

1. Program Number:

18160111-F

2. Project Title:

Herring Program – ASL Study and Aerial Milt Surveys

3. Principal Investigator(s) Names:

Stormy Haught

4. Time Period Covered by the Report:

February 1, 2018-January 31, 2019

5. Date of Report:

April 2019

6. Project Website (if applicable):<http://pwssc.org/herring-research-and-monitoring/>**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 overarching 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 39 hours of spring aerial surveys of Prince William Sound during 12 flights from March 24 to April 19, 2018. The number of survey flights in 2018 was slightly below the 1997-2017 average, while the overall flight time was slightly above the 1997-2017 average (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 4.52 mile days of spawn in 2018, the lowest on record (1973-2018, 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.

We conducted R/V Solstice-based herring sampling surveys from April 6 to April 17, 2018. During vessel surveys of Prince William Sound, we collected herring samples with purse seine at Hell’s Hole (April 11), Cedar Bay (April 12) and Rocky Bay (April 13), and with cast net during spawning events at Read Head (April 7) and Canoe Pass (April 17). We processed and summarized ASL data (Fig. 2) from over 2,600 herring collected during vessel surveys in 2018. These samples included herring sampled for this project as well as other HRM projects including disease and reproduction/maturity studies. ADF&G provided the R/V Solstice as a research platform for reproduction/maturity and disease projects and collected pre-spawn and spawning Pacific herring for other HRM projects.

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.

In fall 2018 we began a review of herring scale age interpretations from years 2013 to 2016 in light of unusual patterns in size at age during these years (Fig. 3). We re-read subsamples of these years and found good overall reader agreement with the original agers (~80%). However, we did identify an unusual pattern of tightly spaced annuli in some age 5+ fish, formed around 2013 (marks 4 and 5 in Fig. 4). Scales that display this pattern have poor agreement between past and current readers. Collaborative discussions with highly experienced herring agers from ADF&G offices in Cordova, Juneau, Anchorage, and King Salmon as well as Prince William Sound Science Center staff are ongoing. Changes to age compositions and size at age averages for age 5+ fish will likely be minor, but this work will require that the ASL database be updated for these years. We have coordinated with the data management project to update 2013-2016 ASL data once this work is complete. Currently, we have re-read all 2014 and 2015 samples with 2013 and 2016 to be re-read by December 2019.

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

	Number of Flights	Average Hours Per Flight	Total Hours of Flight Time
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
<hr/>			
1997-2017			
Average	14	2.7	33.7

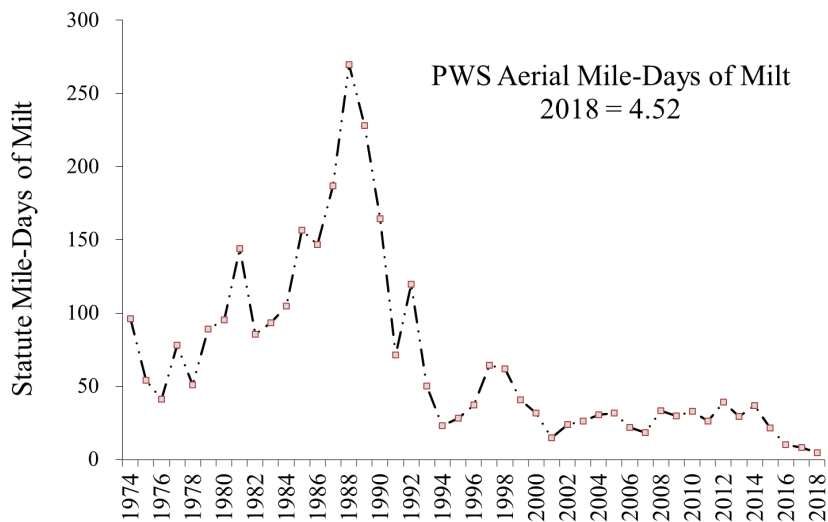


Figure 1. Prince William Sound mile-days of herring milt observed during aerial surveys 1973-2018.

