PRINCE WILLIAM SOUND
SCIENCE
CENTER

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June 29, 2012

Mr. Tom Taylor, Procurement Officer
Department of Fish and Game
Division of Administrative Services
1255 West 8th Street, P.O. Box 115526
Juneau, Alaska 99811-5526

Dear Mr. Taylor,

The Prince William Sound Science Center, along with its subcontracting partner the Sitka Sound Science Center, is pleased to submit the attached proposal under RFP 2013-1100-1020 for the project entitled "Interactions of Wild and Hatchery Pink and Chum Salmon in Prince William Sound and Southeast Alaska." Our two Alaskan 501(c)3 non-profit organizations have the scientific expertise, the logistical capabilities, and the geographic placement to ensure this extremely important research is successful.

The attached proposal describes an approach that will meet the requirements for the RFP. We will begin immediately in 2012 to implement preliminary investigations of ten streams designated for intensive studies of hatchery-wild interactions and to test our proposed methodologies for the required ocean sampling. In spring of 2013 we will test methods for alevin sampling. In summer 2013 we will begin three years of data collection on straying of hatchery fish into 67 streams, some including both species, in Prince William Sound (PWS) and Southeast Alaska (SEAK), as called for in the RFP. In spring of 2014 we will sample alevins in the 10 intensively studied streams and continue this through the spring of 2016, resulting in three full cycles of sampling parents and offspring. Lastly, we propose to complete PWS ocean sampling for hatchery-wild proportions in 2013 and 2014. Our fixed-price bid for this project is $4,462,900.

We trust this proposal will meet the needs of the State of Alaska and its citizens. We stand ready to discuss the proposal at your convenience.

Sincerely,

Karina Hoffman, M.M.A.
President and CEO
Prince William Sound Science Center
khoffman@pwssc.org

Introduction

Prince William Sound Science Center (PWSSC) and its sub-contracting partner Sitka Sound Science Center (SSSC) are well-positioned, both geographically and with the expertise and experience, to address the scientific data collection and analysis services requested in the State of Alaska request for proposals 2013-1100-1020 issued May 7, 2012, entitled "Interactions of Wild and Hatchery Pink and Chum Salmon in Prince William Sound and Southeast Alaska". The overarching questions that need to be addressed are:

(1) What is the genetic stock structure of pink and chum salmon in each region?

(2) What is the extent and annual variability in straying of hatchery pink salmon in Prince William Sound (PWS) and chum salmon in PWS and Southeast Alaska (SEAK)?

(3) What is the impact on fitness (productivity) of wild pink and chum salmon stocks due to straying of hatchery pinks and chum salmon?

We recognize the paramount importance of these questions, the wide variety of other related questions, and their relevance to the future of commercial salmon fisheries in Alaska. These questions have not yet been studied for pink salmon or chum salmon in Alaska or anywhere else to the extent suggested by the RFP. We have devised a plan to efficiently collect, analyze (where requested), and report on all the data required in support of the objectives of the RFP.

The Project

Recent studies have revealed the possibility of relatively large proportions of hatchery-bred salmon in some wild-spawning populations in Alaska (Brenner et al. 2012, Piston and Heinl 2012) and the proportion of strays detected in wild spawning populations appears to be higher in streams closer to hatchery release sites (ADF&G unpublished data, Brenner et al. 2012). However, the sampling designs used to date have not been adequate to estimate the actual extent of straying at the level of the harvest management system, e.g., the district level for PWS pink salmon or the sub-regional level for SEAK chum salmon. While some streams are apparently experiencing high percentages of hatchery strays, many streams have fewer hatchery strays. It is therefore important to:
1) further document the degree to which straying is occurring; 2) assess the range of interannual variability in the straying rates; and, 3)determine the effects of hatchery fish spawning with wild populations on the fitness of wild populations.

Although not part of the requested services in the RFP, previous observations on hatchery fish straying have raised several important questions that can be addressed once the data called for in the RFP is collected:

(1) Are hatchery-bred salmon interbreeding with wild salmon to the extent that fitness and productivity of these stocks are being diminished? If so, does any loss of fitness and productivity continue through subsequent generations? Is a temporal loss of fitness compensated by the addition of spawning stock?

(2) Is the annual assessment of wild stocks (which is in part based on visual observation) so biased by the presence of hatchery salmon that excessive harvest of wild fish is being allowed or that escapement goals are difficult to set and difficult to assess? Or, if the additional enhanced fish have an overall positive effect on the escapement, should they be simply counted as part of that escapement?
(3) Do density interactions diminish the productivity of wild salmon?

This project is designed to collect data that will help to address the questions posed in the RFP. The services proposed herein are largely for data collection but also include data analyses as described in the RFP and detailed further below. First, by collecting a very large number of otoliths from an extensive array of streams, we and collaborating scientists at ADFG will be able to more precisely and accurately answer questions about the extent and degree of straying, as well as the effects of hatchery fish on wild population fitness. (The ongoing mass-marking of all hatchery pink salmon and chum salmon otoliths in Alaska will facilitate the detection of hatchery-bred salmon on the spawning grounds of wild salmon.) The proposed research will also provide more accurate measures of the annual production of natural and hatchery fish by accounting for the actual numbers of adults on the spawning grounds. This research will provide data sufficient to estimate the following for PWS pink salmon and PWS and SEAK chum salmon:

- number of wild salmon spawning in the wild;
- number of hatchery salmon spawning in the wild (hatchery strays);
- production of hatchery salmon (including hatchery strays); and
- production of wild salmon (excluding hatchery strays).

Second, collection of a large number of DNA samples from parents and subsequent offspring alevins in streams known to have high hatchery straying rates will enable Alaska Department of Fish and Game geneticists to evaluate the effects of hatchery strays on the subsequent survival and fitness as compared to offspring in streams known to have low hatchery stray rates (control streams).

To further address the question of the impact of fitness by straying, we propose to gather ancillary phenotypic data from adults whenever possible to correlate with eventual findings on straying and fitness. We will also take scale samples from adult chum salmon when possible, since chum salmon are not easily aged with otoliths and population and phenotypic attributes can be influenced by age structure.

Although the entire project is anticipated in the RFP to extend through 2018 for the straying aspects, and through 2023 for the fitness studies, the scope of this Phase One proposal is limited to the period July 1, 2012 through March 21, 2016. This proposal includes data collection for three complete annual cycles of adults in streams and their resultant offspring alevins. It also includes one prepatory season followed by two full seasons adult sampling in the ocean (because of budget limitations, the third full season of ocean sampling is suggested to be funded at a later date). The work described herein will provide a substantial beginning to the longer-term project. The PWSSC and its partners stand ready to continue the research on this groundbreaking project in 2016 and through to the conclusion of the project.

Overall project management will be by the Prince William Sound Science Center. Since the two study areas (PWS and SEAK) are over 400 nautical miles apart, we will manage the two projects utilizing local expertise and subcontracts for some services. The PWSSC will provide logistics, staff, and facilities to support operations for ocean test fisheries in PWS and stream sampling in PWS. Through a subcontract, the Sitka Sound Science Center (SSSC) will provide leadership and a base for project management and logistical support in SEAK. Under the subcontract, SSSC will fully implement the SEAK stream sampling by hiring, training, and deploying the field teams under scientific protocols developed by the PWSSC Project Manager and the three Project Leaders. Additionally, the largest expenses for this project involve vessel charters; all charters will be sub-contracted to private contractors by PWSSC.

Methods

We have subdivided this complex project into four major components as described in the RFP:

1. PWS ocean sampling;
2. PWS extensive stream sampling for hatchery straying and intensive sampling of DNA for fitness studies;
3. SEAK extensive stream sampling for hatchery straying and intensive sampling of DNA for fitness studies;
4. Data management, analysis; and reporting

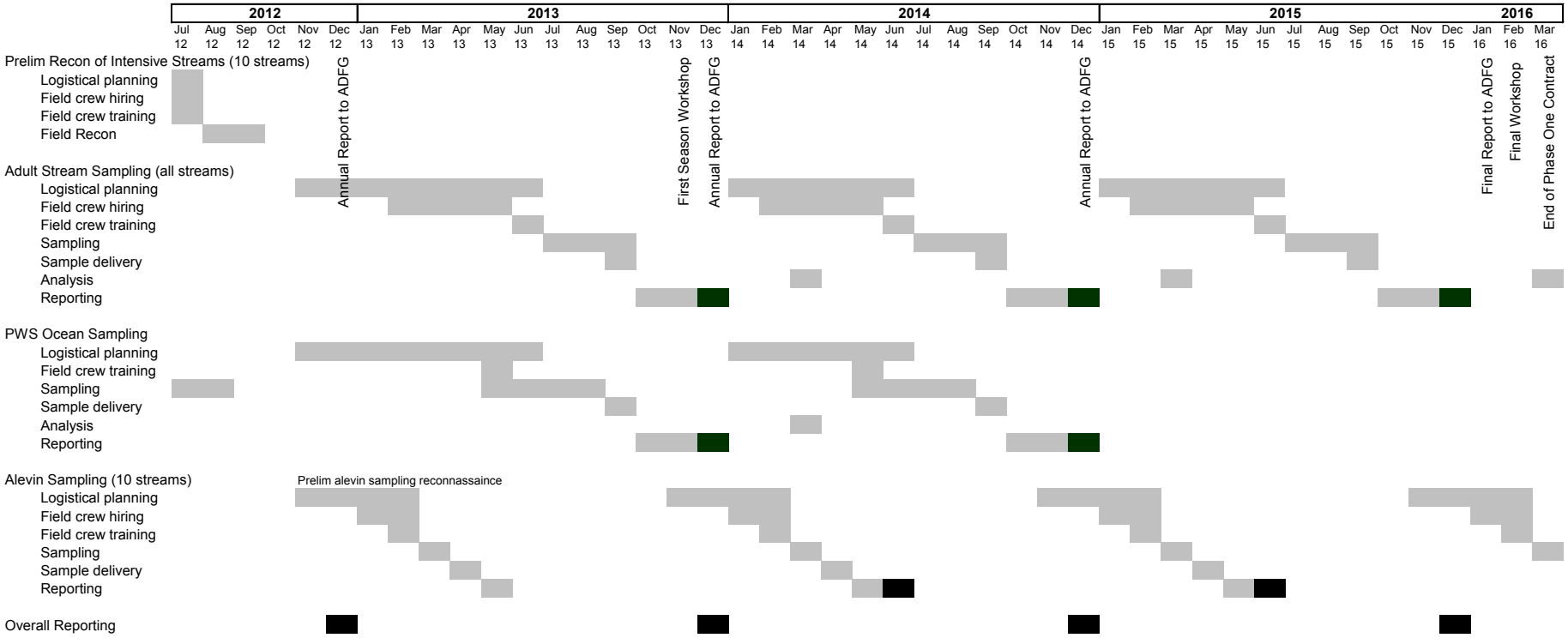
Methods for each component are described below. The timing of the various activities is illustrated in Figure 1, which also provides an overview of how PWSSC proposes to meet all the requirements of the RFP. Our proposed methods follow the methods prescribed in the RFP with only a few minor exceptions as noted below.

OCEAN SAMPLING

The ocean sampling methodology outlined in the RFP is similar to commercial fishing techniques. Therefore the fishing portion of the work during the 2013-2014 field seasons will be conducted by a 32’- 50’ commercial fishing vessel contracted by the PWSSC. The 2012 salmon fishing season is already under way. Once the contract is awarded, it will take time to procure the gillnet and equipment. We will conduct 4-5 days of sampling in August as a trial run for finalizing the station locations and testing the fishing and otolith extraction methods.

The sampling season for ocean run pink and chum salmon will occur from May 15 to August 30. Prior to the beginning of the sampling period, a field camp will be set up in Chenega Bay on Evans Island (Figure 2). This site is located approximately 30 nautical miles (nm) and 54 nm from the two sampling sites in Montague Strait and Hinchinbrook

Figure 1. Overview of project schedule for RFP 2013-1100-1020. Gray-shaded boxes indicate periods of logistical support and field work. Black boxes indicate report preparation. Workshops, annual reports, and final report are also indicated.



Entrance, respectively. By contracting with a commercial fisherman, this will reduce funds needed to charter a live-aboard vessel for hire that would have to "house" scientists and technicians for the duration of the ocean sampling season. The lower cost and location of a field station in Chenega Bay will allow for timely delivery of the fish to be processed and save on fuel costs by reducing the number of trips to Cordova.

According to the RFP, sampling days are suggested to be Monday/Thursday at Montague Strait and Tuesday/Friday at Hinchinbrook Entrance. Every attempt will be made to follow this schedule but may have to be adjusted slightly in case of bad weather. Once the weather clears, fishing will resume at the site that was delayed and the sampling schedule will continue in a staggered manner.

The vessel will make test sets at a fixed station at each site (Table 1, Figure 2) using a 200 fathom drift gillnet consisting of 5 panels. Each panel will be of a different gillnet mesh size; one each of 4 ¾, 4 7/8, 5, 5 1/8, 5 ¼ inch stretch mesh. Each of the panels will be constructed using four colors of #8 Yamaji web; UR28 Dark Blue, YS9 Med. Dark Green, SH79 Med. Light Green, and SH93 Dark Greenish Blue. These are reported to be the most productive web colors for PWS. The adjacent mesh sizes will be staggered: 4 ¾, 5 1/8, 4 7/8, 5 ¼, 5. The net will be hung flat, 60 meshes in depth, and use a 200-pound lead line.

Standard test fishing methods will be 1-hour sets at each station, at each site at the beginning (May 15-June 1) and end (August 15-30) of each fishing season. As the season progresses and as fish numbers entering the Sound increase, the captain will be instructed to monitor catch rates in the net. When catch rate appears to be high (>150 per set) the net will be pulled prior to one hour. When this occurs, sets will be reduced to 30 minutes at each station.

Fish will be retained and the catch from each station will be kept separate in individual brailer bags. For each set, the captain will maintain a logbook that documents the date, time, station name, GPS coordinates, soak time, and weather conditions. This information will also be used to label each brailer bag. After all stations have been completed for the day, the brailer bags will be delivered to the field camp where catches will be sorted by species and pink and chum randomly sub-sampled for otolith extraction. Each day's catch will be entered into the field computer and transmitted to ADFG via email.

Sample Processing and Data Collection. PWSSC personnel will use the field station to process the samples provided by the fishing vessel. A total of 60 individual pink salmon and 60 chum salmon (10 per set from Montague; 20 per set from Hinchinbrook) will be randomly selected from the day's catch and the otoliths extracted. Otolith extraction methods will follow the Alaska Department of Fish and Game (ADFG) port sampling guide (Anonymous 2005). The following fish morphometric data will be collected to accompany the otolith extraction: eye socket to hypural bone length (EH), total length (TL), standard length (SL), Sex (S), body girth (BG), total weight (TW), gonad weight (GW). Trays containing the otoliths will be labeled, sealed and shipped to the Juneau lab every 2-3 weeks when field station personnel are rotated through. Net soak time and catch composition will be used to calculate station, daily, and seasonal CPUE per 100 fathoms of net.

Table 1. Estimated weekly travel times between stations for test fishery

Latitude & Longitude of Location 1	Location 1	Location 2	Approx. Distance (km)	Fishing Time	Picking Time	
Monday (DAY 1)						
60°32'32.67"N 145°45'9.15"W	Cordova	Hinch 1	48	1	0.5	
60°15'42.32"N 146°42'27.19"W	Hinch 1	Hinch 2	6.6	1	0.5	
60°19'16.29"N 146°54'26.39"W	Hinch 2	Hinch 3	6	1	0.5	
60°23'7.80"N 147° 3'55.45"W	Hinch 3	Chenega	38			
60° 3'58.59"N 148° 0'42.56"W	Chenega	Chalmers	28			
Tuesday (DAY 2)						
60° 3'58.59"N 148° 0'42.56"W	Chenega	Mont 1	18	1	0.5	
59°55'30.76"N 147°49'19.54"W	Mont 1	Mont 2	6	1	0.5	
59°57'4.75"N 147°57'23.97"W	Mont 2	Mont 3	7	1	0.5	
59°56'31.29"N 148° 3'35.19"W	Mont 3	Mont 4	1.5	1	0.5	
59°57'4.05"N 148° 5'23.57"W	Mont 4	Mont 5	7.5	1	0.5	
59°58'56.81"N 148°13'1.91"W	Mont 5	Mont 6	6	1	0.5	
59°59'0.07"N 148°23'22.46"W	Mont 6	Chenega	18			
60° 3'58.59"N 148° 0'42.56"W	Chenega	Chalmers	28			
60°13'51.05"N 147°15'39.60"W	Chalmers	Chenega	28			
Wednesday (DAY 3)						
NO SCHEDULE						
Thursday (DAY 4)						
60°32'32.67"N 145°45'9.15"W	Cordova	Hinch 1	48	1	0.5	
60°15'42.32"N 146°42'27.19"W	Hinch 1	Hinch 2	6.6	1	0.5	
60°19'16.29"N 146°54'26.39"W	Hinch 2	Hinch 3	6	1	0.5	
60°23'7.80"N 147° 3'55.45"W	Hinch 3	Chenega	38			
60°13'51.05"N 147°15'39.60"W	Chalmers	Chenega	28			
Friday (DAY 5)						
59°55'30.76"N 147°49'19.54"W	Chenega	Mont 1	18	1	0.5	
59°57'4.75"N 147°57'23.97"W	Mont 1	Mont 2	6	1	0.5	
59°56'31.29"N 148° 3'35.19"W	Mont 2	Mont 3	7	1	0.5	
59°57'4.05"N 148° 5'23.57"W	Mont 3	Mont 4	1.5	1	0.5	
59°58'56.81"N 148°13'1.91"W	Mont 4	Mont 5	7.5	1	0.5	
59°59'0.07"N 148°23'22.46"W	Mont 5	Mont 6	6	1	0.5	
60° 3'58.59"N 148° 0'42.56"W	Mont 6	Chenega	18			
60° 3'58.59"N 148° 0'42.56"W	Chenega	Chalmers	28			
60°13'51.05"N 147°15'39.60"W	Chalmers	Cordova	63			
Saturday/Sunday (DAY 6 & 7)						
				Total Fishing Hours	Total picking hours	
		Total kilometers	528.2			Hours /wk
		Hours at 20 knots	26.41	18	9	**53.41**

Catch exceeding required sample size. Fish that are caught in excess of the required samples will be returned to the water if alive and viable or sold under the ADFG test fishing permit. Tender coverage is available at Port Chalmers, on the west side of Montague Island (60° 14′ N x 147° 15′ W) after June 1, and should continue through the test fishery period. While fewer fish are expected prior to June 1, transporting fish back to Cordova for sales under the ADFG permit may also occur depending on weather and availability of ice.

As proposed, this portion of the project will intercept pink and chum salmon at the entrances to quantify the proportion of hatchery versus wild salmon as they enter PWS to spawn as well as provide daily information on run timing and magnitude to ADFG.

Figure 2. Layout of proposed ocean sampling stations in Montague Strait and Hinchinbrook Entrance.

STREAM SAMPLING

Efficient sampling of spawning salmon to collect otoliths and somatic tissues (for the pedigree/fitness study) hinges on the arrival of the sampling team at the streams shortly after the beginning of peak spawning. The run timing is variable each year so a method to remain mobile and responsive to the actual arrival of the salmon is required and is described below. The specific methods for stream sampling are described in the subsequent sections. Because somatic tissue samples will be collected on a small subset of the streams selected for otolith samples and are selected for a different purpose, the specific methods are also addressed in later sections.

Salmon live for a few days to a few weeks after spawning those spawning sooner survive longer while later-spawning salmon die quicker (Quinn 2005). Because the peak spawning time is often a few weeks after arrival on the spawning grounds and commencement of spawning, the peak is a good time to begin sampling spawned-out salmon and carcasses for otoliths. A time frame for sampling all of the streams would thus be from the time of the earliest observed peak to the time of the latest observed peak with additional scope planned for outliers (streams that are less synchronous with the overall population). Peaks will be assessed in-season based on the aerial surveys.

PWS Stream Sampling

PWS Stream Access. The sampling season for spawned–out pink and chum in PWS will run from mid-July to mid-October. We expect to have one live-aboard vessel to house our sampling crew of six (crew size based on U.S. Coast Guard six pack license). We are constrained to using one vessel in order to keep the total project costs within the scope of the RFP. This in turn limits the sampling scope of the project (number of streams that can be sampled during a given spawning season) to that proposed here. Cordova will be the working base from where we will direct the vessel to sample specific streams on specific days using radio, e-mail, and mobile telephone based on the aerial survey results. From the live-aboard vessel, teams of either three or six, according to stream/population size, will be dropped off at the stream mouths using skiffs.

