

ATTACHMENT B. Annual Project Report Form (Revised 11.21.19)

1. Project Number:

19160111-F

2. Project Title:

Herring Program – ASL Study and Aerial Milt Surveys

3. Principal Investigator(s) Names:

Stormy Haught – Alaska Department of Fish and Game

4. Time Period Covered by the Report:

February 1, 2019-January 31, 2020

5. Date of Report:

March 2020

6. Project Website (if applicable):

<https://pwssc.org/herring/>

7. Summary of Work Performed:

The Alaska Department of Fish and Game (ADF&G) was funded for this project to conduct herring aerial surveys and to sample herring for age, sex, size, and sexual maturity (ASL). In addition to these two over-arching objectives, this project plays a central role in coordinating and collaborating survey and sampling efforts with all Herring Research and Monitoring (HRM) projects. We provide the R/V Solstice as a research platform, collect herring samples for multiple projects, provide logistical support for field work, travel, and sample shipment, and disseminate aerial and vessel survey observations in a timely manner. Spring aerial herring surveys and ASL sampling have been conducted by ADF&G in Prince William Sound since the early 1970s. These two datasets are the longest continuous time-series records of herring in Prince William Sound and as such are critical inputs to age structured modeling and stock assessment efforts, and provide a basis for understanding the population dynamics, changing biomass, and biological processes that are happening in the population. Funding provided by the *Exxon Valdez* Oil Spill Trustee Council allows ADF&G to continue to conduct these surveys and collections and provides continuity for these two long-term datasets. Overall, this critical project serves as a foundation to the HRM program and directly assists, coordinates, or provides data and/or samples to every project within the HRM program.

We conducted 58 hours of spring aerial surveys of Prince William Sound during 19 flights from March 19 to May 3, 2019. The number of survey flights and total flight hours in 2019 were above 1997-2018 averages (Table 1). Herring data collected included location and linear extent of herring milt by flight, classification of herring milt (intensity), and herring school biomass. Data collected on other species included observations on the distribution and abundance of birds, sealions, and other marine mammals. We observed 12.7 mile-days of spawn in 2019, the most since 2015 (Fig. 1). In addition, we integrated all current and past aerial survey data (flight tracks, spawn extents, bird/mammal observations) into a Geodatabase in ArcGIS.

Table 1. Prince William Sound herring aerial survey effort 1997-2018

	Number of Flights	Average Hours Per Flight	Total Hours of Flight Time
1997	12	3.3	33.1
1998	15	3.7	40.9
1999	14	3.6	42.9
2000	8	2.9	20.4
2001	11	2.4	26.4
2002	8	2.3	11.3
2003	10	2.3	15.8
2004	6	2.8	14.0
2005	10	3.2	16.1
2006	12	3.3	40.0
2007	15	2.6	36.3
2008	15	3.4	50.9
2009	17	2.6	39.0
2010	21	2.6	55.1
2011	13	2.7	35.7
2012	17	2.2	38.2
2013	19	1.8	35.0
2014	16	2.0	31.4
2015	19	2.0	38.4
2016	14	2.1	29.3
2017	22	2.7	58.6
2018	12	3.2	38.9
2019	19	3.1	58.2
1997-2018 Average	15	2.7	33.7

We conducted R/V Solstice-based herring sampling surveys from April 3 to April 10, 2019. During vessel surveys of Prince William Sound, we collected herring samples with purse seine near Hinchinbrook Island at Double Bay (April 5), Canoe Pass (April 6), and Whiskey Cove (April 6), and near Montague island at Rocky Bay (April 7). We processed and summarized ASL data (Fig. 2) from over 2,600 herring collected during vessel surveys in 2019. These samples included herring sampled for this project as well as other HRM projects including disease studies. Herring age compositions in 2019 were dominated by the 3-year-old age class, which composed 84% of fish sampled, the largest single-age contribution to Prince William Sound spring herring age structure on record. The trend of declining size at age in recent years continued in 2019 for age-3, -5, -6, -7, and -8 fish, with record low length at age documented for ages > 4.

