FY14 PROGRAM PROJECT PROPOSAL FORM

Project Title: *Genetic stock structure - Herring*

Project Period: 2014

Primary Investigator(s): Dr. Jeffrey Guyon and Sharon Wildes (NOAA)

Abstract:
Understanding if there is one PWS herring stock or multiple stocks is important for proper management of fisheries. We propose to study the genetic uniqueness of herring from PWS to determine if it may be a complicating factor in the recovery process. A previous genetic study of herring in the region indicated that the PWS herring population was genetically distinct from other stocks spawning outside the Sound (O'Connell et al. 1998), providing an impetus for additional work. Several recent studies have made advancements in herring research using microsatellite loci, and have detected fine-scale genetic differentiation among local regions of herring (Beacham et al. 2008; Andre et al. 2011; Wildes et al. 2011). Each microsatellite locus contains multiple alleles making microsatellites ideal genetic markers for analyzing migratory fish with limited stock structure like herring. Based on our experience studying Pacific herring in Southeast Alaska using microsatellite markers (Wildes et al. in 2011), successful completion of this proposal will require (1) increasing the number of genetic samples per collection from the 50 used in the previous analysis (O'Connell et al. 1998) to 150 fish, (2) using an increased number of informative markers (from 5 to 15), (3) analyzing at least two years of collections to examine temporal stability, and if sampling allows (4) spatial stability from collections from two different historical locations (east, west). Evaluation of temporal and spatial variation of herring population(s) in and around PWS using updated genetic protocols will provide important information about herring life history that will contribute to improving the application of the ASA model.

Estimated Budget:
EVOSTC Funding Requested:

FY12	FY13	FY14	FY15	FY16	TOTAL
0	0	$50,500	$53,100	0	103,600

(Funding requested must include 9% GA)

Non-EVOSTC Funds to be used:

FY12	FY13	FY14	FY15	FY16	TOTAL

Date:
August 10, 2013

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I. NEED FOR THE PROJECT

A. Statement of Problem

Pacific herring, once an important fishery, form a critical part of the Prince William Sound (PWS) ecosystem. Stocks remain depressed over the majority of the last20 years and reasons for lack of recovery remain complex and unknown. Information about herring stock structure is critical to determining the best management objectives for recovery of Pacific herring (*Clupea pallasi*) population(s), particularly if a fishery were re-established. It would be important to understand the uniqueness of spawning areas. Results from the genetic analysis outlined in this proposal will help managers understand if multiple sub-stocks are involved in issues such as spawning sites and fidelity, which may contribute to the complexities in understanding their lack of recovery.

B. Summary of Project to Date (if applicable)

Some samples (n=600) have already been collected in 2012 from the Port Gravina, Port Fidalgo, eastern PWS.

II. PROJECT DESIGN

A. Objectives

The primary objective of this proposal is to identify genetic uniqueness of herring in Prince William Sound using a group of 15 informative microsatellite markers to:

a. Determine if unique populations exist by sampling within and around PWS;
b. Determine temporal stability by sampling for two consecutive years at each location;
c. Determine if fine-scale structure exists across two age classes at each site -if ample sample size allows (Same, or different? Answer will aid in evaluation of the adopted-migrant hypothesis);
d. Determine spawning site fidelity of herring in PWS by comparing PWS spawners and nearby spawners outside of the Sound.

B. Procedural and Scientific Methods

Age class will be approximated from size information and DNA will be isolated from two age classes (150 each) from each collection of 500. Scale reading later will determine the age classes. Samples will be genotyped using 15 microsatellite markers, all of which have already been standardized in our laboratory for Pacific herring (Wildes et al., 2011).

C. Data Analysis and Statistical Methods

Resulting genotypes will be analyzed using standard genetic analyses in MICROCHECKER, GENEPOP, and FSTAT. Using PHYLIP, genetic distance among collections will be calculated and a neighbor-joining tree constructed to illustrate genetic relationships. The degree of genetic diversity will be examined with F_{ST} , G-test, and AMOVA among the following collections: (1) inside/outside PWS, (2) between collections within PWS, as samples permit (3) among year classes within a spawning cohort and (4) among years of collections. Finally, genetic results will be summarized to communicate their biological significance, as well as their significance to management and restoration.

D. Description of Study Area

It is anticipated that herring will be collected from within Prince William Sound, with the goal of collecting from both east and west. As a means to examine the fidelity of herring remaining in the Sound or returning to spawn in PWS, additional samples from outside PWS will be used. Through collaboration with the Alaska Department of Fish and Game (ADF&G) in Cordova and Yakatat, the goal will be to collect at least 150 samples from each group (for a specific location, year, spawn time,

and age class). Samples will be collected by coordinating with ADF&G and other EVOS funded projects from locations as outlined in Table 1.