The 1964 earthquake resulted in uplift in excess of 10m as well as subsidence to approximately 2m throughout PWS. This change in vertical position, in combination with a tidal range on the order of 6m, results in extensive shallow areas with mud flats at stream mouths. We will rely on local knowledge of live-aboard skippers as well as shore-zone mapping images (available here: http://alaskafisheries.noaa.gov/shorezone/) on the best times to land and landing points to maximize our efficiency. For example, when possible, each team of three will go to a separate stream or sample a separate reach of a larger stream depending on stream layout and expected population density. Teams will necessarily be combined (six person sampling team) for those streams sampled for the pedigree study (next section. Access to many, if not most, PWS streams may be restricted to high tidal levels when small boats can navigate directly into streams.

We will use the live-aboard vessel as a base of operations. It will also serve as a floating laboratory where we will do initial sample processing such as otolith cleaning as prescribed by ADFG and data uploading. This approach will enable sampling the greatest number of streams per unit time given the logistical constraints of PWS.

Run Timing. Because we will not know the actual run timing of a given cohort in advance, we are using the historical record as a starting point. Run timing for PWS streams is thus based on when salmon have been observed on spawning grounds using historical aerial survey data, as reported for the most recent decade in annual finfish reports produced by ADFG (see Appendix 1 and 2). The most recent finfish report at the time of writing is for the 2010 return year (Appendix 2). In addition to the starting point provided by these data, the actual timing of sampling will be updated and detailed (i.e., specific streams to be sampled on specific dates) in near-real time by communicating with ADFG staff immediately following their regular aerial surveys.

Figures from ADFG finfish reports for PWS were collated and are reproduced here in Appendix 1 (odd years) and Appendix 2 (even years). Pink salmon run timing is assessed here by their odd

and even year brood lines. These figures demonstrate the variable nature of the run timing pattern. Nevertheless it is possible to discern peaks in run timing. The date range with year of occurrence is noted for early, middle, and late peaks for pink salmon. Chum salmon run timing has varied historically between two (in more recent years) or three peaks (2000 to 2003) (Appendix 1 and 2). Since chum salmon spawn somewhat earlier than pink salmon sampling for chum will occur earlier.

Sampling of spawned-out pink and chum salmon in PWS will take place over three months from mid-July to mid-October. We expect to sample each selected stream (Table 3, Figure 3) once each within three approximately one-month-long time blocks beginning in mid-July (e.g., first block = mid-July to mid-August). We expect the initial half-month of sampling (late July) will be primarily for chum salmon whereas the final half-month of sampling (early October) will be primarily for pink salmon. Otherwise the PWS stream sampling effort, which will encompass both species, will be concentrated within a two-month time frame, August and September.

Table 2. Historical run timing of PWS pink and chum salmon from 2000 to 2008 based on ADFG finfish reports. Earliest and latest dates and the year(s) they occurred are noted.

Odd-year PWS pink salmon:
Early peak: 7/19 (2003) to 8/11(2001)
Middle peak: 8/18 (2001) to 8/23 (2003)
Late peak: 9/1 (2007) to 9/6 (2003)
Even-year PWS pink salmon:
Early peak (weak): 8/3 (2006) to 8/7 (2004 & 2010)
Middle peak: 8/12 (2000) to 8/21 (2010)
Late peak: >8/31 (2002) to 9/4 (2004 & 2010)
PWS chum salmon:
Early peak: 7/14 (2001) to 8/11 (2007)
Late peak: 8/22 (2009) to 9/9 (2000)

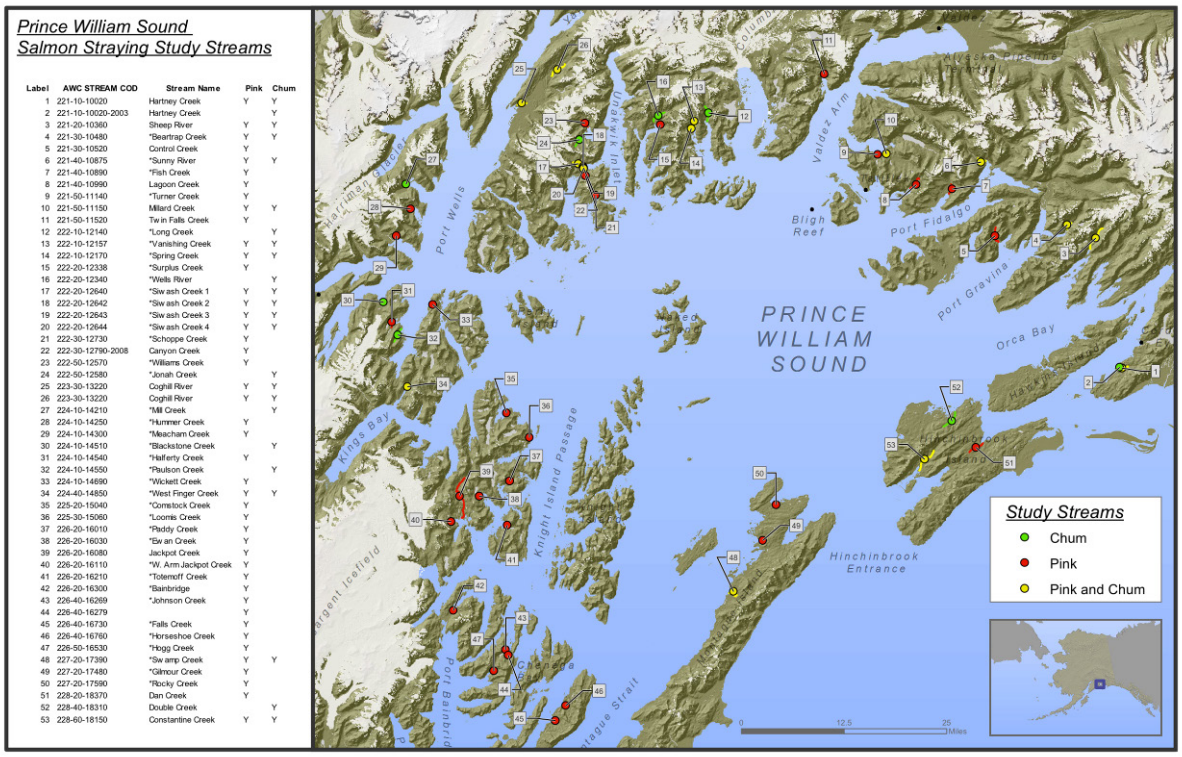


Figure 3. Map of PWS showing the locations of pink and chum, pink, and chum salmon streams based on consolidating the lists 0.03 streams in the RFP.

PWS Otolith Sampling. The purpose for stream otolith sampling is to assess the relative composition of wild salmon versus hatchery strays. Since we will only be able to fully evaluate relative run timing within a stream at the end of the season it will be necessary to over-sample for otoliths to ensure obtaining up to 384 samples per species per stream other than pink salmon from streams selected for the fitness pedigree study. For example, on the first sampling trip it will be unknown whether the carcasses present represent only a small portion or a major portion of the overall run of that year. We will use a simple guideline of planning to sample 100 males and 100 females on each of the three sampling trips. To insure that the 384 sample goal is met we will over-sample on the first sampling of each stream up to 50% if possible. Thus there could be 150 of each sex on some streams after one sampling. If we are unable to sample 100 of each sex on the first sampling, we will attempt to sample 150 of each sex on the second sampling. If we fail to sample 100 of each sex on the first two samplings then 150 of each sex will be sampled on the third. If at least 100 of each sex were sampled on the first two trips then only 100 of each sex will be sampled on the third. There will thus be a maximum of 700 otolith samples for a species in a given stream for the season (except for low straying streams selected for the pedigree study. The desired N = 384 (from RFP) will thus be sub-sampled at the ADFG lab from a collection of no more than about 700 otolith sets (consisting of a left and right pair) from each species sampled in a stream, based on post-season aerial survey information. To meet the RFP otolith target of 1000 pink salmon from low straying streams in the pedigree study (three streams), we will also over-sample relative to a target 334 (117 per sex) per sampling by sampling 400 otolith sets (200 per sex) per sampling trip to ensure that at the end of the season we have 1000.

We will sample for pink and chum otoliths from a set of streams from those already randomly selected by ADFG, as indicated in the RFP. The streams listed in Table 3 collectively provide a standard error of 0.04 based on the RFP. Table 3 has a column indicating whether pink, chum, or both species are to be sampled from a given stream. Table 3 lists 23 pink salmon streams and 17 chum salmon streams. This will be the target number of streams to be sampled per species. We will use the same stratification as shown in the RFP to achieve the suggested number of streams per species per fishing district. We will begin with the selection of streams for otoliths shown on Table 3 at the 0.04 level but will modify it by swapping out streams from the 0.02 lists in the RFP in order to meet the requirements specified in the RFP for the pedigree study streams (see below) while maintaining the above stratification. Once established, we will be sampling the same set of streams each for the duration of this multiple-year project.

Table 3. Listing of candidate PWS streams taken from various tables the RFP.

Fishing district name	Fishing district number	Stream name	Adjacent bodies	Aerial survey stream number	RFP district pink straying rate	% wild pink from Brenner et al 2012	RFP district chum straying rate	% wild chum from Brenner et al 2012	Species to sample	ADFG Stream code	ADFG Anadromous Waters Catalog chart number
Eastern	221	Hartney C	Hartney Bay	2	0.05	98.1	0.01	98.4	pink & chum	221-10-10020	Cordova C-5
Eastern	221	Sheep R	Sheep Bay	36	0.05		0.01		pink	221-20-10360	Cordova C-6, Cordova C-5
Eastern	221	Beartrap R	Beartrap Bay, Gravina	48	0.05		0.01	99.9	pink	221-30-10480	Cordova D-6
Eastern	221	Sunny R	Port Fidalgo	87	0.05		0.01	99.7	chum	221-40-10875	Cordova D-6, Cordova D-7
Eastern	221	Fish C	Fish Bay, Fidalgo	89	0.05		0.01		pink	221-40-10890	Cordova D-7
Eastern	221	Lagoon C	Landlocked Bay, Fidalgo	99	0.05		0.01		pink	221-40-10990	Cordova D-7
Eastern	221	Turner C	Galena Bay	114	0.05		0.01		pink	221-50-11140	Cordova D-7
Eastern	221	Millard C	Galena Bay	115	0.05		0.01		chum	221-50-11150	Cordova D-7
Northern	222	Long C	Long Bay	214	0.08	94.4	0.07	83.7	chum	222-10-12140	Anchorage A-1
Northern	222	Vanishing C	Long Bay	216	0.08	92.8	0.07	97.5	chum	222-10-12157	Anchorage A-1
Northern	222	Spring C	Long Bay	217	0.08		0.07		pink & chum	222-10-12170	Seward D-1, Anchorage A-1
Northern	222	Surplus C	Wells bay	233	0.08		0.07		pink	222-20-12330	Anchorage A-2
Northern	222	Wells R	Wells Bay	234	0.08	97.1	0.07	96.2	chum	222-20-12340	Anchorage A-2
Northern	222	Williams C	Jonah Bay, Unakwik	257	0.08		0.07		pink	222-50-12570	Anchorage A-2
Northern	222	Siwash R	Siwash Bay, Unakwik	264	0.08	86.1	0.07	75.0	pink & chum	222-20-12640 to 222-20-12644	Seward D-2
Coghill	223	Coghill R	Coghill Lake	322	0.03		0.03		pink & chum	223-30-13220	Anchorage A-2, Anchorage A-3
Coghill	223	Mill C	Bettles Bay, Wells	421	0.03	99.0	0.03	97.5	chum	224-10-14210	Seward D-4
Coghill	223	Hummer C	Hummer Bay, Wells	425	0.03		0.03		pink	224-10-14240	Seward D-4
Northwestern	224	Blackstone C	Blackstone Bay	451	0.04		0.06		chum	224-10-14510	Seward D-4, Seward C-4
Northwestern	224	Paulson C	Cochrane Bay	455	0.04	96.2	0.06		chum	224-10-14550	Seward C-4
Northwestern	224	Wickett C	Cochrane Bay	469	0.04	84.9	0.06		pink	224-10-14690	Seward C-4
Northwestern	224	W. Finger C	W. Finger Inlet, Nellie Juan	485	0.04	99.2	0.06	96.9	pink & chum	224-40-14850	Seward C-4
Eshamy	225	Comstock C	Main Bay	504	0.52		0.05		pink	225-20-15040	Seward C-3
Eshamy	225	Loomis C	Eshamy Bay (north of)	506	0.52	28.9	0.05		pink	225-30-15060	Seward B-3
Southwestern	226	Ewan C	Ewan Bay (lagoon)	603	0.18		1.00		pink	226-20-16030	Seward B-4
Southwestern	226	Jackpot R	Jackpot Bay	608	0.18	94.8	1.00		pink	226-20-16080	Seward B-4
Southwestern	226	Bainbridge C	Whale bay (west arm)	630	0.18		1.00		pink	226-20-16300	Seward A-4
Montague	227	Swamp C	Mointague Strait (Mont. Is. S Prt Ch.)	739	0.11	96.2	0.91		chum	227-20-17390	Seward A-1
Montague	227	Cabin C	Port Chalmers	747	0.11		0.91		chum	227-20-17464	Seward B-1
Montague	227	Gilmour C	Mointague Strait (Mont. Is. N Prt Ch.)	748	0.11		0.91		pink	227-20-17480	Seward B-1
Montague	227	Rocky C	Rocky Bay	759	0.11		0.91		pink	227-20-17590	Seward B-1
Southeastern	228	Constantine C	Constantine Harbor	815	0.22	100.0	0.01	98.0	pink & chum	228-60-18150	Cordova B-7
Southeastern	228	Double C	Double Bay, Orca Bay (mud flats)	837	0.22		0.01		chum	228-40-18310	Cordova B-7
Southeastern	228	Widgeon C	Hawkins Cuttoff (mud flats)	837	0.22		0.01		pink	228-20-18370	Cordova B-7

Individual samples will be indentified by their tray number and tray position number as well as a fish ID that will be given to each fish as data is collected in the stream. The sample trays will be labeled with a bar code using bar coding devices that will be provided by ADFG. Recorded data will include the date, stream ID (name and number), GPS data, stream reach if applicable, species, sex, and mid-eye to hypural plate length. The stream reach datum will include whether or not the sample is from the intertidal zone. Otoliths will be prepared for analysis and stored in the 96 sample trays as outlined in the ADFG "Port Sampling Instructions" document on the live-aboard after each day's sampling. At this time on-line data entry will also be accomplished. This will enable the project leader in Cordova to continuously track sampling progress.

PWS Sampling for Pedigree/Fitness Studies. Whereas a representative sampling of PWS streams for pink and chum salmon is the purpose of the otolith–based straying study, the study addressing fitness will sample intensively for pedigree analysis a small set of streams stratified by a pre-defined straying rate. Streams will be sampled in two seasons. As outlined above in *PWS Otolith Sampling,* otoliths and fin clips for DNA analysis will be collected from each adult sampled during the summer. Otoliths will allow determination of adult origin (wild or hatchery). The second season of sampling will be in March the following year, when alevins will be sampled for DNA. There will thus be three summer field seasons: 2013, 2014, and 2015. These will be followed by three March alevin samplings in 2014, 2015, and 2016.

Six streams will be selected in PWS for the intensive sampling needed for the fitness study using the specified criteria from the 0.02 tables in the RFP. We will use stray rate data already collected by ADFG (Brenner et al. 2012). The streams listed in Table 4 are a starting point in stream selection. Preliminary stray rates are indicated in Table 4; this will be done for the remainder (i.e., the 0.02 streams). The selected streams will have a target spawning population size of approximately 3,000 as called for in the RFP. However, within the provisionally selected streams (Table 4), most streams of interest have greater than an order of magnitude range in run size. The project leader will discuss with the ADFG genetics lab personnel how this could affect the analysis, how to optimize stream selection and sampling, and will adjust accordingly.

Table 4. Listing of potential PWS pedigree study streams taken from the 0.03 RFP tables that best meet the straying rate criteria. Run size data obtained from ADFG (Steve Moffitt, pers. comm.).

Even year mean pink run size	Odd year mean pink run size	Minimum run size	Maximum run size	Stream category	% wild pink from Brenner et al 2012	Stream name	Stream number	ADFG stream code
11,700	14,900	1,500	43,800	Low stray	98.1	Hartney C	2	221-10-10020
16,100	9,000	1,400	32,600	Low stray	92.8	Vanishing C	216	222-10-12157
4,000	2,800	2,100	7,500	High stray	66.2	Schoppe C	273	222-30-12730
9,600	5,500	1,700	29,000	Low stray	98.0	Meacham C	430	224-10-14300
3,800	4,100	400	9,800	High stray	66.4	Totemoff C	621	226-20-16210
6,300	6,100	500	18,100	High stray	70.5	Johnson C	655	226-40-16269

The above data were provided by ADFG which disclaims any errors, difficiencies, subsequent analyses and interpretations; values rounded to nearest 100

We will generate spawning ground maps in 2012 during a preliminary survey that will be used to finalize fitness study stream selection. A set of candidate streams will be surveyed and based on those results we will select the six streams. Baseline maps of the six streams will be prepared that provide sufficient resolution to enable redd mapping. This will be used to inform sampling of alevins. These maps will be used by field crews to locate areas with pink salmon redds during each adult sampling trip. We will take GPS readings at each stream reach that will be noted as well. Positions of significant landmarks such as large trees and rock outcroppings will be surveyed and marked on the maps to aid enable orienting the maps at alter dates. The landmarks will be marked by surveyors tape when feasible and marked on the maps along with GPS locations. This will enable accurate positioning during later alevin sampling. Additionally, we may take high-viewpoint photographs of stream reaches to supplement the maps depending on the quality of maps attainable. We will use the most practical combination of maps and photographs to indicate locations of pink salmon redds within each stream reach on each adult sampling trip. We will obtain high-resolution aerial photographs to aid in map making.

A goal during the 2012 preliminary field survey of the six streams to be intensively sampled will be to identify likely spawning reaches. In PWS, pink salmon may spawn from the intertidal as well as considerable distances (i.e., multiple km) upstream. The actual spawning reaches, however, are often discontinuous. Effective alevin sampling will depend on accurate placement of the sampling grid on these spawning reaches and not sections of the stream without spawning.

We propose to establish a within-stream classification system to aid our observations and code our data. Using a prepared map will expedite describing locations of spawning in subsequent sampling trips. Because stream geomorphology can sometimes change, it will be necessary to have discrete maps of each spawning reach to be able to apply a sampling grid. For example, the orientation with respect to compass direction will likely be different for each reach. Therefore the grids will not be aligned in parallel. Instead we will have multiple rectangular sampling grids. Each will have finite dimensions. This will enable tallying up the spawning area so that it can be divided into the RFP-defined number of sampling grid squares (1000). As well, we will incorporate findings learned by the SEAK group during their 2012 and 2013 preliminary surveys and testing of redd pumping methods, and implement them into the PWS study.

In March (the RFP-determined alevin sampling period), the areas around the streams will have a snow cover with a depth measured in meters. With reduced winter stream flow the locations will appear significantly different from the summer to fall season when we observed spawning. We anticipate a need to position the sampling grid to within ~ 1 meter to correctly superimpose sampling grids as outlined in the RFP. Sampling grid as outlined in the RPF will be super-imposed on maps of stream reaches. On arrival at the locations at time of alevin sampling, grids will be established using positions from the photographs and maps as well as GPS coordinates. There may be multiple grids according to the distribution of spawning reaches and redds noted the previous summer. The grids and squares within each grid will be numbered so that it will be possible to reconstruct the original location in the stream.

Once grids have been set up in streams, sampling for alevins will commence using a suction dredge as described by McNeil (1964) and improved by Collins et al. (2000). Due to the number of samples needed as described in the RFP, there will be two suction dredge teams working simultaneously in each stream. Once the prescribed sample set is obtained from a given stream grid set, the total number of samples obtained will be evaluated. If necessary, the grids will be re-sampled until the desired total is obtained. Each sample will be comprised of no more than 25 alevins from each grid-based square per the RPF (the rest will be released back into the stream). Each sample will be placed in a separate pre-labeled vial and preserved with ethanol as prescribed by the ADFG Genetics Conservation Laboratory ("Salmon Sampling Instructions" document downloadable from the GCL website; William Templin and Judy Berger, ADFG, pers. comm.).

