retained for subsistence purposes subject to the limitations described in 5 AAC 01.645(e); and

(3) groundfish taken incidentally in a subsistence net fishery, consistent with applicable subsistence salmon laws and regulations, are lawfully taken and may be retained for subsistence purposes.

(i) Repealed 3/14/2009.

(j) In addition to the requirements under 5 AAC 01.010(h), a buoy attached to one end of a subsistence gillnet must be marked in printed type with the first initial, last name, and address of the subsistence permit holder, or the ADF&G vessel license number of the vessel used to operate the gear, in numbers and letters that are

(1) at least one inch high;

(2) in a color that contrasts with the background; and

(3) plainly visible when the gear is in the water.

5 AAC 01.625. Waters closed to subsistence fishing. (a) All tributaries of the Copper River and waters of the Copper River that are not in the Upper Copper River District are closed to the taking of salmon.

(b) Salmon may not be taken in any area closed to commercial salmon fishing unless permitted in 5 AAC 01.610 – 5 AAC 01.645.

(c) The following waters are closed to the taking of whitefish with gillnet gear:

(1) Lake Louise, north of a line from 62° 21.24′ N. lat., 146° 38.14′ W. long. to 62° 21.43′ N. lat., 146° 37.56′ W. long.;

(2) Susitna Lake, east of a line from 62° 21.38′ N. lat., 146° 38.31′ W. long. to 62° 21.72′ N. lat., 146° 38.24′ W. long. and east of a line from 62° 28.58′ N. lat., 146° 40.57′ W. long. to 62° 28.36′ N. lat., 146° 40.52′ W. long.;

(3) Tyone Lake, south and west of a line from 62° 28.86′ N. lat., 146° 39.95′ W. long. to 62° 28.79′ N. lat., 146° 39.66′ W. long.

5 AAC 01.630. Subsistence fishing permits. (a) Except as provided in this section, fish other than salmon and freshwater fish species may be taken for subsistence purposes without a subsistence fishing permit.

(b) Salmon and freshwater fish species may be taken only under authority of a subsistence fishing permit.

(c) Repealed 6/2/88.

(d) Only one subsistence fishing permit will be issued to each household per year.

(e) The following apply to Glennallen Subdistrict subsistence salmon fishing permits:

(1) only one type of gear may be specified on a permit;

(2) only one Glennallen Subdistrict subsistence salmon fishing permit per calendar year may be issued to a household;

(3) permits must be returned to the department no later than October 31, or a permit for the following year may be denied as provided in 5 AAC 01.015(c);

(4) repealed 6/12/2003;

(5) repealed 6/12/2003;

(6) repealed 3/14/2009;

(7) only the permit holder and the authorized member of the household listed on the subsistence permit may take salmon;

(8) a subsistence permit holder shall record all harvested fish on the permit, in ink, before concealing the fish from plain view or transporting the fish from the fishing site; for the purposes of this paragraph, "fishing site" means the location where the fish is removed from the water and becomes part of the permit holder's bag limit;

(9) repealed 3/14/2009.

(f) Repealed 6/12/2003.

(g) Repealed 3/30/2000.

(h) A subsistence fishing permit may be issued to a village council, or other similarly qualified organization whose members operate fish wheels for subsistence purposes in the Glennallen Subdistrict, to operate fish wheels on behalf of members of its village or organization. A permit may only be issued following approval by the department of a harvest assessment plan to be administered by the permitted council or organization. The harvest assessment plan must include

(1) provisions for recording daily catches for each fish wheel;

(2) sample data collection forms;

(3) other information specified by the department;

(4) location and number of fish wheels;

(5) the full legal name of the individual responsible for the lawful operation of each fish wheel; and

(6) other information determined by the department to be necessary for effective resource management.

(i) Unless otherwise provided in this section, regulations governing fishing under the authority of a village council permit issued under (h) of this section, or other permit issued under this section, are those generally applicable to Glennallen Subdistrict subsistence fishing permits.

(j) The following additional provisions apply to the Glennallen Subdistrict subsistence fishing permits issued under (h) of this section:

(1) the permit will list all households and household members for whom the fish wheel is being operated;

(2) the allowable harvest may not exceed the combined seasonal limits as listed in (e) of this section, for the households listed on the permit; the permittee will notify the department when households are added to the list, and the seasonal limit may be adjusted accordingly;

(3) members of households listed on a permit issued to a village council or other similarly qualified organization, are not eligible for a separate household subsistence fishing permit for the Upper Copper River District;

(4) under authority delegated through a permit issued to a village council or other similarly qualified organization, an individual or individuals designated by the permitted group may issue household subsistence fishing permits to households not listed as participants in fishing fish wheels operated directly by a village council or other similarly qualified

organization; the permittee may also register fish wheels; the harvest assessment plan may authorize the permittee to collect, compile, and report to the department the subsistence harvests of these household permit holders;

(5) authority to enforce all applicable laws and regulations may not be delegated through permits issued under (h) of this section.

5 AAC 01.640. Marking of subsistence-taken fish. (a) A person may not possess salmon taken under the authority of an Upper Copper River District subsistence permit unless both tips (lobes) of the tail fin (caudal) have been removed from the salmon before the person conceals the salmon from plain view or transports the salmon from the fishing site.

(b) A person may not possess rainbow trout or steelhead trout retained under 5 AAC 01.610(e) unless both tips (lobes) of the tail fin (caudal) have been removed from the fish before the person conceals the fish from plain view or transports the fish from the fishing site.

(c) A person may not possess salmon taken under the authority of a Prince William Sound Area subsistence permit unless both the top and bottom lobes of the tail fin (caudal) have been completely removed from the salmon before the person conceals the salmon from plain view or transports the salmon from the fishing site.

(d) For the purposes of this section, "fishing site" means the location where the fish is removed from the water and becomes part of the permit holder's bag limit or is retained.

