FY15 PROJECT PROPOSAL SUMMARY PAGE

Continuing, Multi-Year Projects

Proposals are due to the EVOSTC office by September 2, 2014. Please note that the information in your proposal and budget form will be used for funding review. Late proposals, revisions or corrections may not be accepted.

Project Title: PWS Herring Program – Herring Condition Monitoring

Project Period: February 1, 2015 – January 31, 2016

Primary Investigator(s): Ron Heintz, NOAA Auke Bay Laboratory, 17109 Pt. Lena Loop Road, Juneau, AK 99801, ron.heintz@noaa.gov and Kristen B. Gorman, Prince William Sound Science Center, 300 Breakwater Ave, PO Box 705, Cordova, AK 99574, kgorman@pwssc.org

Study Location: Prince William Sound

Project Website: http://pwssc.org/research/fish/pacific-herring/

Abstract*: Outlined here is a single herring monitoring project that is a part of an integrative program that will enhance the current herring 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.

This project will be furthering the development of an overwinter herring mortality model that began with an ongoing monitoring project initiated in 2007, and incorporates results from Prince William Sound herring research dating as far back as the 1990's. Accordingly, herring are sampled in November and the following March (Objectives 1 and 2). The model runs by applying herring condition observations made before and after winter (Objective 3). Proposed sampling will commence in November 2012 and end in March 2016. The purpose of the time series is to relate overwinter mortality to herring recruitment.

Additionally, this project will be furthering the development of an overwinter herring mortality model with additional data types including proximate composition, RNA/DNA, and diet (Objective 6), as well energy levels per se. The goal is to use physiological indicators to realistically modify the daily energy loss rate in the overwintering model. The results of model improvement will be tested using the March data model validation approach that began in 2007.

We will no longer be assessing competitive effects of other juvenile fishes on condition of age-0 herring using stable isotope analysis as noted in previous proposals (Objective 4). Our experience with the sampling program is that we were unable to target the sample sizes needed for other species to make this a realistic goal. However, this year we intend to examine the relationship between age-0 herring length and scale growth (Objective 5) using existing data collected as part of this program, in order to better interpret long-term scale data held by Alaska Department of Fish and Game within the context of energetics.

Estimated Budget:

EVOSTC Funding Requested* (*must include 9% GA*):

FY12	FY13	FY14	FY15	FY16	TOTAL
0	230,620	238,601	251,572	253,861	974,654

Non-EVOSTC Funds to be used:

FY12	FY13	FY14	FY15	FY16	TOTAL
0	0	0	42,431	0	0

**If the amount requested here does not match the amount on the budget form, the request on the budget form will considered to be correct.*

Date: 8/15/2014

I. EXECUTIVE SUMMARY

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.

Studies conducted since the 1990's suggest that age-0 PWS herring begin winter deficient in energy, which leads to significant overwinter mortality. Starvation was confirmed by using RNA/DNA as a physiological indicator. It is hypothesized that when these constraints are relaxed, first winter survival is much greater and this leads to enhanced recruitment. Specific objectives for the Herring Condition Monitoring (HCM) project follow:

Objective 1. Monitor juvenile herring condition by sampling in November.

Objective 2. Monitor juvenile herring condition by sampling in March.

Objective 3. Apply resultant observations from Objectives 1 and 2 to continue refining an overwintering mortality model with the addition of physiological indicators.

Objective 4. Assess competitive interactions with fishes using stable isotope analyses (objective not continued in 2015).

Objective 5. Examine relationships between age-0 herring scale growth and body length (objective new in 2015).

Objective 6. Monitor seasonal changes in juvenile herring diets (November vs. March) and examine relationship between diet and herring condition (continuing objective although not specifically defined in previous proposals).

