FY 22-31 *PROJECT* PROPOSAL
LONG-TERM RESEARCH AND MONITORING PROGRAM

Does this proposal contain confidential information? ☐Yes ☒No

Project Number and Title

Gulf Watch Alaska Long-Term Research and Monitoring Program: Herring Research & Monitoring Component

22170111-F Surveys and age, sex, and size collection and processing

Primary Investigator(s) and Affiliation(s)

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Date Proposal Submitted

August 13, 2021

Project Abstract (maximum 300 words)

The proposed project will conduct spring aerial surveys to document Pacific herring milt distribution and biomass as well as the distribution and abundance of sea lions, other marine mammals, and birds associated with herring schools or spawn. This proposed project will also provide a research platform (R/V Solstice) for an adult herring disease sample collection and processing. Finally, this proposed project will collect and process age, sex, and size samples of herring collected by the acoustics survey, spawning surveys, and disease sampling. Aerial survey and age, sex, and size data have been collected since the early 1970s and are an essential part of the age-structured models used by the Alaska Department of Fish and Game to estimate the historical and future biomass for fisheries management. This project will help to meet the overall program goals of providing sound scientific data and products to inform resource managers and the public of changes in herring stocks and in the PWS ecosystem.

EVOSTC Funding Requested (round to the nearest hundred, must include 9% GA)

FY22	FY23	FY24	FY25	FY26	FY22-26 Total
$156,617	$227,363	$194,086	$172,224	$177,807	$928,097
FY27	**FY28**	**FY29**	**FY30**	**FY31**	**FY27-31 Total**
$183,596	$189,592	$195,811	$202,259	$208,946	$980,203
				FY22-31 Total	*$1,908,299*

**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.*

Non-EVOSTC Funds to be used, (round to the nearest hundred) please include source and amount per source:

FY22	FY23	FY24	FY25	FY26	FY22-26 Total
$55,030	$56,405	$57,815	$59,261	$60,742	$289,253
FY27	**FY28**	**FY29**	**FY30**	**FY31**	**FY27-31 Total**
$62,261	$63,817	$65,413	$67,048	$68,724	$327,263
				FY22-31 Total	*$616,516*

Funding is provided for some permanent Alaska Department of Fish and Game staff that work on this project through State of Alaska general fund budgets.

1. EXECUTIVE SUMMARY (maximum ~1500 words, not including figures and tables)

This project will help to meet the overall goals of providing sound scientific data and products to inform resource managers and the public of changes in herring stocks and in the Prince William Sound (PWS) ecosystem. There are no proposed hypotheses to be tested directly from this project; however, this project will continue long-term monitoring programs to 1) conduct aerial surveys to collect data associated with spring Pacific herring (*Clupea pallasii*) spawning events, 2) collect and process age, sex, and size (ASL) samples from prespawn and spawning aggregations of Pacific herring, and 3) provide vessel support for spring disease sampling, and collection and processing of ASL samples for target strength assessment.

Spring aerial survey data have been collected since 1972 (Funk 1994), and spring acoustics surveys have been consistently conducted since 1995 (Willette et al. 1999). ASL data are available since 1973 (Sandone 1988); however, collections of both data sets have been more extensive since the early 1980s. Aerial surveys were used to document spring herring biomass 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). Prior to 1988, the aerial survey program's primary objectives were to collect biomass data for an annual index, document the distribution and linear extent of milt, document herring temporal movements, and document the distribution of commercial fishing boats, fishing tender boats, and processor boats (Brady 1987).

Brady (1987) described how herring arrive on the spawning grounds over time and may be available to document on multiple aerial surveys. Therefore, the biomass over several days of surveys cannot be summed to estimate the total or peak biomass. Consequently, peak biomass was calculated as the largest biomass observed in all areas on a single survey (Brady 1987). Additional biomass with a discrete time separation would also be added, but these conservative methods were required to estimate the peak biomass because the amount of time herring were available to observation by aerial surveys was unknown and likely variable (Funk and Sandone 1990).

Brady (1987) also detailed how the variable bathymetry of herring spawning areas in Prince William Sound has a large influence on the observer's ability to see herring schools. Herring may spawn in shallow bays (e.g., Rocky Bay, Montague Island), shallow beaches (e.g., Hells Hole beach), or deep bays (e.g., Fairmont Bay on the North Shore). The influence of bathymetry on observer efficiency suggests an aerial biomass index will probably not be comparable across years. Although Funk and Sandone (1990) indicated that peak biomass values may be a useful relative abundance, issues with biomass observations described by Brady (1987) and Funk and Sandone

(1990) caused the Alaska Department of Fish and Game (ADF&G) to investigate the use of an index of spawn from observations of milt. The advantages of milt observations compared to school biomass observations are 1) herring schools likely spawn a single time (e.g., a single day), but a herring school may be observed for several days prior to, or after spawning and 2) milt is relatively easy to observe from the air and observation efficiency is generally not influenced by ocean bathymetry (Brady 1987).

Two indices considered for spawn documented from aerial surveys were 1) discrete miles of milt over the season and 2) 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 days of spawning on the same beach (Brady 1987). Mile-days of milt probably provide a better index to abundance because they account for multiple spawning days on the same beach, but may be biased if the number of surveys varies significantly across years (Funk 1994). Additionally, although bathymetry probably will not influence observation of milt, it is likely one factor that will influence the biomass of spawning fish for each linear mile of milt observed. Willette et al. (1999) collected paired spawn deposition survey estimates from dive surveys and aerial survey estimates of miles of milt; the short tons (dive survey) per mile of milt (aerial survey) were much larger on Montague Island beaches when compared to short tons per mile of milt in northern or northeastern PWS beaches. Montague Island shoreline typically has large shallow, subtidal areas with complex kelp structure while the northern and northwestern beaches tend to have a steeper gradient to deep waters and less complex kelp structure.

Funk (1994) used the discrete miles of milt index in his ASA model rather than the mile-days of milt index because there were fewer surveys flown in the early years (1970s). However, subsequent runs of the ASA model have excluded the earlier years and use of the mile-days of mile index.