5 AAC 01.645. Subsistence bag, possession, and size limits. (a) The total annual possession limit for a Glennallen Subdistrict subsistence salmon fishing permit is as follows:

(1) for a household with one person: 30 salmon, of which no more than five may be king salmon if taken by dip net;

(2) for a household with two persons: 60 salmon, of which no more than five may be king salmon if taken by dip net;

(3) 10 salmon for each additional person in a household over those specified in (2) of this subsection, except that the household's limit under (2) of this subsection for king salmon taken by dip net does not increase;

(4) upon request, a permit for additional salmon will be issued with the following limits:

(A) no more than a total of 200 salmon for a permit issued to a household with one person, of which no more than five may be king salmon if taken by dip net;

(B) no more than a total of 500 salmon for a permit issued to a household with two or more persons, of which no more than five may be king salmon if taken by dip net.

(b) In the Copper River District and other locations open to commercial salmon fishing, the annual subsistence salmon limit is as follows:

(1) 15 salmon for a household of one person;

(2) 30 salmon for a household of two persons;

(3) 10 salmon for each additional person in a household over those specified in (2) of this subsection;

(4) no more than five king salmon may be taken per permit.

(c) The daily bag limit for halibut is two fish and the possession limit is four fish. A person may not take or possess halibut under sport fishing regulations and under this section on the same day.

(d) The daily bag limit for lingcod is two fish and the possession limit is four fish. A person may not take or possess lingcod under sport fishing regulations and under this section on the same day. Lingcod retained must measure at least 35 inches from the tip of the snout to the tip of the tail. Undersized lingcod shall be returned to the water immediately without further harm.

(e) The daily bag limit for rockfish is as follows:

(1) from May 1 through September 15, the daily bag limit is four fish and the possession limit is eight fish, of which only two per day and two in possession may be nonpelagic rockfish; a person may not take or possess rockfish under sport fishing regulations and under this section on the same day;

(2) from September 16 through April 30, the daily bag and possession limit is eight fish, of which only two per day and two in possession may be nonpelagic rockfish; a person may not take or possess rockfish under sport fishing regulations and under this section on the same day.

(f) The daily bag limit for sharks is one fish and the possession limit is two fish. A person may not take or possess sharks under sport fishing regulations and under this section on the same day.

(g) The bag, possession, and annual limits for whitefish are 1,000 fish.

(h) The bag and possession limit for Arctic grayling is five fish, with an annual limit of 20 fish per water body, excluding stocked lakes. A person may not take or possess Arctic grayling under sport fishing regulations and this section on the same day.

(i) The bag and possession limit for lake trout is two fish, with an annual limit of 10 fish per water body. A person may not take or possess lake trout under sport fishing regulations and this section on the same day.

(j) The bag and possession limit for burbot is five fish, except in those waters specified in 5 AAC 52.023, where the bag and possession limit is two fish. The annual limit for burbot is 10 fish per water body. A person may not take or possess burbot under sport fishing regulations and this section on the same day.

(k) The bag and possession limit for rainbow/steelhead trout is two fish, of which only one may be 20 inches or greater in length, with an annual limit of 10 fish per water body. A person may not take or possess rainbow/steelhead trout under sport fishing regulations and this section on the same day.

5 AAC 01.647. Copper River Subsistence Salmon Fisheries Management Plans. (a) The purpose of this plan is to ensure that adequate escapement of salmon in the Copper River system occurs and that subsistence uses, as described under AS 16.05.258 and 5 AAC 99.010, are accommodated.

(b) The following are directives pertaining to the management of Copper River System salmon:

(1) this policy governs only those salmon which pass the department sonar counters located at the Million Dollar Bridge;

(2) the department shall manage the Copper River commercial salmon fishery to attain a total escapement of salmon into the Copper River as specified in 5 AAC 24.360 to ensure that an adequate escapement reaches the spawning grounds and to provide for hatchery brood stock and for subsistence, personal use, and sport fisheries.

(c) – (h) Repealed 4/28/84.

(i) Salmon, other than king salmon, may be taken in the vicinity of the former Native village of Batzulnetas under the following conditions:

(1) unless modified by this subsection, 5 AAC 01.001 – 5 AAC 01.040 and 5 AAC 01.600 – 5 AAC 01.645 apply to this fishery;

(2) salmon may be taken only under the authority of a Batzulnetas subsistence salmon fishing permit issued by the department;

(3) salmon may be taken only in those waters of the Copper River between ADF&G regulatory markers located near the mouth of Tanada Creek and approximately one-half mile downstream from that mouth and in Tanada Creek between ADF&G regulatory markers identifying the open waters of the creek;

(4) fish wheels and dip nets only may be used on the Copper River; dip nets and spears only may be used in Tanada Creek;

(5) salmon may be taken only from June 1 through September 1 or until the season is closed by emergency order; fishing periods are to be established by emergency order and are two days per week during the month of June and 3.5 days per week for the remainder of the season;

(6) king salmon taken must be released to the water unharmed; fish wheels must be equipped with a livebox or be monitored at all times;

(7) annual bag and possession limits are as specified in 5 AAC 01.645(a);

(8) the permit must be returned to the department's Glennallen office no later than September 30 of each year.

(j) Repealed 3/14/2009.

(k) Repealed 6/12/2003.

5 AAC 01.648. Prince William Sound Subsistence Salmon Fisheries Management Plans. (a) Salmon may be taken for subsistence purposes in those waters of the Southwestern District, as described in 5 AAC 24.200, and along the northwestern shore of Green Island from the westernmost tip of the island to the northernmost tip, only as follows:

(1) repealed 6/27/93;

(2) salmon may be taken only by seines up to 50 fathoms in length and 100 meshes deep with a maximum mesh size of four inches, or by gillnets up to 150 fathoms in length, except that pink salmon may be taken in fresh water by dip nets only;

(3) repealed 3/14/2009;

(4) repealed 3/14/2009;

(5) no fishing is allowed within the closed waters areas described in 5 AAC 24.350 and 5 AAC 39.290 for commercial salmon fisheries; only pink salmon may be taken in fresh water;

(6) there are no bag and possession limits for this fishery;

(7) repealed 3/14/2009.

