Fishery Data Series No. 25-16

2023 Southeast Alaska Herring Stock Assessment Survey

by

Kyle Hebert

May 2025

Alaska Department of Fish and Game **Divisions of Sport Fish and Commercial Fisheries**

Symbols and Abbreviations

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Weights and measures (metric)

centimeter	cm
deciliter	dL
gram	g
hectare	ha
kilogram	kg
kilometer	km
liter	L
meter	m
milliliter	mL
millimeter	mm

Weights and measures (English)

cubic feet per second	ft^3/s
foot	ft
gallon	gal
inch	in
mile	mi
nautical mile	nmi
ounce	oz
pound	lb
quart	qt
yard	yd

Time and temperature

day	d
degrees Celsius	°C
degrees Fahrenheit	°F
degrees kelvin	K
hour	h
minute	min
second	s

Physics and chemistry

all atomic symbols	
alternating current	AC
ampere	A
calorie	cal
direct current	DC
hertz	Hz
horsepower	hp
hydrogen ion activity (negative log of)	pH
parts per million	ppm
parts per thousand	ppt, ‰
volts	V
watts	W

General

Alaska Administrative Code	AAC
all commonly accepted abbreviations	e.g., Mr., Mrs., AM, PM, etc.
all commonly accepted professional titles	e.g., Dr., Ph.D., R.N., etc.
at	@
compass directions:	
east	E
north	N
south	S
west	W
copyright	©
corporate suffixes:	
Company	Co.
Corporation	Corp.
Incorporated	Inc.
Limited	Ltd.
District of Columbia	D.C.
et alii (and others)	et al.
et cetera (and so forth)	etc.
exempli gratia (for example)	e.g.,
Federal Information Code	FIC
id est (that is)	i.e.
latitude or longitude	lat or long
monetary symbols (U.S.)	$, ¢
months (tables and figures): first three letters	Jan,...,Dec
registered trademark	®
trademark	™
United States (adjective)	U.S.
United States of America (noun)	USA
U.S.C.	United States Code
U.S. state	use two-letter abbreviations (e.g., AK, WA)

Mathematics, statistics

all standard mathematical signs, symbols and abbreviations	
alternate hypothesis	H_A
base of natural logarithm	*e*
catch per unit effort	CPUE
coefficient of variation	CV
common test statistics	(F, t, χ^2, etc.)
confidence interval	CI
correlation coefficient (multiple)	R
correlation coefficient (simple)	r
covariance	cov
degree (angular)	°
degrees of freedom	df
expected value	*E*
greater than	>
greater than or equal to	≥
harvest per unit effort	HPUE
less than	<
less than or equal to	≤
logarithm (natural)	ln
logarithm (base 10)	log
logarithm (specify base)	log_2, etc.
minute (angular)	′
not significant	NS
null hypothesis	H_O
percent	%
probability	P
probability of a type I error (rejection of the null hypothesis when true)	α
probability of a type II error (acceptance of the null hypothesis when false)	β
second (angular)	″
standard deviation	SD
standard error	SE
variance	
population	Var
sample	var

FISHERY DATA SERIES NO. 25-16

2023 SOUTHEAST ALASKA HERRING STOCK ASSESSMENT SURVEY

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ABSTRACT

Pacific herring *Clupea pallasii* are important prey for many marine species found in Southeast Alaska and are harvested in fisheries for subsistence, personal use, commercial, and research purposes. The Southeast Alaska Herring Management plan (5 AAC 27.190(3)) requires the Alaska Department of Fish and Game to assess the abundance of mature herring for each stock before allowing commercial harvest. Included here are results of stock assessment surveys completed primarily during 2023, including summaries of herring spawn deposition surveys and age-weight-length sampling, which are the principal model inputs used to forecast herring abundance. In 2023, spawn deposition surveys were conducted only for Sitka Sound and Craig area stocks. Spawn deposition surveys were not conducted in several other traditionally major spawning areas due to low levels of observed spawn, although aerial surveys of spawning were continued on a limited basis. The shoreline in state waters where spawn was documented in Southeast Alaska and Yakutat during aerial surveys for major spawn areas in 2023, combined for all areas, was 141.1 nautical miles. Post-fishery spawn deposition biomass estimates, combined for all surveyed stocks, totaled 297,346 tons. During the 2022–2023 season, a commercial winter bait fishery was opened in Craig with a guideline harvest level (GHL) of 4,657 tons. A commercial purse seine sac-roe fishery was opened in Sitka Sound with a GHL of 30,124 tons. A commercial spawn-on-kelp fishery was open in Craig with an allocation of 7,019 tons of herring, allowing for the highest possible kelp allocation for pounds. There were no other commercial herring fisheries opened during the 2022–2023 season. Herring harvested commercially during the 2022–2023 season totaled 10,942 tons, not including herring impounded for spawn-on-kelp fisheries or spawn-on-kelp products.

Keywords: Pacific herring, *Clupea pallasii,* Southeast Alaska, spawning populations, dive surveys, stock assessment, fishery

PURPOSE

The primary intents of this report are to document data collected from fall 2022 through spring 2023 and to provide historical perspective by presenting general trends in Southeast Alaska herring populations. The data presented in this report include the principal inputs for models that are used to forecast mature herring biomass and age compositions for the ensuing year. Per regulations, biomass forecasts are compared to stock-specific threshold biomass levels to determine whether a fishery will be allowed in a particular area. Biomass forecasts are coupled with appropriate exploitation rates (maximum of 20%) to determine the allowable harvest levels, and allocations for commercial quotas for each fishery are determined by the appropriate regulations and management plans.

INTRODUCTION

Pacific herring *Clupea pallasii* have been the target of commercial fisheries in Alaska since 1878, with harvests growing to multi-million pounds annually by 1882 (Cobb 1905). As fisheries developed, the desire for better knowledge and understanding of herring populations grew, leading to the initiation of research programs. Initially, studies were focused on observations made from trends in commercial catch, especially during the height of the large-scale reduction fishery that peaked in 1930. As questions arose about the cause of fluctuations in catch, the lack of herring availability, and the impact of commercial fishing on herring, and as fishery science theory developed worldwide, scientific techniques were applied to herring populations in Alaska. The quantitative, fishery-independent study of herring began in Alaska by the early 1930s, and research was carried out by the U.S. Department of Commerce, Bureau of Fisheries. Rounsefell and Dahlgren (1935) measured spawning levels by area and attempted to differentiate spawning populations in Southeast Alaska through analyzing vertebrae counts and growth rates and through tag–recapture studies. By the 1940s, the importance of age class strength became recognized for monitoring and predicting herring abundance, and research was largely conducted by the U.S. Department of the Interior, Fish and Wildlife Service (USFWS). Estimates and forecasts of abundance and yield by age became mainstays of management during this time. By 1953, programs were in place for standardized, detailed collection of data from spawning grounds, including aerial surveys, measurements of spawn along shoreline, egg density, and egg mortality, which enabled estimation of spawning biomass (Grice and Wilimovsky 1957). The USFWS continued to lead herring research in Alaska after statehood in 1959, operating under a cooperative agreement with the State of Alaska during 1960 and 1961. However, in 1962 the cooperative agreement was discontinued, and herring spawn surveys conducted by USFWS were suspended. Starting in 1963 the Alaska Department of Fish and Game (ADF&G) began conducting aerial surveys in the Craig–Hydaburg and Sitka areas, which were later expanded to other important herring spawning areas.

ADF&G instituted a full research project in 1971 to evaluate herring stocks in Southeast Alaska. This project was developed in response to greater demands on the resource by the commercial bait and developing sac roe fisheries. The goal of the project was to provide the biological data necessary for scientific-based fishery management of the region's herring stocks.

A variety of survey techniques have been used in the past to assess herring stocks in Southeast Alaska, including aerial visual estimates, hydroacoustic surveys using vessels, and spawn deposition surveys using scuba gear. Data generated during these stock assessment surveys—along with data collected for age, weight, and length estimates—are used directly in the management of all commercial herring fisheries conducted in Southeast Alaska. Data are currently analyzed using 1 of 2 different stock assessment models used to estimate and to forecast mature herring abundance and biomass. These models include an integrated statistical catch-age model (SCAA, historically known as age-structured analysis, or ASA, model) and a biomass accounting model.

Since 1971 biomass estimates and abundance forecasts of mature herring in Southeast Alaska were based on either hydroacoustic surveys or the product of estimates of egg density and area of spawn deposition (called *spawn deposition* method). Currently, the SCAA model is used for herring populations with longer (i.e., generally a minimum of 10 years) time series of stock assessment data, and the biomass accounting model may be used for all other stocks where fisheries occur or on occasion when time constraints prevent use of the SCAA model. These 2 models are not mutually exclusive of the spawn deposition method. Spawn deposition data (i.e., total egg deposition estimates) are an important element of SCAA and biomass accounting models. A primary difference between the 2 approaches is the number and type of data inputs required to conduct the respective analyses and the model outputs. Biomass estimates derived from the spawn deposition method use only the most recent spawn deposition data and do not factor in trends in age composition or weight-at-age. A conversion factor based on an estimate of the number of eggs per ton of herring is applied to the total egg estimate to compute spawning biomass. In contrast, the SCAA model uses a time series of age compositions, weight-at-age, total egg deposition, and catch, along with fecundity relationships to estimate biomass; it produces estimates of mean survival, maturity, selectivity, and recruitment. Biomass accounting, which does not require a data time series, is based on spawn deposition estimates adjusted for natural mortality, age-specific growth, and recruitment, which are elements produced by the SCAA model, usually from a nearby herring stock. A more detailed explanation of the SCAA and biomass accounting models and how the objective estimates are used in these models are provided by Carlile et al. (1996).

Since 1993, when data has allowed, the SCAA model has been used to estimate and forecast the abundance of herring for 4 major Southeast Alaska herring stocks: Sitka, Craig, Seymour Canal, and Revillagigedo Channel (also called *Revilla Channel*, which refers to the greater Kah Shakes–

Cat Island and Annette Island spawning areas). The SCAA model has also been used whenever possible for Tenakee Inlet since 2000. For these 5 potential commercial harvest areas or spawning populations, the time series of data has been or had been sufficient to permit the use of SCAA for hindcasting historical biomass and forecasting future biomass. Other areas, which may support significant herring fisheries but lack data time series suitable for SCAA, are candidates for biomass accounting. This simpler modeling approach began in 1996 and has been used to generate forecasts for West Behm Canal, Ernest Sound, Hobart Bay–Port Houghton, and Hoonah Sound. SCAA and biomass accounting models are mentioned here to provide historical perspective and because they are important elements of the overall stock assessment of herring in Southeast Alaska. Although results from these models are not discussed in this report, the key data inputs for these models are presented.

METHODS AND PROCEDURES

AERIAL AND SKIFF SURVEYS

A combination of aerial and skiff surveys was used to record spawning activities during the spring, to document spawn timing, and to estimate the distance of shoreline that received herring spawn. These surveys focused on several historically important spawning areas (Figure 1) and several minor spawning areas in Southeast Alaska. Aerial surveys typically commenced prior to the historical first date of spawning for each stock. Historical spawning dates by stock are presented in Figures 2–11. In addition to documenting herring spawn and herring schools, estimates of numbers and locations of herring predators—such as birds, sea lions, and whales—were recorded. Once concentrations of predators were observed, aerial and skiff surveys were conducted more frequently (e.g., daily or sometimes multiple flights per day) to ensure accurate accounting of herring distribution and herring spawn. The shoreline where herring spawn (milt) was observed was documented on a paper chart or electronic handheld device during each survey and then later uploaded to computer mapping software to measure the shoreline distance that received spawn. A chart depicting the total unique shoreline where spawn was documented at any time during the duration of the spawning event was used as the basis for targeting and designing the spawn deposition dive surveys.

SPAWN DEPOSITION SURVEYS

Optimal timing of spawn deposition surveys is about 10 days after the first significant spawning day of the season in each spawning area. This delay usually allows adequate time for herring to complete spawning and marine mammals to leave the area while minimizing the time eggs are subjected to predation or wave action that may remove eggs from the spawning area. What determines a *significant* first spawning level depends on the size of the spawning stock but is typically at least 1 nautical mile and can be several nautical miles. To account for egg loss from the study site prior to the survey, a 10% correction factor is applied to the estimate of observed egg deposition. The 10% correction factor is an estimate based on several studies that have been conducted to estimate herring egg loss from deposition areas in British Columbia (for example, see Schweigert and Haegele [2001]; Haegele [1993a,1993b]) and in Prince William Sound. These studies found that the extent of egg loss due to predation and physical environmental stress depends upon several things, including length of time since deposition, depth, and kelp type. Historically, a correction factor based on 10% egg loss prior to survey has been used in Southeast Alaska, British Columbia, and Prince William Sound. Although this factor continues to be used in Alaska to maintain time series consistency, more recent studies suggest that 25–35% egg loss may be more accurate. Because the length of time since egg deposition is a key factor contributing to egg loss, a serious attempt has been made to conduct surveys within 10 days; however, at times surveys were delayed to balance survey scheduling for simultaneous spawning events or to accommodate availability of survey participants. Surveys conducted substantially after the 10-day period may tend to result in underestimates of egg deposition and therefore mature biomass. Historical dates of spawn deposition surveys are presented in Table 1.

Shoreline Measurement and Transect Orientation

Spawn documented during aerial surveys was transcribed in ArcMap (version 10.3) over raster images of nautical charts published by the National Oceanic and Atmospheric Administration, using the NAD 1983 datum and State Plane Alaska FIPS 5001 (ft) Projected Coordinate System. Spawn was drawn to conform to the shoreline so that any given segment of shoreline that received spawn had an approximately equal chance of being sampled during the dive survey. This process required a tradeoff so that shoreline features could be smoothed without adhering too closely to the shore on a small scale, but also without drawing straight lines that did not adequately capture enough detail to design a meaningful survey.

Shoreline measurement—and consequently transect placement—can be subjective at times, depending on the location of spawn deposition relative to the shoreline, bottom contour and depth, and map resolution. Fine measurement of a convoluted shoreline may substantially increase measurements of spawn but may not be appropriate for instances when spawn deposition does not closely follow the shoreline. In such situations, less resolution is used for measurements and transects are placed perpendicular to a theoretical shoreline, so they intersect the spawn in a meaningful way to sample across the spawn zone. Conversely, spawn may closely follow a convoluted shoreline, requiring finer resolution of measurements; in this situation, transects are placed perpendicular to the actual shoreline contingent upon physical features such as depth, bottom slope, and distance to the opposite shore. For example, a steeply sloped shoreline with a narrow band of spawn habitat (typical of Sitka Sound) requires finer resolution for shoreline mapping as opposed to an area with a broad gentle slope (e.g., Craig) interspersed with rocks and reefs at some distance from shore. For some spawning areas (e.g., Sitka), a *base map* is used, which depicts a standardized shoreline used to draw spawn, and which has been developed by considering many years of spawning. Base maps are intended to reduce among-year variability associated with drawing spawn on shorelines and therefore reduce variability in egg deposition estimates.

Another consideration is that the termination of transects while still in the egg zone may be necessary if spawn is present on the opposing shoreline. Transects are halted at the midpoint of opposing shoreline to prevent oversampling areas where a potential transect might have been placed. Similarly, transects that are surveyed within small coves are terminated at a central convergence point where other potential transects would intersect. Transects are terminated for these 2 situations to minimize bias due to unequal sampling probability of the spawn zone, although it is unlikely that bias would be eliminated without further corrections (Li et al. 2011). A theoretical example of a spawn line drawn along the shore, and how the layout of potential transects are considered for these instances, is presented in Figure 12.

The same procedure and patterns of drawing spawn were followed in 2023 as in past years; however, the process requires that judgment be used based on experience and knowledge of the local spawning areas. The intent of drawing a smoothed spawn line is to produce a survey area that is oriented along the spawn. The result of this orientation is that transects laid perpendicularly to the spawn line will sample egg density throughout the entire width of the spawn, while minimizing bias to the estimate of egg abundance. A second objective of measuring the spawn observed along shorelines is to obtain an estimate of spawn length, which factors into the estimate of overall spawn area, and is discussed more below. For the Sitka Sound and Craig areas, standardized baseline representations of herring spawn shoreline have been developed and were used for analyses presented here. These baseline maps provide a predetermined line for drawing spawn in the current year that is consistent with prior years. The baseline maps were developed using documented historical spawn and local knowledge of the area to produce what was deemed the most sensible representation of shoreline for repeated use in herring aerial surveys and spawn deposition surveys.

Once the spawn shoreline was established, a single linear measurement of the shoreline was made using XTools Pro, a measuring tool extension used within ArcMap. The shoreline was divided evenly into 0.10 nautical mile segments, which were then randomly selected for transect placement. Therefore, transects were placed no closer than 0.10 nmi to each other, which was done to prevent adjacent transects from unintentional crossing due to slight errors in compass bearing or while navigating underwater.

Sample Size

The number of transects selected was proportional to the linear distance of spawn and followed, at a minimum, the average of suggested sampling rates listed in Table 2. Sampling rates in Table 2 were estimated using data from previous surveys. The statistical objective of the spawn deposition sampling was to estimate herring egg densities (per quadrate) such that the lower bound of a 90% confidence interval was at least within 30% of the mean egg density estimate. This method also supports the objective of estimating the total egg deposition at a particular location with the specified precision. A one-sided confidence interval was used because there is more concern to avoid overestimating, rather than to avoid underestimating the densities of spawn deposition. The number of actual transects selected for a survey are frequently increased beyond the minimum suggested rate to increase transect spatial distribution, potentially reduce variance, and make efficient use of scheduled vessel time.

The minimum target number of transects is estimated as follows:

$$n = \frac{\left(S_b^2 - \frac{S_2^2}{\overline{M}} + \frac{S_2^2}{\overline{m}} \right)}{\left(\frac{x\bar{d}}{t_\alpha} \right)^2 + \frac{S_b^2}{N}}; \qquad (1)$$

where

n	=	number of transects needed to achieve the specified precision;
S_b^2	=	estimated variance in egg density among transects;
S_2^2	=	estimated variance in egg density among quadrates within transects;
$\overline{M}$	=	estimated mean width of spawn;
$\overline{m}$	=	estimated mean number of 0.1 m quadrates per transect;

x	=	specified precision, expressed as a proportion (i.e., 0.3 = 30%);
$\bar{d}$	=	overall estimated mean egg density;
t_a	=	critical t value for a one-sided, 90% confidence interval; and
N	=	estimated total number of transects possible within the spawning area.

Field Sampling

Transect direction was determined by comparing the physical features of the actual dive location to a chart depicting the spawn along the shoreline and then setting a compass bearing perpendicular to the spawn shoreline. Transects began at the highest point of the beach where eggs were observed and continued down to the depth in the subtidal zone where no further egg deposition was observed, typically around 21 m (70 ft) of depth. The section of each transect that was above the waterline was surveyed by walking until reaching a depth in the water that required diving (usually about 2 feet), at which point diving commenced. All diving was conducted in compliance within limits and guidelines outlined in the ADF&G Dive Safety Manual (Hebert 2006). Normally, little if any herring egg deposition occurs deeper than 21 m, although occasionally eggs will occur to or even below 24 m (80 ft).

A 2-stage sampling design, similar to that of Schweigert et al. (1985), was used to estimate the density of herring eggs. The field sampling procedure entailed 2-person dive teams swimming along transects and recording visual estimates of the number of eggs within a 0.1 m^2 sampling frame placed on the bottom at 5-meter intervals. Eggs throughout the entire water column were included if they were within the dimensions of the frame. Situations where eggs were found on vertical canopy kelps such as *Macrocystis* spp. required divers to swim up along the length of the kelp to estimate eggs while maintaining reference to the sampling frame. To help estimate the number of eggs, estimators used the standard reference of 40,000 eggs per single layer of eggs within the sampling frame, which was determined mathematically using measurements of average egg diameter and frame dimensions. Additional data recorded included bottom substrate type (Appendix A), primary vegetation type upon which eggs were deposited (Appendix B), percent vegetation coverage within the sampling frame, and frame depth. Since sampling frames were spaced equidistant along transects, the record of the number of frames was also used to compute transect length.

VISUAL ESTIMATE CORRECTION

Because surveys rely on visual estimates rather than actual counts of eggs within the sampling frame, measurement error occurs. To minimize bias and the influence of measurement error on estimates of egg deposition within each frame, estimator-specific correction coefficients were applied to adjust egg estimates either up or down depending on an estimator's tendency to underestimate or overestimate. Correction coefficients were calculated by double sampling frames independent of those estimates obtained along regular spawn deposition transects (Jessen 1978). Samples for correction coefficients were collected by visually estimating the number of eggs within a 0.1 m^2 sampling frame and then collecting all the eggs within the frame for later more precise estimation in a laboratory. First, eggs on a variety of vegetations (e.g., algae, kelp, sea grass) were collected underwater and then while onboard a vessel assembled into a variety of sample sizes among vegetation categories. Approximately 10 samples for each of 5 vegetation categories were created, and attempts were made to create samples of varying egg density and varying total egg abundance within each vegetation type. Vegetation categories included eelgrass (ELG), fir kelp (FIR), large leafy brown kelp (LBK), rockweed (FUC), and hair kelp (HIR; see Appendix A1 for species included within each category). Next, divers placed individual samples within sampling frames that were longlined along a shallow depth contour of about 10 ft. Next, potential herring survey egg estimators (i.e., someone who may make herring egg estimates along transects if they are properly calibrated) dove along the longline, making estimates of each sample, recording estimates on sample labels, and placing them in a mesh bag attached to each sampling frame. To collect the samples after estimation, divers removed the vegetation (e.g., algae, kelp, sea grass) along with the eggs and preserved them in 100% salt brine solution in heavy grade plastic zip-sealing bags. Samples were transported to the ADF&G Mark, Tag and Age Laboratory in Juneau, where analysis was conducted within the following few months. Lab estimates were made for each sample by stripping eggs from vegetation, counting the number of eggs within 2 or 3 subsamples (typically about 1,000 eggs each), and then measuring the volumes of subsamples and full samples to calculate total eggs by proportion.

Correction coefficients were calculated as the ratio of sums of all laboratory estimates to all visual estimates, within each kelp type, for each estimator. To reduce potential of highly variable correction coefficients, minimum sample size guidelines were used. Data from the last 3 years were pooled if there were at least a total of 6 samples for each estimator and kelp type, with at least 3 samples in at least 2 of the 3 years. If this was not satisfied, then samples from prior years were added until the minimum sampling guideline was met. The intent of these sampling guidelines was to achieve a reasonably adequate sample size to minimize variation, but also to develop correction coefficients that reflected an estimator's tendency to estimate high or low in the most recent years.

Vegetation-specific estimator correction coefficients were applied to egg estimates when the appropriate vegetation type matched. For example, the large leafy brown kelp correction coefficient was applied when kelp types that fit that description were encountered on transect, and the eelgrass correction coefficient was applied when eelgrass was encountered. When eggs were encountered on transect that were loose in the water column, were adhering to bare rock, or were on vegetation types that were not like the categories sampled for calibration of egg estimates, an estimator-specific correction coefficient based on the average of all vegetation-specific estimator correction coefficients was applied.

ESTIMATES OF TOTAL EGG DEPOSITION

Total egg deposition for each spawning area (t_i) was estimated as follows:

$$t_i = a_i \bar{d}_i, \qquad (2)$$

where a_i is the estimated total area (m^2) on which eggs have been deposited; and $\bar{d}_i$ is the estimated mean density of eggs per 0.1 m^2 quadrate, extrapolated to 1 m^2 area (eggs/m^2) at spawning area i. The total area on which eggs have been deposited (a_i) is then estimated as

$$a_i = l_i \bar{w}_i, \qquad (3)$$

where l_i is the total length of shoreline (m) that received spawn (determined from aerial and skiff surveys); and w_i is the mean width of spawn (m), as determined by the mean length of transects conducted at spawning area i.

The mean egg density (eggs/m^2) at area i ($\bar{d}_i$) is calculated as

$$\bar{d}_i = 10 \cdot \left[\frac{\sum_h \sum_j \sum_k v_{hijk}\, c_{hk}}{\sum_h m_{hi}} \right], \tag{4}$$

where v_{hij} is the visual estimate of egg numbers by estimator h, at area i, quadrate j, on vegetation type k. The c_{hk} term refers to a diver-specific, vegetation-specific correction coefficient to adjust visual estimates made by estimator h on vegetation type k; m_{hi} is the number of quadrates visually estimated by estimator h at area i. Because egg estimates are made within 0.1 m quadrates, multiplying by 10 expresses the mean density in per 1.0 m^2. Vegetation-specific estimator correction coefficients (c_{hk}) are calculated as follows:

$$c_{hk} = \frac{r_{hk}}{q_{hk}}, \tag{5}$$

where r_{hk} is the sum of laboratory estimates of eggs collected from quadrates that were visually estimated by estimator h on vegetation type k, and q_{hk} is the sum of visual estimates of eggs for estimator h on vegetation type k.