In 2008 ADF&G began using a tablet computer and a geographic information system (GIS) application to collect aerial survey data (Bochenek 2010). Because digital maps are scalable and allow much more data to be added to a small area (contrast with the 25 paper maps used prior to 2008), and because of interest in herring predator distribution and abundance, additional effort was employed in documenting numbers and locations of predators such as Stellar sea lions, humpback whales, killer whales, Dall's porpoises, and bird aggregations (mostly gulls) associated with herring schools or spawn.

Age, sex, and size data from Pacific herring have been collected from commercial fisheries and fishery independent research projects since the early 1970s. ADF&G currently has an archive containing approximately 210,000 scales paired with size and sex data (most of the archive has been collected since 1979). Summaries of many of these data have been published (e.g., Sandone 1987, Funk and Sandone 1990, Willette et al. 1999). Processing methods are similar those described by Baker et al. (1991); however, electronic fish measuring boards have been used to enter sample summary data and individual fish data (standard length in mm, whole body weight in grams, and sex) at the time of processing since 1989. Gonad weights have been collected from prespawning fish (both sexes) in most years since 1994 (n = 8,500).

Scales are used to estimate age for PWS collections rather than otoliths because they are much easier to collect and prepare for examination. Additionally, Chilton and Stocker (1987) reported that Chi-square tests of age compositions from paired otoliths and scales collected off the British Columbia coast could not refute the null hypothesis that they were from the same population. Interpretation of age from otoliths indicated that there were older fish than interpreted from scales; however, few fish older than age-10 are found in PWS, so fish

interpreted at age-9 and older are combined into an age category 9+. No age validation or tests of paired age structures have been completed for PWS herring.

Mile-days of milt, acoustics estimates, and ASL data sets are essential parts of age structured model ADF&G uses to estimate the historical biomass and project pre-fishery run biomass a year ahead for management (e.g., Hulson et al. 2008). Additionally, the mile-days of milt, acoustics estimates, and ASL data are part of the Bayesian formulation of the ASA model (Muradian 2015, Muradian et al. 2017). This project will conduct aerial surveys to collect data related to spring herring spawning events, provide vessel support for disease sample collections; and capture and process herring to generate age, sex, and size summaries and mean target strength for acoustic biomass estimates.

2. RELEVANCE TO THE INVITATION (maximum 300 words)

The FY22-31 Invitation for Proposals seeks to continue a long-term research and monitoring (LTRM) program that maintains continuity and builds upon the efforts of the previous FY12-16 and FY17-21 cooperative agreements. The projects proposed here are long-term, core herring monitoring projects that provide critical data to other PWS herring projects including modeling, disease, and acoustic biomass efforts, and also inform ADF&G fisheries management. Accepting this proposal will allow the long-term efforts to monitor relative abundance and age and size structure of PWS herring to continue.

The first overarching goal to provide sound scientific data and products that inform management agencies and the public of changes in the environment and the impact of these changes on injured resources is inherent in the projects proposed here. The ADF&G aerial survey and ASL work has historically provided PWS herring fisheries managers with relative abundance and population structure data critical to PWS herring fisheries management. These projects are the longest running and most consistent PWS herring data collection efforts, and as such are integral to the program, and critical to other herring research projects.

The overarching goal to monitor changes in herring stocks, which reflect the status of herring in PWS and also the overall health of the PWS ecosystem is accomplished through the continuation of the aerial survey and ASL projects. The long-term mile-days of milt index as well as the time series of age and size compositions are critical to detecting changes in abundance and population structure. Herring ASL data such as size at age, and aerial observations of predators and marine mammals associated with herring aggregations provide insights into the overall health of the PWS ecosystem.

3. PROJECT HISTORY (maximum 400 words)

This proposal is for continuation of the EVOSTC project 21170111-F. Previously the surveys were supported by ADF&G, but because there is no fishery the surveys were slated to end. Spring aerial survey data have been collected by ADF&G since 1972 (Funk 1994). ASL data are available since 1973 (Sandone 1988); however, collections of both data sets have been more extensive since the early 1980s.

Aerial surveys were used to document spring herring biomass and were the primary management tool prior to the development of the first age structured assessment model (ASA) in 1988 (Brady 1987, Funk and Sandone 1990). Biomass is estimated as school surface area converted to biomass from a few paired observations of aerial observers and vessel harvests (Brady 1987, Fried 1983, Funk and Sandone 1990). Surface area and biomass conversion methods are as described in Brady (1987) and Lebida and Whitmore (1985). Prior to 1988,

the aerial survey program's primary objectives were to collect biomass data for an annual index, document the distribution and linear extent of milt, document herring temporal movements, and document the distribution of the commercial fleet (Brady 1987). Additionally, the locations of large aggregations of Stellar sea lions and other marine mammals were often noted on paper maps.

Age and biomass data from this project as well as the acoustic biomass project are evaluated annually by ADF&G fisheries managers relative to regulatory thresholds in The *Prince William Sound Herring Management Plan* (5 AAC 27.365). A detailed operational plan for PWS herring aerial surveys and ASL work was published in 2019 (Shepherd and Haught 2019).

Summary results and discussion are published annually in PWS Area Finfish Management Reports (Haught et al. 2017, Russell et al. 2017, Vega et al. 2018, Russell et al. 2021, Morella et al. 2021) and in annual and synthesis reports to the *Exxon Valdez* Oil Spill Trustee Council (EVOSTC; e.g., Haught 2020, Pegau and Aderhold 2020). Annual PWS herring summaries are also included in the National Oceanic and Atmospheric Administration Gulf of Alaska Ecosystem Status Report (Pegau et al. 2018, 2019, 2020). Shapefiles of aerial survey observations and ASL tabular data are uploaded to the Research Workspace annually and age and size compositions are disseminated to acoustic biomass, disease, and modeling projects. A historical analysis of shifts in PWS herring spawn timing and distribution using aerial survey and ASL data has been submitted for publication (McGowan et al. 2021).

