FY14 PROGRAM PROJECT PROPOSAL FORM

Project Title: PWS – Juvenile Herring Intensive Monitoring

Project Period: February 1, 2014 – January 31, 2015

Primary Investigator(s): W. Scott Pegau, Prince William Sound Science Center, Box 705, Cordova, AK 99574 wspegau@pwssc.org
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Abstract:

Described here is a single process study project that is a part of an integrative program that will enhance the current monitoring efforts, and examine aspects of particular life stages to allow better modeling of Prince William Sound herring populations. The long-term goal of the program is to improve predictive models of herring stocks through observations and research. The herring monitoring program is necessarily of coarse temporal and spatial resolution with just two observations per year at narrowly defined sampling sites spread around the large area comprising Prince William Sound. Data interpretation requires a greater context to impart greater meaning. In the case of temporal variation of herring condition it would be useful to know (1) how sensitive the herring overwinter mortality model is to starting time, and (2) the timing of recovery from winter starvation. In the case of spatial variation of herring condition it would be useful to know how sensitive the herring overwinter mortality model is to immigration and emigration from areas immediately adjacent to where herring are sampled at the time of our November and March surveys.

Fine-scale temporal and spatial variability at designated herring monitoring sites has never been characterized and therefore remains a data gap with potential ramifications for interpreting observed variation of herring condition that is part of the herring monitoring program as well as the aforementioned modeling. This will be addressed by sampling at Simpson Bay, which has been a key monitoring site for juvenile herring since the 1990's. Energy content and RNA/DNA will be measured monthly from September 2011 until June 2012 to assess fine-scale temporal variability. Fine-scale spatial variability will be assessed by sampling in November and March five separate sub-areas of a more extensive Simpson Bay than what is typically done during surveys. The results of the analysis will be contributed to the herring synthesis effort that will take place in FY14.

Estimated Budget:
EVOSTC Funding Requested:

FY12	FY13	FY14	FY15	FY16	TOTAL
207,000	77,300	20,400	0	0	304,700

(Funding requested must include 9% GA)

Non-EVOSTC Funds to be used:

FY12	FY13	FY14	FY15	FY16	TOTAL

Date:
8/30/13

I. NEED FOR THE PROJECT

A. Statement of Problem

Robust Pacific herring (*Clupea pallasii*) populations, suitable for exploitation by commercial fisheries, are typically sustained by periodic recruitment of strong year classes into the adult spawning population. However, the Prince William Sound (PWS) herring population has not had a strong recruitment class since 1989, when the Exxon Valdez Oil Spill (EVOS) occurred. In the EVOS settlement herring were identified as an injured resource and they remain listed as an unrecovered species by the EVOS Trustee Council (EVOSTC). Understanding why herring have not recovered in Prince William Sound requires understanding potential bottlenecks in the herring life cycle. The identification of the limiting conditions to herring recovery requires a series of focused process studies combined with monitoring of the natural conditions that affect herring survival.

Described here is a single project that is a part of an integrative program that will enhance the current monitoring efforts of the Alaska Department of Fish and Game (ADF&G), and examine aspects of particular life stages to allow better modeling of herring populations. The long-term goal of the program is to improve predictive models of herring stocks through observations and research. While we do not anticipate that there will be a major change in our modeling ability in the next five years, we expect that the combination of monitoring and focused process studies will provide incremental changes over the next twenty years and result in a much better understanding of herring populations by the end of the program.

The herring monitoring program is necessarily of coarse temporal and spatial resolution with just two observations per year at narrowly defined sampling sites spread around the large area comprising Prince William Sound (PWS). Data interpretation requires a greater context to impart greater meaning. In the case of temporal variation of herring condition it would be useful to know (1) how sensitive the herring overwinter mortality model is to starting time, and (2) the timing of recovery from winter starvation. The latter is important since the overwinter mortality model predicts that as little as 1 % of the November population would survive to May given a continuation of starvation after March (Kline 2011). PWS herring as late as May have been in very poor condition (Norcross et al. 2001). In the case of spatial variation of herring condition it would be useful to know how sensitive the herring overwinter mortality model is to immigration and emigration from areas immediately adjacent to where herring are sampled at the time of our November and March surveys. The herring population sampled at a given time at a sampling site is defined by the swath of water sampled by the device(s) used (e.g., a net), which is very small compared to the size of the habitat and thus may not be reflective of the local herring population.