SPAWNING BIOMASS ESTIMATION

The total number of eggs per spawning area is a key element in assessing and forecasting herring spawning biomass. Although spawning biomass calculated directly from egg deposition is not an input for the SCAA or biomass accounting models, like total egg deposition estimates, it does provide a useful rough estimate of biomass each year. These values can be useful for comparison among years to track general trends in abundance, and they are intuitive in that the estimates do not change with subsequent years of data. Conversely, SCAA-derived hindcasted estimates change with each model run as new data is added.

The conversion of eggs to spawning biomass is calculated using a stock-specific fecundity-to-weight relationship for the areas where fecundity estimates are available (Sitka Sound, Seymour Canal, Craig, Kah Shakes–Cat Island). For all other stocks, the fecundity-to-weight relationship is calculated from the closest spawning stock where fecundity estimates are available (Table 3). The estimate for each area is calculated as follows:

$$b = h_{\bar{g}} * \bar{g}, \tag{6}$$

where

b = estimated total spawning biomass;

$h_{\bar{g}}$ = number of fish of mean weight in the area; and

$\bar{g}$ = mean weight of fish for each area, weighted by age composition.

The number of fish of mean weight ($h_{\bar{g}}$) is calculated as follows:

$$h_{\bar{g}} = \frac{\left(\frac{t}{L}\right) * 2}{f_{\bar{g}}}, \tag{7}$$

where

L = egg-loss correction factor (0.9), which accounts for an estimated 10% egg mortality between the time eggs are deposited and spawn deposition surveys are conducted; and

$f_{\bar{g}}$ = estimated fecundity of fish of mean weight, using equations listed in Table 3.

AGE AND SIZE

Herring samples were collected from several stocks or spawning areas located throughout Southeast Alaska through a combination of skiff spawn surveys, aerial spawn surveys, commercial fisheries, and test fisheries (when prosecuted). Sample collection gear varied with location and historically has included purse seines, gillnets, cast nets, or trawls. Cast nets were used when fish were in shallow water during active spawning. Herring sampled from commercial fisheries were collected from individual harvesters or tenders while on the fishing grounds. Dates, gear used, and geographic locations of all samples were recorded.

Based on multinomial sampling theory (Thompson 1987), a sample size of 511 ages is considered sufficient to provide age composition estimates that deviate no more than 5% (absolute basis) from the true value, with an alpha level of 0.10 (i.e., the chance of rejecting a true value is about 10 percent). The minimum sampling goal was set at 525 fish to ensure that at least 500 readable scales would be obtained for aging from each commercial fishery (i.e., purse seine or gillnet samples) and each spawning stock (i.e., cast net samples).

All samples were packaged and labeled in 5-gallon buckets and frozen for later processing at the ADF&G Mark, Tag and Aging Laboratory in Juneau, Alaska. After thawing samples in the laboratory, the standard length (mm) of each fish (tip of snout to posterior margin of the hypural plate) was measured. Fish were weighed on an electronic balance to the nearest 10th of a gram.

A scale was removed from each fish for age determination. The preferred location is on the left side anterior to the dorsal fin or beneath the left pectoral fin. Scales were cleaned and dipped in a solution of 10% mucilage glue and placed unsculptured side down on glass slides. Aging was conducted by viewing scale images on a microfiche projector to count annuli. Age data for early years (1980–1998) were obtained by viewing scales through a dissecting microscope, varying the light source for an optimum image of the annuli. From 1999 to present, age has been determined by mounting scales on a microfiche reader to project a larger scale image to see annuli more easily. Each fish was assigned an anniversary date for each completed growing season. Samples were generally collected before growth resumed in the spring, and scales were aged based on the number of summer growth periods observed. For example, if a herring hatched in the spring of 2011 and was collected in the fall of 2012, then 2 growing seasons had occurred (age-2). If the herring had been collected in the spring of 2013 before growth had resumed, it was also recorded as age-2. Occasionally spawning occurs late (e.g., June) after growth resumes, producing *plus growth* on scales, which is ignored as it does not represent a full growth period. Scales were spot-checked by a second reader for age verification, and if agreement between readers was less than 80%, the entire sample was re-aged.

Condition Factor

Condition factor (CF) was calculated to provide a general indication of overall condition of fish based on body proportion. Condition factor was based on the method described in Nash et al. (2006) and was estimated as follows:

$$CF = \left(\frac{w}{l^3}\right) * 100, \tag{8}$$

where

w = whole body wet weight in grams, and
l = standard length in millimeters.

Sea Temperature

Daily sea surface temperature was recorded in spawning areas for most stocks using Onset HOBO StowAway TidbiT temperature loggers. For each stock, a single temperature logger was placed at a location central to historical spawning at a depth between about 10 ft mean lower low water (MLLW) and 20 ft MLLW. Temperature has been recorded daily at 6-hour intervals for up to 20 years in some spawning areas. Daily mean, minimum, and maximum sea temperature was calculated for each spawning area. Overall annual mean temperature was calculated as the mean of all averaged daily values. Mean annual minimum temperatures and mean annual maximum temperatures were calculated as the mean of the minimum or maximum values that occurred during each annual cycle.

HARVEST STRATEGY

Allowable harvest levels for commercial herring fisheries in Southeast Alaska are set based on a harvest strategy that involves a graduated harvest rate paired with a minimum threshold of mature herring. When herring biomass is forecasted to be at or above threshold, a harvest rate of 10–20% is applied to the biomass forecast. For most herring stocks, the harvest rate may be set at 10% when the biomass forecast is at threshold up to a maximum of 20% when the forecast is 6 times the threshold or greater. The 1 exception is the Sitka Sound area, where the harvest rate is set at 12% when the forecast is at threshold, and at a maximum of 20% when the forecast is twice the threshold or greater. Maximum harvest rates used for herring in Southeast Alaska are based on studies in Alaska and elsewhere that concluded a maximum 20% harvest rate is sufficiently conservative to maintain healthy stocks of herring when paired with appropriate thresholds (Zheng et al. 1993; Doubleday 1985). The sliding scale element of the harvest rate calculation used for Southeast Alaska herring was included as an additional precautionary measure to reduce the harvest rate as stock biomass declines toward the threshold.

Threshold biomass levels have been established for each commercially exploited stock in Southeast Alaska and are intended to reduce the risk of sharp declines in abundance due to recruitment failure and to maintain adequate herring abundance for predators. Commercial harvest of herring is not permitted unless the forecast of mature herring meets or exceeds the threshold. For Sitka Sound and West Behm Canal, threshold levels were based on analyses using simulation models to estimate 25% of the average unfished biomass (Carlile 1998a, 2003). In the case of Sitka Sound, the threshold was subsequently increased by the Board of Fisheries on 2 occasions (1997 and 2009) to provide additional protection to the stock and to help alleviate concerns over adequate subsistence opportunities to harvest the resource. For the Tenakee Inlet stock, 25% of the average unfished biomass was estimated using the same methods; however, because the resulting value was lower than the 3,000-ton threshold that existed at that time, the existing threshold was retained as a precaution (Carlile 1998b). For all other stocks in Southeast Alaska, thresholds were established by reviewing historical estimates of abundance, historical knowledge of stock size fluctuation and distribution, and manageability of minimum quotas. Threshold levels during the 2022–2023 season ranged from 2,000 tons (Hoonah Sound and Hobart Bay) to 25,000 tons (Sitka Sound).

Management Plan

The following management plan was in place for the 2022–2023 Southeast Alaska commercial herring fisheries. It was adopted by the Alaska Board of Fisheries at its January 1994 meeting.

> **5 AAC 27.190. Herring Management Plan for Southeastern Alaska Area**. For the management of herring fisheries in the Southeastern Alaska Area, the department
>
> (1) shall identify stocks of herring on a spawning area basis;
>
> (2) shall establish minimum spawning biomass thresholds below which fishing will not be allowed;
>
> (3) shall assess the abundance of mature herring for each stock before allowing fishing to occur;
>
> (4) except as provided elsewhere, may allow a harvest of herring at an exploitation rate between 10 percent and 20 percent of the estimated spawning biomass when that biomass is above the minimum threshold level;
>
> (5) may identify and consider sources of mortality in setting harvest guidelines;
>
> (6) by emergency order, may modify fishing periods to minimize incidental mortalities during commercial fisheries.

Additionally, the following regulation was in effect to set harvest levels in Sitka Sound:

> **5 AAC 27.160 Quotas and guideline harvest levels for Southeastern Alaska Area.**
>
> (g) The guideline harvest level for the herring sac roe fishery in Sections 13-A and 13-B shall be established by the department and will be a harvest rate percentage that is not less than 12 percent, not more than 20 percent, and within that range shall be determined by the following formula:
>
> $$\text{Harvest Rate Percentage} = 2 + 8\left[\frac{\text{Spawning Biomass (in tons)}}{20{,}000}\right]$$
>
> The fishery will not be conducted if the spawning biomass is less than 25,000 tons.

Although there are several other regulations within the Alaska Administrative Code that pertain to specific herring fisheries in Southeast Alaska, the above general management plan represents the over-arching requirements for setting harvest levels for herring fisheries in the region.

RESULTS

Aerial and Skiff Surveys

Aerial and skiff surveys of herring activity, herring spawn, and marine mammal and bird activity were conducted at major stock locations. These surveys began on March 13, 2023, in Sitka Sound and ended on May 19, 2023, in the Seymour Canal, Northern Stephens Passage, and Hobart Bay–Port Houghton areas. Notes of activity related to herring or herring spawning were recorded in aerial survey logs (see Appendix C). Surveys or observations were conducted by staff from each area office (Ketchikan, Petersburg, Sitka, Juneau, Haines, and Yakutat) and covered important or traditional herring spawning locations within each management area. Occasionally, private pilots or local residents may report observations of active spawning. Spawning timing for each monitored spawning area, including dates of first, last, and major spawning events, is summarized in

Figure 13. ADF&G may at times complete aerial surveys of Annette Island Reserve while en route to other spawning areas located in state waters.

The total documented spawn for major spawning areas in state waters where aerial surveys were conducted in Southeast Alaska and Yakutat in 2023 was 141.1 nmi. This measurement did not include spawning around Annette Island Reserve, or numerous minor spawning areas in Southeast Alaska or Yakutat (see Appendix C for a detailed accounting of other minor spawn areas throughout Southeast Alaska). The highest levels of spawn were observed in the Sitka Sound area (83.5 nmi) and in the Craig area (29.4 nmi). Spawning observed in other survey areas ranged from 0 nmi in Hoonah Sound to 7.6 nmi for the Tenakee Inlet spawning stock.

SPAWN DEPOSITION SURVEYS

During spring 2023, spawn deposition dive surveys were conducted only in Sitka Sound and Craig spawning areas. The first survey was conducted April 11–15 in the Sitka Sound area, followed by the Craig area during April 17–18 (Table 1). Egg estimates by transect for each spawning area are presented in Table 4.

Due to low levels of observed spawning, spawn deposition dive surveys were not conducted in 2023 in several historically surveyed areas, including Kah Shakes–Cat Island, Seymour Canal, Tenakee Inlet, Lynn Canal, Hoonah Sound, West Behm Canal, Ernest Sound, and Hobart Bay–Port Houghton. These areas are considered *inside* stocks (i.e. less exposed to open ocean as Sitka and Craig, which are considered *outside* stocks), and for several years have persisted at low levels based on observed spawn mileage levels. Aerial surveys were made opportunistically in several additional minor spawning areas, but low observed spawning again indicated dive deposition surveys were not warranted. In some minor areas specifically (e.g., Bradfield Canal), surveys conducted in previous years revealed that despite substantial miles of observed spawn only a narrow band of spawning habitat existed, resulting in relatively low egg deposition and therefore lessening justification for egg deposition surveys (see Appendix C).

In the Sitka Sound and Craig areas, egg deposition estimates in 2023 were relatively high—respectively the 4th and 5th highest on record. In Sitka Sound, an increase from 14.6 trillion eggs to 19.9 trillion eggs was due primarily to a substantial increase in egg density, which increased from 813,231 eggs/m^2 in 2022 to 1,395,411 eggs/m^2 in 2023. In Craig, the egg deposition estimate declined from 5.3 trillion to 4.0 trillion eggs, which was attributable to a decrease in spawn zone area (5,836,022 m^2 to 4,043,624 m^2) despite an increase in egg density, from 817,542 eggs/m^2 in 2022 to 887,127 eggs/m^2 2023. A summary of the 2023 survey results, including spawn mileage, average transect length, area of egg deposition, egg density, estimated egg deposition, and estimated spawning biomass, is presented in Table 5. For comparison of 2023 spawning stock abundance to prior years, estimates of historical spawning biomass for each stock, including inside and outside stocks, are presented in Figures 14–19.

Visual Estimate Correction

Minimum sample size guidelines (at least 6 samples per vegetation type for 2 of last 3 years) were met for all estimators. Correction coefficients applied to 2023 spawn deposition visual estimates ranged from 0.49 to 1.52 and are presented in Table 6.

Visual review of observed versus laboratory estimates of eggs suggests the presence of linear relationships for some estimators, but nonlinear relationships for others. These nonlinear patterns are caused by an innate tendency to underestimate when egg numbers in sample frames are high.

A similar nonlinear pattern has been observed for aerial estimates of salmon in streams (see Jones et al. 1998); however, correction coefficients in that study were also calculated as straight ratios of known to estimated values. For herring egg correction coefficients presented here, values were calculated as an overall ratio of values summed across the entire range of lab-estimated and visually estimated values, which was considered to adequately correct visual estimates. However, because nonlinear relationships probably exist that bias correction coefficients low, the result is that estimates of egg abundance are also probably biased low.

AGE AND SIZE

A combined total of 6,014 herring were sampled from all stocks and gear types (cast net, purse seine, and pound) during the 2022–2023 season. Of those, 5,838 herring were processed to determine age, weight, length, and sex, for those herring age-3 or greater. The reduction of sample size was due to exclusion of age-1 and age-2 herring, fish that could not be aged due to regenerated scales, or data that was otherwise unusable.

Samples of the spawning areas in Craig, Sitka Sound, Revilla Channel, Seymour Canal, Tenakee Inlet, Northern Stephen's Passage, and Yakutat were taken using cast nets. Samples from Craig and Sitka Sound were collected throughout the geographic extent of the active spawn (Figures 20–21), and throughout the duration of spawning (Figure 13), focusing on the most intense spawning events when feasible. All other spawning areas were sampled more sporadically, as weather and time permitted, and may not have captured the full spatial or temporal range of spawning (Figures 22–25).

Samples were also obtained from all commercial fisheries that were conducted in 2022–2023. Fisheries sampled included Sitka Sound sac-roe, Craig winter bait, and Craig spawn on kelp. Samples were obtained opportunistically from vessels or tenders during or shortly after the fishery openings. Sample locations during fisheries are shown in Figures 20–21.

The minimum sample goal of 500 aged fish per sampling event (gear–fishery combination) was met or exceeded for most areas and fisheries where samples were obtained. The goal was not achieved for Seymour Canal, Tenakee Inlet, or North Stephen's Passage (Table 7). Although age and size samples were not obtained for several other traditionally sampled stocks, aerial surveys were completed and observed spawn locations are presented for those stocks in Figures 26–29.

Age Composition

Age composition data were obtained for 7 spawning areas in the region in 2023: Sitka Sound, Craig, Revilla Channel, Seymour Canal, Tenakee Inlet, Northern Stephen's Passage, and Yakutat Bay. Samples were not obtained from Ernest Sound, Hobart Bay–Port Houghton, Hoonah Sound, Lynn Canal, or West Behm Canal due to low levels of observed spawn, or inability to sample due to weather or other circumstances. Frequency distributions of herring ages from sampled spawning areas are presented in Tables 8–14 and Figures 30–33.

Observed age distributions among sampled areas were more variable than in recent years. This fluctuation is probably because the dominant 2016 age class has waned. In some areas the 2016 age class was still very prominent as age-7 in 2023, including Sitka, Craig, Tenakee Inlet, and Northern Stephens Passage. In other areas, the proportion of age-4 herring exceeded age-7 (such as Kah Shakes–Cat Island and Seymour Canal). For several areas, there appears to have been substantial age-3 recruitment, including Sitka, Craig, Kah Shakes-Cat Island, Tenakee Inlet, and Seymour Canal. In some cases, the proportion of age-3 approached or exceeded that of age-7, signifying the decline of the strong 2016 age class, and suggesting another strong year class may be entering the population. For perspective, historical age compositions of spawning populations are presented in Figures 34–43.

Based on observed proportions of age-3 herring, recruitment in 2023 appears to have been at least moderate, if not high. In 2023, age-3 proportions observed in sampled spawning populations ranged 21–41%.

The proportions of age-3 herring entering the mature population each year fluctuates in a similar, cyclical pattern among stocks in the region, with high and low years synchronized in many instances in magnitude, trajectory, or both (Figure 44). When northern and southern stocks are considered separately, the synchronized pattern is even more apparent within each group. For example, in 2015 a high proportion of age-3 herring were observed for all stocks; however, in 2016 a relatively low to moderate proportion of mature age-3 herring were observed in most spawning areas. It appears that age-3 proportions for spawning areas in 2023 were generally higher than those observed in 2022, and in all cases exceed the median recruitment observed over the last few decades.

Size-at-age

Based on cast net samples in 2023, there remains a clear distinction between mean weight-at-age for Sitka Sound and other spawning stocks of herring in Southeast Alaska (Figure 45). Although several stocks had similar weight-at-age at age-3, by age-4 Sitka Sound herring attained a higher average weight than other stocks and the divergence increased with each age group. In 2023 herring samples were obtained from Yakutat Bay outer coastal stock, revealing the most comparable weight-at-age to Sitka Sound herring.

Mean length-at-age among spawning areas has a similar pattern to weight-at-age. Although the distinction between Sitka Sound herring mean length-at-age and other Southeast Alaska stocks is visually apparent, it is not as great as observed for mean weight-at-age (Figure 46). Length-at-age for Sitka Sound and Yakutat Bay herring is virtually the same for every age group.

Trends in weight-at-age over time are variable among stocks (Figures 47–56). For most stocks, a common pattern is evident: weights of age-3 herring have been relatively stable over the past few decades, whereas those of older ages appear to have gradually declined. The decline appears to be more pronounced for the oldest age classes. The current range of mean weight among age classes appears narrower than it was 3 decades ago. Although the mean weight-at-age of herring is less now than it was 30 years ago, weight generally declined during the late 1980s to the early to mid-2000s but then appears to have stabilized over the past 15 years for most stocks. The exception is Sitka Sound, where weight-at-age appears to have remained relatively stable over the past 20 years; however, this followed a period of low weight-at-age in the early 1990s, a time when anecdotally herring had been described as *pencil herring*. Data presented here only date back to the late 1980s, which coincided with the period of low weight and low condition factor of Sitka area herring. Weight-at-age in 2023 appears to continue the upward trend that has been observed over the past few years (for stocks where data are available).

To understand whether changes in weight-at-age are due solely to body mass—or if changes in length-at-age play a role—it is helpful to calculate condition factors. Condition factors have been calculated to roughly gauge herring health using the physical dimensions of herring (i.e., weight-to-length ratio) over time (Figures 57–66). Data obtained from cast net samples during active spawn events were used to calculate condition factors. Data sets are more complete and consistent for cast net samples than commercial samples, allowing easier comparison among stocks. Weight estimates derived from samples taken from actively spawning herring probably produce lower average values that contain more variability than would be expected from pre-spawning fish sampled during the commercial fishery; however, the overall trends in condition factor are expected to be the same. Another benefit of using data from cast net samples is that bias is expected to be lower than fishery-dependent data that may be influenced by selection of larger fish.

Mean condition factors of herring from most stocks in Southeast Alaska follow the same general pattern over the last 2 decades: relatively low in the early 1990s and peaking in the early 2000s, followed by a decline until about 2007. Starting in 2008, condition factors for most stocks increased sharply, peaking in 2010 and then declined sharply to 2012. The condition factors calculated in 2023 for stocks where data was available are relatively high—comparable to or exceeding those of 2022—and indicate a continued increase over the past few years.

COMMERCIAL FISHERIES

Commercial harvest is permitted in an area only if the forecasted spawning biomass meets or exceeds a minimum threshold (Table 15). If that threshold is met or exceeded, then a sliding-scale harvest rate of between 10 and 20 percent of the forecasted spawning biomass is calculated to determine the appropriate harvest level. For Sitka Sound, the allowable harvest rate ranges from 12 to 20 percent of the forecasted spawning biomass.

During the 2022–2023 fishing season, only 3 commercial herring fisheries were conducted in Southeast Alaska. These 3 fisheries took place in 2 spawning areas, Sitka Sound and Craig. Products resulting from these fisheries included sac-roe, food and bait, and spawn on kelp. A summary of locations, harvest levels, and periods of harvest is presented in Table 16.

Sac Roe Fisheries

The only commercial sac roe fishery in 2023 was conducted in the Sitka Sound area. There were no sac-roe fisheries announced for Seymour Canal, West Behm Canal, Hobart Bay–Port Houghton, or Kah Shakes–Cat Island areas. These areas remained closed to sac roe fisheries because estimates of spawning biomass and forecasts were not conducted, primarily due to low levels of observed spawn. Lynn Canal was historically a sac roe fishery area; however, the Board of Fisheries rescinded regulations allowing a fishery in that area at its January 2018 meeting in Sitka.

Sitka Sound

In Sitka Sound, the 2023 forecast was 150,617 tons, and the guideline harvest level (GHL) was set at 30,124 tons. The GHL was calculated based on the maximum allowable 20% of the SCAA-forecasted biomass. No decrements were made to the GHL. This decision was a departure from recent years, when GHLs were lowered to account for uncertainty surrounding the forecasted return of the large 2016 age class. Decrements were not made in 2023 because after several years of observation of that age class, forecasts were less uncertain, making reductions unwarranted.

The fishery went on 2-hour notice on March 23, 2023, at 8:00 AM. Beginning with the first fishery opening on March 26, 2023, the fishery was opened for 8 days through April 7, closing on April 11, 2023. The landed catch totaled 10,200 tons, with an average mature roe percentage of 10.8%.

The catch represented 34% of the GHL. Landings were made by 29 of the 47 active permit holders for the fishery.

Seymour Canal

There was no commercial fishery in the Seymour Canal area during the 2022–2023 season, because no stock assessment survey or forecast was conducted due to low levels of observed spawn.

West Behm Canal

There was no commercial fishery in the West Behm Canal area during the 2022–2023 season, because no stock assessment survey or forecast was conducted due to low levels of observed spawn.

Hobart Bay–Port Houghton

There was no commercial fishery in the Hobart Bay–Port Houghton area during the 2022–2023 season, because no stock assessment survey or forecast was conducted due to low levels of observed spawn.

Kah Shakes–Cat Island

There was no commercial fishery in the Kah Shakes–Cat Island area during the 2022–2023 season because no stock assessment survey or forecast was conducted due to low levels of observed spawn.

Winter Bait Fisheries

During the 2022–2023 season, the only winter food and bait fishery was in the Craig area. All other winter bait areas were closed due to low levels of observed spawn.

Craig

The fishery was opened in the Craig area on October 1, 2022, and was closed by regulation on February 28, 2023. The bait allocation was 4,657 tons, which was by regulation 60% of the total GHL of 7,661 tons. A total of 742 tons of herring were harvested.

Ernest Sound

There was no commercial fishery in Ernest Sound during the 2022–2023 season due to low levels of observed spawn and reduced funding.

Tenakee Inlet

There was no commercial fishery in Tenakee Inlet during the 2022–2023 season due to low levels of observed spawn and reduced funding.

Spawn-on-Kelp Pound Fisheries

In the spawn-on-kelp (SOK) fisheries, closed-pound fishing involves capturing reproductively mature herring and releasing them into a net impoundment within which kelp is suspended. The herring are released from the pound after they spawn on the kelp and the kelp with eggs is then sold. Open-pound fishing involves suspending kelp from a floating frame structure in an area where herring are spawning. The herring are not impounded but instead they naturally spawn on the suspended kelp. The kelp blades with eggs are removed from the water then sold. In the

Southeast Alaska herring SOK fisheries, a closed or an open pound may be operated by 1 or more Commercial Fisheries Entry Commission (CFEC) permit holders (Coonradt et al. 2017).