4. PROJECT DESIGN

A. Objectives and Hypotheses

Data will be collected to meet the overall goals of providing sound scientific data and products to inform resource managers and the public of changes in herring stocks and in the PWS ecosystem. These surveys provide necessary biomass and population structure data to evaluate herring stocks in relation to regulatory thresholds and provide critical inputs to modeling, disease, and acoustic biomass projects. These data will add to data collected since 1972 (aerial surveys) and 1973 (age, sex, and size data) and are critical to both PWS herring fisheries management and ongoing research efforts. Details of this project are also described in Shepherd and Haught 2019.

Objectives of this proposed project are as follows:

1) Conduct spring aerial surveys to collect data on survey routes, location and linear extent of herring milt, classification of herring milt, herring school biomass; distribution and abundance of sea lions, other marine mammals and bird aggregations associated with herring or herring spawn; and other relevant environmental or anthropogenic observations.

2) Collect, process, summarize, and distribute age, sex, and size data from herring collected during acoustics surveys, spawning grounds surveys, *Herring Disease Program* surveys, or other relevant collections.

3) Provide a vessel (R/V Solstice) as a research platform for an adult acoustics survey, disease sampling, and collection of pre-spawn and spawning Pacific herring samples. Mean length from pre-spawn samples will be used to estimate Pacific herring target strength for the acoustics work.

B. Procedural and Scientific Methods

Aerial Surveys

Aerial surveys generally begin in mid- to late March or earlier if there are reports of herring aggregations, spawn, or large predator aggregations. The first survey usually covers the eastern side of Prince William Sound because the spawn timing is generally earlier on the east side (Port Gravina and Port Fidalgo), however the first survey may be expanded based on boat or pilot reports from other areas. Surveys continue once or twice a week until herring schools or spawn are detected by a survey flight or reported by other pilots or boats. Once spawning begins surveys will be conducted daily in the area where spawn is detected if weather conditions are appropriate. Surveys will be expanded to other portions of the PWS area (North shore, Naked Island, Montague Island, and Kayak Island) in April or based on pilot or boat reports. Survey interval, duration, and area are adjusted in-season to allow available funding to last until approximately mid-May.

Surveys are conducted in a float equipped, fixed-wing aircraft flying at an elevation of ~1,200 feet. Primary and secondary observers are used for each flight. The primary observer sits in the back seat and uses a tablet computer to enter survey metadata in a spreadsheet and georeferenced survey data in an ESRI ArcPad application connected to a Bluetooth GPS (Bochenek 2010). The primary observer also attaches a camera to the inside of the back window facing out to collect either video or a still image every 1 or 2 seconds.

The secondary observer sits in the front passenger seat and reports observations to the primary observer, collects observations on paper maps as a hardcopy duplicate in case of digital failure, deploys a handheld GPS as a backup to the Bluetooth capable GPS, and takes georeferenced photos with a GPS-enabled digital single lens reflex (DSLR) camera and fast lens (F2.8) of spawning events, large biomass aggregations, and large herring predator groups.

Measurements made during the survey include estimating the linear extent of milt, estimating the biomass of herring schools from surface area, estimating the number and species of marine mammals at a location, and estimating the number of birds at a location.

Herring spawn activity is located visually through discoloration of water in coastal regions caused by the presence of herring milt (Fig. 1). The linear extent of miles of milt are estimated visually utilizing landmarks, coastal features, and detailed GIS shapefiles and are digitized directly into the ESRI ArcPad file on the survey tablet using a stylus. Spawn activity is assigned a qualitative descriptor based on density and extent of discoloration: active light, active medium, active heavy, dissipating, and drift (Table 1). These categories are recorded in the database associated with the digitized shapefile. Precise estimation for miles of milt are calculated later using ArcGIS measurement tools after the survey data has been reviewed and correlated with digital photographs and video from the survey.

Biomass of individual herring schools is estimated using a surface area to short tons (st) conversion (Lebida and Whitmore 1985, Brady 1987). A sighting tube with a known focal length is used to calibrate observer estimation of surface area on a few herring schools at the beginning of each survey. Gridlines within the sighting tube provide a visual reference for known ground distances at a given elevation (Fig. 2). Herring school sizes can then be estimated based on the surface area proximity to gridlines within the tube and are generally split into three classifications with corresponding biomass conversions: Small, Medium, and Large (Table 2). Very large and/or irregularly shaped schools are visually separated into Small size class sections and the total number of these

sections enumerated for the school. Size classes are used as guidelines for estimating biomass of schools that fall in between the general classifications.

Figure 1. Discoloration of water due to presence of milt from herring spawning activity.

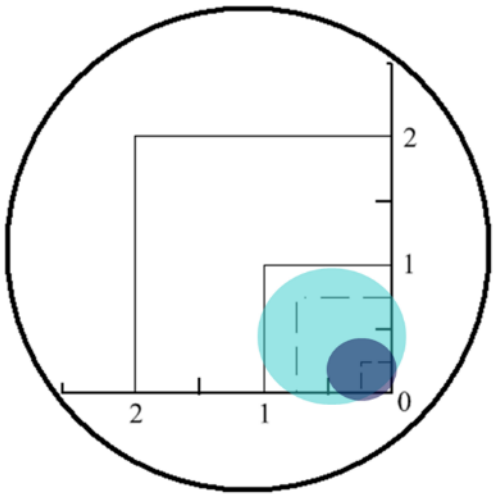


Figure 2. Gridlines within sighting tube used for calibrating estimation of herring school surface area. The shaded circles represent herring schools.

Table 1.–Herring spawning activity classifications by presence and extent of milt.