Table 1

Location	Area	Year	Collected from Late Spawn	Number* Analyzed
Montague area	Western PWS	2014	500	300
St. Matthews Bay	Eastern PWS	2012	600	200
		2013	500	200
		2014	500	200
Kamishak	Cook Inlet	2012	200	200
Yakutat	Central Alaska	2008	200	200
Kukak	Kodiak	2013	150	150
Total			**2650**	**1450**

***number analyzed will include two year classes, obtained from the larger amount collected.

E. Coordination and Collaboration with the Program

This project is part of the Overall Project Objective 1: Provide information to improve input to the age-structure-analysis (ASA) model, or test assumptions within the ASA model. Evaluation of temporal and spatial variation of herring population(s) in PWS using updated genetic protocols will provide important information about herring life history that will contribute to improving the application of the ASA model.

III. CV's/RESUMES

CURRICULUM VITAE

NAME: Jeffrey R. Guyon

WORK ADDRESS: Genetics Program, ABL/TSMRI/AFSC/NMFS
17109 Point Lena Loop Rd
Juneau, AK 99801
jeff.guyon@noaa.gov

EDUCATION:

Jun 1983 - May 1987	B.S. in Mathematics, U.S. Coast Guard Academy, New London, CT
Aug 1993 - Aug 2000	Ph.D. in Biochemistry, University of Notre Dame, Notre Dame, IN

EMPLOYMENT AND WORK EXPERIENCE:

May 1987 - Jun 1993	Staff Officer, United States Coast Guard
Aug 1993 - Aug 1997	Graduate student, University of Notre Dame, South Bend, IN
Aug 1997 - Aug 2000	Graduate Student, Massachusetts General Hospital, Boston, MA.
Aug 2000 - Dec 2004	Post-doctoral fellowship, Children's Hospital Boston, Boston, MA.
Jan 2005 – Jun 2007	Instructor, Children's Hospital Boston, Boston, MA.
Jul 2007 – Jun 2008	Geneticist, Alaska Department of Fish and Game, Anchorage, AK.
Jul 2008 – Apr 2010	Supervisory Geneticist, Auke Bay Laboratories, Juneau, AK.
Apr 2010 – present	Program Manager, Auke Bay Laboratories, Juneau, AK.

SCIENCE BIBLIOGRAPHY (selected)

1. Farley, E.V., A. Starovoytov, S. Naydenko, R. Heintz, M. Trudel, C. Guthrie, L. Eisner, and J.R. Guyon. (2011) Implications of a warming eastern Bering Sea for Bristol Bay sockeye salmon. ICES Journal of Marine Science **68**:1138-46.
2. McCraney, W.T., Farley, E.V., Kondzela, C.M., Naydenko, S.V., Starovoytov, A.N., and J.R. Guyon. (2012) Genetic stock identification of overwintering chum salmon in the North Pacific Ocean. Environmental Biology of Fishes 94:663-668.
3. McCraney, W. T., Saski, C.A. and Guyon, J.R. 2012. Isolation and characterization of 12 microsatellites for the commercially important sablefish, *Anoplopoma fimbria*. Conservation Genetics Resources 4(2): 415-417.
4. Vulstek, S. C., Linderoth, T.P., Guyon, J.R., and D.A. Tallmon. 2013. Spatio-temporal population genetic structure and mating system of red king crab (*Paralithodes camtschaticus*) in Alaska. Journal of Crustacean Biology in press.
5. Garvin, M. R., Kondzela, C. M., Martin, P. C., Finney, B., Guyon, J., Templin, W. D., DeCovich, N., Gilk-Baumer, S. and Gharrett, A. J. (2013), Recent physical connections may explain weak genetic structure in western Alaskan chum salmon (*Oncorhynchus keta*) populations. Ecology and Evolution. doi: 10.1002/ece3.628

Collaborators/coauthors within last 4 years:

Alexander, M	Children's Hospital Boston, Boston, MA
Cheng, W	Alaska Department of Fish and Game, Anchorage, AK
DeCovich, N	Alaska Department of Fish and Game, Anchorage, AK
Eisner, L.	National Marine Fisheries Service, Juneau, AK
Farley, E.V	National Marine Fisheries Service, Juneau, AK
Finney, B	Departments of Biological Sciences and Geosciences, Idaho State University, Pocatello, Idaho

