PROPOSAL SIGNATURE FORM

THIS FORM MUST BE SIGNED BY THE PROPOSED PRINCIPAL INVESTIGATOR AND SUBMITTED ALONG WITH THE PROPOSAL. If the proposal has more than one investigator, this form must be signed by at least one of the investigators, and that investigator will ensure that Trustee Council requirements are followed. Proposals will not be reviewed until this signed form is received by the Trustee Council Office.

By submission of this proposal, I agree to abide by the Trustee Council's data policy (Trustee Council Data Policy*, adopted March 17, 2008) and reporting requirements (Procedures for the Preparation and Distribution of Reports**, adopted June 27, 2007).

PROJECT TITLE:	*PWS Herring Survey:* Sound Wide Juvenile Herring, Predator, and Competitor Density via Aerial Surveys, submitted under the BAA AB133F-09-RP-0059
Printed Name of PI	Evelyn D. Brown
Email:	flyingfishltd@embarqmail.com
Mailing Address	P.O. Box 169
City, State, Zip	Husum, WA 98623-0169
Phone:	509-493-8900; cell 509-637-0340
Signature of PI:	Date:

Printed Name of PI	
Email:	
Mailing Address	
City, State, Zip	
Phone:	
Signature of PI:	Date:

Printed Name of PI	
Email:	
Mailing Address	
City, State, Zip	
Phone:	
Signature of PI:	Date:

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FY10 INVITATION
PROPOSAL SUMMARY PAGE

Project Title: *PWS Herring Survey*: Sound Wide Juvenile Herring, Predator, and Competitor Density via Aerial Surveys, submitted under the BAA AB133F-09-RP-0059

Project Period: FY10-FY13

Primary Investigator(s): Evelyn D. Brown, Ph. D., Flying Fish Ltd. (a private company); flyingfishltd@embarqmail.com

Study Location: Prince William Sound

Abstract: As a component of the integrated PWS Herring Survey (Pegau, P.I.), this project provides 1) a sound-wide, spatially-explicit map of juvenile herring densities, 2) synoptic distributions of herring predator and competitors, and 3) builds on 5 years of previous PWS surveys. June-August surveys map age 1 overwinter survivorship, the timing, spatial extent, and density of age 0 recruiting to nursery habitat, summer mortality of age 1 herring, as well as associated changes in predator/competitor densities. Validation sampling will be provided by a shared vessel with the PWS Herring Survey monthly zooplankton cruises (Campbell, P.I.). Combined with data from other projects within and outside of the PWS Herring Survey, this project's data provides 1) inputs, outputs, and validation for overwinter survival and density-dependent models of predation, growth and disease, 2) an initial estimate of age 2 immature herring recruitment, and 3) spatial information needed to plan, initiate, and evaluate intervention actions.

Key Words: juvenile herring, distribution, Prince William Sound, aerial surveys, predation, density

Estimated Budget:
EVOS Funding Requested *(must include 9% GA)*

FY10	FY11	FY12	FY13	Total
$160,141	$153,056	$153,056	$35,001	$501,254

Non-EVOS Funds to be used:

FY10	FY11	FY12	FY13	Total
$10,000	$10,000	$10,000	$10,000	$40,000

Date: April 15, 2009

PROJECT PLAN

I. NEED FOR THE PROJECT

A. Statement of Problem

i. History of the Problem and Relevant Post-EVOS Research

The failure of Prince William Sound (PWS) populations of Pacific herring (*Clupea pallasi*) to recover from the 1989 Exxon Valdez oil spill and the following 1993 disease event (Marty et al 2003) is linked to a failure in recruitment over the last 16 years. It is the longest period of time since the early 1900s that PWS has gone without a single strong herring recruitment event (Skud et al. 1960; Reid 1971; Brown 2003). Herring fisheries in PWS remain closed and the ecosystem impacts from reduced levels of this key forage fish species remains unknown. An entire generation of PWS youth has grown up immersed in Exxon Valdez oil spill issues and without the cultural knowledge of a "herring spring". Formerly during late March and April, the local communities and harbors around the Sound appeared to awaken from a dreary Alaskan winter in a whirl of activity surrounding herring tracking, harvesting, processing, and preserving. Everyone involved was left with a long-lasting appreciation of what a key ecosystem species means by witnessing the synonymous awakening of PWS with the herring spawning migration which attracted thousands of noisy sea birds, shore birds, and marine mammals. The harbors in PWS have been relatively quiet in early spring for as long as this new generation can remember. The youth no longer venture out to witness the event therefore lack the instinctual understanding of the importance of herring to the PWS ecosystem. Rehabilitation and restoration of the PWS herring population would not only invigorate local economies including subsistence and provide a measure of ecosystem health, but would also provide a cultural healing that is hard to quantify.

The continued concern for lack of PWS herring recovery, lack of integration among herring projects, and lack of proposed restoration actions motivated a grass-roots group from Cordova to push for the formation of an integrated herring program (IHP). In 2006, a herring steering committee was organized and the progress to date is the current 2009 Integrated Herring Restoration Plan Draft within the Exxon Valdez Oil Spill Trustee Council (EVOS TC) structure. The plan comprises three main components: intervention, core monitoring, and research needed to support the first two components. Data from core monitoring is used in models to identify key bottlenecks in time and space and by life stage that limit population recovery. Identification of key bottlenecks guides intervention actions with the highest chance of success. Six potential bottlenecks have been identified: 1) high larval herring mortality associated with advection and predation or cannibalism prior to metamorphosis and recruitment to nursery habitat, 2) overwintering survival of age 0 herring limited by fat stores and energy gained during the late summer bloom and by the timing of the spring bloom or length of winter fasting, 3) predator-prey-competitor interaction processes affecting growth and survival for age 0 and 1 herring year around, 4) marine mammal predation on adults mainly in the winter with the potential for size-selective removal of the younger adults, 5) recruitment of immature age 2 herring from the nursery habitats to adult schools limited by low numbers of adult aggregations and resulting in emigration or vagrant losses, and 6) disease processes that might be exacerbated when non-immune recruits join with an infected but immune adult school. In an analysis of recruitment with seasonal environmental factors lagged to match life history stages, eight critical stages were identified spanning 1-5 above: 1) spring, age 1 after first winter, 2) late summer, adult feeding prior to cohort year, 3) late summer, age 0 and end of larval drift/metamorphosis, 4) late summer, age 1 herring entering 2^{nd} winter, 5) late summer, age 2 herring joining adults schools, 6) fall, adults beginning overwintering prior to cohort year, 7) fall, age 0 herring entering overwintering period, and 8) fall, age 2 immature herring entering overwintering areas with adults (Brown 2003). This analysis provided potential clues as to where and when to look for bottlenecks, but more importantly, it demonstrated that no one period had a dominate influence on recruitment and year class formation. The bottleneck processes may have additive affects or vary in influence from year to year. In addition, all of the processes listed have density-dependent relationships that are often non-linear and often difficult to describe. A combination of modeling and data from targeted core monitoring explicitly specified in time and space to capture the bottleneck process will be required to identify intervention actions with the highest likelihood for success.

Understanding processes limiting recovery of pink salmon and herring was the main goal of Sound Ecosystem Assessment (SEA – an EVOS TC funded ecosystem project) which began in 1995. SEA herring focused process studies entirely on the overwintering period (bottleneck 2; Paul and Paul 1998a, 1998b, 1999). From those studies, an energetic overwintering (OW) model (Patrick et al. 2000) was developed and validated. The two main inputs to this model are simple energetic measurements taken at the beginning of winter fasting, using inexpensive bomb calorimeters, and a winter time series from temperature loggers placed within the juvenile distribution. The output predicts a survival rate based on the range of fall energetic values. However, the SEA project ended after three years and the OW model was never tested at a population level to gage the relative importance of the OW period as a bottleneck limiting recruitment. As a result, identification of the relative importance among critical bottlenecks is still incomplete. With the draft IHRP in place, the current invitation lists herring surveys with a focus on juvenile herring distribution and habitats as a high priority with the potential to address bottlenecks 3), possibly 5), and 6) in the next three years and, combined with the current funding for herring modeling, test the OW model on a population level.

This proposal addresses the request for information on juvenile herring as part of a suite of proposals addressing the “Herring Survey” topic of the “Integrated Herring Program” category in the current invitation. An overview project coordinating the individual survey efforts has been submitted by W. Scott Pegau entitled “PWS Herring Survey: Community Involvement, Outreach, Logistics, and Integration”. The project proposed here is summarized in Dr. Pegau’s overview proposal. This project applies the broadest brush to monitoring using aerial surveys to collect spatially-explicit herring, predator and competitor density measurements over the largest geographic area among the survey projects.

ii. Aerial Survey Background

Aerial surveys are employed around the world to census hundreds of species of small surface schooling and large individual fishes that frequent the surface. Herring, sardines, anchovy, capelin (*Mallotus villosus*), and sand lance (*Ammodytes hexapterus*) are known to school in tight aggregations with distinctive shapes and are often found in oceanic surface waters (Mais 1974; Squire 1978; Fresh 1979; Blaxter and Hunter 1982; Hara 1985; Misund 1993; Carscadden et al. 1994; Brown 2002; Brown et al. 2002). Many pelagic fish are arranged in shoal or school groups (Cram and Hampton 1976; Smith 1978; Fiedler 1978). Distribution of herring and capelin is thought to be contiguous. Known areas of seasonal aggregations are unique to a particular population (Templeman 1948; Campbell and Winter 1973; Sinclair 1988; Stocker 1993). Given that these forage species form distinct, easily identifiable schools, and that ship avoidance is often a problem when schools are near the surface, aerial surveys are a logical choice for assessments. Airplanes are fast, measurements are not limited by shallow water, and sample swaths measure in hundreds of meters compared to a few meters for acoustics. Configurations of fish and their predators are viewed without disturbance. Synoptic comparisons of large regions are possible because of the speed and coverage of aerial data collection.

Aerial surveys have their limitations as well. Visual aerial surveys are limited to surface waters where light penetrates. Accuracy and precision of aerial survey results, due to sighting conditions, surveyor bias, changes in vertical distribution of fish schools, or species identification, are difficult to measure and often go unmeasured (Hunter and Churnside, 1995). Standardizing survey parameters, such as weather criteria, aircraft speed, altitude, time of day, etc., can minimize error from sighting conditions (Caughley et al., 1976). Calibrating and training surveyors can also reduce error from bias. A reduction or accounting for other types of error requires identification and the quantification of those error sources. Especially helpful is the coupling of acoustics and aerial surveys (Cram and Hampton 1976), as in the SEA project, where school depth distributions measured with sonar are used to correct surface school counts for subsurface distribution to obtain an absolute estimate of abundance rather than an index of density. School depth distribution is especially important if there is spatial variability with a given survey time period.