B. Summary of Project to Date

The milestones of sample collection and processing for this project were completed as scheduled. During late winter the numbers of samples were limited as the fish became more difficult to locate. The analysis phase is in progress.

For Heintz' component of the project, biological data (lengths, weights) has been collected on all YOY herring received at ABL from the PWS collections in September 2011 through June 2012. Due to prioritizing chemical analysis of samples associated with related herring projects (herring growth and condition, herring fatty acid study), processing has been delayed slightly from the original timeline. Samples are currently in queue for chemical analysis, which is expected to be completed in fall 2013.

A setback to the project occurred when one of the principal investigators (Dr. Thomas Kline) left the Prince William Sound Science Center in June 2013. The Science Center is currently seeking a replacement for Dr. Kline and Dr. Pegau has taken responsibility for the project until a suitable replacement can be found. The gap in personnel may impact the completion of the analysis of this project, however Dr. Pegau worked with Dr. Kline to ensure a smooth transition of materials and is in a position to rapidly bring a new person up to speed or complete the deliverables if needed.

II. PROJECT DESIGN
A. Objectives

We have sought input for the design of the first five year proposal from scientists with ADF&G, NOAA, the current PWS herring survey program, and other institutions. Based on that input we have arrived at the following objectives for the first five-year period.

1) *Provide information to improve input to the age-structure-analysis (ASA) model, or test assumptions within the ASA model.* The ASA model is currently used by ADF&G for estimating herring biomass (Hulson et al. 2008). The proposed monitoring efforts are designed to address this objective by either expanding the data available for the existing ASA model or by providing information about factors that determine the size of recruitment events.

2) *Inform the required synthesis effort.* Proper completion of a detailed synthesis means being able to access and manipulate different sources of data and information. We are proposing projects that make data available to all researchers.

3) *Address assumptions in the current measurements.* Many of the existing studies are based on historical or logistical constraints. We are proposing research necessary to put the existing measurements into context spatially and temporally. This effort will allow the design of the most accurate and efficient monitoring program.

4) *Develop new approaches to monitoring.* With technological advances we have the potential to improve our monitoring programs so they require less effort or reduce the need to collect fish.

Because we are at the beginning of a twenty-year effort, we want to maximize the value of any data collected. The objectives listed above are designed to ensure that research and monitoring efforts within the expected twenty-year program are most effective. The programs addressing the objectives provide the information necessary to evaluate existing efforts while continuing to move towards our long-term goal.

Objectives specific to this project:

1. Expanded area Simpson Bay sampling in November 2011 and March 2012
2. Sample Simpson Bay monthly from September 2011 to June 2012

B. Procedural and Scientific Methods

We will sample at a single bay, Simpson Bay. However, the spatial scope of what is considered Simpson Bay will be expanded during the November and March sampling periods. The scope of this expansion (Fig. 1) is based on a combination of where herring have been previously sampled and where herring have been observed acoustically (R. Thorne. Pers. comm.).

<u>Sampling to increase spatial resolution (objective 1):</u> For this project we will augment current monitoring samples by sampling Simpson Bay as an aggregate of five sub-areas within the designated expanded bay area during November and March (Fig. 1). This entails dividing the designated expanded Simpson Bay into five sub-areas and sampling systematically within each area rather than just one location (the expansion per se is thus for four additional Simpson sites).