For each composite alevin sample (one vial) data will include the pre-labeled vial number, the number of alevins in the vial, a stream-specific sample number, a stream ID (name and number), GPS data, a stream reach – grid number if multiple grids, grid square (redd) number, and the sampling date. The stream reach datum will include whether or not the sample is from the intertidal zone.

For each adult salmon sampled for the pedigree/fitness study we will obtain otoliths, up to 500 fish per stream in high-stray-rate streams, and 1,000 fish per stream in low-stray-rate streams, and a fin clip will be taken from the same fish for DNA analysis. Samples will be taken from spawned out fish, either when still living or as fresh carcasses. For DNA, a bony fin clip (dorsal, anal, pectoral, pelvic, or caudal) will be collected from each sampled adult and preserved in individually marked, non-denatured ethanol-filled vials. We will also collect phenotypic data (e.g., sex, length) which will be associated with the fin clip sample identifier and sample date. In addition to the data described above, there will also be a genetics sample number per fish. These

various numbers and data sets will enable the project leader to merge the disparate data sets being collected.

SEAK Stream Sampling

Specific methods for SEAK stream sampling will be essentially the same as described for PWS. However, SEAK streams are further separated, especially among the three sub districts: Southern Southeast, Northern Inside, and Northern Outside, so the extreme distances between streams will influence some of the field logistics.

Thirty-four streams will be sampled in Southeast Alaska for chum salmon otoliths and four of those for additional genetic tissue sampling (Table 5, Figure 4). The streams are generally grouped into three regions: seven in Southern Southeast (inside waters from Sumner Strait to Dixon Entrance); 24 in Northern Southeast Inside (inside waters north of Sumner Strait); and three in Northern Southeast Outside (outside waters of Chichagof and Baranof islands) (Figure 4).

Four of the streams will be intensively sampled for adult otoliths, genetic tissues, and subsequent alevins to support the pedigree/fitness studies. The four index streams we propose to intensively sample are: Fish and Sawmill creeks (high straying – Piston and Heinl 2012), and Saltery Bay Head and Swan Cove Creek (low straying– Piston and Heinl 2012) for the fitness studies, subject to discussions with the Department.

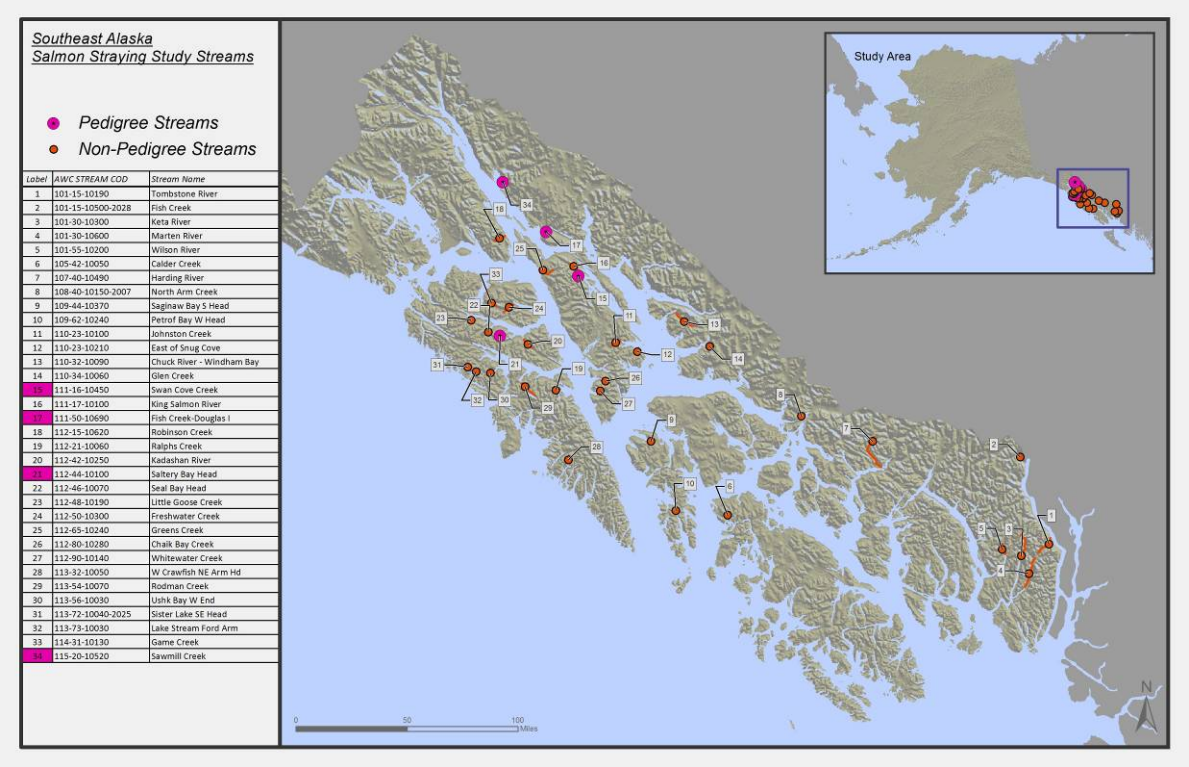
The streams in Table 5 mostly correspond to the list suggested in the RFP, except that Sawmill Creek was added because it is a good candidate for a high-straying, small-population, intensively monitored stream, and the Berners River was dropped because it is adjacent to Sawmill Creek (but much larger). Two suggested streams, West Bay Head Creek, and Weir Creek North Arm are proposed to be removed from the suggested list because they are in very close proximity to other similar suggested streams and considered to be redundant.

Stream Access for SEAK Adult Sampling. The average range of summer chum spawn-out and carcass availability in SEAK is between late July and early September with the peak abundance in the middle two weeks of August (Andy Piston, ADFG, personal communication). Sampling events will vary for each stream, depending on chum salmon abundance, run timing, and weather. We will communicate regularly with ADF&G area management biologists about the results of their in-season aerial surveys to gauge the availability of carcasses at target streams and direct our sampling crews to the areas most likely to be productive for sampling. Every effort will be made to collect samples throughout the accessible length of the stream on each sampling event.

Table 5. Streams to sampled in Southeast Alaska. Shaded streams are those tentatively selected for the intensive pedigree sampling.

ADF&G Region 1 Stream Number	Anadromous Waters Catalog Number	Name	Av % Stray (Piston and Heinl 2012)	Av recent peak esc (Piston and Heinl 2011)
101-15-019	101-15-10190	Tombstone River		8000
101-15-085	101-15-10500-2028	Fish Creek	0.8	3200
101-30-030	101-30-10300	Keta River		12000
101-30-060	101-30-10600	Marten River	1.4	3500
101-55-020	101-55-10200	Wilson River		8000
105-42-005	105-42-10050	Calder Creek		2500
107-40-049	107-40-10490	Harding River	5.3	7500
108-41-010	108-40-10150-2007	North Arm Creek		1100
109-44-037	109-44-10370	Saginaw Bay S Head		1500
109-62-024	109-62-10240	Petrof Bay W Head		900
110-23-008	110-23-10100	Johnston Creek		1500
110-23-040	110-23-10210	East of Snug Cove		1100
110-32-009	110-32-10090	Chuck River - Windham Bay		1300
110-34-006	110-34-10060	Glen Creek	8.0	1400
111-16-040	111-16-10450	Swan Cove Creek	9.0	800
111-17-010	111-17-10100	King Salmon River		3500
111-50-069	111-50-10690	Fish Creek-Douglas I	78.8	1900
112-15-062	112-15-10620	Robinson Creek	17.1	1300
112-21-006	112-21-10060	Ralphs Creek	6.2	3800
112-42-025	112-42-10250	Kadashan Creek		3000
112-44-010	112-44-10100	Saltery Bay Head	1.8[a]	2000
112-46-009	112-46-10070	Seal Bay Head	1.8	5000
112-48-019	112-48-10190	Little Goose Creek		4500
112-50-030	112-50-10300-2001	Freshwater Creek	11.6	1200
112-65-024	112-65-10240	Greens Creek		1500
112-80-028	112-80-10280	Chaik Bay Creek	5.5	4500
112-90-014	112-90-10140	Whitewater Creek		3500
114-31-013	114-31-10130	Game Creek	4.3	4000
113-54-007	113-54-10070	Rodman Creek		6000
113-56-003	113-56-10030	Ushk Bay W End		4500
	115-20-10520	Sawmill Creek	62.5	1500
113-72-005	113-72-10040-2025	Sister Lake SE Head	0.5	7000
113-73-003	113-73-10030	Lake Stream Ford Arm	6.9	1900
113-32-005	113-32-10050	W Crawfish NE Arm Hd	2.1	6000

In summer of 2012, the four streams to be intensively studied (Table 5) will be visited once each for 1-2 days of preliminary reconnaissance. One of the streams (Fish Creek on Douglas Island), can be accessed by road. The other three will be accessed by boat. One 3-person field crew will be required over approximately two weeks to complete the preliminary reconnaissance. Otoliths will be collected from each stream to further validate the observed straying rate in the three previously sampled streams and to ensure that the straying rate is low in Saltery Bay Head Creek which has never been sampled for straying (although its closely neighboring Seal Bay Head Creek has been observed to have very low straying). Spawning patterns and locations will also be preliminarily observed so that mapping methods can be refined as the basis for establishing the future geospatial grids required for eventual alevin sampling. We will also collect scale samples from the same fish sampled for otoliths to estimate the age structure.



Label	AWC STREAM COD	Stream Name
1	101-15-10190	Tombstone River
2	101-15-10500-2028	Fish Creek
3	101-30-10300	Keta River
4	101-30-10600	Marten River
5	101-55-10200	Wilson River
6	105-42-10050	Calder Creek
7	107-40-10490	Harding River
8	108-40-10150-2007	North Arm Creek
9	109-44-10370	Saginaw Bay S Head
10	109-62-10240	Petrof Bay W Head
11	110-23-10100	Johnston Creek
12	110-23-10210	East of Snug Cove
13	110-32-10090	Chuck River - Windham Bay
14	110-34-10060	Glen Creek
15	111-16-10450	Swan Cove Creek
16	111-17-10100	King Salmon River
17	111-50-10690	Fish Creek-Douglas I
18	112-15-10620	Robinson Creek
19	112-21-10060	Ralphs Creek
20	112-42-10250	Kadashan River
21	112-44-10100	Saltery Bay Head
22	112-46-10070	Seal Bay Head
23	112-48-10190	Little Goose Creek
24	112-50-10300	Freshwater Creek
25	112-65-10240	Greens Creek
26	112-80-10280	Chalk Bay Creek
27	112-90-10140	Whitewater Creek
28	113-32-10050	W Crawfish NE Arm Hd
29	113-54-10070	Rodman Creek
30	113-56-10030	Ushk Bay W End
31	113-72-10040-2025	Sister Lake SE Head
32	113-73-10030	Lake Stream Ford Arm
33	114-31-10130	Game Creek
34	115-20-10520	Sawmill Creek

Figure 4. Locations of sampling streams in Southeast Alaska. Shaded streams in the list are proposed to be the intensively sampled streams for the pedigree studies.

In the summers of 2013, 2014, and 2015, the 30 streams for the hatchery-wild straying studies only (Table 5) will be visited two times each, plus the 4 intensive fitness study streams (Table 5) will be visited three times each for a total of 72 stream visits over the period of summer chum spawning. The 30 SEAK summer chum straying-only streams will be sampled for up to 384 otolith samples per stream in two visits. We estimate one day of work for each of these field visits. The four intensively sampled streams are estimated to require two days of field work per visit. We therefore estimate a total of 84 field days (not counting training, preparations, transit, weather conditions and other unforeseen events) for all the summer adult sampling in SEAK. We will need two 4-person crews to complete this work over an 8-week period (56 total days available for each crew to complete 42 days of field work).

The most effective way to distribute the work and to enable covering the wide geographic range of streams in SEAK is via the contracting of two live-aboard boats. There will be a southern crew and a northern crew. The vessels will move from location to location at night while the crew is sleeping, and anchor during the day while the crew is accessing a stream. Each vessel will be equipped with a zodiac and/or small jet boat for accessing the stream mouths. The crews will also be outfitted with camping gear so that they can remain ashore if necessary for efficiency or safety. Depending on the stream configuration and spawner distribution of the fitness study streams, carcass weirs may be necessary to ensure adequate numbers of spawned-out fish are sampled, especially in the low-stray-rate streams.

Spring Alevin Sampling Access and Timing.- Similar to the access logistics for adult stream sampling, the spring alevin sampling will require access to the four intensively studied streams in

March of each year. One stream (Fish Creek) is accessible by road from Juneau, another by airboat or jet boat from Glacier Highway north of Juneau, and the other two require a live-aboard charter for the 4-person crew. For full alevin sampling, three field days are required at each of the four streams, for a total 12 field days not including training, preparations, transit, weather conditions and other unforeseen events.

In March 2013, we will conduct preliminary reconnaissance and alevin collection for genetic analysis. Redd pumping gear and stream access under late winter conditions will be evaluated. Information from this preliminary reconnaissance and method testing will be shared with the PWS team. Because the full sampling of parents begins in 2013, the first complete alevin sampling of the four intensive streams will begin in March, 2014 and then continue in March 2015 and 2016.

Biological Sampling Methods. - Specific methods for otolith collection, tissue collections, and data management will be the same as for PWS and are described above.

Hatchery Straying Studies.- The proportions of hatchery and wild spawners will be determined in the 36 streams similarly to PWS by collecting otoliths from up to 384 adult summer chum salmon per stream in combination, during two visits to each stream. As in PWS, since we will only be able to fully evaluate relative run timing within a stream at the end of the season, it will be necessary to over-sample for otoliths on the first visit to ensure obtaining up to 384 samples. For example, on the first sampling trip it will be unknown whether the spawn-outs and carcasses present represent only a small portion or a major portion of the overall run of that year. In SEAK, we will use a simple guideline of sampling up to 150 males and 150 females on the two sampling trips (except for the pedigree study streams – see next section)

Pedigree/Fitness Studies.- In four of the streams, additional otoliths will be collected, up to a total of 500 per stream in high-stray-rate streams, and 1,000 per stream in low-stray-rate streams, and tissues will be taken from the same fish for DNA analysis. We will attempt to over-sample on each visit to the pedigree study streams to ensure adequate numbers of samples if there are no spawn-outs available on the last visit (i.e., 250 per stream per visit in low-staying streams and 500 per visit in high-straying streams).

Samples will be taken from spawned out fish, either when still living or as fresh carcasses. Otoliths and a bony fin clip (dorsal, anal, pectoral, pelvic, or caudal) will be collected from each sampled adult and preserved in individually marked, non-denatured ethanol-filled tubes. We will also collect phenotypic data (e.g., sex, length) that will be associated with the tissue sample identifier and sample date. Depending on the configuration and spawner distribution of the fitness study streams, carcass weirs may be necessary to ensure adequate numbers of spawned-out fish for sampling, especially in the low-stray-rate streams.

During the adult sampling process, the extent of the spawning area in each stream will be defined and mapped. We will employ a combination of GPS, GIS, and on-the-ground benchmarking to map and relocate the spawning areas and to develop the stratified sampling grid which is described further under Alevin Sampling below.

Alevin Sampling. - Alevins will be collected from each study stream by hydraulic sampling ("fry-pumping") in March following the spawning year. We will use a portable pump to extrude and

capture alevins within a standard 0.5-m diameter sample basket. A stratified sampling grid will be developed for each stream, with 1,000 sample sites equally spaced to cover the area of spawning mapped the previous fall. Initially, every fourth site starting with site 1 and continuing to site 997 will be sampled, so that a minimum of 250 standard samples are taken from each stream. All alevins from each sample site will be sorted by species and the chum salmon will be counted. Up to 25 chum salmon alevins will be retained for genetic analysis in sample-specific ethanol-filled vials; the rest will be released back into the stream. Sampling will proceed in an upstream direction. If at least one alevin is captured at 200 or more sites, sampling will be considered adequate. Otherwise, samplers will return to the start of the grid and sample every fourth site, starting with site 2 and continuing until the minimum target sample size (200 with at least one alevin) or to site 998. In the latter case, the process would be repeated until the minimum sample size is attained or all 1000 sites are sampled.

Sample Deliveries

Sample handling and delivery will follow the guidelines outlined by the ADFG labs that will be processing the samples.

Processing and Shipping.- Otolith samples will be cleaned and packaged in 96-sample trays. Otolith cleaning from stream samples will take place onboard the live-aboard vessels following each sampling excursion. Otolith cleaning from ocean samples will take place in the Chenega lab described above. At the end of each sampling season, the project leader of each sub-project will contact the ADFG Otolith Processing Lab and make arrangements for shipping of their samples to Juneau. This will be done using a trackable method such as Express Mail or via Alaska Airlines.

Genetics samples will be preserved in alcohol, which is considered a hazardous material (hazmat). Personnel at the ADFG suggested shipping samples to them using Alaska Marine Lines (AML). Accordingly at the end of each sampling season, the project leader of each sub-project will contact their local AML office obtain the necessary documents and packing materials for hazmat and ship via their samples to the ADFG Genetics Conservation Lab in Anchorage.

Number of samples.- As requested in the RFP, 384 otolith samples (pairs) are to be collected from each straying-only stream, 500 adult otolith pairs and DNA tissue samples from each low-straying pedigree stream, and 1,000 otolith pairs and DNA samples from each high-straying pedigree stream. Because of the "oversampling" described above, the number of samples collected from the field will be greater. ADFG lab personnel will then randomly select the appropriate number of pairs to actually process. The RFP also calls for about 2,500 alevin sampled from each of the pedigree streams. We therefore estimate the number of otolith, adult DNA tissue samples, and alevin samples from PWS and SEAK streams to be delivered to the two ADFG labs for Phase One as follows:

	Number of streams	Maximum samples collected per stream	Number to be subsampled per stream by ADFG lab	Samples to be processed by ADFG labs 2012[b]	2013	2014	2015	2016
Otoliths								
PWS chum	17	700	384		6528	6144	6144	
PWS pink	17	700	384		6528	8448	8448	
PWS pink pedigree[a]	6	750	500		3000	4500	4500	
SEAK chum	28	600	384	300	10752	11520	11520	
SEAK chum pedigree[a]	4	1125	750		3000	3000	3000	
Total otoliths				**300**	**29808**	**33612**	**33612**	
SEAK Chum Scales[c]	**4**	200	100	**400**	**400**	**400**	**400**	
DNA								
PWS pink adult[a]	6	750	500		3000	4500	4500	
PWS pink alevin	6	2500	2500			15000	15000	15000
SEAK chum adult[a]	4	1125	750		3000	3000	3000	
SEAK chum alevin	4	2500	2500			10000	10000	10000
Total DNA samples					**3000**	**19500**	**19500**	**15000**

[a] Average of 750 to be collected of 500 in low-straying streams and 1,000 in high-strayig streams

[b] Estimated number of trial samples to be delivered to ADFG labs

c Optional - suggested addition to allow estimation of the chum age structure for the fitness study

DATA MANAGEMENT, ANALYSIS, AND REPORTING

Data Management

A subcontractor will be retained initially to create a project database that will integrate all the samples in a geospatially referenced system. Emphasis will be on reliable methods for linking all data relevant to a given fish, such as otolith, genetic, morphometric scale, geographic location, etc. Further, we will confer with ADFG staff to create a system, or modify an existing one, that integrates project data compatibly with ADFG systems. Data management will also focus on creating detailed metadata that is discoverable, understandable, and usable by ADFG.

All data collected for this project will be entered into electronic form in the field whenever possible for upload to the main database either in real time or as soon as communication with the database is possible. That way, the project manager, project leaders, and ADFG personnel can be rapidly updated on the status of data collection. All data will be geo-spatially referenced so that it relates to a specific stream and, where appropriate, to a specific location in a stream. Hand-written field books (Rite-in-the-Rain) will be maintained to back up the electronic information. The PWSSC will also back up all of the data collected on a second server.

Data Analysis

Data analysis under this Phase One proposal will be performed by the Project Manager and the Project Leaders following guidance in the RFP.