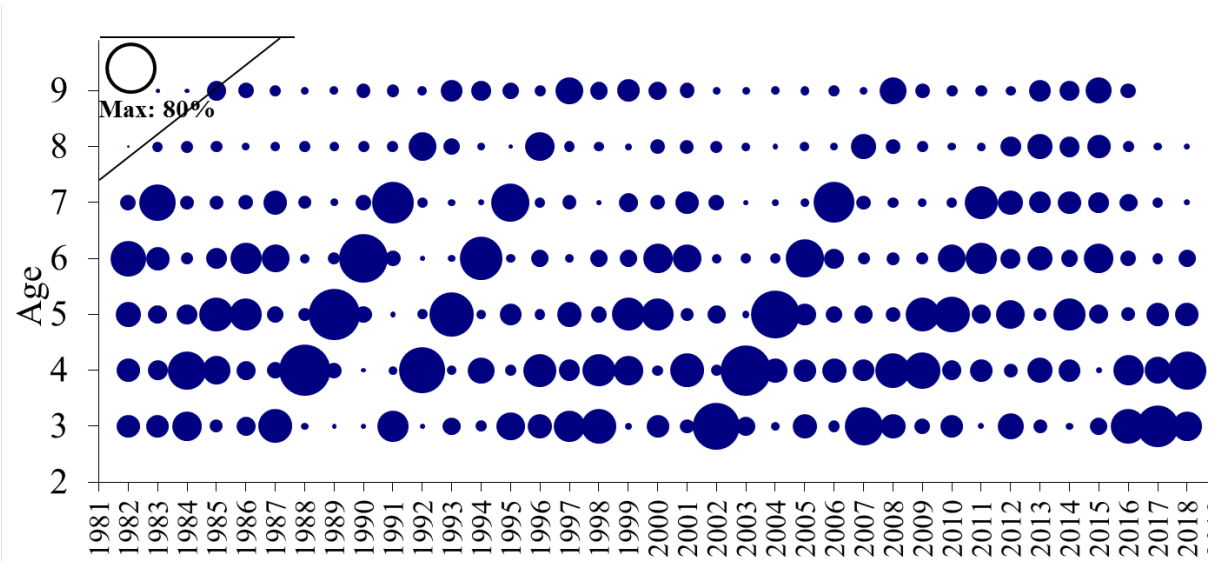


Figure 2. Spring Prince William Sound herring age composition by year 1982-2018, all gear types combined.

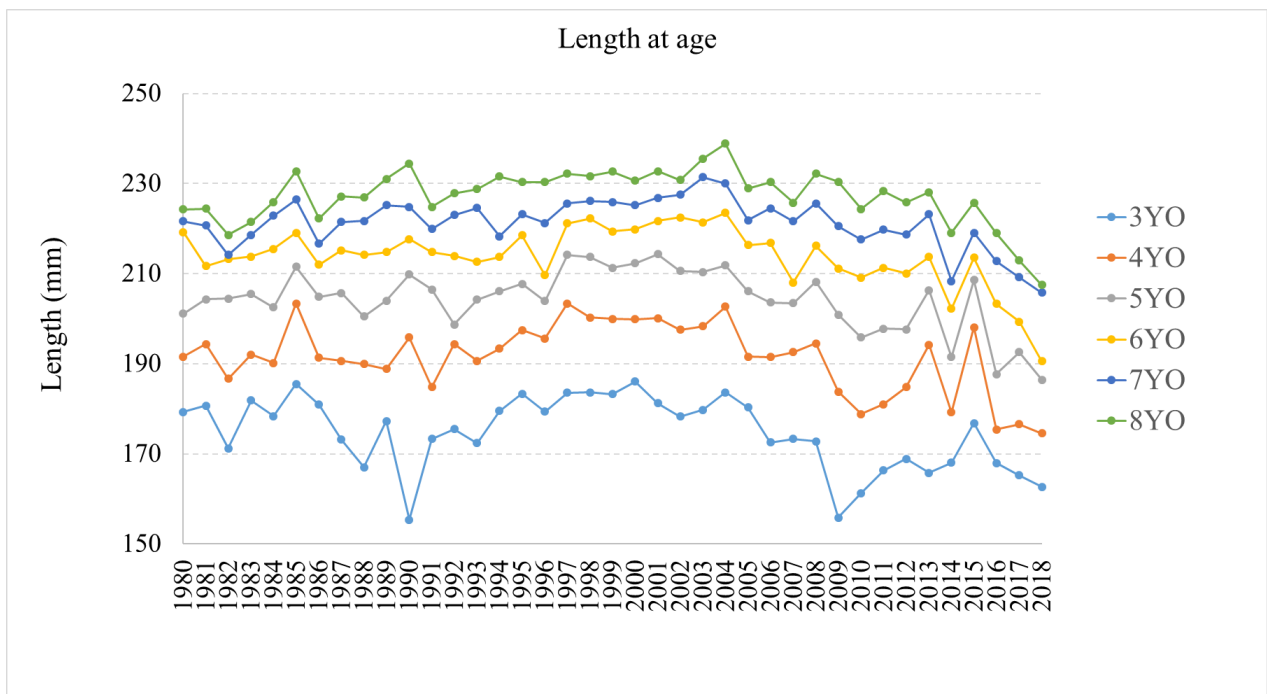


Figure 3. Spring Prince William Sound herring length at age 1980-2018, all gear types combined.