<u>Sampling to increase temporal resolution (objective 2):</u> For this project we will augment current November and March monitoring by also sampling Simpson Bay in September, October, December, January, April, May, and June as we are presently doing (sampling limited to either sub-areas 1 or 2 in Fig. 1 according to greatest fish abundance). The target minimum sample size at each time is 100 herring for energetics and 50 fish for RNA/DNA.

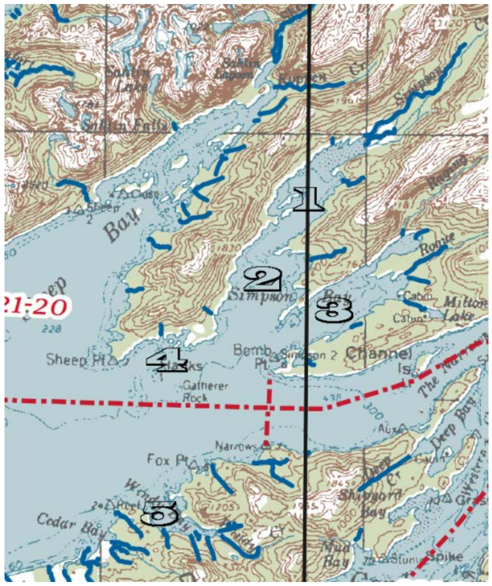

Figure 1. Map of Simpson Bay and surrounding waters showing five sampling areas.

The experimental design of the ongoing monitoring, i.e., sampling during November and March is a good match with respect to the experimental results used to develop the overwinter mortality model (Kline and Campbell 2011). The overwinter mortality model is based, in part, on a laboratory energy loss experiment that was conducted from 1 December to 25 January (Paul and Paul 1998). Therefore, measuring initial conditions during November is a good match. As well, one Paul and Paul (1998) experiment ended on 1 April, a good match to our field observations made in late March.

The energy value of herring that died during laboratory experiments ranged by 0.8 kJ/g wet mass (Paul and Paul 1998). The monthly (30 days) energy loss rate is very similar at 0.7 kJ/g wet mass suggesting this is a good sampling interval for the planned process study. If for example we sampled at twice per month, the expected energy loss would be ~ 0.3 kJ/g wet mass, much less than this range. Furthermore, with sampling trips possibly taking up to 10 days to complete from planned starting dates due to weather, there could be less than 10 days between samples, resulting in negligible change in measured energy.

Short-term (time intervals of months) increases in fish density previously observed at herring sampling sites suggest the possibility of localized migration (Table 1 in Stokesbury et al. 2002). For example, an undetected movement of the herring population to just outside/inside a given sampling bay prior to a survey would mimic a population loss/gain. If the condition of groups of herring within a bay was heterogeneous such short movements could result in a false apparent change in condition. For example, only those fish with higher condition might have migrated out. To test for this effect during our process study, we will sample more extensively during November and March during the process study year (late summer 2011 to spring 2012). The more extensive area comprising Simpson Bay will be sub-divided into five parts with one part corresponding to existing sampling. Therefore only the four additional parts need to be sampled as part of this study. To assess possible effect on the mortality model, the top 20% (the approximate present survival rate between November and March as well as between March and April) of each of the five sub-areas will be compared. Therefore at least 100 herring need to be sampled yielding 20 for this comparison. The mortality model will be run for each of the five sub-areas. The five outcomes will be compared with the five observed March distributions using ANOVA. At the end of the project we will make any necessary recommendations for altering sampling within a bay so as to achieve better representation.

Measurements of energy density can be misleading if the relative concentrations of lipid and protein remain constant when growth resumes. This would translate as a constant energy density leading the mortality model to overestimate mortality due to starvation. Monitoring growth would provide a more direct measure of the onset of feeding. Use of RNA/DNA as an indicator of feeding can be used to indicate the onset of feeding (Sewall et al. 2011). Moreover, RNA/DNA responds more quickly to changes in nutritional status than energy density.