(b) Salmon may be taken for subsistence purposes in those waters north of a line from Porcupine Point to Granite Point, and south of a line from Point Lowe to Tongue Point, only as follows:

(1) repealed 6/27/93;

(2) salmon may be taken only by seines up to 50 fathoms in length and 100 meshes deep with a maximum mesh size of four inches, or by gillnets up to 150 fathoms in length with a maximum mesh size of six and one-quarter inches, except that pink salmon may be taken in fresh water by dip nets only;

(3) repealed 3/14/2009;

(4) repealed 3/14/2009;

(5) no fishing is allowed within the closed waters areas described in 5 AAC 24.350 and 5 AAC 39.290 for commercial salmon fisheries; only pink salmon may be taken in fresh water;

(6) there are no bag and possession limits for this fishery;

(7) repealed 3/14/2009.

Article 13. Yakutat Area.

5 AAC 01.650. Description of Yakutat Area. The Yakutat Area includes all waters of Alaska between the longitude of Cape Suckling and the longitude of Cape Fairweather.

5 AAC 01.660. Fishing seasons and periods. (a) Unless restricted in this section or 5 AAC 30.365, or unless restricted under the terms of a subsistence fishing permit, fish may be taken at any time in the Yakutat Area.

(b) From the beginning of the commercial salmon net season through the end of the commercial salmon net season the weekly subsistence fishing period is from 6:00 a.m. Friday to 6:00 p.m. Saturday, unless extended by emergency order. This subsection applies to each river and bay fishery individually.

(c) Repealed 6/30/83.

(d) Repealed 5/31/2009.

5 AAC 01.666. Customary and traditional subsistence uses of fish stocks and amounts necessary for subsistence uses. (a) The Alaska Board of Fisheries finds that the following fish stocks are customarily and traditionally taken or used for subsistence:

(1) herring and herring spawn in waters of Yakutat Bay, including Russell Fjord, within a line from the westernmost point of Point Manby to the southernmost point of Ocean Cape;

(2) bottomfish and halibut in waters of Yakutat Bay, including Russell Fjord, and in waters of Alaska from Point Manby, at 59° 41.66′ N. lat., 140° 19.57′ W. long., to 59° 39.17′ N. lat., 140° 26.75′ W. long. to Ocean Cape, at 59° 31.62′ N. lat., 139° 49.87′ W. long., to 59° 29.69′ N. lat., 139° 55.18′ W. long.;

(3) salmon in fresh water upstream from the terminus of streams and rivers of the Yakutat Area from the Doame River to the Tsiu River, in waters of Yakutat Bay and Russell

Appendix B: PWS Personal Use Finfish Regulations, 2017-2018

(4) west of a line from an ADF&G regulatory marker at "Green Timbers" at 59° 37.67′ N. lat., 151° 28.38′ W. long. on the Homer Spit to an ADF&G regulatory marker located approximately 300 yards east of the Homer airport access road at 59° 38.35′ N. lat., 151° 28.71′ W. long.

(c) Salmon may be taken only with a set gillnet. No set gillnet may exceed 35 fathoms in length, six inches in mesh size, and 45 meshes in depth. No part of a set gillnet may be operated within 600 feet of another set gillnet. No person may operate more than one set gillnet. No part of a set gillnet may be set or operated more than 500 feet from the mean high water mark. No set gillnet may be set seaward of another set gillnet.

(d) Salmon may be taken only under authority of a permit issued through the department's Homer office.

(e) The annual limit is set by 5 AAC 77.525(c).

Article 12. Prince William Sound Area.

5 AAC 77.550. Description of the Prince William Sound Area. The Prince William Sound Area includes all waters of Alaska between the longitude of Cape Fairfield and the longitude of Cape Suckling.

5 AAC 77.553. Personal use shrimp fishery. Repealed 2016.

5 AAC 77.556. Personal use Dungeness crab fishery. Repealed 2016.

5 AAC 77.557. Personal use king crab fishery. Repealed 2016.

5 AAC 77.558. Personal use Tanner crab fishery. Repealed 2016.

5 AAC 77.559. Personal use clam fishery. Repealed 2016.

5 AAC 77.570. Waters closed to personal use fishing. The waters of the Prince William Sound Area are closed to the personal use taking of finfish, except that salmon may be taken in the Chitina Subdistrict, as described in 5 AAC 77.591.

5 AAC 77.591. Copper River Personal Use Dip Net Salmon Fishery Management Plan. (a) Salmon may be taken in the Chitina Subdistrict only under the authority of a Chitina Subdistrict personal use salmon fishing permit. Only one Chitina Subdistrict personal use salmon fishing permit may be issued to a household per calendar year. A household may not be issued both a Copper River subsistence salmon fishing permit and a Chitina Subdistrict personal use salmon fishing permit.

(b) Salmon may be taken from June 7 through September 30. The commissioner shall establish a preseason schedule, including fishing times, for the period June 7 through August 31 based on daily projected sonar counts at the sonar counter located near Miles Lake. This abundance-based preseason schedule will distribute the harvest throughout the season. The commissioner may close, by an emergency order effective June 7, the Chitina Subdistrict personal use salmon fishing season and shall reopen the season, by emergency order, on or before June 15 depending on the run strength and timing of the sockeye salmon run. Adjustments shall be made to the preseason schedule based on actual sonar counts compared to projected counts. If the actual sonar count at Miles Lake is more than the projected sonar count, the commissioner shall close, by emergency order, the season and immediately reopen it during which additional fishing times will be allowed. If the actual sonar count at Miles Lake is less than projected sonar count, the commissioner shall close, by emergency order, the season and immediately reopen it during which fishing times will

be reduced by a corresponding amount of time.