II. COORDINATION AND COLLABORATION

A. Within a EVOSTC-Funded Program

The HCM project is structured to be part of a collaborative programmatic effort being led by the Prince William Sound Science Center (PWSSC), the Prince William Sound Herring Research and Monitoring (HRM) program supported by EVOSTC. The HRM program also includes monitoring of disease, as well as studies of adult and juvenile biomass using acoustic techniques. As part of the HRM, the HCM project interacts with virtually all other aspects of the program and personnel from multiple projects work in cooperation. For example, the HCM project will furnish one field technician for field sampling. Previous herring technicians have been simultaneously collecting, sorting, and preparing samples for multiple investigators such as Dr. Hershberger's disease program as part of research cruise duties. Field sampling is being conducted on shared research vessels, with funding for vessel charter time outside the scope of this project. We further rely on environmental data provided by the Gulf Watch Alaska program. Additionally, local fishermen associated with Cordova District Fishermen United, which is a component of the larger HRM program's logistics, collects spring herring samples.

B. With Other EVOSTC-funded Projects
None

C. With Trustee or Management Agencies
The HCM project is an ongoing collaboration between PWSSC and NOAA. Bomb calorimetry and preparation of samples for stable isotope analyses are conducted at PWSSC under the supervision of project PI, Kristen Gorman. Proximate composition, RNA/DNA, and dietary analyses are conducted at NOAA's Auke Bay laboratory under the supervision of project PI, Ron Heintz. The current proposal also includes a new collaboration between PWSSC and ADF&G in Cordova to conduct scale analyses.

Here, a new collaboration is proposed with ADF&G in Cordova to conduct scale analyses. Steve Moffitt, Fisheries Biologist III with ADF&G in Cordova, has indicated a willingness to collaborate on this component of the proposal by provided services for herring scale analysis and access to long-term herring scale datasets through a revision in budgets to cover ADF&G personnel.

III. PROJECT DESIGN – PLAN FOR FY15

A. Objectives for FY15

Objective 1. Monitor juvenile herring condition by sampling in November.

Objective 2. Monitor juvenile herring condition by sampling in March.

Objective 3. Apply resultant observations from Objectives 1 and 2 to continue refining an overwintering mortality model with the addition of physiological indicators.

Objective 4. Assess competitive interactions with fishes using stable isotope analyses (objective not continued in 2015).

Objective 5. Examine relationships between age-0 herring scale growth and body length (objective new in 2015).

Objective 6. Monitor seasonal changes in juvenile herring diets (November vs. March) and examine relationship between diet and herring condition (continuing objective although not specifically defined in previous proposals).

B. Changes to Project Design
There are no major changes planned for the design of the HCM project within the scope of energetic sampling and application to the overwinter herring mortality model (**Objectives 1-3, 6**).

We have decided to discontinue work aimed at assessing competitive interactions between age-0 herring and other fishes (**Objective 4**). As a new PI, Kristen Gorman has decided that the current database does not have the necessary sample sizes to achieve this objective as previous collections of other fishes have been sparse do to sampling techniques.

This year, we plan to pursue a new project that examines age-0 herring growth using scale data as a predictor of age-0 herring body size (**Objective 5**). This information will be used to improve our understanding of how changes in scale growth patterns correlate with known variation in fish length and energetic state, specifically for age-0 herring. Importantly, this relationship will greatly expand ADF&G's long-term database that includes age-0 herring growth based on scale analysis of older fish,

and allow for insights on how relationships between fish size and energetic state relate to successful recruitment. This project will use existing data already collected as part of the HCM project. We plan to examine a stratified random sample of 8 size classes between 50 and 120 mm defined by 10 mm increments. Within each 10 mm size class, we expect to analyze between 50 – 60 individual scales, which would result in the analysis of approximately 400 - 500 samples. Scales will be examined through a microfiche equipped with a scanner by an ADF&G technician located in Cordova, AK. The scanner feeds the image into a computer's frame-grabber board. Using software calibrated to the magnification of the image, a series of lines will be overlaid on the scale image from the focus to the scale edge by the reader to mark the annuli on the image. The number of annuli and the spacing between annuli will be collected in a database and collated with the existing information about the herring. The image and the overlaid measurements maybe saved for future reference. Predictive models will use standard statistical approaches (i.e., least-squares regression, ANOVA) within an Information-Theoretic (AIC) context.