We will calculate the following estimates for PWS and SEAK as soon as we have the results of the hatchery-wild proportions returned from the ADFG lab:

- number of wild salmon spawning in the wild;
- number of hatchery salmon spawning in the wild (hatchery strays);
- production of hatchery salmon (including hatchery strays); and
- production of wild salmon (excluding hatchery strays).

We will estimate the fraction of the total run (from ocean sampling in PWS and from commercial catches in SEAK) and the fraction of spawning abundance composed of hatchery salmon (from the hatchery-wild proportions estimated for the streams). These two fractions can be expressed as

functions of catches (which are known), broodstock at the hatchery (which are known) and escapements to natural spawning systems (which are not). These two functions represent two equations with two unknowns (run size of wild salmon and the number of hatchery strays in the region). Solving these two equations will produce estimates of these numbers, and subsequently estimates of the four bulleted numbers above.

Estimates of Hatchery-Wild Proportions.- Upon receipt of the data from the ADFG lab analysis of otoliths in February of each year (Tom Taylor, ADFG, email letter), we will be able to estimate the hatchery/wild proportions in the test fishery and stray rates in each stream, district (PWS) or subregion (SEAK), and for the overall PWS and SEAK regions. For a given district, the fraction of hatchery fish and the variance for each district will be weighted by the aerial survey index in each of the three temporal strata in the district. The fraction of hatchery fish for PWS and SEAK overall will be weighted by the aerial survey abundance in each district. These hatchery-wild proportions will provide estimates of θ and λ described in the RFP. In SEAK, the hatchery-wild proportions can be derived from the commercial catch sampling, as described in the RFP, and will need to be provided to the project leaders by ADFG staff for inclusion in the total run size calculations.

Estimates of Hatchery and Wild Run Sizes.- Estimated run sizes will be calculated, as described in the RFP, as soon as hatchery-wild proportion data becomes available. The run sizes will be estimated for districts and subregions and for PWS or SEAK as a whole. Data from the ocean test fisheries will be used, for each transect, to calculate the proportion of hatchery fish in the run on each test fishing day, estimated as the average of the station proportions weighted by the station CPUE. The proportion of hatchery fish for the season is the average of the daily proportions weighted by the daily CPUE and extrapolated over all days. The hatchery-wild proportions of the annual run throughout PWS is the average of the transect proportions weighted by the transect CPUE. The overall estimates of the hatchery and wild run sizes will be calculated using the equations presented in the RFP to estimate R_H the size of the run of hatchery fish; R_W the size of the run of wild fish; S_H the number of hatchery strays that survive the fishery (and end up spawning); and S_W the number of wild fish that end up spawning.

Run size estimates for the district (PWS) and subregion (SEAK) will be attempted based on ancillary information to guide the proportional breakout of the overall estimates. For example, the relative proportions of fish observed in aerial surveys, weighted by the number of times streams were successfully flown, could potentially be used to calculate the relative run sizes of hatchery and wild fish by district. We will consult with ADFG biometricians regarding the best approach for using these ancillary data to discriminate the district or subregion estimates.

All genetic fitness analysis for the pedigree studies will be performed by ADFG scientists.

As described in the Project section above, there are a number of other analyses that are possible with the data being collected. We recognize that these analyses were not called for in the RFP, so they are not included in the bid. However, PWSSC scientists have the expert capabilities and interest to collaborate with ADFG scientists on such analyses under future contracts.

Reporting

Written reports.- Reports will be made to ADFG as described in the RFP and shown in Figure 1. Proposed reports will consist of complete description of preceding field data methods and the data collected. Reports will include any analyses that can be made with the data available up to that time. Reports will be progressive, i.e., will include all data and analyses from the beginning of the project up to the date of the report. Annual progress will be submitted in December of each year, except that the final report will be submitted in January of 2016, so that it can be reviewed by ADFG staff and then revised based on their comments prior to the March, 2016 contract end date.

Workshops. – The Project Manager and one or more Project leaders will host a workshop in late November or early December of 2013 to provide ADFG staff with an in-person overview of the progress made and challenges encountered, so that mid-course adjustments can made if necessary. As requested in the RFP, we will host a workshop in February of 2016 to summarize the data collected and the findings to that date.

Management Plan

The project will be conducted under the overall management of the Prince William Sound Science Center (PWSSC). PWSSC staff members have the scientific capabilities, practical experience, and administrative capacity to successfully manage this large project. All contract management, administrative requirements, personnel management, and subcontracting will be managed by PWSSC in Cordova. Because of the project's complexity and huge geographic coverage some portions will be subcontracted to other organizations and private vendors. In particular, the SEAK stream sampling portion of the project will be contracted to SSSC in Sitka and all vessel needs will be by contract from PWSSC.

Project Organization

The overall structure of the management relationships is illustrated in Figure 5. The senior official for the project is Ms. Katrina Hoffman, President and CEO of the PWSSC. Ms. Hoffman will delegate implementation of the project to Project Manager Dr. Eric Knudsen, who will provide his service under contract to PWSSC. Dr. Knudsen will be responsible for ensuring that all aspects of the project are carried out efficiently, within budget, with the highest level of attention to scientific methods, and with adherence to all safety and training policies. He will routinely coordinate with the three Project Leaders described below, and their staff members, to ensure success of the project. He and the Project Leaders will develop written protocols for the field crews. Dr. Knudsen will also lead the team of Project Leaders in the data analysis and reporting required under the contract. Dr. Knudsen will also coordinate with the database contractor on the appropriate system to develop in support of the project.

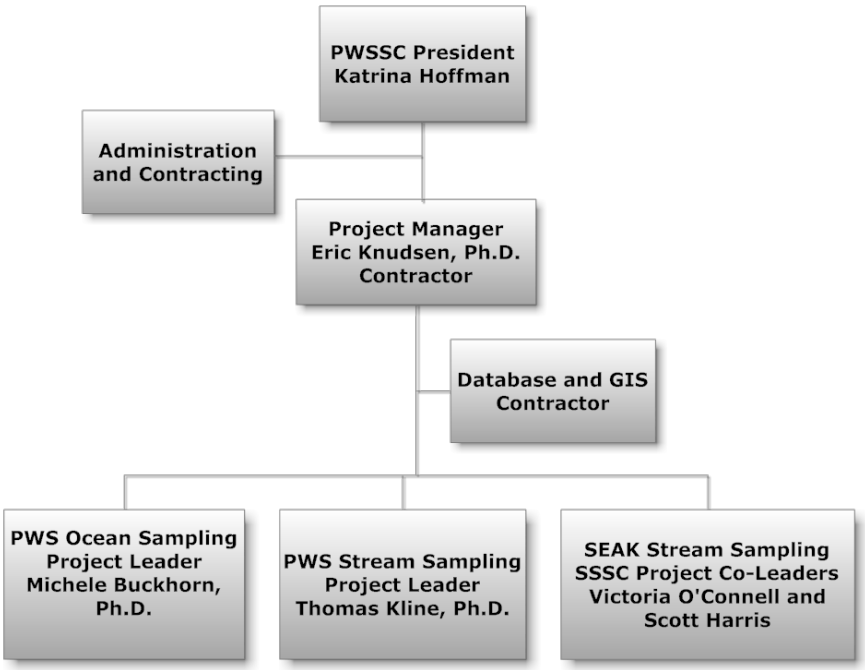


Figure 5. Organizational structure for PWSSC hatchery-wild research project management.

Each of the three major sampling components will be supervised by a project leader who will coordinate and direct the activities of the respective sampling. The project leaders will be responsible for logistical planning and execution, hiring and training field teams, and scientific rigor of the sampling activities.

Ocean sampling.- The ocean sampling project leader will be Dr. Michele Buckhorn, PWSSC staff scientist. Because the ocean sampling is basically the same as commercial fishing techniques, the fish collection will be contracted to fishermen. Dr. Buckhorn and/or one temporary technician or will be aboard the contracted vessel(s) at times to observe and train the crew. Dr. Buckhorn and/or the technician will also process all the fish samples for otolith removal and processing, as well as the measurement and recording of all ancillary data.

PWS stream sampling.- PWS stream sampling will be managed by Dr. Thomas C. Kline and the operation will be based from the PWSSC in Cordova. Tom is an expert in salmon ecology and research. Under the Project Manager's guidance, he will hire, train, and deploy field crews to execute the field protocols in PWS streams. A live-aboard vessel will be chartered from a PWS community.

SEAK stream sampling. – The SEAK stream sampling Co-Project Leaders will be Victoria O'Connell and Scott Harris of the Sitka Sound Science Center. Between the two, they have extensive experience with implementing field projects in Southeast Alaska. Under the Project Manager's guidance, they will hire, train, and deploy field crews to execute the field protocols. The SEAK operations will be based out of Sitka and managed by SSSC who will supervise the entire operation under the guidance of the Project Manager. Live-aboard vessels will be chartered from Southeast communities.

Schedule

The overall schedule of sampling, analysis, and reporting is summarized in Figure 1. A summary of the expected timing of major activities is:

Year	Season	Activity
2012	Summer	Preliminary trials of the ocean sampling. Initial reconnaissance on the 10 intensive streams to begin mapping Collect otoliths from potential intensive streams where the stray rates are uncertain
2013	Spring	Preliminary evaluation of the redd pumping techniques on one or more SEAK streams
	Summer	PWS Ocean sampling PWS and SEAK streams sampling – extensive and intensive
	Winter	Annual progress report and workshop
2014	Spring	Intensive alevin sampling in PWS and SEAK
	Summer	PWS Ocean sampling PWS and SEAK streams sampling – extensive and intensive
	Winter	Annual progress report
2015	Spring	Intensive alevin sampling in PWS and SEAK
	Summer	PWS and SEAK streams sampling – extensive and intensive
2016	Winter	Annual progress report and workshop
	Spring	Intensive alevin sampling in PWS and SEAK

Deliverables

The deliverables for this project include 1) access to the project database, 2) the large number of samples described under Sample Delivery above, 3) the annual progress reports and the final report, and 4) two workshops.

Experience and Qualifications

Experience and qualifications of the responsible official, the project manager, and the project leaders are briefly summarized below. Detailed CVs for each are attached in the Appendices.

Ms. Katrina Hoffman, President and CEO of the PWSSC will be the responsible official on the contract. Ms. Hoffman is the President and CEO of the Prince William Sound Science Center, a 501(c)(3) research and education institute located in Cordova, Alaska. She is also Executive Director of the Oil Spill Recovery Institute. She is the administrative Principal Investigator of a five-year, multimillion-dollar Long Term Monitoring Program funded by the Exxon Valdez Oil Spill Trustee Council. She sits on the board of the Alaska Ocean Observing System and also holds a seat on the North Pacific Research Board. Hoffman earned a Master's degree in marine policy at the University of Washington. She worked for Washington Sea Grant at the University of Washington, focusing on West Coast shoreline management policy and international sustainable shoreline development programs. For two years, she served as Chairperson of the Sustainable Coastal Communities Action Coordination Team for the West Coast Governors' Agreement on Ocean Health. Their work resulted in a policy action plan for the three states of Washington, Oregon and California to jointly focus on economic development, sustainable aquaculture and fisheries, non-consumptive tourism and recreation, and ports and clean marinas.

She is an experienced, certified science educator and has spent over 2,000 hours at sea conducting ship-based biological oceanography and marine science research for the Monterey Bay Aquarium Research Institute and Occidental College.

Dr. Eric Knudsen will serve as the overall Project Manager. He has extensive experience managing large and complex projects. He is the retired Chief of the Marine and Freshwater Ecology Branch at the USGS Alaska Science Center. Dr. Knudsen is a veteran, having served honorably in the U.S. Coast Guard from 1966 to 1970. He earned his B.S. degree in fisheries science from the University of Massachusetts and an M.S. in fisheries science, and a Ph.D. in wildlife and fisheries science from Louisiana State University. He has 37 years post-baccalaureate experience in fisheries and wildlife, much of which has been concentrated on research and management of Pacific salmonids in Alaska and the Pacific Northwest. During his career with the U.S. Fish and Wildlife Service and the U.S. Geological Survey, and recently as an independent consultant, Dr. Knudsen has been involved in researching salmonid ecology, population status and trends, and habitat interactions. He has many professional publications and is the senior editor of three books on salmon science and management. Dr. Knudsen is a Past President of the Washington–British Columbia Chapter and the Western Division, American Fisheries Society. He currently chairs the Board of Directors of the Prince William Sound Science Center and is the volunteer Research Program Director for the Sustainable Fisheries Foundation. He is also a Co-Founder of Ecologists Without Borders. Dr. Knudsen has won numerous awards, the highest of which is the prestigious Award of Excellence of the Western Division, AFS.

Dr. Thomas. C. Kline, Jr., will serve as the Project Leader for PWS stream sampling.
Dr. Kline has managed numerous large-scale projects and collaborated on multi-disciplinary, multi-investigator, and multi-institutional projects including Sound Ecosystem Assessment (SEA) and Northeast Pacific Program of U.S. Global Ocean Ecosystem (NEP- U.S. GLOBEC) that focused on the Gulf of Alaska region.
From approximately two decades of research experience, Dr. Kline has extensive familiarity with the Prince William Sound ecosystem. Dr. Kline is particularly knowledgeable on the Sound's wild and hatchery salmon populations, which includes peer-reviewed publications dealing with wild and hatchery salmon ecology and recruitment. Dr. Kline has over two decades of peer-reviewed publications addressing the ecology of salmonids that span the geography of Alaska – from the North Slope to Southwestern Alaska and to Southeastern Alaska. Dr. Kline has more than three decades of field experience working in Alaskan freshwater salmon habitats. Dr. Kline has sampled or collected observational data of all salmonid life stages, from adults to eggs, alevins, fry, and smolt. He has conducted aerial surveys of salmon on spawning grounds and has had aerial photographs published. Dr. Kline has systematically sampled otoliths from spawned-out salmon. Dr. Kline has made extensive observations of salmon run timing, species interactions, and spawning behavior in Prince William Sound area streams and has extensive experience working in close proximity to brown and black bears in Alaska.

Dr. Michele Buckhorn will serve as the Project Leader for the PWS ocean salmon test fishery project. Her doctorate degree is in Ecology from the University of California, Davis, with an area of emphasis (AOE) in Marine Ecology. Dr. Buckhorn has extensive experience working in marine ecosystems along the Pacific Coast of the United States and Mexico as well as leading field teams in adverse and remote working conditions. She has worked with a variety of fish

species (grouper, salmon, sharks, and herring) investigating a variety of life history aspects (community ecology, reproduction and age and growth) as well as using advanced technologies to assess population and movement of fishes (hydroacoustics and telemetry). As a graduate student, she served as the U.C. Davis student chapter president for the Cal-Neva chapter of American Fisheries Society. She has written and illustrated a Guide to the Marine Fishes of the Gulf of California where she conducted her dissertation research.

Ms. Victoria O'Connell of the SSSC will co-lead the SEAK portion of the stream sampling. Ms. O'Connell is the operations manager for the Sitka Sound Science Center and has demonstrated skills at managing large, complex projects. She holds a Bachelors degree in Fisheries from the University of Washington and studied marine algae and invertebrates at Friday Harbor Marine Laboratories. Ms. O'Connell has 30 years of fisheries biology experience and leadership in Alaska. She served as Groundfish Project Leader for the Southeast Region groundfish project of Alaska Department of Fish and Game between 1995 and 2006 and was responsible for research and management of state managed groundfish in southeastern Alaska. O'Connell has been a PI on numerous research projects and at-sea surveys involving rockfish, lingcod, sablefish, marine habitats and marine mammal interactions with fisheries and has published journal papers and agency reports on these topics. These projects were funded by NMFS, National Undersea Research Center, Alaska State Department of Fish and Game, and the North Pacific Research Board. She also heads the National Science Foundation-funded Scientist in Residency Fellowship at the Science Center.

Mr. Scott Harris, M.Sc., will serve as the Co-Project Leader on the SEAK portion of the research in association with the SSSC. Mr. Harris is the Watershed Program Manager for the Sitka Conservation Society and was one of the founders of the Sitka Sound Science Center. He has extensive experience developing and managing federal / non profit collaborative projects in the fields of watershed restoration and ecological monitoring. He is currently the co-PI on the Sitkoh River Restoration Project. He also has over 10 years of experience leading large groups of students in extended wilderness expeditions (with the National Outdoor Leadership School), including managing risk and logistics for field work. He also worked as a wildlife research technician for multiple federal agencies. He has a B.S in Aerospace Engineering from the University of Texas and a M.S in Natural Resources Management from the University of Alaska Fairbanks.

Cost Proposal

The total cost for the project with all aspects requested in the RFP, except the third year of ocean sampling, is estimated at **$4,462,900**, which constitutes our formal, fixed-price bid under the RFP. If the third year ocean sampling were to be included, the cost is estimated to increase by $305,000 to $4,767,900. We have studied the RFP diligently and made the best bid we possibly can. PWSSC charges low overhead (30%) and we only charge overhead on the first $25,000 of contracts over that amount, therefore the overhead is extremely low on this bid (only 11% of the total cost of the project). A notable majority of the high costs of this project are in vessel charters made necessary by the nature of the research and the extreme geographical extent of the sampling locations.

We look forward to discussing this proposal and its budget with ADFG personnel if there is interest in reconfiguring the project within the budgeted amount. We chose the option of postponing the third year of ocean sampling because continuing the three cycles of adult stream sampling and the subsequent sampling of alevins seemed the higher priority. However, we recognize that ADFG may have different preferences for prioritizing activities under this project.

The detailed budget for the project is presented below in Table 6.

Personnel

All named personnel are permanent full-time Prince William Sound Science Center employees. Non-permanent employees that will be hired for the stream sampling will be temporary employees and expected to work seven days a week for ten hours per day during the field season. These employees will include a summer team leader, a summer assistant team leader, four summer technicians, and four March technicians. The field season consists of training and wrap-up periods as well as the duration spent in the field. Their monthly salaries will be year by year as indicated in the spreadsheet. All monthly dollar amounts for permanent full-time PWSSC employees include monthly salary and fringe benefits which cover health insurance, retirement, personal time off, worker's compensation and maritime worker's compensation. Monthly rates for temporary field technicians include regular pay, overtime, FICA, and worker's compensation. Pay for the Project Manager and all SSSC employees are covered under respective contracts.

Travel

The PWS Ocean sampling field station will be located in Chenega Bay on Evans Island. PWSSC personnel will rotate in and out every 2-3 weeks. Round-trip costs for Cordova Air are estimated to be $1000 per trip at 5 trips annually (2013-2015). The PWS Stream sampling Project Leader is budgeted for two round-trips from Cordova to Juneau or other location for one planning and/or scientific meeting per year. One round-trip from Seattle to Juneau, Sitka, and Cordova is budgeted for the Program Manager per year. Other travel required by the Project Manager will be covered from other sources. Travel for the Sitka based Project Leaders is budget within the SSC contract. A limited amount of travel and temporary lodging is also budgeted in the SSSC contract for the SEAK field teams in case of the need to move around SEAK.

Contractual

A majority of the costs for this project will be subcontracted by PWSSC to the SSSC for implementing the SEAK stream sampling and to vessel operators in PWS and SEAK. The costs for the Project Manager will also be contracted.

SEAK Stream Sampling.- All costs for the SEAK stream sampling, except vessel charters, will be subcontracted to the SSSC. SEAK staff will provide project leaders who will in turn hire, train, and deploy the field teams. Their subcontract will include all costs for field and lab equipment, data recorders, communications, safety equipment, training, travel, and supplies.

***Vessel Charters*.--** For the PWS ocean sampling, a vessel will be chartered in 2012 for one week to complete a late-season ocean test fishery, so we can test our proposed methods. In 2013 and 2014 the 17-week test fishery will be sent out to bid for a commercial fishing vessel and crew. The charter cost will include the vessel, one captain, one crew, fuel, and food costs.

The PWS stream sampling will also require vessel charters estimated at $2K/day. The proposal includes a 10-day survey effort in 2012 followed by a full season of sampling in the summer beginning in 2013 (90-day charters) and March alevin sampling to begin in 2014 (20-day charters). The summer sampling will occur from 2013 to 2015 and the alevin sampling will occur 2014 to 2016.