(c) Salmon may be taken only with dip nets.

(d) A personal use salmon fishing permit holder shall record all harvested salmon on the permit, in ink, before concealing the salmon from plain view or transporting the salmon from the fishing site. Permits must be returned to the department and the conditions specified in 5 AAC 77.015(c) must be met. For the purposes of this subsection, "fishing site" means the location where the salmon is removed from the water and becomes part of the permit holder's bag limit.

(e) The total annual limit for each personal use salmon fishing permit is 25 salmon for the head of household and 10 salmon for each dependent of the permit holder, except that only one king salmon may be retained per household.

(f) The maximum harvest level for the Chitina Subdistrict personal use salmon fishery is 100,000 – 150,000 salmon, not including any salmon in excess of the inriver goal or salmon taken after August 31. If the Copper River District commercial salmon fishery is closed for 13 or more consecutive days, the maximum harvest level in the Chitina Subdistrict is reduced to 50,000 salmon.

(g) Rainbow or steelhead trout incidentally taken may not be retained and must be released immediately and returned to the water unharmed.

(h) For the purposes of this section, the Chitina Subdistrict consists of all waters of the mainstem Copper River from the downstream edge of the Chitina-McCarthy Road Bridge downstream to an east-west line crossing the Copper River as designated by ADF&G regulatory markers located approximately 200 yards upstream of Haley Creek.

Article 13. Yakutat Area.

5 AAC 77.600. Description of Yakutat Area. The Yakutat Area includes all waters of Alaska between the longitude of Cape Suckling (144° W. long.) and a line projected southwest from the westernmost tip of Cape Fairweather.

5 AAC 77.605. Fishing districts. Districts are described in 5 AAC 30.200.

5 AAC 77.610. Personal use shrimp fishery. In the personal use shrimp fishery,

(1) there is no closed season;

(2) there is no daily possession limit; and

(3) a pot used to take shrimp under this chapter must have

(A) no more than four tunnel eye openings; no tunnel eye opening may exceed 15 inches in perimeter;

(B) a bottom perimeter of no more than 153 inches; and

(C) a volume of no more than 25 cubic feet.

5 AAC 77.612. Personal use Dungeness crab fishery. In the personal use taking of Dungeness crab,

(1) there is no closed season;

(2) the daily bag and possession limit is 20 male crab;

(3) the minimum legal size for male Dungeness crab is six and one-half inches in shoulder width; male Dungeness crab less than the minimum legal size and female Dunge-

Appendix C: PWS Federal Subsistence Regulations, 2015-2017

Prince William Sound Area Subsistence Fishing

The Prince William Sound Area includes all waters of Alaska between the longitude of Cape Fairfield and the longitude of Cape Suckling. These regulations apply on inland waters within or adjacent to the Chugach National Forest, and Wrangell-St. Elias National Park and Preserve, and exclude marine waters. General domain lands managed by the Bureau of Land Management are open to fishing only on non-navigable waters and the Gulkana River portions designated as a wild and scenic river.

Upper Copper River District consists of all waters of the mainstem Copper River, from the mouth of the Slana River downstream to an east-west line crossing the Copper River approximately 200 yards upstream of Haley Creek, as designated by ADF&G regulatory markers.

The Chitina Subdistrict consists of all waters of the Upper Copper River District downstream of the downstream edge of the Chitina-McCarthy Road Bridge.

The Glennallen Subdistrict consists of all remaining waters of the Upper Copper River District.

[See Map 12 on previous page.]

Customary and Traditional Use Determinations

Area	Species	Determination
Southwestern District and Green Island.	Salmon	• *Residents of the Southwestern District, which is mainland waters from the outer point on the north shore of Granite Bay to Cape Fairfield, and Knight Island, Chenega Island, Bainbridge Island, Evans Island, Elrington Island, Latouche Island, and adjacent islands.*
North of a line from Porcupine Point to Granite Point, and south of a line from Point Lowe to Tongue Point.	Salmon	• *Residents of the villages of Tatitlek and Ellamar.*
Chitina Subdistrict of the Upper Copper River District.	Salmon	• *Residents of Cantwell, Chickaloon, Chisana, Chistochina, Chitina, Copper Center, Dot Lake, Gakona, Gakona Junction, Glennallen, Gulkana, Healy Lake, Kenny Lake, Lower Tonsina, McCarthy, Mentasta Lake, Nabesna, Northway, Paxson-Sourdough, Slana, Tanacross, Tazlina, Tetlin, Tok, Tonsina, and those individuals living along the Tok Cutoff from Tok to Mentasta Pass, and along the Nabesna Road.*
Glennallen Subdistrict of the Upper Copper River District.	Salmon	• *Residents of the Prince William Sound Area and residents of Cantwell, Chickaloon, Chisana, Dot Lake, Healy Lake, Northway, Tanacross, Tetlin, Tok, and those individuals living along the Alaska Highway from the U.S./Canada border to Dot Lake, along the Tok Cutoff from Tok to Mentasta Pass, and along the Nabesna Road.*
Batzulnetas Area: Waters of the Copper River and Tanada Creek between National Park Service regulatory markers.	Salmon	• *Residents of Dot Lake and Mentasta Lake.*
Remainder of the Prince William Sound Area.	Salmon	• *Residents of the Prince William Sound Area.*