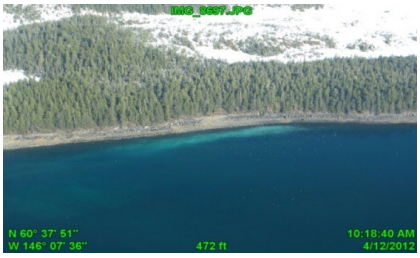
CLASS	Description	Example photo
Active Light	Fish actively spawning, but little milt in the water and very light coloring. Usually some marine mammals (sea lions, harbor seals, or harbor porpoises) or sea birds associated with the spawn.	
Active Medium	Fish actively spawning and moderate amounts of milt in the water and much lighter coloring. Almost always some marine mammals (sea lions, harbor seals, or harbor porpoises) or larger groups of sea birds associated with the spawn.	
Active Heavy	Fish actively spawning, and large amounts of milt in the water. The color is usually bright white to blue green. Almost always larger groups of marine mammals (sea lions, harbor seals, or harbor porpoises) or sea birds associated with the spawn.	
Dissipating	Milt that is likely from the previous day. Very dispersed with few marine mammals. May still be many sea birds on the beach eating eggs. Generally not included in our summary of mile-days of spawn unless we did not document the active spawn previously.	
Drift	Areas of milt that have drifted with the current offshore or away from the areas of active spawn. For example, tides or currents regularly cause milt to drift offshore for up to a mile or more off points. Drift is not summed with active spawn for calculating the total extent of spawn.	

Table 2.–Herring school size class and corresponding surface area, diameter, and biomass (short tons, st).

Size Class	Surface Area	Diameter	Biomass
Small	1962 ft^2 (181 m^2)	50 ft (15.2 m)	10 st
Medium	7850 ft^2 (725 m^2)	100 ft (30.4 m)	40 st
Large	31400 ft^2 (2902 m^2)	200 ft (60.8m)	160 st

Surface area of herring schools for the remainder of the survey is estimated visually without the sighting tube after calibration and requires the use of polarized lens eyewear (Fig. 3). Herring school observations and size estimation are entered as point data in the tablet's ArcPad application georeferenced via GPS or placed with the stylus based on landmarks and map features.

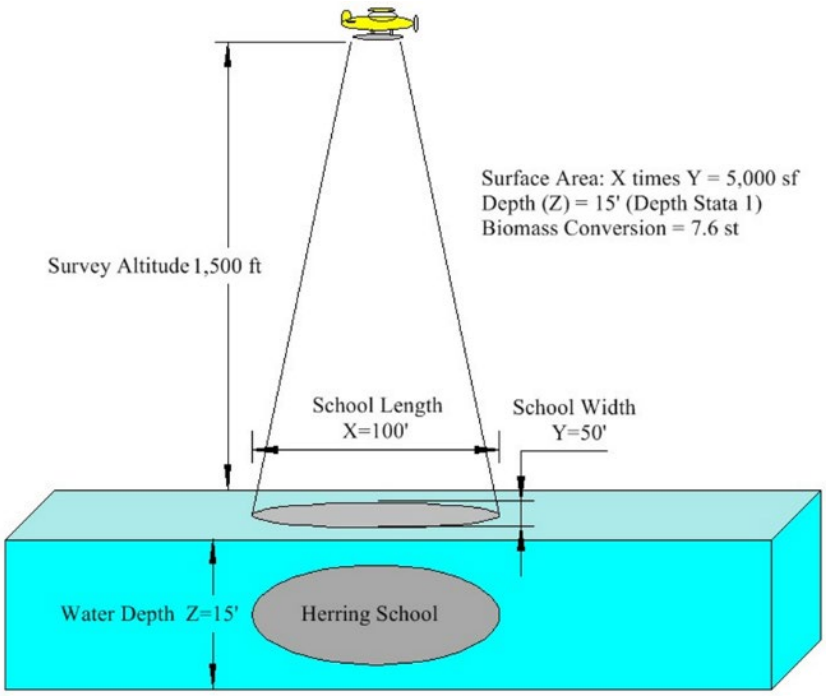


Figure 3. Aerial estimation of herring school surface area for conversion to short tons (st) biomass (Lebida and Whitmore 1985).

Marine mammal sightings are recorded in the tablet ArcPad application as point data, avian aggregations as line data, using GPS and other landmarks, identified at the species or type level (e.g., Stellar sea lion, gulls), and abundance is directly counted for small groups (~<30) or estimated for larger groups (~>30).

After each survey all electronic data are transferred to the local Cordova ADF&G network. ArcPad data are downloaded from the tablet for processing with ESRI ArcMap. DSLR photos are transferred for editing with Adobe Lightroom. The handheld GPS is downloaded with DNRGPS software. Videos or images are downloaded from the video camera using either GoPro Quik or Garmin VIRB software. Observations on paper maps are examined for complete survey information and stored for use in post-season processing.

At the end of the survey season, milt locations, classification and lengths are adjusted by comparing data collected on the GIS application to the digital photography and video imagery. Estimates of large marine mammal aggregations (~>30) are adjusted by counting individuals from survey photographs. Georeferenced survey photographs are transformed into shapefiles.

After adjustments are complete, the individual survey GIS data are combined into shapefiles for the year and then added to the historical GIS shapefiles. These historical shapefiles allow comparison across all years for milt observations (1973–2017), survey routes (1997–2017), sea lion location and abundance (currently 2008–2017), other marine mammals (currently 2008–2017), and birds (currently 2008–2017).

ASL

ASL processing methods are outlined in Baker et al. (1991) with only a few changes. Samples are stratified by area, time, and gear. Sample sizes (n=450) are set to estimate the age composition of each sample to within ±5% of the true proportion 90% of the time (Thompson 1992) assuming no more than 10% of the scales are unreadable. Herring are collected in the field and frozen in large 6 mm plastic bags with labels inside the bag that document the date, time, location, gear, samplers, and the number of bags. Other information including the coordinates of the sample location are collected and added to a sample log. Often more than 450 fish are collected, so an equal number of fish are randomly selected from each bag for processing to meet the sample goal. From the fish selected for processing, 10 fish at a time are place on a tray and their length measured to the nearest mm (standard length, tip of snout to hypural plate (Fig. 4), whole weight to the nearest gram collected from an electronic balance, sex determined from examination of the gonads (1=male, 2=female, 3= unknown), and gonad condition estimated from examination of the gonad (scale of 1, undeveloped, to 8, recovering from spawning). All these data are collected directly into an electronic fish measuring board. The precision of length measurements collected on the electronic fish measuring board have been tested and are within ±1mm. Weights are collected with an electronic balance that is checked with calibration weights (and recalibrated if necessary) prior to each sampling event.

