PROPOSAL SIGNATURE FORM

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PROJECT TITLE: Physical Oceanographic Factors Affecting Productivity in Juvenile Pacific Herring Nursery Habitats, submitted under the BAA

Printed Name of P.I. Shelton M. Gay, III

Signature of P.I. ______________________________ Date ____________

Trustee Council Use Only **Project No:** ________________ **Date Received:** ________________	**PROPOSAL SUMMARY PAGE**

Project Title - Physical Oceanographic Factors Affecting Productivity in Juvenile Pacific Herring Nursery Habitats, submitted under the BAA

Project Period:	FY 07-FY 09
Proposer:	Shelton M. Gay III (PhD Dissertation Research Project) Prince William Sound Science Center (Committee advisors include Drs. Tim Dellapenna, Steve DiMarco and Alijandro Orsi of Texas A&M University and Dr. Steve Okonnen of University of Alaska, Fairbanks.)
Study Location:	Prince William Sound

Abstract

Past research of juvenile Pacific herring in PWS has shown that recruitment is highly influenced by conditions within nursery sites affecting survival within the first year. Studies of the physical oceanography of nursery fjords has indicated that each site has a unique set of hydrographic conditions that are influenced by both local processes and water exchange between the GOA and PWS. These factors vary significantly depending on geographic location. The proposed study will build upon past research by continuing a hydrographic time series within nursery fjords and collect high resolution data on currents and hydrography to determine the dominant mechanisms of water exchange and circulation within two experimental fjords; one located in a highly productive sub-region (Simpson Bay) and one located in less productive sub-region influenced by tidewater glacial outflow (Whale Bay). Also, this project will provide a physical context for a suite of biological sampling proposed for these sites.

Funding:	EVOS Funding Requested:	FY 07	$ 71.4K - Approved
		FY 08	$ 55.8K - Pending
		FY09	$ 25.5K – Pending
		TOTAL:	$152.7K

Date:	August 2, 2006

PROJECT PLAN

NEED FOR THE PROJECT

Statement of the Problem

The importance of Pacific herring to the Prince William Sound (PWS) ecosystem has been shown from various studies of the diet of marine mammals and birds (Agler et al. 1999; Matkin et al. 1999; Irons et al. 2000). This coupling is particularly strong for Steller sea lions. For example, research in 2000 revealed intensive night-time foraging of sea lions on over-wintering herring schools (Thomas and Thorne 2001), and subsequent studies have shown strong correlations between herring abundance and sea lion abundance in PWS, including a collapse of both populations following the Exxon Valdez Oil Spill (EVOS) (Thomas and Thorne 2003). Since EVOS, herring populations in PWS have generally remained at low levels and, therefore, the commercial fishery has essentially remained closed for more than a decade. Any effort to restore herring to stock levels of the 1980's requires knowledge of the distribution and of early life stages and what factors primarily affect survival and recruitment.

In 1995 the Sound Ecosystem Assessment (SEA) project began research focusing on ecological factors affecting recruitment of Pacific herring (*Clupea pallasi*). This study found that many of the small fjords and bays within PWS comprise the nursery habitat during the early life stages of this species and that the juveniles remain within nursery sites for up to two years (Stokesbury et al., 2000). Thus larval and juvenile herring survival is highly influenced by habitat conditions within individual inlets (Norcross et al., 2001; Foy and Norcross 2001.).

During SEA a series of oceanographic surveys was undertaken to study the physical properties of various nursery fjords and bays in Prince William Sound (PWS), Alaska (Fig. 1). The initial cruises were in the spring and summer of 1994 and focused on the hydrography of inlets within western PWS (Gay and Vaughan, 1998). In 1995, research was extended to other regions of the Sound, and included both oceanographic and biological characteristics believed to affect the growth and survival of juvenile herring. At this time, nursery habitats within four principal regions of PWS were selected by the University of Alaska at Fairbanks (UAF) for intensive study over the period from fall of 1995 to spring of 1998. These sites included Whale Bay, Eaglek Bay, Simpson Bay and Zaikof Bay (Fig. 1).

The primary objective of the initial oceanographic surveys of juvenile herring habitat was to quantify the seasonal changes in water temperature, salinity and density within the four bays representing sub-regional habitats over a period of several years. These features of hydrography potentially impact the survival of young herring in two ways: first, annual variation in stratification from heat and freshwater input influences the local production and availability of plankton food sources (Foy and Norcross, 1999b and 2001), and second, water temperature directly affects larval growth rates in the summer, and metabolism and feeding behavior of juveniles during the winter (Foy and Paul, 2000; Foy and Norcross, 1999a).
Juvenile (age 0) herring were also found to frequently occupy the heads of various inlets, particularly in winter (Stokesbury et al., 2000). These inner regions tended to exhibit higher stratification relative to the main fjord basins (Gay and Vaughan, 2001), and the seasonal

hydrography and circulation in these sites may therefore be important in producing zooplankton locally and/or retaining plankton advected into the fjord over time. Freshwater input also tends to be relatively high in the inner basins as most have small rivers entering at the heads, and their protected nature allows sea-ice to develop during the winter. This ice provides a refuge from avian predators and the colder water temperatures (Gay and Vaughan, 2001) may generally enhance winter survival by reducing metabolism, and hence starvation (Paul and Paul, 1998).

A secondary objective of this research was to identify regions of convergence, divergence, shear and ephemeral fronts associated primarily with the tidal currents. Larval herring and zooplankton are advected to various nursery sites by the general circulation within PWS (Wang et al., 2001). The role of the currents in causing either drift or retention within nursery sites had not been determined, thus measuring these features of circulation was deemed of value in identifying potential transport mechanisms. This research was only partly successful, however, as the scale of many of these processes is extremely small and their nature too dynamic in time and space to be easily resolved or predicted given the limitations of the study design. In three of the nursery fjords some persistent (and ephemeral) features were identified as possible transport mechanisms. These included broad scale fronts due to advection of water derived from tidewater glaciers, subsurface flow reversals caused by baroclinc tides, and large eddies formed at the mouths of fjords due to lateral variation in the flow field, and entrainment caused by relatively strong currents moving across (i.e. perpendicularly) to the mouth.

The proposed research will build upon the data base within PWS fjords started under SEA to provide a more objective description of the seasonal dynamics of physical factors affecting productivity of nursery fjords and potential coupling of high recruitment of juvenile herring to broad-scale advection from the GOA into PWS. It is also intended to address the limitations inherent in the SEA study, by providing a more comprehensive set of physical data that can be tested with advanced statistical methods used to discern the dominant mechanisms forcing the circulation within fjords and hence advection and/or retention of plankton and larval herring.

PROJECT DESIGN

A. Objectives

The proposed study will be part of a PhD dissertation designed to build upon the past results of surveys conducted during SEA. This will be accomplished by meeting the following objectives.

1. To continue a time series of basic physical and biological parameters including temperature (T), salinity (S), density (Sigma-t), fluorescence (F) and turbidity (TB) measured during the SEA project within four nursery fjords used by juvenile Pacific herring, and to compare these results with similar data being collected at oceanographic moorings and high spatial resolution hydrographic cruises conducted as part of the PWS (Ocean) Observing System (PWSOS).

2. To quantify conditions that influence advection of nutrients and plankton into two experimental nursery fjords by measuring features of hydrography and circulation pertaining to exchange of water near the mouth. These data should provide evidence of a direct linkage

between the seasonal phytoplankton and zooplankton biomasses in these small tertiary basins to broad-scale features of circulation within PWS.

3. To provide descriptions of the general circulation within two nursery fjords (one per year) by obtaining high resolution physical data on the flow field and its affects on the spatial distribution of physical properties. These data will provide a basis for determining the nature of transient mechanisms affecting both advection and retention of plankton and larval fish, as well as aggregations (or patches) of the planktonic food resources of juvenile herring.

B. Procedural and Scientific Methods

Four Nursery Fjords

This study proposes to continue a time series of basic seasonal physical and biological properties within four fjords previously surveyed in Prince William Sound, Alaska during the SEA project (Fig. 1). In general, to accomplish this will require oceanographic cruises to be carried out seasonally from late winter (late March or early April) to late fall (October to early November). During these cruises physical data comprised of temperature, salinity (T/S), pressure (p), fluorescence (a proxy for phytoplankton) and turbidity (primarily associated with glacial meltwater) will be measured throughout the water column at stations pre-established during SEA (see below). In late fall and late winter sampling will be conducted during cruises proposed to measure abundance of juvenile herring and zooplankton (see accompanying proposals submitted by R.Thorne and T. Kline). During the highly productive period from spring to early fall, however, the hydrographic data will be collected on a monthly basis during cruises sponsored by PWSOS by a separate vessel, which will be collecting synoptic thermosalinograph (TSG) data in the surface (1m) layer. At this time certain stations may be relocated outside the mouths of the fjords to overlap with current TSG work and with past surveys of the large primary basins conducted during the SEA project (Vaughan et al., 2001) and OSRI sponsored cruises (Vaughan and Gay, 2002). During TSG surveys hydrographic profiles will also be collected at stations located along the standard route through PWS (Fig. 2).

The physical data, including temperature and salinity (T/S) will be collected using either a SeaBird Electronics (SBE) 19*plus* or a 19.03 conductivity/temperature/depth (CTD). These instruments are accurate to 0.01^{o} *C*, 0.001 Siemens/*m* and 0.25% of full scale pressure range of 50 to 1000 psia[1]. The ancillary data (fluorescence and turbidity) will be collected with a WetLabs FLSTUB fluorometer/turbidimeter. From late spring to early fall, all stations will be occupied whenever possible, but in the late fall and late winter/spring (March-early April) the number of stations will be reduced to a core set since hydrographic conditions are more uniform spatially at that time of the year (Muench and Schmidt, 1975; Gay and Vaughan, 2001; Vaughan et al., 2001). The locations and number of stations occupied during the summer will essentially follow the sampling regimen used during the SEA project by Gay and Vaughan (2001). These stations are shown below for each fjord in Figure 3. They were located to obtain either grids covering the larger basins or lines of stations within long narrow arms. Station distances range from 0.5 to 1.0*km*.

The proposed hydrography data will be collected in both 2007 and 2008 and should provide a basis for comparing interannual differences in physical processes, such as sub-regional heat and freshwater fluxes, stratification and turbulent mixing, with temporal and spatial variation in these same processes over PWS (SEA and OSRI) and the GOA shelf (GLOBEC). The broad-scale advection of GOA water into PWS is believed to be potentially important in enhancing productivity within herring nursery habitats during certain years (Kline 1999). The direct comparisons of physical properties within fjords to conditions across PWS (determined from the TSG cruises) and indirect comparisons with physical data from current meter/CTD moorings currently placed in Hinchinbrook Entrance and Montague Strait should therefore provide an indication of how exchange of surface and deep water from the GOA into PWS extends into the small secondary and tertiary fjords, and how these advective processes interact with localized processes driven by variation in climate and freshwater runoff.

Fig. 1. Locations of four fjords surveyed during the SEA herring research project conducted from 1995 to early 1998.