These fisheries present unique challenges to fishery management, primarily because herring are released alive after spawning in pounds, which makes determining herring usage and mortality difficult to estimate. Attempts have been made to estimate the amount of herring placed into pounds by brailing and weighing herring from pounds instead of releasing after spawning; however, these were largely unsuccessful due to low sample size of pounds and uncertainty about herring losses (e.g., to sea lion or eagle predation) prior to brailing. Estimates of herring use in SOK pounds have been completed in Prince William Sound (PWS) by measuring egg deposition on kelp and pound webbing, egg retention within herring, and herring fecundity to back calculate the number of herring (Morstad and Baker 1995; Morstad et al. 1992). These studies found that approximately 12.5 tons of herring are used for each ton of spawn-on-kelp product. However, because mean pound size in PWS fisheries is substantially larger than those used in Southeast Alaskan fisheries, this ratio may not be directly comparable. Nevertheless, because no studies have been completed in Southeast Alaska, this conversion is used to approximate herring usage for Southeast Alaska pound fisheries, particularly when reporting estimates over time for comparability. Other estimates of the amount of herring in pounds have also been used, which are based on observations of fishery managers during fisheries. These estimates have ranged from 10 to 20 tons of herring per closed pound structure and have been used as inputs to stock assessment models. To estimate herring dead loss from pounds, a mortality rate of 75% is assumed for herring that are placed into pounds.

The only area open to the commercial harvest of SOK during the 2022–2023 season was Craig. The other SOK areas in the region, Hoonah Sound, Ernest Sound, and Tenakee Inlet, were not opened during the 2022–2023 season because surveys and forecasts were not conducted, primarily due to low levels of observed spawn in 2022.

Craig

A total of 41 closed pounds were actively fished, by a total of 79 permit holders. Of the 41 closed pounds, there were 5 single, 33 double, and 3 triple-permit pounds. No open pounds were fished. Total harvest was 128 tons of spawn on kelp.

Hoonah Sound

There was no commercial fishery in Hoonah Sound during the 2022–2023 season due to low level of observed spawn.

Ernest Sound

There was no commercial fishery in Ernest Sound during the 2022–2023 season due to low level of observed spawn.

Tenakee Inlet

There was no commercial fishery in Tenakee Inlet during the 2022–2023 season due to low level of observed spawn.

Bait Pound (Fresh Bait and Tray Pack) Fisheries

During the 2022–2023 season, there was no harvest of herring for fresh bait pounds or tray-pack in Southeast Alaska.

Test Fisheries

There was 224 tons of herring test fishery harvest in Southeast Alaska during the 2022–2023, which took place in Sitka Sound and was landed as winter bait.

DISCUSSION

Annual spawn deposition surveys and sampling for age and size are the primary sources of fishery-independent data used to assess herring stocks in Southeast Alaska. These data are valuable inputs for the models used to estimate and forecast mature biomass; these biomass forecasts are measured against fishery threshold levels to determine if commercial fisheries may be allowed. Although the models typically provide the department's best estimates of biomass, age composition, and other outputs such as recruitment and mortality rates, the egg deposition, age, and size data can also be used when necessary to roughly estimate biomass, age composition and size. The results of the survey and sampling data provide a simple *preview* of raw data and trends in herring populations prior to the modeled results. Although they do not represent the final, best estimates, they provide an intuitive, quick review of stock status until model estimates are available.

SPAWN DEPOSITION

The combined observed spawning biomass estimated in 2023 for Sitka Sound and Craig, as converted from egg deposition estimates, was 297,346 tons. This estimate is more than twice the mean biomass for all Southeast Alaska herring stocks combined and among the highest estimates of regional biomass since the department instituted a herring stock assessment program in 1971. The estimate for these 2 stocks is about 22% more than the 243,822 tons estimated for 2022. The Sitka Sound and Craig stocks typically account for about 80% of the spawning biomass in Southeast Alaska. Sitka Sound observed spawning biomass increased by 37% in 2023 relative to 2022, and Craig decreased by 25%. Although error estimates surrounding the biomass estimates for Sitka and Craig were not calculated, it is assumed that changes greater than 20% reflect biologically meaningful changes in the spawning population levels.

Spawn deposition estimates for 2023 suggest that herring spawning biomass in Southeast Alaska remains at a high level relative to the period 1980–2022. This is true despite only surveying Sitka Sound and Craig in 2023. The 2023 combined estimate of 297,346 tons for both surveyed areas represents a moderate increase from the 2022 estimate of 243,822 tons; however, other herring spawning areas in the region remain at low levels.

The continued disparate biomass levels observed for outside and inside water herring stocks remains a mystery. Between about 2011 and 2016, herring spawning stocks located in inside waters (stocks except Sitka and Craig) collectively underwent a sharp decline in spawning levels and biomass, while spawning stocks along the outer coast (Sitka and Craig) did not undergo the same decline. This drop followed a period of building from the late 1990s, which peaked during 2008–2011. Coincident with the decline were reductions to state budgets, which prevented full annual stock assessment surveys for most herring stocks in the region beginning in 2016—although low spawning levels also contributed to the lack of traditional egg deposition dive surveys. Stock assessment surveys have continued uninterrupted for only the 2 largest stocks, Sitka Sound and Craig, and so firm conclusions cannot be made about broader herring biomass trends throughout the region. Limited aerial surveys have continued in areas, which have provided some information about stock levels; however, miles of shoreline do not necessarily provide an accurate depiction of spawning biomass. Nonetheless, when considering spawn mileage alone in areas other than Sitka Sound and Craig, herring stocks in the region remain at low levels in 2023 relative to the past few decades. This pattern suggests that outer coastal stocks are faring far better than those with less exposure to open ocean influence. It is unknown why this pattern persists. Herring population is especially susceptible to environmental influences, and abundance is known to fluctuate dramatically (e.g., Toresen 2001).

Multiple factors may be responsible for the decrease in inside water stocks since 2011. Factors contributing to the decline may include increasing populations of predatory marine mammals, such as humpback whales and Stellar sea lions (Muto et al. 2016, Fritz et al. 2016); increasing levels of predatory fish or possibly squid; or recent shifts in water temperatures, which could negatively affect herring food sources, life history, spawn timing, and metabolism. Of course, another contributing factor may be commercial fishing. Although commercial fishing has occurred during some years for some inside water stocks, the similarity in declines of these stocks, which for some occurred in the absence of fishing in recent decades (e.g., West Behm Canal, Lynn Canal), suggests that the declines may also have a substantial environmental influence. Additionally, the fact that the Sitka and Craig stocks have not decreased as inside water stocks have—with record high levels in recent years despite the most frequent fisheries and often the highest harvest rates allowable—further clouds the possibility that commercial harvest has been solely responsible for the decline.

Although the increase observed for Sitka and decrease observed for Craig spawning biomass over the past year are most likely due to actual changes in the herring population levels, there is also a chance that the changes are at least partly a function of estimate error, or a combination of both. Because error estimates were not calculated for spawn deposition estimates, it is possible that the changes in biomass were due, at least in part, to estimate error.

Estimates of observed spawning biomass presented in this report are based primarily on egg deposition estimates (as opposed to model-derived results), and are presented here solely to provide a general, broad-brush view of trends in mature herring biomass. These estimates should not necessarily be considered the most accurate estimate of biomass in any given year. For all herring stocks in Southeast Alaska, when available, the results of SCAA or biomass accounting models are considered to provide more reliable estimates of spawning biomass and are the basis for forecasting herring abundance and setting harvest levels. A primary reason that the SCAA model provides more reliable estimates is that it incorporates several other sources of data and information, such as age composition, catch, and fecundity, and it combines a long time series of data to estimate spawning biomass, whereas spawn deposition-derived estimates rely on only a single year of spawn deposition data. An advantage of using biomass estimates derived from spawn deposition is that they provide a time series of fixed historical values. Conversely, SCAA hindcast estimates are derived from single model runs, which may be less intuitive because they change with each model run. Additionally, in some years modeling may not be completed for some stocks due to inadequate data or a very low level of spawning, leaving gaps in the time series of estimates. Because spawn deposition surveys are conducted annually, biomass estimates derived from egg deposition provide a consistent and comparable time series to gauge trends.

AGE COMPOSITION

Age compositions of most sampled spawning areas in 2023 revealed that the exceptionally strong 2016 age class is no longer dominant but still prominent as age-7 herring. This strong year class has been reported for herring populations in Kodiak and Prince William Sound, and historically similar broad-scale large recruitments have been observed in Sitka Sound and Prince William Sound (Carls and Rice 2007).

The specific mechanism that caused this recruitment spike over such a large scale is uncertain, but it was likely linked to a common pattern in ocean temperature. This cohort was hatched in spring 2016, which coincided with the tail end of an unusually warm water mass that circulated through the northern Pacific Ocean, commonly known as *the blob* (Gentemann et al. 2017). Although speculation, it is possible that elevated sea temperatures from the blob helped produce marine conditions favorable to larval and juvenile herring survival in 2016, ultimately leading to a large recruitment 3 years later when those fish first entered the spawning population. This marine heatwave was well known to have widespread effects on other species and marine communities across the North Pacific, although the implications to populations and the ecosystem are not yet fully understood (Ferriss and Zador 2020).

The relatively high proportions of mature age-7 herring observed in 2023 suggest that this cohort continues to be a large component of Southeast Alask populations but that it is nearing the end of its prominence. In 2023 there appears to have been notable age-3 recruitment, with proportions approaching or exceeding those of age-7 herring for several stocks. One of the highest proportions of age-3 herring in 2023 was for the Sitka stock, where there was also an increase in observed spawning biomass, suggesting that this new age class may replace the waning 2016 age class as the most dominant. It is difficult to gauge the impacts of this new recruitment on inside water stocks, lacking biomass surveys.

For herring stocks sampled in 2023, estimates of age composition continued to follow patterns that are generally expected from tracking previous cohorts; that is, the proportion of cohort sizes either grew or declined because of increases due to maturation or decreases due to natural mortality and no surprising or abrupt changes were observed in relative cohort strength (see Figures 34–43). These patterns also lend support to the assumption that the method of aging scales from 2023 samples was consistent with those methods used in prior years, which has been a concern in prior years (Hebert 2012a and 2012b).

Historical patterns of age composition, and particularly proportions of age-3 herring, persist among stock groups within the region. These patterns suggest that similar marine conditions may be present among certain areas within the region (Figure 44). The proportion of mature age-3 herring within each stock appears to be correlated to the latitude of the spawning stock. There continues to be 2 broad areas within the region where the mean proportion of age-3 herring is similar. For stocks south of latitude 56 degrees (i.e., those in the lower half of the region: Craig, West Behm Canal, Ernest Sound, and Kah Shakes–Cat Island), the mean proportion of age-3 herring is relatively high; for stocks at 57 degrees and northward (Sitka, Hobart Bay, Seymour Canal, Hoonah Sound, Tenakee Inlet, and Lynn Canal), the proportions are relatively low. The strength of the 2019 age-3 pulse overrode the usual pattern seen among stocks on separate sides of the latitudinal split, further indicating that age class was exceptional. Proportions of age-3 observed in 2023 also appear to depart from the historical pattern. For all spawning areas where age data was collected north or south of the latitudinal split, the proportion of age-3 herring exceeded—sometimes greatly—the median of the past few decades.

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TABLES AND FIGURES

Table 1.–Historical dates of herring spawn deposition surveys in Southeast Alaska.

Year	Sitka	Craig	Ernest Sound	West Behm Canal	Revilla Channel	Hobart Bay	Seymour	Tenakee	Hoonah Sound	Lynn Canal
1976	5/1-6	–	–	–	4/13-24	–	–	–	–	–
1977	4/26-28	–	–	–	4/13-19	–	–	–	–	–
1978	4/18-21	–	–	–	4/10-11	–	5/14-16	–	–	5/2-4
1979	–	–	–	–	4/9-12	–	--	–	–	–
1980	–	–	–	–	4/7-11	–	5/15-16	–	–	5/13-15
1981	4/10-11	–	–	–	4/1-4	–	5/14-15	–	5/4	–
1982	4/13-22	–	–	–	4/4-18	–	5/24-25	–	–	–
1983	4/13-17, 29	–	–	–	4/5-11	–	5/9-11	–	–	5/6
1984	4/10-17	–	–	–	4/10-15	–	5/4	5/5-7	5/8	5/4
1985	*	*	*	*	*	*	*	*	*	*
1986	*	*	*	*	*	*	*	*	*	*
1987	*	*	*	*	*	*	*	*	*	*
1988	4/15-20	3/24-25	–	–	4/8-12	–	5/5-7	5/10-11	–	5/14
1989	4/10-16	4/7-9	–	–	--	–	5/17-19	5/10-12	4/18-19	–
1990	4/15-18	4/14	–	–	3/29-4/12	–	5/7-10	5/5-6	5/20-23	–
1991	4/25-27	*	*	*	*	*	*	*	*	*
1992	4/23-26	3/30, 4/18-21	5/2	–	4/14-17	5/10-11	5/9-10	–	5/5	–
1993	4/10-13	4/8	4/29-30	4/25-26	4/22-24	5/5	5/10-11	5/7-8	5/6	–
1994	4/8-11	4/18-19	5/6	5/4-5	4/15-17	5/7-8	5/12, 19	–	4/29-30	–
1995	4/7-10	4/6	5/2-3	–	4/20-22	5/4-6	5/23-24	–	4/27-28	–
1996	3/29, 4/2-4, 23-24	4/17-18	5/1	4/21	4/19-20	5/10	5/16, 29	5/15-16	5/12-13	–
1997	4/7-9	4/22-23	–	4/29-5/1	4/16-17	5/9	5/12-13	5/10-11	5/6-8	–
1998	4/1-3	4/12-14	4/22-23	4/20, 22-23	4/9	4/29-30	5/2, 8-9	5/5-7	5/4-5	–
1999	4/7-9	4/10, 20	–	4/16-17	4/14-15	4/4-5	5/11-12	5/7-8	5/9	–
2000	4/4-6	4/13-14	4/25	4/17-18	4/16-17	5/11	5/12-13	5/3-4, 6	5/7	–
2001	4/9-10	4/18-19	4/24	4/21-22	4/20	5/11-12	5/21-22	5/8-9	5/6-7	–
2002	4/8-11	4/16-18	4/21	4/19-20	–	5/10-11	5/30-31	5/3-4, 6	5/7	–
2003	4/8-11, 22	4/13-14	4/27	4/24-26	–	5/8-9	5/10	5/7	5/5-6	–

-continued-

Table 1.–Page 2 of 2.

Year	Sitka	Craig	Ernest Sound	West Behm Canal	Revilla Channel	Hobart Bay	Seymour	Tenakee	Hoonah Sound	Lynn Canal
2004	4/15-19	4/8-9	4/11, 21	4/19-20	–	5/9-10	5/11-12	5/7-8	5/5	5/13
2005	4/9-12	4/17-19	5/4	4/21	–	5/9-10	5/10-11	5/7	5/5-6	5/18
2006	4/7-8	4/10-11	4/14-15	4/29	–	5/7	5/10	5/8	5/4-5	5/26
2007	4/13-16, 24	4/18-19	4/24-25	4/23, 5/4	–	5/22	5/21	5/5	5/7	5/25
2008	4/10-14	4/15-16	5/2-3	4/18	–	5/13	5/16	5/10	5/7-8	5/21
2009	4/18-20	4/15-16	4/23	4/21-22	–	5/14-15	5/13-14	5/8-9	5/6-7	5/11-12
2010	4/16-19	4/14-15	4/22	4/20	–	5/5-6	5/7-8	5/11	5/9-10	5/12-13
2011	4/18-20	4/14-15	4/24	4/23	–	5/8-9	5/9-10		5/5-6	--
2012	4/13-16	4/21-22	4/24	4/23	–	5/5	5/12-13	5/8	5/7	5/10-11
2013	4/8-12, 5/2-5	4/14-15	4/17	4/16	–	5/8	5/13-14	5/11	5/12	5/10
2014	4/7-11, 24-26	4/13	4/22	4/15	–	5/1	5/10	5/7	5/8	5/9
2015	4/10-13, 5/6-7	4/8	4/21-22	–	4/6	5/5	5/11	5/9	5/6	5/10
2016	4/1-3, 20-21	4/8-9	4/26-27	–	–	–	5/8	–	–	5/7
2017	4/12-14, 28	4/7-8	–	–	–	–	5/15	–	–	–
2018	4/8-11, 24-25	4/13-14	–	–	–	–	–	–	–	–
2019	4/12-15	4/9-10	–	–	4/6	–	–	–	–	–
2020	4/4-6, 8-9	4/13-14	–	–	4/11	–	–	–	–	–
2021	4/17-21	4/15-16	–	–	4/11-12	–	–	–	–	–
2022	4/13-16	4/17-18	–	–	4/9	–	–	–	–	–
2023	4/11-15	4/17-18	–	–	–	–	–	–	–	–

Note: En dashes represent years without surveys. Asterisks represent years when surveys were completed but records of dates are missing.

Table 2.–Transect minimum sampling rates used for 2023 herring spawn deposition surveys.

Area	Estimated target transects per nautical mile of spawn[a]			
	Based on 1994 analysis	Based on 1997 analysis	Based on 2000 analysis	Average
Sitka	0.2	0.6	0.3	0.4
West Behm Canal	–	0.4	1.7	1.1
Seymour Canal	2.8	2.4	1.2	2.1
Craig	0.8	3.1	1.3	1.7
Hobart/Houghton	4.5	1.7	3.6	3.3
Ernest Sound	1.9	5.0	3.5	3.5
Hoonah Sound	2.9	1.0	0.7	1.5
Tenakee Inlet	5.1	1.2	1.6	2.6
Average	2.6	1.9	1.7	2.1

[a] Values represent the number of transects that will produce a lower bound of the one-sided 90% confidence interval that is within 30% of the mean egg density.

Table 3.–Fecundity relationships used for estimating 2023 herring spawning biomass for stocks in Southeast Alaska.

Sample year	Stock sampled	Fecundity equation	Stocks where fecundity equation is applied
2005	Sitka Sound	fecundity = –3032.0 + 198.8*weight	Sitka, Tenakee Inlet, Hoonah Sound
1996	Seymour Canal	fecundity = –1573.3 + 222.4*weight	Seymour, Hobart–Houghton, Lynn Canal
1996	Craig	fecundity = –1092.3 + 210.5*weight	Craig
1996	Kah Shakes–Cat Island	fecundity = –1310.0 + 202.1*weight	Ernest Sound, West Behm Canal

Table 4.–Herring egg estimates (in thousands) by transect for 2023 spawn deposition surveys conducted in Southeast Alaska. Frame counts are the number of quadrats estimated along each transect.

	Craig		Sitka Sound Kruzof Stratum		Sitka Sound Eastern Stratum	
Transect Number	Egg estimate	Frame count	Egg estimate	Frame count	Egg estimate	Frame count
1	210	4	8,575	57	185	7
2	201	10	210	13	380	7
3	593	14	1,789	26	204	7
4	3,996	38	1,352	23	1,111	23
5	32	3	2,582	35	939	14
6	196	9	8,959	82	1,208	9
7	221	14	94,069	65	608	13
8	117	8	3,654	47	56	10
9	25	4	1,773	32	0	1
10	212	8	4,066	45	48	5
11	1,053	11	9,806	72	714	31
12	1,152	18	10,072	57	123	14
13	76	5	6,788	74	116	6
14	3,219	33	1,715	26	800	7
15	20,271	30	820	25	1	4
16	3,931	80	11,369	39	247	14
17	190	9	60	11	0	1
18	799	13	1,165	38	329	16
19	0	1	36	5	2,249	17
20	2,570	25	145	15	0	1
21	10	4	–	–	1	3
22	44	3	–	–	905	19
23	12	6	–	–	590	28
24	207	5	–	–	661	16
25	836	4	–	–	68	5
26	1,777	36	–	–	1,820	13
27	113	9	–	–	1,788	16
28	160	7	–	–	94	5
29	448	14	–	–	332	5
30	1,128	24	–	–	3,370	15
31	107	9	–	–	1,236	7
32	570	26	–	–	111	12
33	*	*	–	–	589	5
35	306	14	–	–	52	3
35	20	7	–	–	1,815	15
36	–	–	–	–	912	8
37	–	–	–	–	1,355	10
38	–	–	–	–	0	1
39	–	–	–	–	281	3
40	–	–	–	–	2,482	15
Average	1,318	15	8,450	39	695	10
Total	44,800	505	169,005	787	27,780	411

Note: En dashes indicate no survey transects planned or completed. Asterisks indicate that transects were planned but not completed.

Table 5.–Summary of results of herring spawn deposition surveys in Southeast Alaska for 2023.

Spawning stock	Number of transects completed	Average length of transects (m)	Observed spawn (nmi)	Area of survey (m^2)	Average egg density ($eggs/m^2$)	Total eggs in survey area (trillions)	Mean fish weight (g)[d]	Estimated fecundity of fish of mean weight	Estimated number of fish	Post-fishery mature biomass (tons)
Craig	34	74	29.40	4,043,624	887,127	3.986	106.7	21,368	373,060,473	43,878
Sitka Sound (total)	60	86	83.84	12,837,517	1,395,411	19.904	118.2	20,456	1,946,020,845	253,468
Kruzof stratum	20	197	17.80	6,485,982	2,147,453	15.476	–	–	–	–
Eastern stratum	40	51	57.10	5,432,865	675,916	4.080	–	–	–	–
post survey – Kruzof[a]	–	20	0.04	1,458	2,147,453	0.003	–	–	–	–
post survey – Eastern[a]	–	51	9.64	917,212	337,958	0.344	–	–	–	–
Kah Shakes–Cat Is.	–	–	4.60	–	–	–	–	–	–	–
Seymour Canal[b]	–	–	4.60	–	–	–	–	–	–	–
Ernest Sound[b]	–	–	1.90	–	–	–	–	–	–	–
Hobart–Houghton[b]	–	–	1.30	–	–	–	–	–	–	–
Hoonah Sound[b,c]	–	–	0.00	–	–	–	–	–	–	–
Lynn Canal[b]	–	–	0.70	–	–	–	–	–	–	–
Tenakee Inlet[b]	–	–	7.60	–	–	–	–	–	–	–
West Behm Canal[be]	–	–	3.00	–	–	–	–	–	–	–
Yakutat Bay[b]	–	–	4.21	–	–	–	–	–	–	–
Total	94	–	141.15	16,881,141	–	23.890	–	–	2,319,081,317	297,346
Average	47	161	–	8,440,570	1,141,269	11.945	112.4	20,912	–	–

Note: En dashes indicate data not available due to lack of survey (no funding or little or no spawn observed), or a total/average is not appropriate.

[a] Not surveyed, but applied average transect length and average egg density as follows, respectively for each strata: Kruzof post survey used 10% and 100%, Eastern post survey used 100% and 50%.

[b] No spawn deposition survey conducted due to low observed mileage in traditional spawning areas.

[c] Very infrequent aerial surveys conducted, so spawning may have been present but not observed.

[d] Represents mean weight of fish (g) in spawning population, weighted by age composition.

[e] Spawn was reported by public but not confirmed by ADF&G, although eggs were found at reported location later.

Table 6.–Correction coefficients used for herring spawn deposition estimates in Southeast Alaska in 2023.

	Estimator[a]								
Kelp type	A	B	C	D	E	F	G	H	Average
Eelgrass	1.12	0.86	0.89	0.91	0.82	0.94	0.80	1.13	0.93
n =	30	30	30	30	30	30	20	32	29
Fucus	1.52	0.90	0.78	1.38	1.13	1.11	1.38	1.48	1.21
n =	29	29	29	29	28	29	20	30	28
Fir kelp	0.74	0.93	0.49	0.80	0.74	0.64	0.61	0.74	0.71
n =	29	29	29	29	29	29	20	28	28
Hair kelp	1.37	0.91	1.08	1.07	1.06	1.24	1.05	1.03	1.10
n =	31	30	30	30	30	30	20	34	29
Large brown kelp[b]	1.31	0.81	0.72	1.07	0.82	0.84	0.84	1.51	0.99
n =	27	27	26	27	27	27	17	32	26
Average[c]	1.21	0.88	0.79	1.05	0.92	0.96	0.94	1.18	0.97

[a] Estimator identity is withheld to prevent results from altering estimating patterns in future years.

[b] Values are applied to genera *Agarum, Alaria*, *Costaria*, *Cymethere*, *Laminara, Saccharina*, and *Macrocystis*.

[c] Values are applied to estimates of eggs that are loose, on rock, or on unclassified kelp types.

Table 7.–Summary herring samples aged for Southeast Alaska stocks in 2022–2023.

	Commercial fishery			Survey	Test fishery	
Stock	Herring gillnet	Pound	Purse seine	Cast net	Purse seine	Total
Craig	–	517	512	538	–	1,567
Ernest Sound	–	–	–		–	–
Hobart–Houghton	–	–	–		–	–
Hoonah Sound	–	–	–	–	–	–
Lynn Canal	–	–	–	–	–	–
Seymour Canal	–	–	–	214	–	214
Sitka Sound	–	–	599	1,511	–	2,110
Tenakee Inlet	–	–	–	414	–	414
West Behm Canal	–	–	–	–	–	–
Revilla Channel	–	–	–	540	–	540
North Stephen Pass.	–	–	–	465	–	465
Yakutat	–	–	–	528	–	528
Total	–	517	1,111	4,210	–	5,838

Note: En dashes indicate that no samples were collected due to lack of funding or lack of observed spawning.