continued on next page

Customary and Traditional Use Determinations		
Area	**Species**	**Determination**
Federal public waters of the Copper River drainage upstream from Haley Creek.	Freshwater fish	• *Residents of Cantwell, Chisana, Chistochina, Chitina, Copper Center, Dot Lake, Gakona, Gakona Junction, Glennallen, Gulkana, Healy Lake, Kenny Lake, Lower Tonsina, McCarthy, Mentasta Lake, Nabesna, Northway, Slana, Tanacross, Tazlina, Tetlin, Tok, Tonsina, and those individuals living along the Tok Cutoff from Tok to Mentasta Pass, and along the Nabesna Road.*
Waters of the Prince William Sound Area, except for the Copper River drainage upstream of Haley Creek.	Freshwater fish, including Trout, Char, Whitefish, Grayling, Suckers, and Burbot.	• *Residents of the Prince William Sound Area, except those living in the Copper River drainage upstream of Haley Creek.*
Gulkana National Wild and Scenic River.	Freshwater fish	• *Residents of Cantwell, Chisana, Chistochina, Chitina, Copper Center, Dot Lake, Gakona, Gakona Junction, Glennallen, Gulkana, Healy Lake, Kenny Lake, Lower Tonsina, McCarthy, Mentasta Lake, Nabesna, Northway, Paxson-Sourdough, Slana, Tanacross, Tazlina, Tetlin, Tok, Tonsina, and those individuals living along the Tok Cutoff from Tok to Mentasta Pass, and along the Nabesna Road.*
Waters of the Bering River area from Point Martin to Cape Suckling.	Eulachon	• *Residents of Cordova.*
Waters of the Copper River Delta from the Eyak River to Point Martin.	Eulachon	• *Residents of Cordova, Chenega Bay, and Tatitlek.*

Special Provisions

- If you take Rainbow Trout/steelhead incidentally in other subsistence net fisheries, you may retain them for subsistence purposes, unless restricted in this section.
- In the Copper River drainage, you may take salmon only in the waters of the Upper Copper River District, or in the vicinity of the Native Village of Batzulnetas. You may accumulate harvest limits of salmon authorized for the Federal public waters of the Copper River Drainage upstream from Haley Creek with harvest limits of salmon authorized under State of Alaska sport fishing regulations.
- In the Prince William Sound Area within Chugach National Forest and in the Copper River drainage downstream of Haley Creek, you may accumulate Federal subsistence fishing harvest limits with harvest limits under State of Alaska sport fishing regulations, providing that accumulation of fishing harvest limits does not occur during the same day.

Customary Trade Within the Upper Copper River District

- The total number of salmon per household taken within the Upper Copper River District and exchanged in customary trade between rural residents and between rural residents and others may not exceed 50% of the annual harvest of salmon by the household. The total cash value of salmon per household taken within the Upper Copper River District and exchanged in customary trade between rural residents and individuals other than rural residents may not exceed $500 annually.

- Customary trade sales of salmon must be immediately recorded on a customary trade recordkeeping form. The recording requirement and the responsibility to ensure the household limit is not exceeded rests with the seller.

Regulations

You may take salmon in the Upper Copper River District only as outlined below:

- You may not possess salmon taken with an Upper Copper River District subsistence fishing permit, unless you immediately remove the anal fin from the salmon (See Fin Identification, page 19). "Immediately" means prior to concealing the fish from plain view or transporting the fish more than 50 feet from where the fish was removed from the water.
- You must release Rainbow Trout/steelhead taken by dip net in the Upper Copper River District and return them unharmed to the water. If you catch Rainbow Trout/steelhead incidentally while subsistence fishing with fish wheels, you may retain them. Any Rainbow Trout/steelhead you retain for subsistence purposes must have the anal fin removed immediately (See Fin Identification, page 19). "Immediately" means prior to concealing the fish from plain view or transporting the fish more than 50 feet from where the fish was removed from the water.

Upper Copper River District			
Species	**Gear**	**Incidental Catches**	**Season**
Salmon	Fish wheels Dip nets Rod and Reel	**Fish wheels:** You may retain Rainbow Trout/steelhead or other freshwater fish caught incidentally to salmon by fish wheels. **Dip nets:** You may not retain and must release unharmed Rainbow Trout/steelhead caught incidentally to salmon by dip net. Other freshwater fish species caught incidentally to salmon by dip net may be retained.	May 15 through Sept. 30 by permit only. However, the opening date of the Chitina Subdistrict will likely be later than May 15. It will be opened by Special Action and will be announced via a news release.

Upper Copper River District *Glennallen and Chitina Subdistricts —Total combined annual harvest limits*	
Household Size	**Annual Harvest Limits and Permit Restrictions**
One-person household	30 salmon (including no more than 5 Chinook by dip net and 5 Chinook by rod and reel) Upon request, permits will be issued for up to 200 salmon total (Chinook limit does not change).
Household of two or more persons	60 salmon (including no more than 5 Chinook by dip net and 5 Chinook by rod and reel), plus 10 salmon for each additional person in a household over 2 persons, except that the household's limit for Chinook Salmon taken by dip net or rod and reel does not increase. Upon request, permits will be issued for up to 500 salmon total (Chinook limit does not change).

For Upper Copper River District subsistence Salmon fishing permits:

- Only one permit per subdistrict will be issued to each household per year. If a household has been issued permits for both subdistricts in the same year, both permits must be in your possession and readily available for inspection while fishing or transporting subsistence-taken fish in either subdistrict. A qualified household may also be issued a Batzulnetas Salmon fishery permit in the same year.
- Multiple types of gear may be specified on a permit, although only one type of gear may be operated at any one time;
- You must return your permit no later than October 31, or you will be denied a permit for the following regulatory year.

- A fish wheel may be operated by only one permit holder at one time; that permit holder must have the fish wheel marked as required by this section during fishing operations;
- Only the permit holder and the authorized members of the household listed on the subsistence permit may take salmon.
- A permit holder must immediately record all retained fish on the permit. "Immediately" means prior to concealing the fish from plain view or transporting the fish more than 50 feet from where the fish was removed from the water.
- A permit holder must personally operate the fish wheel or dipnet.
- You may not loan or transfer a subsistence fish wheel or dip net permit, except as permitted.