This work is performed by ADF&G commercial fisheries research and management personnel. The results of both the aerial surveys and age/size structure are critical to the management of herring commercial fisheries in Prince William Sound. The estimates of aerial biomass as well as acoustic biomass and age structured assessment model outputs are central in evaluating the population in relation to regulatory thresholds set in the Prince William Sound Herring Management Plan (5 AAC 27.365). Results of these surveys are disseminated to all relevant ADF&G commercial fisheries management and research staff.

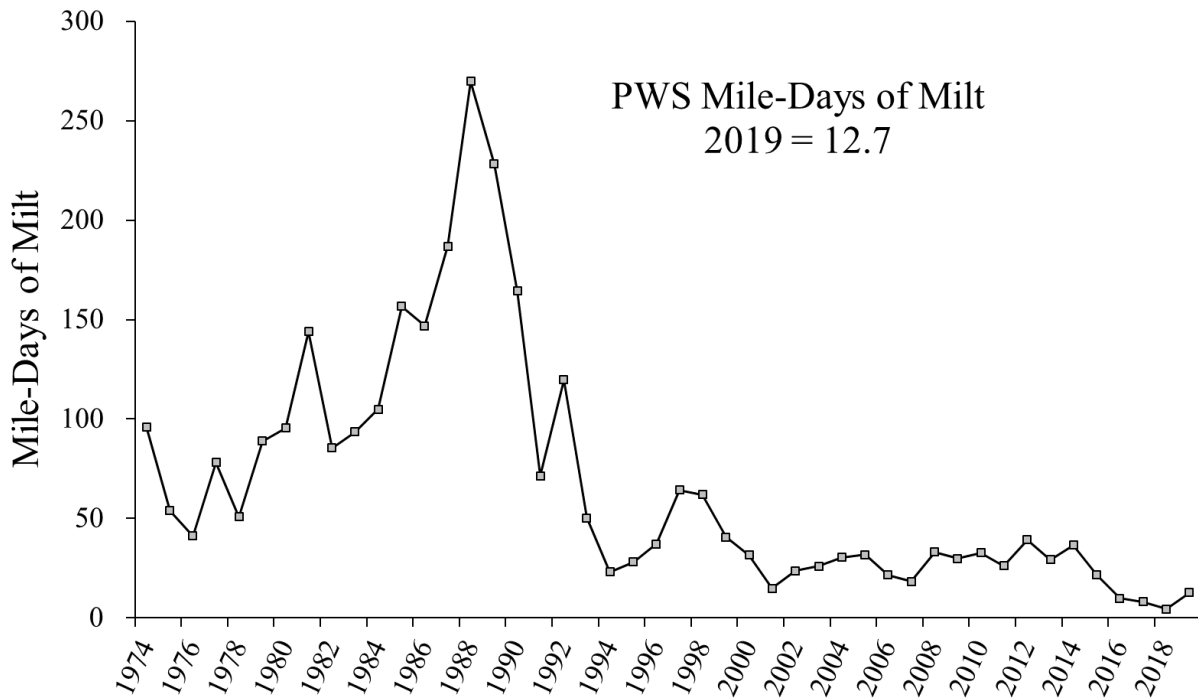


Figure 1. Prince William Sound (PWS) mile-days of herring milt observed during aerial surveys 1974-2019.