IV. SCHEDULE

A. Project Milestones for FY 15

Objective 1. Monitor juvenile herring condition by sampling in November.
Fieldwork to be accomplished by November 2015
Laboratory work to be accomplished by July 2016

Objective 2. Monitor juvenile herring condition by sampling in March.
Fieldwork to be accomplished by March 2015
Laboratory work to be accomplished by November 2015

Objective 3. Apply resultant observations from Objectives 1 and 2 to continue refining an overwintering mortality model with the addition of physiological indicators.
Analyses to be accomplished by November 2015 with data collected in November 2014 and March 2015.

Objective 4. Assess competitive interactions with fishes using stable isotope analysis.
This objective is no longer being pursued as discussed previously.

Objective 5. Examine relationships between age-0 herring scale growth and fish length/energetic state.
Laboratory and statistical analyses to be accomplished by January 2016.

Objective 6. Monitor seasonal changes in juvenile herring diets (November vs. March) and examine relationship between diet and herring condition.
Laboratory work to be accomplished by July 2016, for fieldwork samples collected in March and November 2015.

B. Measurable Project Tasks for FY 15

FY 15, 1st quarter (February 1, 2015 - April 31, 2015)

February – April 2015:	*Ongoing laboratory work for samples collected in November 2014 and March 2015*
March 2015:	*2015 Sampling*

FY 15, 2nd quarter (May 1, 2015-July 30, 2015)

May – July 2015:	*Ongoing laboratory work for samples collected in March 2015*

FY 15, 3rd quarter (August 1, 2015 – October 31, 2015)

August – October 2015: *Ongoing laboratory work for samples collected in March 2015*
Application of data collected in November 2014 and March 2015 to overwinter mortality model.

FY 15, 4th quarter (November 1, 2015- January 31, 2016)

November – January 2016: *Ongoing laboratory work for samples collected in November 2015*
November 2015: *2015 Sampling*

V. PROJECT PERSONNEL – CHANGES AND UPDATES

Kristen Gorman is a new PI at the Prince William Sound Science who will be taking up projects previously led by Dr. Tom Kline including the current Herring Condition Monitoring project. Kristen is will defend her Ph.D. in the fall of 2014. She completed a M.Sc. in 2005 at Simon Fraser University, Vancouver BC, working in collaboration with Alaska USGS scientists on the energetics of egg production by female greater scaup ducks nesting in western Alaska. Her PhD work was also conducted at Simon Fraser University under the supervision of Prof. Tony D. Williams. Her dissertation work examined Southern Ocean marine food webs and variation in breeding performance by three species of *Pygoscelis* penguins. Her thesis work incorporated techniques such as stable isotope analyses, physiological assays related to energy management in birds, and population genetic markers to examine regional breeding rookery structure along the western Antarctic Peninsula.

Fletcher Sewall is a PhD candidate researching juvenile herring survival and recruitment who contributes to the project components associated with the NOAA Auke Bay Laboratory and within the purview of Ron Heintz, including sample processing, data analysis, and drafting reports and manuscripts.

VI. BUDGET

A. Budget Forms (Attached)

See attached documents.

B. Changes from Original Proposal

If your FY15 funding request differs from your original proposal, provide a detailed list of the changes and discuss the reason for each change.

C. Sources of Additional Funding

NOAA in-kind contributions:		
Source	*Purpose*	*Amount*
NOAA staff salaries	Training and oversight of labor for sample processing, contract writing and administration	$ 40,088.13
NOAA instrument amortization	Use of instruments in sample processing, analytical chemistry	$ 2,343.25
	Total	$ 42,431.38

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Professional Preparation

2014: Simon Fraser University, Faculty of Science; Ph.D. Major: Ecology and Evolutionary Biology, expected Fall 2014.
2005: Simon Fraser University, Faculty of Science; M.Sc. Major: Ecology and Evolutionary Biology.
1996: Dickinson College, Carlisle, PA, USA; B.S. Major: Biology.