Table 8.–Summary of age, weight, and length for the Sitka Sound herring stock in 2022–2023.

Gear type, season	Parameter	Age category 3	4	5	6	7	8+	Total
Survey cast net, spring	Number of fish	527	101	133	49	653	48	1,511
	Percent age composition	35%	7%	9%	3%	43%	3%	100%
	Average weight (g)	62.1	90.9	105.2	117.6	135.4	148.8	110.0
	Standard deviation weight (g)	14.2	20.2	21.4	24.8	24.4	27.1	22.0
	Average length (mm)	165	185	194	201	208	213	194
	Standard deviation length (mm)	10.4	11.7	9.0	9.6	9.3	9.1	9.8
Commercial purse seine, spring	Number of fish	198	41	60	13	265	22	599
	Percent age composition	33%	7%	10%	2%	44%	4%	100%
	Average weight (g)	70.9	102.5	121.4	141.0	152.9	164.9	125.6
	Standard deviation weight (g)	15.1	23.3	18.4	21.4	24.4	21.6	20.7
	Average length (mm)	168	186	196	204	207	214	196
	Standard deviation length (mm)	10.0	11.9	7.6	7.6	8.7	8.3	9.0

Table 9.–Summary of age, weight, and length for the Craig herring stock in 2022–2023.

		Age category						
Gear type, season	Parameter	3	4	5	6	7	8+	Total
Survey cast net, spring	Number of fish	112	35	67	13	289	22	538
	Percent age composition	21%	7%	12%	2%	54%	4%	100%
	Average weight (g)	66.8	79.0	99.5	104.2	111.9	121.0	97.1
	Standard deviation weight (g)	13.4	15.5	21.2	14.8	22.2	28.3	19.3
	Average length (mm)	167	177	188	190	196	198	186
	Standard deviation length (mm)	9.3	10.2	9.8	9.2	10.0	10.4	9.8
Commercial pound, spring	Number of fish	199	43	61	9	195	10	517
	Percent age composition	38%	8%	12%	2%	38%	2%	100%
	Average weight (g)	68.4	81.1	105.4	112.8	122.7	132.5	103.8
	Standard deviation weight (g)	12.8	15.6	19.7	24.6	25.3	24.3	23.9
	Average length (mm)	165	173	186	190	194	199	185
	Standard deviation length (mm)	8.6	8.9	8.9	12.6	10.9	12.7	12.6
Commercial purse seine, winter	Number of fish	152	59	90	15	320	10	646
	Percent age composition	24%	9%	14%	2%	50%	2%	100%
	Average weight (g)	66.1	79.0	108.6	107.6	125.6	138.1	104.2
	Standard deviation weight (g)	16.1	17.9	19.5	16.6	22.3	16.1	18.1
	Average length (mm)	163	171	187	187	195	201	184
	Standard deviation length (mm)	11.6	10.1	9.6	8.6	10.1	7.7	9.6

Table 10.–Summary of age, weight, and length for the Seymour Canal herring stock in 2022–2023.

		Age category						
Gear type, season	Parameter	3	4	5	6	7	8+	Total
Survey cast net, spring	Number of fish	64	93	5	2	47	3	214
	Percent age composition	30%	43%	2%	1%	22%	1%	100%
	Average weight (g)	55.6	60.4	79.8	82.0	84.8	119.1	80.3
	Standard deviation weight (g)	11.0	12.6	9.0	1.8	12.6	10.8	9.6
	Average length (mm)	155	157	171	171	175	192	170
	Standard deviation length (mm)	8.9	9.3	6.1	4.9	7.5	6.9	7.3

Table 11.–Summary of age, weight, and length for the Kah Shakes–Cat Island herring stock in 2022–2023.

		Age category						
Gear type, season	Parameter	3	4	5	6	7	8+	Total
Survey cast net, spring	Number of fish	195	52	203	8	75	7	540
	Percent age composition	36%	10%	38%	1%	14%	1%	100%
	Average weight (g)	56.7	69.5	81.2	77.4	103.1	96.8	80.8
	Standard deviation weight (g)	15.5	15.5	14.9	18.3	22.7	26.2	18.8
	Average length (mm)	159	171	178	175	191	187	177
	Standard deviation length (mm)	11.5	11.7	9.5	11.2	10.7	12.7	11.2

Table 12.–Summary of age, weight, and length for the North Stephens Passage herring stock in 2022–2023.

		Age category						
Gear type, season	Parameter	3	4	5	6	7	8+	Total
Survey cast net, spring	number of fish	55	143	10	45	203	9	465
	percent age composition	12%	31%	2%	10%	44%	2%	100%
	average weight (g)	43.5	48.8	60.9	61.4	67.8	89.9	62.1
	standard deviation weight (g)	10.6	10.7	12.9	9.5	12.6	20.9	12.8
	average length (mm)	147	153	163	164	168	183	163
	standard deviation length (mm)	11.2	9.9	9.6	7.4	9.2	9.9	9.5

Table 13.–Summary of age, weight, and length for the Tenakee Inlet herring spawning area in 2022–2023.

		Age category						
Gear type, season	Parameter	3	4	5	6	7	8+	Total
Survey cast net, spring	Number of fish	169	81	23	5	128	8	414
	Percent age composition	41%	20%	6%	1%	31%	2%	100%
	Average weight (g)	64.2	76.8	100.3	89.3	107.0	109.0	91.1
	Standard deviation weight (g)	9.8	12.1	18.2	16.4	18.1	15.1	14.9
	Average length (mm)	166	175	188	188	193	196	184
	Standard deviation length (mm)	6.5	8.6	8.7	12.3	9.1	8.9	9.0

Table 14.–Summary of age, weight, and length for the Yakutat Bay herring spawning area in 2022–2023.

		Age category						
Gear type, season	Parameter	3	4	5	6	7	8+	Total
Survey cast net, spring	Number of fish	99	78	46	57	217	31	528
	Percent age composition	19%	15%	9%	11%	41%	6%	100%
	Average weight (g)	68.2	93.0	101.9	112.6	127.8	143.9	107.9
	Standard deviation weight (g)	12.1	15.0	18.5	17.8	27.8	21.7	18.8
	Average length (mm)	169	188	193	200	207	213	195
	Standard deviation length (mm)	8.9	7.8	10.2	9.1	12.4	9.9	9.7

Table 15.–Summary of Southeast Alaska herring target levels for the 2022–2023 season.

Area	Minimum spawning biomass threshold (tons)	Forecast (tons)	Target exploitation rate (%)[a]	Guideline harvest level (tons)
Craig[b]	5,000	38,804	20.0	7,761
Ernest Sound	2,500	–	0.0	–
Hobart Bay–Port Houghton	2,000	–	0.0	–
Hoonah Sound	2,000	–	0.0	–
Seymour Canal	3,000	–	0.0	–
Sitka Sound	25,000	150,617	20.0	30,124
Tenakee Inlet	3,000	–	0.0	–
West Behm Canal	6,000	–	0.0	–
Lynn Canal	5,000	–	0.0	–
Kah Shakes–Cat Island	6,000	–	0.0	–

[a] Represents the total target exploitation for all fisheries on a particular stock; actual allocations by fishery are determined according to Alaska Administrative Code Title 5 under 5 AAC 27.160, 27.185, and 27.190.

[b] Biomass accounting used to produce forecast this year (instead of age-structured model) due to time constraints.

Table 16.–Summary of commercial herring harvest during the 2022–2023 season.

Fishery	Gear	Area	District	Opening[a]	Closing[b]	Harvest (tons)[c]
Winter food and bait	Purse seine	Craig	3/4	1 Oct 2022	28 Feb 2023	742
Winter food and bait	Purse seine	Tenakee Inlet	12	Not open	Not open	–
Winter food and bait	Purse seine	Ernest Sound	7	Not open	Not open	–
Winter food and bait	Purse seine	Hobart Bay	10	Not open	Not open	–
Subtotal						742
Sac roe	Purse seine	Sitka Sound	13	28 Mar 2023	11 Apr 2023	10,200
Sac roe	Purse seine	Lynn Canal	11	Not open	Not open	–
Sac roe	Gillnet	Seymour Canal	11	Not open	Not open	–
Sac roe	Gillnet	Hobart Bay	10	Not open	Not open	–
Sac roe	Gillnet	Kah Shakes	1	Not open	Not open	–
Sac roe	Gillnet	West Behm Canal	1	Not open	Not open	–
Subtotal						10,200
Spawn on kelp	Pound	Hoonah Sound	13	Not open	Not open	–
Spawn on kelp	Pound	Tenakee Inlet	12	Not open	Not open	–
Spawn on kelp	Pound	Ernest Sound	7	Not open	Not open	–
Spawn on kelp	Pound	Craig	3	17 Mar 2023	15 Apr 2023	128
Subtotal						128
Test fishery-bait	Purse seine	Sitka	13	23 Jan 2023	27 Jan 202	224

[a] For spawn-on-kelp fisheries, represents when seining was opened.

[b] For spawn-on-kelp fisheries, represents end of removing spawn on kelp from pounds; for purse seine fisheries represents date of last opening.

[c] Values expressed in tons of whole herring, except for spawn-on-kelp fisheries, where values are tons of eggs-on-kelp product.

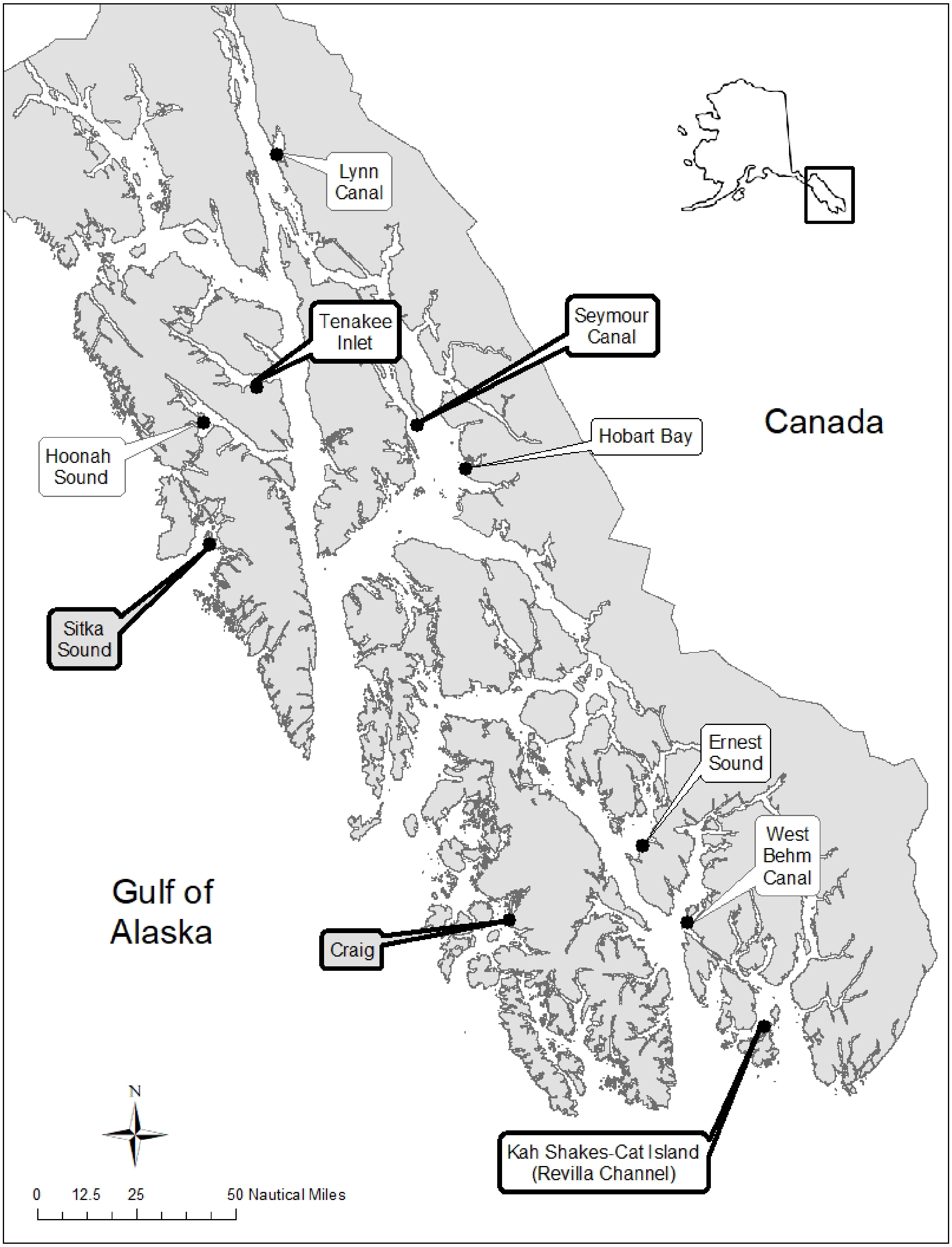

Figure 1.–Locations of monitored traditional herring spawning areas in Southeast Alaska. Labels with shading and bold outline indicate areas where spawn deposition surveys and age-size sampling were conducted during the 2023 spawning season; labels with only bold outline indicate only age-size sampling of herring was completed during the 2023 spawning season; no sampling other than aerial surveys were conducted in areas where labels have no shading or bolding.

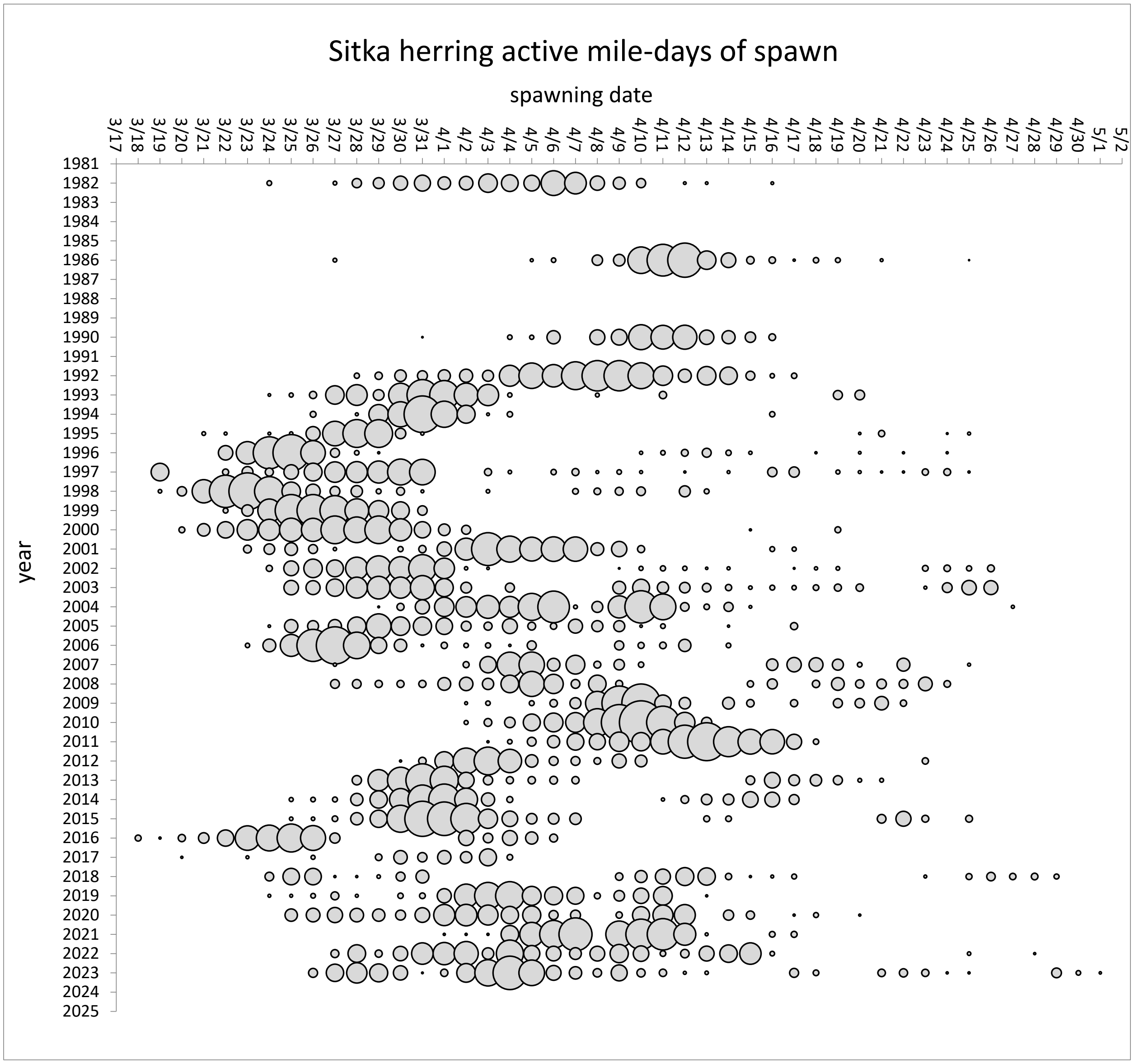

Figure 2.–Historical dates of active spawn observed for the Sitka Sound herring stock. The size of circles represents the total mileage of active spawn observed on each day, relative to all other days of spawn. For reference, the largest circle represents a day of 48 nautical miles of spawn and the smallest circles represent "spot spawns", which here have been given an arbitrary value of 0.1 nautical mile. For entire years with blanks, data could not be located.

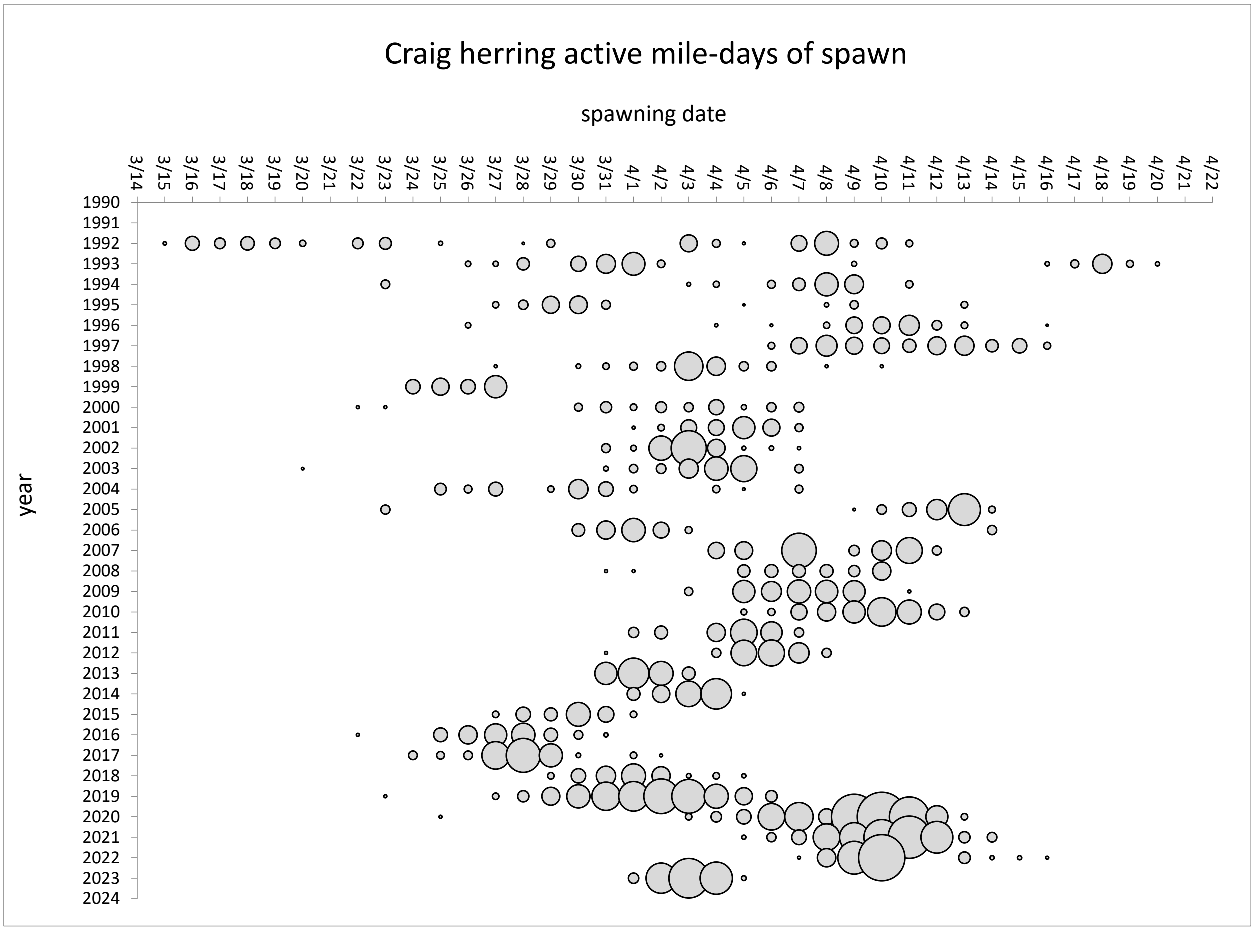

Figure 3.–Historical dates of active spawn observed for the Craig herring stock. The size of gray circles represents the total mileage of active spawn observed on each day, relative to all other days of spawn. For reference, the largest circle represents a day of about 30 nautical miles of spawn and the smallest circles represent "spot spawns", which here have been given an arbitrary value of 0.1 nautical mile. Black circles represent days of active spawn, but for which no estimates of daily mileage are available.

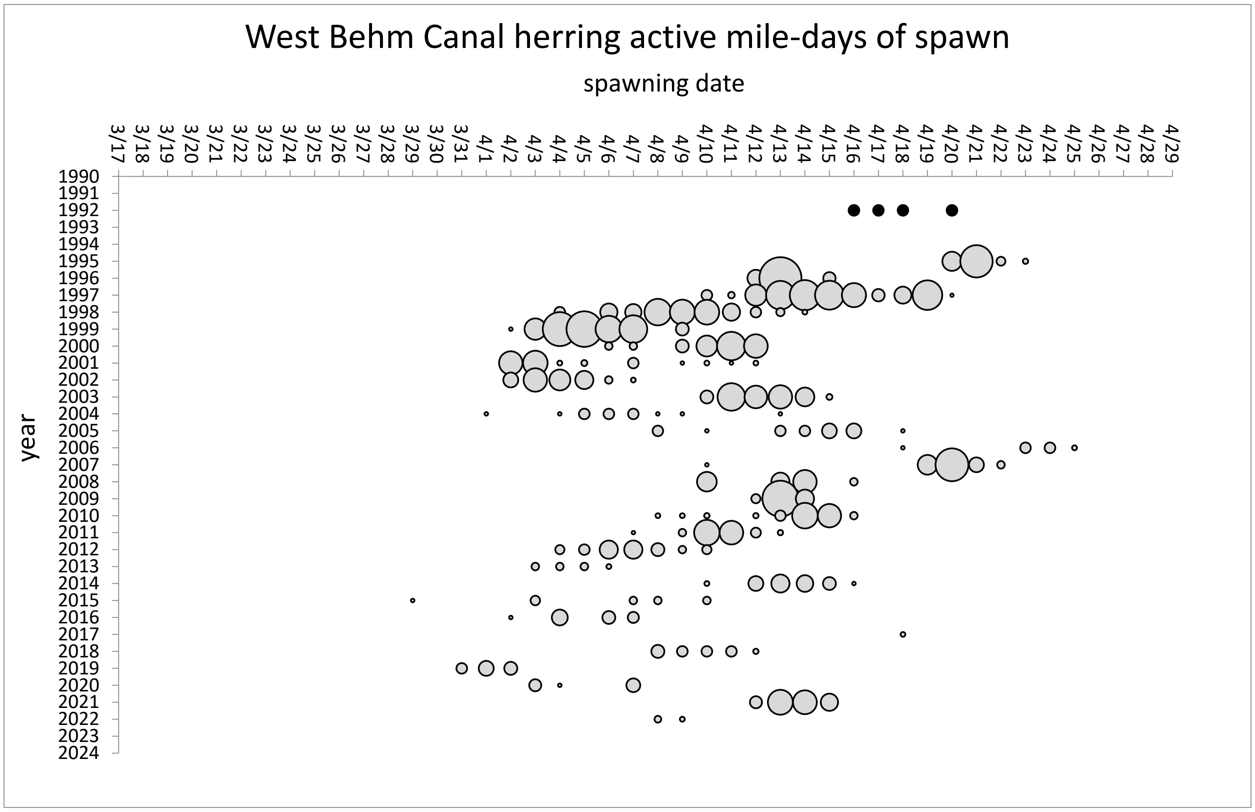

Figure 4.–Historical dates of active spawn observed for the West Behm Canal herring stock. The size of gray circles represents the total mileage of active spawn observed on each day, relative to all other days of spawn. For reference, the largest circle represents a day of 12 nautical miles of spawn and the smallest circles represent “spot spawns”, which here have been given an arbitrary value of 0.1 nautical mile. Black circles represent days of active spawn, but for which no estimates of daily mileage are available. For years with blanks, data could not be located.