Experimental Nursery Bay

This study proposes to obtain high spatial and temporal resolution data on the circulation and hydrography within two nursery areas (Simpson Bay in 2007 and Whale Bay in 2008) to provide a physical context for describing transient (i.e. tidal/meterological) mechanisms affecting both advection and retention of zooplankton and larval fish within a highly productive nursery habitat (see proposal by R. Crawford) versus a potentially poor habitat influenced by glacial advection. To accomplish this objective high resolution acoustic Doppler current profiler (ADCP) surveys will be conducted monthly from May to August to provide estimates of: 1) the basin-scale flow-field; and 2) transport estimates at the mouth. In either case, the measurements will be made through at least one full diurnal tidal period (~25hrs). Tides within PWS are principally semidiurnal (M_2) and current velocities range from 30 to $50 cm\ s^{-1}$ (Niebauer et al.,1994). However, currents in PWS fjords (Gay and Vaughan, 2001) have a much larger range (5 to 150 $cm\ s^{-1}$) and marked fluctuations in flow occur due to variation in tidal prisms (i.e. amplitudes). The present study will therefore attempt to sample circulation and hydrography on both neap and spring tides in order to measure the extremes in the tidally forced flows.

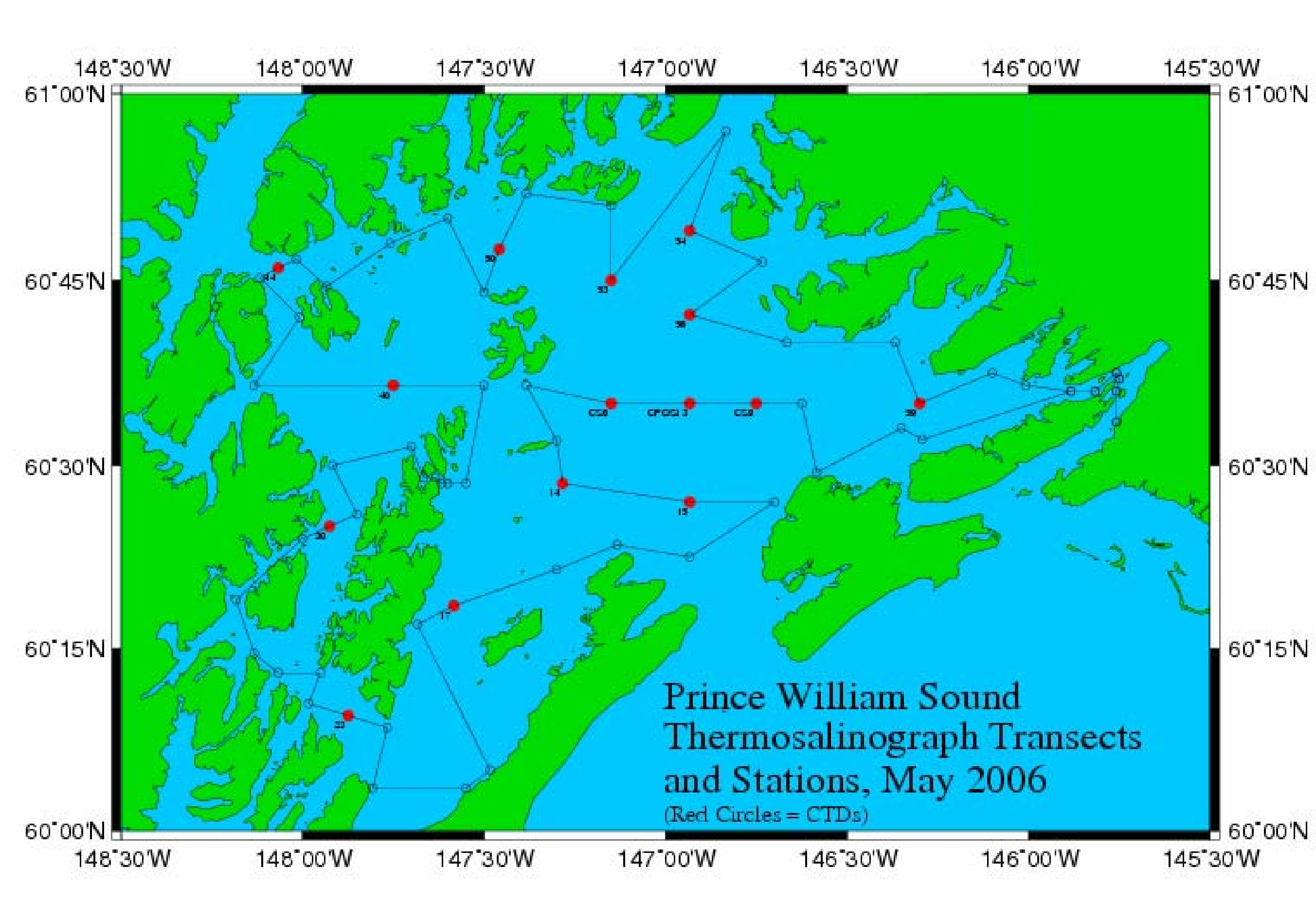

Fig. 2. Standard transects and oceanographic stations occupied during thermosalinograph cruises sponsored by the Alaska Ocean Observing System as part of the PWSOS.

In addition to the ADCP data, hydrography data will be collected continuously with an undulating Chelsea Instruments Aquashuttle and a SBE19.03 CTD placed on the tow-sled housing the ADCP. Other ancillary data will include wind speed and direction, and air temperatures measured by a portable weather station. This station will be set up prior to the first monthly cruise. In addition to these data, time series measurements of heat and freshwater fluxes will be obtained using two moorings each equipped with a near-surface and deep CTD deployed respectively in the deep (70-80*m*) portion of the Northern Arm (i.e. north of the sill) and near the mouth (40-50*m*) (Fig. 3c). These moorings will be deployed in the spring and retrieved in the fall. Calibration casts will be performed at both times using the SBE19 *plus* CTD to determine offset and drift in the sensors prior to a post-cruise calibration to be performed by SBE Inc. The details of the sampling design for all instruments are addressed in the following sections.

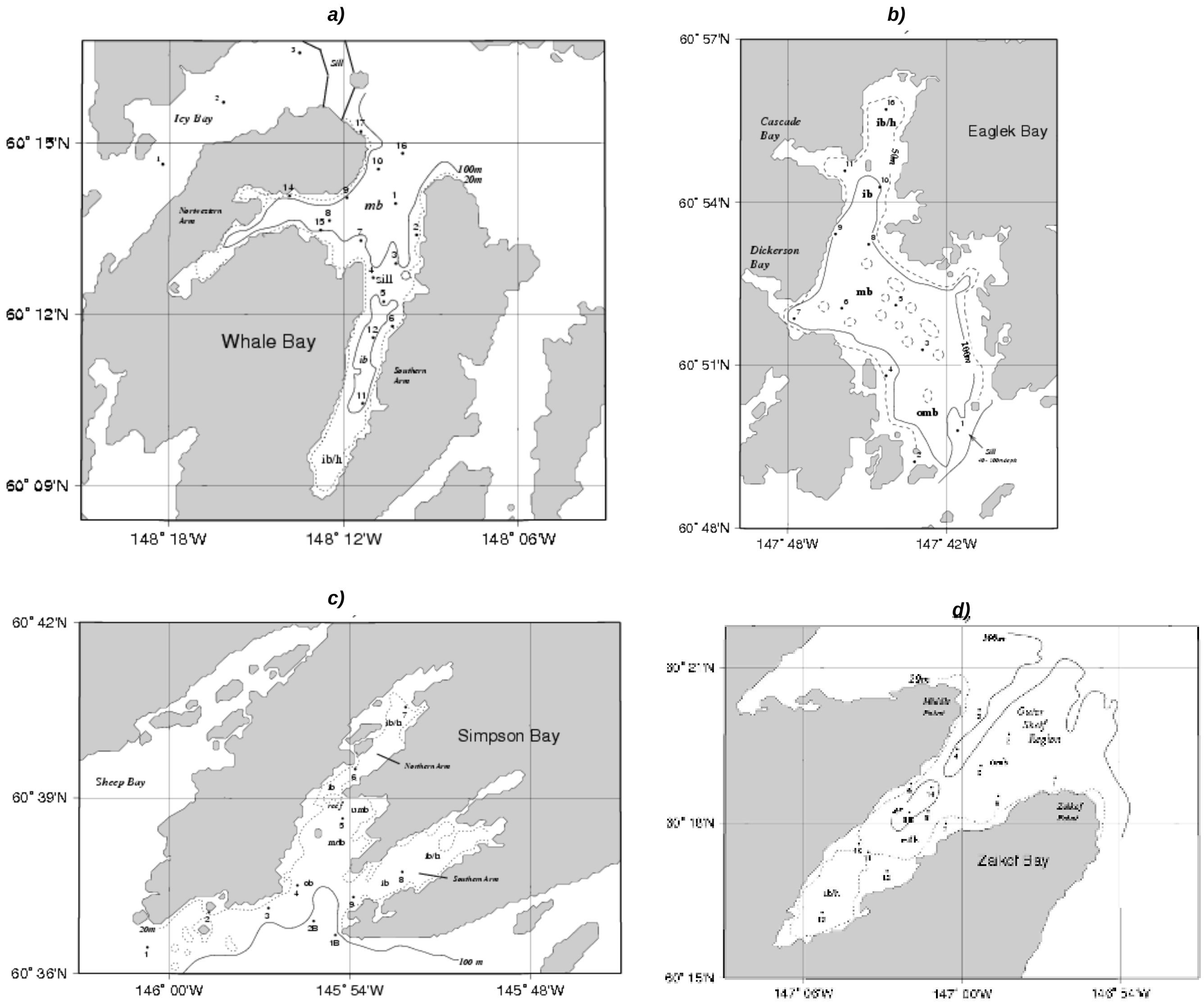

Fig. 3. Locations of oceanographic stations within the four fjords surveyed during the SEA herring project.

<u>Circulation</u>. The objectives of measuring circulation within nursery fjords is to describe the general flow-field and to determine the dominant mechanisms of water exchange between small tertiary basins and PWS. Examples of ADCP transects conducted in Simpson Bay during SEA are shown in Figure 4. A similar series of transects will be made in 2007 and 2008. However, in contrast to SEA, which used a 150*kHz* instrument, data will also be collected with a 600*kHz* ADCP. An example of currents obtained with this instrument is also shown in Figure 4. As can be seen, these data appear to have a much higher spatial resolution (~40 vs. 6 vectors per km). These differences are due in part to the fact that no ensemble averaging was done to the data. The raw (un-averaged) data tend to be much cleaner in comparison to the 150*kHz* unit, and this a result of greater backscatter associated with the higher frequency, faster ping rate and relatively large depth bins. In addition, transects will be made continuously over at least one full diurnal

tidal cycle (~25 hrs) and repeated to obtain a minimum of 6 cross-sections during each semidiurnal tide (i.e. one ebb and flood phase). Depending on vessel speed, sampling intervals for all transects will range from 1.86 to 2*hrs* and frequencies will range from 0.49 to 0.54*cph*. The latter frequencies exceed the fundamental semidiurnal Nyquist frequency (~0.08*cph*) by a factor > 6. Therefore, the data should be amenable to harmonic analysis described below.