Aerial surveys have been employed to locate and map herring schools since small airplanes have been available in Alaska. The earliest surveys with documented data in PWS occurred in the 1950s (historic data records from Alaska Department of Fish and Game, Cordova office) before the development of standardized methodologies for translating school surface areas to biomass. Fish schools were counted but the main accomplishment was mapping the miles or extent of spawning along the shore and the recognition of the value of aerial surveys to herring assessments. Because the fishery and markets were severely depressed at the time, stock assessment programs were virtually non-existent. With the onset of the herring roe markets in the late 1960s, Alaska Department of Fish and Game (ADFG) developed an assessment program with aerial surveys as the main tool in the early 1970s (Brady et al. 1987). By 1985, a standard methodology had been established using a sighting tube to measure school sizes and a series of seine catch validations to translate the school data into biomass estimates for adult herring (Lebida and Whitmore 1985). The method of categorizing schools by size, associating the size to a biomass, and adding the school biomasses by region is still used today as a pre-season assessment tool along with the mapping of spawning extent (personal communication, Steve Moffit, ADFG, Cordova office). The population indices from aerial surveys are key components of the Age-Structured-Analysis (ASA) virtual population model ADFG uses to estimate escapement and to calculate a forecast used to manage the resource inseason. ADFG also uses aerial surveys to estimate salmon stream escapement and to report migration paths of salmon to facilitate sampling.

Because of their value for adult herring, aerial surveys were adopted as a key tool for ecosystem studies of juvenile herring and forage fish in PWS. In 1995, the SEA herring Principal Investigators (Restoration Project 95320T) identified the failure of larval and/or juvenile herring survival as limiting to recovery. However, basic distribution and density information needed to establish study sites was lacking. Broad-scale acoustic and aerial surveys were initiated to document distribution with sufficient vessel sampling to properly interpret and validate both types of data (Norcross et al. 1999). Over the SEA period (1995-1997), aerial methods were perfected, sources of error and probability of detection were measured, and optimal survey periods were identified for juvenile herring, sand lance, and, to a lesser extent, capelin, eulachon (*Thaleichthys pacificus*), and jelly fish (*Aurelia labiata*) aggregations (Brown and Norcross 1997; Brown and Borstad 1998; Brown and Moreland 2000). Detection and error was also calculated for gulls, alcids, and marine mammals associated with herring aggregations which represent key predator species. Details of the statistical model and error rates are described in the Data Analysis and Statistical Methods section since this same survey design is proposed for this project. Sand lance (Sturdevant and Hulbert 2000), juvenile capelin (Brown 2002), and eulachon represent potential competitors to juvenile and adult herring. Jelly fish aggregations are predators of herring larvae and shelter age 0 pollock (Purcell et al. 2000) which eventually compete with (Sturdevant et al. 2000) and prey on juvenile herring. Distributions of these auxiliary species may be important in future analyses and studies of competition, predation, and factors limiting larval survival and archiving this data is achieved at no extra cost. In 1997, significant correlations of aerial-derived forage fish distributions to sea bird foraging patterns caused the Alaska Predator Experiment (APEX, another EVOS TC funded ecosystem project) to continue the juvenile herring/forage fish aerial surveys for an additional two years providing a baseline of 5 years of juvenile herring and associated species distributions and densities (Brown et al. 2000; Figures 2-3; Table 1). Data from these surveys have been published and used broadly in analyses or foraging models of herring, capelin, kittiwakes, river otters, and jelly fish (Purcell et al. 2000; Suryan at al. 2002; Brown 2002; Brown et al. 2002; Ainley et al. 2003; Ben_David et al. 2005; Jodice et al. 2006; Suryan et al. 2006; Ford et al. in press). The ecological value of the aerial data is enhanced by synoptic counts and recorded behaviors of associated predators which are observed undisturbed in natural foraging patterns. This is not possible from ship-board surveys where surface schools avoid the ship and disturb foraging behavior (Logerwell and Hargreaves 1996).

From the 5 years of PWS aerial surveys, May through August was identified as the optimal period for juvenile herring surveys due to the surface-oriented school depth distribution (Brown and Norcross 1997; Brown and Moreland 2000; Stokesbury et al. 2000; Figure 1). Acoustic surveys indicated that a large proportion of the age 0-2 juvenile herring schools were at or within 30 m of the surface during this period but in June and July, the average depths were less than 20 m placing the majority of the population in visual range from the air. However, aerial surveys conducted May through August documented hundreds of juvenile herring schools around the edges of the nursery bays during the day in water too shallow (< 10m) for the acoustics vessel. It is therefore reasonable to assume that the acoustic depth ranges are biased low during the summer with the long days and may actually be missing a large portion of the population. In addition, depth distribution was age specific with older juveniles found over a larger depth range than age 0 but the depth distribution summaries were not separated by age for the reports and publications. Therefore, a goal of this project will be to revisit the combined aerial and acoustic surveys to determine a corrected depth distribution that can be used to estimate absolute numbers and to normalize annual aerial survey indices for inter-annual variability in depth distribution. In addition, the effect of age on depth distribution will be determined. Checking age-specific depth distribution in a few key sites may be an annual calibration need for long term aerial surveys and may be a protocol for other projects as well. Recommended monitoring protocols is an objective of this project.

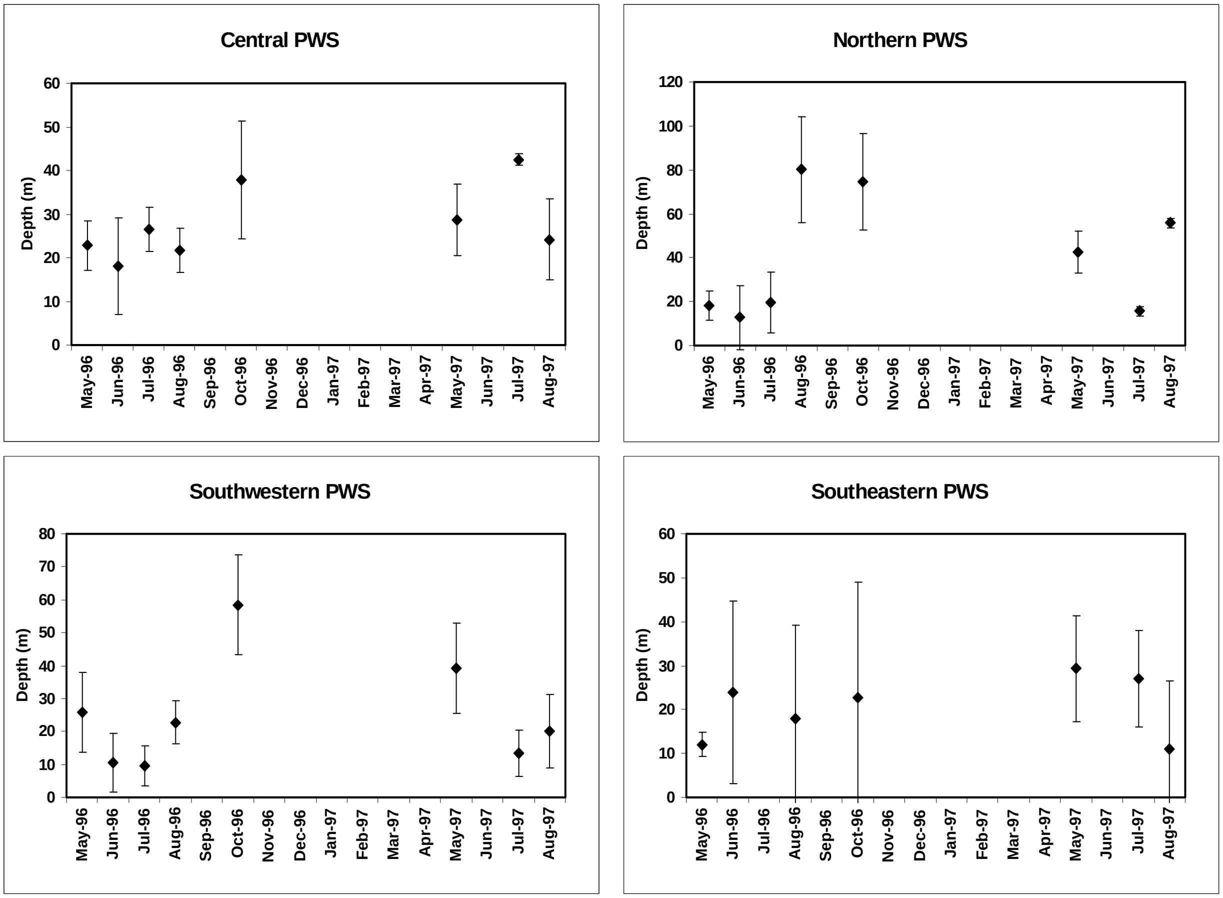

Figure 1. Spatial and temporal variability in depth distribution measured with a towed acoustic array of juvenile herring ages 0-2 measured at the four SEA bays representing four regions of PWS; surface-oriented schools in shallow regions of the bay (< 10 m) were observed only with aerial surveys resulting in a bias toward deeper mean distributions from May through August (Brown and Moreland 2000).

Species- and age-specific survey periods and validation requirements were also identified. Surveys in June produced the best estimates of age-1 herring abundance and were associated with low error rates because overlapping species or age 0 herring schools were not present. By July and August, age 0 herring and sand lance recruited to nearshore regions. Although these schools were distinct from age 1 herring schools in shape, size and location, the error rate associated with school identification increased due to the similarity between age 0 herring and sand lance schools. Because of this, school sampling was required July and August to establish a correction factor for age 0 herring mis-identified as sand lance. The sampling rate by net capture was not sufficient to correct species identification in all regions and a camera system was developed. By mounting a remote cam at the end of a long pole at the front of a fast vessel (Figure 4), the validation rate vastly improved by filming a large number of surface schools (example in Figure 4) mapped from the aerial survey and the front mounting eliminating the ship avoidance problem. Camera validation was achieved by guiding the vessel to a specific area where sand lance appeared to be mixed with age 0 herring. Once the vessel was at the assigned location, the aerial surveyor would detour from the survey path and guide, by radio, the vessel into as many schools as logistically possible over a period of 1-2 hours. Using camera sampling, the sampling rate increased by an order of magnitude allowing the calculation of species correction factors for all regions of concern. Typically, species overlap was a problem in limited regions and an 8-10 day period was sufficient for vessel validation from a small, inexpensive platform. The sampling techniques, optimal survey periods and error rates developed during the SEA and APEX aerial programs were used to design this aerial core monitoring program for the IHRP and the PWS Herring Survey project.

B. Relevance to 1994 Restoration Plan Goals and Scientific Priorities.

This project is responding directly to 'Herring Surveys', item #2 in the FY2010 Invitation. It is part of an integrated and collaborative effort to collect a suite of information on juvenile herring in PWS that will eventually lead to a refinement of core monitoring needs and the ability to evaluate restoration options. A summary of this project is described in the administrative overview for the integrated herring survey proposal led by Dr. Scott Pegau of the Prince William Sound Science Center entitled: *PWS herring survey*: Community Involvement, Outreach, Logistics, and Synthesis. The main goal is to develop a cost-effective, simple tool providing key data monitoring, intervention and improved stock assessment that can be transferred to the community. The project addresses several of the data needs listed in the herring survey topic including: locating herring nursery bays, identifying recruitment rates and distribution of age 0 fish to the bays, providing population counts, and predator counts. The four bays listed as site priorities in the invitation are included in the broad scale survey of PWS and can be evaluated amongst the entire suite of populated nursery bays in terms of continued occupation and relative density. In addition, potential competitor species are mapped and the end product is a spatially-explicit description of density for all species recorded. Because the bottleneck processes are density-dependent and vary across spatial regions, tracking locations and densities of juvenile herring and how they change over time is a key data piece for understanding the roadblocks to recovery.