Similarly, RNA/DNA could be used to indicate when feeding ceases in fall. When feeding ceases, energy density will remain elevated until fish deplete glycogen reserves and sufficient lipid is catabolized relative to protein to effect a change in energy density. Thus, reliance on energy density can underestimate the period in which feeding ceases. By combining RNA/DNA and energy density analysis the mortality model can provide better estimates of potential mortality.

C. Data Analysis and Statistical Methods

Other than tests specific to the experimental design aspects unique to this project (section B), the data analysis and statistical methods are the same as described in the accompanying Herring Condition Monitoring project. Energy measurement techniques will be done consistent with previous Prince William Sound herring studies dating as far back as the 1990's (Kline and Campbell 2011).

The null hypothesis for the higher spatial resolution sampling is that the five sub-areas of Simpson Bay have the same value for each of the parameters being measured. This will be tested using ANOVA. For example, the whole body energy density should not vary spatially within the greater Simpson Bay. If this is so then small scale migration (within this area) should not be a concern.

The expectation for the monthly observations is that they will follow a consistent pattern over the course of the observation period. An inconsistent pattern would be if the values of a given parameter shifted erratically rather than with a consistent pattern. For example, energy values decreased, then increased, then decreased, etc. Evidence of immigration would be supported by a combination of erratic variation and a systematic relationship among shifting values consistent with two more populations mixing. The differences corresponding to these hypothetical populations would have to be consistent with the differences among the five sub-areas sampled in November and March to suggest shifting around of sub-populations (e.g., the herring residing in each of the five sub-areas at a given time) from nearby.

However, if the de-trended monthly differences exceeded the differences from within the five sub-areas, it would suggest immigration/emigration from a greater space domain than that reflected by the expanded Simpson Bay sampling scheme of this project. If this is the case we may need to adjust the herring monitoring sampling strategy.

D. Description of Study Area

The study area includes all of Prince William Sound (N, E, S, and W boundaries of respectively, ~ 61, -145.5. 60, and -149°). However, most of the projects will focus on the four bays (Zaikof, Whale, Eaglek, and Simpson) that were extensively studied during the Sound Ecosystem Assessment study and PWS Herring Survey program (Figure 2). This allows the work to build upon the historical research completed in those bays. These bays also cover four different quadrants of the Sound. We anticipate a potential build out to include other bays or contraction based on the results from the synthesis. As part of the synthesis effort we will be reviewing the question "What is the appropriate sampling distribution?" as applied to the questions of juvenile herring condition and providing an index of juvenile abundance.

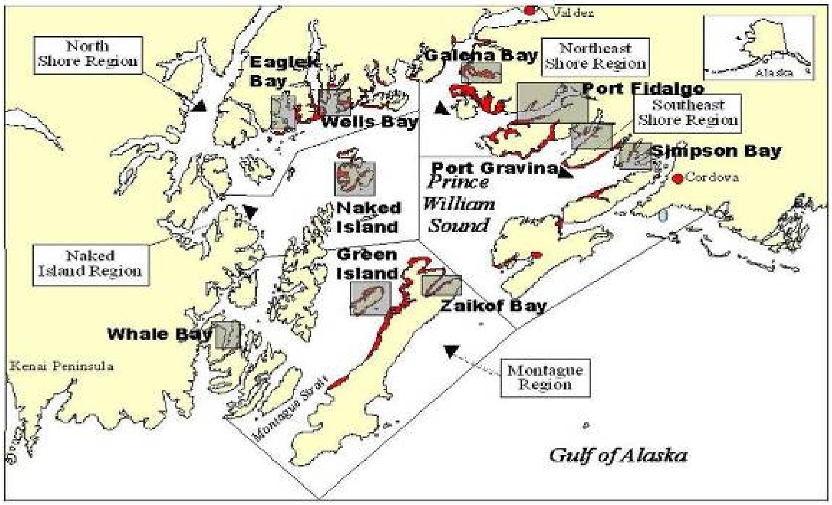

Figure 2. PWS study area, including the four SEA bays (Whale, Zaikof, Eaglek, and Simpson, as well as other bays historically important for juvenile herring.