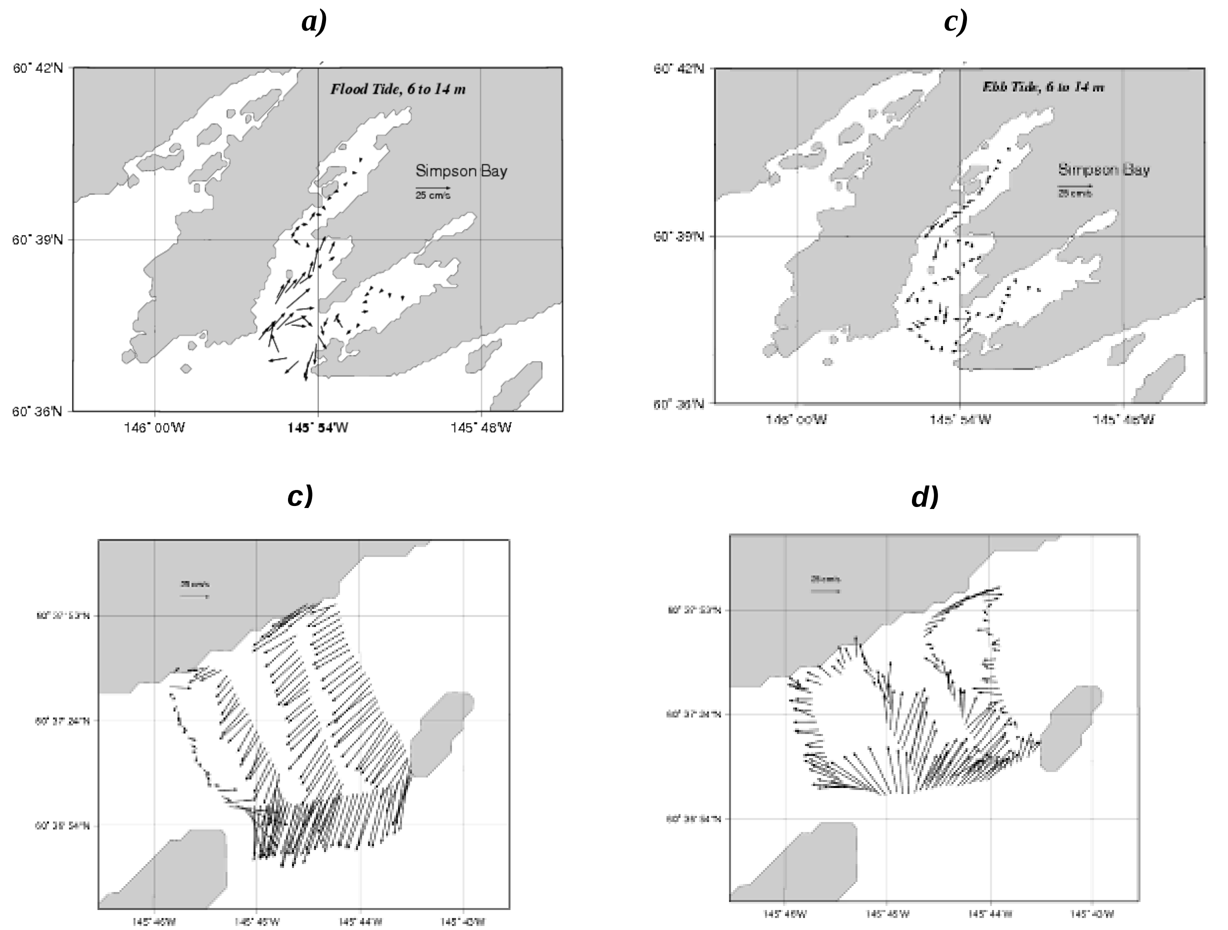

Fig. 4. Examples of currents measured at Simpson Bay with a 150 kHz ADCP: a and b) and at Salmo Point with a 600 kHz ADCP: c and d). Note that the spatial resolution of data collected with the 600 kHz instrument is nearly 7 times that of the 150 kHz unit.

Due to the greater basin depths at Whale Bay (~300*m*) it will be necessary to use the 150*kHz* ADCP in this fjord to obtain bottom tracking (i.e. measure absolute vs. relative flow). The inner basins are much shallower (~120*m*), however, and these regions should be amenable to surveying with the 600*kHz* unit. The total number of depth bins in the main fjord will range from 20 to 30, but the spatial resolution will be relatively coarse since vessel speeds can not be reduced, as this would prohibit obtaining an adequate number of repeated transects. It may be possible to reduce ensemble averages from 120*s* to 60*s*, which would affectively double the resolution of that shown. This will depend on the limit of error based on the ADCP settings.

The 600 *kHz* ADCP will be towed beside the survey vessel on an aluminum Biosonics acoustic tow-sled, whereas the 150 *kHz* unit will be mounted to the side of either a 16*m* (52*ft*) fiberglass seine vessel. Both instruments contain an internal compass, which allows velocities to be determined independently of ship navigational data. The transducers will be immersed to a depth of ~ 1*m* and rotated 45^o to remove bias induced by having two on-axis beams measuring the ship (i.e. tow-sled) velocity (Trump, 1989). Bottom tracking will be attainable during all surveys, and the depth of the first velocity bin (including a 1*m* blanking distance) will be ~ 2*m* for the 600*kHz* unit and 4m for the 150*kHz* ADCP. Vessel speeds will range from 2.75 to $3m\ s^{-1}$. At these speeds turbulence around the transducers will be negligible and should produce no bubbles to cause either beam loss or contamination of data (Gay and Vaughan, 2001). Air entrainment has caused problems in the past with vessel side-mount systems only when excessive ship-roll caused transducers to be lifted near the surface. In such cases, surveys were suspended and resumed later during calm conditions. Weather was not a problem at Whale since this fjord tends to be protected from winds. Nor should it be problematic for the towed instrument since the transducers will be deeper in the water. Also, if a recoil system is set-up to allow the tow cable to free wheel then the problem of vessel roll due to swell can be minimized.

High Resolution Hydrography. In addition to the ADCP measurements, a synoptic data set consisting of high spatial resolution hydrography will be collected with a Chelsea Instruments (CI) Aquashuttle equipped with an Aquapack CTDF. The Aquapack sensors have the following accuracies: T = 0.005 ^oC; Cond. = 0.001 *S/m* and p = 0.2*m*, and a fluorometer accurate to 0.01μ*g/l*. Due to low vessel speeds, the Aquashuttle will be manually lowered and raised via a deck-winch while the vessel is underway. Thus a series of oblique profiles of temperature, salinity and fluorescence within the upper 50 to 100*m* of the water column will be obtained. These measurements in combination with the ADCP data should indicate where features of circulation, such as eddies, convergences and divergences, may create fronts between water masses differing in both origin and T/S properties. These zones can also occur between regions of stratified water and regions of mixing caused by turbulence (Mann and Lazier 1991), and hence can cause concentrations (i.e. spatial patchiness) of plankton and larval fish.

An example of data collected with an Aquashuttle in Simpson Bay the during SEA is shown in Figure 5. In both plots spatial variation in the hydrography indicates the presence of fronts located in the near-surface layer at the mouth (Fig. 5a) and a deeper subsurface layer located between the main basin and northern arm of the fjord (Fig. 5b). The contours for the shallow (5-10*m*) layer contained 47 grid points, or an average spatial frequency of 2.3 casts km^{-1}, whereas the deeper layer (20-30*m*) contained slightly more than half this number, or a frequency of 1.5 casts km^{-1}. The proposed study will attempt to increase the cast frequency to a range of 3.0 to 6.0 km^{-1} (the actual number will vary depending on depth). The high frequency of these data relative to individual CTD stations should have the capacity to resolve fine-scale features of hydrography as they develop and change during the tidal cycle due to tide rips associated with eddies, reversals and current shear (i.e. instabilities in the flow-field). The increased resolution should also provide better tracking of the broad scale features (such as the fronts shown in Fig. 5) produced by advection of water into the fjord with physical properties differing than those of water in the main and inner basins.

Temporal and Spatial Aliasing

Since water properties can not be measured simultaneously throughout the experimental bay, a certain amount of aliasing in the data will be unavoidable due to the time differences between transects. During SEA, the lack of repeatability in sampling transects created limitations in determining the exact phasing of currents with respect to the tide changes and in precisely tracking fronts associated with current shear. In the proposed research, however, transects will be sampled well above the Nyquist frequency, and least squares harmonic analysis can therefore be applied to the data to determine the phasing relative to the tides. Also, the aliasing for successive transects will be quite small as sampling times will range from 10 to 15*min*; at most < 1/20th of a typical tide stage.

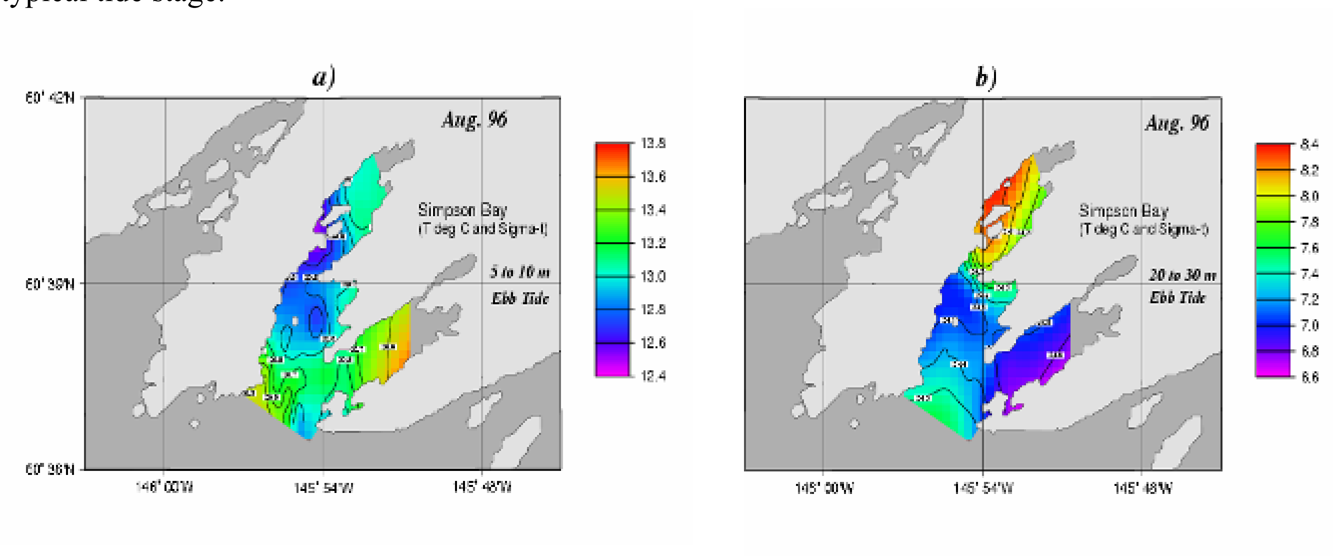

Fig. 5. Examples of high resolution hydrography data collected in Simpson Bay during SEA with a Chelsea Instruments Aquashuttle. Note the presence of fronts in the surface layer (a) and deep layer (b) and a deep reversed density gradient (b) extending from the mouth into the main basin.

Ancillary Data

As stated above, ancillary data comprised of time series of weather and stationary temperature and salinity measurements are proposed to be collected during the summer period within Simpson and Whale. The meteorological data will consist of wind speed and direction, and air temperature collected with a portable weather station owned by the PWS Regional Citizens Advisory Council (PWSRCAC). The CT data will be collected by a surface (2-3*m*) and a deep (50-150*m*) CT (a SBE16.03 at the surface and a SBE37 microcat in the deep layer) mounted on an oceanographic mooring. The moorings will consist of one long (3*m*) surface spar buoy connected to a bottom anchor with 3/16 in. Spectra line (Fig. 6). The surface CT will be directly attached to the base of the spar buoy and the deep CT will be attached to the line. The weather sensors, including an anemometer and thermometer may be attached to the mast of the buoy. Otherwise, these instruments will be mounted to a tower placed on land. The buoy platform would be preferable in that there would be no shadowing of winds caused by topography.

However, under moderately strong winds the anemometer may be laid over at too high an angle due to drag on the spar buoy. This sensor may therefore need to be mounted with a gimble.