Results from this project will allow members of the herring research team and the modelers to determine how variability in herring density and distribution, overlaid with varying zooplankton concentrations and ocean conditions, affect herring processes such as energetic gains, growth, predation, and disease because all ground sampling locations are surveyed. Annual estimates of age-specific juvenile herring abundance will enable an estimate of age 0 to 1 survival that could be linked to the herring processes. Annual estimates of age 2 herring provide an initial estimate of potential adult recruitment. Changes in distributions observed will aid in the interpretation of tagging/marking studies. Finally, this project will help with intervention site selection by providing a map of full and empty juvenile nursery bays. The recipients are community members anxious to find out when, where and how intervention can occur as well as those directly involved with the project. Recipients also include local ADFG managers seeking the means to gage population recovery and improve predictive capabilities by using an index of recruitment. Mapping techniques and software currently being used by ADFG have been adopted in order to facilitate a combined aerial survey database and a project objective has been included for the ultimate transfer of the project to the community.

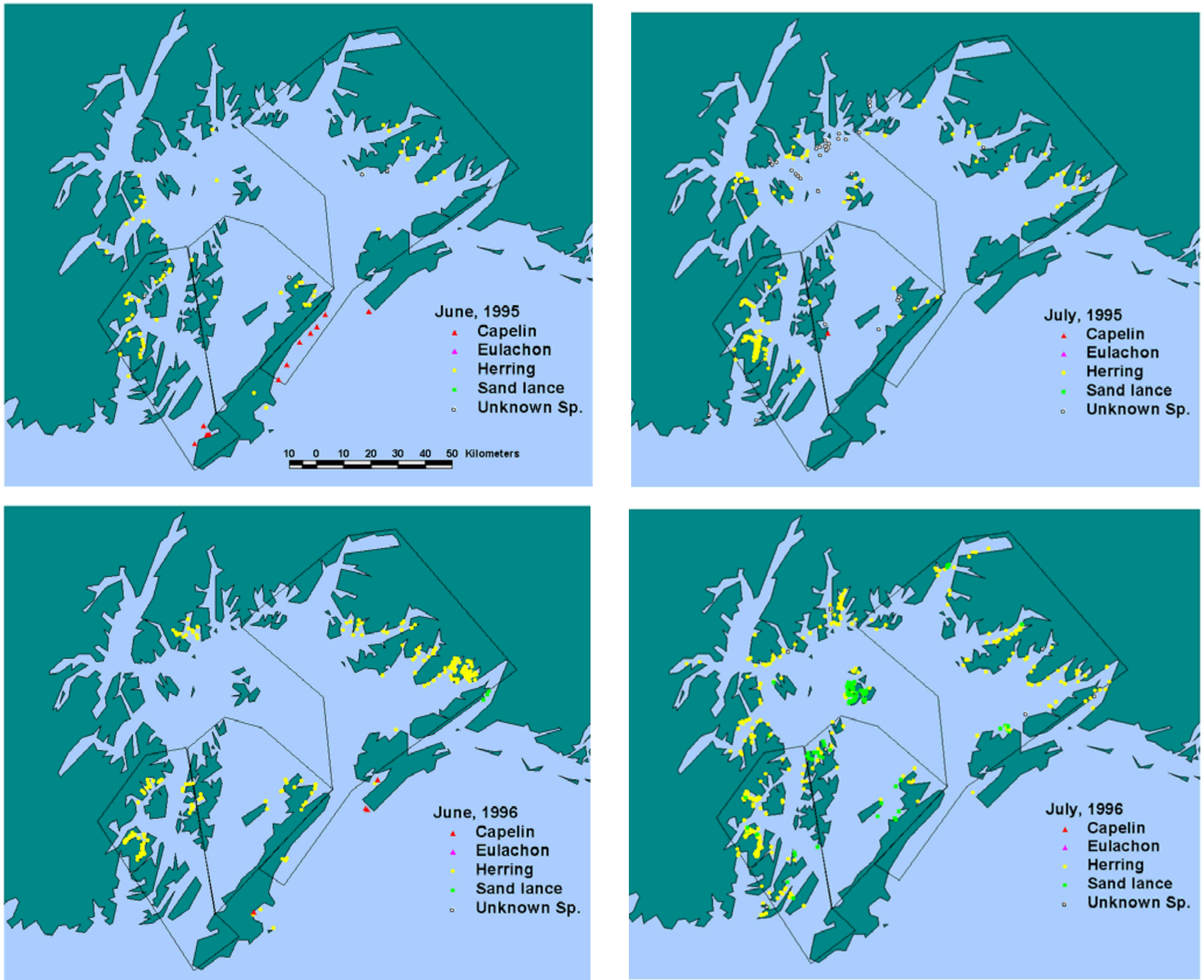

Figure 2. Distribution of forage fish schools by species in June and July, 1995 and 1996. The black lines denote the geographic query regions for the APEX project shown in Table 1.

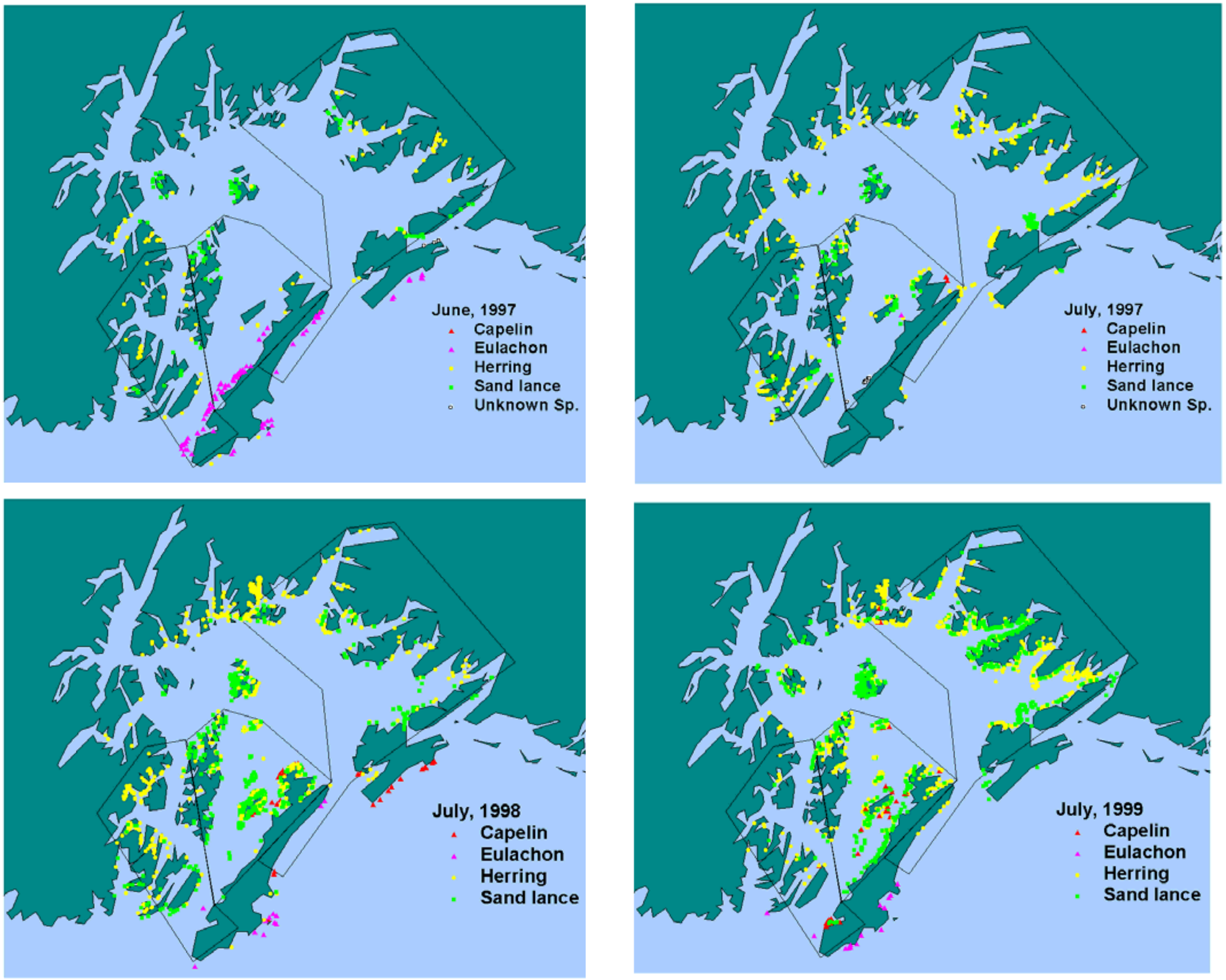

Figure 3. Distribution of forage fish schools by species in June and July, 1997 and July only for 1998 and 1999. The black lines denote the geographic query regions for the APEX project..

Table 1.An example of aerial survey summary data means corrected for errors and expressed in density or total abundance normalized for area flown by subregions of PWS for a few key species.

			1995			1996			1997		1998		1999	
Species	**Index**	**Area**	**June**	**July**	**August**	**June**	**July**	**August**	**June**	**July**	**July**	**August**	**July**	**August**
Herring	Density by Surface Area	Northeast	7.10	3.02	15.15	28.10	10.52	3.40	2.11	6.78	1.83	1.27	5.34	4.95
	(total m^2 SA/km^2 flown)	Central	7.11	3.44	8.74	37.99	2.32	9.07	2.16	7.62	2.69	15.91	4.72	0.52
		Southwest	18.21	19.26	0.00	57.92	13.79	6.32	4.06	1.57	26.56	0.39	3.61	1.99
	Index of Abundance**	Northeast	3196.84	1356.90	6818.15	12647.14	4733.69	1527.96	949.20	3052.25	824.79	569.51	2404.71	2225.94
	(total SA schools m^2)	Central	1492.61	723.09	1835.50	7978.09	487.19	1903.98	454.03	1600.27	565.70	3340.61	991.15	108.80
		Southwest	4552.90	4815.82	0.00	14480.38	3447.11	1580.16	1015.21	392.49	6639.09	97.99	901.51	496.47
Sand lance	Density by Surface Area	Northeast	0.00	0.00	0.00	0.00	3.09	10.03	2.19	23.74	1.41	0.65	5.12	12.09
		Central	0.00	0.00	0.00	0.00	4.82	11.22	6.98	11.87	19.15	13.22	10.50	12.50
		Southwest	0.00	0.00	0.00	0.00	2.06	2.38	2.99	4.09	23.68	13.30	4.22	12.18
	Index of Abundance**	Northeast	0.00	0.00	0.00	0.00	1391.71	4513.25	984.21	10684.74	635.45	294.69	2302.91	5439.63
		Central	0.00	0.00	0.00	0.00	1012.05	2355.31	1466.22	2493.21	4020.49	2776.21	2205.35	2624.31
		Southwest	0.00	0.00	0.00	0.00	514.99	595.76	746.80	1021.79	5919.18	3324.71	1055.64	3045.00
Jellyfish	Density by Surface Area	Northeast	0.00	3.03	3.39	0.00	0.00	0.00	0.00	0.00	5.13	0.08	7.65	2.00
		Central	0.00	0.21	0.69	0.00	0.00	0.00	0.00	0.00	2.99	3.35	0.78	0.00
		Southwest	0.00	0.85	2.30	0.00	0.00	0.00	0.00	0.00	23.57	0.00	2.84	0.00
	Index of Abundance**	Northeast	0.00	1364.68	1524.39	0.00	0.00	0.00	0.00	0.00	2310.50	37.63	3440.93	901.24
		Central	0.00	43.96	144.49	0.00	0.00	0.00	0.00	0.00	628.25	703.64	163.43	0.00
		Southwest	0.00	211.55	573.88	0.00	0.00	0.00	0.00	0.00	5891.88	0.00	709.41	0.00
Kittiwakes	Total Observed	Northeast	1101	1616	13942	570	997	627	7089	1929	16317	4923	19488	5671
		Central	251	561	767	398	521	1685	867	2079	13458	5647	22605	819
		Southwest	21693	576	324	172	989	13	696	395	2061	236	20302	48
	Total Foraging	Northeast	593	1077	11618	461	814	167	3630	1334	5381	244	8922	2274
		Central	207	440	730	360	409	0	653	1398	6428	750	12880	603
		Southwest	8397	464	281	172	853	13	408	263	1541	76	10671	18
Glac.-Winged	Total Observed	Northeast	48	3177	1501	0	1561	25	1506	3	94	49	730	88
		Central	4	70	40	0	1	0	0	0	0	5	467	2
		Southwest	1	20	0	0	6	0	0	0	0	0	85	1
	Total Foraging	Northeast	26	1324	0	0	937	0	602	3	6	0	216	25
		Central	2	23	0	0	1	0	0	0	0	0	254	1
		Southwest	0	20	0	0	0	0	0	0	0	0	65	0
Alcids	Total Observed	Northeast	20	0	38	0	231	5	91	3	2105	602	1090	470
		Central	0	0	28	0	65	0	0	5	489	399	1918	0
		Southwest	30	0	0	0	59	15	2	12	5	58	1487	0
**	Expansions to abundance index based in Average km^2 flown per Area of NE, 450; C, 210, and SW, 250													