Live-aboard vessel charters for SEAK stream sampling are also budgeted under contracting. In 2012, we have accounted for six days of charter for preliminary surveys and otolith collection in the four pedigree/fitness streams. In 2013, there are 3 days of charter for preliminary testing of redd sampling methods in March and then a total of 94 days (two vessels) of charter for the summer stream sampling which continues annually though 2015. Beginning in March, 2014 and continuing through 2016, the budget includes 8 days of vessel charter each year for intensive sampling of alevins at the pedigree/fitness streams.

Database management. - In 2012, a private contractor will be retained to help project database and to ensure it conforms to ADFG functionality. Small amounts are budgeted annually for database maintenance.

Project Manager.- PWSSC will contract annually for the part-time services of the Project Manager. The budgeted amount for the Manager is based on $70/hr for one month of time in 2012, and then 3.4, 3.3, 3.4, and 1.5 months in the ensuing years.

Commodities

Commodities includes a variety of materials and supplies necessary for the field work, such as waterproof marine radios, cell phones, and field computing devices. This includes otolith extraction tools, trays, and chemicals for cleaning otoliths (according to Port Sampling Guide). It also includes all safety and other training. The SEAK commodities are included under the SSSC contract. Brailer bags for the oceans sampling catches are alos included under commodities.

Equipment

The ocean sampling will require the purchase of two and a half custom-made, 200-fathom gillnets. Due to the specialty nature of the gillnet (e.g. utilizing 5 panels of mesh sizes vs. 1-2 by the commercial fishery), we estimate net costs to be $8,200/net. Nets will be built in panels and then shackled together to achieve the 200 fathoms. A 3-panel middle net will be constructed for the 2012 test sampling, the outer mesh panels for the first net and a second net will be fabricated for the 2013-2014 fishing seasons. The ocean sampling will also utilize an automated Limnoterra fish measuring board IV/83. The Fish measuring board will be connected to a field laptop (Panasonic toughbook) to collect salmon morphometrics at the field camp and to transmit daily catch information to ADF&G.

Indirect Costs

PWSSC is eligible to charge a federally approved non-profit indirect cost (IDC) rate of 48% annually but only charges 30% on all personnel, travel, contractual, equipment, and commodities costs. However, for this contract, PWSSC will only charge IDC for the first $25K per large subcontract annually.

Table 6. Detailed Proposal Budget for CY2012-CY2016.

PWSSC PROPOSAL BUDGET FOR RFP 2013-1100-1020
"Interactions of Wild and Hatchery Pink and Chum Salmon in Prince William Sound and Southeast Alaska"

Budget Category:	Proposed CY 12	Proposed CY 13	Proposed CY 14	Proposed CY 15	Proposed CY16	TOTAL PROPOSED
Personnel	$35.9	$257.7	$300.9	$228.5	$82.7	**$905.6**
Travel	$3.3	$12.0	$14.1	$9.0	$4.4	**$42.8**
Contractual (total)	$118.7	$846.6	$914.6	$751.4	$146.1	**$2,777.4**
Commodities	$14.5	$63.1	$68.0	$54.0	$18.5	**$218.1**
Equipment	$18.2	$8.2	$0.0	$0.0	$0.0	**$26.4**
SUBTOTAL	$190.6	$1,187.6	$1,297.6	$1,042.9	$251.7	**$3,970.3**
Indirect @ 30% MTDC	$45.0	$131.6	$149.3	$121.3	$45.5	**$492.6**
PROJECT TOTAL	$235.5	$1,319.2	$1,446.9	$1,164.2	$297.1	**$4,462.9**
Other Resources (Cost Share	$0.0	$0.0	$0.0	$0.0	$0.0	**$0.0**

CY12	Project Title: WILD HATCHERY SALMON INTERACTIONS

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs		Sum
Michele Buckhorn (PWS Ocean sampling	PWS Ocean sampling PI	0.5	8.7		4.4
Megan McKinzie (PWS Ocean sampling)	PWS Ocean sampling technician	0.5	5.0		2.5
T. Kline (PWS stream sampling)	PWS Stream sampling PI	1.5	11.0		16.5
M. Hess (PWS stream sampling)	PWS Stream sampling Sr. tech	1.0	4.5		4.5
Stream sampling techs (2)	Stream sampling techs (2)	2.0	4.0		8.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
	Subtotal	5.5	33.2	0.0	
				Personnel Total	$35.9

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
1 R/T CDV JNO (PWS stream sampling)	0.6	1	3	0.2	1.2
1 R/T SEA JNO SIT CDV	0.9	1	6	0.2	2.1
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$3.3

Contractual Costs:	Contract
Description	Sum
Vessel charter for test fishing. 5 days @ $2500/day (PWS Ocean sampling)	10.0
vessel charter fuel for test fishing	0.9
printing/mailing/copying (PWS Ocean sampling) $50/man/month - 1 month	0.1
network/communication (PWS Ocean sampling) $140/man/month - 1 month	0.1
Vessel charter stream surveys 10 d @ 2K (PWS stream sampling)	20.0
network/communication (PWS stream sampling) $140/man/month - 3.5 months	0.5
printing/mailing/copying (PWS stream sampling) $50/man/month - 3.5 months	0.2
data plan for field phones $50/month/phone	1.2
SSSC for SEAK portion	47.5
Vessel charter for SEAK	12.0
Project Manager	11.2
Database development	15.0
Contractual Total	$118.7

Commodities Costs:				Commodities
Description				Sum
office supplies (PWS Ocean sampling)				0.5
PWS stream sampling field gear				6.0
PWS stream sampling gear for sampling				2.0
PWS stream sampling - Marine radio waterproof				1.0
PWS stream sampling - Weatherproof cell phone				1.0
PWS stream sampling - safety gear				1.0
PWS stream sampling - field computer device				1.0
Brailer bags 10@$200/each (PWS Ocean sampling)	10.0	0.2		2.0
			Commodities Total	$14.5

New Equipment Purchases:	Number	Unit	Equipment
Description	of Units	Price	Sum
200 fathom gillnet (PWS Ocean sampling)	1.0	8.2	8.2
LIMNOTERRA FMB IV/83 (PWS Ocean sampling)	1.0	5.0	5.0
FIELD LAPTOP (PWS Ocean sampling)	1.0	5.0	5.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
		New Equipment Total	$18.2

CY13	**Project Title: WILD HATCHERY SALMON INTERACTIONS**

Personnel Costs:		Months	Monthly		Personnel
Name	Project Title	Budgeted	Costs		Sum
Michele Buckhorn	PWS Ocean sampling PI	6.0	8.7		52.2
Megan McKinzie (PWS Ocean sampling)	PWS Ocean sampling tech	4.0	5.2		20.8
T. Kline (PWS stream sampling)	PWS Stream sampling PI	6.0	11.0		66.0
M. Hess (PWS stream sampling)	PWS Stream sampling Sr. tech	6.0	4.5		27.0
PWS stream sampling field team leader	PWS stream sampling field team	3.5	5.4		18.9
PWS stream sampling field assistant team	PWS stream sampling field team	3.5	4.8		16.8
PWS stream sampling field techs (4 ea. 14	PWS stream sampling field team	14.0	4.0		56.0
					0.0
					0.0
					0.0
					0.0
					0.0
	Subtotal	43.0	43.6	0.0	
				Personnel Total	$257.7

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
Air transport RT Port San Juan to Cordova (PWS Ocean sam	1.0	5			5.0
1 R/T CDV JNO (PWS stream sampling)	0.6	2	6	0.2	2.4
Air Charters (PWS stream sampling)	2.0	1			2.0
1 R/T SEA CDV JNO SIT	1.0	1	8	0.2	2.6
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$12.0

Contractual Costs:	Contract
Description	Sum
Fishing vessel with 1 captain and 1 crew - 17 weeks (PWS Ocean sampling)	175.0
Network/communication ($140/man/month) (PWS Ocean sampling) - 10 months	1.4
printing/mailing/copying ($50/man/month) (PWS Ocean sampling) - 10 months	0.5
Vessel charter summer stream sampling 90 d @ 2K (PWS stream sampling)	180.0
Network/communication ($140/man/month) (PWS stream sampling) - 19 months	2.7
Network/communication ($50/man/month) (PWS stream sampling) - 19 months	1.0
shipping includes hazmat (PWS stream sampling)	3.0
data plan for mobile device ($50/month/phone)	1.2
SSSC for SEAK portion	238.8
Vessel Charter for SEAK	200.0
Database management	5.0
Project Manager	38.1
Contractual Total	$846.6

Commodities Costs:	Commodities
Description	Sum
Ocean safety training ((PWS Ocean sampling)	0.5
Canvas-side field tent for Chenega Field Camp (PWS Ocean sampling)	15.0
Sampling supplies (PWS Ocean sampling)	3.0
Float coats/foul weather gear (PWS Ocean sampling)	0.6
PWS stream sampling field gear (waders, float coats rain gear)	9.0
PWS stream sampling gear for sampling	10.0
PWS stream sampling - Marine radio waterproof, cell phone, field computing device, safety gear	10.0
PWS stream sampling - lab supplies	10.0
PWS stream sampling - computer and office supplies	5.0
Commodities Total	$63.1

New Equipment Purchases:	Number	Unit	Equipment
Description	of Units	Price	Sum
200 FATHOM GILL NET (PWS Ocean sampling)	1.0	8.2	8.2
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
New Equipment Total			$8.2

CY14	Project Title: WILD HATCHERY SALMON INTERACTIONS

Personnel Costs:			Months	Monthly		Personnel
Name	Project Title		Budgeted	Costs		Sum
Michele Buckhorn	PWS Ocean sampling PI		6.0	8.7		52.2
Megan McKinzie (PWS Ocean sam	PWS ocean sampling tech		4.0	5.2		20.8
T. Kline (PWS stream sampling)	PWS Stream sampling PI		6.0	11.0		66.0
M. Hess (PWS stream sampling)	PWS Stream sampling Sr. tech		6.0	4.5		27.0
PWS stream sampling field team le	PWS stream sampling field team		3.5	5.4		18.9
PWS stream sampling field assista	PWS stream sampling field team		3.5	4.8		16.8
PWS stream sampling field techs (4	PWS stream sampling field team		14.0	4.0		56.0
PWS alevin sampling field techs (4	PWS stream sampling field team		8.0	5.4		43.2
						0.0
						0.0
						0.0
						0.0
	Subtotal		51.0	49.0	0.0	
					Personnel Total	$300.9

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
Air transport RT Port San Juan to Cordova (PWS Ocean sam	1.0	5			5.0
1 R/T CDV JNO (PWS stream sampling)	0.6	2	6	0.2	2.4
Air Charters (PWS stream sampling)	2.0	1			2.0
1 R/T SEA SIT JNO	0.9	1	10	0.2	2.9
1 R/T SEA CDV	0.8	1	5	0.2	1.8
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$14.1

Contractual Costs:	Contract
Description	Sum
Fishing vessel with 1 captain and 1 crew - 17 weeks (PWS Ocean sampling)	175.0
Network/phone ($140/man/month) (PWS Ocean sampling)	1.4
printing/mailing/copying ($50/man/month) (PWS Ocean sampling)	0.5
Vessel charter summer stream sampling 90 d @ 2K (PWS stream sampling)	180.0
Vessel charter March alevin sampling 20 d @ 2K (PWS stream sampling)	40.0
Network/communication ($140/man/month) (PWS stream sampling) - 19 months	2.7
Network/communication ($50/man/month) (PWS stream sampling) - 19 months	1.0
shipping includes hazmat (PWS stream sampling)	3.0
data plan for mobile device ($50/month/phone)	1.2
Vessel Charters for SEAK	216.0
SSSC for SEAK portion	251.9
Database management	5
Project Manager	37.0
Contractual Total	$914.6

Commodities Costs:	Commodities
Description	Sum
office supplies (PWS Ocean sampling)	1.0
cruise supplies (PWS Ocean sampling)	1.0
Canvas-side field tent for Chenega Field Camp (PWS Ocean sampling)	15.0
PWS stream sampling field gear (waders, float coats rain gear)	18.0
PWS stream sampling gear for sampling	10.0
PWS stream sampling - Marine radio waterproof, cell phone, field computing device, safety gear	10.0
PWS stream sampling - lab supplies	10.0
PWS stream sampling - computer and office supplies	3.0
Commodities Total	$68.0

CY15	Project Title: WILD HATCHERY SALMON INTERACTIONS

Personnel Costs:			Months	Monthly		Personnel
Name	Project Title		Budgeted	Costs		Sum
T. Kline (PWS stream sampling)	PWS Stream sampling PI		6.0	11.0		66.0
M. Hess (PWS stream sampling)	PWS Stream sampling Sr. tech		6.0	4.6		27.6
PWS stream sampling field team le	PWS stream sampling field team		3.5	5.4		18.9
PWS stream sampling field assista	PWS stream sampling field team		3.5	4.8		16.8
PWS stream sampling field techs (4	PWS stream sampling field team		14.0	4.0		56.0
PWS alevin sampling field techs (4	PWS stream sampling field team		8.0	5.4		43.2
			0.0	0.0		0.0
			0.0	0.0		0.0
			0.0			0.0
						0.0
	Subtotal		41.0	35.2	0.0	
					Personnel Total	$228.5

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
1 R/T CDV JNO (PWS stream sampling)	0.6	2	6	0.2	2.4
Air Charters (PWS stream sampling)	2.0	1			2.0
1 R/T SEA CDV SIT JNO	1.0	1	10	0.2	3.0
1 R/T SEA SIT JNO	0.8	1	4	0.2	1.6
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$9.0

Contractual Costs:	Contract
Description	Sum
Vessel charter summer stream sampling 90 d @ 2K (PWS stream sampling)	180.0
Vessel charter March alevin sampling 20 d @ 2K (PWS stream sampling)	40.0
Network/communication ($140/man/month) (PWS stream sampling) - 19 months	2.7
Network/communication ($50/man/month) (PWS stream sampling) - 19 months	1.0
shipping includes hazmat (PWS stream sampling)	3.0
data plan for mobile device ($50/month/phone)	1.2
Database management	5.0
SSSC for SEAK portion	258.5
Vessel charters SEAK	222.0
Project manager	38.1
Contractual Total	$751.4

Commodities Costs:	Commodities
Description	Sum
office supplies (PWS ocean sampling)	1.0
PWS stream sampling field gear (waders, float coats rain gear)	18.0
PWS stream sampling gear for sampling	10.0
PWS stream sampling - Marine radio waterproof, cell phone, field computing device, safety gear	10.0
PWS stream sampling - lab supplies	10.0
PWS stream sampling - computer and office supplies	5.0
Commodities Total	$54.0

CY16	Project Title: WILD HATCHERY SALMON INTERACTIONS

Personnel Costs:			Months	Monthly		Personnel
Name	Project Title		Budgeted	Costs		Sum
T. Kline (PWS stream sampling)	PWS Stream sampling PI		2.5	11.5		28.8
M. Hess (PWS stream sampling)	PWS Stream sampling Sr. tech		2.5	4.6		11.5
PWS alevin sampling field techs (4	PWS stream sampling field team		8.0	5.3		42.4
			0.0	0.0		0.0
			0.0	0.0		0.0
			0.0	0.0		0.0
			0.0	0.0		0.0
			0.0	0.0		0.0
			0.0			0.0
						0.0
						0.0
						0.0
	Subtotal		13.0	21.4	0.0	
					Personnel Total	$82.7

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
1 R/T CDV JNO (PWS stream sampling)	0.6	2	6	0.2	2.4
1 R/T SEA CDV SIT JNO	1.0	1	5	0.2	2.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$4.4

Contractual Costs:	Contract
Description	Sum
Vessel charter March alevin sampling 20 d @ 2K (PWS stream sampling)	40.0
Network/communication/printing/mailing/copying (PWS stream sampling)	2.0
shipping includes hazmat (PWS stream sampling)	1.0
SSSC for SEAK portion	68.3
Vessel charters SEAK	18.0
Project Manager	16.8
Contractual Total	$146.1

Commodities Costs:	Commodities
Description	Sum
PWS stream sampling field gear (waders, float coats rain gear)	9.0
PWS stream sampling gear for sampling	2.0
PWS stream sampling - Marine radio waterproof, cell phone, field computing device, safety gear	2.5
PWS stream sampling - lab supplies	2.0
PWS stream sampling - computer and office supplies	3.0
Commodities Total	$18.5

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McNeil, W. J. 1964. A method of measuring mortality of pink salmon eggs and larvae. Fish. Bull. 63:575–588.

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Piston, A. W., and S.C. Heinl. 2012. Hatchery Chum Salmon Straying Studies in Southeast Alaska, 2008-2010., Fisheries Manuscript Series 12-01. Alaska Department of Fish and Game, Anchorage, Alaska.

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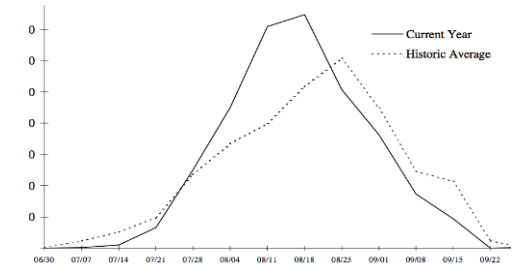
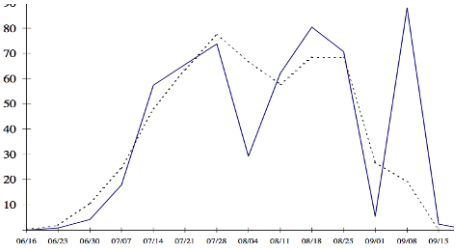
Appendix 1. Odd-year Prince William Sound run timing graphs reproduced from ADFG finfish reports.

Pink **Chum**





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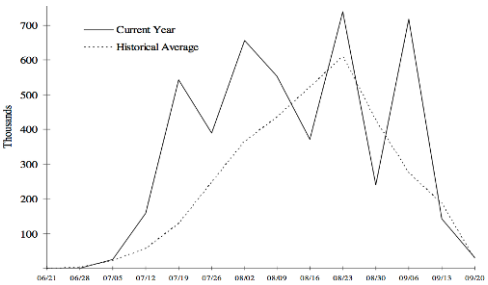
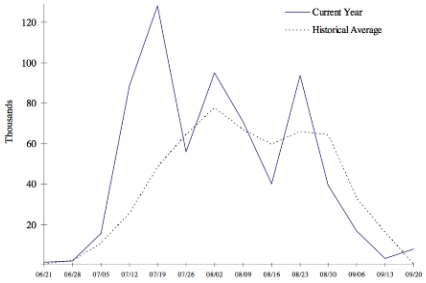
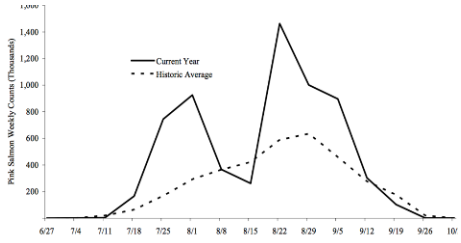
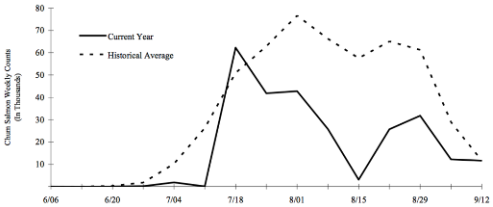


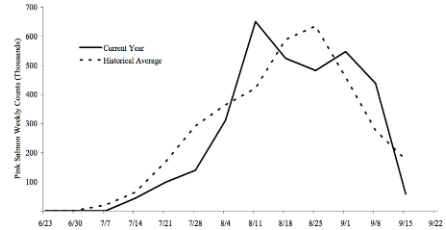


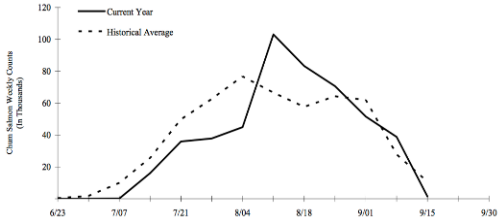
2003



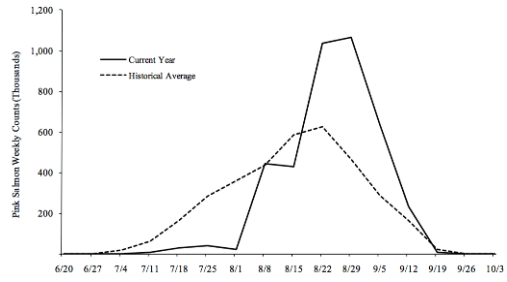


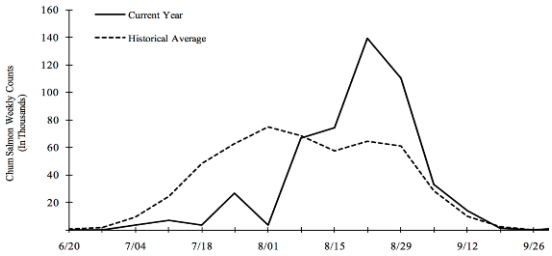
2005





2007

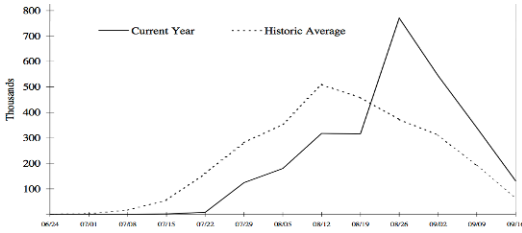


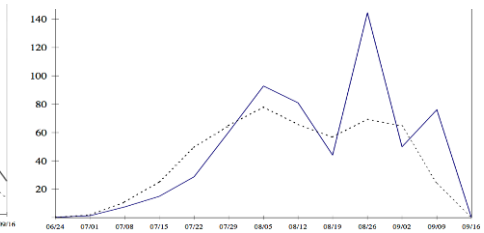


2009

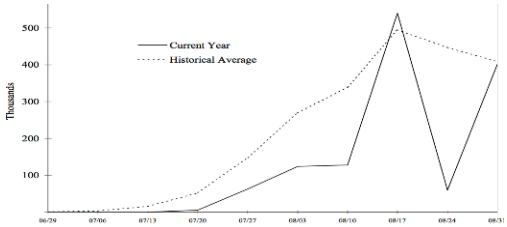
Appendix 2. . Even-year Prince William Sound run timing graphs reproduced from ADFG finfish reports.