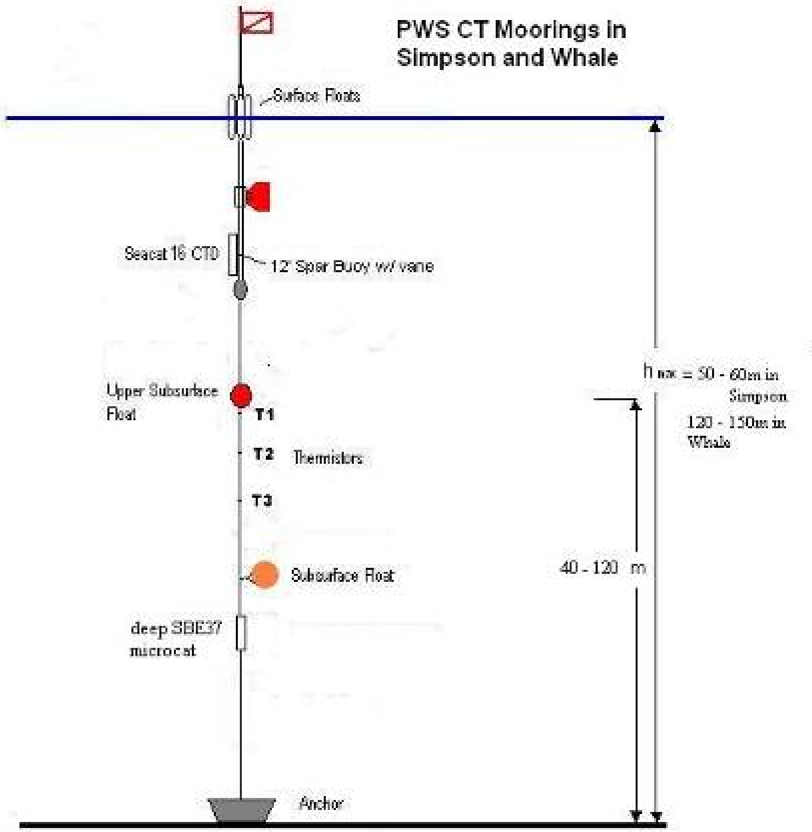

Fig. 6. Design of oceanographic moorings equipped with SBE Seacat 16.03s and SBE37 Microcats. Note that weather sensors will probably be mounted to the top mast.

C. Data Analysis and Statistical Methods

The methods applied to the proposed research will follow standard procedures for obtaining descriptive physical oceanographic data. Details regarding the procurement and processing of these data are given in Gay and Vaughan (2001). A summary of data precision and limits on error are given below for each of the data sets described in the methods as well as types of advanced statistical tests applicable to the data.

CTD Profiles and Moorings

The number and spacing of stations established during SEA was sufficient to minimize standard errors of temperature and salinity to ≤5% of the mean values over all depths within the four fjords (Appendix A). The scan rate of sensors on the SBE 911*plus* is 8*Hz*. Given a drop rate of 0.5 to 0.75*m/s* the data resolution will range from 10 to 16 *data points/m*. Data will be post processed using SeaBird's Seasoft programs, which allow low pass filtering, aligning sensor outputs in time, marking bad scans, removal of T/S spikes and averaging into 1*m* depth bins. Additional stations may be added depending upon the amount of variability observed among casts. However, spatial heterogeneity in the physical properties will be most effectively measured using the high resolution CTD data provided by the Aquashuttle. This instrument is described in more detail below. The CTD mooring data will require a minimum amount of post-processing (i.e. conversion to engineering units only). However, the data will be initially corrected by using calibration data obtained by making casts with the SBE19*plus* profiler.

ADCP Profiles

The 600 and 150*kHz* ADCP's will be in a towed and hull mounted configuration respectively. The data quality will be checked following procedures outlined by Trump (1989). Both of these instruments contain an internal flux-gate compass, which has a precision and accuracy of $\pm 0.5^o$ and $\pm 2^o$ respectively. They will require *insitu* calibration in order to check for magnetic effects induced by the vessel's engine's, generators, and pumps, etc. Calibration procedures for hull mounted ADCP's are given by Munchow et al. (1995) and similar methods can be applied to the towed instrument. The data for the 150*kHz* APCP will be collected vertically into 4*m* depth bins and temporally over 60*s* to produce averaged segments every 0.1-0.2*km*. Standard deviations of these data will range from 0.6 to 1.0*cm/s* depending upon water conditions. The statistical precision of these data can be increased, however, by averaging more pings and/or increasing the segment lengths. The data from the 600*kHz* ADCP will be collected into vertical depth bins of 2*m* (also depending upon water conditions affecting statistical precision). However, a total of 20 -30 pings per ensemble will provide a standard deviation of 0.5-0.6*cm/s*, and temporal averaging will further reduce this error significantly. For example, a 10*s* ensemble interval at a vessel speed of 2.5*m/s* (~5*kts*) will yield raw segments of currents every 0.03*km* with a precision of about ± 0.6*cm/s*. Post-processing of these data by ensemble averaging at 60*s* will yield average currents every 0.16*km* with a precision of ± 0.2*cm/s*.

High Spatial Resolution CTD Data

The high resolution hydrographic profiles (made with either a CI Aquapack or a SBE 19.03 CTD) will require additional post-processing other than conversion to engineering units. The sampling rate for either instrument when used on the Aquashuttle is 1*Hz* and the average data resolution will range from 0.2 to 0.35 *m/sample* vertically and 2.5 to 2.75 *m/sample* horizontally. This will yield a cast frequency of 1.2 to 6 *casts/km* depending upon maximum depth and vessel speed (e.g. given a maximum speed of 2.75*mps*, a transect length of 3*km*, and a cast depth of 50*m* a total of 6-7 casts would be taken). This should be sufficient to observe regions of varied hydrography across fronts caused by wind and tidal mixing. Post-processing of the Aqashuttle data will include vertical averaging into 1*m* depth bins (to minimize sampling bias caused by variation between ascent/descent rates) and georeferencing using GPS data collected during the ADCP transects.

Statistical Analysis

In addition to basic descriptive statistics (derived by programs written in Basic and Fortran) the data will be further tested with more advanced statistics (Emmory and Thompson, 2004) used to determine the integral time and spatial scales (to assess the dominant scales of variation and adequacy of sampling resolution), Eigenvector analysis (to determine the dominant modes of variation by a group of factors), and Harmonic Analysis (to determine the dominant frequencies of cyclical processes such as tides and storm events). Both the high resolution and moored CTD data will be amenable to the harmonic and integral scales analysis. However, the application of these tests will be directed by the student's graduate committee.

Historical Data Sets

The most comprehensive historical data set for the PWS region includes CTD profiles made in the 1970's and 80's by UAF (CFOS program), the mid to late 90's by PWSSC (SEA program), and from 2000 to present by PWSSC (OSRI Nowcast/Forecast monitoring program). Other data sets exist for the GOA shelf through various publications (Royer, Johnson, etc.) and more recently through the GLOBEC Northeast Pacific program. These results will be used in a synthesis to compare past and present physical oceanographic conditions within the PWS/GOA shelf region to the upper 100*m* and deep (>100*m*) layer conditions observed within nursery fjords to determine in what years broad-scale advection may have occurred.

D. Description of Study Area

The proposed study will take place in four fjords within PWS (Fig. 1). Two of these sites (Simpson and Zaikof) are relatively shallow (50-70*m*) and the main basins tend to exhibit relatively uniform T/S conditions due to turbulent mixing from a combination of wind and tidal forcing. In contrast, the other two fjords are relatively deep (200-300*m*) and exhibit strong T/S stratification, which is not completely eroded in the winter (Gay and Vaughan, 2001). Each site has a set of factors that produce hydrographic conditions unique to that location. These factors include differences in local climate (affecting heat flux), watershed topography and proximity to tidewater glacial fjords (affecting heat and freshwater content), basin morphometery and maximum depth (both affecting tidal currents and stratification) and proximity to the main entrances into PWS (affecting water exchange with the GOA).

E. Coordination and Collaboration with Other Efforts

The proposed study will be conducted in coordination and collaboration with other ongoing research programs including OSRI and AOOS sponsored oceanographic moorings, TSG cruises and hydrographic profiles within PWS. Additional research projects supported either directly or indirectly by the proposed research include Trends in adult and juvenile herring distribution and abundance in PWS, (R. Thorne, PWSSC), Prince William Sound Herring Forage Contingency, (T. Klein, PWSSC), and Characterization of Pacific herring nursery habitat in Prince William Sound, (R. Crawford, PWSSC). The data will also be used to help with validation of a Life-Stage

Specific Ecosystem Model of PWS Pacific Herring (D. A. Kiefer, System Science Applications), and possibly in a non-EVOS sponsored model of PWS fjord-circulation (R. Hetland, TAMU).

SCHEDULE

A. Project Milestones

A proposed schedule of cruises and the oceanographic stations and transects occupied is given in Table 1. As listed, the surveys to determine general hydrography (CTD casts) will be done on a seasonal basis, in accordance with sampling scheme for the juvenile herring surveys (Thorne Proposal, 2006) and during TSG surveys. In contrast, the high resolution data will be collected on a monthly basis and if possible synoptically with surveys of juvenile herring and zooplankton distribution and abundance (Thorne and Klein Proposals, 2006).

Table 1. Schedule of Research Cruises for Physical Oceanographic Surveys in 2007 and 2008

	Calendar	Year
Month	2007	2008
Jan		
Feb		
Mar	*Adult,* **Juvenile herring , CTDs**	*Adult,* **Juvenile herring , CTDs**
Apr		
May	TSG Cruises & HR[1] Data in Simpson	TSG Cruises & HR Data in Whale
Jun	TSG Cruises & HR Data in Simpson	TSG Cruises & HR Data in Whale
Jul	TSG Cruises & HR Data in Simpson	TSG Cruises & HR Data in Whale
Aug	TSG Cruises & HR Data in Simpson	TSG Cruises & HR Data in Whale
Sep		
Oct	*Juvenile herring, CTDs*	*Juvenile herring, CTDs*
Nov		
Dec		

1 HR = high resolution data

B. Measurable Project Tasks

FY07 1st Quarter (October 1, 06 to December 31, 06)

October	Project funding approved by Trustee Council
	CTD profiles collected during Juvenile herring survey

FY07 2nd Quarter (January 1, 07 to March 31, 07)

January	Annual Marine Science Symposium
March	CTD profiles collected during Juvenile herring survey

FY07 3rd Quarter (April 1, 07 to June 30, 07)

May and June	Conduct first two full CTD surveys in the four fjords and first set of comprehensive (HR) surveys of Simpson Bay

FY07 4th Quarter (July 1, 07 to September 30, 07)

July and August	Conduct second two full CTD surveys in the four fjords and second set of comprehensive (HR) surveys of Simpson Bay Submit Annual Report

FY08 1st Quarter (October 1, 06 to December 31, 06)

October/November	CTD profiles collected during Juvenile herring survey

FY08 2nd Quarter (January 1, 08 to March 31, 08)

January	Annual Marine Science Symposium
March	CTD profiles collected during Juvenile herring survey

FY08 3rd Quarter (April 1, 08 to June 30, 08)

May and June	Conduct first two full CTD surveys in the four fjords and first set of comprehensive (HR) surveys of Whale Bay

FY08 4th Quarter (July 1, 08 to September 30, 08)

July and August	Conduct second two full CTD surveys in the four fjords and second set of comprehensive (HR) surveys of Whale Bay Submit Final Report

RESPONSIVENESS TO KEY TRUSTEE COUNCIL STRATEGIES

Community Involvement and Traditional Ecological Knowledge (TEK)

The proposed research will incorporate community involvement and traditional knowledge by using local fishermen for boat charters and anecdotal information on physical features observed while commercial fishing in the locations of interest. In past EVOS sponsored projects field demonstrations of the physical oceanographic sampling technology were provided to students involved with the Youth Area Watch, and at least one public seminar is given each year in Cordova. Articles on research are also routinely contributed to the Breakwater, PWSSC's newsletter (www.pwssc.gen.ak.us/breakwater).