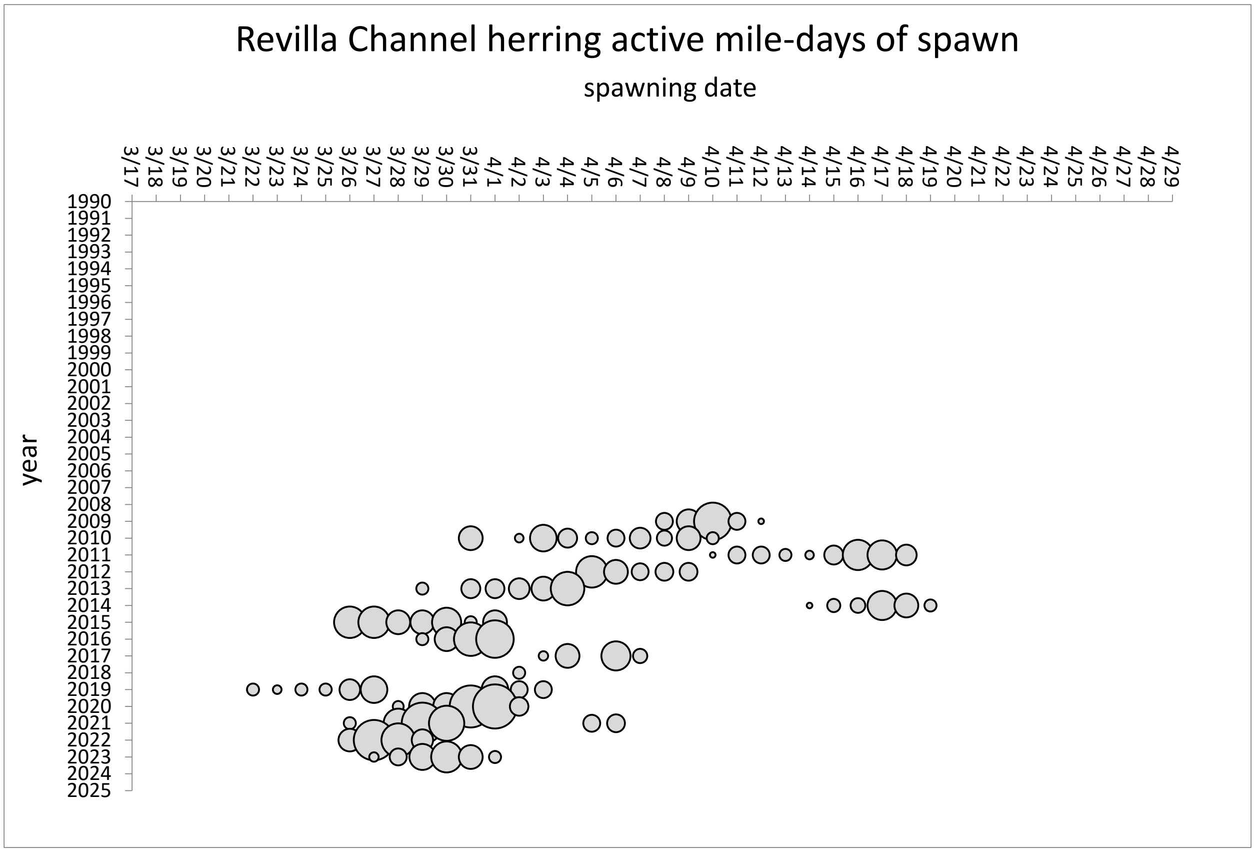

Figure 5.–Historical dates of active spawn observed for the Revilla Channel herring stock. The size of gray circles represents the total mileage of active spawn observed on each day, relative to all other days of spawn. For reference, the largest circle represents a day of about 7 nautical miles of spawn and the smallest circles represent "spot spawns", which here have been given an arbitrary value of 0.1 nautical mile. For years with blanks, data could not be located or is not yet summarized.

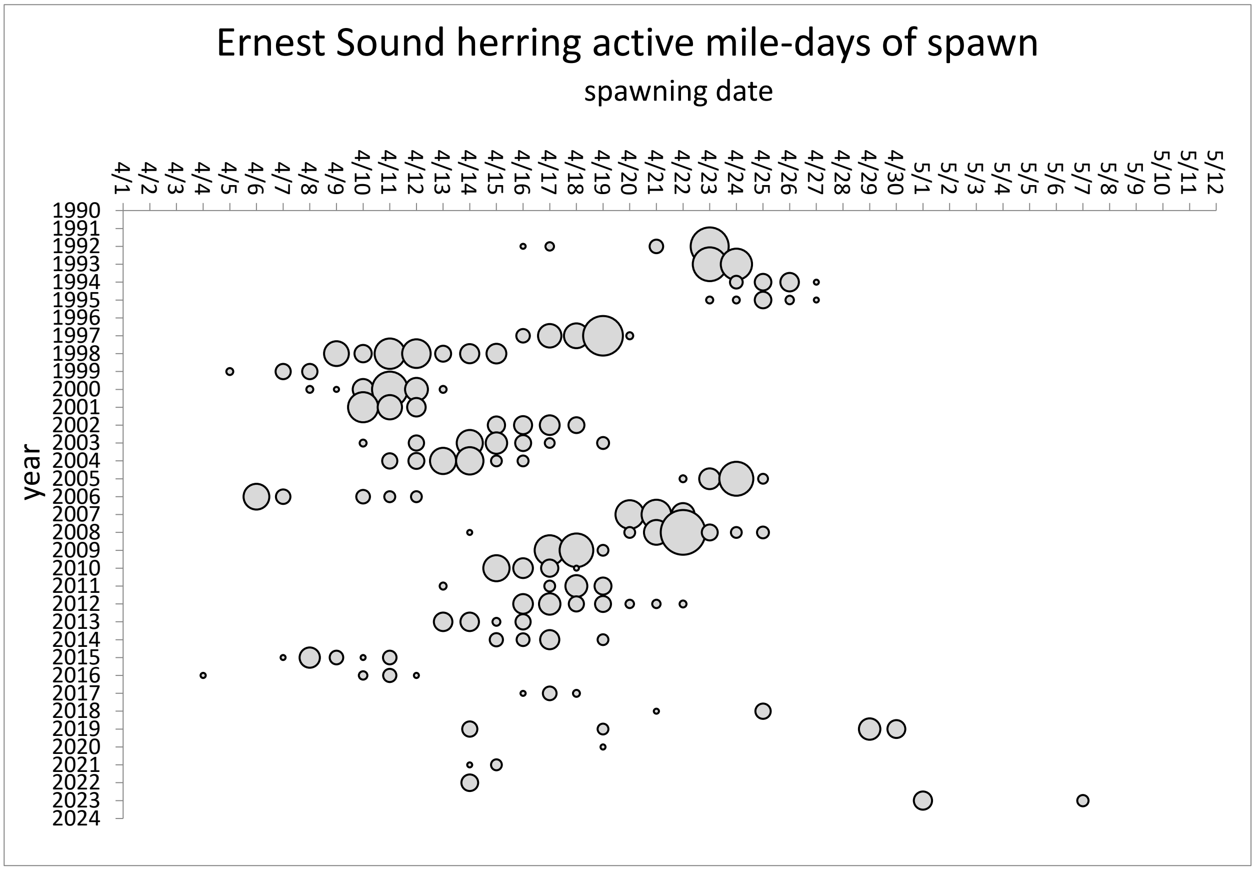

Figure 6.–Historical dates of active spawn observed for the Ernest Sound herring stock. The size of gray circles represents the total mileage of active spawn observed on each day, relative to all other days of spawn. For reference, the largest circle represents a day of about 9 nautical miles of spawn and the smallest circles represent "spot spawns", which here have been given an arbitrary value of 0.1 nautical mile.

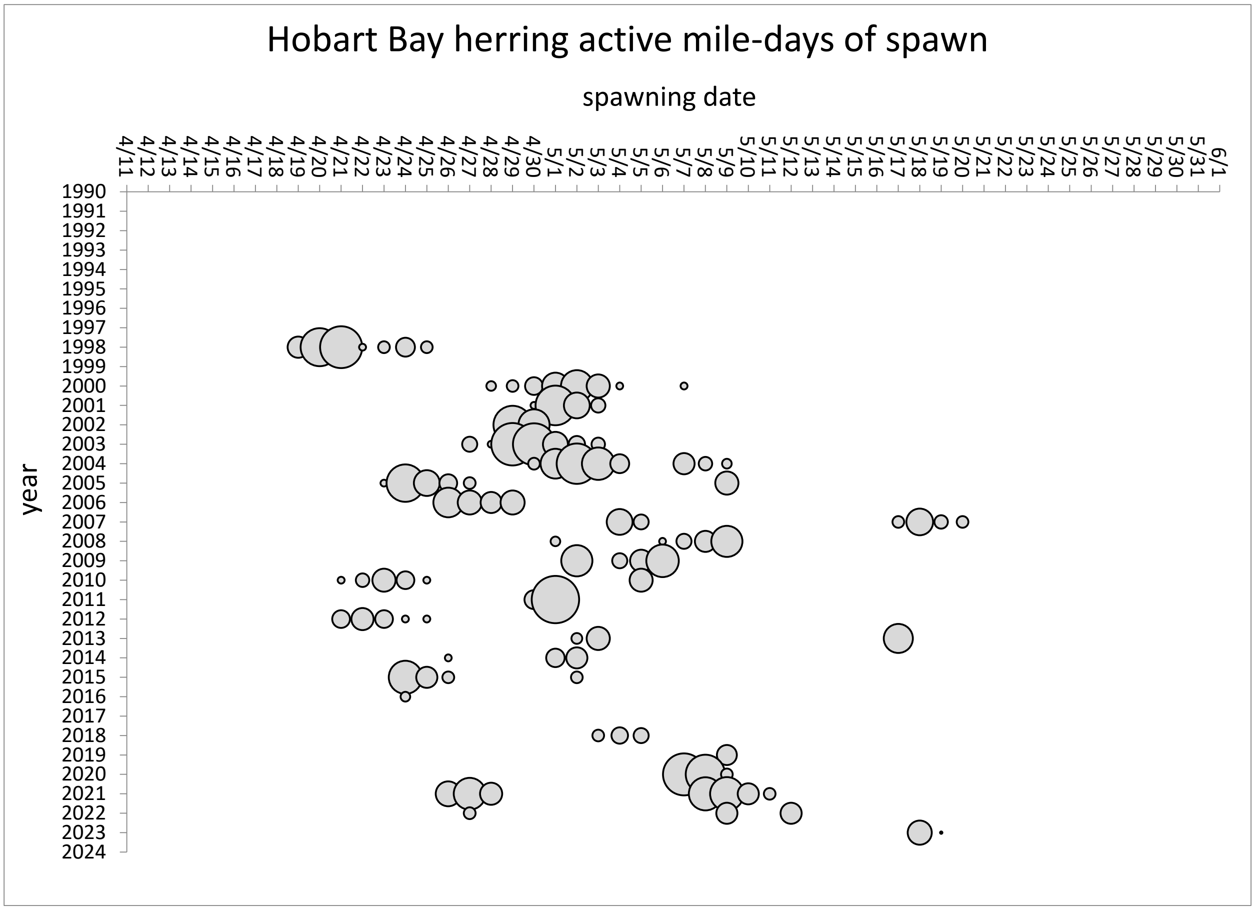

Figure 7.–Historical dates of active spawn observed for the Hobart Bay herring stock. The size of gray circles represents the total mileage of active spawn observed on each day, relative to all other days of spawn. For reference, the largest circle represents a day of about 6 nautical miles of spawn and the smallest circles represent "spot spawns", which here have been given an arbitrary value of 0.1 nautical mile. For years with blanks, data could not be located.

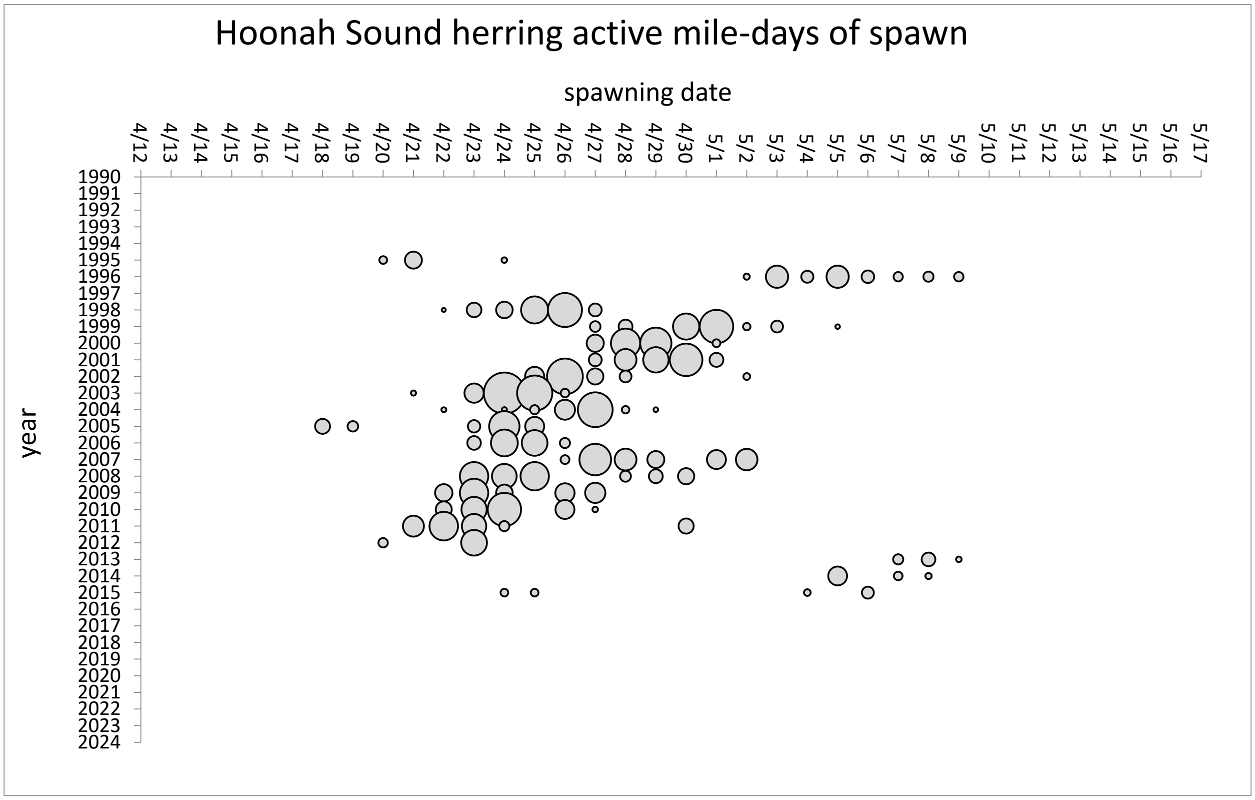

Figure 8.–Historical dates of active spawn observed for the Hoonah Sound herring stock. The size of gray circles represents the total mileage of active spawn observed on each day, relative to all other days of spawn. For reference, the largest circle represents a day of about 12 nautical miles of spawn and the smallest circles represent "spot spawns", which here have been given an arbitrary value of 0.1 nautical mile. For years prior to 1995, data could not be located. For entire blank years since 2015 spawn has not been observed, although aerial survey flights have been much less frequent than were done in prior years.

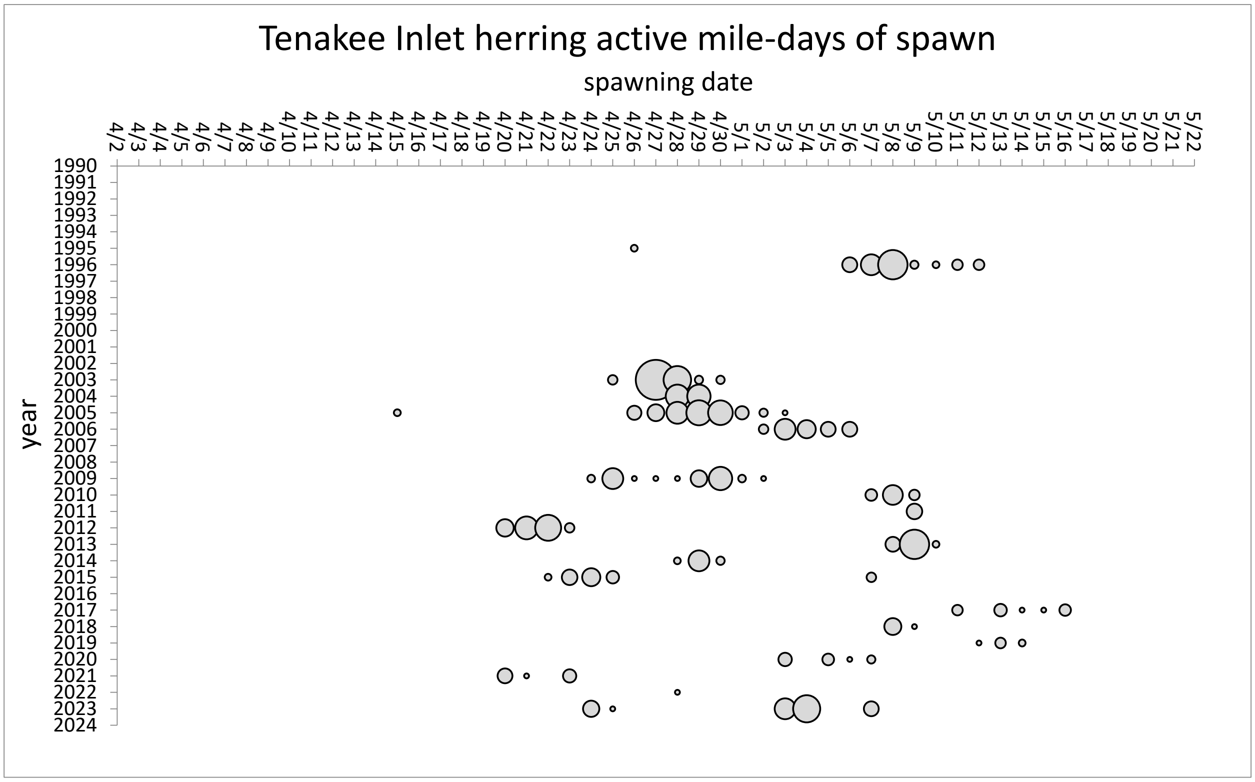

Figure 9.–Historical dates of active spawn observed for the Tenakee Inlet herring stock. The size of gray circles represents the total mileage of active spawn observed on each day, relative to all other days of spawn. For reference, the largest circle represents a day of about 8 nautical miles of spawn and the smallest circles represent “spot spawns”, which here have been given an arbitrary value of 0.1 nautical mile. For years with blanks, data could not be located.

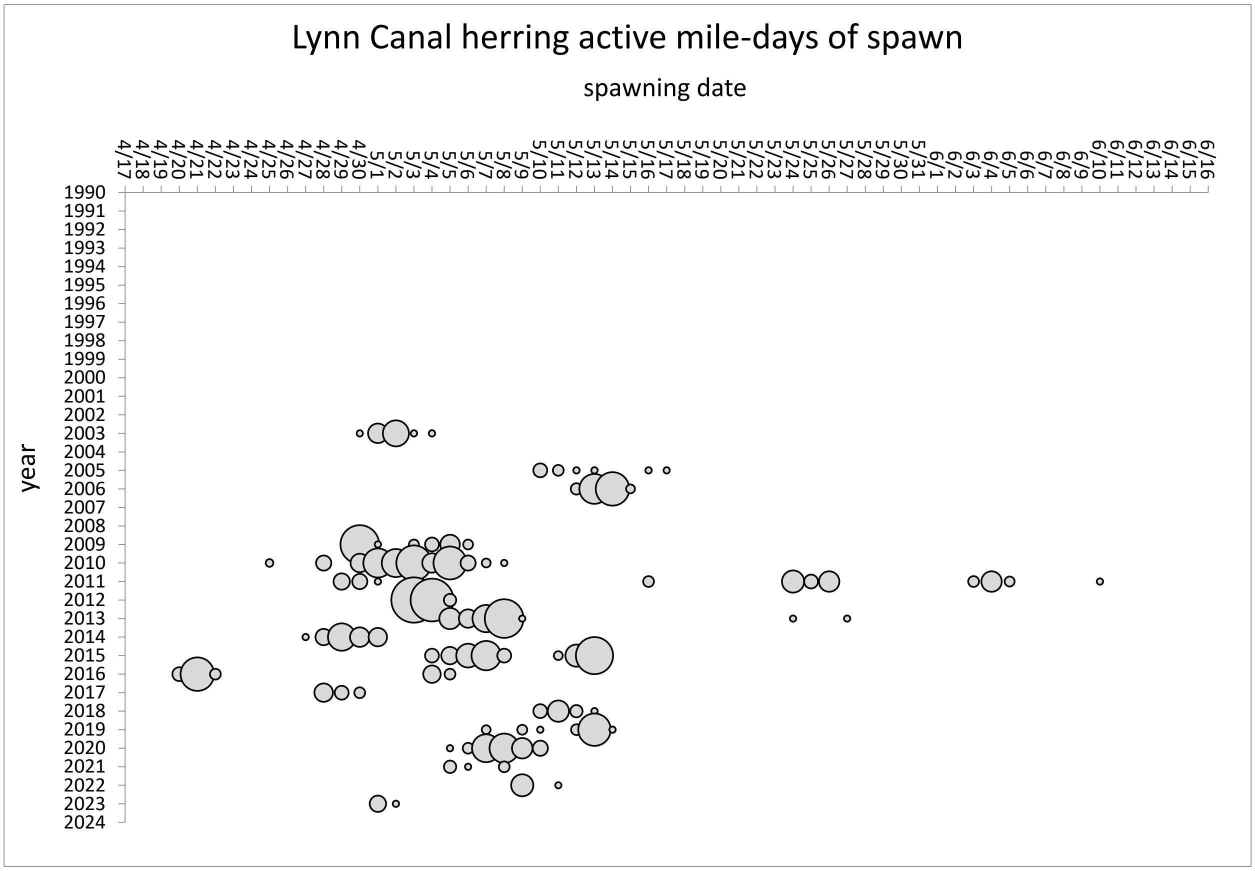

Figure 10.–Historical dates of active spawn observed for the Lynn Canal herring stock. The size of gray circles represents the total mileage of active spawn observed on each day, relative to all other days of spawn. For reference, the largest circle represents a day of about 5 nautical miles of spawn and the smallest circles represent “spot spawns”, which here have been given an arbitrary value of 0.1 nautical mile. For years with blanks, data could not be located or is not yet summarized.

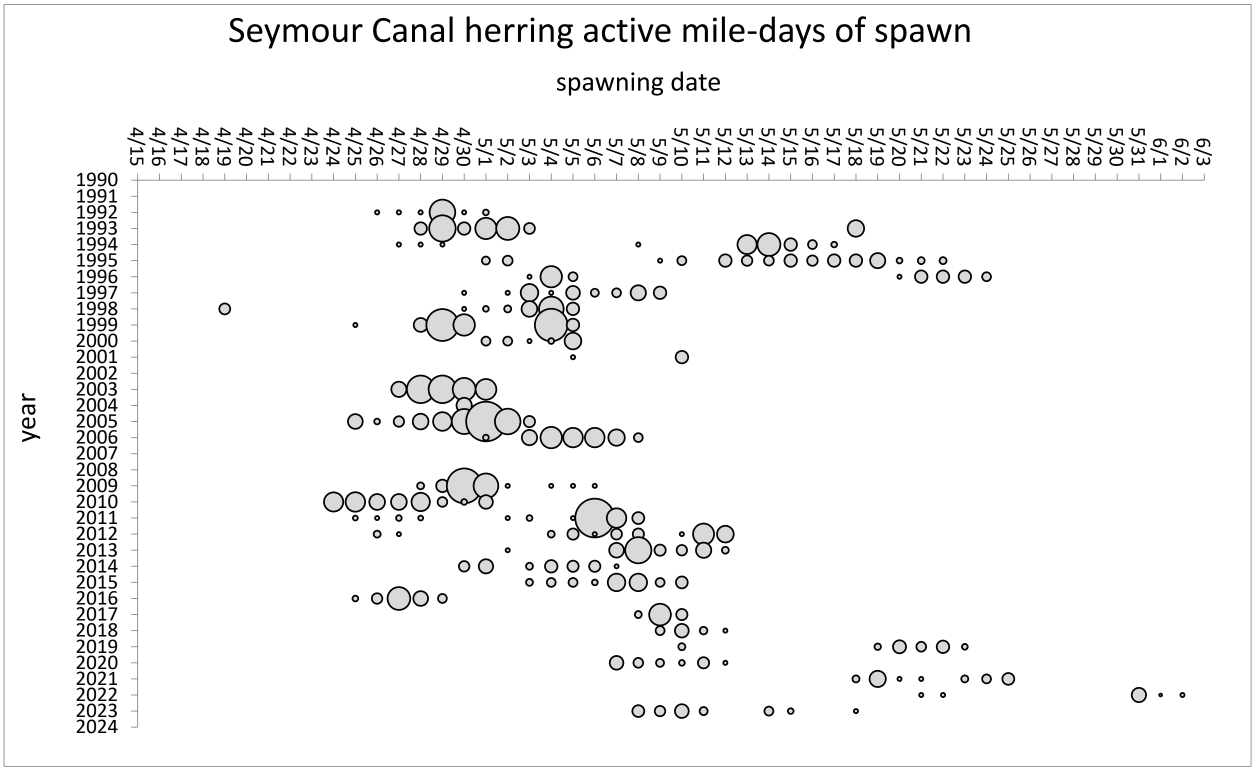

Figure 11.–Historical dates of active spawn observed for the Seymour Canal herring stock. The size of gray circles represents the total mileage of active spawn observed on each day, relative to all other days of spawn. For reference, the largest circle represents a day of about 10 nautical miles of spawn and the smallest circles represent "spot spawns", which here have been given an arbitrary value of 0.1 nautical mile. For years with blanks, data could not be located.