Appointments

2014: Research Ecologist, Prince William Sound Science Center, Cordova, AK.
2008: Ph.D. Candidate, Department of Biological Sciences, Simon Fraser University, Burnaby, BC.
2005: Research Assistant, Polar Oceans Research Group, Sheridan, MT.
2002: M.Sc. Candidate, Department of Biological Sciences, Simon Fraser University, Burnaby, BC.
1999: Wildlife Field Technician, Oregon State University, Corvallis, OR.
1997: Wildlife Field Technician, University of Wisconsin, Madison, WI.

Selected Publications

Gorman, K.B., T.D. Williams, and W.R. Fraser. 2014. Ecological sexual dimorphism and environmental variability within a community of Antarctic penguins (genus *Pygoscelis*). *PLoS ONE* 9(3): e90081.

Crossin, G.T., P.N. Trathan, R.A. Phillips, **K.B. Gorman,** A. Dawson, K.Q. Sakamoto, and T.D. Williams. 2012. Variation in baseline corticosterone predicts foraging behaviour and parental care in macaroni penguins. *The American Naturalist* 180(1):E31-E41.

Bestelmeyer, B.T., A.M. Ellison, W.R. Fraser, **K.B. Gorman**, S.J. Holbrook, C.M. Laney, M.D. Ohman, D.P.C. Peters, F.C. Pillsbury, A. Rassweiler, R. Schmitt, and S. Sharma. 2011. Analysis of abrupt transitions in ecological systems. *Ecosphere* 2(12):art129.

Gorman, K.B., D. Esler, P.L. Flint, and T.D. Williams. 2008. Nutrient reserve dynamics during egg production by female Greater Scaup (*Aythya marila*): relationships with timing of reproduction. *Auk* 125(2):384-394.

Gorman, K.B., P.L. Flint, D. Esler, and T.D. Williams. 2007. Ovarian follicle dynamics of female Greater Scaup during egg production. *Journal of Field Ornithology* 78(1):64-73.

Other Relevant Publications

Schofield, O., H. Ducklow, K. Bernard, S. Doney, D. Patterson-Fraser, **K.B. Gorman**, D. Martinson, M. Meredith, G. Saba, S. Stammerjohn, D. Steinberg, and W. Fraser. Penguin biogeography along the West Antarctic Peninsula: Testing the canyon hypothesis with Palmer LTER observations. *Submitted Apr 2013*.

Crossin, G.T., A. Dawson, R.A. Phillips, P.N. Trathan, **K.B. Gorman**, S. Adlard, and T.D. Williams. 2012. Seasonal patterns of prolactin and corticosterone secretion in an Antarctic seabird that moults during reproduction. *General and Comparative Endocrinology* 175(1):74-81.

Badzinski, S.A., P.L. Flint, **K.B. Gorman**, and S.S. Petrie. 2009. Relationships between hepatic

trace element concentrations, reproductive status, and body condition of female greater scaup. *Environmental Pollution* 157(6):1886-1893.

Gorman, K.B., D. Esler, R.L. Walzem, and T.D. Williams. 2009. Plasma yolk precursor dynamics during egg production by female Greater Scaup *(Aythya marila*): characterization and indices of reproductive state. *Physiological and Biochemical Zoology* 82(4):372-381.

Gorman, K.B. and T.D. Williams. 2005. Correlated evolution of maternally derived yolk testosterone and early developmental traits in passerine birds. *Biology Letters* 1(4):461-464.

Synergistic Activities

- Peer-review of manuscripts for *Biology Letters* (4), *Journal of Animal Ecology* (1), *Journal of Avian Biology* (1), *Marine Ecology Progress Series* (4), *Polar Biology* (2), *Waterbirds* (1).
- Association of Polar Early Career Scientists (APECS) Council Member, Research Activities and Education/Outreach Committees (September 2012-2013).
- Graduate student representative to the US Long-Term Ecological Research (LTER) Network for Palmer Station, Antarctica LTER program (September 2010-September 2012).
- Co-organizer for *Les Ecologistes* Seminar Series, Department of Biological Sciences, Simon Fraser University (2010-2011).

Collaborators (last 48 months).