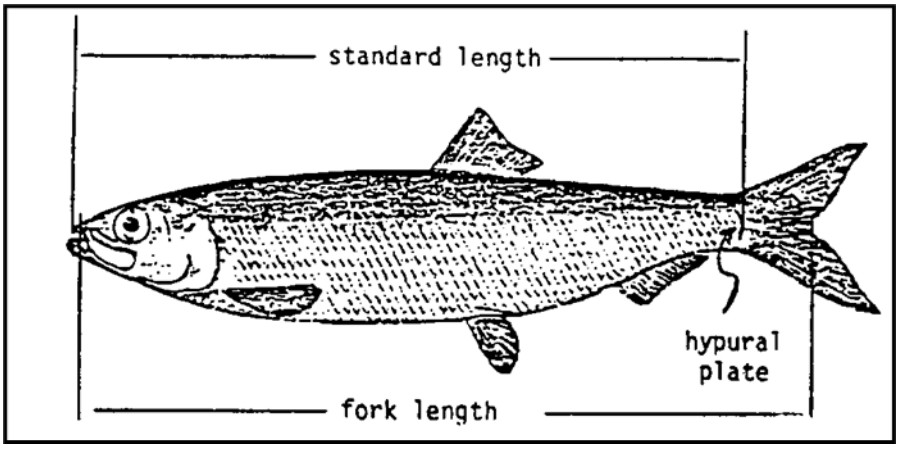


Figure 4. Standard length (tip of snout to end of hypural plate) and fork length measurements (tip of snout to fork of tail).

A scale is then collected from the left side of the fish from a preferred area if possible (Fig. 5). The preferred area is above the lateral line and 3–4 rows of scales back from the operculum. This area generally has symmetrical

growth patterns and distinct annuli. Scales are cleaned and placed on a pre-labeled glass microscope slide after dipping in a solution of 1:10 mucilage glue to water. A single scale from each of 10 fish is placed as two rows of 5 scales on each slide (Fig. 6). Scales are viewed on a microfiche to ensure they are readable for age (not regenerated) and useable for measuring growth increments. If they are not useable to interpret age or measure growth increments, another scale is collected and examined. After all scales are checked they are covered with a second slide and taped together at the label end of the slide. All slides are stored in a labeled box or cabinet tray until examining for age.

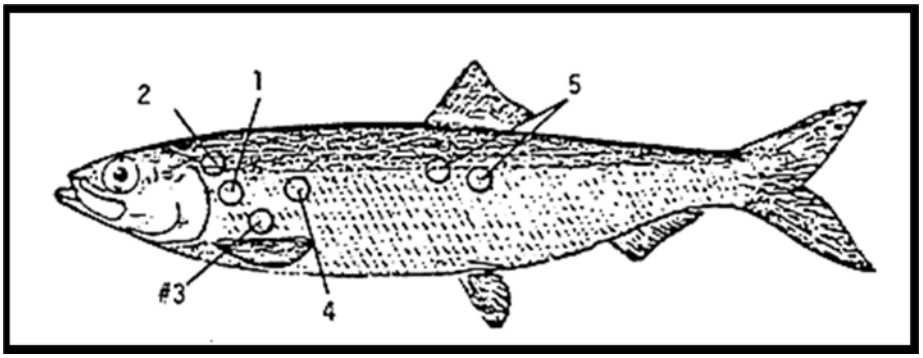


Figure 5.–Preferred areas for collecting scales for age from Pacific herring. Numbers are in order of preference (#1 is most preferred). Scales collected from left side of fish when possible.

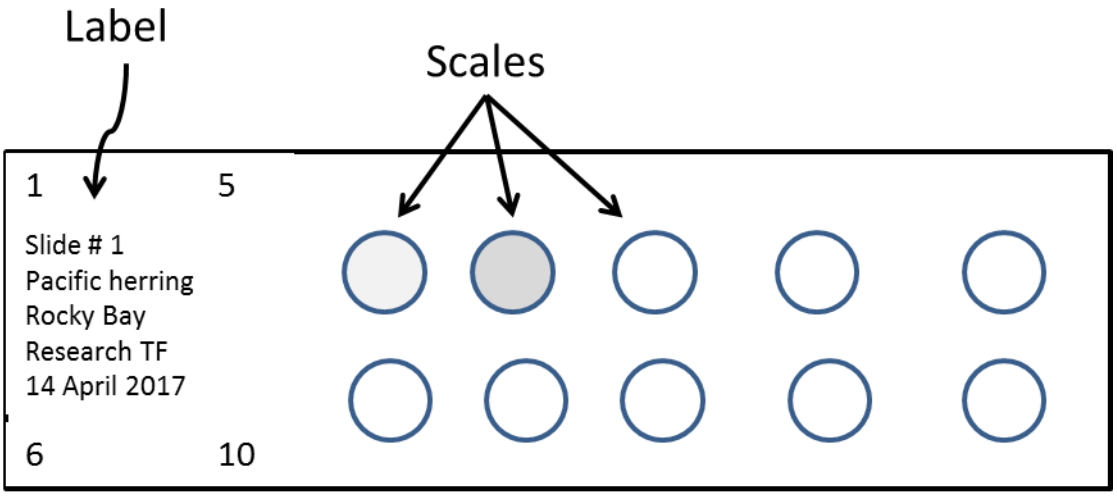


Figure 6.–Example cartoon herring scale slide with scales 1 through 5 (top left to right) and scales 6 to 10 (bottom left to right).

Once a sample is complete, data are downloaded from the electronic fish measuring board into a spreadsheet. The scales are examined for age interpretation on a microfiche by two or three readers. Ages are interpreted independently and then the committee discusses any differences before agreeing on an age by consensus. The crew leader spot checks all samples to reduce the chance of divergence of age estimates by different readers over time (reader drift) in age interpretation. Ages are keyed into the spreadsheet once age interpretation from scales is completed and age, sex, and size composition summaries that include sample size and percentage by age class and sex, mean and standard deviation by age class and sex for weight and standard length, are

generated. Historical data (1973–present) are stored and summarized in spreadsheet form and in the ADF&G PWS herring relational database. Detecting a change in the sex, age, or size composition among areas will depend on sample collection; however, collections have exceeded 1,000 fish per year since 1981.