If you are a fish wheel owner

- You must register your fish wheel with ADF&G or the National Park Service.
- Your registration number and a wood, metal, or plastic plate at least 12 inches high by 12 inches wide bearing either your name and address, Alaska Driver's license number, or Alaska State identification card number in letters and numerals at least 1 inch high must be permanently affixed and plainly visible on the fish wheel when the fish wheel is in the water. Only the current year's registration number may be affixed to the fish wheel, you must remove any other registration number from the fish wheel.
- You are responsible for the fish wheel. You must remove the fish wheel from the water at the end of the permit period.
- You may not rent or lease your subsistence fish wheel for personal gain.

If you are operating a fish wheel

- You may operate only one fish wheel at any one time.
- You may not set or operate a fish wheel within 75 feet of another fish wheel.
- No fish wheel may have more than two baskets.
- You must check your fish wheel at least once every 10 hours, and remove all fish.
- If you are a permittee other than the owner, an additional wood, metal, or plastic plate at least 12 inches high by 12 inches wide, bearing your name and address in letters and numerals at least 1 inch high, must be attached to the fish wheel so that the name and address are plainly visible.

If you are a village council or similar organization whose members operate fish wheels

- Village councils (or other similarly qualified organizations) whose members operate fish wheels for subsistence purposes on behalf of members of its village or organization may request a subsistence fishing permit.
- The permit will list all households and household members for whom the fish wheel is operated. The permit will identify a person who will be responsible for each fish wheel.
- The permit will include provisions for recording daily catches for each fish wheel, location and number of fish wheels, full name of individual responsible for each fish wheel, and other information determined to be necessary for effective resource management.
- The allowable harvest may not exceed the combined seasonal harvest limits for the households listed on the permit; the permittee will notify the ADF&G or the National Park Service when households are added to the list, and the seasonal harvest limits may be adjusted accordingly.
- Members of the households listed on a permit issued to a village council or other similarly qualified organization are not eligible for a separate household subsistence fishing permit for the Upper Copper River District.

Batzulnetas. Under these conditions, residents of Mentasta Village and Dot Lake may take salmon in the vicinity of the former Native village of Batzulnetas only under authority of a Batzulnetas subsistence salmon fishing permit available from the National Park Service:

- **Copper River.** You may take salmon only in those waters of the Copper River between National Park Service regulatory markers located near the mouth of Tanada Creek and approximately one-half mile downstream from that mouth and in Tanada Creek between National Park Service regulatory markers identifying the open waters of the creek.
- You may use only fish wheels, dip nets, and rod and reel in the Copper River.
- **Tanada Creek.** You may use only dip nets, fyke nets, spears, and rod and reel in Tanada Creek. One fyke net and associated lead may be used in Tanada Creek upstream of the National Park Service weir. You may only use a fyke net after consultation with the in-season manager. You must be present when the fyke net is actively fishing. You may take no more than 1,000 Sockeye salmon in Tanada Creek with a fyke net.
- You may take salmon only from May 15 through September 30 or until the season is closed by Special Action.
- You may retain Chinook Salmon taken in a fish wheel in the **Copper River**. You may not take Chinook Salmon in **Tanada Creek.**
- You must return the permit to the National Park Service no later than October 15.

The following regulations apply to specific freshwater streams that flow into Prince William Sound:

You may take Pink Salmon for subsistence purposes from freshwaters with a dip net from May 15 through September 30, 7 days per week, with no harvest or possession limits in these areas:

- Green Island, Knight Island, Chenega Island, Bainbridge Island, Evans Island, Elrington Island, Latouche Island and adjacent islands, and the mainland waters from the outer point of Granite Bay located in Knight Island Passage to Cape Fairfield.
- Waters north of a line from Porcupine Point to Granite Point, and south of a line from Point Lowe to Tongue Point.

FEDERAL DELEGATED OFFICIALS

Copper River Drainage

Superintendent
Wrangell-St. Elias National Park and Preserve

Prince William Sound Area

Cordova District Ranger
Chugach National Forest

See Directory at the back of this book for contact information.

Appendix D: Customary and Traditional Criterion, Regulations, and Coding Examples

Table 1. Example of Alaska Administrative Code Subsistence finfish regulations transcribed into an excel format in preparation for coding.

Year	Area	Regulation	Title	Section	Text
1993	PWS	5 AAC 01.600.	DESCRIPTION OF THE PRINCE WILLIAM SOUND AREA	0	The Prince William Sound area includes all waters of Alaska between the longitude of Cape Fairfield and the longitude of Cape Suckling.
1993	PWS	5 AAC 01.605.	DESCRIPTION OF DISTRICTS AND SUBDISTRICTS	0	The Upper Copper River District consists of all waters of the mainstem Copper River from the mouth of the Slana River downstream to an east-west line crossing the Copper River approximately 200 yards upstream of Haley Creek as designated by ADF&G regulatory markers.
1993	PWS	5 AAC 01.605.	DESCRIPTION OF DISTRICTS AND SUBDISTRICTS	1	The Chitina Subdistrict consists of all waters of the Upper Copper River District downstream of the downstream edge of the Chitina-McCarthy Road Bridge.
1993	PWS	5 AAC 01.605.	DESCRIPTION OF DISTRICTS AND SUBDISTRICTS	2	The Glennallen Subdistrict consists of all remaining waters of the Upper Copper River District.
1993	PWS	5 AAC 01.610	FISHING SEASONS	a	Unless restricted in this section and 5 AAC 01.625, or unless restricted under the terms of a subsistence fishing permit, other than rainbow trout and steelhead trout, may be taken at any time in the Prince William Sound Area.
1993	PWS	5 AAC 01.610	FISHING SEASONS	b	Salmon may be taken in the Upper Copper River District only as follows:
1993	PWS	5 AAC 01.610	FISHING SEASONS	b.1	In the Glennallen Subdistrict, from June 1 though September 30
1993	PWS	5 AAC 01.610	FISHING SEASONS	b.2	The Chitina Subdistrict is closed to subsistence salmon fishing;
1993	PWS	5 AAC 01.610	FISHING SEASONS	b.3	When the Copper River subsistence fishery is closed or restricted because of an inadequate escapement of sockeye or chinook salmon, the fishery may be reopened September 1 for the taking of Coho salmon, which constitute the majority of salmon at that time.
1993	PWS	5 AAC 01.620.	LAWFUL GEAR AND GEAR SPECIFICATIONS	a	Fish may be taken by gear listed in sec. 10(a) of this chapter unless restricted in this section or under terms of a subsistence permit