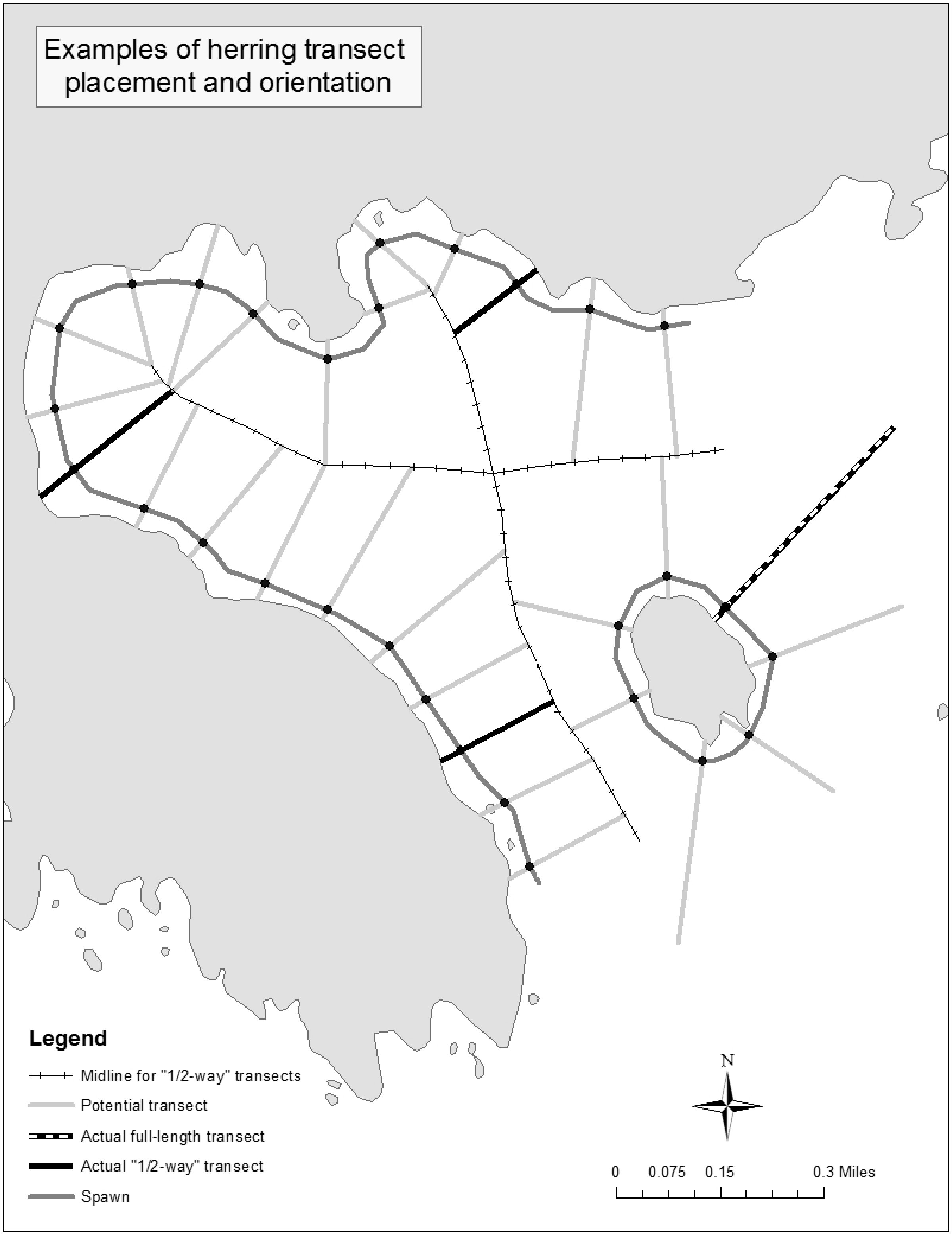

Figure 12.–Example of hypothetical herring transect placement and orientation, representing points at which transects should be halted to prevent over sampling.

Stock	8-Mar	9-Mar	10-Mar	11-Mar	12-Mar	13-Mar	14-Mar	15-Mar	16-Mar	17-Mar	18-Mar	19-Mar	20-Mar	21-Mar	22-Mar	23-Mar	24-Mar	25-Mar	26-Mar	27-Mar	28-Mar	29-Mar	30-Mar	31-Mar	1-Apr	2-Apr	3-Apr	4-Apr	5-Apr	6-Apr	7-Apr	8-Apr	9-Apr	10-Apr	11-Apr	12-Apr	13-Apr	14-Apr	15-Apr
Sitka Sound	ns	ns	ns	ns	ns	ns	ns	ns	ns	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.0	7.8	10.7	8.3	5.2	0.1	1.3	9.0	17.9	29.3	17.0	5.6	3.9	1.8	6.6	1.7	1.3	0.2	0.3	0.0	0.0
Revilla Channel										0.0	ns	ns	ns	0.0	ns	ns	0.0	ns	ns	0.3	1.0	2.4	3.4	2.1	0.1	ns	ns	ns	ns										
Craig										0.0	ns	ns	ns	ns	ns	ns	0.0	ns	ns	ns	0.0	ns	0.0	ns	1.3	11.2	19.4	12.8	0.3	ns	0.0	ns	ns	0.0	ns	ns	ns	ns	ns
West Behm Canal																							3.0	ns	ns	0.0	ns	ns	ns	ns	0.0	ns	ns	0.0	ns	ns	ns	ns	ns
Yakutat Bay																															u	u	u	u	u	ns	u		

continued	16-Apr	17-Apr	18-Apr	19-Apr	20-Apr	21-Apr	22-Apr	23-Apr	24-Apr	25-Apr	26-Apr	27-Apr	28-Apr	29-Apr	30-Apr	1-May	2-May	3-May	4-May	5-May	6-May	7-May	8-May	9-May	10-May	11-May	12-May	13-May	14-May	15-May	16-May	17-May	18-May	19-May	20-May	21-May	22-May	23-May	24-May
Sitka Sound	0.0	2.0	0.8	0.0	ns	1.4	1.7	1.3	0.1	0.1	ns	ns	ns	2.4	0.5	0.1	ns																						
Ernest Sound	ns	0.0	ns	ns	ns	ns	ns	0.0	ns	ns	ns	ns	ns	ns	ns	1.4	ns	ns	ns	ns	ns	0.5	0.0	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
Hoonah Sound	ns	ns	0.0	0.0	ns	ns	ns	ns	ns	0.0	ns	ns	ns	0.0	ns																								
Seymour Canal	ns	ns	0.0	ns	ns	ns	ns	ns	0.0	ns	ns	ns	0.0	ns	ns	ns	ns	0.0	ns	ns	ns	ns	0.9	0.7	1.2	0.4	ns	ns	0.5	0.2	0.0	ns	0.1	0.0	ns	ns	ns	ns	ns
N. Stephens Pass.	ns	ns	0.0	ns	ns	ns	ns	ns	0.0	ns	ns	ns	0.0	ns	ns	ns	ns	0.0	ns	ns	ns	ns	0.1	1.3	1.3	0.0	ns	ns	ns	0.0	0.0	ns	0.0	0.0	ns	ns	ns	ns	ns
Tenakee Inlet	ns	ns	0.0	ns	ns	ns	ns	ns	1.2	0.1	ns	ns	ns	ns	ns	ns	ns	2.0	3.4	ns	ns	1.0	0.0	ns	ns	ns	ns	ns	ns	0.0	ns	ns	ns	ns					
Lynn Canal	ns	ns	0.0	ns	ns	ns	ns	ns	0.0	0.0	ns	ns	0.0	ns	ns	0.7	0.1	0.0	0.0	ns	ns	ns	0.0	ns	ns	ns	ns	ns	ns	ns	ns	ns	0.0	ns					
Hobart/Houghton	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	0.0	ns	ns	ns	0.0	ns	ns	ns	ns	0.0	ns	0.0	ns	ns	ns	0.0	ns	0.0	ns	1.3	0.0	ns	ns	ns	ns	ns
Haines						u	u																																

Figure 13.–Spawn timing of herring stocks in Southeast Alaska during spring 2023. Values indicate daily measurements of nautical miles of active spawn recorded during aerial surveys. Shaded area depicts dates when cast-net samples were taken. Boxed areas indicate duration of spawning (first to last dates of observed spawn). Dates with no survey are depicted by “ns”. Blank dates indicate dates that are outside of historical spawning timing and so surveys had not commenced or were concluded. Dates with “u” signify spawn was reported, but extent of each day is unknown (in Haines approximately 3.5 nm from Battery Point to Mud Bay Point). In West Behm Canal, spawn was reported by public but not confirmed by ADF&G, although eggs were found on beach later.

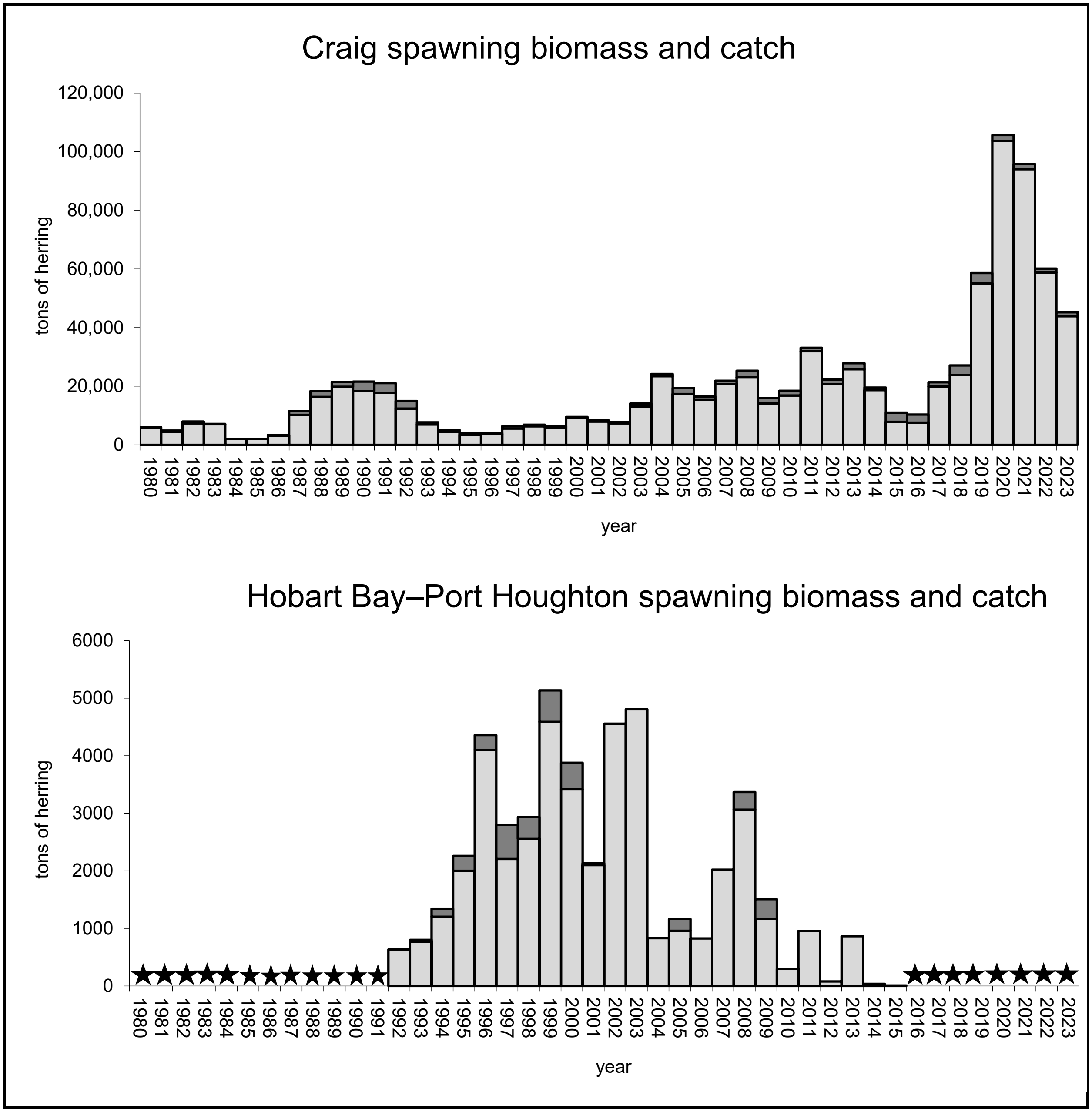

Figure 14.–Observed herring post-fishery spawning biomass (light gray bars), based on spawn deposition surveys, and catch (dark gray bars) for stocks in the Craig and Hobart Bay–Port Houghton areas, during 1980–2023. Stars represent years when spawn deposition surveys were not conducted.

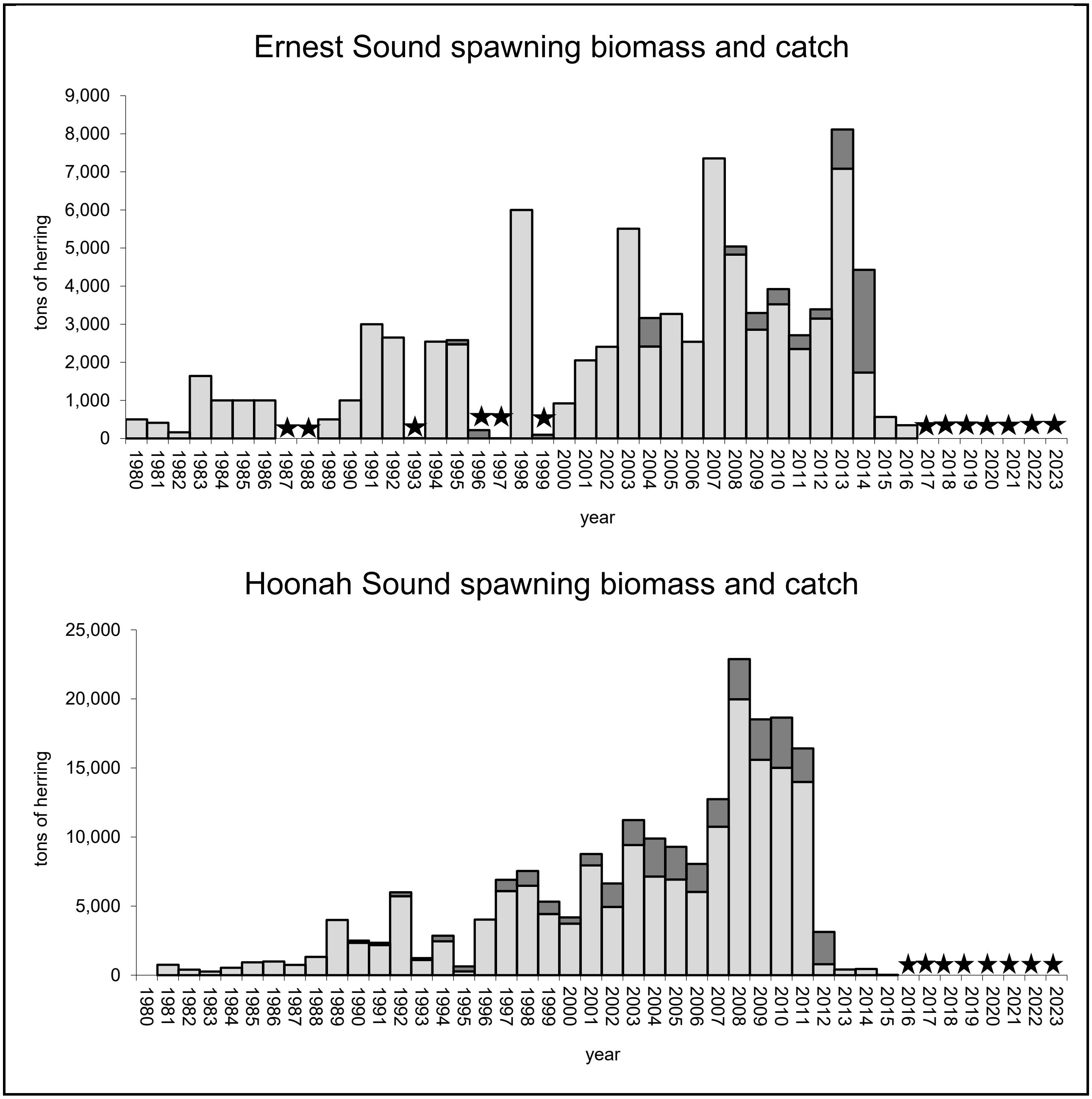

Figure 15.–Observed herring post-fishery spawning biomass (light gray bars), based on spawn deposition surveys or hydroacoustic surveys, and catch (dark gray bars) for stocks in the Ernest Sound and Hoonah Sound areas, during 1980–2023. Stars represent years when spawn deposition surveys were not conducted.

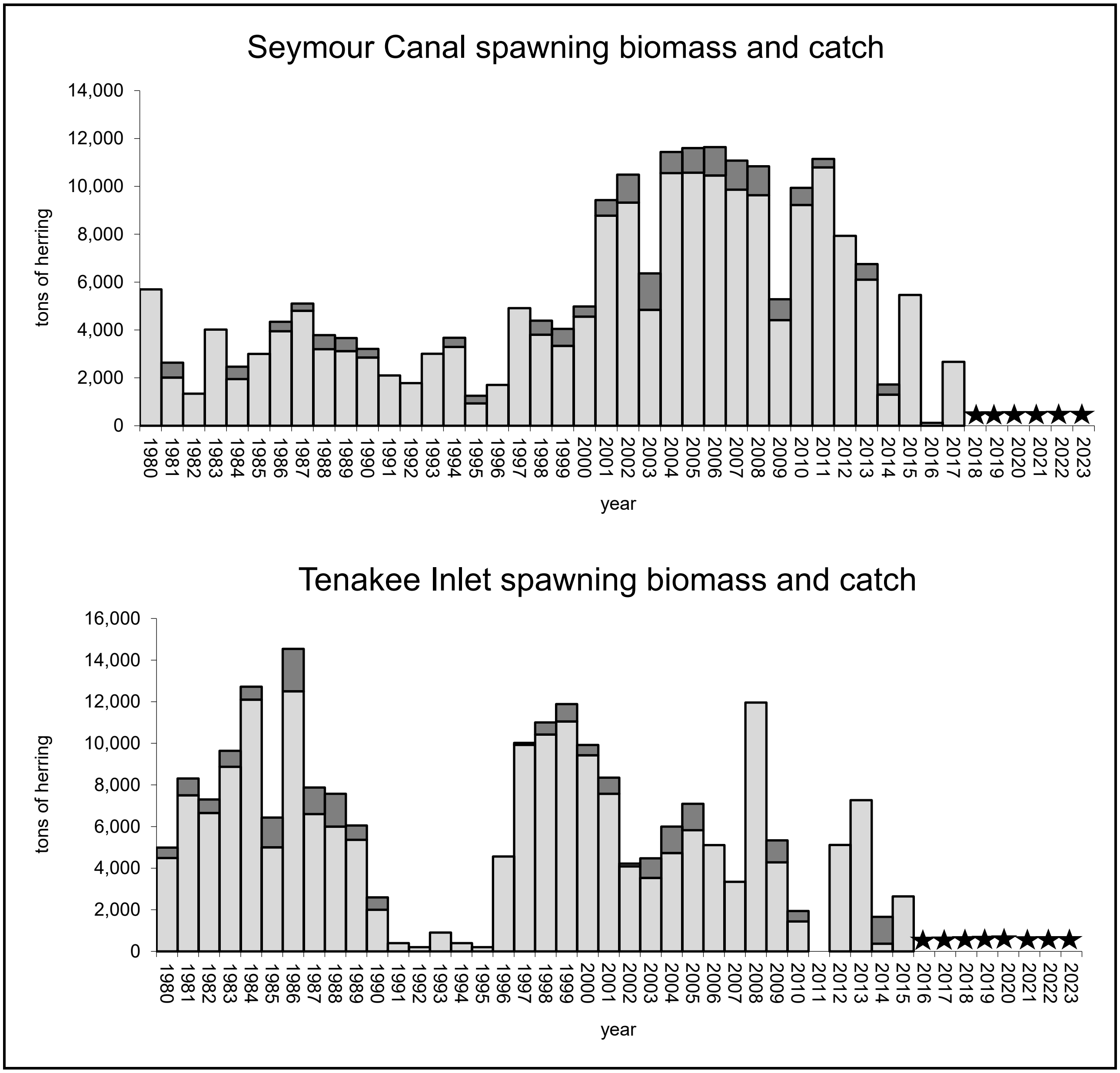

Figure 16.–Observed herring post-fishery spawning biomass (light gray bars), based on spawn deposition surveys or hydroacoustic surveys, and catch (dark gray bars) for stocks in the Seymour Canal and Tenakee Inlet areas, during 1980–2023. Stars represent years when spawn deposition surveys were not conducted.

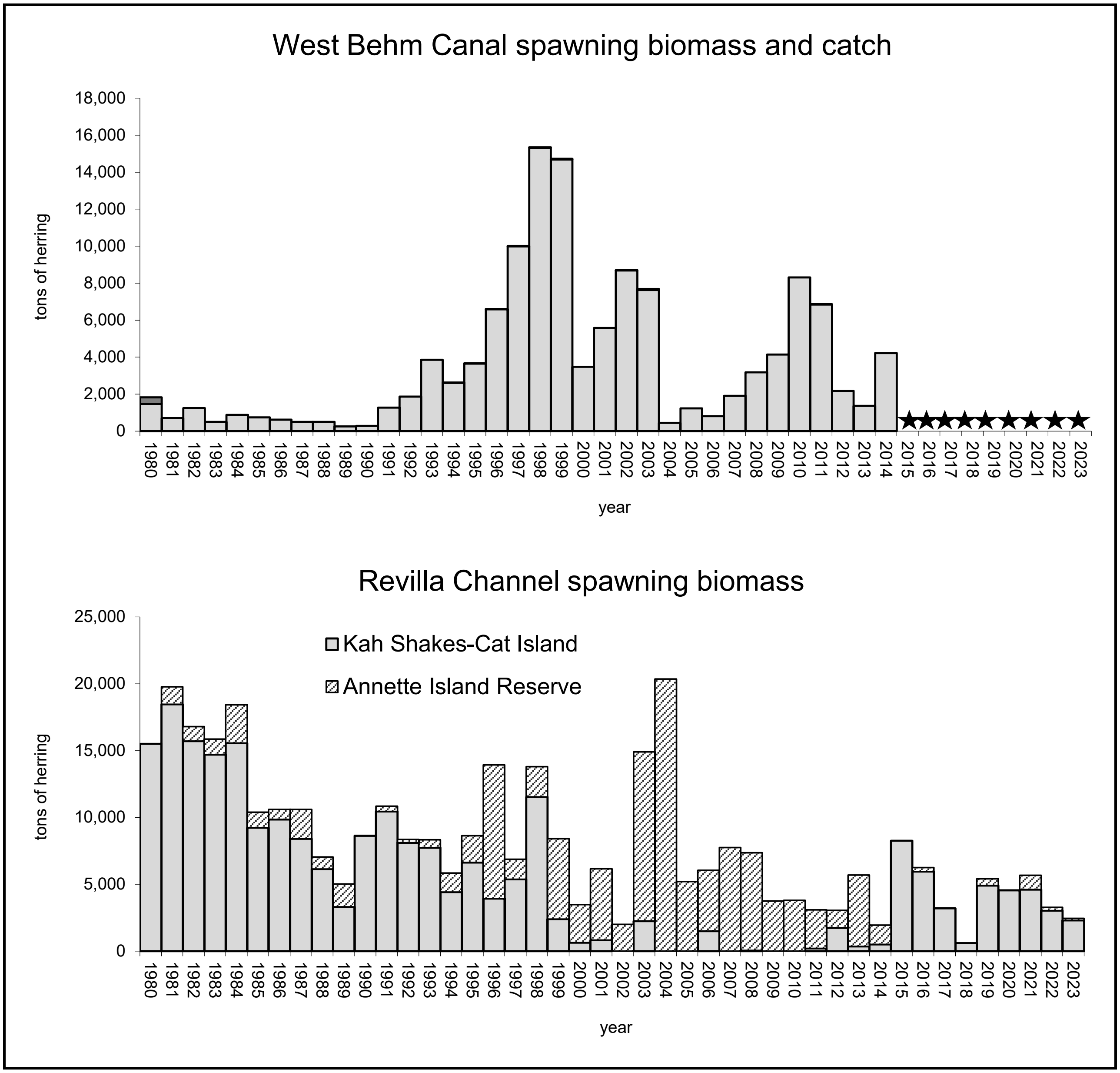

Figure 17.–Observed herring post-fishery spawning biomass, based on spawn deposition surveys or hydroacoustic surveys for stocks in the West Behm Canal and Revilla Channel (Kah Shakes–Cat Island – Annette Island) areas, during 1980–2023. Annette Island spawning biomass estimates were made as the product of the length of observed linear shoreline spawn mileage and a fixed approximated value of 500 tons of herring per nautical mileage of shoreline, based on the estimated mean value over the period 1991–2000; the same was done for Kah Shakes–Cat Island for years without a survey (2002–2014, 2017, 2018, 2023).