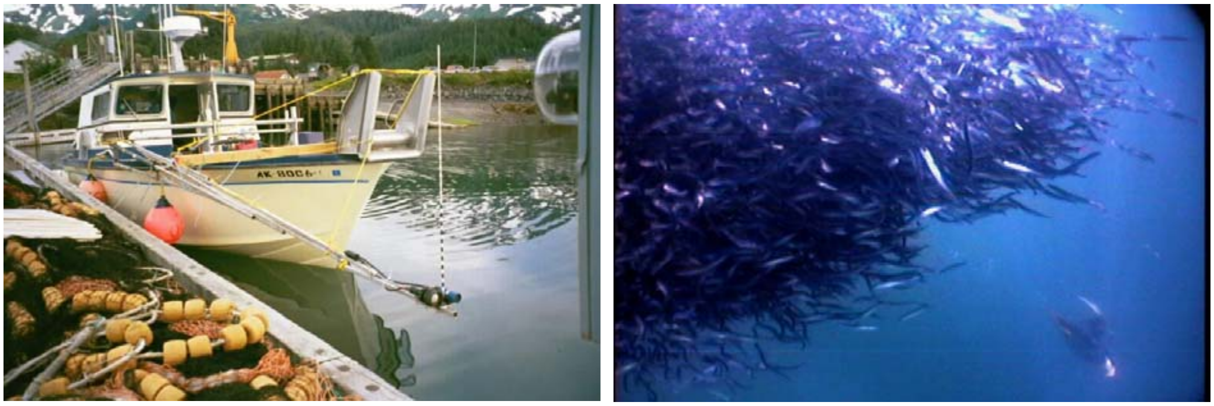

Figure 4. The front mounted camera system (left) used to identify surface schools allowing estimation of a species identification correction error for age 0 herring and sand lance schools. An example of a photo obtained using this system showing a school of sand lance with a predatory puffin exiting the scene (right). This particular sand lance school was properly identified by the aerial surveyor.

II. PROJECT DESIGN

A.Objectives

This project will address the three main objectives of the integrated PWS herring survey group sited in the overview proposal (Pegau – PI):

1) Identify juvenile rearing bays for use in restoration planning
2) Measure factors limiting the success of herring including predation
3) Provide protocols and recommendations for spatial and temporal coverage of monitoring projects for inclusion in the long term core monitoring plan

This project has the following additional objectives unique to this study:

4) Provide a distribution of age 1 and age 0 herring densities to allow sampling for density-dependent effects
5) Document variability in the timing and duration of age 0 recruitment to the bays as well as the potential competing species (age 0 sand lance)
6) Estimate an annual survival rate for age 0 to age 1 herring
7) Provide the broad scale density distribution input needed to allow population level testing of the existing overwintering and predator-prey-growth models developed during the SEA project
8) Provide an initial estimate of age 2 immature herring recruitment to the adult population

9) Provide distributions of sea birds and marine mammals overlapping herring distribution to examine the effects of herring density on predator distribution and potential predation rates

10) Provides a map of zero to high density juvenile nursery areas to assisting in planning, initiating, and evaluating intervention actions

11) Establish depth correction measurements and protocols for future aerial surveys

12) Train and calibrate local spotter pilots, ADFG staff, or other dedicated residents to allow the transfer of this monitoring program to the community.

B. Procedural and Scientific Methods

Project field planning will involve a meeting of the P.I.s involved in the integrated PWS Herring Survey effort. Attendance and participation by community members including local fishermen, spotter pilots, ADFG staff, the local Marine Advisory agent, the native village organizations, and the local aquaculture association, will be facilitated by holding an informational meeting in Cordova. Field season planning will include a coordinated sampling and survey schedule, a list of personnel and equipment needs, and logistical issues that will be solved collectively. This level of planning is required because of the shared sampling platforms, multi-purpose cruises and surveys, shared equipment, and shared personnel. For this aerial component, a partnership has been established with local fish spotter pilots and ADFG surveyors to expand their survey efforts into the juvenile nursery habitat. Many are already involved on a voluntary basis in the spring helping ADFG identify and track spawning locations of the reduced population because of the severe budget restrictions on herring stock assessment without the fishery. In addition, several fish spotters have been observing the small forage schools around the sound for many years, but have never been directed how to measure these schools and how to discriminate species. Over the next three field seasons, these pilots and other individuals exhibiting the ability to spot and measure schools, will be taught the survey technique including computer mapping application and be calibrated using the double counting technique (see statistical section below; Obj. 3 and 12). ADFG generally requires a three year training and calibration period for aerial surveyors with a goal of reducing error from surveyor bias. This P.I. is anticipating a similar timeline. The training goal is one new surveyor a year leaving Cordova with a talent base with known and measurable bias.

Aerial survey transects will be flown approximately parallel to shore within a broad-scale region covering all the shorelines within and immediately adjacent to PWS similar to the flight path during SEA and APEX (Brown and Moreland 2000; Figure 5). There is evidence that the Outer Kenai (OK) immediately west of PWS is an overflow or additional juvenile rearing area for PWS and this region will be surveyed if time and budget allow. A survey of the entire area including the OK takes about 4-6 days, 3-6 hrs each day, in a Cessna 185 float plane or equivalent at approximately 203.7 km hr-1 (110 knots). Areas not sampled are the heads of fjords and small coves inaccessible due to insufficient space for a 360° turn and with low clouds, fog, or high winds. The shoreline is followed in a single line but flat 360° turns were allowed when recorded feature density was high to ensure complete counts within a given swath area. During post-survey data processing, the 360° loops are removed to prevent underestimating density. Previous surveys indicated that for the smaller juvenile schools, a flight altitude of 305 m (1000 ft) is optimal based on ability to discriminate a 1 m diameter feature and the angle of light reflection illuminating the school.

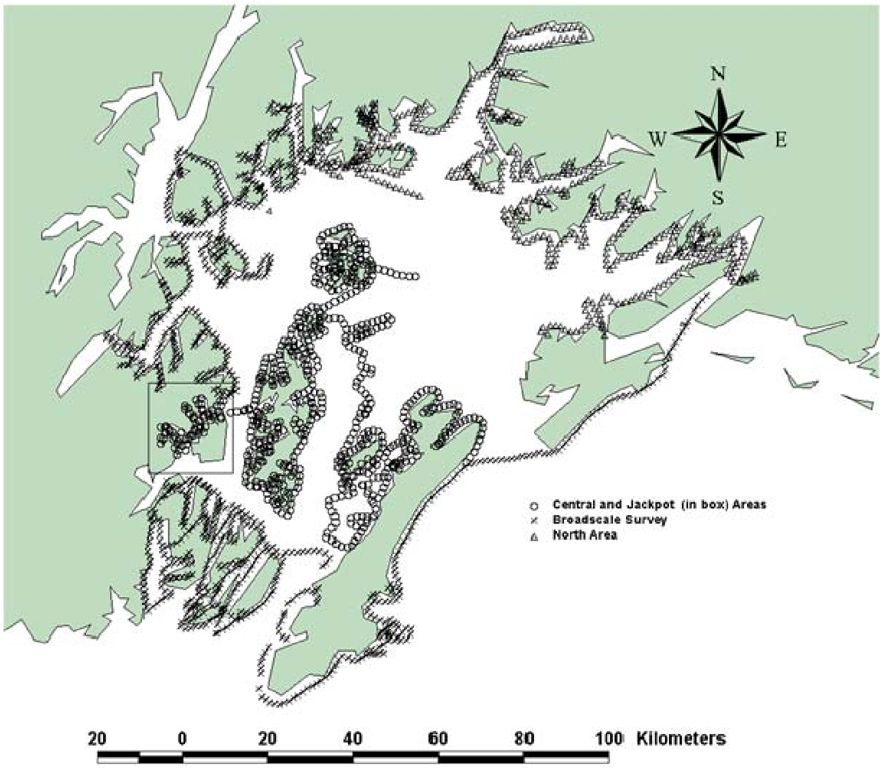

Figure 5. The APEX July survey flight path 1998 requiring 4-6 days of 6-hr surveys depending on the hours spent coordinating with vessels on school validation measurements or ground counts.

The survey schedule will be prioritized around ground sampling efforts and coordinated vessel surveys with the plankton cruises (Campbell P.I.). There will be a 10 day survey in June to collect 2 measurements of age 1 first year overwinter survivor (Obj. 1, 2, 4, 6, 7, 9, and 10) and age 2 herring distribution prior to this cohort's exit from the bays (Obj. 8). Following in July, 15 days are needed to collect 3 measurements and 10 days in August allowing the pre-winter estimate of age 0 herring distribution and density as well as the timing of near shore recruitment for both age 0 herring and sand lance (Obj. 1, 2, 4, 5, 6, 7, 9, and 10).

Prior to each survey, radio communications will be established for weather checks and to confirm a start/ending point for each survey. In order to minimize the effect of survey condition bias on accuracy of the results, criteria have been established for determining whether or not to proceed with a survey. Winds over 25 knots (creating a sea state of over 1 beaufort scale or 1 m wave heights), an average ceiling (cloud cover) is at or below 250m, and a steady downpour of rain preclude surveys. Conditions outside of the criteria may significantly affect the quality and accuracy of the survey data.