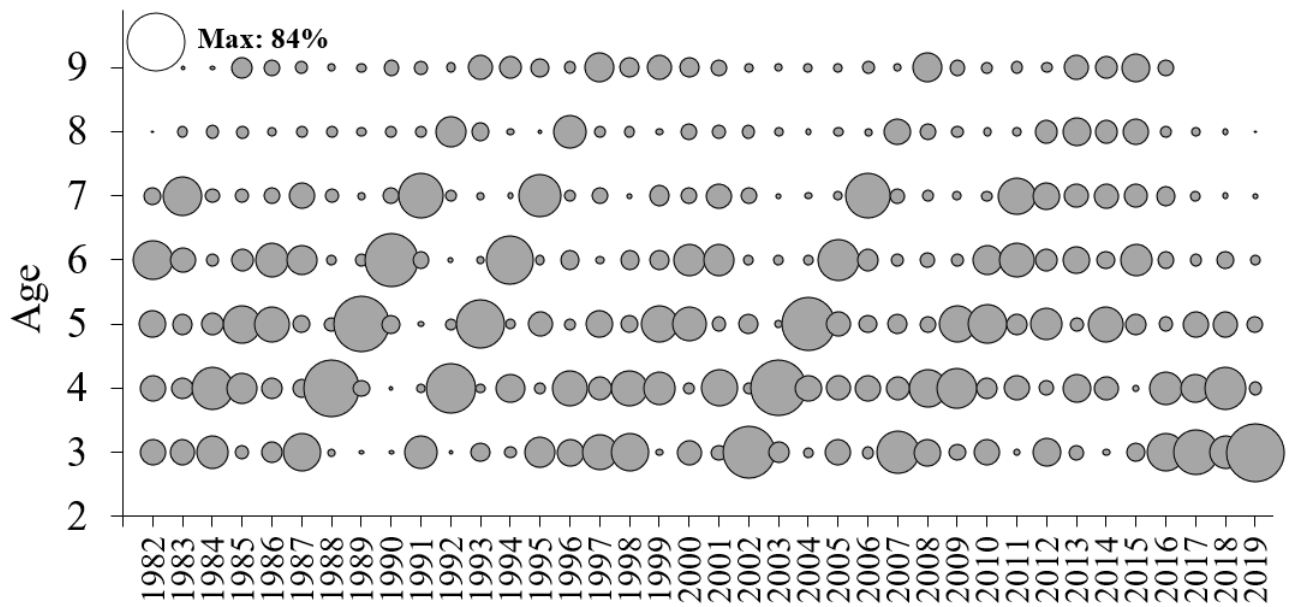


Figure 2. Spring Prince William Sound herring age composition by year 1982-2019.