S Badzinski (Bird Studies Canada), B Bestelmeyer (New Mexico State U), J Blum (Polar Oceans Res. Group), G Crossin (Dalhousie U), S Doney (Woods Hole), A Dawson (C. Ecol Hydrol, NERC), H Ducklow (Marine Biological Lab), A Ellison (Harvard U), E Erdmann (U Wisconsin Madison), D Esler (Simon Fraser U), P Flint (AK-USGS), W Fraser (Polar Oceans Res Group), M Hipfner (Canadian Wildlife Service), S Holbrook (UC Santa Barbara), P Horne (Polar Oceans Res Group), J Joy (Simon Fraser U), S Laney (U Texas El Paso), H Lucas (Polar Oceans Res. Group), D Martinson (Lamont-Doherty), M Meredith (Brit Ant Surv), M Ohman (SCRIPPS), D Patterson-Fraser (Polar Oceans Res. Group), D Peters (New Mexico State U), S Petrie (Bird Studies Canada), B Pickering (Polar Oceans Res. Group), R Phillips (BAS), F Pillsbury New Mexico State U), A Rassweiler (UC Santa Barbara), K Sakamoto (Hokkaido U), O Schofield (Rutgers U), S Sharma (U Wisconsin Madison), S Stammerjohn (Inst Arctic Alpine Res), D Steinberg (VIMS), P Trathan (BAS), R Vos (Simon Fraser U), R Walzem (Texas A&M), T Williams (Simon Fraser U).

Graduate Advisors (PhD)

Simon Fraser University: T. Williams, W. Fraser (Polar Oceans Res Group), D. Esler, R. Ydenberg

Memberships

Sigma Xi, American Society of Naturalists, The American Ornithologists' Union, Pacific Seabird Group, The Explorers Club.

CURRICULUM VITAE

Fletcher Sewall
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EDUCATION

- PhD candidate, Fisheries Oceanography 2010 – present
  University of Alaska Fairbanks
- Master of Applied Science, Marine Ecology and Fisheries Biology 2005
  James Cook University, Australia.
- Bachelor of Science, Psychology 1993
  University of Alaska Anchorage

PROFESSIONAL EXPERIENCE

Chemical/Biological Laboratory Assistant. 12/15/2005 – present NOAA-NMFS Auke Bay Laboratories Recruitment Energetics & Coastal Assessment program (independent contractor).

Eight years of research-related experience including manuscript preparation, data analyses, chemical laboratory analyses, and fieldwork in support of NOAA fisheries research at the Auke Bay Laboratories.

Publications and presentations

- Principal investigator/lead author of study concerning use of nucleic acid ratios and lipid content as indicators of winter performance of juvenile Pacific herring. In preparation for submission to peer-reviewed scientific journal. [Sewall, Heintz, and Vollenweider. In review. Value of growth and energy storage as predictors of winter survival of YOY herring in Prince William Sound.]
- Principal investigator/lead author of study concerning proximate composition and fatty acid analysis of fish embryos and larvae. Published findings in peer-reviewed scientific journal. [Sewall & Rodgveller 2009, Changes in body composition and fatty acid profile during embryogenesis of quillback rockfish (*Sebastes maliger*), Fishery Bulletin 107(2): 207-220.]
- Developing poster presentations of research findings. Alaska Marine Science Symposium, 2009 – 2014.
- Presenting research findings. Prince William Sound Herring Survey principal investigators meetings, 2011 – 2014.
- Collaborating with scientists from Auke Bay Labs and other state, federal, university, and private agencies to develop research proposals and to synthesize research findings for dissemination.