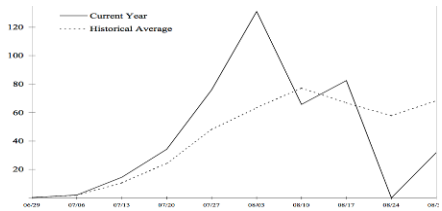
Pink **Chum**



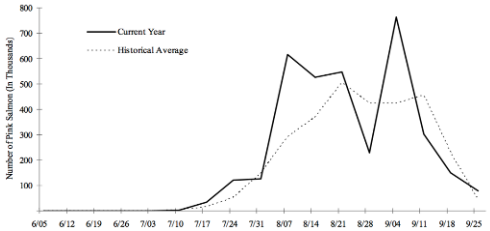


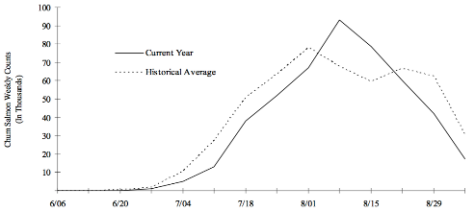
2000



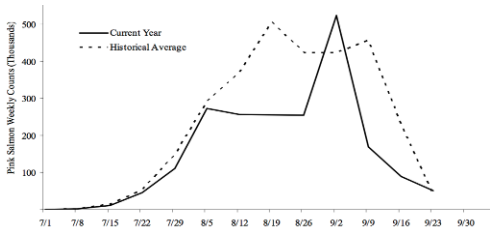


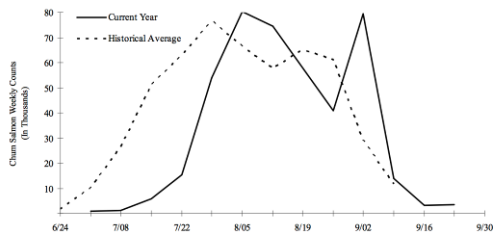
2002



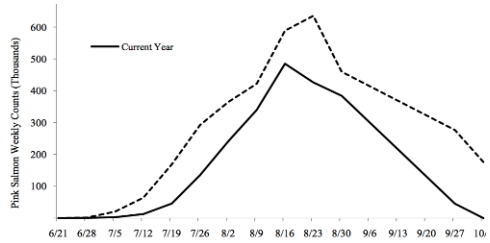


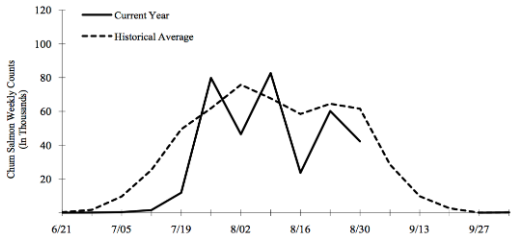
2004



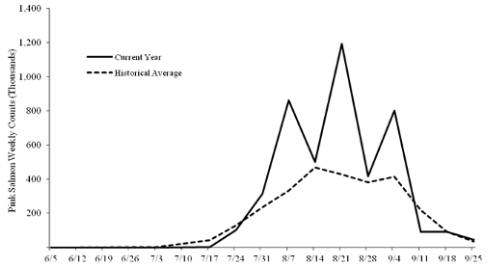


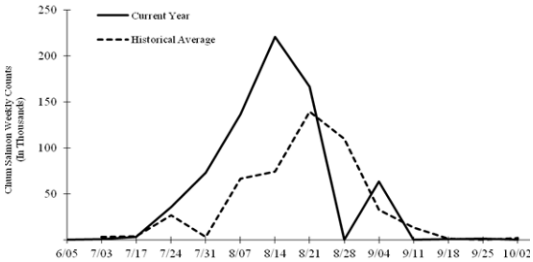
2006





2008





2010

Appendix 3. Senior Staff Resumes

E. Eric Knudsen, Ph.D., Consulting Fisheries Scientist
360-421-0828, eericknudsen@gmail.com

EDUCATION:
Bachelor of Science, Fisheries Science, University of Massachusetts, Amherst - 1974
Master of Science, Fisheries Science, Louisiana State University, Baton Rouge - 1976
Doctor of Philosophy, Wildlife and Fisheries Science, Louisiana State University - 1990

MILITARY EXPERIENCE (Veteran): U.S. Coast Guard, 1966 – 1970

WORK EXPERIENCE:

Consulting Fisheries Scientist, 10/03 – present. 13033 Sunrise Dr, Mt. Vernon, WA 98273, Home/Office Phone: 360-424-5767, Cell Phone: 360-421-0828, e-mail: **eericknudsen@gmail.com**, Consult primarily on projects that promote the health and sustainability of Pacific salmonids and other fisheries in Alaska and the Pacific Northwest. Serve as an independent expert reviewer of NOAA biological opinions and ESA recovery plans and as an expert witness on other fisheries issues. Expert on habitat alteration effects on fish and aquatic habitats. Lead scientific advancements of life-history-based salmon population modeling. Organize and edit book compilations of scientific papers advancing fisheries sustainability and salmon population modeling.

Chief, Marine and Freshwater Ecology Branch, USGS-Alaska Science Center, **7/98 – 10/03** (retirement), 1011 East Tudor Rd., Anchorage, AK 99516.
Managed the USGS-ASC Marine and Freshwater Ecology Branch, overseeing the operations of about 55 full-time scientific staff, 20 seasonal employees, 20 volunteers, and several contract employees. The total Branch annual budget in 2003 was approximately $5.5 million. Fish and wildlife research conducted by the Branch throughout the state of Alaska was extremely diverse and complex. The position required frequent guidance, consultation, and negotiation with staff, collaborators, and client agencies regarding scientific methods and experimental design on a variety of fish and wildlife research topics.

Fisheries Research Team Leader, USGS-Alaska Science Center, **8/94 – 7/98**, 1011 East Tudor Rd., Anchorage, AK 99516.
Designed, organized, coordinated, and implemented fisheries research projects in Alaska. Coordinated and collaborated with external clients to understand their research needs. Developed research proposals and study plans and published research results. Supervised an average of six staff members. Research included topics in marine, freshwater, and anadromous fisheries population ecology using traditional net sampling, radio and sonic telemetry, genetic analyses, and stable isotopic techniques.

Assistant Project Leader, Western Washington Fishery Resource Office, U.S. Fish and Wildlife Service, 7/87 - 7/94 Olympia, WA 98502.
Developed opportunities to restore anadromous salmonids through cooperative, interagency, and stakeholder ventures and by obtaining outside funding. Coordinated field work, directed data management and analysis, and prepared reports as necessary to further the restoration of depleted salmon and steelhead. Developed performance plans, work guidance, and performance appraisals for six staff members.

Instructor, Research Associate, and Ph.D. Candidate, Louisiana State University, School of Forestry, Wildlife, & Fisheries, 8/81 - 7/87 Baton Rouge, LA 70803,
Coordinated, implemented, and supervised a multi-disciplinary team for 3.5 years of field research and 2.5 years of analysis and reporting on a comprehensive study of coastal marsh water control structure impacts on estuarine-dependent fisheries resources. The study focused on differences in ecological fisheries production between various estuarine and coastal habitats.

Consulting Fisheries Biologist, 8/80 – 8/81, Olympia, WA
Conducted instream flow studies on five Western Washington rivers.

Fisheries Management Biologist, U.S. Fish and Wildlife Service, Fisheries Assistance Office, 11/76 - 8/80 Olympia, WA 98502.
Assisted tribal and U.S. attorneys in preparing for litigation of Phase II (the environmental portion) of U.S. v. Washington. Designed and coordinated studies to determine the effects of channelization and grazing on juvenile salmonids in western Washington. Participated in other fisheries research and management activities in the Puget Sound area.

AWARDS:
Dr. Knudsen's dedication to fisheries science has been frequently recognized, most notably:
1985 - USFWS, Special Achievement Award
1986 - Dr. T.B. Ford Memorial Scholarship Award
1987 - Outstanding Publication Award, Louisiana Wildlife Biologists Association
1991 - USFWS, Region 1, Fisheries Management Biologist of the Year
1999 - Sustainable Fisheries Foundation, Outstanding Achievement Award
2004 - Western Division, American Fisheries Society, Award of Excellence
2006 - American Fisheries Society, Distinguished Service Award.
2009 - Washington-British Columbia Chapter, AFS, Past President's Award
2010 - Washington-British Columbia Chapter, AFS, Distinguished Service Award

PROFESSIONAL SOCIETY ACTIVITIES:
Member, American Fisheries Society since 1972;
Chaired numerous committees and participated in organization of many conferences and symposia;
President, Western Division AFS, 2001-2002;
Chair, AFS Program Committee, 2005 – Anchorage;
President, North Pacific International Chapter AFS 2007-2008
Chair, American Fisheries Society 2009 Strategic Planning Committee
Chair, AFS 2011 Seattle Annual Meeting Fundraising Committee
Fellow, American Institute of Fisheries Research Biologists

CURRENT PROFESSIONAL APPOINTMENTS:
Chair, Prince William Sound Science Center, Board of Directors, Cordova, Alaska
Co-Founder and Board Vice-Chair, Ecologists Without Borders
Sustainable Fisheries Foundation, Research Program Director and Steering Committee Member

SELECTED PEER-REVIEWED PUBLICATIONS:

Knudsen, E.E., and J.H. Michael, editors. 2009. Pacific Salmon Environmental and Life History Models: Advancing Science for Sustainable Salmon in the Future. American Fisheries Society Symposium 71.

Knudsen, E.E., and J.H. Michael. 2009. Introduction: the past, present, and future of Pacific salmon environmental and life history models. Pages 3-22 *in* E.E. Knudsen and J.H. Michael, Jr., editors. Pacific Salmon Environmental and Life History Models: Advancing Science for Sustainable Salmon in the Future. American Fisheries Society Symposium 71.

Kline, T.C., C.A. Woody, M.A. Bishop, S.P. Powers, and E.E. Knudsen. 2007. Assessment of Marine-Derived Nutrients in the Copper River Delta, Alaska, Using Natural Abundance of the Stable Isotopes of Nitrogen, Sulfur, and Carbon. Pages 51-60 In C.A. Woody, editor, Sockeye Salmon Evolution, Ecology, and Management. American Fisheries Society Symposium 54.

Knudsen, E.E., and E.G. Doyle. 2006. Science and Technology are essential for sustaining salmon populations and their ecosystems. Pages 311-332 in R.T. Lackey, D.H. Lach, and S.L. Duncan, editors. Salmon 2100: the future of wild Pacific salmon. American Fisheries Society, Bethesda, Maryland.

Sullivan, P.J., J.A. Acheson, P.L. Angermeier, T. Faast, J. Flemma, C.M. Jones, E.E. Knudsen, T.J. Minello, D.H. Secor, R. Wunderlich, and B.A. Zanetell. 2006. Defining and implementing best available science, policy, and management. American Fisheries Society, Bethesda, Maryland and Estuarine Research Federation, Port Republic, Maryland.

Knudsen, E.E., D.D. MacDonald, and Y.K. Muirhead, editors. 2004. Sustaining North American fisheries. American Fisheries Society, Symposium 43, Bethesda, Maryland.

MacDonald, DD., and E.E. Knudsen. 2004. Toward fisheries sustainability in North America: issues, challenges, and strategies for action. Pages 271-281 *in* Knudsen, E.E., D.D. MacDonald, and Y.K. Muirhead, editors. 2004. Sustaining North American fisheries. American Fisheries Society, Symposium 43, Bethesda, Maryland.

Knudsen, E. E., E. W. Symmes, and F. J. Margraf. 2003. Searching for a life history approach to salmon escapement management. Pages 261-276. In J.N. Stockner, editor, Nutrients in the freshwater salmonid ecosystem. American Fisheries Society Special Publication 34, Bethesda, Maryland.

Meka, J., E. E. Knudsen, D.C. Douglas, and R.E. Benter. 2003. Variable migratory patterns of different rainbow trout life history types in a southwest Alaska watershed. Transactions of the American Fisheries Society 132: 717-732.

Knudsen, E.E. 2002. Ecological perspectives on Pacific salmon: can we sustain biodiversity and fisheries? Pages 277-319 In M. L. Jones and K. D. Lynch, editors. Sustaining North American salmon: perspectives across regions and disciplines. American Fisheries Society, Bethesda, Maryland.

Knudsen, E.E., C.R. Steward, D.D. MacDonald, J.E. Williams, and D.W. Reiser, editors. 2000. Sustainable Fisheries Management: Pacific Salmon. Lewis Publishers, Boca Raton, Florida.

Knudsen, E.E. 2000. Managing Pacific salmon escapements: the gaps between theory and reality. Pages 237-272 *in* E.E. Knudsen and C.R. Steward, D.D. MacDonald, J.E. Williams, and D.W. Reiser, editors.. Sustainable Fisheries Management: Pacific Salmon, Lewis Publishers, Boca Raton, Florida.

Milner, A.M., E.E. Knudsen, C. Soiseth, A.L. Robertson, D. Schell, I.T. Philips, and K, Magnuson. 2000. Colonization and development of stream communities across a 200-year gradient in Glacier Bay National Park, Alaska. Canadian Journal of Fisheries and Aquatic Sciences 57:2319-2335.

Knudsen, E.E., B.D. Rogers, R.F. Paille, W.H. Herke, and J.P. Geaghan. 1996. Juvenile white shrimp growth, mortality, and emigration in weired and unweired Louisiana marsh ponds. North American Journal of Fisheries Management 16(3):640-652.

Rogers, B.D., W.H. Herke, and E.E. Knudsen. 1992. Effects of three different water-control structures on the movements and standing stocks of coastal fishes and macrocrustaceans. Wetlands 12:106-120.

Herke, W.H., E.E. Knudsen, P.A. Knudsen, and B.D. Rogers. 1992. Effects of semi-impoundment of Louisiana marsh on fish and crustacean nursery use and export. North American Journal of Fisheries Management 12:151-160.
Knudsen, E.E., R.F. Paille, B.D. Rogers, W.H. Herke, and J.P. Geaghan. 1989. Effects of a fixed-crest weir on brown shrimp *Penaeus aztecus* growth, mortality, and emigration in a Louisiana coastal marsh. North American Journal of Fisheries Management 9:411-419.
Knudsen, E.E., and S.J. Dilley. 1986. Effects of riprap bank reinforcement on juvenile salmonids in five western Washington streams. North American Journal of Fisheries Management 7:351-356.
Knudsen, E.E., C.E. Stephens, and W.H. Bradshaw. 1984. A method for measuring streamflows in rivers. North American Journal of Fisheries Management 4:459-461.
Chapman, D.W., and E.E. Knudsen. 1980. Channelization and livestock impacts on salmonid habitat and biomass in western Washington. Transactions of the American Fisheries Society 109:357-363.
Knudsen, E.E., and W.H. Herke. 1978. Growth rate of marked juvenile Atlantic croakers, *Micropogon undulatus*, and length of stay in a coastal marsh nursery in southwestern Louisiana. Transactions of the American Fisheries Society 107:12-20.
Knudsen, E.E., W.H. Herke, and J.M. Mackler. 1977. The growth rate of marked juvenile brown shrimp, *Peneaus aztecus*, in a semi-impounded coastal marsh. Proceedings of the Gulf and Caribbean Fisheries Institute 29:144-159.

Curriculum Vitae

THOMAS CLAYTON KLINE, JR.
June, 2012

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Cordova, Alaska 99574

(907) 424-5800 x233 (voice)
(907) 424-5820 (fax)
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Citizenship: United States of America

Education

1991	Ph.D. in Oceanography, University of Alaska, Fairbanks
1983	M.S. in Fisheries, University of Washington, Seattle
1979	B.S. in Fisheries, University of Washington, Seattle
1976	B.S. in Oceanography, University of Washington, Seattle
1972-74	Coursework at Sophia University, Tokyo

Research Interests

- Meso-scale aquatic ecosystem processes
- Coupling of nutrient cycling and biogeochemical ecology with oceanographic processes
- Fish ecology with emphasis on salmonids
- Natural stable isotope abundance techniques
- In situ technology and application

Research Accomplishments

- I developed natural stable isotope abundance techniques for providing evidence that production derived in the Gulf of Alaska plays a significant role subsidizing Prince William Sound fish food webs
- I discovered the existence of large inter-annual variations in natural stable isotope abundance in the Gulf of Alaska and their probable cause by meso-scale eddies
- Based on stable isotope evidence I posited that meso-scale eddies drive inter-annual variation in marine survival rate and hence recruitment of pink salmon from Prince William Sound.
- I developed natural stable isotope abundance techniques that provided the first direct evidence of the significant role of anadromous salmon marine derived nutrients in freshwater ecosystems
- I developed natural stable isotope abundance techniques for detecting amphidromous fish migrations in the Alaska North Slope

Professional Experience

1994-2012	Research Scientist, Prince William Sound Science Center
1995-2012	Director, Prince William Sound Science Center Scientific Diving Program
1995-2012	Diving Safety Officer, Prince William Sound Science Center Scientific Diving Program

1992-93	Instructor, University of Alaska Fairbanks
1991-94	Postdoctoral Fellow, University of Alaska Fairbanks
1985-91	Research Assistant, University of Alaska Fairbanks
1984-85	Teaching Assistant, University of Washington
1977-83	Research Assistant, University of Washington

Teaching Experience

1993	Upward Bound Math/Science, Marine Science
1992	Fisheries 400, Fisheries Science
1991	Marine Science and Limnology 460, Marine Studies for Science Teachers with Drs. R. Highsmith, R. T. Cooney, and J. J. Kelley, taught at the Kasitsna Bay Marine Laboratory
1991	Marine Science and Limnology 611, Field Problems in Marine Biology with Dr. R. Highsmith, taught at the Kasitsna Bay Marine Laboratory
1984-85	Fisheries 405, Economically Important Mollusca with Dr. K. K. Chew
1984	Fisheries 454, Aquatic Food Chains with Dr. F. B. Taub

Professional Societies

American Academy of Underwater Sciences

American Geophysical Union

American Fisheries Society

American Society of Limnology and Oceanography

Research Papers

38. Kline, T.C., Jr. 2010. Stable carbon and nitrogen isotope variation in the northern lampfish and *Neocalanus*, marine survival rates of pink salmon, and meso-scale eddies in the Gulf of Alaska. Progr. Oceanogr. 87:49-60.

37. Kline, T.C., Jr. 2009. Characterization of carbon and nitrogen stable isotope gradients in the sub-Arctic Pacific Ocean using terminal feed stage copepodite V *Neocalanus cristatus.* Deep-Sea Research II 56:2537-2552.