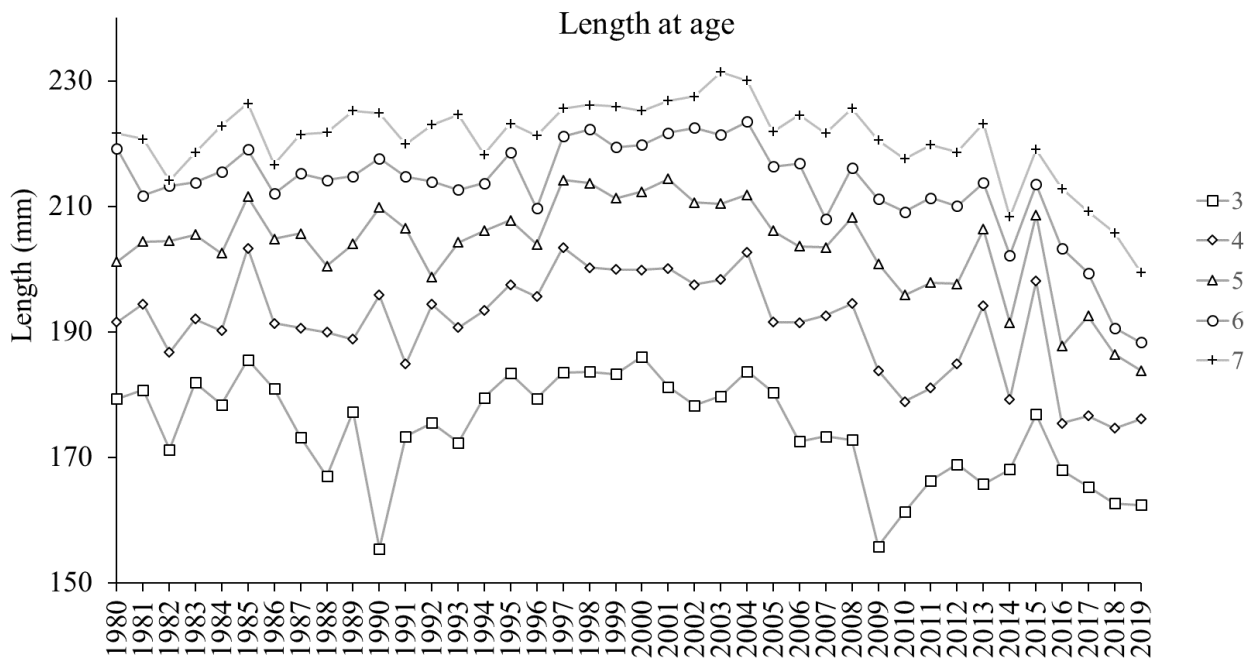


Figure 3. Spring Prince William Sound herring length at age 1980-2019.

8. Coordination/Collaboration:

A. Long-term Monitoring and Research Program Projects

1. Within the Program

This project coordinated and collaborated with all HRM projects. We provided daily aerial survey results and boat-based observations to all field programs. We provided the R/V Solstice (as well as ADF&G personnel) as a research platform for disease sampling (project 18120111-E), and reproductive maturity sampling (18170111-D). We aged ~400 herring, collected gonad samples, and provided transport logistics for the disease project (project 18120111-E). We provided 2018 herring ASL results to the adult acoustics survey (project 18120111-G) and provided aerial survey and ASL results to the modeling and stock assessment project (project 18120111-C).

2. Across Programs

a. Gulf Watch Alaska

We provided aerial mile-days of milt and biomass datasets to Gulf Watch Alaska's humpback whale project (19120114-O) to explore relationships with humpback whale abundance.

b. Data Management

This project provided updates for all aerial survey and ASL datasets including spatial data (ArcGIS files) to the Data Management program for dissemination to other researchers.

B. Individual Projects

N/A

C. With Trustee or Management Agencies

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We contribute timeseries indicators to the National Oceanic and Atmospheric Administration's Gulf of Alaska Ecosystem Status Report to the North Pacific Fisheries Management Council for 2019 (Zador et al. 2019, <https://access.afsc.noaa.gov/REFM/REEM/ecoweb/index.php>).

9. Information and Data Transfer:

A. Publications Produced During the Reporting Period

1. Peer-reviewed Publications

McGowan D.W., T.A. Branch, S. Haught, and Scheuerell. (In Prep). Multi-decadal shifts in the distribution and timing of Pacific herring (*Clupea pallasii*) spawning in Prince William Sound, Alaska.

2. Reports

Arimitsu, M., J. Piatt, R.M. Suryan, S. Batten, M.A. Bishop, R.W. Campbell, H. Coletti, D. Cushing, K. Gorman, S. Hatch, S. Haught, R.R. Hopcroft, K.J. Kuletz, C. Marsteller, C. McKinstry, D. McGowan, J. Moran, R.S. Pegau, A. Schaefer, S. Schoen, J. Straley, and V.R. von Biela. 2019. Chapter 3 Synchronous collapse of forage species disrupts trophic transfer during a prolonged marine heatwave. In M.R. Suryan, M.R. Lindeberg, and D.R. Aderhold, eds. The Pacific Marine Heatwave: Monitoring During a Major Perturbation in the Gulf of Alaska. Gulf Watch Alaska Long-Term Monitoring Program Draft Synthesis Report (*Exxon Valdez* Oil Spill Trustee Council Program 19120114). *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Haught, S. 2019. ASL Study and Aerial Milt Surveys. FY18 annual report to the *Exxon Valdez* Oil Spill Trustee Council, project 18160111-F. *Exxon Valdez* Oil Spill Trustee Council, Anchorage, AK.