Table 2. Example of the coding process for PWS Subsistence, Personal Use, and Federal Finfish Regulations.

Year, AAC Code, and Title	Text	Code and reasoning
1980 5 AAC 01.630(b.2) “Subsistence Fishing Permits”	. If the gross family income for the previous year **exceeds $6,000**;	The bold text to the left is in reference to the income a family must be under in order to receive a higher allotment of salmon each season. From 1980 to 1981 that income cap doubled, essentially making the pool of subsistence users who were allowed to receive that larger allotment much bigger. Due to this increase, this regulation is less restrictive and received a code of **positive one.**
1981 5 AAC 01.630(b.2)	If the gross family income for the previous year is **more than $12,000**;	

"Subsistence Fishing Permits"		
2010 5 AAC 01.620(c.4) "Lawful Gear and Gear Specifications"	. [A permit holder must]…check the fish wheel at least once every 10 hours and remove all fish caught by the fish wheel;	There is no bolded text to the left because there is no change between this regulation from 2010 to 2011, so the change in regulation is coded as **zero.**
2011 5 AAC 01.620(c.4) "Lawful Gear and Gear Specifications"	[A permit holder must]…check the fish wheel at least once every 10 hours and remove all fish caught by the fish wheel;	
1997 5 AAC 77.590(f) "Copper River Personal Use Dip Net Salmon Fishery Plan"	The maximum harvest level for the Chitina Subdistrict personal use salmon fishery is 100,000 salmon, not including any salmon in excess of the inriver goal or salmon taken after August 31.	The bolded text to the left indicates the change between this regulation from 1997 to 1998. This additional text creates a more strict regulation concerning the maximum harvest level for salmon in the area. It places in a stipulation that could cause the amount users are allowed to harvest to go down in certain cases. Due to this additional text and the stipulation it provides, I would give this change in regulation a code of **negative one.**
1998 5 AAC 77.590(f) "Copper River Personal Use Dip Net Salmon Fishery Plan"	The maximum harvest level for the Chitina Subdistrict personal use salmon fishery is 100,000 salmon, not including any salmon in excess of the inriver goal or salmon taken after August 31**. If the Copper River District commercial salmon fishery is closed for 13 or more consecutive days, the maximum harvest level in the Chitina Subdistrict is reduced to 50,000 salmon.**	

Table 3. ADF&G Customary and Traditional Criteria, retrieved from ADF&G Customary and Traditional worksheets. [77]

8 Customary and Traditional Use Criteria (originally 10 in 1980)
1. A long-term consistent pattern of noncommercial taking, use, and reliance on the fish stock or game population that has been established over a reasonable period of time of not less than one generation, excluding interruption by circumstances beyond the user's control such as unavailability of the fish or game caused by migratory patterns.
2. A pattern of taking or use recurring in specific seasons of each year.
3. A pattern of taking or use consisting of methods and means of harvest that are characterized by efficiency and economy of effort and cost.
4. The area in which the noncommercial, long-term, and consistent patterns of taking, use, and reliance upon the fish stock or game population has been established.
5. A means of handling, preparing, preserving, and storing fish or game that has been traditionally used by past generations, but not excluding recent technological advances where appropriate.

[77] (Fall and Simeone 2010)

6. A pattern a taking or use that includes the handing down of knowledge of fishing or hunting skills, values, and lore from generation to generation.
7. A pattern of taking, use, and reliance where the harvest effort or products of that harvest are distributed or shared, including customary trade, barter, and gift-giving.
8. A pattern that includes taking, use, and reliance for subsistence purposes upon a wide diversity of the fish and game resources and that provides substantial economic, cultural, social, and nutritional elements of the subsistence way of life.

Appendix E: SPSS results

Table 1: The mean, standard error (SE), degrees of freedom (df), t-value, and p-value for PWS Chinook and Sockeye Salmon, for the year a negative regulation was put into place, from 1979-2015. Using an Independent Means t-test with a 95% CI and statistically significant p-value <.05*.

Test Type	Fishery	Species	Mean	df	t	p (2-tailed)	Statistically Significant
Independent Means T- test	Subsistence	Sockeye	No change: 81,683.97 More Restrictive: 47,870.78	34	1.900	.066	.066> .05 no
Independent Means T- test	Subsistence	Chinook	No change: 3,417.79 More Restrictive: 2,403.83	34	1.142	.262	.262> .05 no
Independent Means T- test	Personal Use	Sockeye	No change: 106,459.18 More Restrictive: 101,226.07	21	.177	.861	.861> .05 no
Independent Means T- test	Personal Use	Chinook	No change: 2,257.06 More Restrictive: 2,440.24	21	-.202	.842	.842> .05 no
Independent Means T- test	Commercial	Sockeye	No change: 1,242,894.65 More Restrictive: 1,142,186,81	34	.468	.643	.643 >.05 No
Independent Means T- test	Commercial	Chinook	No change: 32,959.55 More Restrictive: 35,316.00	34	-.414	.682	.682> .05 No
Independent Means T- test	Overall (subsistence, personal, and commercial)	Sockeye	No change: 1,464,433.49 More Restrictive: 1,245,287.63	34	.974	.337	.337 >.05 No
Independent Means T- test	Overall (subsistence, personal, and commercial)	Chinook	No change: 37,251.16 More Restrictive: 40,225.73	34	-.488	.629	.629 >.05 No

Table 2: The mean, standard error (SE), degrees of freedom (df), t-value, and p-value for PWS Chinook and Sockeye Salmon, for the year after a negative regulation was put into place, from 1979-2015. Using an Independent Means t-test with a 95% CI and statistically significant p-value <.05*.