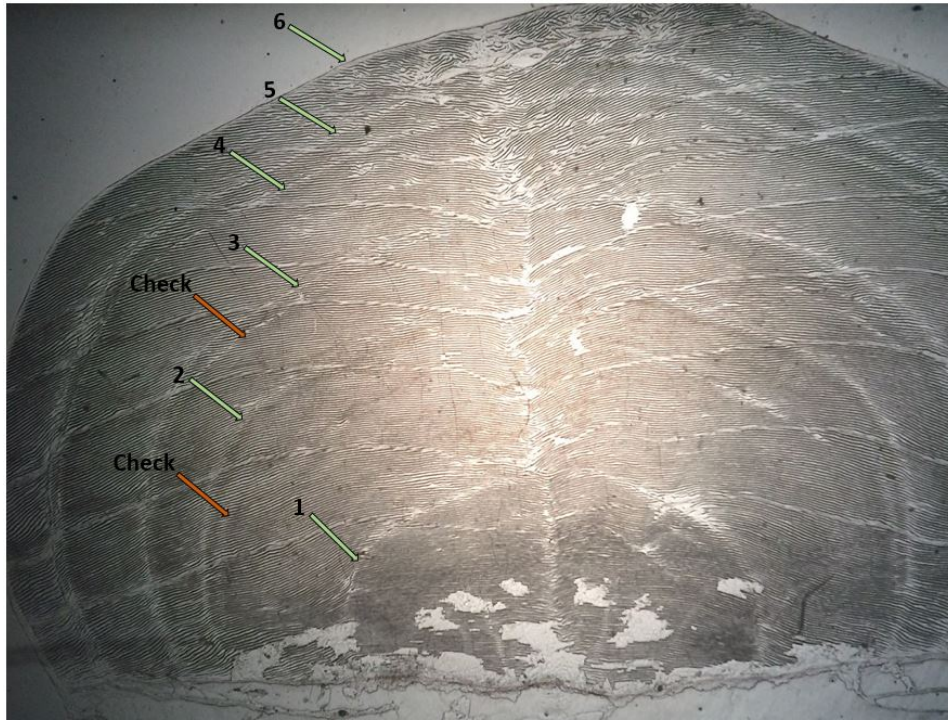


Figure 4. 2015 Prince William Sound herring scale showing unusual pattern of tightly spaced annuli (marks 4 and 5).

8. Coordination/Collaboration:

A. Projects Within a Trustee Council-funded program

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, Hershberger), and reproductive maturity sampling (project 18170111-D, Gorman). We aged ~400 herring, collected gonad samples, and provided transport logistics for the disease project (project 18120111-E, Hershberger). We also provided a small number of samples (seine captured herring) to the herring migration project (project 18120111-B, Bishop). Finally, we provided 2018 herring ASL results to the adult acoustics survey (project 18120111-G, Rand) and provided aerial survey and ASL results to the modeling and stock assessment project (project 18120111-C, Branch).

2. Across Programs

a. Gulf Watch Alaska

We provided aerial mile-days of milt and biomass datasets to Gulf Watch Alaska project 18120114-O (Moran and Straley) in order to explore relationships with humpback whale abundance.

b. Data Management

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

c. Lingering Oil

N/A

B. Projects not Within a Trustee Council-funded program

These data are regularly requested and provided to academic researchers and others outside of the HRM project. There is much interest in the Prince William Sound herring population from the general public and other stakeholders (including permit holders); ADF&G provides these data upon request.

C. With Trustee or Management Agencies

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 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.

9. Information and Data Transfer:

A. Publications Produced During the Reporting Period

Vega, S. L., C. W. Russell, J. Botz, and S. Haught. (in Press). 2017 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. (In Prep). 2018 Prince William Sound area finfish management report. Alaska Department of Fish and Game, Fishery Management Report No. XX-XX, Anchorage.