Haught, S. W.S. Pegau, and P. Rand. 2019. Chapter 1 PWS herring survey designs. In, W.S. Pegau and D.R. Aderhold, editors. Herring Research and Monitoring Science Synthesis. Herring Research and Monitoring Synthesis Report, (*Exxon Valdez* Oil Spill Trustee Council Program 20120111). *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

McGowan, D.W., T.A. Branch, S. Haught, and M. Scheuerell. 2019. Chapter 3 Multi-decadal shifts in the distribution and timing of Pacific herring spawning in Prince William Sound, Alaska. In, W.S. Pegau and D.R. Aderhold, editors. Herring Research and Monitoring Science Synthesis. Herring Research and Monitoring Synthesis Report, (*Exxon Valdez* Oil Spill Trustee Council Program 20120111). *Exxon Valdez* Oil Spill Trustee Council, Anchorage, Alaska.

Pegau, S.W., J. Trochta, and S. Haught. 2018. Prince William Sound Herring. Pages 84-88 [In] S. Zador and E. Yasumiishi, editors. Ecosystem Status Report 2018, Gulf of Alaska. North Pacific Fisheries Management Council Stock Assessment and Fishery Evaluation Report 2018, Anchorage.

Shepherd, C.S., and S. Haught. 2019. Pacific herring aerial surveys and age, sex, and size processing in the Prince William Sound Area, 2018–2021. Alaska Department of Fish and Game, Regional Operational Plan ROP.CF.2A.2019.05, Cordova.

Vega, S. L., C.W. Russell, J. Botz, and S. Haught. (In Press). 2018 Prince William Sound area finfish management report. Alaska Department of Fish and Game, Fishery Management Report No. XX-XX, Anchorage.

Vega, S.L., C.W. Russell, J. Botz, and S. Haught. 2019. 2017 Prince William Sound area finfish management report. Alaska Department of Fish and Game, Fishery Management Report No. 19-07, Anchorage.

3. Popular articles

Haught, S. 2019. Mile Days of Milt. Delta Sound Connections. Prince William Sound Science Center (https://pwssc.org/wp-content/uploads/2019/05/DSC-2019_WEB.pdf).

B. Dates and Locations of any Conference or Workshop Presentations where EVOSTC-funded Work was Presented

1. Conferences and Workshops

Haught, S. 2019. Prince William Sound herring spawn and ASL, 2019. Oral presentation, Herring Research and Monitoring 2019 PI meeting, Homer, AK, October 10, 2019

2. Public presentations

N/A

C. Data and/or Information Products Developed During the Reporting Period, if Applicable

Data and information products developed during the reporting period include: 2019 individual aerial survey maps (distributed to HRM participants, other herring researchers, and a variety of stakeholders within 24hrs of survey), 2008-2019 aerial herring biomass observations shapefiles, 1973-2019 aerial herring spawn observations shapefiles, 1997-2019 herring aerial survey routes shapefiles, 2008-2019 aerial survey marine bird observations shapefiles, 2008-2019 aerial survey marine mammal observations shapefiles, 2008-2019 aerial survey sea lion observations shapefiles, ASL database updated through 2019, and age structure and size at age summaries by sample and overall (pooled).

D. Data Sets and Associated Metadata that have been Uploaded to the Program's Data Portal

Data sets and associated metadata that have been uploaded to the Gulf of Alaska Data Portal include: 2019 aerial survey maps, 2008-2019 aerial herring biomass observations shapefiles, 1973-2019 aerial herring spawn observations shapefiles, 1997-2019 herring aerial survey routes shapefiles, 2008-2019 aerial survey marine bird observations shapefiles, 2008-2019 aerial survey marine mammal observations shapefiles, 2008-2019 aerial survey sea lion observations, 2014-2019 herring ASL data.