During the survey, both flight path (transect) and features along path will be recorded. ADFG has developed an ArcPad application that simplifies mapping data in real time. A touch pad, field quality computer communicates with a blue tooth GPS and displays the flight track along a map as well as the recorded data points from the application. Customizing the application will allow entry of the suite of information collected and will conform output to agency standards. At the beginning of each flight, information detailing pilot, weather, water visibility, wind, wind direction, tide stage, wave height and other notes that may affect survey results are recorded in the log program and on paper. Information or "sightings" such as numbers of fish schools, species of fish, surface area of schools, numbers of birds or mammals, behavior of birds, or oceanographic features (tidal fronts) are recorded. Field sampling, acoustic surveys, validation via landing on top of schools, or observations recorded on film from a vessel synoptic along the flight path (Campbell P.I.) are also recorded. Single or double letter codes were developed for fish, bird and mammal species (such as h for herring, sd for sandlance, kw for kittiwakes, hs for harbor seals etc). Bird behavior was recorded as foraging or plunging (pl), resting on water (rw), resting on shore (rs), aggregated tightly on water over school (tw), traveling (tr) or flying in a "broad area search" (bs). The flight path and sightings needed to guide coordinated field sampling can be downloaded at any time and provided to field samplers with a memory stick or printed and delivered the next air day. At the end of each survey the database (dbf) file with the sightings and the flight path will be downloaded and archived on a back up hard drive. The sighting dbf will be error checked for typos or miscoded lines. An access data base will be contructed to hold the flight paths, sighting tables, survey log, data coding key, and calibration parameters. The data base will be available to other researchers at the end of each survey period and summarized in the annual report. Coordination with ADFG and their database contractor will be crucial to archive the data base and to recode the ArcGIS dbf files with latitudes and longitudes for use in the model software, Google Earth, or other mapping applications.

Fish schools will be counted and surface area estimated using a sighting tube. The sighting tube is constructed of PVC pipe with a grid drawn on mylar on the end. The focal length of the tube is 216 mm and can be calibrated for ground distance covered by reference line (X) for any survey altitude, when length of the grid reference line (L), focal length of the tube (F), and survey altitude (A) are known, by using the equation:

$X = A\,(^{L}/_{F})$ (Lebida and Whitmore 1985; Brady 1987). (1)

The use of the grid is particularly important for large schools. Diameter is measured for round schools while maximum length and width are measured for elliptical shape. For irregular shapes (U-shaped, long wavy bands, etc.) length and width of separate sections are measured and combined to give a total estimate. Video or still cameras will be taken as often as possible during July and August to provide validation of school recognition when matched with catches and for measurement of recognition error.

C. Data Analysis and Statistical methods

Line Transect Model, Precision and Accuracy

The line transect model adopted for the previous surveys and proposed for this project was designed specifically for aerial surveys (Quang and Lanctot 1991) where surveyors are mapping data to one side of the transect line over a range of sighting angles (in contrast to a single angle for ground transects) and the transect line or flight path is a blind spot. The application of this model is described in detail within SEA and APEX reports (Brown and Norcross 1997; Brown and Borstad 1998; Brown and Moreland 2000):

$$\hat{D} = \frac{n\hat{f}(d)}{L}, \ \hat{N} = 2A\hat{D} \ \text{or} \ \hat{N} = \frac{n}{\hat{p}}, \ C = \frac{1}{\hat{p}} \qquad (2)$$

where *D* is density whether expressed as school counts, surface area, or converted abundance and biomass; n is the observed schools or birds, *f(d)* is the maximum height of the probability density function or detection curve (*f(x)*) of distances (*x*) at distance *d* from the center of the transect/flight path, *L* is the length of the transect, *N* is the total number of animals, schools, or biomass estimated in the area, A is the area sampled (*L* x swath), *p* is the probability of detection and *C* is the visibility coefficient. In this model, perfect detection is assumed at *d*. In order to account for the blind spot, that occurs directly under and some distance to the side of the aircraft, the probability density function for *f(x)* takes the form of a truncated beta curve:

$$f(x) = K_f(\alpha,\beta)(\frac{x-a}{b-a})^{\alpha-1}(\frac{b-x}{b-a})^{\beta-1}, \ c \le x \le h, \ a \le c < h \le b, \ \alpha < 2, \ \beta > 2 \qquad (3)$$

Where *f* integrates to 1 over [*c*,*h*], *x* is the distance from the center of the transect to the sighting, *a* is the left-hand limit (not observed) to the beta curve and *b* is the right-hand limit (not observed). The truncation of the curve due to the blind spot under the aircraft occurs at *c* and the right hand truncation occurs at *h*. The swath is estimated as *h*-*c*. Imperfect detection at *d* affects the accuracy or bias of the abundance estimate resulting in undercounting. Because it was desirable to measure accuracy and bias, imperfect detection was assumed during the SEA and APEX projects requiring an adjustment to the probability of detection. A corrected probability (p_{corr}) is substituted for *p* in equation 2. Variance of density estimates is estimated by:

$$v(\hat{D}) = v(\frac{y\hat{f}(d)}{p_{corr}L}) + \varepsilon_I + \varepsilon_N \qquad (4)$$

Variability about the mean of density estimates include spatial and temporal variability in observed schools *y*, detection error *f(d)* and bias p_{corr} affecting the accuracy of the mean density estimate for a given transect segment *L*. In addition, discrimination error, ε_I, is introduced by misidentification of fish species or age classes and ε_N is from natural, short-term variability in vertical fish distribution or sighting conditions both affecting precision. These variance terms were estimated during the SEA and APEX projects.

The corrected probability of detection (p_{corr}) was estimated by two methods. First, two experienced and calibrated surveyors compared visual school counts and surface areas estimates to unbiased high resolution imagery over a series of defined regions to produce a range of error. Secondly, one experienced surveyor compared counts and surface area estimates with experienced and inexperienced surveyors over a series of regions with two counting simultaneously but independently using the double counting method (Rivest et al. 1995). The former method (visual to image) provides an estimate of unavoidable identification error even after calibration of a surveyor. The latter method (visual to visual) provides a range of error and a means of measuring calibration (Obj. 12). The detection curve *f(x)* and the extracted maximum value *f(d)* was estimated by recording the sighting angle associated with a large sample size of each species of interest sighted. Discrimination error ε_I, was estimated from ground truthing (net samples and video) over 400 schools and by comparing that error matrix to a discriminate function model using school size, shape, distance from shore and depth of water at school location. Short term natural variability ε_N due to vertical school movement and sighting conditions was estimated by modeling repeat counts spaced 1 to 36 hr apart. Depth distribution correction factors would minimize or eliminate the need for this error term. Along transect resolution was estimated at 81 to 85 meters at the 110 knot airspeed using 1995-1999 GPS technology. Improved GPS accuracy may improve this resolution but given airspeed, 50 m might be the expected highest resolution attainable. The area sampled is calculated by multiplying the length along the transect (*L*) by the effective swath width (*h-c*)or width of the truncated beta curve *f(x)*. Surveyor bias ($1-R^2$) is estimated from the R^2 value of the regression between visual and image counts while the undercounting rate is estimated as $1-1/p_{corr}$. Table 2 lists the model parameters estimated during SEA and APEX that will be applied for this project as well as the calibration goal for p_{corr} to be applied to surveyor trainees.

Table 2. Aerial survey line transect model parameters and error terms. The calibration goals represent measurements to determine if a trainee is ready to provide formal survey estimates based on minimization of error (Obj. 12).

Species:	**Alcids**	**Kittiwakes /Gulls**	**Herring**		**Sand lance**	
Model Parameters			**school counts**	**school surface area**	**school counts**	**school surface area**
Bias						
f(d)	0.23	0.18	0.30		0.28	
Effective swath(m)	1424		474			
d – max. detection distance(m)	700		600			
p_{corr} Calibrated	-	-	0.928	0.998	0.928	0.998
Double Counting:						
p_{corr} Trainee	-	-	0.727			
p_{corr} Calibration Goal			0.900			
Random Error						
se(f(d))	0.003	0.005	0.003		0.003	
se(p_{corr} Calibrated)	-	-	0.066	0.025	0.066	0.025
ε_I	-	-	3.9%		19.6%	
ε_N	-	-	14.6%	18.3%	14.6%	18.3%
$\varepsilon_I + \varepsilon_N$	-	-	18.5%	22.2%	34.2%	37.9%
Other Statistics						
Surveyor bias Calibrated - Goal			4.0%	0.3%	4.0%	0.3%
Surveyor bias Trainee			6.5%	7.0%	6.5%	7.0%
Undercounting Calibrated – Goal			7.8%	0.2%	7.8%	0.2%
Undercounting Trainee			37.5%	37.6%	37.5%	37.6%

Aerial Expansion Factor and Depth distribution Bias (Obj. 11)

In order to correct acoustic-derived depth distributions for juvenile herring missed in the upper 10 m and in the shallow regions around the bays and correct aerial data for variability in vertical depth distribution (reduce or eliminate ε_N), the two data types must be joined and compared. Sampling periods and nursery bays where simultaneous acoustic and aerial surveys occurred (1995-1997 – SEA project) will be extracted from the data suite. The horizontal overlap must be determined by mapping both data types over each bay's bathymetry and determining the aerial count in the shallow regions inaccessible to the vessels. These counts will be considered separately from the survey total leaving aerial mapped schools within the acoustic region. Using known fish lengths and weights by age and a literature based herring school volume (e.g. Pitcher 1979) the total biomass by age of herring will be estimated from the school surface area measurements within and outside of the acoustic survey region. For each acoustic survey, the total volume surveyed will be estimated. The age specific acoustic count of schools and biomass will be extrapolated to fill each nursery bay sampled using a calculated bay volume and multiplying the acoustic estimates by the bay to survey volume ratio. The counts and biomass of schools within the acoustic region will be compared between the two methods. If aerial measurements are lower and a fraction of the schools are 20 m or deeper, the ratio of acoustic to aerial counts or biomass is the depth correction factor. The ratios can be compared across a range of depth distributions observed to provide the range of correction factors that might be expected. If the aerial measurements are higher, the acoustic survey is most likely missing surface schools in the upper 20 m via ship avoidance or the occurrence of fish in the "dead zone" immediately under the transducer. In order to correct the acoustic depth distribution ranges for shallow fish, the aerial school estimates for shallow regions outside the acoustic region are assigned a depth range of less than or equal to 10 m and added to the extrapolated acoustic estimates. The aerial schools within the acoustic region are assumed to be included in the acoustic extrapolation. The depth distribution and mean depth is re-estimated and the difference in means (aerial-acoustic vs. acoustic only) represents the depth distribution bias. The ratio of aerial-acoustic and acoustic only could be used to correct stand alone acoustic survey results for error due to shallow school distributions.

Annual Survival Rate (Obj. 6)

In order to calculate the annual mortality rate between age 0 and 1 herring, the error corrected aerial survey school counts must be extrapolated to abundance using sampled lengths and a literature based school spacing value of $(0.7 \text{ body lengths})^3$ (Pitcher 1979). This extrapolation can be done at any spatial scale but will be meaningless at spatial scales smaller than an individual nursery bay (approximately 6 km). The age 1 count for a region is subtracted from the age 0 count for the same region from the previous year as long as the means are significantly different from one another (t test) given the variance estimates. An increase in age 1 herring over age 0 within a given region may indicate sampling error in fish size, unaccounted error in the aerial counts, or juvenile herring migration and movement among regions. The juvenile age-specific counts can also be used to test the predictive capabilities of age 0 and 1 juvenile survival models.