Galdzicki, M.	Children's Hospital Boston, Boston, MA
Garvin, M.R	School of Fisheries and Ocean Sciences, University of Alaska Fairbanks, Juneau, Alaska
Gharrett, A.J.	School of Fisheries and Ocean Sciences, University of Alaska Fairbanks, Juneau, Alaska
Gilk-Baumer, S	Alaska Department of Fish and Game, Anchorage, AK
Goswami, J	Children's Hospital Boston, Boston, MA
Grant, W.S	Alaska Department of Fish and Game, Anchorage, AK
Grauvogel, Z	Alaska Department of Fish and Game, Anchorage, AK
Gussoni, E.	Children's Hospital Boston, Boston, MA
Guthrie,C.M.III	National Marine Fisheries Service, Juneau, AK
Heintz, R.	National Marine Fisheries Service, Juneau, AK
Howell, M	Children's Hospital Boston, Boston, MA
Huang, P	Children's Hospital Boston, Boston, MA
Jun, S.J	Children's Hospital Boston, Boston, MA
Kalluri, R	Children's Hospital Boston, Boston, MA
Karpf, J	Children's Hospital Boston, Boston, MA
Kawahara, G	Children's Hospital Boston, Boston, MA
Kondzela, C.M	National Marine Fisheries Service, Juneau, AK
Kunkel, L.M	Children's Hospital Boston, Boston, MA
Linderoth, T.P	University of Alaska Southeast, Juneau, Alaska
Martin, P.C	Concerned Area M Fishermen, 2771 Deer Creek Drive, Bozeman, Montana
McCraney,W.T	National Marine Fisheries Service, Juneau, AK
Mitchell, M	Children's Hospital Boston, MA,
Mizuno, Y	Dept of Neurology, Gunma U. Grad School of Medicine Maebashi, Gunma 371-8511, Japan
Montanaro, F.	Children's Hospital Boston, Boston, MA
Murphy, J	National Marine Fisheries Service, Juneau, AK
Myers, J	Children's Hospital Boston, Boston, MA
Nakamura, Y	Children's Hospital Boston, Boston, MA
Naydenko, S.	Pacific Scientific Research Fisheries Center, Vladivostok 690950, Russia
Nguyen, H	National Marine Fisheries Service, Juneau, AK
Okamoto, K	Dept. of Neurology, Gunma U. Grad. School of Medicine, Maebashi, Gunma 371-8511, Japan
Pusack, T	Children's Hospital Boston, Boston, MA
Sasaoka, T.	Dept. of Neurology, Gunma U. Grad. School of Medicine, Maebashi, Gunma 371-8511, Japan
Saski, C.A	Clemson University, Clemson, SC
Sohn, R.L	Children's Hospital Boston, Boston, MA
Starovoytov, A.	Pacific Scientific Research Fisheries Center, Vladivostok 690950, Russia
Steffen, L.S	Children's Hospital Boston, Boston, MA
Tallmon, D.	University of Alaska Southeast, Juneau, Alaska
Templin, W.D	Alaska Department of Fish and Game, Anchorage, AK
Thorne, M	Children's Hospital Boston, Boston, MA
Trudel, M.	Division of Fisheries and Oceans, Canada
Vollenweider, J	National Marine Fisheries Service, Juneau, AK
Vulstek, S.C	National Marine Fisheries Service, Juneau, AK
Wildes, S.L	National Marine Fisheries Service, Juneau, AK
Zon, L.	Children's Hospital Boston, Boston, MA

CURRICULUM VITAE

Sharon Wildes

Current Position: Research Fisheries Geneticist

Address: Ted Stevens Marine Research Institute
Alaska Fisheries Science Center
National Marine Fisheries Service/NOAA
17109 Point Lena Loop Rd.
Juneau, AK 99801
Phone: 907-789-6081
Email: Sharon.Wildes@noaa.gov

Education:

B. S., Biology, emphasis on Genetics, Hiram College, Hiram, Ohio, 1987.
Graduate Coursework at University of Alaska
- Russian Language I and II, 1992, 1993
- Fisheries Genetics, 1992
- Vascular Plants of Southeast AK, 1991
- Natural History of Alaska, 1990

Graduate Coursework at Case Western Reserve University
- Spanish I and II, 1986, 1987.
- Mammalian Physiology, 1988

Employment:

Research Assistant, Cleveland Metro General Hospital and Case Western Reserve University, 1987-1989. Investigated human neuropathological afflictions.
Research Geneticist, Auke Bay Labs, 1990-present. Population genetics, stock composition analyses, species identification.