C. Data Analysis and Statistical Methods

These are monitoring projects and data outputs are primarily the result of data summaries and summary statistics rather that statistical tests. For ASL data, age composition is estimated in each fishery and spawning event by gear type for time and area strata with sample sizes sufficient to simultaneously estimate all age proportions to within ± 5% at the 90% level of precision. Mean standard length and whole body weight is estimated for each fishery and spawning event by gear type for time and area strata with sample sizes such that the relative error is ± 5% at the 95% level of precision. Mean gonad weight of prespawning fish is estimated for time and area strata with sample sizes such that the relative error is ± 5% at the 95% level of precision. Sex composition is estimated in each fishery and spawning event by gear type for time and area strata with sample sizes sufficient to estimate proportions to within ± 5% at the 95% level of precision. For aerial surveys, summary statistics of observation and survey effort data are generated.

D. Description of Study Area

The study area will include all of Prince William Sound and Copper River/Bering River coastal areas between Cape Suckling to the east and Cape Puget to the west. The bounding coordinates are 61.300 N, -144.00 W and 59.750 N, -148.760 W.

5. COORDINATION AND COLLABORATION

A. With the Alaska SeaLife Center or Prince William Sound Science Center

These projects coordinate with Prince William Sound Science Center (PWSSC) personnel and projects extensively. Daily aerial and vessel survey maps and updates are provided to other field projects in the herring program to guide other herring sampling and observation projects (tagging, acoustic biomass). Timely reports of herring schooling or spawning activity, or aggregations of birds or sea mammals associated with herring activity are shared with all projects. Staff are occasionally shared between ADF&G and PWSSC for lab and sampling duties. Data generated by the ASL program is critical to the PWSSC acoustic biomass project (PI Rand, 22120111-G). These projects have daily contact with the Herring coordinator and other herring PIs during the field season.

B. Within the EVOSTC LTRM Program

Environmental Drivers Component

We currently do not collaborate with the Environmental Drivers Component. Combining the Gulf Watch Alaska (GWA) and Herring Research and Monitoring (HRM) programs into one LTRM program will provide greater opportunity for coordination and collaboration.

Pelagic Monitoring Component

Herring growth from scale reading was used in one GWA synthesis publication lead by PI Arimitsu (Arimitsu et al. 2021) with the forage fish project (22120114-O) and mile-day milt is correlated with humpback whale abundance (PIs Moran and Straley, 22120114-O). Combining the GWA and HRM programs into one LTRM program will provide even greater opportunity for coordination and collaboration with the forage fish (22120114-C), humpback whale (22120114-O), and other projects.

Nearshore Monitoring Component

We currently do not collaborate with the pelagic monitoring component. Combining the GWA and HRM programs into one LTRM program will provide greater opportunity for coordination and collaboration.

Lingering Oil Monitoring Component

Because lingering oil data are collected once in a 5-year period and the oil is not currently bioavailable, we do not anticipate incorporating these data into our project. We look forward to status reports from the Lingering Oil Component.

Herring Research and Monitoring Component

PWS Herring Research and Monitoring Program –Acoustics Survey (22120114-G).

The proposed project will share the R/V Solstice vessel research platform with a PWSSC staff member to conduct the adult acoustics survey. ADF&G acoustics equipment will be shared with the Acoustics Survey project if necessary. This proposed project will also capture and process age, sex, and size samples to calculate mean target strength by time or area strata for use in acoustics echo integration. Aerial surveys conducted by this proposed project will provide additional location information on herring aggregation for acoustics surveys.

PWS Herring Research and Monitoring Program – Herring Disease Program (22120114-E)

The proposed project will provide research platform vessel support (R/V Solstice) for Herring Disease Program staff to capture and process adult herring for disease sampling similar to past years. Additionally, this project will help collect scales for fish age and interpret the scales for age.

PWS Herring Research and Monitoring Program – Population modeling (22120114-B)

The proposed project will collect mile-days of milt, provide vessel support for the acoustics survey, and provide ASL data to update the time series of data required for the Bayesian population dynamics model.

Synthesis and Modeling Component

Aerial surveys and ASL monitoring programs are integral to herring synthesis efforts by providing a long-term time series of abundance and population age and size structure. These survey projects have operated successfully over many years and have produced the longest and most consistent time series of PWS herring data available. The mile-day of milt index provides an anchor for herring population modeling efforts and age data provide necessary inputs to the age-structured models. Mile-day of milt was also recently used in a GWA synthesis publication (Suryan et al. 2021). We anticipate greater cross-project collaboration through the GWA LTRM Synthesis and Modeling Component (PI Suryan, 2222LTRM)

Data Management Project

The proposed project will provide additional herring aerial survey and herring ASL data for use by other HRM Component projects. Past EVOSTC and ADF&G funding has allowed us to provide aerial survey GIS data files for linear extent of spawn (1973–2020), survey routes (1997–2020), sea lion distribution and abundance (2008–2020), other marine mammals distribution and abundance (2008–2020), and bird aggregations (2008–2020).

C. With Other EVOSTC-funded Projects (not within the LTRM Focus Area)

Current EVOSTC-funded projects not within the LTRM focus area have not intersected with this project so far. As the EVOSTC funds future projects outside the GWA LTRM program we will evaluate their applicability to our project and coordinate as appropriate.

D. With Proposed EVOSTC Mariculture Focus Area Projects

We look forward to working with the EVOSTC's Mariculture Program and projects they embark on. We anticipate they will be interested in GWA-LTRM datasets and we expect there will be opportunities for coordination and collaboration. Although this project has no formal collaborations with mariculture projects, historical survey observations of the location and timing of herring spawning, staging, and rearing activity should be considered in mariculture siting. This is important to reduce potential impacts of mariculture operations on PWS herring and reduce potential impacts of herring spawning activity on mariculture operations.

E. With Proposed EVOSTC Education and Outreach Focus Area Projects

The GWA-LTRM program will develop an outreach plan that includes coordination and collaboration with the Trustee's Education and Outreach Program and projects. We look forward to participating in education and outreach opportunities where our project findings can contribute to a better understanding of the Gulf of Alaska ecosystem by the general public. This project will assist public outreach through public presentations of methods and results.