10. Response to EVOSTC Review, Recommendations and Comments:

EVOSTC Science Panel Comment. The Science Panel appreciates the substantial effort involved in this work and the quality of this proposal. We especially want to acknowledge and express appreciation for the inclusion of retrospective data summaries, as shown in Figures 1-4. We further recognize that this work is fundamentally important for all of the herring projects. We note

specifically the comment that weather impacted aerial survey efforts in 2018 (39.5 hours in 2018) and also that 2018 represented an “historical low” for the estimated mile-days of spawn. Did the adverse weather and low sampling effort contribute to the low estimate?

In view of the vital importance of this estimate of spawn we wondered if the PI had concerns about the adequacy of the survey effort. Specifically, was it limited by resources?

PI Response (10/31/18). 2018 survey efforts were limited by the unusual prevalence of poor visibility and/or high wind flight conditions. Funding, staff availability, and pilot/aircraft availability were adequate in 2018.

EVOSTC Science Panel Comment. We also suggest that any further retrospective information about the aerial surveys, especially any data regarding the spatial coverage and temporal frequency and duration of flights could be useful for future analyses, particularly with reference to potential changes in herring distributions. Can and or should the mile-days reported be standardized by sampling effort?

PI Response (10/31/18). Temporal and spatial data exists for historical surveys and a detailed spatial analysis of survey routes could be informative. The estimates generated by the aerial surveys were designed to be an index of relative abundance, comparable across the historical time series. As such, it is important to keep survey methods as consistent as possible to retain comparability among years. Unless a clear benefit was apparent, we would not support weighting mile-days of milt estimates by survey effort.

EVOSTC Science Panel Comment. To reiterate we strongly encourage support for adequate survey effort to verify that the observed reduced spawn extent isn’t an artifact of reduced survey coverage - and to ensure that major spawning is not missed. As with some other field sampling projects in the HRM program, the Science Panel is concerned that sampling effort is adequate to make population-level inferences.

PI Response (10/31/18). Aerial surveys can only occur during Visual Flight Rules conditions as weather conditions allow. We fly when the weather allows. Estimates of mile-days of milt should be considered an index, and the surveys were designed to provide an estimate of relative abundance comparable across the historical time series. As such, changes in the method should be avoided if possible to retain the comparability of these estimates. Linear regression, using number of surveys (x) vs. mile-days of milt (y) shows a highly significant positive relationship when applied the entire time series (1973-2018). High numbers of surveys were flown 1981-1992, coinciding with high estimates of mile-days of milt during the same period.

11. Budget:

Budget Category:			Proposed FY 17	Proposed FY 18	Proposed FY 19	Proposed FY 20	Proposed FY 21	TOTAL PROPOSED	ACTUAL CUMULATIVE
Personnel			\$54.5	\$54.5	\$54.5	\$54.5	\$54.5	\$272.5	\$239.8
Travel			\$1.4	\$1.4	\$1.4	\$1.4	\$1.4	\$6.8	\$1.5
Contractual			\$94.6	\$94.6	\$94.6	\$94.6	\$94.6	\$473.0	\$94.2
Commodities			\$2.1	\$2.1	\$2.1	\$2.1	\$2.1	\$10.5	\$37.4
Equipment			\$0.0	\$0.0	\$0.0	\$0.0	\$1.5	\$1.5	
		SUBTOTAL	\$152.6	\$152.6	\$152.6	\$152.6	\$154.1	\$764.3	\$372.9
General Administration (9% of			\$13.7	\$13.7	\$13.7	\$13.7	\$13.9	\$68.8	N/A
		PROJECT TOTAL	\$166.3	\$166.3	\$166.3	\$166.3	\$167.9	\$833.1	
Other Resources (Cost Share Funds)			\$54.5	\$54.5	\$54.5	\$54.5	\$54.5	\$272.5	