Resource Management Applications

The proposed research is an extension of the SEA project, which was a cooperative effort with various state and federal agencies including ADF&G, UAF and USFS (Cooney, 2001). Physical oceanography influences marine ecosystems as a bottom-up process, and the information from this project should therefore support management models that are used to make decisions on herring fisheries management. This would occur via support of other models that predict primary and secondary production given changes in environmental conditions driven by the physics (e.g. NPZ models). This data will aid in the assessment of factors affecting juvenile herring age structure and condition used to provide a potential forecast of recruitment. I have also worked with ADF&G personnel in Cordova including Steve Moffitt and Bob Berceli either formally during workshops or informally in discussions of how scientific research at PWSSC can be utilized by resource managers.

PUBLICATIONS AND REPORTS

No costs for publications are specifically requested in this proposal beyond those for annual and final reports.

LITERATURE CITED

Agler, B.A., S.J. Kendall, D.B. Irons and S.P. Klosiewski 1999. Declines in marine bird populations in Prince William Sound, Alaska, coincident with a climatic regime shift, Waterbirds 22:98-103.

Cooney, R.T., Allen, J.R., Bishop, M.A., Eslinger, D.L., Kline, T.C., Jr., McRoy, C.P., Milton, J., Norcross, B.L., Olsen, J., Patrick, E.V., Salmon, D., Scheel, D., Thomas, G.L., Vaughan, S.L., and Willette, T.M. (*This volume*) Ecosystem controls of pink salmon (*Oncorhynchus gorbushcha*) and Pacific herring (*Clupea pallasi*) production in Prince William Sound, Alaska: a Sound Ecosystem Assessment (SEA) synthesis. *Fish. Oceanogr.* 10 (Suppl 1):1-13.

Emory W.J. and R.E. Thompson (2004). Data Analysis Methods in Physical Oceanography. Pergamon Press.

Fofonoff, N.P. and R.C. Millard Jr. (1983). Algorithms for computation of fundamental properties of seawater. Unesco technical papers in marine science no. 44. pp.53.

Foy, R.L. and Norcross, B.L. (1999a) Feeding behavior of herring (*Clupea pallasi*) associated with zooplankton availability in Prince William Sound, Alaska. In: *Ecosystem Consideration in Fisheries Management.* Proceedings of the International Symposium on Ecosystem Consideration in Fisheries Management. Alaska Sea Grant College Program Report No. 99-01. University of Alaska Fairbanks, pp. 129-135.

Foy, R.L. and Norcross, B.L. (1999b) Spatial and temporal variability in the diet of juvenile Pacific herring (*Clupea pallasi*) in Prince Willliam Sound, Alaska. *Can. J. Zool.* **0**:000-000.

Foy, R.L. and Paul, A.J. (2000) Winter feeding and changes in somatic energy content for age 0 Pacific herring in Prince William Sound, Alaska. *Trans. Am. Fish. Soc.* **0**:000-000.

Foy, R.J. and B.L. Norcross 2001. Temperature effects on zooplankton assemblages and juvenile herring feeding in Prince William Sound, Alaska. Pp. 335-346, in F. Funk, J. Blackburn, D. Hay, A.J. Paul, R Stephanson, R. Toresen and D. Witherell (eds) Herring Expectations for a new Mellennium, Alaska Sea Grant College Program, AK-SG-01-04.

Gay, S. M. III and Vaughan, S.L. (1998) Descriptive physical oceanography of bays and fjords in Prince William Sound, Alaska used as nursery habitat by juvenile Pacific Herring *(Clupea pallasi).* Annual report to Exxon Valdez Restoration Office. Anchorage, Alaska. 26 pp.

Gay, S.M. III and S.L.Vaughan (2001). Seasonal hydorgraphy and tidal currents of bays and fjords in Prince William Sound, Alaska. *Fish. Oceanogr.* 10 (Suppl. 1), 159-193.

Irons, D.B., S.J. Kendall, W.P. Erickson, L.L. McDonald and B.K. Lance. 2000. Nine years after the EXXON VALDEZ oil spill: effects on marine bird populations in Prince William Sound, Alaska. The Condor 102:723-737.

Johnson, W.R., Royer, T. C. and Luick, J. L. (1989) On the seasonal variability of the Alaska Coastal Current. *Journal of Geophysical Research* **93***:* 12423-12438.

Kline, Jr., T.C. (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 l):94-117.

Mann, K. H. and J. R. N. Lazier. 1991. Dynamics of marine ecosystems: biological-Physical interactions in the oceans. Blackwell Scientific Publications, Boston, MA. 466 pp.

Matkin, C., G. Ellis, E. Saulitis, L. Barrett-Lennard and D. Matkin 1999. Killer Whales of Southern Alaska. North Gulf Oceanic Society, Homer, AK, 96p.

Munchow, A., Coughran, M.C., Hendershott, M.C., and Winant, C.D. (1993) Performance and calibration of an acoustic doppler current profiler towed below the surface. *J. Atmos. Oceanic Techn.* (*Need vol. & pages*)

Niebauer, H. J., Royer, T. C., and Weingartner, T. J. (1994) Circulation of Prince William Sound, Alaska. *J. of Geophys. Res.* Vol. 99, No. C7, pp. 14,113-14,126.

Norcross, B.L. *et al.* 2001. A synthesis of the life history and ecology of juvenile Pacific herring in Prince William Sound, Alaska. Fish Ocean **10** (Suppl 1):42-57

Paul, A.J. and Paul, J.M. (1998) Comparisons of whole body energy content of captive fasting age-0 Pacific herring (*Clupea pallasi* Valenciennes) and cohorts over-wintering in nature. *J. Exp. Mar. Biol. Ecol.* **226**:75-86.

Royer, T. C. (1979) On the effect of precipitation and runoff on coastal circulation in the Gulf of Alaska, Journal of Physical Oceanography, 9, 555-563.

Royer, T. C., Hansen, D. V. and Pashinki, D. J. (1979) Coastal flow in the northern Gulf of Alaska as observed by dynamic topography and satellite tracked drogued drift buoys. *Journal of Physical Oceanography* **9**: 555-563.

Royer, T. C. (1982) Coastal fresh water discharge in the northeast Pacific. *J. of Geophys. Res.* **87**:2017-2021.

Stokesbury, K.D., J. Kirsch, E.D. Brown, G.L. Thomas and B.L. Norcross 2000. Spatial distributions of Pacific herring, *Clupea pallasi*, and walleye pollock, *Theragra chalcogramma*, in Prince William Sound, Alaska. Fish. Bull. 98:400-409.

Thomas, G.L. and R.E. Thorne 2001. Night-time Predation by Steller Sea Lions. Nature **411**:1013.

Thomas, G.L. and R.E. Thorne 2003. Acoustical-optical assessment of Pacific herring and their predator assemblage in Prince William Sound, Alaska. Aquatic Living Resources 16:247-253.

Trump, C. L. (1989) Three practical hints on using vessel mounted ADCPs. *Marine Technology Society Journal* **23**(3): 28-35.

U.S. GLOBEC 1996. See implementation plan on the following web site: *http://globec. coas. oregonstate.edu/groups/nep/reports/reports.home.html*

Vaughan S. L., Mooers, C.N.K., Wang, J., and Gay, S.M. (*This volume*) Physical processes influencing the pelagic ecosystem of Prince William Sound. *Fish. Oceanog.* **0**:000-000.

Wang, J., Jin, M., Patrick, E.V., Allen, J.R. Moores, C.N.K. Eslinger, D.L. and Cooney, R.T. (2001) Numerical simulations of the seasonal circulation patterns and thermohaline structure of Prince William Sound, Alaska. *Fish. Oceanog.*

RESUME OF SHELTON MANN GAY III

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EXPERIENCE:

5/94 - PRESENT **Physical Oceanographer and Marine Technician** Prince William Sound Science Center
Cordova, Alaska

January 2006: Began a PhD program at Texas A&M University, College Station, Texas Advisors: Dr.Tim Dellapenna and Steve Dimarco. Dissertation will continue research on the physical oceanography of fjords in Prince William Sound.

At the Science Center my responsibilities involve marine technical work including preparation, deployment and trouble-shooting of oceanographic instruments, and scientific work including data processing, analysis, and writing research results into reports and journal publications.

Research Projects . 1) 1994 to 1998- Sound Ecosystem Assessment (SEA). Served as lead marine technician for oceanographic surveys of Prince William Sound (PWS), investigating seasonal hydrography and circulation, phytoplankton and zooplankton standing stocks and nutrient levels. Project objectives were to link physical forcing mechanisms in PWS with interannual variation in phytoplankton and zooplankton production, and the counteracting effects of prey sheltering (i.e. plankton abundance) and fish predation on survival of juvenile pink salmon and Pacific herring. During this time I was also the lead physical oceanographer for a portion of the SEA project investigating fjord nursery habitats of juvenile Pacific herring. This study involved seasonal surveys of tidal circulation (currents) and hydrography within fjords in relation to diet composition, growth and winter survival of herring. A report was submitted in April 1998 to the Exxon Valdez Oil Spill (EVOS) Trustee Council and a peer reviewed paper was published in 2001 (see below).

2) April – May 1995 - Contributed to a joint study with the Alaska Dept. of Fish and Game (ADFG) and the University of Alaska at Fairbanks (UAF) regarding the effects of wave energy on losses of herring spawn. The project involved deployment of tide/wave gauges during large scale spawning events in intertidal and subtidal locations along the shoreline of Montague Island, PWS Alaska.

3) June to Sept 1998 - Conducted a seasonal hydrographic survey of Kenai Fjords, Alaska in collaboration with Dr. Peter Armato of the U.S. Park Service. The study involved measuring T/S profiles from CTD casts, collecting water samples for nutrient analysis, and net tows for zooplankton. A final report detailing the physical properties of three tidewater glacial fjords located along the outer Kenai Peninsula was submitted to the Park Service in the fall of 1998.

4) 1999 to 2004 - Oil Spill Recovery Institute (OSRI) and EVOS Trustee Council sponsored research cruises to validate a Princeton Ocean Model (POM), developed by the University of Miami (UM), and to further investigate water exchange processes between the Gulf of Alaska and PWS. Project objectives included measuring currents within the central basin of PWS and at Hinchinbrook Entrance (HE) using a towed ADCP, collecting CTD data, and redeploying an ADCP mooring at HE (annually through 2002). More recent work for OSRI has included planning and implementing shallow and deep oceanographic moorings at HE and Montague Strait, and a circulation study in the central basin of PWS utilizing surface and subsurface (10m) drifters. Drifter trajectories were compared with CODAR data (UAF) and predictive models including NOAA HAZMAT (OSCAR- Oil Spill Contingency and Response) and UM POM results. Additional research in 2004 involved a study of the tidal circulation and hydrography in locations near Cordova, Alaska, proposed as alternative sites for the disposal of fish offal from Cordova's Seafood Processors. A poster presentation regarding this project was given at the Marine Science Symposium in Anchorage, Alaska in January 2005.