F. With Trustee or Management Agencies

This proposal is submitted by ADF&G PWS Commercial Fisheries Division staff and produces information critical to the sustainable management of PWS Herring fisheries. Age and biomass data from this project as well as the acoustic biomass project are evaluated annually by ADF&G fisheries managers relative to regulatory thresholds in the PWS Herring Management Plan (5 AAC 27.365).

G. With Native and Local Communities

This project has frequent, collaborative interactions with Alaska Native and local communities. ADF&G staff in Cordova and subsistence users, primarily from Tatitlek and Cordova, share information and observations on a near daily basis during the spring season. The daily results of ADF&G herring surveys are disseminated to a wide list of stakeholders in a timely fashion. Subsistence users often utilize the daily survey maps produced by this project to target herring or herring spawn harvests. Conversely, ADF&G frequently focuses aerial survey routes and timing based on observations provided by subsistence users from eastern PWS communities. The historical relationships and open communications are valuable to both local community members and survey operations.

The GWA-LTRM program and this project are committed to involvement with local and Alaska Native communities. Our vision for this involvement will include active engagement with the Education and Outreach Focus Area, program-directed engagement through the Program Management project (2222LTRM), and project-level engagement. During the first year of the funding cycle (FY22), the GWA program will reach out to local communities and Alaska Native organizations in the spill affected area to ask what engagement they would like from us and develop an approach that invites involvement of PIs from each project, including this one. Our intent as a program is to provide effective and meaningful community involvement that complements the work of the Education and Outreach Focus Area and allows communities to engage directly with scientists based on local interests.

6. DELIVERABLES

Deliverables for this project include, individual aerial survey maps (distributed to HRM participants, other herring researchers, and a variety of stakeholders within 24 hrs of survey), annual aerial herring biomass observations shapefiles, annual aerial herring spawn observations shapefiles, annual herring aerial survey routes shapefiles, annual aerial survey marine bird observations shapefiles, annual aerial survey marine mammal observations shapefiles, annual aerial survey sea lion observations shapefiles, annual ASL database, and age structure and size at age summaries by sample and overall. In addition, results will be reported in annual, and synthesis, and final reports required by EVOSTC and in the annual ADF&G PWS Area Finfish Management Reports.

7. PROJECT STATUS OF SCHEDULED ACCOMPLISHMENTS

Project milestones and tasks by fiscal year and quarter, beginning February 1, 2022. Fiscal Year Quarters: 1= Feb. 1-April 30; 2= May 1-July 31; 3= Aug. 1-Oct. 31; 4= Nov. 1-Jan 31.

	FY22				FY23				FY24				FY25				FY26			
Milestone/Task	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Milestone: Fieldwork																				
Aerial surveys	X	X			X	X			X	X			X	X			X	X		
Acoustics and disease support survey	X				X				X				X				X			
Milestone: Lab Analysis																				
Herring ASL sample processing	X	X	X		X	X	X		X	X	X		X	X	X		X	X	X	
Milestone: Data																				
Quality control ASL data		X				X			X					X				X		
Quality control and editing of aerial shape files		X				X			X					X				X		
Analysis of aerial survey data			X				X			X					X				X	
Combing aerial survey shape files into historical version			X				X			X					X				X	
Upload previous FY data/metadata to workspace		X				X			X					X				X		
Distribute ASL sample summary			X				X			X					X				X	
Milestone: Reporting																				
Annual reports	X				X				X				X				X			
Deliverables																				
Data posted online		X				X				X				X				X		

	FY27				FY28				FY29				FY30				FY31			
Milestone/Task	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Milestone: Fieldwork																				
Aerial surveys	X	X			X	X			X	X			X	X			X	X		
Acoustics and disease support survey	X				X				X				X				X			
Milestone: Lab Analysis																				
Herring ASL sample processing	X	X	X		X	X	X		X	X	X		X	X	X		X	X	X	
Milestone: Data																				
Quality control ASL data		X				X			X					X				X		
Quality control and editing of aerial shape files		X				X			X					X				X		
Analysis of aerial survey data			X				X			X					X				X	

Milestone/Task	FY27				FY28				FY29				FY30				FY31			
	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4
Combing aerial survey shape files into historical version			X				X			X					X				X	
Upload previous FY data/metadata to workspace		X				X			X					X				X		
Distribute ASL sample summary			X				X			X					X				X	
Reporting																				
Annual reports	X				X				X				X				X			
Final report																				X
Deliverables																				
Data posted online		X				X				X				X				X		

8. BUDGET

Budget Forms (Attach)Please see Gulf Watch Alaska Long-Term Research and Monitoring workbook.

Budget Category:	Proposed FY 22	Proposed FY 23	Proposed FY 24	Proposed FY 25	Proposed FY 26	5- YR TOTAL PROPOSED	ACTUAL CUMULATIVE
Personnel	$72,526	$80,489	$76,197	$78,102	$80,055	$387,368	
Travel	$1,560	$1,599	$1,639	$1,680	$1,722	$8,200	
Contractual	$67,000	$85,063	$72,493	$75,421	$78,479	$378,456	
Commodities	$2,600	$2,665	$2,732	$2,800	$2,870	$13,666	
Equipment	$0	$38,775	$25,000	$0	$0	$63,775	
Indirect Costs Rate = 0%	$0	$0	$0	$0	$0	$0	
SUBTOTAL	$143,686	$208,590	$178,060	$158,003	$163,125	$851,465	
General Administration (9% of subtotal)	$12,932	$18,773	$16,025	$14,220	$14,681	$76,632	N/A
PROJECT TOTAL	$156,617	$227,363	$194,086	$172,224	$177,807	$928,097	
Other Resources (In-Kind Funds)	$55,030	$56,405	$57,815	$59,261	$60,742	$289,253	