36. Kline, T.C. Jr., J.L. Boldt, E.V. Farley, Jr., L.J. Haldorson, and J.H. Helle. 2008. Pink salmon (*Oncorhynchus gorbuscha*) marine survival rates reflect early marine carbon source dependency. Progr. Oceanogr. 77:194-202

35. Kline, T.C. Jr. 2008. Ontogenetic, temporal, and spatial variation of feeding niche in an unexploited population of walleye pollock (*Theragra chalcogramma*). *In*: G.H. Kruse, K. Drinkwater, J.N Ianelli, J.S. Link, D.L Stram, V. Wespestad, and D. Woodby (eds), Resiliency of gadid stocks to fishing and climate change. University of Alaska Sea Grant, Fairbanks. AK-SG-08-01. p. 251-269.

34. Kline, T.C., Jr. 2007. Rockfish trophic relationships in Prince William Sound, Alaska, based on natural abundance of stable isotopes. *In*: J. Heifetz, J. DeCosimo, A. Gharrett, M. Love, V. O'Connell, and R. Stanley (eds) Biology, Assessment, and Management of Pacific Rockfishes. University of Alaska Sea Grant, Fairbanks. AK-SG-07-01. p. 21-37.

33. Kline, T.C., Jr., C.A. Woody, M.A. Bishop, S.P. Powers, and E.E. Knudsen. 2006. Assessment of marine-derived nutrients in the Copper River Delta, Alaska using natural abundance of the stable isotopes of

nitrogen, sulfur, and carbon. *In:* C.A. Woody (ed.), Sockeye salmon ecology, evolution, and management. American Fisheries Society, Symposium 54:51-60.

32. Kline, T.C., Jr. 2003. Implications of Trophic Level when Assessing the Role of Salmon-Derived Nutrients for Lacustrine Juvenile Sockeye Salmon Ecology using the Natural Abundance of $^{15}N/^{14}N$. *In:* J. Stockner (ed.). Restoring Nutrients to Salmonid Ecosystems. American Fisheries Society, Bethesda. p.229-236.

31. Kline, T.C. Jr. and T.M. Willette. 2002. Pacific salmon (*Oncorhynchus*) early marine feeding patterns based on $^{15}N/^{14}N$ and $^{13}C/^{12}C$ in Prince William Sound, Alaska. Can. J. Fish. Aquat. Sci. 59: 1626–1638.

30. Kline, T.C., Jr. The Relative Trophic Position of *Cancer magister* Megalopae within the Planktonic Community of the Sub-Polar Northeastern Pacific Ocean. 2002. *In:* A.J. Paul, E.G. Dawe, R. Elner, G.S. Jamieson, G.H. Kruse, R.S. Otto, B. Sainte-Marie, T.C. Shirley, and D. Woodby (eds.). Crabs in Cold Water Regions: Biology, Management, and Economics. University of Alaska Sea Grant, AK-SG-02-01, Fairbanks. p.645-649.

29. T. J. Weingartner, K. O. Coyle, B. P. Finney, R.R. Hopcroft, T. E. Whitledge, R. D. Brodeur, M. Dagg, E. Farley, D. Haidvogel, L. Haldorson, A. Hermann, S. Hinckley, J. Napp, P. J. Stabeno, **T. C. Kline**, C. Lee, E. Lessard, T. C. Royer, S. Strom. 2002. The Northeast Pacific GLOBEC Program: Coastal Gulf of Alaska. Oceanogr. 15:48-63.

28. Cooney, R.T., J.R. Allen, M.A. Bishop, D.L. Eslinger, **T. Kline**, B.L. Norcross, C.P. McRoy, J. Milton, J. Olsen, V. Patrick, A.J. Paul, D. Salmon, D. Scheel, G.L. Thomas and S.L. Vaughan. 2001. Ecosystem control of pink salmon (*Oncorhynchus gorbuscha*) and Pacific herring (*Clupea pallasi*) populations in Prince William Sound, Alaska. . Fish. Oceanogr. 10 (Suppl. 1):1-13.

27. Norcross, B.L., E.D. Brown, R.J. Foy, M. Frandsen, S. Gay, **T.C. Kline, Jr**., D.M. Mason, E.V. Patrick, A.J. Paul, and K.D.E. Stokesbury. 2001. A synthesis of the early life history and ecology of juvenile Pacific herring in Prince William Sound, Alaska. Fish. Oceanogr. 10 (Suppl. 1):42-57.

26. Kline, T.C., Jr. 2001. The trophic position of Pacific herring in Prince William Sound Alaska based on their stable isotope abundance. *In:* F. Funk, J. Blackburn, D. Hay, A.J. Paul, R. Stephenson, R. Toresen, and D. Witherell (eds.), Herring: Expectations for a New Millennium. University of Alaska Sea Grant, AK-SG-01-04, Fairbanks. p. 69-80.

25. Paul, A.J, J.M. Paul and **T.C. Kline, Jr.** 2001. Estimating whole body energy content for juvenile Pacific herring from condition factor, dry weight, and carbon/nitrogen ratio. *In:* F. Funk, J. Blackburn, D. Hay, A.J. Paul, R. Stephenson, R. Toresen, and D. Witherell (eds.), Herring: Expectations for a New Millennium. University of Alaska Sea Grant, AK-SG-01-04, Fairbanks. p. 121-133.

24. Eslinger, D.L., R.T. Cooney, C.P. McRoy, A. Ward, T.C. **Kline**, Jr., E.P. Simpson, J. Wang, and J. R. Allen. 2001. Plankton dynamics: observed and modeled responses to physical conditions in Prince William Sound, Alaska. Fish. Oceanogr. 10 (Suppl. 1):81-96.

23. Kline, T.C., Jr. 2001. Evidence of biophysical coupling from shifts in natural stable carbon and nitrogen isotopes in Prince William Sound, Alaska. *In:* Kruse, G.H., N. Bez, A. Booth, M.W. Dorn, S. Hills, R.N. Lipcius, D. Pelletier, C. Roy, S.J. Smith, and D. Witherell (eds.), Spatial Processes and Management of Marine Populations. University of Alaska Sea Grant, AK-SG-01-02, Fairbanks. p. 363-375.

22. Kline, T.C., Jr. 1999. Temporal and Spatial Variability of $^{13}C/^{12}C$ and $^{15}N/^{14}N$ in pelagic biota of Prince William Sound, Alaska. Can. J. Fish. Aquat. Sci. 56 (Suppl. 1) 94-117.

21. Kline, T.C., Jr. 1999. Monitoring changes in oceanographic forcing using carbon and nitrogen isotopes in Prince William Sound pelagic biota. *In:* Ecosystem Approaches for Fisheries Management. Alaska Sea Grant College Program Report No. 99-01. University of Alaska Fairbanks. p. 87-95.

20. Kline, T. C. Jr. 1999. The ultimate lens for underwater still photography? *In*: (eds) Diving for Science...1999, Proceedings of the American Academy of Underwater Sciences Nineteenth Annual Scientific Diving Symposium. American Academy of Underwater Sciences. Nahant, MA. p. 61-63.

19. Kline, T.C., Jr. and R.A. Lewin. 1999. Natural $^{15}N/^{14}N$ abundance as evidence for N_2 fixation by *Prochloron* (Prochlorophyta) endosymbiotic with didemnid ascidians. Symbiosis 26:193-198.

18. Kline, T.C., Jr. and D. Pauly. 1998. Cross-validation of trophic level estimates from a mass-balance model of Prince William Sound using $^{15}N/^{14}N$ data. *In:* Funk, F., T.J. Quinn II, J. Heifetz, J.N. Ianelli, J.E. Powers, J.F. Schweigert, P.J. Sullivan, and C.-I. Zhang. (eds.) Fishery Stock assessment Models. Alaska Sea Grant College Program Report No. 98-01. University of Alaska Fairbanks. p. 693-702.

17. Kline, T.C., Jr., W.J. Wilson, and J.J. Goering. 1998. Natural isotope indicators of fish migration at Prudhoe Bay, Alaska. Can. J. Fish. Aquat. Sci. 55:1494-1502.

16. Kline, T.C., Jr. 1997. Confirming forage fish food web dependencies in the Prince William Sound ecosystem. *In*: Forage Fishes in Marine Ecosystems. Proceedings of the International Symposium on the Role of Forage Fishes in Marine Ecosystems. Alaska Sea Grant College Program Report No. 9701. University of Alaska Fairbanks. p. 257 - 269.

15. Kline, T.C., Jr., J.J. Goering, and R.J. Piorkowski. 1997. The effect of salmon carcasses on freshwater systems. *In*: A. Milner and M. Oswood (eds.), Alaskan Freshwaters of Alaska, Ecological Synthesis. Ecological Studies 119:179-204, Springer-Verlag. New York.

14. Kline, T. C. Jr. and J.J. Goering. 1997. North slope amphidromy assessment. University of Alaska Coastal Marine Institute OCS Study MMS 97-0001. p. 85-101.

13. Kline, T.C., Jr., and D. Scheel. 1996. Octopus research in Prince William Sound Alaska: the birthing of a scientific diving program and the role of the AAUS. *In*: M.A. Lang and C. C. Baldwin (eds.), Methods and Techniques of Underwater Research, Proceedings of the American Academy of Underwater Sciences Sixteenth Annual Scientific Diving Symposium. American Academy of Underwater Sciences. Nahant, MA. p. 137-140.

12. Kline, T. C. 1995. Evaluation of an underwater single lens reflex camera equipped with automatic focus, automatic exposure and water contact optics. *In*: D. E. Harper (ed.), Diving for Science...1995, Proceedings of the American Academy of Underwater Sciences Fifteenth Annual Scientific Diving Symposium. American Academy of Underwater Sciences. Nahant, MA. p. 35-41.

11. Kline, T.C. Jr., J.J. Goering, O.A. Mathisen, P.H. Poe, P.L. Parker, and R.S. Scalan. 1993. Recycling of elements transported upstream by runs of Pacific salmon: II. $\delta^{15}N$ and $\delta^{13}C$ evidence in the Kvichak River watershed, southwestern Alaska. Can. J. Fish. Aquat. Sci. 50:2350-236.

10. Kline, T. C. 1993. Stable isotope ecology of Alaskan sockeye salmon lakes. *In*: Heine, J. N., and N. L. Crane (eds.), Diving for Science...1993, Proceedings of the American Academy of Underwater Sciences Thirteenth Annual Scientific Diving Symposium. American Academy of Underwater Sciences. Nahant, MA. p. 89-94.

9. Kline, T. C. 1992. Nitrogen Isotope Technique Provides Direct Evidence for Fertilization of Sockeye Nursery Lakes by Salmon Carcasses. SFOS Highlights RH92-1, University of Alaska Fairbanks, Fairbanks, Alaska 4p.

8. Mathisen, O.A. and T.C. **Kline**. 1992 Harbor seals in Iliamna Lake, Bristol Bay, Alaska. Juneau Center for Fisheries and Ocean Scinces, University of Alaska Fairbanks, JCFOS 9203. Juneau, Alaska. 9pp.

7. Kelley, J.J., T.A. Gosink, T C. **Kline**, and M. Aota. 1992. Carbon dioxide and other trace gases in Arctic seas. Proceedings of the Seventh International Symposium on Sea Ice and the Okhotsk Sea. Mobetsu, Hokaido, Japan.

6. Alexander, V., and T.C. **Kline**, Jr. 1992. Biological resources of the northern Pacific and projections for the 1990's; The northeast Pacific. Proceedings of the Second Northern Pacific Rim Fisheries Conference: Business Development through Market Economy. Vladivostock, USSR.

5. Kline, Thomas Clayton, Jr. 1991. The significance of marine-derived biogenic nitrogen in anadromous Pacific salmon freshwater food webs. Ph.D. Thesis, University of Alaska Fairbanks, Fairbanks, Alaska, 114pp.

4. Kline, T.C. Jr., J. J. Goering, O. A. Mathisen, and J. P. Koenings. 1990. Recycling of elements transported upstream by run of Pacific salmon (RETURNS). Research on Pacific Salmon Biology, Alaska Sea Grant College Program, Volume Report No. 90-08. p.10-11.

3. Kline, T.C. Jr., J.J. Goering, O.A. Mathisen, P.H. Poe, and P.L. Parker. 1990. Recycling of elements transported upstream by runs of Pacific salmon: I. $\delta^{15}N$ and $\delta^{13}C$ evidence in Sashin Creek, southeastern Alaska. Can. J. Fish. Aquat. Sci. 47:136-144.

2. Mathisen, O.A., P.L. Parker, J.J. Goering, T.C. **Kline**, P.H. Poe, and R.S. Scalan. 1988. Recycling of marine elements transported into freshwater by anadromous salmon. Verh. Int. Ver. Limnol. 23:2249-2258.

1. Kline, Thomas Clayton, Jr. 1983. The effect of population density on the growth rate of the butter clam, *Saxidomus giganteus*. M. S. Thesis, University of Washington, Seattle, 104pp.

Recent Collaborators

Cooney, R., Haldorson, L., Whitledge, T. (U. AK Fairbanks); Welker, J. (U. AK Anchorage); Bishop, M., Buckhorn, M., Campbell, R., Gay, S., Pegau, S., Thorne, R. (PWSSC); Brenner, R., Moffitt, S. (AK Dept. Fish and Game); Knudsen, E., Woody, C., Hershberger, P. (USGS); Farley, E., Helle, J., Vollenveider, J., Heintz, R., Canino, M. (NMFS/NOAA); Patrick, V. (U. MD); Kiefer, D. (U. So. CA); Boldt, J., Hay, D. (DFO, Canada); Brown, E. (unaffiliated); J. Moran, T. Linley (PNNL, Richland, WA).

Graduate and Post-Graduate Advisors

Chew, K. (M.S., Univ. Washington), Goering, J. (Ph. D., Univ. Alaska Fairbanks), Kelley, J. (Post-doctoral, Univ. Alaska Fairbanks)

Graduate and Post-Graduate Advisees

Campbell, R. (PWSSC), Carlisle, Aaron (Stanford Univ.)

Curriculum Vitae: Michele Leigh Buckhorn

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Education:

Ph.D. 2009 University of California, Davis, Ecology (AOE Marine Ecology)

Advisors: Marcel Holyoak, PhD and Peter B. Moyle, PhD

B.A. 1999 University of California, Santa Cruz, Biology

A.S. 1993 American River College, Math and Physical Sciences

Related Employment:

Adjunct Faculty. Miami University of Ohio Global Field Program. 2012- present.

Principal Investigator. Hydroacoustic assessment of juvenile and adult herring in Prince William Sound. 2012- present.

Postdoctoral Researcher Fish Ecologist, Prince William Sound Science Center. 2010 – 2012

Postdoctoral Researcher. U.C. Davis. Department of Wildlife, Fish and Conservation Biology. 2008-2009.

EDUCATION

2009 Ph.D., Graduate Group in Ecology (AOE: Marine Ecology), University of California, Davis.

Advisors: Marcel Holyoak, PhD. and Peter Moyle, PhD.

1999 University of California, Santa Cruz. Bachelor of Arts. Biology.

1997 American River College. Sacramento, CA. Associate in Science. Math and Physical Sciences.

Graduate of Great Distinction.

RESEARCH EXPERIENCE

Fish Ecologist. Prince William Sound Science Center, Cordova AK. June 2010 to present.

Hydroacoustic assessment of herring populations in Prince William Sound.

Scientific Aide. Dept. of Water Resources, West Sacramento, California. November 2009-May 2010.

Assisting with fish monitoring projects associated with State Water Project in Sacramento and San Joaquin

Counties.

Postdoctoral Researcher. U.C. Davis. San Francisco Bay, California July 2009-November 2009.

Tracking juvenile Salmonid outmigration through San Francisco Estuary, California in order to assess the potential effects of channel dredging and disposal on migration patterns and survival.

Postdoctoral Researcher. U.C. Davis. San Francisco Bay, California July 2008-June 2009.

Tracking movement patterns and behaviors of sevengill sharks in San Francisco Bay, California to determine habitat usage and resident status.

http://biotelemetry.ucdavis.edu/pages/bio_Buckhorn.htm

Doctoral Research. U.C. Davis. Loreto Marine Park, Loreto, Baja California Sur. 2004-2007.

The effects of serial depletion of predators on reef community structure to effectively design marine reserves that sustain fisheries target species as well as protect local biodiversity in Loreto Marine Park, Baja California Sur.

Graduate Research Assistant.

Metapopulation structure of endangered species Valley Elderberry Longhorn Beetle (VELB) doing GIS surveys of unperturbed, degraded and mitigations sites.

Research Diving Assistant. Loreto Marine Park, Loreto, Baja California Sur. April-May 2001.

Assistant for Comunidad y Biodiversidad (Community and Biodiversity), a Mexican NGO conservation organization (www.cobi.org.mx).

Research Diving Assistant. Monterey Bay, Monterey, California. Nov. 1999 and May 2000.

Assistant to Masters candidate from University of California, Santa Cruz. Arnold Amman amman@biology.ucsc.edu. Recruitment of rockfishes (*Sebastes spp.*) in Monterey Bay, California.

Research Diving Assistant. Bahia Concepcion, Baja California Sur. Jan.-Feb. 2000.

Assistant to Ph.D. candidate from University of California, Santa Cruz. Diana Steller steller@biology.ucsc.edu. Interactions between rhodolith beds in Bahía Concepción and related marcrofauna, in particular the scallop (*Argopecten circularis*).

Minority International Research Training (M.I.R.T.) Program Guaymas, Sonora, Mexico. January 1999 to May 2000. Group projects: Fish otolith catalog from fish sampling and from Gulf of California sea lion (*Zalophus californianus*) scat collection; marine bird censuses of the nearby islands (San Carlos and Guaymas area); census of whale species in the upper gulf. Individual Projects: Guide to the marine fishes from the Gulf of California (see below); fluctuating asymmetry of vaquita (*Phocoena sinus*), looking at population fitness of an endemic and

endangered northern Gulf of California porpoises measuring the bilateral symmetry of craniums from museum specimens. Program Director: C. Leo Ortiz, Ph.D. U.C. Santa Cruz.

Biology 162: Marine Ecology of the Sea of Cortez U.C. Santa Cruz/Sonora, Mexico

Fall Quarter 1998. Foraging behavior of round stingrays (*Urolophus spp.*)at Cholla Bay, Sonora Mexico.

SCUBA DIVING CERTIFICATIONS

1999 N.A.U.I. MASTER DIVER (Scientific Diver Certification from U.C. Santa Cruz. Dive under A.A.U.S. diving regulations)

1997 P.A.D.I. ADVANCED OPEN WATER

1993 P.A.D.I. OPEN WATER

GRANTS AND SCHOLARSHIPS

2012 Exxon Valdez Oil Spill Trustee Grant

2008 Aquarium of the Bay Research Grant

2007 Stockton Sportsmen Club Scholarship

2005 University Research Expeditions Programs (UREP) Research Grant

2005 NORTEK Student Equipment Grant Award

2004 U.C. MEXUS Dissertation Grant.

2004 Dean's Commitment Fellowship, Department of Graduate Studies, U.C. Davis.

2003 National Fish and Wildlife Foundation/Budweiser Conservation Scholarship.

2001 Ford Foundation Pre-Doctoral Fellowship for Minorities.

1998 U.S. Environmental Protection Agency (EPA) Tribal Lands Environmental Science Scholarship Administered by the American Indian Science and Engineering Society (AISES)

1997 U.S. Environmental Protection Agency (EPA) Tribal Lands Environmental Science Scholarship Administered by the American Indian Science and Engineering Society (AISES)

ACADEMIC AWARDS AND HONORS

1999 Honors Senior Thesis Research "Field Guide to the Marine Fishes from the Gulf of California." Biology Department, U.C. Santa Cruz.

1999 Outstanding Poster Presentation Winner for Biological Sciences UC Santa Cruz Natural

Sciences Undergraduate Research Symposium Poster Presentation. 1999. Senior Thesis

Research "Field Guide to the Marine Fishes from the Gulf of California."

1997 Talent Roster for Outstanding Minority Students at a Two Year College.

American River College, Sacramento CA

Publications

Book:

Buckhorn, Michele L. Guide to the Marine Fishes from the Gulf of California. American Fisheries Society. In press.

Peer reviewed journal articles:

Erisman, B. E., M. L. Buckhorn, et al. (2007). "Spawning patterns in the leopard grouper, *Mycteroperca rosacea*, in comparison with other aggregating groupers." Marine Biology (Berlin) 151(5):849-1861.