5) 2005 – Responsible for designing, planning and deploying five ADCP moorings in PWS for the Alaska Ocean Observing System. These moorings consisted of pairs of ADCPs (upward and downward looking) located at about 100m depth, with additional strings of TS sensors (SBE37 microcats) at 30, 100 and 10m above the bottom respectively. Additional work included a presentation at the ADCP's in Action conference held in San Diego, CA by RD Instruments and an OSRI oceanography cruise involving towed ADCP and hydrography measurements made over five days with semidiurnal tidal cycles measured at both Hinchinbrook Entrance and Montague Strait.

First Authored Publications . 1) Gay, S.M. III and S.L. Vaughan (2001) *Seasonal hydrography and tidal circulation of bays and fjords in Prince William Sound, Alaska.* Fisheries Oceanography pp. 159-193. 2) *Factors influencing sub-regional variation in the upper layer hydrography of small fjords in Prince William Sound, Alaska .* To be submitted to either Estuaries or Estuarine, Coastal and Shelf Science . 3) *Deep water exchange and renewal within small fjords of Prince William Sound, Alaska.* to be submitted to one of the above journals.

Second Authored Publications . 1) Norcross, B.L., Brown, E.D., Foy, R.J., Frandsen, M., Gay, S.M., Kline, T.C., Jr., Mason, D.M., Patrick, E.V., Paul, A.J., and Stokesbury, K.D.E. (2001) *A synthesis of the life history and ecology of juvenile Pacific herring in Prince William Sound, Alaska.* Fisheries Oceanography pp. 42-57 2) Vaughan, S.L., C.N.K. Mooers, and S.M. Gay III (2001) *Physical variability in Prince William Sound during the SEA study (1994-1998).* Fisheries Oceanography pp.58-80.

Presentations: Presentations of research results were made at various meetings including the International Association of Physical Sciences of the Ocean (IAPSO) meeting in Honolulu, HI, August 1995; AAAS meeting in Fairbanks, AK, September 1995; EVOS annual meeting in Anchorage, AK, March 1999; and AGU Ocean Sciences meetings in San Diego, CA, February 1998, Honolulu, HI, February 2002 and Portland, OR, January 2004; and the Eastern Pacific Ocean Conference (EPOC) in Sydney BC, September 2004.

Equipment and Computer Experience : CTD's including Sea-Bird Electronics (SBE) 911/plus w/ water sampling rossette, SBE 19.03 profilers, SBE 16.03's); ADCP's including towed, hull-mounted and moored RD Instruments Broad Band Blue Water and Workhorse units; EG&G Acoustic Releases, Chelsi Instruments (CI) Aquashuttle w/ FOCAL optical plankton counter, CI AQUAPACK (CTD and fluorescence) and tide-wave gauges (SBE 26). Marine Tech. duties include scheduling calibrations, performing equipment maintenance and repair, trouble-shooting at sea; designing ADCP moorings and equipment set-up for deployment of DR-ADCP's on small vessels; modifying towbodies for housing instruments; work on electric/hydraulic winches and telemetry cables. Computer skills include communication and programming of instruments, and programming in Fortran, Matlab and QBASIC to perform data analysis (UNIX Sun work stations and IBM compatible PCs).

EDUCATION:

1992 - 1993 **GRADUATE COURSES** Universtiy of Alaska of Fairbanks, Alaska

Marine Biology, Physical Oceanography and Electronics

1979 - 1984 **M.S. BIOLOGY** Northern Arizona University, Flagstaff, Arizona

Background in mammalogy, ornithology, limnology, forest and range ecology, fisheries biology and agrostology. One semester in technical aspects of forestry.

1978 - 1979 **GRADUATE STUDENT** West Virginia University, Morgantown, West Virginia

Basic background in wildlife biology and management, and graduate level statistics, forest ecology and microclimatology.

1973 - 1976 **B.S. BIOLOGY** Virginia Polytechnic Inst. & State Univ., Blacksburg, Virginia

Background in animal ecology, vertebrate natural history (ichthyology, herpetology and mammalogy), basic and advanced genetics, developmental biology, ethology, aquatic biology, plant morphology and independent study.

FY 07 funding was approved at the 11/14/06 Trustee Council meeting; FY 08 & FY 09 funding is pending.

BUDGET JUSTIFICATION - $152.7K

1. Personnel (Total: $20.8K in FY07, $21.2K in FY08 and $16.5K in FY09)

Personnel costs will cover the salary of the Principal Investigator (PI) while employed by PWSSC in Cordova from May to September in FY07 and FY08; 3 months of support are requested in FY09. Costs while at TAMU in College Station, Texas will be covered by both a Teaching and Research Assistance Award.

2. Travel (Total: $1.5K in FY07, $1.7K in FY08 and $1.1K in FY09)

Travel costs include round-trip airfare in FY07 and FY08 from College Station, Texas to Anchorage, Alaska for the PI to attend the Ocean Sciences meeting held annually in January. In FY09, travel is from Cordova and only for the P.I.

3. Contractual (Total: $20.1K in FY07, $16.6K in FY08 and $0.6K in FY09)

Contractual costs include chartering vessels for oceanographic surveys, fabrication of equipment necessary for deploying sampling gear, and repair/calibration of equipment, office costs, etc.

1) Vessel Charters: Two vessels of opportunity will be used to collect CTD data. One will be in operation to conduct surveys of juvenile herring and requires no further funding. The second vessel will be engaged in TSG operations and due to the extra time and fuel expenditures this project will require further assistance with costs. The third vessel will be chartered specifically for intensive work (diel surveys) in Simpson Bay. A seine type vessel is required to simultaneously deploy sampling gear, including a large oceanographic winch to operate the Aquashuttle.

2) Network & Office Costs: Funds to cover basic costs of office work including (but not limited to) computer network, phone, fax, copying, mail and freight.

3) Repair of CI Aquapack: Funds are required to ship this instrument back to the manufacturer for repair of the communication circuitry. The total cost is an approximation at this time (until CI inspects the problem).

4) Calibration Costs: Funds are necessary for shipping CTs back to SBE Inc. to check and calibrate the instruments. For FY07 only two Seacat 16.03 CTs will need calibration. In FY08, both the Seacats and Microcats will require calibration.

5) Fabrication Costs: The fabrication of a second spar-buoy for deployment of one CT mooring will be required. One of these buoys (shown schematically in Fig. 6) will

also probably house meteorological instrumentation in addition to the near-surface CT .

4.Commodities ($1.3K in FY07 and FY08, and $0.5K in FY09) – Request is for miscellaneous field and office supplies, batteries and maintenance supplies for some of the equipment, and lines and shackles for the moorings.

5.Equipment ($8.5K in FY07)
Request is for purchase of two Microcat CTDs at a cost of $4.3K each.

DATA MANAGEMENT AND QUALITY ASSURANCE/QUALITY CONTROL (QA/QC) STATEMENT

The design of the proposed research is given in the section above on Procedural and Scientific Methods. The study will generate two basic types of data that are routinely collected by physical oceanographers: 1) hydrography data collected by CTD casts at oceanographic stations, including measurements of temperature (T), conductivity (C), pressure (P), fluorescence (F) and turbidity (objective 1, page 4, paragraph 5); and 2) transects conducted with towed or vessel mounted instruments collecting data on currents, including vector components (*u*,*v*, and *w*), magnitudes and directions, and ancillary data such as pitch, roll, heading, echo intensity, error velocity and percentage of good data returns, and high spatial resolution hydrography comprised of continuous CTD casts, measuring T, C, P and F (objectives 2 and 3, pages 4 and 5, paragraphs 5 and 2).

Data collection methods for the majority of the above instruments are given in Gay and Vaughan (2001), and are also summarized in this proposal (pages 4 to 10). The first level of data management and quality assurance for physical oceanographic data is in standardizing the procedures used to deploy the various instruments. For example, using a standard cast procedure for CTDs ensures quality control so that instruments: a) properly equilibrate to the water conditions prior to down-casts, b) do not exceed the maximum drop rates (limited by pump speeds) and c) expedite the post-processing of the data (QC of the data). Similar procedures are done when deploying the Aquashuttle. However, the data require user specified algorithms for post-processing (see Data Analysis and Statistical Methods, page 13, paragraph 3).

Data management in the field is done by filling out field sample forms or logs of data that identify each CTD or transect with its times (local and GMT), locations (i.e. geo-referencing), maximum depth, depth or length of line paid out, etc. In the cases of the towed or vessel mounted instruments depth is determined by either a pressure sensor (CI Aquapack), fixed depth below the surface by marks on the tow cable (towed ADCP), or immersion of the pressure housing (vessel side-mounted ADCP). Additional data management in the field will include uploading and checking data for instrument malfunctions as soon as feasible (i.e. following retrieval, or as data are streamed to the computer in the case of real-time output from towed instruments), and making back-up copies of the raw data during the cruises.

Metadata and Conversion Algorithms

The conversion of physical data into engineering units (i.e. ascii data) is typically done by applying instrument counts to polynomial equations using specific calibration coefficients[1]. With the exception of RDI, all of the equations used for converting data from the various instruments are provided by the manufacturers upon purchase. These come in the form of calibration data sheets and software files containing the coefficients and the equations. These files are an integral part the manufacturer’s software and are used to produce the ascii data either in real-time (Aquapack data) or in post-processing (SBE and Wetlabs data). Each of the instruments typically generates a list of meta data describing the sensor serial numbers, programming set-up, status (battery voltage, data buffer capacity), etc. In the case of the Wetlabs instrument, however, the data are integrated with the SBE 19*plus* sensor output and therefore the meta data are part of the SBE data files. The other instruments all have their own suite of meta data that is output along with the variables of interest.

Appendix A shows examples of metadata for SBE and RDI data files. In each case there are identifiers used to clarify the fields, and in the example for the CTD data the calibration coefficients used for conversion are included. The electronic version of this proposal contains pdf files listing the specifications, precisions and accuracies for most of the instruments to be used. The methods and algorithms used by SBE and Wetlabs for data measurements are given in various publications listed on their web sites http://seabird.com, and http://wetlabs.com. Those used by RDI to convert Doppler shift and echo intensity data into current vectors are proprietary. For more details on all of the remaining instruments see online documentation at http//rdinstruments.com, and http//chelsea.co.uk. Note that the 150*kHz* ADCP is now only available as a custom order and the closest instrument shown on the web site to this ADCP is the 75*kHz* Long Ranger. The Continental Shelf 150 Broad Band ADCP that will be used in this project has a range of ~ 300m and typically collects data in 4 *m* to 8 *m* bins and ensemble temporal averaging of over 60*s*. The actual settings used during data collection depend on the standard deviation obtained for the Doppler shift given the number of water ping, depth bins and temporal averaging.

Data Processing and Analysis

All data processing and analysis will be accomplished with a combination of software provided by the manufacturers and algorithms written in Basic, Fortran and Matlab by the PI (or other oceanographers). Post-processing of CTD data will include data QC to remove spurious values and spikes caused by misalignment of sensors in time/space and reversals due to ship roll, low-pass filtering, bin averaging and derivation of additional oceanographic parameters such as depth (m) density (sigma-t), specific volume anomaly, potential temperature, sound velocity, etc.[2] Similar processing will be done with the hydrography data collected with the Aquashuttle using

1 Sea-Bird Electronics, Inc. (2005) specifications and application note no.31. 1808 136th Place N.E., Bellevue, WA 98005.

Basic and Fortran programs written to perform temporal/spatial averaging and derivation of other oceanographic parameters using standard subroutines (Fofonoff and Millard, 1983).