D. Description of Study Area

The study area will consist of PWS and adjacent Gulf of Alaska between latitude 58.0° and 61.0° N and longitude 146.0° and 150.0° W.

E. Coordination and Collaboration with Other Efforts.

As part of the integrated PWS Herring Survey, coordination and collaboration are built into the study plans. Validations using the camera method described above will be collected from the vessel conducting the July and August zooplankton sampling cruises (Campbell – PI) and as a result, those cruises will be extended 8 to 10 days. All charter costs are imbedded in Dr. Pegau's overview project. Results from this study will be used to adjust sampling sites for other survey projects and monitoring in years 2 and beyond and assist in interpretations of experimental tagging/marking studies. Feasibility projects (e.g. from Native Village of Eyak) entailing experimental bay repopulations will be assisted in terms of evaluation by providing estimates of age 0 herring in the bays before and after the experiments. The data from this project will be available on a monthly basis following each set of surveys with a summary each fall. The databases are openly shared and will be posted on the EVOS and PWSSC web sites. Finally, the spatially-explicit density estimates from this survey coupled with the energetic, zooplankton, predator, and disease sampling from other survey projects represent critical inputs to EVOS herring modeling efforts ((Project Number: 070810 Project Title: An Ecosystem Model of Prince William Sound Herring:A Management & Restoration Tool, Keifer et al.) by 1) allowing expansion of the existing overwintering model to testing on a population level, 2) tuning and testing the newly formulated recruitment dynamics model, 3) providing the range of observed densities needed to develop and run the summer predator-growth model, and 4) the range of densities needed to tune and test a disease model that is under construction.

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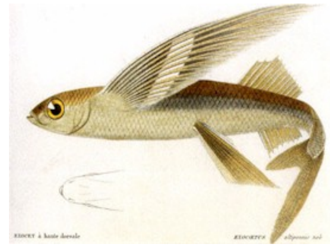
Curriculum Vitae for Evelyn D. Brown
Owner, Flying Fish Ltd
866 Hwy 141
P.O. Box 169
Husum, WA 98623-0169
Reg: 509-493-8900
Cell: 509-637-0340
Email: flyingfishltd@embarqmail.com



Education:

B.S. Zoology and Chemistry, University of Utah, Salt Lake City, 1977

M.S. Fisheries Biology and Aquacultural Engineering, Oregon State University, Corvallis, OR, 1980

PhD Fisheries, University of Alaska Fairbanks, Fairbanks, AK, 2003

Dissertation Title: Stock structure and environmental effects on year class formation and population trends of Pacific herring, *Clupea pallasi*, in Prince William Sound, Alaska (involved life-history, spatially-explicit conceptual model for the population, time series-climate effects analysis, and development of environmental recruitment model using GAM).

Relevant Publications (Primary):

Brown, E.D. and J.M. Churnside. Detecting and monitoring foraging events at an ecological hot spot in the southeastern Bering Sea. Mar.Ecol.Prog.Ser.

Brown, E.D., Churnside, J.H., Collins, R.L., Veenstra, T., Wilson, J.J., and Abnett, K. 2002. Remote sensing of capelin and other biological features in the North Pacific using lidar and video technology. ICES Journal of Marine Science, 59: 1120-30.

Brown, E.D. 2002. Life history, distribution and size structure of Pacific capelin in Prince William Sound and the Northern Gulf of Alaska. ICES Journal of Marine Science, 59: 983-996

Brown, E.D., Seitz, J., , H. P. Huntington, and B. L. Norcross. 2002. Ecology of Herring and Other Forage Fish as Recorded by Resource Users of Prince William Sound and the Outer Kenai, Alaska. Alaska Fishery Research Bulletin, 9(2): 75-101.

Brown, E.D. and B.L. Norcross. 2001. Effect of herring egg distribution and ecology on year-class strength and adult distribution: preliminary results, Page 335-346 *in* International Symposium on Herring: Expectations for a New Millennium, University of Alaska Sea Grant AK-SG-01-00.

Brown, E.D., S. Vaughan, and B.L. Norcross. 1999. Annual and seasonal spatial variability of herring, other forage fish, and seabirds in relation to oceanographic regimes in Prince William Sound, Alaska *in* Ecosystem Approaches for Fisheries Management, University of Alaska Sea Grant, AK-SG-99-01, Fairbanks, Alaska.

Brown, E.D., T.T. Baker, J.E. Hose, R.M. Kocan, G.D. Marty, M.D. McGurk, B.L. Norcross, and J. Short. 1996. Injury to the early life history stages of Pacific herring in Prince William Sound after the *Exxon Valdez* oil spill. Am. Fish. Soc. Symp. 18. pp. 448-462.

Brown, E.D., B.L Norcross, and J.W. Short. 1996. An introduction to studies on the effects of the *Exxon Valdez* oil spill on early life history stages of Pacific herring, Clupea pallasi, in Prince William Sound, Alaska. *Can J. Fish. Aq. Sci.* 53: 2337-2342

(Co-Author)

Norcross, B.L., E.D. Brown, R.J. Foy, M.Frandsen, S.M. Gay, M. Jin, J. Kirsch, T.C. Kline, D.M. Mason, C.N.K. Mooers, E.V.Patrick, A.J. Paul, K.D.E. Stokesbury, S.J. Thornton, S.L. Vaughan, J.Wang. 2001. A synthesis of life history and ecology of juvenile Pacific herring in Prince William Sound, Alaska. Fisheries Oceanography 10 (Suppl. 1): 42-57.

Norcross, B.L. and E.D. Brown. 2001. Estimation of first-year survival of Pacific herring from a review of recent stage-specific studies. Pages 535-558 *in* International Symposium on Herring: Expectations for a New Millennium, University of Alaska Sea Grant AK-SG-01-00.

Collaborators (last 4 years)

James Churnside, NOAA ETL Boulder, CO

Mike Collins, Upper Edge (fish spotter and wildlife guide), Cordova, AK

Herring Steering Committee Members, EVOS TC, Development of IHRP

Dave Irons, USFWS, Migratory Bird Unit, Anchorage, AK

Dale Kiefer, University of Southern California, LA, CA

Brenda Norcross, University of Alaska Fairbanks, Fairbanks, AK

Vince Patrick, PWSFRAP, Cordova, AK

Dan Roby, Oregon State University, Corvallis, OR

Jerry Thon and the Washington/Oregon Sardine Fleet and Spotter Pilots, Astoria Holdings, Astoria, OR

Heather Woody and Tribal Herring Committee, Sitka Tribal Association, Sitka, AK

III. SCHEDULE

A. Project Milestones

Objective 1. Determine juvenile herring and predator distribution across the sound. *To be met annually by September each year.*

Objective 2. Determine density-dependent spatial correlations of predator and competitors to herring distributions. *To be met by September each year.*

Objective 3. Determine value of annual distribution information to monitoring and modeling efforts and define need for validation sampling and depth distribution correction measurements. *To be met by September 2012.*

Objective 4. Same as objective 1.

Objective 5. Calculate the timing and peak of age 0 school counts and biomass. *To be met each year by October.*

Objective 6. Calculate the change in abundance of a cohort. *To be met by October 2011 and again in 2012.*

Objective 7. Deliver the full data set to the modeling group with locations overlapping energetic, herring stomach content, predator, and zooplankton sampling identified. *To be met annually by November each year*.

Objective 8. Determine the abundance and distribution of age 1 and 2 herring observed in June and deliver to the modelers and ADFG. *To be met by September each year*.

Objective 9. Deliver full data base to predator sampling group and predation modelers. *To be met by November each year*.

Objective 10. Identify nursery areas with no or low densities of juvenile herring and deliver to the feasibility projects. *To be met by August each year..*

Objective 11. Analyze past data and identify future field collection needs. *To be met by April, 2011*.

Objective 12. Identify and train one individual per year with an end goal of 1 fully calibrated and two trainees. *To be met by September 2012.*

B. Measurable Project Tasks (year categories per RFP)

<u>Planning Year</u>

FY10, 1st Quarter (October 1, 09 to December 31, 09)

November	*Equipment purchase and set up*

FY10, 2nd Quarter (January 1, 10 to March 31, 10)

January	*Annual Marine Science Symposium*
March	*Secure aircraft and configure for surveys*

FY10, 3rd Quarter (April 1, 10 to June 30, 10)

May	*Planning Workshop*
June	*Age 1-2 herring survey*

FY10, 4th Quarter (July 1, 10 to September 30, 10)

July-August	*Age 0-1 herring survey and coordinated vessel sampling*
August	*Submit Annual Report – deliver data to feasibility projects*
September	*Edit and distribute database*

Field year 1

FY11, 1st Quarter (October 1, 10 to December 31, 10)

November	*Depth distribution analysis data prep*
	Meet with modelers to input data

FY11, 2nd Quarter (January 1, 11 to March 31, 11)

January	*Annual Marine Science Symposium*
March	*Complete depth distribution analysis*

FY11 3rd Quarter (April 1, 11 to June 30, 11)

May	*Workshop*
June	*Age 1-2 herring survey*

FY11 4th Quarter (July 1, 11 to September 30, 11)

July-August	*Age 0-1 herring survey and coordinated vessel sampling*
August	*Submit Annual Report – deliver data to feasibility projects*
September	*Edit and distribute database*

Field year 2

FY12 1st Quarter (October 1, 11 to December 31, 11)

November	*Meet with modelers to input data*

FY12 2nd Quarter (January 1, 12 to March 31, 12)

January	*Annual Marine Science Symposium*

FY12 3rd Quarter (April 1, 12 to June 30, 12)

May	*Workshop*
June	*Age 1-2 herring survey*

FY12 4th Quarter (July 1, 12 to September 30, 12)

July-August	*Age 0-1 herring survey*
September	*Edit and distribute database*
	Identify trained surveyors and protocols for equipment use

Report writing year

FY13 1st Quarter (October 1, 12 to December 31, 12)

October	*Synthesis workshop*
December	*Complete data analysis*

FY13 2nd Quarter (January 1, 13 to March 31, 13)

January	*Annual Marine Science Symposium and Synthesis workshop*
March	*Prepare data transfer, Synthesis workshop*

FY13 3rd Quarter (April 1, 13 to June 30, 13)

April	*Draft Final report*

Budget Justification

Personnel

Dr. Evelyn Brown, Principal Investigator (P.I.) requests 3.5 months of time, $27,160 total, for each of three years and an additional 2.0 months of time, $15,520 total, during the reporting year for a grand total of $97,000. Funded activities will include administering the project, planning and scheduling the field season with collaborators, communications with collaborators and community members, purchasing and arranging for preparation and installation of survey data acquisition equipment (field computer, GPS, aerial camera, vessel camera, vessel sampling net), conducting the surveys, archiving and editing the resulting database, disseminating and communicating results, data analysis, reporting, and presenting results at symposia.

Technician (to be named) is requested for 2 months per year, $6400 total, for each of three years, and a single month, $3,200 total, during the reporting year for a grand total of $22,400. Funded activities will include assistance with equipment preparations, computer and software maintenance, office tasks related to the project (copying, mailing, etc.), data archival, data queries, mapping, preparing data for analysis, and report production.

Benefits are not included in the costs.