Reports:

Chapman, E.D., A.R. Hearn, M.L. Buckhorn, A.P. Klimley, P.E. Lacivita, W.N. Brostoff, A.M. Bremner (2009). "Juvenile Salmonid Outmigration and Distribution in the San Francisco Estuary: 2008-2009." U.S. Army Corp ofEngineers, LTMS. 87 pp.

In preparation

Buckhorn, M.L., P.T. Sandstrom, and A.P. Klimley. Tidally synched movements of sevengill sharks (*Notorynchus cepedianus*) in San Francisco Bay. Target journal: Environmental Biology of Fishes

Buckhorn, M.L. Age, growth and reproduction of leopard grouper (*Mycteroperca rosacea*): evidence of a behaviorally mediated Allee effect. Target journal: Journal of Fish Biology.

Buckhorn, M.L. Identification and monitoring of spawning aggregations to enhance fishery management of leopard grouper (*Mycteroperca rosacea*) in Loreto Marine Park. Target journal: Fishery Bulletin.

Buckhorn, M.L. Influence of habitat and exploitation on reef fish assemblages in Loreto Marine Park. Target journal: Marine Biology.

Selected Presentations

2011 Buckhorn, M.L. and Richard Thorne. Juvenile Herring Assessment In Prince William Sound. American Fisheries Society 141st Annual Meeting. Seattle, WA.

2011 Buckhorn, M.L., Richard Thorne, James Thorne. Evaluation of a Floating, Two-Vessel Towed Transducer System for Detection of Near-Surface Fishes. Poster. American Fisheries Society 141st Annual Meeting. Seattle, WA.

2009 Buckhorn, M.L. Movements of sevengill sharks (*Notorynchus cepedianus*) in San Francisco Bay. Poster. Joint Meeting of Ichthyologists and Herpetologists. Portland, Oregon.

2009 Buckhorn, M.L. Movements of sevengill sharks (*Notorynchus cepedianus*) in San Francisco Bay. California Estuarine Research Society Annual Meeting. Bodega Bay, California.

2007 Buckhorn, M.L. Age and growth of leopard grouper, *Mycteroperca rosacea*, in Loreto Marine Park, Baja California Sur. Western Society of Naturalists 88th Annual Meeting. Ventura, California.

2007 Buckhorn, M.L. Leopard grouper, *Mycteroperca rosacea*, spawning aggregations in Loreto Marine Park, Baja California Sur. American Fisheries Society 137th Annual Meeting. San Francisco, California.

2007 Buckhorn, M.L. Age and growth of leopard grouper, *Mycteroperca rosacea*, in Loreto Marine Park, Baja California Sur. American Fisheries Society 137th Annual Meeting. San Francisco, California.

2005 Erisman, B.E., M.L. Buckhorn, P.A. Hastings. Unusual spawning patterns in the leopard grouper (*Mycteroperca rosacea*) from the Gulf of California: Implications for conservation and management. Western Society of Naturalists 86th Annual Meeting. Monterey California.

2005 Buckhorn, M.L. Reef organism diversity in relation to leopard grouper spawning sites in Loreto Marine Park: Implications for management. Invited symposium speaker. MPAs: Fitting the Pieces into the Fisheries Mosaic. American Fisheries Society 135th Annual Meeting. Anchorage Alaska.

Recent Collaborators

Richard Thorne, PhD., Prince William Sound Science Center

A. Pete Klimley, PhD., UC Davis

Jorge Torre, PhD., Comunidad y Biodiversidad, AC, Mexico

Andrea Saenz, PhD., Comunidad y Biodiversidad, AC, Mexico

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Sitka Sound Science Center
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Marine fisheries biologist with thirty years experience working with marine fisheries, research, and assessment including in-situ submersible and scuba surveys, fisheries management, marine mammal and fishery interactions, project management, grant writing, and outreach through peer-reviewed and popular publications, and scientific, public, and classroom presentations. Specializing in collaborative projects between the fishing industry, science, and government. Currently co-principal investigator on NOAA funded project " Southeast Alaska Sperm Whale Avoidance Partnership: Fishermen, managers, and scientists working together to improve sablefish assessments and reduce interactions between sperm whales and longline gear".

Education

Friday Harbor Laboratory, Marine Zoology & Botany 1982

University of Washington, Fisheries 1979-81, B.S.

Rutgers University, Fisheries, undergraduate 1977-78

Employment

- Operations Manager, Sitka Sound Science Center.
- Fisheries Consultant, dba Coastal Marine Research, 2007 to present
- Commercial longline deckhand (cooking, baiting, gutting), F/V Cherokee, 2007-present
- Elderhostel group leader, Southeast Rainforest program, 2008
- Marine Debris Coastal Cleanup, project leader, Sitka, Southeast Alaska 2008-present
- State of Alaska, Department of Fish and Game, Commercial Fisheries Division:
- Groundfish Project Leader, Fisheries Biologist III, 1995 to 2006
- Project Assistant: Fisheries Biologist II, ADF&G, 1988-1995
- Research Biologist: Fisheries Biologist I, ADF&G, 1983-88
- Port Sampler: Fisheries Technician III, ADF&G, 1982-83
- Biological Consultant/Diver, Alaska Coastal Research, 1981-82
- Field Technician, Moclips Cetalogical Society, Hawaii, 1979
- Student Volunteer, National Marine Fisheries Service, Marine Mammal Laboratory, *R/V Western Viking*, Bering and Chukchi Seas, summer 1978

Experience

Operations Manager, Sitka Sound Science Center. Responsible for over-seeing operations of the SSSC facility and programs. Facility includes an educational fish hatchery, and aquarium. Supervise Aquaculture Director and Aquarium Manager. Develop, coordinate and oversee educational and scientific research programs based at the SSSC. Scientific investigator on projects funded by NOAA, NPRB, and NSF. Current research projects include Marine Debris cleanup, Sperm Whale/longline interaction research, and invertebrate surveys. **Director, SSSC Scientist in Residency Fellowship (SIRF) Program**. Coordinate and oversee National Science Foundation funded project. The SIRF program brings 6 established marine scientists to Sitka for a month mini-sabbatical where they spend a week in local classrooms or involved in community outreach and 3 weeks dedicated the their own work, research, or publication activity.

Coastal Marine Research: Scientific Consultant for marine fish research, education and management projects including fish, marine habitats, marine mammal/fishery interactions, spatial management and marine protected areas, and movement studies of whales, grant writing and administration, field work, outreach, publication and presentations.

Contracts included:

- **Research Biologist and administration of the Fishermen's Conservation Network** to reduce multispecies rockfish bycatch by identifying and GIS mapping areas of high bycatch (Alaska Longline Fishermen's Association ALFA). This project established an incentive based multispecies bycatch reduction network for sablefish and halibut longline fishermen fishing in the Gulf of Alaska. Conceived project, wrote grant, and secured foundation funding for ALFA for project collaborating with longliners in the Gulf of Alaska; developed logbooks and data protocols including development of multi-layer GIS maps, displaying and analyzing data; public outreach and media events (print and radio) to inform potential participants; conducted field trials on longline vessels; responsible for quality control of database; collected and analyzed confidential fishery data.
- **Research Fish Biologist for the Southeast Alaska Sperm Whale Avoidance Project** (Alaska Longline Fishermen's Association, University of Alaska Southeast, Scripps Oceanographic Institute), including real-time reporting network for sighting data and field testing of deterrent onboard longline vessels. Working with scientists and fishermen developed potential sperm whale deterrent devices and tested these devices in field trials onboard sablefish longline vessels to be conducted in July 2010. Presented project overview and results at several venues.
- **Research Biologist for in-situ Submersible Survey of Fish Abundance in Marine Protected Areas of Central California** (Moss Landing Marine Laboratories). Participated as an observer conducting line transects from a research submersible for multispecies assessment of Marine Protected Areas of Central California. Responsibilities included species identification, enumeration, transcription and providing review and data quality of other observer's data, working in a shipboard lab.
- **Rockfish Habitat Associations** (National Marine Fisheries Service).

Reviewed submersible video tapes identifying rockfish, habitat, and associations.

- **Facilitator for recreational fishing education** (Alaska Conservation Foundation). Wrote and received funding to bring graduate students to Sitka to discuss their research results regarding rockfish survival and release of fish at depth. Contacted the media and provided outreach advertising the workshops. Developed brochure to provide to public and constructed rockfish release devices for lending.

Group Leader, Alaska Share – Elderhostel: Group leader for Elderhostel residential program "Southeast Rain Forest Discovery". Responsible for week-long residential Elderhostel groups, including daily oversight, transportation, group discussion, logistics, and presentation, education, and field trips on marine biology and fishery portions of presentations to group.

Groundfish Project Leader: Southeast Region, Commercial Fisheries Division, Alaska Department of Fish and Game (ADF&G). Project Leader responsible for research, assessment and management of southeast Alaska commercial groundfish fisheries including longline and pot fishery for sablefish, longline fishery for rockfish, and troll fishery for lingcod. Work

proactively and directly with agency personnel, commercial fishermen and scientists to develop and implement groundfish port sampling programs, groundfish resource assessment surveys, sablefish tagging studies, rockfish break-away tagging, studies of life histories of groundfish species, onboard observer programs, management plans, and evaluation of marine protected areas; conduct in-situ surveys using SCUBA and submersibles and stock assessment for demersal shelf rockfish and lingcod; analyze confidential commercial fishing information for use

in management and assessment of commercial groundfish species; author peer- reviewed journal papers on stock assessment, life history, and tagging; write grants to acquire funding for projects: administered annually 6 grants worth a total of 1.1 million dollars; supervisory responsibility for 1 research analyst, 3 biologists and 3 technicians; responsible for public outreach, education, and presentation of management and research objectives and activities to diverse user groups including commercial fishermen, conservationists, agency personnel, stock assessment scientists, and regulatory authorities at the local, state, national, and international level.

Principal Investigator for the following ADF&G projects:

- 1996-2007: Eastern Gulf of Alaska Demersal Shelf Rockfish Assessment Project: The use of Sidescan Sonar in Seafloor Classification with a Direct Application to Commercial Fisheries Management.
- 1994-2007: In-situ Studies of DSR and lingcod: Using sidescan sonar and Direct Observation to Define the Relationship between Fish Density and Habitat Complexity.
- 1997-1999: Characterization and Implementation of a No-Take Groundfish

Marine Reserve at the Edgecumbe pinnacles area.

- 1989: Evaluation of Submersibles and ROVs as Tools for Estimating the Abundance of Rockfish and Inventorying Rockfish Habitat.
- 1990 and 1991: Definition of the Relationship between Demersal Shelf Rockfish Abundance and Habitat Complexity Based on in-situ Observations from a Submersible.
- 1992: Depth distribution of lingcod (Ophiodon elongatus) egg-masses in central Southeast Alaska using scuba and submersible surveys.

Co-investigator for the following project:

- 2005-present: Sperm whale and longline fishery interactions in the Gulf of Alaska, Cooperative Research between scientists, fishermen and government.

Appointments

- Member, NMFS False Killer Whale Take Reduction Team, Hawaii, 2010-present
- Board Member, Executive Committee, Sitka Sound Science Center, 2009-present
- Sitka Fish and Game Advisory Committee, Executive Committee, 2008-2010
- Member and stock assessment author, Plan Team of the North Pacific Fishery Management Council's Gulf of Alaska Plan Team, 1994 to 2006.
- Alaska Representative to the Technical Subcommittee of the Canada/United States Groundfish Committee, 1994 to 2006, Chairman in 1996, 2003.
- Member, National Academy of Sciences Ocean Studies Board Committee to study Recreational Fisheries Survey Methods, 2005-2006
- Member, National Marine Fisheries Service National Ecosystem Principles Advisory Panel, 1997-1999
- .Member, North Pacific Fishery Management Council's Essential Fish Habitat Technical Committee, 1997-1998.
- Secretary/Treasurer of the Marine Fisheries Section of the American Fisheries Society, 1993-1996.

Awards

- Western Groundfish Conference Achievement Award 2010
- Director's Achievement Award, 2006, Commercial Fisheries Division, Alaska Department of Fish and Game

Selected Publications

Yoklavich, M.M. and **V. O'Connell**. 2008. Twenty years of Research on demersal Communities Using the Delta Submersible in the Northeast Pacific. Marine Habitat Mapping and Technology for Alaska, J.R. Reynolds and H.G. Greene (eds). Alaska Sea Grant College Program, Univ. AK Fairbanks. Doi:10.4027/mhmta.2008.10

Thode, A, J. Straley, K Folkert, **V. OConnell**. 2007. Observations of potential acoustic cues that attract sperm whales to longline fishing in the Gulf of Alaska J. Acous. Soc. Am. 122(2), 1265- 1277.

Tiemann, C, A. Thode, J. Straley, K Folkert, and **V. OConnell**. 2006. Three-dimensional localization of sperm whales using a single hydrophone. J. Acous. Soc. Am. 120 (4), 2355-65.

Starr, R., **V. O'Connell**, and S. Ralston. 2004. Movements of lingcod (*Ophiodon elongates*) in Southeast Alaska: potential for increased conservation and yield from marine reserves. Can J Fish Aquat Sci 16:1-13.

O'Connell, V., D. Carlile, and C. Brylinsky. 2003. Demersal Shelf Rockfish Stock Assessment and Fishery Evaluation Report for 2003. RIR IJ02-44. Alaska Department of Fish and Game, Juneau, Alaska. 43 pp.

O'Connell, V. 2002. *Sebastes ruberrimus* IN the Rockfishes of the Northeast Pacific, M. Love, M. Yoklavich, and L Thorsteinson, 248-250,University of California Press, Berkeley, Ca.

Parker, S.J., S.A. Berkeley J.T. Golden, D. R. Gunderson, J. Heifetz, M.A. Hixon, R. Larson, B.M. Leaman, M.S. Love, J.A. Musick, **V.M. O'Connell**, S. Ralston, H.J. Weeks, and M.M. Yoklavich. 2000. Management of Pacific Rockfishes: AFS Policy Statement. Fisheries 25(3): 22-30.

H.G. Greene, M.M. Yoklavich, R.M. Starr, **V.M. O'Connell**, W.W. Wakefield, D.E. Sullivan, J.E. McRea, and G.M. Cailliet. 1999. A classification scheme for deep seafloor habitats. Oceanological Acta 22(6):663-678.

O'Connell, V.M., W.W. Wakefield, and H.G. Greene. 1998. The Use of a No-take Marine Reserve in the Eastern Gulf of Alaska to Protect Essential Fish Habitat. pp. 126-133 IN

Mary Yoklavich ED. Proceedings of the Workshop on Marine Harvest Refugia for West Coast Rockfishes. NOAA Tech Rpt.

O'Connell, V.M. and W. Waldo Wakefield 1995. Editors: Applications of Side-scan sonar and laser-line systems in fisheries research: Alaska Department of Fish and Game Special Publication No 9, p 11-14.

O'Connell, V.M. and D.W. Carlile. 1994. Comparison of a Remotely Operated Vehicle and a Submersible for Estimating Abundance of Demersal Shelf Rockfishes in the Eastern Gulf of Alaska. N. Amer. J. Fish. Mgt 14:196-201.

R.D. Stanley, B.M. Leaman, L. Haldorson, and **V.M. O'Connell**. 1994. Movements of tagged adult yellowtail rockfish, *Sebastes flavidus*, off the west coast of North American. Fishery Bulletin 92:655-663.

O'Connell, V.M. 1993. Submersible Observations on Lingcod, *Ophiodon elongatus*, Nesting Below 30 M off Sitka, Alaska. Mar. Fish. Rev. 55(1): 19-24 p.

O'Connell, V.M. and D.W. Carlile. 1993. Habitat specific density of adult yelloweye rockfish in the eastern Gulf of Alaska. Fish. Bull. 91(2) 308-313.

O'Connell, V.M. 1991. A preliminary examination of breakaway tagging demersal rockfishes. Alaska Department of Fish and Game, Division of Commercial Fisheries, Fishery Research Bulletin No. 91-06. 8 p.

Rosenthal, R.J., **V.M. O'Connell**, and M. Murphy. 1988. Feeding ecology of ten species of rockfishes from the Gulf of Alaska. Calif. Fish and Game. 74 (1):16-37

Kramer, D.E. and **V.M. O'Connell**. 1986. Guide to Northeast Pacific rockfishes, Genera *Sebastes* and *Sebastalobus*. Marine Advisory Bull. No. 25. 78 pp.

Scott Harris

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EDUCATION

M.S. Natural Resources Management (2004) - University of Alaska at Fairbanks B.S. Aerospace Engineering with Highest Honors (1990) - University of Texas

EXPERIENCE

Founder and Sole-proprietor, Alaska Coast Wilderness Expeditions, LLC, 2008 - present

Created outfitter-guide business to conduct wilderness-based expeditions and provide outdoor skills instruction. Obtained Tongass National Forest permit. Developed marketing plan and website (www.alaskacoastexpeditions.com). Developed business and accounting skills for a private business.

Chairman (2010-present) and Member (2007-2009), Sitka Sound Science Center Board of Directors Helped found the Sitka Sound Science Center, a 501c3 non-profit corporation - including developing a strategic plan, conducting budget oversight, writing grants, and developing partnerships. Currently providing board leadership during a significant transition period.

Conservation Solutions Director, Sitka Conservation Society, 2007 - present

Helped transition local conservation 501c3 non-profit corporation from a strategy based on litigation to one based on collaboration. Developed partnerships with federal and state land management agencies, other non-profits, and the University of Alaska. Managed landscape restoration, community collabora tive, and Wilderness research projects - including planning, writing and obtaining grants, supervising staff, public outreach, budget oversight, and reporting. Worked effectively with a diverse Board of Direc tors.

Member, Sitka Conservation Society Board of Directors, 2006-2007 Served on Board before moving to a staff position.

Assistant Professor and Director, Sheldon Jackson College Center for Outdoor Education, 2005-2007 Developed a summer program offering accredited courses that combined the disciplines of outdoor leadership and environmental sciences. Helped write and obtain federal education grant. Supervised staff and students. Developed a risk management system. Helped manage budget and facilities for an outdoor center and the outdoor leadership degree program. Instructed courses.

Senior Staff Instructor, National Outdoor Leadership School (NOLS), 1996-2005

Led expedition-based courses to teach and develop leadership skills. NOLS is an internationally recog nized leader in leadership education and training. Supervised staff and students. Cumulatively led ap proximately 500 students over 170 weeks in the field.

Research and Teaching Assistant, University of Alaska at Fairbanks, 2001-2003

Wildlife Research Technician, 1993-1998

Collected, analyzed, and reported on research projects for various federal agencies and non-profit organizations: raptor migration, avian winter ecology, coyote-wolf sympatry and ecology, tropical rainforest restoration, and shorebird/waterfowl/passerine population surveys.

Program Manager and Research Engineer, NASA Ames Research Center, 1987-1993

Managed a 5-year, $1.5M aeronautical wind tunnel test project. Developed research methodology, over saw equipment design and fabrication, managed the budget, implemented research program, supervised staff, and published results.

ADDITIONAL QUALIFICATIONS

- Computer skills- website development and management, GIS - ArcMap, QuickBooks, Photo-editing, desk top publishing, spreadsheets, word-processing
- Spanish language fluency
- Private Pilot's License - single engine land and sea, instrument rated, 400 hours
- USCG 25-ton captain's license (expected October 2010)

- Extensive field logistics planning and outdoor experience in challenging environments, including Alaska and Patagonia and both land and sea

PERSONAL

- 9 year Alaska resident (and seasonally since 1994)
- Married with one son
- Physically fit
- Tau Beta Pi (engineering honor society)
- Alpha Phi Omega (community service fraternity)

PUBLICATIONS

- *A Market Survey of Ecotourists in the Valdivian Temperate Forest Ecoregion of Chile*. University of Alaska at Fairbanks, December 2004.
- *Computation of Wind-Tunnel Wall Corrections for Complex Models Using a Low-Order Panel Method*, D.L. Ashby and S.H. Harris. AIAA. 1993.
- *Small-Scale Wind-Tunnel Investigation of an Advanced Fighter Configuration Semi-Span Wing*, K.J. Langan and S.H. Harris. AIAA. 1993.
- *Maneuvering Technology for Advanced Fighter Aircraft*, M.G. Alexander, S.H. Harris, and R.H. Byers. SAE International. 1992.