The current data collected with the two RDI ADCPs will be post-processed by the following procedure: 1) conversion to ascii (engineering) units using RDI's software; 2) QC of the data by checking for data loss (i.e. bad bins) and unrealistic sudden changes in velocity, checking the ancillary data for beam loss, low percentage of good echoes, high error velocities (i.e. poor consistency in measurements among beams); 3) removal of bad bins or segments (ensemble averages); 4) interpolation/extrapolation to produce a final 'clean' data set. Further data reduction for the purpose of reporting will include layer averaging (accomplished by programs written in either Basic, Fortran or Matlab) and gridding (using algorithms such as Krieging, Minimum Curvature, Inverse Distance, etc.) written as part of graphics representation software such as Generic Mapping Tool (University of Hawaii), Grapher and Surfer (Golden Graphics, Boulder CO). Advanced statistical tests such as harmonic analysis, auto and cross-correlation/covariance, Eigenvalues, etc. will be run with programs written in Matlab.

Data Storage and Handling

All quantitative physical data collected will be stored electronically on computers and back-up media such as CDs and DVDs. Data will be backed-up in the field following uploading from instruments or completion of file writing in the case of real-time data. All processing steps will be documented and intermediate files saved and backed-up along with the final processed and analyzed data.

Instrument Calibrations

Aside from performing calibration casts for the CT moorings, all instruments (except RDI ADCPs) will be sent back to the manufacturer for post-cruise calibrations either annually (SBE16 Seacats) or biannually (SBE19*plus* , SBE37 Microcats and CI Auqapack). The SBE16s require more frequent calibrations since they have older style sensors and electronics.

2 Sea-Bird Electronics, Inc. (2005) data processing user manual software v. 5.34a. 1808 136th Place N.E., Bellevue, WA 98005.

APPENDIX A. Examples of Meta Data for SBE and RDI Data Files

1. Example of meta data for an SBE CTD data file

Instrument serial number, upload datafile, set-up and status:

```
* Sea-Bird SBE19plus Data File:
* FileName = C:\My Documents\ak606tsgc048.hex
* Software Version 1.50
* Temperature SN =  4773
* Conductivity SN =  4773
* System UpLoad Time = Jun 24 2006 14:06:59
* F/V Alena K
* AK606
* ds
* SeacatPlus V 1.6  SERIAL NO. 4773    24 Jun 2006  22:06:26
* vbatt = 12.4, vlith =  8.3, ioper =  65.1 ma, ipump =  39.8 ma,
* wait four seconds for biowiper to close, iext01 =  55.4 ma
*
* status = not logging
* number of scans to average = 1
* samples = 72990, free = 486250, casts = 62
* mode = profile, minimum cond freq = 2800, pump delay = 30 sec
* autorun = no, ignore magnetic switch = no
* battery type = alkaline, battery cutoff =  7.3 volts
* pressure sensor = strain gauge, range = 870.0
* SBE 38 = no, Gas Tension Device = no
* Ext Volt 0 = yes, Ext Volt 1 = yes, Ext Volt 2 = no, Ext Volt 3 = no
* echo commands = yes
* output format = raw HEX
* S>
```

Calibration coefficients for converting raw data to engineering units:

```
 * SeacatPlus V 1.6  SERIAL NO. 4773    24 Jun 2006  22:06:55
* temperature:  08-mar-06
*     TA0 = 1.252114e-03
*     TA1 = 2.627939e-04
*     TA2 = -1.320481e-07
*     TA3 = 1.524150e-07
*     TOFFSET = 0.000000e+00
* conductivity:  08-mar-06
*     G = -1.020485e+00
*     H = 1.337537e-01
*     I = -2.227477e-04
*     J = 3.432042e-05
*     CF0 = 2.766116e+03
*     CPCOR = -9.570000e-08
*     CTCOR = 3.250000e-06
*     CSLOPE = 1.000000e+00
* pressure S/N = 7193, range = 870 psia:  30-jan-06
*     PA0 = -1.286078e-01
*     PA1 = 2.645991e-03
*     PA2 = -6.415912e-12
*     PTCA0 = 5.190734e+05
*     PTCA1 = -1.119338e+01
*     PTCA2 = 4.218478e-01
*     PTCB0 = 2.475413e+01
*     PTCB1 = -5.750000e-04
*     PTCB2 = 0.000000e+00
*     PTEMPA0 = -7.274188e+01
*     PTEMPA1 = 4.916496e+01
*     PTEMPA2 = -3.066672e-01
*     POFFSET = 0.000000e+00
* volt 0: offset = -4.686526e-02, slope = 1.248314e+00
* volt 1: offset = -4.645158e-02, slope = 1.249373e+00
* volt 2: offset = -4.679053e-02, slope = 1.249253e+00
* volt 3: offset = -4.638842e-02, slope = 1.249655e+00
```

```
*     EXTFREQSF = 1.000003e+00
* dh
```

Cast meta data identifying date, time and number of scans, etc:

```
* cast  48 22 Jun 2006 18:48:52 samples 49280 to 50953, avg = 1, stop = mag switch
* S>
```

List of variables to be initially converted and derived:

```
# nquan = 12
# nvalues = 134
# units = specified
# name 0 = scan: Scan Count
# name 1 = timeS: Time, Elapsed [seconds]
# name 2 = prdM: Pressure, Strain Gauge [db]
# name 3 = tv290C: Temperature [ITS-90, deg C]
# name 4 = c0mS/cm: Conductivity [mS/cm]
# name 5 = flECO-AFL: Fluorescence, Wetlab ECO-AFL/FL [mg/m^3]
# name 6 = upoly0: Upoly 0, Turbidimeter
# name 7 = nbin: number of scans per bin
# name 8 = depSM: Depth [salt water, m], lat = 60
# name 9 = sal00: Salinity [PSU]
# name 10 = sigma-t00: Density [sigma-t, Kg/m^3 ]
# name 11 = flag: flag
# span 0 =        459,       1045
# span 1 =    114.497,    261.055
# span 2 =      1.000,    134.000
# span 3 =     5.0527,    12.2755
# span 4 =  30.764489,  33.029437
# span 5 =     9.8855,    11.4881
# span 6 =  24.261663,  24.285019
# span 7 =          3,         17
# span 8 =      0.991,    132.694
# span 9 =    26.4293,    32.0688
# span 10 =    19.8948,    25.3170
# span 11 = 0.0000e+00, 0.0000e+00
# interval = decibars: 1
# start_time = Jun 22 2006 18:48:52
# bad_flag = -9.990e-29
# sensor 0 = Frequency 0  temperature, 4773, 08-Mar-06
# sensor 1 = Frequency 1  conductivity, 4773, 08-Mar-06, cpcor = -9.5700e-08
# sensor 2 = Pressure Number
# sensor 3 = Extrnl Volt  0  WET Labs, ECO_AFL
# sensor 4 = Extrnl Volt  1  userpoly 0, 0281, 11-Jan-06
# datcnv_date = Jun 30 2006 13:21:25, 5.34a
# datcnv_in = C:\SBE4223\2006\pwstsgJun06_ctd\ak606tsgc048.hex
```

Calibration file used for data conversion and list of standard post-processing steps using SBE algorithms in the Data Processing software

```
C:\SBE4223\2006\pwstsgJun06_ctd\4773_Mar06.con
# datcnv_skipover = 240
# filter_date = Jun 30 2006 13:34:59, 5.34a
# filter_in = C:\SBE4223\2006\pwstsgJun06_ctd\ak606tsgc048.cnv
# filter_low_pass_tc_A = 0.500
# filter_low_pass_tc_B = 1.000
# filter_low_pass_A_vars = tv290C c0mS/cm
# filter_low_pass_B_vars = prdM
# alignctd_date = Jun 30 2006 13:35:34, 5.34a
# alignctd_in = C:\SBE4223\2006\pwstsgJun06_ctd\ak606tsgc048.cnv
# alignctd_adv = tv290C 0.500
# binavg_date = Jun 30 2006 13:36:01, 5.34a
# binavg_in = C:\SBE4223\2006\pwstsgJun06_ctd\ak606tsgc048.cnv
# binavg_bintype = decibars
# binavg_binsize = 1
# binavg_excl_bad_scans = yes
# binavg_skipover = 0
# binavg_surface_bin = no, min = 0.000, max = 0.000, value = 0.000
# Derive_date = Jun 30 2006 13:36:26, 5.34a
# Derive_in = C:\SBE4223\2006\pwstsgJun06_ctd\ak606tsgc048.cnv
C:\SBE4223\2006\pwstsgJun06_ctd\4773_Mar06.con
```

```
# file_type = ascii
```

2. Example of a meta data file collected with an RD Instruments ADCP

```
[RDI WinRiver Configuaration File]
Version=1.03.000

[Subsection]
Use All Ensembles=YES
First Ensemble=0
Last Ensemble=131071

[Offsets]
ADCP Transducer Depth [m]=1
Magnetic Variation [deg]=26
Heading Offset [deg]=0
One Cycle K=0
One Cycle Offset=0
Two Cycle K=0
Two Cycle Offset=0

[Processing]
Speed of Sound Correction=0
Salinity [ppt]=0
Fixed Speed Of Sound [m/s]=1500
Mark Below Botom Bad=YES
Backscatter Type=0
Intensity Scale [dB/cts]=0.43
Absorption [dB/m]=0.139
Projection Angle [deg]=0
Cross Area Type=0
Use 3 Beam Solution For BT=YES
Use 3 Beam Solution For WT=NO
BT Error Velocity Threshold [m/s]=0.1
WT Error Velocity Threshold [m/s]=1.5
BT Up Velocity Threshold [m/s]=10
WT Up Velocity Threshold [m/s]=10
Fish Intensity Threshold [counts]=50
Near Zone Distance=2.1

[Discharge]
Top Discharge Estimate=0
Bottom Discharge Estimate=0
Power Curve Coef=0.1667
Cut Top Bins=0
Cut Bins Above Sidelobe=0
River Left Edge Type=0
Left Edge Slope Coeff=0.5
River Right Edge Type=0
Right Edge Slope Coeff=0.5
Shore Pings Avg=10

[Edge Estimates]
Begin Shore Distance=100
Begin Left Bank=YES
End Shore Distance=100

[Depth Sounder]
Use Depth Sounder In Processing=NO
Depth Sounder Transducer Depth [m]=0
Depth Sounder Transducer Offset [m]=0
Depth Sounder Correct Speed of Sound=NO
Depth Sounder Scale Factor=1

[GPS]
GPS Time Delay [s]=0

[External Heading]
External Heading Offset=0
```

```
[Recording]
Filename Prefix=SALM
Output Directory=C:\My Documents\
GPS Recording=YES
DS Recording=NO
EH Recording=NO
Maximum File Size [MB]=0
Comment #1=
Comment #2=
Next Transect Number=0


[Commands]
BX1400
BA20
WS100
BP10
WP20
EA26
ES20
EZ1011101
ED10
EX00111
WD111100000
WS100
WN100
WE2000
WI0
WF100

[Wizard Commands]

[Wizard Info]
ADCP Type=1
Use Radio Modem=NO
Use GPS=NO
Use Depth Sounder=NO
Use External Heading=NO
Max Water Depth=50
Max Water Speed=1
Max Boat Speed=1
Material=0
Water Mode=1
Beam Angle [deg]=20

[Charts]
East Velocity Minimum=-0.5
East Velocity Maximum=0.5
North Velocity Minimum=-0.5
North Velocity Maximum=0.5
Up Velocity Minimum=-0.6096
Up Velocity Maximum=0.6096
Error Velocity Minimum=-0.6096
Error Velocity Maximum=0.6096
Velocity Magnitude Minimum=0
Velocity Magnitude Maximum=0.5
Velocity Direction Minimum=0
Velocity Direction Maximum=360
Projected Velocity Minimum=-0.5
Projected Velocity Maximum=0.5
Depth Minimum=0
Depth Maximum=70
East Displacement Minimum=-88.34080384
East Displacement Maximum=1855.15688064
North Displacement Minimum=-169.836100617
North Displacement Maximum=1886.569013696
Intensity Minimum=40
Intensity Maximum=255
Backscatter Minimum=0
Backscatter Maximum=255
```

```
Correlation Minimum=0
Correlation Maximum=255
Discharge Minimum=-1
Discharge Maximum=1
Heading Minimum=0
Heading Maximum=360
Pitch Roll Minimum=-10
Pitch Roll Maximum=10
Water Speed Minimum=0
Water Speed Maximum=0.5
Boat Speed Minimum=0
Boat Speed Maximum=5

[Fixed Commands]
CR1
CF11110
BA30
BC220
BE100
BP1
BR2
ES0
EX10111
TE00000000
TP000020
WA50
WE1500
WF50
WM1
WN50
WP1
WS50
WV170
WZ005
```