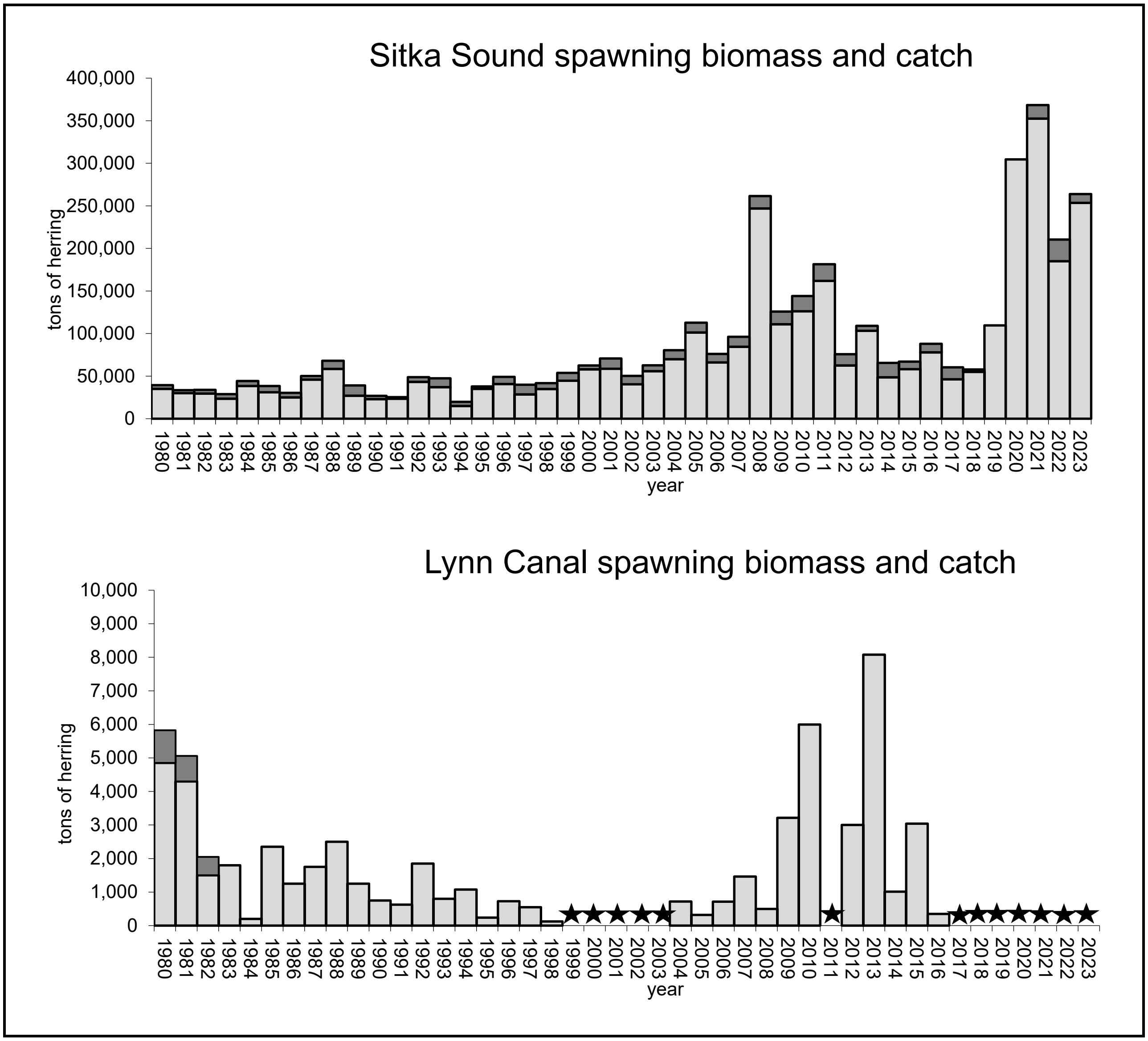

Figure 18.–Observed herring post-fishery spawning biomass (light gray bars), based on spawn deposition surveys, and catch (dark gray bars) for stock in the Sitka Sound and Lynn Canal areas, during 1980–2023. Estimates of spawning biomass for Lynn Canal prior to 2004 were made using a variety of methods (e.g., hydroacoustics or visual estimates of spawn density converted to biomass), and results should be viewed as approximations. Stars represent years when spawn deposition surveys were not conducted.

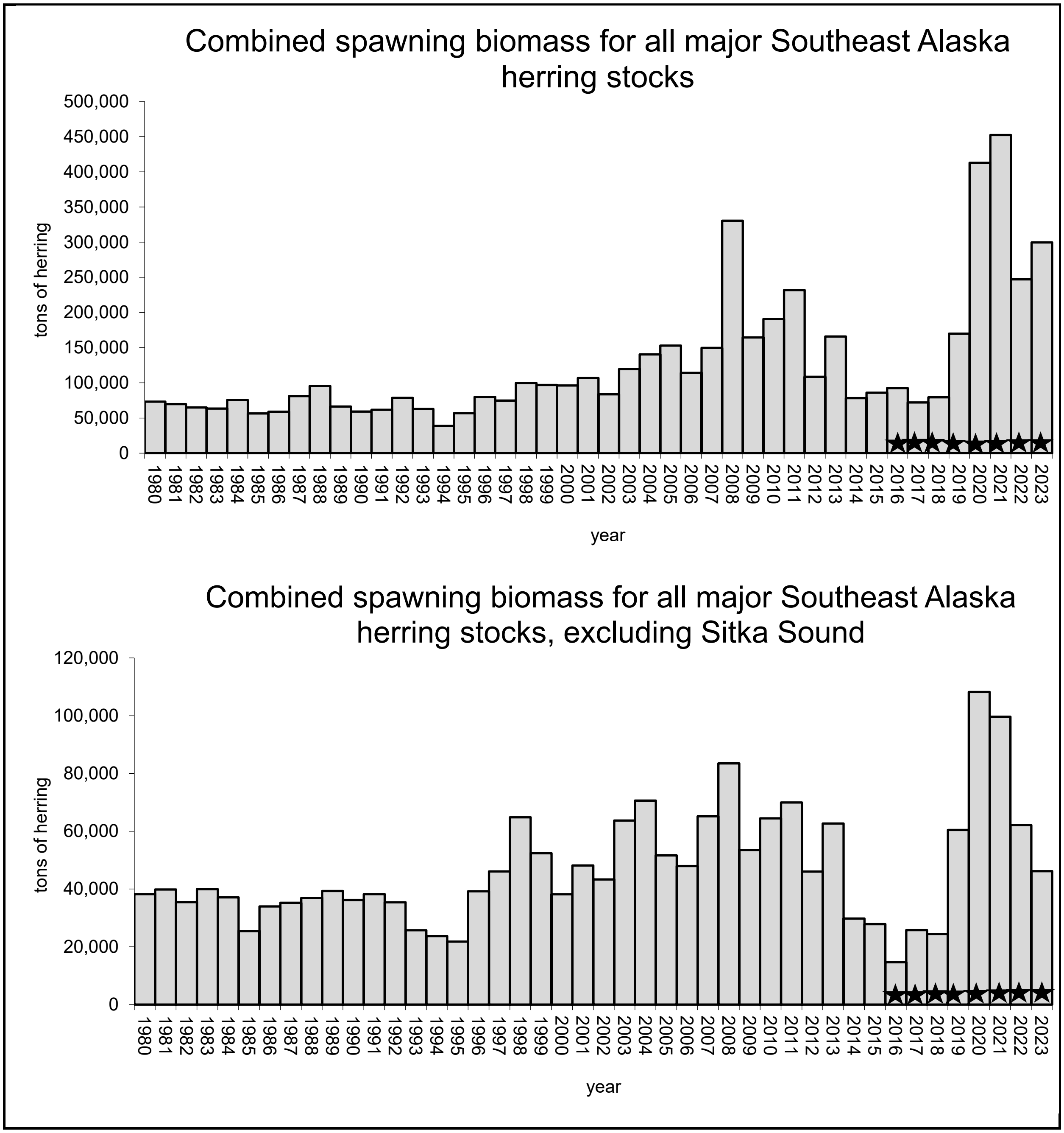

Figure 19.–Combined observed herring post-fishery spawning biomass, based on spawn deposition surveys or hydroacoustic surveys, for major herring stocks in Southeast Alaska, during 1980–2023. Recent years represent an underestimate of regional total biomass; because of the ten spawning areas that have been historically monitored, the following number of areas were surveyed in recent years: 2016, 6 areas; 2017, 7 areas; 2018, 2 areas; 2019-2022, 3 areas; and 2023, 2 areas. Stars represent years when spawn deposition surveys were not conducted in at least 1 of the 10 major spawning areas since 2016.

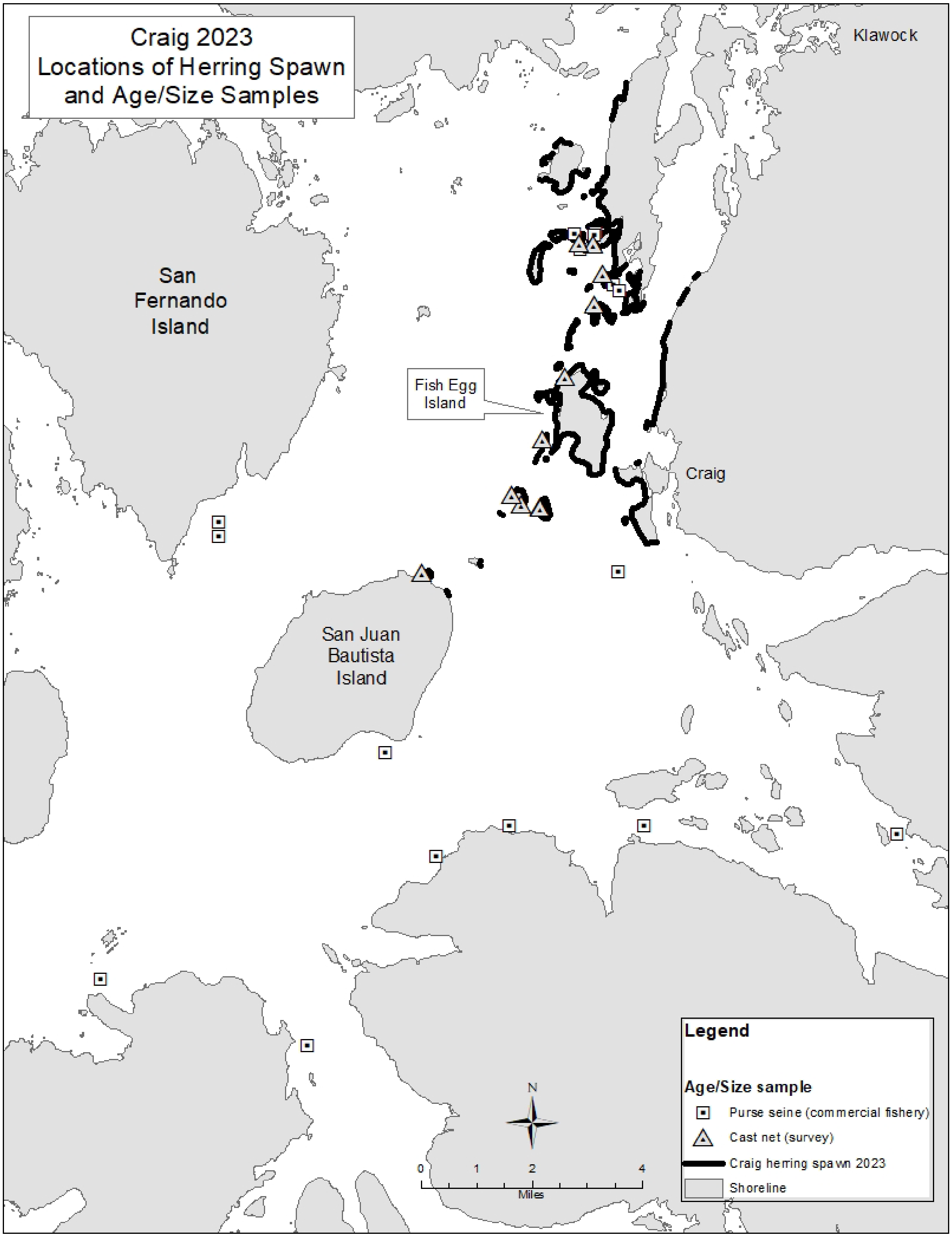

Figure 20.–Locations of herring spawn and samples for estimates of age and size for the Craig herring stock for the 2022–2023 season. Cumulative herring spawn denoted by thick black line along shoreline.

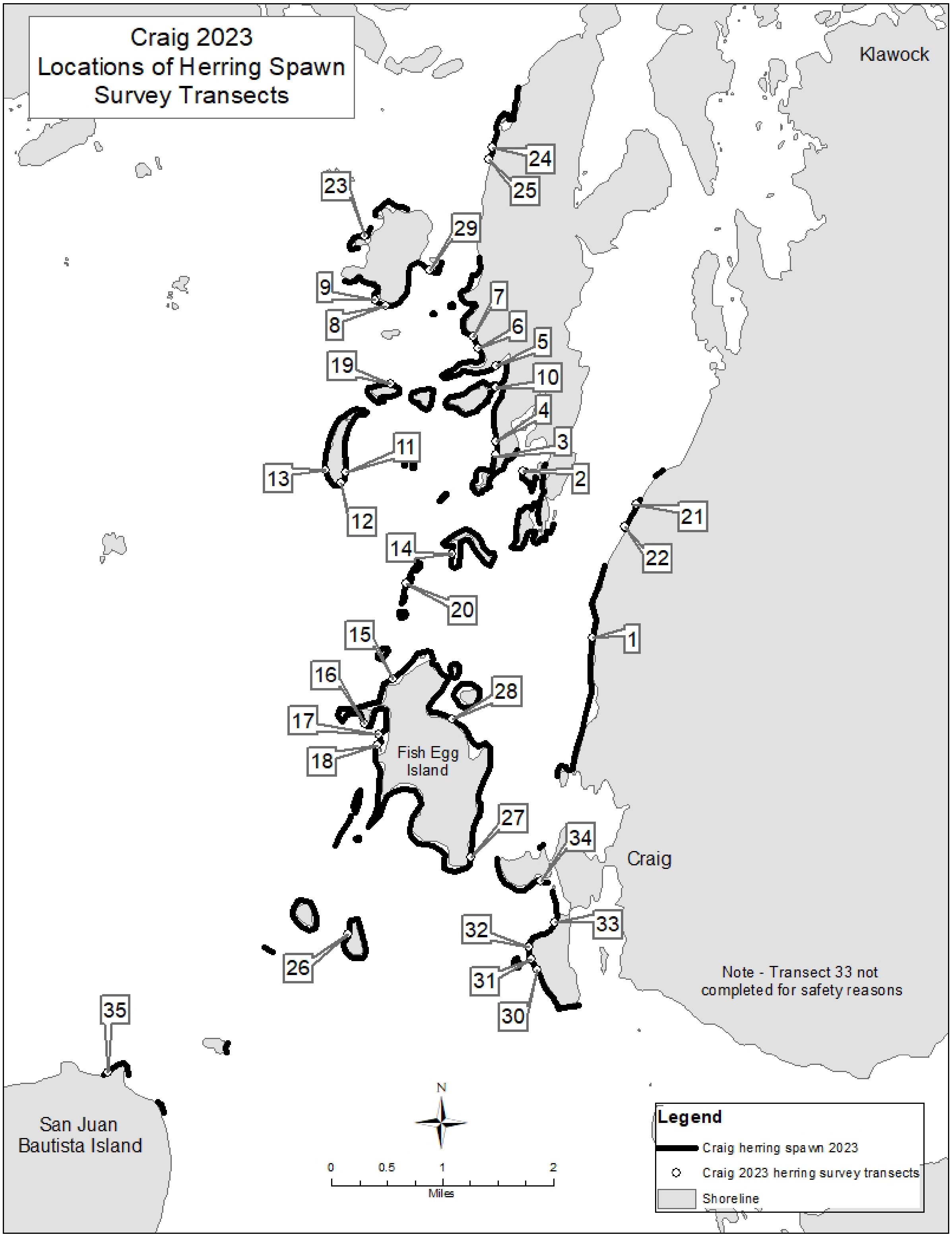

Figure 21.–Locations of herring spawn and egg deposition dive survey transects for the Craig herring stock for the 2022–2023 season. Cumulative herring spawn denoted by thick black line along shoreline.

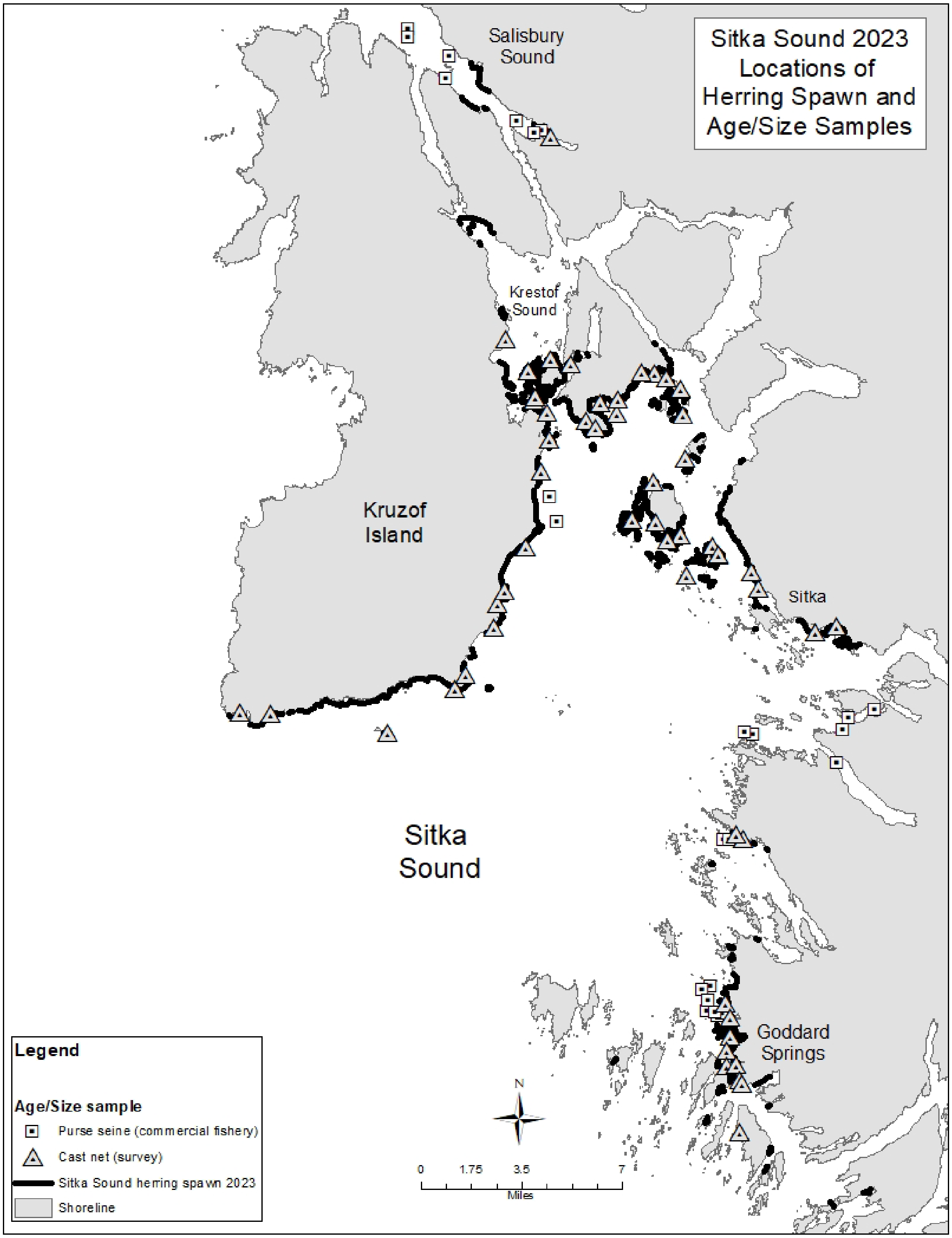

Figure 22.–Locations of herring spawn and samples collected for estimates of age and size for the Sitka Sound herring stock for the 2022–2023 season. Cumulative herring spawn denoted by thick black line along shoreline.

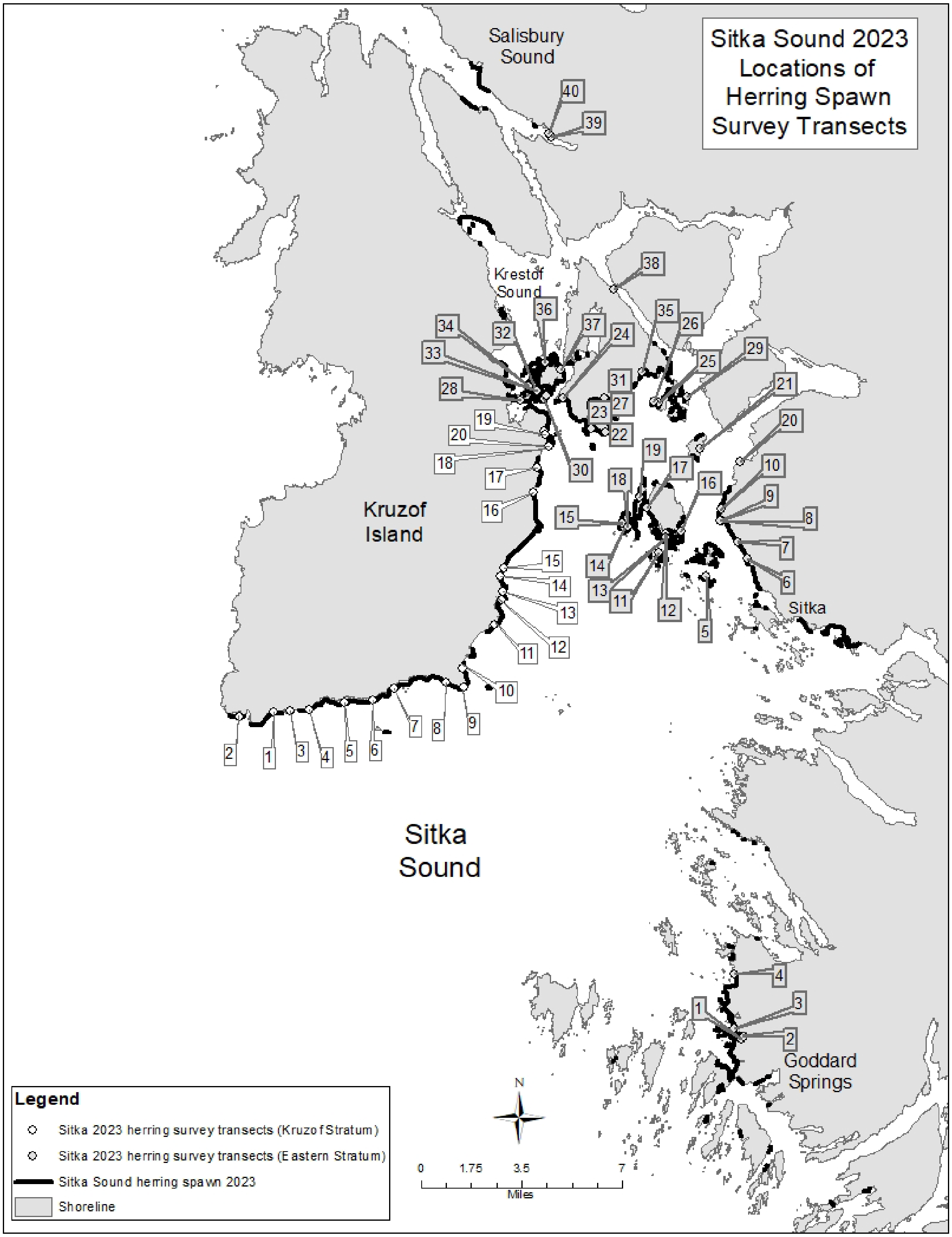

Figure 23.–Locations of herring spawn and egg deposition dive survey transects for the Sitka Sound herring stock for the 2022–2023 season. Cumulative herring spawn denoted by thick black line along shoreline.