Service:

Juneau Federal Employee of the year 1995.
Chair and proceedings editor, 19th N.E. Pacific pink and chum workshop 1999.
Science Outreach- Elementary to University- 1987-present.

Current Research Activities:

mtDNA barcoding of pacific sand lance and analysis of sequence data for species identification.
Species identification of rougheye/blackspotted rockfish complex using SNP and microsatellite markers.
Microsatellite development of Arctic cod
Examination of microsatellite frequencies for Arctic cod and capelin
Microsatellite development of Pacific sleeper sharks
mtDNA sequence evaluation of Pacific sleeper sharks in the Bering Sea and Gulf of Alaska

Publications:

Wildes, S.L., J.W. Orr, Y. Kai, N. Raring, T. Nakabo, O. Katugin, and J. Guyon. Systematics of North Pacific sand lances of the genus *Ammodytes* based on molecular and morphological evidence, with the description of a new species from Japan. In Prep.

Liu, J.X., A. Tatarenkov, T.D. Beacham, V. Gorbachev, **S. Wildes**, and J. Avise. 2011. Effects of Pleistocene climatic fluctuations on the phylogeographic and demographic histories of Pacific herring (Clupea pallasii). Mol. Ecol. 20:3879-3893.

Wildes, S.L., J.J. Vollenweider, H.V. Nguyen and J.R. Guyon. 2011. Genetic variation between outer-coastal and fjord populations of Pacific herring *(Clupea pallasi)* in the eastern Gulf of Alaska. Fishery Bulletin 109:382-393.

Orr, J. W., and **S. L. Hawkins**. 2008. Species of the rougheye rockfish complex: resurrection of *Sebastes melanostictus* (Matsubara, 1934) and a redescription of *Sebastes aleutianus* (Jordan and Evermann, 1898) (Teleostei: Scorpaeniformes). Fishery Bulletin 106(2):111-134.

Hawkins, S.L., L., J. Heifetz, C. M. Kondzela, J. E. Pohl, R. Wilmot, O. N. Katugin, and V. N. Tuponogov (2005). Genetic variation of rougheye rockfish (*Sebastes aleutianus*) and shortraker rockfish (*S. borealis*) inferred from allozymes. Fish. Bull. 103:524-535.

Hawkins, S. L., N. V. Varnavskaya, E.A. Matzak, V. V. Efremov, C. M. Guthrie III, R. L. Wilmot, H. Mayama, F. Yamazaki, and A. J. Gharrett (2002). Population structure of odd-broodline Asian pink salmon and its contrast to the even-broodline structure. Journal of Fish Biology 60, 370-388.

Collaborators/coauthors within last 4 years:

Canino, Dr. Mike, Alaska Fisheries Science Center, Seattle, WA
Guthrie, Charles, Alaska Fisheries Science Center, Auke Bay Lab, Juneau, AK
Guyon, Dr. Jeffery, Alaska Fisheries Science Center, Auke Bay Lab, Juneau, AK
Heifetz, Dr. Jon, Alaska Fisheries Science Center, Auke Bay Lab, Juneau, AK
Kai, Dr. Yoshiaki, Kyoto University, Japan
Katugin, Dr. Oleg, Russian Academy of Science, Vladivostok, Russia
Knoth, Brian, Alaska Fisheries Science Center, Kodiak, AK
Kondzela, Dr. Christine, Alaska Fisheries Science Center, Auke Bay Lab, Juneau, AK
Nakabo, T., Kyoto University, Japan
Nelson, Dr. R. John, Seastar Biotech, Victoria BC, Canada
Orr, Dr. Jay, Alaska Fisheries Science Center, Seattle, WA
Raring, Nate, Alaska Fisheries Science Center, Seattle, WA
Schwenke, Piper, Northwest Fisheries Science Center, WA
Vollenweider, Johanna, Alaska Fisheries Science Center, Auke Bay Lab, Juneau, AK
Wilmot, Dr. Richard, Alaska Fisheries Science Center, Auke Bay Lab, Juneau, AK

IV. SCHEDULE

A. Project Milestones

Objective 1. To identify population structure of herring in Prince William Sound.
To be met by September 2017

B. Measurable Project Tasks

FY 14, 1st quarter (February 1 – May 31, 2014)
February, 2014 *Project funding available*

FY 14, 2nd quarter (June 1, 2014-August 30, 2014)
Finalize samples to analyze, Isolate DNA

FY 14, 3rd quarter (September 1, 2014-November 30, 2014)
Begin collection of microsatellite data

FY 14, 4th quarter (December 1, 2015 – January 31, 2015)
Continue collection of microsatellite data

V. BUDGET

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