2007 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2006 - September 30, 2007

Budget Category:	Authorized FY 2006	Approved FY 2007	Proposed FY 2008	Proposed FY 2009				
Personnel		$ 20.8	$ 21.2	$ 16.5				
Travel		$ 1.5	$ 1.7	$ 1.1				
Contractual		$ 20.1	$ 16.6	$ 0.6				
Commodities		$ 1.3	$ 1.3	$ 0.5				
Equipment		$ 8.5	$ -	$ -				
Subtotal	$0.0	$ 52.1	$ 40.8	$ 18.7				
Indirect at 25.57%		$ 13.4	$ 10.4	$ 4.8				
Project Total w/o G&A	$0.0	$ 65.5	$ 51.2	$ 23.4	Approved FY 2007	Estimated FY 2008	Estimated FY 2009	Project Total
Trustee Agency GA (9% of Project Total)		$ 5.9	$ 4.6	$ 2.1				
Project Total w/G&A		$ 71.4	$ 55.8	$ 25.5	$71.4	$55.8	$25.5	$152.7
Full-time Equivalents (FTE)		0.3	0.3	0.3				
	Dollar amounts are shown in thousands of dollars.							
Other Resources								

Comments:
Unauthorized travel in the amount of $3,200 was removed during the proposal review processes. This resulted in an additional reduction of $1,200 in Indirect and Agency G&A, The travel not funded was for your advisor, Tim Dellapenna from Texas A&M , Galveston campus, to attend the Annual Marine Science Symposium in FY 07 and FY 08. **This project was funded for FY 07 only; FY 08 & FY 09 are pending.**

CTD Surveys in late fall and late winter within the four nursery bays would be conducted on vessel charters provided by the following collaborative projects:
1) "Trends in adult and juvenile herring distribution and abundance in Prince William Sound" (Principal Investigator Richard Thorne, Prince William Sound Science Center) proposed for EVOS 07 funds
2) Stellar Sea Lion Winter Food Limitation study (Nov 07 only juvenile herring survey; Principal Investigator Richard Thorne, Prince William Sound Science Center), funded by NOAA.

FY07 - FY 09

Project Number: 070817
Project Title: Physical Oceanographic Factors Affecting Productivity in Junvenile Pacific Herring Nursery habitats - Submitted under the BAA
Name: Prince William Sound Science Center. Shelton M Gay III

FORM 4A Non

Prepared:

2007 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2006 - September 30, 2007

Personnel Costs:				Months Budgeted	Monthly Costs	Overtime	Proposed FY 2007
	Name	Position Description					
	Shelton M. Gay III	Principal Investigator		4.0	5.2		20.8
		Subtotal		4.0	5.2	0.0	
						Personnel Total	$20.8

Travel Costs:		Ticket Price	Round Trips	Total Days	Daily Per Diem	Proposed FY 2007
	Description					
	College Station to Anchorage for Alaska Marine Symposium	0.7	1	5	0.2	$1.5
					Travel Total	$1.5

FY07

Project Number: 070817
Project Title: Physical Oceanographic Factors Affecting Productivity in Junvenile Pacific Herring Nursery habitats - Submitted under the BAA
Name: Prince William Sound Science Center. Shelton M Gay III

Prepared:

2007 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2006 - September 30, 2007

Contractual Costs:	Proposed
Description	FY 2007
Vessel Charter - provided by collaborative proposal, P.I. Thorne	
Vessel Charter - primarily provided by PWSOS TSG cruises - these funds include additional fuel and time cost	5.0
Vessel Charter - seine vessel for intensive surveys at Simpson bay	10.0
network costs (based on $100/mo x staff mo)	0.4
phone/fax/copying charges/mail/freight	0.2
Repair of Chelsea Instruments Aquapack (note this needs to be sent back to the manufacturer in the UK)	3.0
calibration for 2 SBE16 Seacats	1.0
fabrication costs of spare buoy for CT mooring	0.5
Contractual Total	20.1

Commodities Costs:	Proposed
Description	FY 2007
field & office supplies	0.5
batteries & maintenance supplies for Seacats	0.3
lines, shackles etc. for moorings	0.5
Commodities Total	1.3

FY07

Project Number: 070817
Project Title: Project Physical Oceanographic Factors Affecting Productivity in Junvenile Pacific Herring Nursery habitats - Submitted under the BAA
Name: Prince William Sound Science Center, Shelton Gay III

Prepared:

2007 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2006 - September 30, 2007

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 2007
SBE37 microcat CTDs (includes shipping)	2	4.3	8.5
Those purchases associated with replacement equipment should be indicated by placement of an R.			
		New Equipment Total	8.5

Existing Equipment Usage: Description	Number of Units	
600 kHz ADCP - Prince william sound Science Center (loaned from ADF&G)	1	
Chelsea Instr. Aquashuttle w/ Aquapack CTDF (includes winch w/ slip rings)	1	
SBE16 Seacat CT	2	
SBE19plus CTD w flourometer & turbidity	1	
SBE 19 CTD	1	
surface mooring buoys and anchors	2	
poratble weather station (RCAC)	1	
Safety equipment - Prince William Sound Science Center	1	
Desktop Computers and software (PWSSC)	1	
SUN Unix workstation	1	
laptop	1	

FY07

Project Number: 070817
Project Title: Project Physical Oceanographic Factors Affecting Productivity in Junvenile Pacific Herring Nursery habitats - Submitted under the BAA
Name: Prince William Sound Science Center, Shelton Gay III

Prepared

2007 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2006 - September 30, 2007

Personnel Costs:			Months	Monthly		Proposed
Name	Position Description		Budgeted	Costs	Overtime	FY 2008
Shelton M. Gay III	Principal Investigator		4.0	5.3		21.2
	Subtotal		4.0	5.3	0.0	
					Personnel Total	$21.2

Travel Costs:	Ticket	Round	Total	Daily	Proposed
Description	Price	Trips	Days	Per Diem	FY 2008
College Station to Anchorage for Alaska Marine Symposium	0.7	1	5	0.2	$1.7
				Travel Total	$1.7

FY08

Project Number: 070817
Project Title: Physical Oceanographic Factors Affecting Productivity in Junvenile Pacific Herring Nursery habitats - Submitted under the BAA
Name: Prince William Sound Science Center. Shelton M Gay III

Prepared:

Contractual Costs: Description	Proposed FY 2008
Vessel Charter - provided by collaborative proposal, P.I. Thorne	0
Vessel Charter - primarily provided by PWSOS TSG cruises - these funds include additional fuel and time cost	5.0
Vessel Charter - seine vessel for intensive surveys at Whale Bay	10.0
network costs (based on $100/mo x staff mo)	0.4
phone/fax/copying charges/mail/freight	0.2
calibration for 2 SBE16 Seacats	1.0
Contractual Total	16.6

Commodities Costs: Description	Proposed FY 2008
field & office supplies	0.5
batteries & maintenance supplies for Seacats	0.3
lines, shackles etc. for moorings	0.5
Commodities Total	1.3

FY08

Project Number: 070817
Project Title: Project Physical Oceanographic Factors Affecting Productivity in Junvenile Pacific Herring Nursery habitats - Submitted under the BAA
Name: Prince William Sound Science Center, Shelton Gay III

Prepared:

2007 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2006 - September 30, 2007

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 2008
Those purchases associated with replacement equipment should be indicated by placement of an R.			
New Equipment Total			0.0

Existing Equipment Usage: Description	Number of Units	
600 kHz ADCP - Prince william sound Science Center (loaned from ADF&G)	1	
Chelsea Instr. Aquashuttle w/ Aquapack CTDF (includes winch w/ slip rings)	1	
SBE16 Seacat CT	2	
SBE19plus CTD w flourometer & turbidity	1	
SBE 19 CTD	1	
surface mooring buoys and anchors	2	
poratble weather station (RCAC)	1	
Safety equipment - Prince William Sound Science Center	1	
Desktop Computers and software (PWSSC)	1	
SUN Unix workstation	1	
laptop	1	

FY08

Project Number: 070817
Project Title: Project Physical Oceanographic Factors Affecting Productivity in Junvenile Pacific Herring Nursery habitats - Submitted under the BAA
Name: Prince William Sound Science Center, Shelton Gay III

Prepared

2007 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2006 - September 30, 2007

Personnel Costs:			Months Budgeted	Monthly Costs	Overtime	Proposed FY 2009
Name	Position Description					
Shelton M. Gay III	Principal Investigator		3.0	5.5		16.5
	Subtotal		3.0	5.5	0.0	
					Personnel Total	$16.5

Travel Costs:	Ticket Price	Round Trips	Total Days	Daily Per Diem	Proposed FY 2009
Description					
Cordova to Anchorage for Alaska Marine Sympoisum	0.3	1	4	0.2	$1.1
				Travel Total	$1.1

FY09

Project Number: 070817
Project Title: Physical Oceanographic Factors Affecting Productivity in Junvenile Pacific Herring Nursery habitats - Submitted under the BAA
Name: Prince William Sound Science Center. Shelton M Gay III

Prepared:

2007 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2006 - September 30, 2007

Contractual Costs:	Proposed
Description	FY 2009
network costs (based on $100/mo x staff mo)	0.4
phone/fax/copying charges/mail/freight	0.2
Contractual Total	0.6

Commodities Costs:	Proposed
Description	FY 2009
field & office supplies	0.5
Commodities Total	0.5

FY09

Project Number: 070817
Project Title: Project Physical Oceanographic Factors Affecting Productivity in Junvenile Pacific Herring Nursery habitats - Submitted under the BAA
Name: Prince William Sound Science Center, Shelton Gay III

Prepared:

2007 EXXON VALDEZ TRUSTEE COUNCIL PROJECT BUDGET
October 1, 2006 - September 30, 2007

New Equipment Purchases: Description	Number of Units	Unit Price	Proposed FY 2009
Those purchases associated with replacement equipment should be indicated by placement of an R.			
		New Equipment Total	0.0

Existing Equipment Usage: Description	Number of Units	

FY09	Project Number: 070817 Project Title: Project Physical Oceanographic Factors Affecting Productivity in Junvenile Pacific Herring Nursery habitats - Submitted under the BAA Name: Prince William Sound Science Center, Shelton Gay III

Prepared