E. Coordination and Collaboration with Other Efforts

This proposal is structured to be part of a collaborative programmatic effort being led by the Prince William Sound Science Center. Program coordination will primarily be through e-mail and phone communications. Annual meetings are planned in Cordova, tentatively in May, for all investigators to share information between themselves and with the community. These in-person meetings are vital to ensure proper communication among programs.

Dr. Pegau will act as the program team leader and be responsible for ensuring a coordinated and focused research program that leverages other assets whenever possible. He will be responsible for ensuring proper scientific oversight of individual projects and reporting to the EVOSTC. He will lead the development of annual work plans and the synthesis of findings from these programs. He will be responsible for coordinating the efforts of the herring research program with those of the Long-term Monitoring program. He will also be responsible for outreach and public input efforts.

Dr. Pegau currently is the coordinator of the existing EVOSTC funding PWS Herring Survey program. This program consists of ten individual projects that provide a coordinated examination of juvenile herring in Prince William Sound. This proposal is heavily influenced by the early findings from that effort. Dr. Pegau also serves as the Research Program Manager for the Oil Spill Recovery Institute (OSRI). In that capacity he is responsible for developing annual work plans, ensuring proper reporting, making reports available, developing partnerships to leverage funding, and to ensure outreach of OSRI activities. All activities that provide experience delivering the team leader duties outline in the request for proposals.

One of his duties is to ensure proper scientific oversight of the research programs. To accomplish this we will be setting up a four-person scientific oversight panel that will help guide the program and ensure the research is relevant to the long-term goal. The team will consist of people representing Alaska Department of Fish and Game, the National Oceanic and Atmospheric Administration, academia, and the local fishing community. There will be annual Principal Investigator meetings in Cordova each year to provide updates to the oversight panel, improve coordination between projects, and provide outreach and public input opportunities. This meeting will be in the spring so that there is opportunity to provide input on the development of the next year's work plan. In an effort to be proactive in the scientific oversight we sought input on the development of this proposal from ADF&G, NOAA, Cordova District Fishermens United (CDFU), and others. Team development and input on research direction was also sought at the 2011 Alaska Marine Science Symposium.

Coordination with the EVOSTC Long-term Monitoring program is critical to the success of the herring program. The ability to develop a predictive tool using the juvenile condition component requires an understanding of when feeding may occur and hence the need to coordinate with the oceanographic monitoring component. Predation by whales, fish, and birds are also considered potential factors inhibiting the recovery of herring. In that regard we will be looking to the monitoring program for information on the changes in the predator population base. That information will be critical if the herring program chooses to focus on predation during future efforts. The forage fish component and our efforts to develop an index of juvenile herring populations must inform each other. We expect that our hydroacoustic surveys and direct capture efforts will help provide measures of total fish biomass as well as forage fish populations. We will also work together to identify historical data that both programs would benefit from as part of the data management efforts. Throughout the proposal writing effort, the herring and long-term monitoring efforts led by Kris Holderied have been working together to identify how the two programs can inform and complement each other.

Other important programs for coordinating with are the existing PWS herring survey program and existing ADF&G herring research. This program has been developed with input from both of these programs and the focus of this proposal is extending the interpretation of the data from those two programs. The Herring Survey program will still be operating in FY12 and FY13. There are field observations scheduled in FY12 and in FY13 funds are strictly for analysis and report writing. Included in the report writing is a synthesis of previous and current research. This report will be finished in FY13 and be the basis for the synthesis required under this request for proposals.

Lead Principal Investigator Dr. Thomas C. Kline, Jr. will be responsible for the execution of project's energy observations and energy modeling and oversight of the proposed project. Dr. Kline is a world-leader in applying natural stable isotope abundance to fish ecology problems. Dr. Kline has been a research scientist at the Prince William Sound Science Center (PWSSC) since 1995. During this time he has led numerous projects on the oceanography of Prince William Sound and adjacent Gulf of Alaska. He has published dozens of research papers based on the resulting data.