Travel

The total travel cost for all years is $49,480. For each of the three field years, the costs include 4 trips to Cordova for field planning, research collaboration, and field data collection as well as an annual trip to Anchorage for the marine symposium. During the reporting year, 3 trips to Cordova are required for a synthesis meeting and collaborative analyses and reporting as well as the annual trip to Anchorage. In addition, travel is requested during that final year to attend one symposium which is likely to be the International Herring Symposium (location unknown at this time) to present the work and submit a publication.

Contractual

The majority of the contractual costs are for the air charter required to perform the surveys ($84,000) and the hourly charter rate includes fuel and a digital camera and mount for school documentation and validation. The remaining $2,000 is to supplement the ADFG contract with the firm used to build the custom application and program the aerial survey computer with the GPS as well as maintain the database; the supplement is required because the additional work required by this project is outside the scope of the current contract with ADFG. There are no contracting costs during the reporting year.

Commodities

The cost for commodities is $1,800 for the first three years and $1,675 for the report year to include digital storage media, office printing and copying charges, office supplies, field supplies (batteries, protective gear, safety gear, notebooks), soft ware licensing and purchase and postage and shipping.

Equipment

The only equipment cost ($6,500) occurs in the first year and is needed to purchase two field quality touch pad computers with blue tooth GPS units needed for field data collection and to be compatible with ADFG aerial survey standards. Because calibration of community surveyors will require real time training and double counting, 2 systems are required. The second system will also act as a back up during single surveyor flights to prevent equipment-related problems that would interfere with performing the surveys.

Indirect Costs:

Flying Fish Ltd charges a flat 5% overhead rate for all direct costs that contributes to the fixed cost of the business including office rent, administrative fees including billings, wear and tear on office equipment and computers, and repairs of existing equipment.

Non-Federal Matching Funds

Flying Fish Ltd is donating the 1.5 man months ($10,000) of time to perform community involvement, training of community participants (including the Native Village of Eyak, Native Village of Tatitlek, Chenega IRA Council, and former herring fishermen) in this and other monitoring or intervention projects, and technical assistance with proposed and ongoing community projects especially related to intervention. As a long-time herring biologist in the region with a back ground in aquaculture, this P.I. has a long history of experience with planning and executing herring field programs including, collecting and handling live herring eggs, larvae, and juvenile fish, building nets and structures to hold herring, constructing egg deposition media and egg protection frames, and determining appropriate pen stocking densities. This P.I. has always and remains committed to empowering local residents to become active participants in resource monitoring and management and to help mitigate the remaining social, cultural and economic stress resulting from the spill.

Data Management and QA/QC statement

1. The study design, line transect model, model parameters, estimation of error, and statistics used for the survey and data analysis is fully described on pages 13 through 18. The only physical samples required will be net samples of fish from surface schools and bird identifications collected by PWS Herring Survey collaborators and shared with this project. The number of samples has not been specified but this P.I. will seek and acquire data from any sampling activity that has temporal overlap with the surveys and that can be used to validate school or predator identifications.

2. Data characteristics and procedures for data collection have been described in Sections 1Aii and are given in the Research Plan in section IIB. The field computer and sighting tube used to measure school surface area has also been described in IIB. The general survey condition data (wind speed, time at start, tide stage, visibility cloud cover, and ceiling) is recorded on paper at the beginning of the survey and later typed into the data with a time code (for matching with coordinate); changes in survey conditions along the transect are also recorded with time codes. Sampling activities observed from the air (vessel and sample type, personnel involved, etc.) are described on paper with time codes as well as notes concerning potential coding errors typed on the computer that cannot be fixed in real time. The recorded sightings are directly entered via a custom application, on the computer via ArcMap which geo-codes each sighting within 50-80 m (resolution) to a specific location along the flight path, which is also recorded. Sightings include species for fish, marine mammals, and jellyfish, species group for seabirds (gulls or alcids), counts of fish schools, jellyfish aggregations, and individual predators. Behavioral codes (matching federal standards for coding) for sea birds are also recorded for their ecological significance (i.e. plunging or milling indicating foraging behavior vs traveling) and because these behaviors are easily seen from the air. Fish school shape is recorded as well as the diameter (round) or length and widths (oval or irregular) of individual schools in sighting tube tick units. The locations of tidal fronts along the transect are recorded as these are important oceanographic features affecting larval drift and nursery habitats. Occasional sightings that are recorded include locations of sea ice, active ship sampling activities (to facilitate data matching after the survey and to be matched with information from the written log) counts of salmon sharks, sea ducks (non specific), and other infrequent species observed. The flight path is also recorded and includes a latitude and longitude, time code to the second, distance from last coordinate, and cumulative along transect distance. Digital imagery obtained from the vessel camera mount will be used in a non-quantitative way to identify species. Digital imagery obtained from the aircraft will be archived and examined only if a visual reminder is needed for editing school census data, for reporting and for collaborating projects interested in extracting predation information recorded. Video time codes are match to flight path time codes to locate captured video frames.

3. None of the equipment used requires calibration but the training of new visual surveyors does and that procedure is described in section IIB. The data is considered acceptable after the values in each column match the data type and coding for that column and the potential errors noted on paper during the survey have been checked and edited (e.g. wrong school count listed, mis-typed species, etc.). Error checking is performed after each flight when the data is downloaded and archived to a portable hard drive and copied to CDs (redundant storage). Daily error checked sighting and flight path tables are appended to an ACCESS database. Daily flight log

information from paper notes are also recorded with a column for time codes to allow matching with time coded coordinates.

4. Data conversion occurs within the database using calculated columns. For the flight path, the effective sampling swath for both birds and fish are multiplied by the distance between logged coordinates to produce an area sampled for birds and fish for each coordinate pair. These numbers are added consecutively in another column for each survey to produce an along transect cumulative area sampled for birds and fish. This enables coordinate-specific queries of the data set to calculate the total sample area by summing the coordinate pair areas. The cumulative area at the end of a daily flight path represents the total area sampled that day. The school diameter or length and width estimates are in tick units and equation 1 in section II describes the altitude dependent conversion required to translate ticks to meters. The surface area is estimated by the equation for a circle with round schools, the equation for an ellipse for oval schools, and for a rectangle with oblong or irregular schools.

5. Not applicable to this project.

6. The analysis and statistics have been fully described in section IIB. Data reduction needs will be determined by the integrated PWS Herring Survey planning sessions and by specified requests from the modelers. The data can be summarized in time and space in an infinite number of ways depending on the query specifications. The depth distribution analysis will require a reduction and summarization of the data to the scale of specific nursery bays or regions that covers a particular acoustic survey that have not yet been specified.

EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 10- FY 12

Budget Category:	Proposed FY 10	Proposed FY 11	Proposed FY 12	Proposed FY 13	TOTAL PROPOSED
Personnel	$33,560.0	$33,560.0	$33,560.0	$18,720.0	$119,400.0
Travel	$13,080.0	$13,080.0	$13,080.0	$10,780.0	$50,020.0
Contractual	$86,000.0	$86,000.0	$86,000.0	$0.0	$258,000.0
Commodities	$1,800.0	$1,800.0	$1,800.0	$1,675.0	$7,075.0
Equipment	$6,500.0	$0.0	$0.0	$0.0	$6,500.0
Indirect *(will vary by proposer)*	$ 5,978.0	$ 5,978.0	$ 5,978.0	$ 936.0	$18,870.0
SUBTOTAL	$146,918.0	$140,418.0	$140,418.0	$32,111.0	$459,865.0
General Administration (9% of subtotal)	$13,222.6	$12,637.6	$12,637.6	$2,890.0	$41,387.9
PROJECT TOTAL	$160,140.6	$153,055.6	$153,055.6	$35,001.0	$501,252.9
Other Resources (Cost Share Funds)	$10,000.0	$10,000.0	$10,000.0	$10,000.0	$40,000.0

COMMENTS: In order to facilitate community involvement and training, to ultimately perform this survey work using local efforts, Flying Fish Ltd. Is donating a match of $10,000 in equivalent labor toward that cause. In the past, herring spotter pilots were active in the community and were passing knowledge on to new pilots on an annual basis. With the loss of the fisheries, the ability to enumerate herring from the air has been reduced to a very small number within the community, most of whom have since retired or gone on to other work. Time in the community spent transferring aerial survey methods, training and calibrating potential "fish spotters", and identifying individuals to continue the monitoring work in the future will be donated.

FY10 - 13

Project Title: PWS Herring Survey: Sound Wide Juvenile Herring, Predator, and Competitor Density via Aerial Surveys, submitted under BAA AB133F-09-RP-0059
Lead PI: Evelyn Brown

FORM 4A
NON-TRUSTEE
AGENCY SUMMARY

EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 10- FY 12

Personnel Costs: Name	Project Title	GS/Range/ Step	Months Budgeted	Monthly Costs	Overtime	Personnel Sum
Evelyn Brown	Principal Investigator	48.5 hourly	3.5	7760.0		27,160.0
Unknown	Technician	15 hourly	2.0	3200.0		6,400.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		5.5	10960.0	0.0	
					Personnel Total	$33,560.0

Travel Costs: Description	Ticket Price	Round Trips	Total Days	Daily Per Diem	Travel Sum
PWS Herring Survey planning meeting	1000.0	1	5	180.0	1,900.0
Field sampling - PWS - peak summer rates	1000.0	3	35	180.0	9,300.0
January Marine Science Symposium - Anchorage	800.0	1	6	180.0	1,880.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$13,080.0

FY10

Project Title: PWS Herring Survey: Sound Wide Juvenile Herring, Predator, and Competitor Density via Aerial Surveys, submitted under BAA AB133F-09-RP-0059
Lead PI: Evelyn Brown

FORM 4B PERSONNEL & TRAVEL DETAIL

EXXON VALDEZ **OIL SPILL TRUSTEE COUNCIL**
DETAILED BUDGET FORM FY 10- FY 12

Contractual Costs: Description	Contract Sum
Air Charter - June survey - 2 measurements over 10 days for a total of 60 survey hours @ $400 per hour	24,000.0
Air Charter - July survey - 2 measurements over 15 days for a total of 90 survey hours @ $400 per hour	36,000.0
Air Charter - August survey - 2 measurements over 10 days for a total of 60 survey hours @ $400 per hour	24,000.0
Set up of field collection computer and mapping software to comply with ADFG aerial survey standards	2,000.0
Vessel charter to provide camera images of aerial mapped schools for validation - included in Plankton proposal (Campbell - PI)	0.0
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$86,000.0

Commodities Costs: Description	Commodities Sum
Digital storage	100.0
Office printing & copying	300.0
Field supplies (e.g. batteries, protective gear, etc.)	150.0
Postage/shipping	200.0
Software licensing (ArcPad)	450.0
ArcGIS licensing - assuming acquisition through agency or university affiliation	600.0
Commodities Total	$1,800.0

FY10

Project Title: PWS Herring Survey: Sound Wide Juvenile Herring, Predator, and Competitor Density via Aerial Surveys, submitted under BAA AB133F-09-RP-0059
Lead PI: Evelyn Brown

FORM 4B CONTRACTUAL & COMMODITIES DETAIL

EXXON VALDEZ **OIL SPILL TRUSTEE COUNCIL**
DETAILED BUDGET FORM FY 10- FY 12

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
Touch pad computer to comply with ADFG aerial survey requirements	2.0	3,000.0	6,000.0
Bluetooth GPS units	2.0	250.0	500.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
			0.0
		New Equipment Total	$6,500.0