Budget Category:	Proposed FY 27	Proposed FY 28	Proposed FY 29	Proposed FY 30	Proposed FY 31	5- YR TOTAL PROPOSED	ACTUAL CUMULATIVE	**TEN YEAR TOTAL**
Personnel	$82,056	$84,107	$86,210	$88,365	$90,574	$431,313		$818,681
Travel	$1,767	$1,809	$1,854	$1,901	$1,948	$9,280		$17,479
Contractual	$81,672	$85,006	$88,488	$92,125	$95,924	$443,213		$821,669
Commodities	$2,942	$3,015	$3,091	$3,168	$3,247	$15,462		$29,129
Equipment	$0	$0	$0	$0	$0	$0		$63,775
Indirect Costs Rate = 0%	$0	$0	$0	$0	$0	$0		$0
SUBTOTAL	$168,437	$173,937	$179,643	$185,558	$191,693	$899,268		$1,750,733
General Administration (9% of subtotal)	$15,159	$15,654	$16,168	$16,700	$17,252	$80,934	N/A	$157,566
PROJECT TOTAL	$183,596	$189,592	$195,811	$202,259	$208,946	$980,203		**$1,908,299**
Other Resources (In-Kind Funds)	$62,261	$63,817	$65,413	$67,048	$68,724	$327,263		**$616,516**

B. Sources of Additional Funding

Non-EVOSTC Funds to be used, please include source and amount per source:

FY22	FY23	FY24	FY25	FY26	FY22-26 Total
$55,030	$56,405	$57,815	$59,261	$60,742	$289,253
FY27	**FY28**	**FY29**	**FY30**	**FY31**	**FY27-31 Total**
$62,261	$63,817	$65,413	$67,048	$68,724	$327,263
				FY22-31 Total	*$616,516*

Funding is provided for some permanent ADF&G staff that work on this project through State of Alaska general fund budgets. These include 3 months Fishery Biologist III salary for Primary Investigator (Jennifer Morella), $11,039/month, $33,119 FY22 total), 0.5 months of Fishery Biologist III salary for ASL seine crew/secondary observer ($11,039/month, $5,519 total), 0.5 months of Fishery Biologist II salary for ASL seine crew/secondary observer ($8,797/month, $4,398 total), and 1 month of Fish and Wildlife Technician II salary for 2 ASL technicians ($5997/month, $11,994 total).

9. LITERATURE CITED

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10. PROJECT PERSONNEL

Jennifer Morella
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Education

B.S. Fisheries Science, Oregon State University, June 2013

Select Work History

Fisheries Biologist III, Prince William Sound Area Finfish Research Biologist, Alaska Dept. Fish & Game 4/2021 – Present. Cordova, AK.

Fisheries Biologist II, Prince William Sound Area Assistant Finfish Research & Management Biologist, Alaska Dept. Fish & Game 3/2019 – 4/2021. Cordova, AK.

Fisheries Biologist I, Cordova Otolith Laboratory Supervisor, Alaska Dept. Fish & Game 8/2017 – 3/2019. Cordova, AK.

Fisheries and Aquatic Ecologist II, National Ecological Observatory Network 6/2016 –8/2017. Fairbanks, AK.

Fisheries Biologist, Real Time Research Consulting 10/2015–7/2016. Bend, OR.

Fisheries Technician Crew Leader, US Fish and Wildlife Service 5/2013–10/2013, 5/2014–10/2014, 5/2015–10/2015 Fairbanks, AK.

Fisheries Technician, Pacific States Marine Fisheries Commission, 10/2014–5/2014 Fort Bragg, CA

Forestry Technician, US Forest Service, 6/2011–12/2011, 6/2012–12/2012

Recent Publications

Botz, J., C. W. Russell, J. Morella, and S. Haught. 2021. 2020 Prince William Sound area finfish management report. Alaska Department of Fish and Game, Fishery Management Report No. 21-18, Anchorage.

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Collaborators in the last 4 years:

Bev Agler, Alaska Department of Fish and Game –Mark, Tag, Age Lab, Juneau
Trevor Branch, University of Washington
Jeremy Botz, Alaska Department of Fish and Game – Commercial Fisheries Division, Cordova
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Kristen Gorman, University of Alaska, Fairbanks
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James Savereide, Alaska Department of Fish and Game – Sport Fish Division, Fairbanks
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THE STATE of ALASKA
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August 9, 2021

To: Mandy Lindeberg - NOAA, GWA-LTRM Program Lead
Shiway Wang, EVOSTC Executive Director

Re: *Letter of Commitment*

We are pleased to provide this letter of commitment for the proposed project "Surveys and age, sex, and size collection and processing, 22170111-F" led by principal investigator (PI), Jennifer Morella. This proposal was drafted by the PI in response to the EVOSTC's FY22-31 Invitation for Proposals and subsequent request for final submission on August 13, 2021. The cost for this project over a ten-year period will be $2,367,300 (without EVOSTC GA). This includes some non-EVOSTC funds that are in-kind contributions we support totaling an estimated $618,516 for the life of the project (e.g., salaries of permanent staff, field travel, contracts, commodities, and equipment use).

This project proposal is part of the larger multi-agency Gulf Watch Alaska Long-Term Research and Monitoring (GWA-LTRM) program proposal package. This package represents a continued commitment of the successful long term research and monitoring projects supported by the EVOSTC and various agencies and organizational investments since 1973. This project seeks to continue spring aerial surveys to document Pacific herring milt distribution and biomass as well as the distribution and abundance of sea lions, other marine mammals, and birds associated with herring schools or spawn. This proposed project will also provide a research platform (*R/V Solstice*) for an adult herring disease sample collection and processing. Finally, this proposed project will collect and process age, sex, and size samples of herring collected by the acoustics survey, spawning surveys, and disease sampling. Aerial survey and age, sex, and size data have been collected since the early 1970s and are an essential part of the age-structured models used by the Alaska Department of Fish and Game to estimate the historical and future biomass for fisheries management. This project will help to meet the overall program goals of providing sound scientific data and products to inform resource managers and the public of changes in herring stocks and in the PWS ecosystem.

Sincerely,

Sam Rabung
Director
Division of Commercial Fisheries
Alaska Department of Fish and Game
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samuel.rabung@alaska.gov