Chemical and biological laboratory analysis

- Familiarity and experience with sample preparation and extraction procedures for analysis of hydrocarbons in marine tissue and sediment samples, including use of column chromatography and high performance liquid chromatography (HPLC).
- Cleaning and maintaining laboratory glassware, analytical instruments, and other chemistry laboratory equipment to a high standard that ensures contaminant-free use in multiple applications, including fatty acid analysis and trace hydrocarbon analysis.
- Performing lipid analysis on juvenile and adult fish, marine mammal, and invertebrate samples by modified method of Folch et al (1957): extracting lipids from homogenized tissue samples using accelerated solvent extractor (ASE) and other equipment described in the analytical chemistry protocols for Auke Bay Labs lipid analysis; determining masses of lipid extracts using gravimetric analysis.
- Using microscale laboratory techniques to extract lipids from larval fish and small tissue samples and analysing using spectrophotometry with sulphophosphovanillin (SPV) reagent.
- Preparing lipid samples for fatty acid analysis by carrying out acid-catalyzed transesterification of fatty acids in lipid extracts.
- Familiarity and experience with operation of gas chromatograph-mass spectrometer (GC-MS) for fatty acid quantification in marine tissue samples.
- Determining concentrations of nucleic acids and RNA/DNA ratios in larval fish and in muscle tissues of juvenile and adult fish by protocols of Calderone et al (2001), using a microplate fluorescence spectrophotometer and ethidium bromide.

- Verifying that sample results from chemical processing are within acceptable statistical bounds for quality assurance, including reproducibility of results, comparability to standard reference materials, and minimal contaminant levels.
- Collaborating with senior chemist in ongoing refinement of standard operating procedures and quality assurance criteria for analytical chemistry processes.
- Preparing a variety of types and size ranges of sample organisms and tissues for analyses, including: using preservative solutions for small invertebrate organisms, anaesthetizing fish, and homogenizing sample tissues through physical mixing by mortar/pestle, electric tissue homogenizer, and sonification equipment.
- Organizing, storing and processing biological samples in accordance with processing needs to maintain sample integrity, including use of supercold (-80 °C) freezing, liquid nitrogen, nitrogen gas flushing of storage containers, and BHT antioxidant.
- Generating biological data on a variety of fish species at different life stages, including: lengths of adult and larval fish; wet and dry tissue masses of adult, larval, and embryonic fish; size and maturity stage of gonads; fish stomach contents; bioelectrical impedance analysis (BIA) data.
- Dissecting juvenile and adult fish and preparing samples for pathological analyses, including collecting peripheral blood smears, and aseptic removal of heart, kidneys, spleen and liver.

Data analysis and recordkeeping

- Performing univariate and multivariate statistical analyses on biological, chemical, and bioenergetics data using MS Access database, MS Excel, and Minitab software.
- Maintaining accurate, organized records including sample chain of custody information for extensive sample inventories, biological data, and chemical data, in both paper records and Access database.

Mentorship and training experience

- Training multiple personnel in various analytical chemistry procedures, including sample processing, and cleaning and maintaining scientific instruments.
- Training multiple personnel in sample chain of custody recordkeeping and entry of biochemical and biological data in Access database.
- Coordinating and overseeing completion of chemical and biological processing tasks by contractors to accomplish project objectives within specified timelines.
- Mentoring high school biology students competing in regional Intel Science Fair; advised on study design, implementation, and statistical analysis.
- Judging regional Intel Science Fair projects, involving evaluation of written and oral presentations by high school students, and student interviews.
- Assisting outreach coordinator with Sea Week activities, including conducting age-appropriate activities for pre-school through junior high students.

Wet laboratory animal husbandry

- Assisting with design and set up of equipment for use in wet laboratory experiments, e.g., carbon dioxide-enriched seawater exposure of fish embryos.
- Feeding and maintenance of live marine organisms (fish, invertebrates) in Auke Bay Labs wet laboratory facilities for bioenergetics studies.
- Assisting with maintenance of aquaria and touch tanks for public display, including feeding and care of fish and invertebrate organisms.

Fieldwork

- Collecting and identifying of a variety of Alaskan marine fishes, including forage fishes.
- Conducting fieldwork for obtaining forage fish and invertebrate samples, habitat and environmental data, and marine mammal observations, including: live-aboard marine research cruises of over two weeks' duration, traveling by small plane, transporting equipment by foot over rugged terrain, and working in remote locations in all weather conditions.
- Deploying various types of field equipment for obtaining forage fish and other biological samples and environmental/oceanographic data, including: beach seines, mid-water trawls, hook-and-line, fyke nets, cast nets, plankton nets, Niskin bottles, CTD devices, split-beam echo sounder, rotary laser level/stadia rods, and salinity/temperature/DO/pH meters.