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

Oral presentation, Herring Research and Monitoring PI meeting, Anchorage, AK, November 14, 2018

Oral presentation, Prince William Sound Science Center Tuesday Night Talk, Cordova, AK, December 18, 2018

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

Data and information products developed during the reporting period include: 2018 individual aerial survey maps (distributed to HRM participants, other herring researchers, and a variety of stakeholders within 24hrs of survey), 2008-2018 aerial herring biomass observations shapefiles, 1973-2018 aerial herring spawn observations shapefiles, 1997-2018 herring aerial survey routes shapefiles, 2008-2018 aerial survey marine bird observations shapefiles, 2008-2018 aerial survey marine mammal observations shapefiles, 2008-2018 aerial survey sea lion observations shapefiles, ASL database updated through 2018, 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 Data Portal include: 2018 aerial survey maps, 2008-2018 aerial herring biomass observations shapefiles, 1973-2018 aerial herring spawn observations shapefiles, 1997-2018 herring aerial survey routes shapefiles, 2008-2018 aerial survey marine bird observations shapefiles, 2008-2018 aerial survey marine mammal observations shapefiles, 2008-2018 aerial survey sea lion observations, 2014-2018 herring ASL data.

10. Response to EVOSTC Review, Recommendations and Comments:

FY18 Science Panel Comments: “The Panel appreciates the support this proposal provides to the entire herring program...This proposal seems to one that provides important technical services to the herring program as well as to ADF&G...This text is also very ‘Alaska-centric’ – and almost appears defensive of existing approaches and methodology. A case in point concerns the use of ‘mile-days’ as the fisheries-independent index of herring abundance. This usage should be examined, both within, and outside of the context of the assessment model. There may be valid, biological reasons why ‘mile days’ could tend to inflate estimates of escapement, depending on the circumstances. This comment should not be taken as a criticism of this proposal, but applied to the entire herring program. The metric of spawning is fundamental to PWS herring and it warrants more attention – especially analyses of spatial and temporal variability, combined with herring population characteristics (size, age, etc.)...”

Although we agree that mile-days of milt could tend to inflate estimates of “escapement” in some scenarios, the use of mile-days of milt as an index of herring abundance was implemented due to the shortcomings of other aerially observable indices. Aerial estimates of biomass, for example, have been used in Prince William Sound to document spring herring abundance since the early 1970’s and were the primary management tool prior to the development of the first statistical catch-at-age model or age structured assessment model (ASA) in 1988 (Brady 1987, Funk and Sandone 1990). However, the variable bathymetry of PWS herring spawning areas has a large influence on the ability to observe herring schools (Brady 1987). The influence of bathymetry on observer efficiency makes a biomass index less likely to be comparable across years than a milt index. In addition to generally not being influenced by bathymetry, milt observations have advantages over biomass observations because herring schools likely spawn a single time, but a herring school may be observed for many days prior to, or after spawning, and milt is relatively easy to observe from the air.

Two indices considered for spawn documented from aerial surveys are discrete miles of milt over the season and the sum of miles of milt for all survey days (mile-days of milt). Discrete miles of milt do not account for multiple spawning events in the same area, so are unlikely to be a good index of total abundance in areas with multiple spawning event days on the same beach (Brady 1987). In recent years, spawning has primarily occurred in two locations, each with multiple spawning events per year. In our current scenario, mile-days of milt likely provide a better index to abundance as they account for multiple spawning events on the same beach.

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	\$95.6
Travel	\$1.4	\$1.4	\$1.4	\$1.4	\$1.4	\$6.8	\$0.5
Contractual	\$94.6	\$94.6	\$94.6	\$94.6	\$94.6	\$473.0	\$61.0
Commodities	\$2.1	\$2.1	\$2.1	\$2.1	\$2.1	\$10.5	\$29.3
Equipment	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$0.0	\$3.1
SUBTOTAL	\$152.6	\$152.6	\$152.6	\$152.6	\$152.6	\$762.8	\$189.5
General Administration (9% of subtotal)	\$13.7	\$13.7	\$13.7	\$13.7	\$13.7	\$68.7	N/A
PROJECT TOTAL	\$166.3	\$166.3	\$166.3	\$166.3	\$166.3	\$831.5	
Other Resources (Cost Share Funds)	\$54.5	\$54.5	\$54.5	\$54.5	\$54.5	\$272.5	