Dr. Kline is currently the principal investigator of the *Exxon Valdez* Oil Spill Trustee Council project 'Prince William Sound Herring Survey: Pacific Herring Energetic Recruitment Factors**'** that is investigating the role of food sources and energy status of herring for recruitment. He was the principal investigator of several previous *Exxon Valdez* Oil Spill Trustee Council projects that had a herring focus. These included Herring Forage Contingency (2007-9), Productivity Dependencies: Stable Isotopes (1998-9), and Sound Ecosystem Assessment: Conforming Food Webs of Fishes with Stable Isotope Tracers (1995-8). Results of these projects have been incorporated into approximately two-dozen scientific publications. The data from the existing project and past projects will synergize with this proposed project.

Co-Principal Investigator Dr. Ron Heintz will be responsible for the execution of the RNA/DNA aspects of the proposed project.

Both investigators are also investigators of ongoing and proposed herring condition monitoring projects that are part of the herring program. This dual role will facilitate near real-time integration of project results with the monitoring program. Both investigators will contribute to programmatic synthesis scheduled to take place in FY14. This synthesis may include suggested changes to the herring monitoring according to depending on outcome.

III. CV's/RESUMES

W. Scott Pegau
Oil Spill Recovery Institute
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Education:
1990 B.S., Physics, University of Alaska, Fairbanks
1996 Ph.D, Oceanography, Oregon State University

Professional Experience:
1987-1990 Research Assistant, University of Alaska, Fairbanks
1990-1996 Graduate Research Assistant, Oregon State University
1996-1997 Research Associate (Post Doc), Oregon State University
1997-1999 Faculty Research Associate, Oregon State University
1999-present Assistant Professor, Oregon State University
2002-2003 Senior Scientist, Kachemak Bay Research Reserve
2003-2007 Research Coordinator, Kachemak Bay Research Reserve
2007-present Research Program Manager, Oil Spill Recovery Institute

Research Interests:
To develop novel oil spill detection and tracking approaches. Understanding the fate and behavior of oil spilled in cold water environments. Development of response options for oceans with sea ice present. Circulation in Prince William Sound, Cook Inlet and the Gulf of Alaska and the associated larval transport. Relationship between oceanographic conditions and fisheries. Application of remote sensing for understanding coastal processes.

Publications
Selected publications

Pegau, W. Scott, Inherent optical properties of the central Arctic surface waters, *J. Geophys Res*, **107**, doi. 10.1029/2000JC000382, 2002.
Montes-Hugo, M. A., K. Carder, R. J. Foy, J. Cannizzaro, E. Brown, and S. Pegau, Estimating phytoplankton biomass in coastal waters of Alaska using airborne remote sensing, *Remote Sens. Environ.* **98**, 481-493, 2005.
Streever, B., R. Suydam, J.F. Payne, R. Shuchman, R.P. Angliss, G. Balogh, J. Brown, J. Grunblatt, S. Guyer, D.L. Kane, J.J. Kelley, G. Kofinas, D.R. Lassuy, W. Loya, P. Martin, S.E. Moore, W.S. Pegau, C. Rea, D.J. Reed, T. Sformo, M. Sturm, J.J. Taylor, T. Viavant, D. Williams, and D. Yokel, Environmental Change and Potential Impacts: Applied Research Priorities for Alaska's North Slope, *Arctic*, **64**, 390-397, 2011.
Moline, M.A., I. Robbins, B. Zelenke, W.S. Pegau, and H. Wijesekera, Evaluation of bio-optical inversion of spectral irradiance measured from an autonomous underwater vehicle, *J. Geophys. Res.*, **117**, 12pp., doi:10.1029/2001JC007352, 2012.
Musgrave, D.L., M.J. Halverson, and W.S. Pegau, Seasonal Surface Circulation, Temperature, and Salinity in Prince William Sound, Alaska, *Cont. Shelf Res.*, doi:10.1016/j.csr.2012.12.001, 2012