Test Type	Fishery	Species	Mean	df	t	p (2-tailed)	Statistically Significant
Independent Means T- test with lag time	*Subsistence*	*Sockeye*	*No change: 78,293.69* *More Restrictive: 57,000.04*	*33*	*1.155*	*.256*	*.256> .05 no*
Independent Means T- test with lag time	Subsistence	Chinook	No change: 3,419.36 More Restrictive: 2,612.31	33	.796	.378	.378> .05 no
Independent Means T- test with lag time	Personal Use	Sockeye	No change: 112,682.60 More Restrictive: 84,629.25	20	.883	.388	.388> .05 no
Independent Means T- test with lag time	Personal Use	Chinook	No change: 1,904.65 More Restrictive: 3,308.15	20	-1.52	.144	.144> .05 no
Independent Means T- test with lag time	Commercial	Sockeye	No change: 1,431,177.42 More Restrictive: 991,248.94	33	2.232*	.033	.033< .05 Yes
Independent Means T- test with lag time	Commercial	Chinook	No change: 32,454.04 More Restrictive: 36,871.83	33	-.771	.446	.446> .05 No
Independent Means T- test with lag time	Overall (subsistence, personal, and commercial)	Sockeye	No change: 1,605,318.89 More Restrictive: 1,164,478.59	33	2.124*	.041	.041<.05 Yes
Independent Means T- test	Overall (subsistence, personal, and commercial)	Chinook	No change: 34,863.03 More Restrictive: 44,281.58	33	-1.586	.122	.122 >.05 No

* Indicates t value significant at .05 because it is greater that 2.03 (the maximum t value we would expect to get by chance alone from a df of 34)

Table 3: The F statistic, p-value, R^2, Pearson coefficient, and regression equations for PWS Sockeye and Chinook Salmon harvest and escapement numbers, from 1979-2015. Using a Simple Linear Regression and 95% CI.

Species	*Fishery*	*Pearson Correlation*	*R^2*	*Regression Equation*	*F(x,x) dF*	*F*	*sig*
Sockeye	Subsistence	.505	.255	Subsistence sockeye harvest = -42684.083 + .142(Sockeye escapement)	F(1,35)	11.986	.001

Chinook	Subsistence	.079	.006	Subsistence chinook harvest = 1949.003 + .021 (chinook escapement)	F(1,35)	.221	.642
Sockeye	Personal Use	.594	.353	PU sockeye harvest = 13932.461 + .131 (sockeye escapement)	F(1,22)	12.014	.002
Chinook	Personal Use	.045	.002	PU chinook harvest = 2568.402 + .009 (chinook escapement)	F(1,22)	.048	.829
Sockeye	Commercial	.802	.643	Commercial Sockeye harvest = -700791.663 + 2.560(sockeye escapement)	F(1,35)	63.167	.000
Chinook	Commercial	.026	.001	Commercial Chinook Harvest = 32419.263 + .322(chinook escapement)	F(1,35)	.024	.877
Sockeye	All	.815	.664	All sockeye harvest = -800836.625 + 2.881 (sockeye escapement	F(1,35)	69.101	.000
Chinook	All	.070	.005	All chinook harvest = 34393.431 + .145 (chinook escapement)	F(1,35)	.174	.679

Table 4: The F statistic, p-value, R^2, Pearson coefficient, and regression equations for PWS Sockeye and Chinook Salmon harvest, escapement numbers, and changes in regulation from 1979-2015. Using a Multiple Linear Regression and 95% CI.

Species	*Fishery*	*Pearson Coefficient*	R^2	*F(x,x) dF*	*F*	*Sig.*	*Regression Equation*
Sockeye	Subsistence	.535	.286	F(2,34)	6.826	.003	Subsistence sockeye harvest = -28118.671-19201.783(reg change) + .133(sockeye escapement)
Chinook	Subsistence	.156	.024	F(2,34)	.426	.657	Subsistence Chinook harvest = 2226.501 – 610.233(reg change) + .020 (chinook escapement)
Sockeye	Personal Use	.641	.411	F(2,22)	7.333	.004	Person use sockeye = 28159 - 20950.630(reg change) + .123(sockeye escapement)
Chinook	Personal Use	.149	.022	F(2,22)	.250	.781	Personal Use chinook = 2496.658 + 514.71(reg change) + .004(chinook escapement)
Sockeye	Commercial	.803	.645	F(2,34)	30.952	.000	Commercial sockeye = -742794.103 + 55372.397?(reg change) + 2.584(sockeye escapement)
Chinook	Commercial	.133	.018	F(2,34)	.306	.739	Commercial Chinook = 30455.707 + 4317.961(reg change) +.054(chinook escapement)
Sockeye	All	.815	.664	F(2,34)	33.574	.000	All sockeye = -809674.506 + 11651.101(reg change) + 2.886(sockeye escapement)
Chinook	All	.128	.016	F(2,34)	.282	.756	All chinook = 32654.634 + 3823.707(reg change) + .148(chinook escapement)