Existing Equipment Usage: Descriptior	Number of Units	Inventory Agency
Aircraft stainless steel camera mounting for high speed vessel school ID validation (mounts to a commercial bowpicker)	1	UAF
Box Trawl designed to sample newly metamorphosed age 0 juvenile herring in a pair trawl configuration	1	UAF
Processing computer and lap top to analyze data	1	NA
Sighting tubes standardized to ADFG school measurement protocols constructed for previous surveys	10	NA
Navigational software	1	NA

FY10

Project Title: PWS Herring Survey: Sound Wide Juvenile Herring, Predator, and Competitor Density via Aerial Surveys, submitted under BAA AB133F-09-RP-0059
Lead PI: Evelyn Brown

FORM 4B
EQUIPMENT DETAIL

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
DETAILED BUDGET FORM FY 10- FY 12

Personnel Costs:		GS/Range/	Months	Monthly		Personnel
Name	Project Title	Step	Budgeted	Costs	Overtime	Sum
Evelyn Brown	Principal Investigator	48.5 hourly	3.5	7760.0		27,160.0
Unknown	Technician	15 hourly	2.0	3200.0		6,400.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		5.5	10960.0	0.0	
					Personnel Total	$33,560.0

Travel Costs:	Ticket	Round	Total	Daily	Travel
Description	Price	Trips	Days	Per Diem	Sum
PWS Herring Survey planning meeting	1000.0	1	5	180.0	1,900.0
Field sampling - PWS - peak summer rates	1000.0	3	35	180.0	9,300.0
January Marine Science Symposium - Anchorage	800.0	1	6	180.0	1,880.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$13,080.0

FY11

Project Title: PWS Herring Survey: Sound Wide Juvenile Herring, Predator, and Competitor Density via Aerial Surveys, submitted under BAA AB133F-09-RP-0059
Lead PI: Evelyn Brown

FORM 4B PERSONNEL & TRAVEL DETAIL

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
DETAILED BUDGET FORM FY 10- FY 12

Contractual Costs: Description	Contract Sum
Air Charter - June survey - 2 measurements over 10 days for a total of 60 survey hours @ $400 per hour	24,000.0
Air Charter - July survey - 2 measurements over 15 days for a total of 90 survey hours @ $400 per hour	36,000.0
Air Charter - August survey - 2 measurements over 10 days for a total of 60 survey hours @ $400 per hour	24,000.0
Set up of field collection computer and mapping software to comply with ADFG aerial survey standards	2,000.0
Vessel charter to provide camera images of aerial mapped schools for validation - included in Plankton proposal (Campbell - PI)	0.0
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$86,000.0

Commodities Costs: Description	Commodities Sum
Digital storage	100.0
Office printing & copying	300.0
Field supplies (e.g. batteries, protective gear, etc.)	150.0
Postage/shipping	200.0
Software licensing (ArcPad)	450.0
ArcGIS licensing - assuming acquisition through agency or university affiliation	600.0
Commodities Total	$1,800.0

FY11

Project Title: PWS Herring Survey: Sound Wide Juvenile Herring, Predator, and Competitor Density via Aerial Surveys, submitted under BAA AB133F-09-RP-0059
Lead PI: Evelyn Brown

FORM 4B
CONTRACTUAL &
COMMODITIES
DETAIL

EXXON VALDEZ **OIL SPILL TRUSTEE COUNCIL**
DETAILED BUDGET FORM FY 10- FY 12

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
			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
		New Equipment Total	$0.0

Existing Equipment Usage: Descriptior	Number of Units	Inventory Agency
Touch Pad field computer and blue tooth GPS	2	Community
Aircraft stainless steel camera mounting for high speed vessel school ID validation (mounts to a commercial bowpicker)	1	UAF
Box Trawl designed to sample newly metamorphosed age 0 juvenile herring in a pair trawl configuration	1	UAF
Processing computer and lap top to analyze data	1	NA
Sighting tubes standardized to ADFG school measurement protocols constructed for previous surveys	10	NA
Navigational software	1	NA

FY11

Project Title: PWS Herring Survey: Sound Wide Juvenile Herring, Predator, and Competitor Density via Aerial Surveys, submitted under BAA AB133F-09-RP-0059
Lead PI: Evelyn Brown

FORM 4B
EQUIPMENT DETAIL

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
DETAILED BUDGET FORM FY 10- FY 12

Personnel Costs: Name	Project Title	GS/Range/ Step	Months Budgeted	Monthly Costs	Overtime	Personnel Sum
Evelyn Brown	Principal Investigator	48.5 hourly	3.5	7760.0		27,160.0
Unknown	Technician	15 hourly	2.0	3200.0		6,400.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		5.5	10960.0	0.0	
					Personnel Total	$33,560.0

Travel Costs: Description	Ticket Price	Round Trips	Total Days	Daily Per Diem	Travel Sum
PWS Herring Survey planning meeting	1000.0	1	5	180.0	1,900.0
Field sampling - PWS - peak summer rates	1000.0	3	35	180.0	9,300.0
January Marine Science Symposium - Anchorage	800.0	1	6	180.0	1,880.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$13,080.0

FY12

Project Title: PWS Herring Survey: Sound Wide Juvenile Herring, Predator, and Competitor Density via Aerial Surveys, submitted under BAA AB133F-09-RP-0059
Lead PI: Evelyn Brown

FORM 4B PERSONNEL & TRAVEL DETAIL

***EXXON VALDEZ* OIL SPILL TRUSTEE COUNCIL**
DETAILED BUDGET FORM FY 10- FY 12

Contractual Costs: Description	Contract Sum
Air Charter - June survey - 2 measurements over 10 days for a total of 60 survey hours @ $400 per hour	24,000.0
Air Charter - July survey - 2 measurements over 15 days for a total of 90 survey hours @ $400 per hour	36,000.0
Air Charter - August survey - 2 measurements over 10 days for a total of 60 survey hours @ $400 per hour	24,000.0
Set up of field collection computer and mapping software to comply with ADFG aerial survey standards	2,000.0
Vessel charter to provide camera images of aerial mapped schools for validation - included in Plankton proposal (Campbell - PI)	0.0
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$86,000.0

Commodities Costs: Description	Commodities Sum
Digital storage	100.0
Office printing & copying	300.0
Field supplies (e.g. batteries, protective gear, etc.)	150.0
Postage/shipping	200.0
Software licensing (ArcPad)	450.0
ArcGIS licensing - assuming acquisition through agency or university affiliation	600.0
Commodities Total	$1,800.0

FY12

Project Title: PWS Herring Survey: Sound Wide Juvenile Herring, Predator, and Competitor Density via Aerial Surveys, submitted under BAA AB133F-09-RP-0059
Lead PI: Evelyn Brown

FORM 4B CONTRACTUAL & COMMODITIES DETAIL

EXXON VALDEZ OIL SPILL TRUSTEE COUNCIL
DETAILED BUDGET FORM FY 10- FY 12

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
			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
		New Equipment Total	$0.0

Existing Equipment Usage: Descriptior	Number of Units	Inventory Agency
Touch Pad field computer and blue tooth GPS	2	Community
Aircraft stainless steel camera mounting for high speed vessel school ID validation (mounts to a commercial bowpicker)	1	UAF
Box Trawl designed to sample newly metamorphosed age 0 juvenile herring in a pair trawl configuration	1	UAF
Processing computer and lap top to analyze data	1	NA
Sighting tubes standardized to ADFG school measurement protocols constructed for previous surveys	10	NA
Navigational software	1	NA

FY12

Project Title: PWS Herring Survey: Sound Wide Juvenile Herring, Predator, and Competitor Density via Aerial Surveys, submitted under BAA AB133F-09-RP-0059
Lead PI: Evelyn Brown

FORM 4B
EQUIPMENT DETAIL

EXXON VALDEZ **OIL SPILL TRUSTEE COUNCIL**
DETAILED BUDGET FORM FY 10- FY 12

Personnel Costs: Name	Project Title	GS/Range/ Step	Months Budgeted	Monthly Costs	Overtime	Personnel Sum
Evelyn Brown	Principal Investigator	48.5 hourly	2.0	7760.0		15,520.0
Unknown	Technician	15 hourly	1.0	3200.0		3,200.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
						0.0
	Subtotal		3.0	10960.0	0.0	
					Personnel Total	$18,720.0

Travel Costs: Description	Ticket Price	Round Trips	Total Days	Daily Per Diem	Travel Sum
PWS Herring Survey synthesis meeting	1000.0	1	5	180.0	1,900.0
PWS Herring Survey analysis/reporting meeting	1000.0	2	10	180.0	3,800.0
January Marine Science Symposium - Anchorage	800.0	1	6	180.0	1,880.0
International Herring Meeting	1300.0	1	10	190.0	3,200.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
					0.0
				Travel Total	$10,780.0

FY13

Project Title: A432
Lead PI: Evelyn Brown

FORM 4B PERSONNEL & TRAVEL DETAIL

EXXON VALDEZ **OIL SPILL TRUSTEE COUNCIL**
DETAILED BUDGET FORM FY 10- FY 12

Contractual Costs: Description	Contract Sum
If a component of the project will be performed under contract, the 4A and 4B forms are required. **Contractual Total**	$0.0

Commodities Costs: Description	Commodities Sum
Digital storage	25.0
Office printing & copying	400.0
Field supplies (e.g. batteries, protective gear, etc.)	0.0
Postage/shipping	200.0
Software licensing (ArcPad)	450.0
ArcGIS licensing - assuming acquisition through agency or university affiliation	600.0
Commodities Total	$1,675.0

FY13

Project Title: PWS Herring Survey: Sound Wide Juvenile Herring, Predator, and Competitor Density via Aerial Surveys, submitted under BAA AB133F-09-RP-0059
Lead PI: Evelyn Brown

FORM 4B CONTRACTUAL & COMMODITIES DETAIL

EXXON VALDEZ **OIL SPILL TRUSTEE COUNCIL**
DETAILED BUDGET FORM FY 10- FY 12

New Equipment Purchases: Description	Number of Units	Unit Price	Equipment Sum
			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
		New Equipment Total	$0.0

Existing Equipment Usage: Descriptior	Number of Units	Inventory Agency
FY10 - 13		
Touch Pad field computer and blue tooth GPS	2	Community
Aircraft stainless steel camera mounting for high speed vessel school ID validation (mounts to a commercial bowpicker)	1	UAF
Box Trawl designed to sample newly metamorphosed age 0 juvenile herring in a pair trawl configuration	1	UAF
Processing computer and lap top to analyze data	1	NA
Sighting tubes standardized to ADFG school measurement protocols constructed for previous surveys	10	NA
Navigational software	1	NA
Note: the camera mounting, box trawl, field computer and a couple sighting tubes should be transferred to PWSSC		
or Native Village of Eyak for use in a community-based monitoring program; UAF does not use the mounting or trawl		
at this time and would appreciate it removed from their warehouse.		

FY13

Project Title: PWS Herring Survey: Sound Wide Juvenile Herring, Predator, and Competitor Density via Aerial Surveys, submitted under BAA AB133F-09-RP-0059
Lead PI: Evelyn Brown

FORM 4B
EQUIPMENT DETAIL