Collaborators

Mary Abercrombie (USF), Robyn Angliss (NOAA), Greg Balogh (USFWS), Mike Banner (UNSW), P. Bhandari (UM), Mary Anne Bishop (PWSSC), Rob Bochenek (Axiom consulting), Emmanuel Boss (U Maine), Kevin Boswell (FIU), Tim Boyd (SAM), Trevor Branch (UW), Evelyn Brown (Flying fish), John Brown, Michele Buckhorn (PWSSC), Lindsay Butters (PWSSC), Rob Cambell (PWSSC), L Carvalho (UCSB), Grace Chang (UCSB), Yi Chao (JPL), Paula Coble (USF), Robyn Conmy (EPA), Tim Cowles (OSU), Helen Czerski (U Southhampton), M. Darecki (PAS), Tommy Dickey (UCSB), C. Dong (IGGP), David Farmer (URI), Jim Farr (NOAA), Scott Freeman (NASA), J. Gemmrich (UVic), P. Gernez (U Nantes), Jess Grunblatt (UAF), Scott Guyer (BLM), Jeff Guyon (NOAA), B. Hagen (SAM), Nate Hall-Patch (IOS), Mark Halverson (PWSSC), Ron Heintz (NOAA), Paul Hershberger (USGS), Ben Holt (JPL), S. Jiang (UCSB), Mark Johnson (UAF), C. Jones (UCSB), Doug Kane (UAF), Lee Karp-Boss (U Maine), George Kattawar (TAMU), John Kelley (UAF), T. King (BIO), Tom Kline (PWSSC), Cory Koch (Wetlabs), Gary Kofinas (UAF), Kathy Kuletz (USFWS), J. Lacoste (Dalhousie), Denny Lassuy (DOI), D. LeBel (Lamont), Ken Lee (BIO), L. Lenain (SIO), Marlin Lewis (Satlantic), Y. Liu (MIT), L. Logan (UMiami), Wendy Loya (Wilderness org), Ted Maksym (WHOI), Darek Manov (UCSB) Phillip Martin (USFWS), W. Melville (SIO), Scott Miles (LSU), Steve Moffitt (ADF&G), Mark Moline (Cal Poly), Sue Moore (NOAA), Rue Morison (UNSW), Dave Musgrave, F. Nencioli (MIO), Carter Ohlmann (UCSB), John Payne (DOI), Sean Powers (USA), Caryn Rea (Conoco), Dan Reed (ADFG), B. Reineman (SIO), Ian Robbins (Cal Poly), B. Robinson (BIO), Chris Roman (WHOI), R. Rottgers (HZG), Scott Ryan (BIO), H. Schultz (UMass), Li Shen (Johns Hopkins), M. Shinki (CRI), Matt Slivkoff(ISMO), M. Sokolski (PAS), Frank Spada (Sea Engineering), Nate Statom (SIO), Darius Stramski (SIO), Bill Streever (BP), Todd Sformo (NSB), Robert Shuchman (Mich Tech), Petere Sutherland (SIO), Hanumat Singh (WHOI), Matt Sturm (ACE), Robert Suydam (NSB), J. Taylor, Richard Thorne (PWSSC), Mike Twardowski (Wetlabs), S. Vagle (IOS), Ronnie Van Dommelen (Satlantic), Tim Viavant (ADFG), Johanna Vollenweider (NOAA), Ken Voss (UMiami), Ian Walsh (Wetlabs), Libe Washburn (UCSB), J. Wei (Dal), Hemantha Wijesekera (NRL), Dee Williams (BOEM), Sharon Wilde (NOAA), Amanda Whitmire (OSU), Jeremy Wilkinson (BAS), Michelle Wood (UO), O. Wurl (Old Domin), D. Yankg (John Hopkins), Dave Yokel (BLM), Dick Yue (MIT), Len Zabilansky (CRREL), Ron Zaneveld (Wetlabs), Chris Zappa (Lamont), Brian Zelenke (Cal Poly)

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EDUCATION:

B.S. Ecology Ethology and Evolution, June 1979, University of Illinois, Urbana May 1979
M.S. Fisheries Biology, May 1987, University of Alaska, Juneau May 1985
PhD: Fisheries Biology, University of Alaska, Fairbanks. May 2009

PROFESSIONAL MEMBERSHIPS:

American Fisheries Society
American Institute of Biological Scientists
American Association for the Advancement of Science

EMPLOYMENT:

Program Manager, Recruitment Energetics and Coastal Assessment Program
National Marine Fisheries Service
Alaska Fisheries Science Center

Employed with NMFS for 27 years

RECENT PUBLICATIONS:

1. **Heintz,RA,** E.C. Siddon, E.V. Farley and J. Napp. In press. Correlation between recruitment and fall condition of age-0 pollock (*Theragra chalcogramma*) from the eastern Bering Sea under varying climate conditions. Deep Sea Research II. Accepted February 2013.
2. Siddon, EC, **Heintz RA**, Mueter FJ (In Press) Conceptual model of energy allocation in walleye pollock (*Theragra chalcogramma*) from larvae to age-1 in the southeastern Bering Sea. Deep Sea Research II. Accepted November, 2012.
3. Rinella, D. J., M. S. Wipfli, C. Stricker and **R. Heintz**. 2012. Salmon returns and consumer fitness: Marine-derived nutrients show saturating effects on growth and energy storage in stream-dwelling salmonids. Canadian Journal of Fisheries and Aquatic Sciences.69(1):73-84. DOI: 10.1139/f2011-133
4. Vollenweider, J.J., J.L. Gregg, **R.A. Heintz**, P.K. Hersberger. Energetic cost of *Ichthyophonus* infection in juvenile Pacific herring (*Clupea pallasi*). J. Parasit ology Research 2011:1-10. doi:10.1155/2011/926812
5. Gregg, KJ.L., J.J. Vollenweider, C.A. Grady**, R. A. Heintz** and P.K. Hershberger. Effects of environmental temperature on the dynamics of Ichthyophonus in juvenile Pacific herring (*Clupea pallasii*). J. Parasitology Research 2011:1-9. doi:10.1155/2011/563412

COLLABORATIONS IN LAST 48 MONTHS

AK. Dep. Fish and Game:	S. Moffit,
University of Alaska Fairbanks:	E. Siddon, A. Pinchuk, F. Mueter, B. Norcross
U.S. Geological Survey:	P. Hershberger
University of Alaska Southeast:	J. Straley
Florida International Univeristy:	K. Boswell
Prince William Sound Science Center:	T. Kline

Oil Spill Research Institute	S. Pegau
University of Washington:	G. Hunt
Bureau Ocean Energy Management:	C. Coon
Sitka Sound Science Center:	A. Sreenivasan
North Slope Borough	L. de Sousa
Louisiana State University	C. Li

IV. SCHEDULE

A. Project Milestones

Objective 1. Expanded area Simpson Bay sampling in November 2011 and March 2012.
Sampling to be met by March 2012, analysis by March 2013, incorporation into project synthesis by October 2013, and incorporated into herring program by March 2014

Objective 2. Sample Simpson Bay monthly from September 2011 to June 2012
Sampling to be met by June 2012, analysis by June 2013, incorporation into synthesis by October 2013, and incorporated into herring program by March 2014

B. Measurable Project Tasks

FY 14, 1st quarter (February 1 – May 31, 2014)
March *Complete analysis*

FY 14, 2nd quarter (June 1, 2014-August 30, 2014)
July *Complete final report*

V. BUDGET

Budget Form (Attached)
Please complete the budget form for each proposed year of the project.