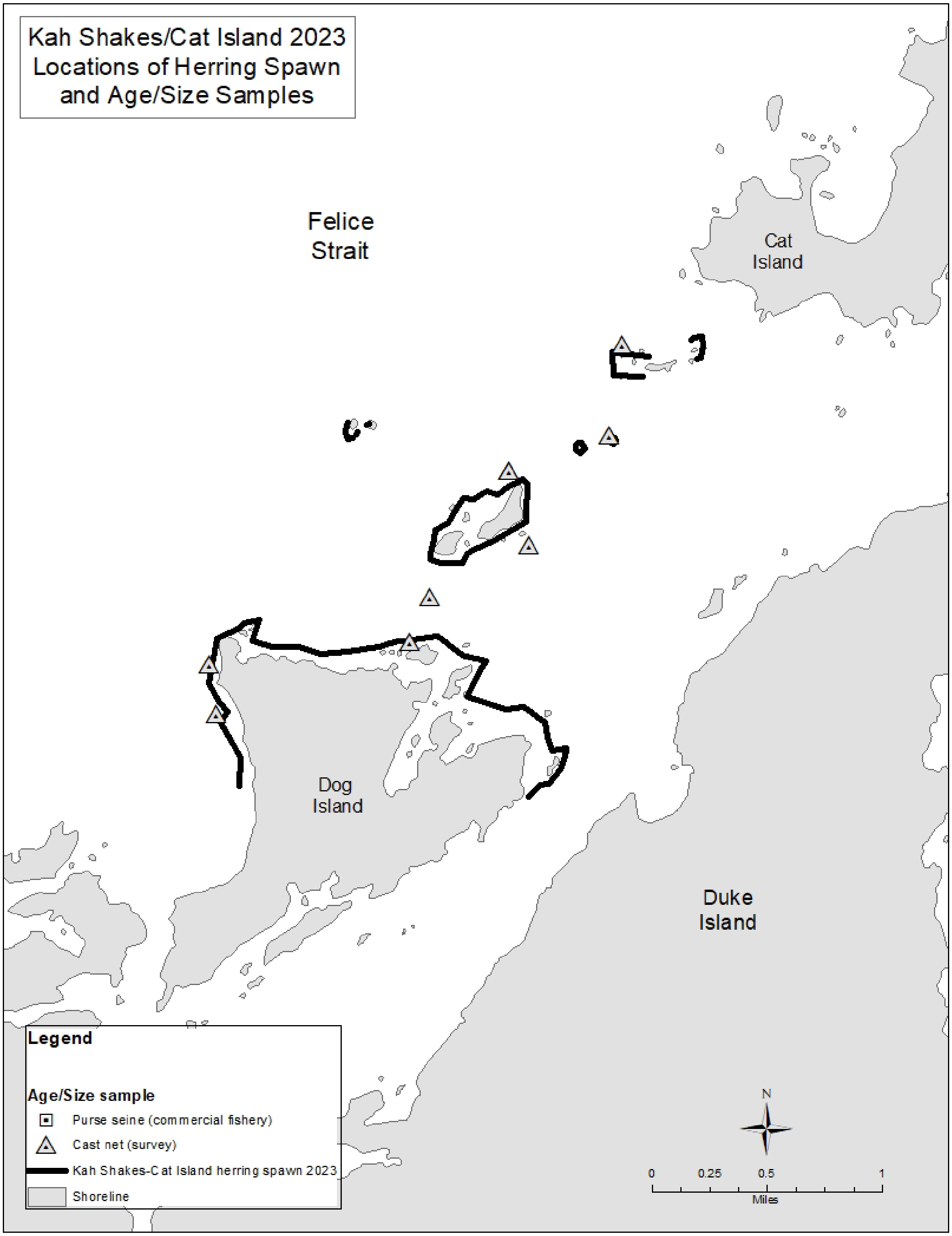

Figure 24.–Locations of herring spawn and samples collected for estimates of age and size for the Kah Shakes/Cat Island (Revilla Channel) herring stock for the 2022–2023 season. Cumulative herring spawn denoted by thick black line along shoreline.

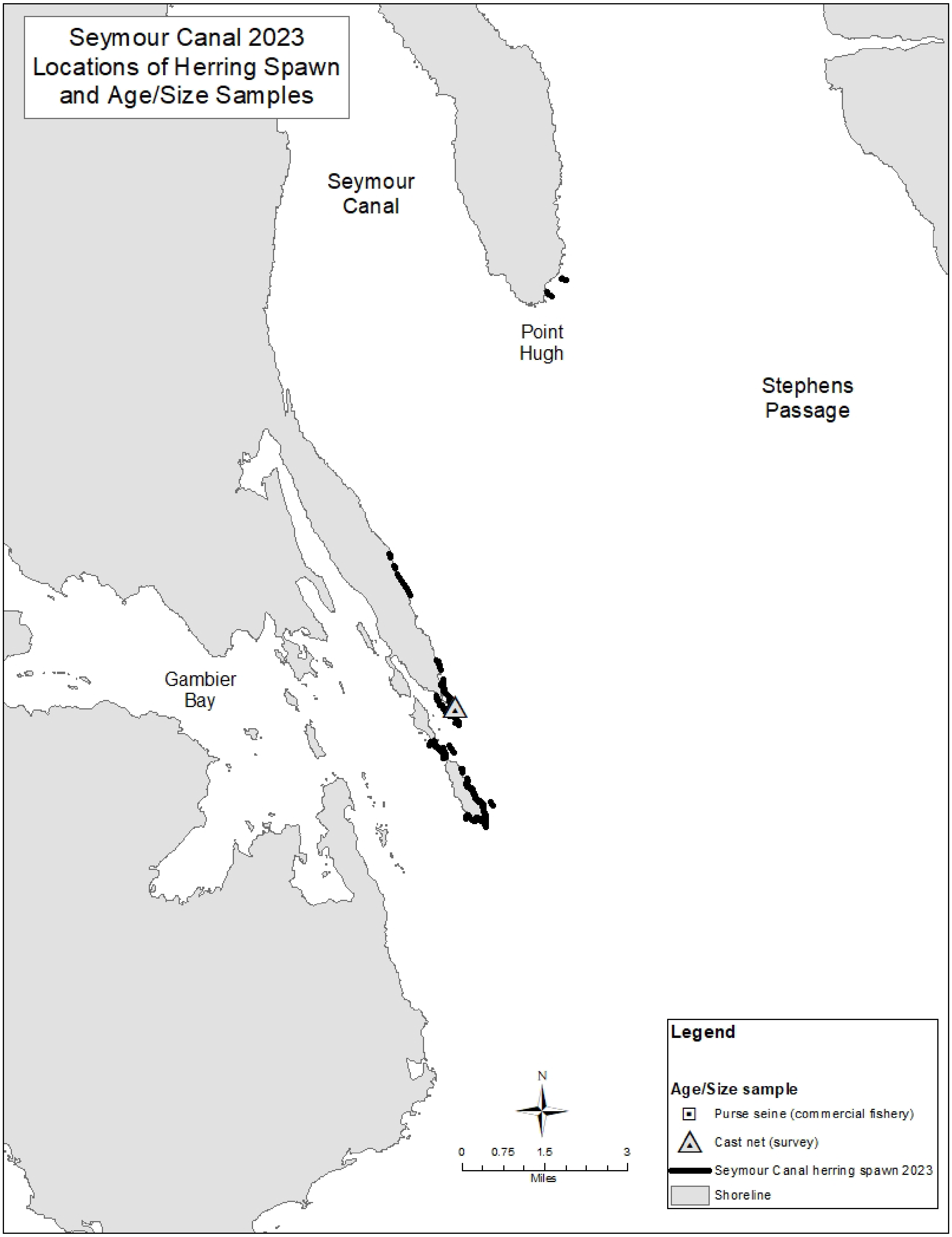

Figure 25.–Locations of herring spawn and samples collected for estimates of age and size for the Seymour Canal herring stock for the 2022–2023 season. Cumulative herring spawn denoted by thick black line along shoreline.

Figure 26.–Locations of herring spawn observed for the Ernest Sound herring stock for the 2022–2023 season. Cumulative herring spawn denoted by thick black line along shoreline.

Figure 27.–Locations of herring spawn observed for the Hobart Bay–Port Houghton herring stock for the 2022–2023 season. Cumulative herring spawn denoted by thick black line along shoreline.

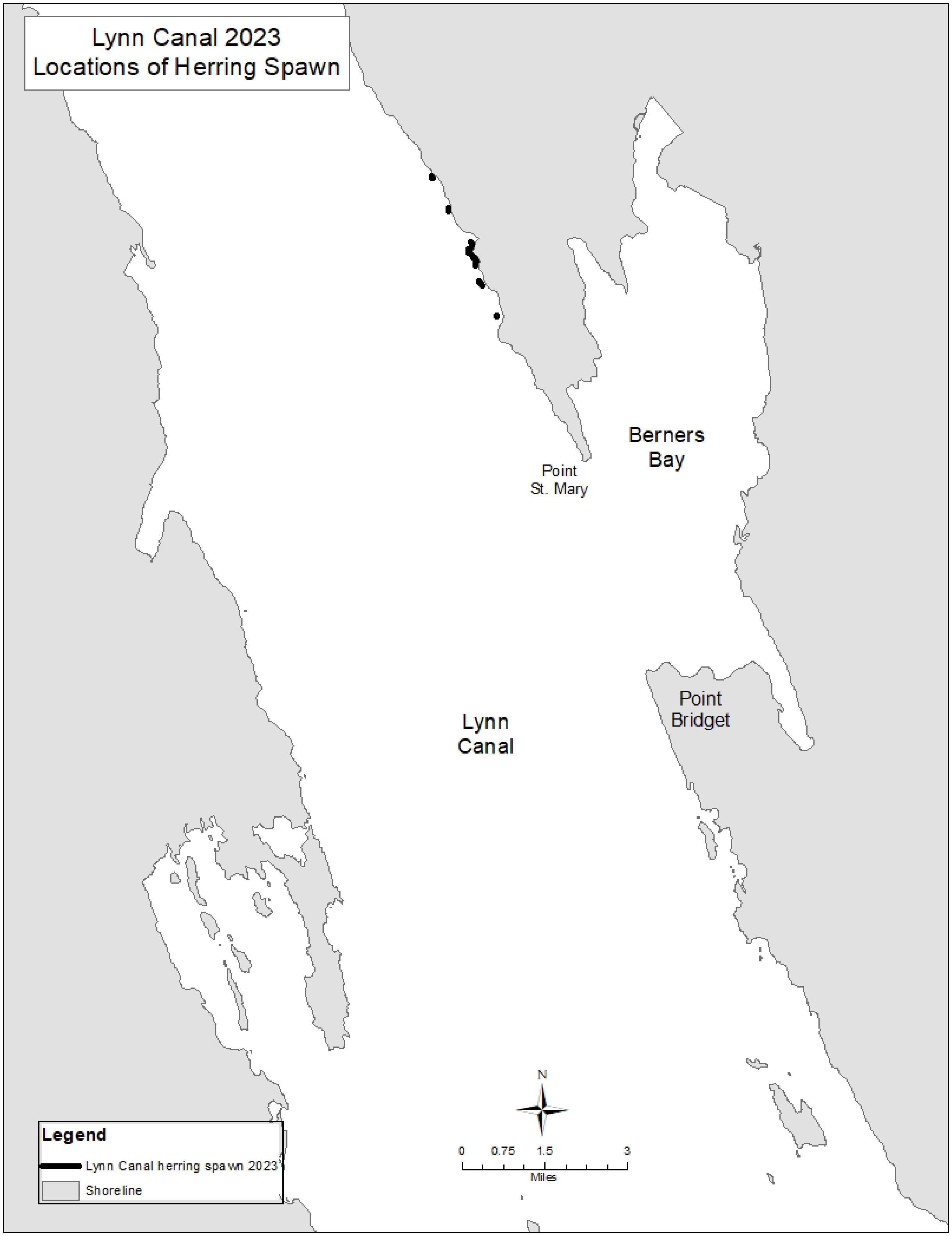

Figure 28.–Locations of herring spawn observed for the Lynn Canal herring stock for the 2022–2023 season. Cumulative herring spawn denoted by thick black line along shoreline.

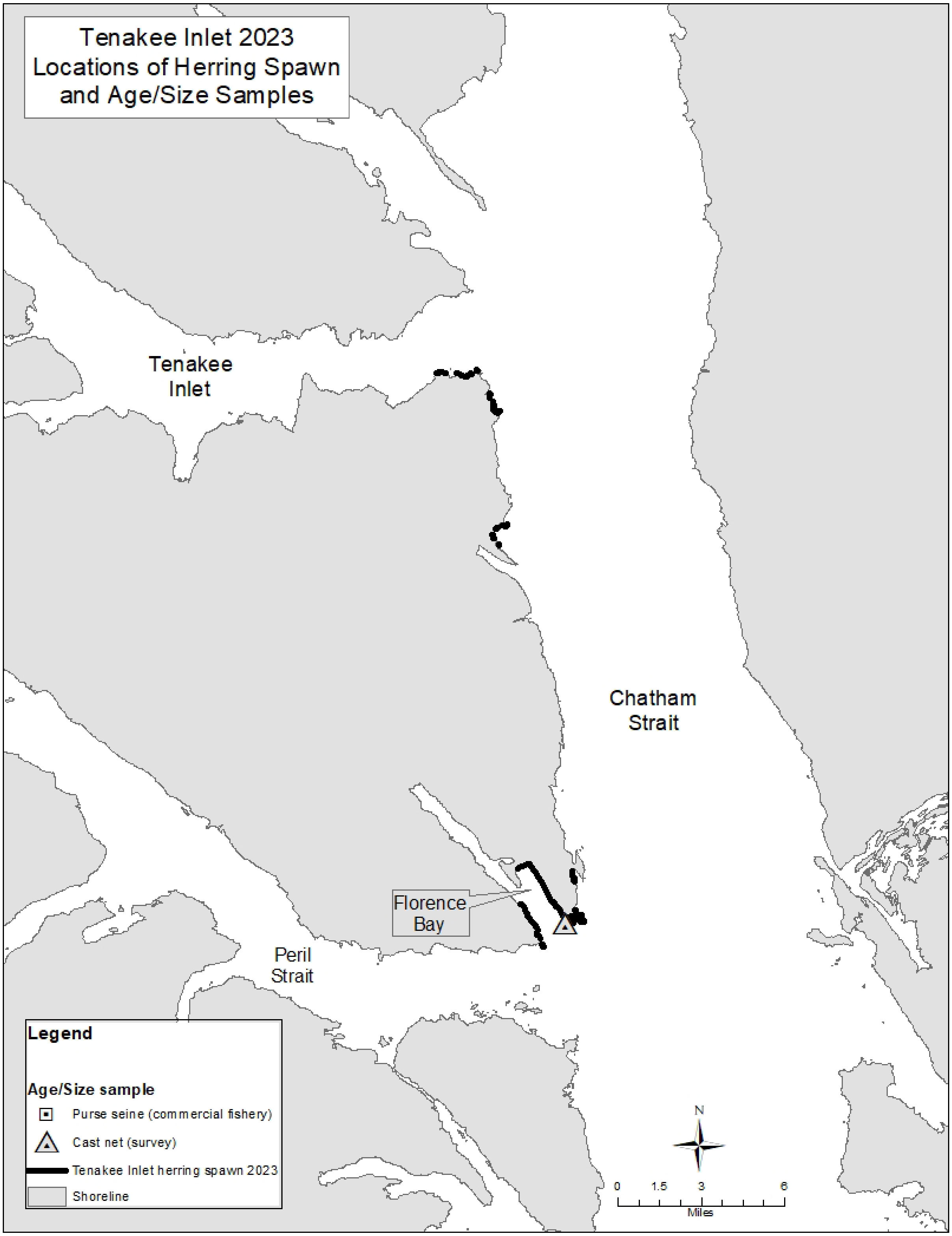

Figure 29.–Locations of herring spawn observed, and samples collected for estimates of age and size for the Tenakee Inlet herring stock for the 2022–2023 season. Cumulative herring spawn denoted by thick black line along shoreline.

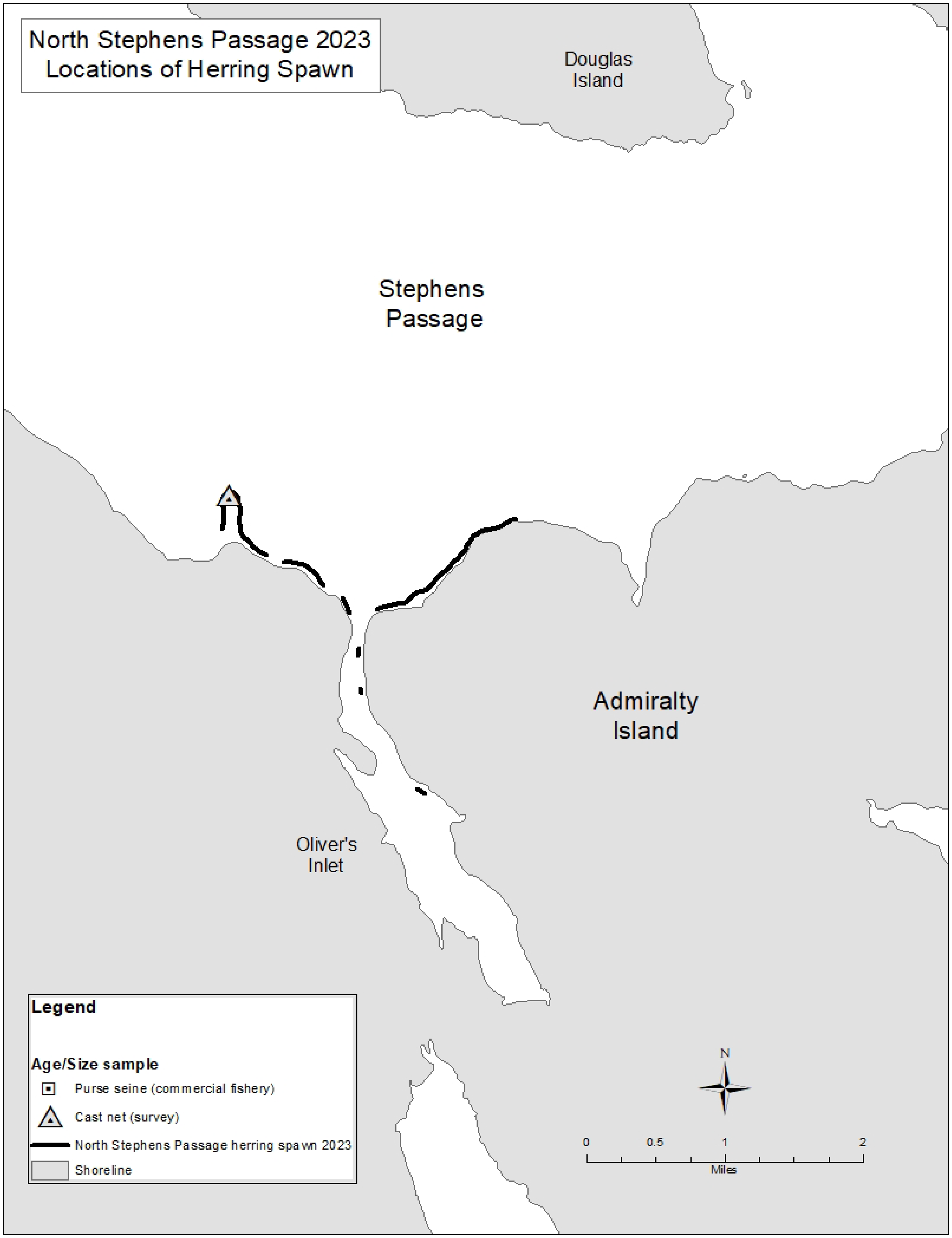

Figure 30.–Locations of herring spawn observed and samples taken for age and size estimates for the Northern Stephens Passage area for the 2022–2023 season. Cumulative herring spawn denoted by thick black line along shoreline.

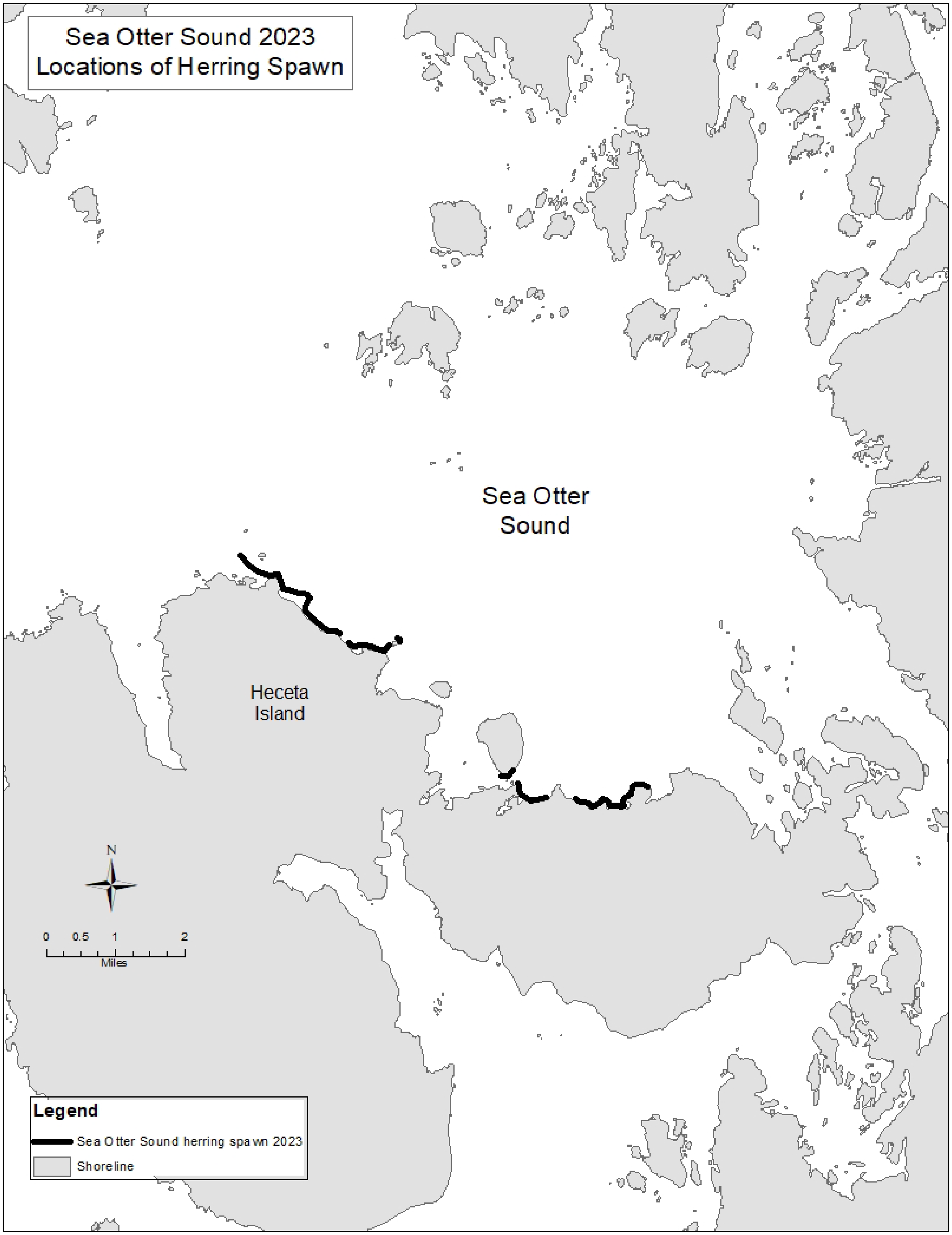

Figure 31.–Locations of herring spawn observed for the Sea Otter Sound area for the 2022–2023 season. Cumulative herring spawn denoted by thick black line along shoreline.

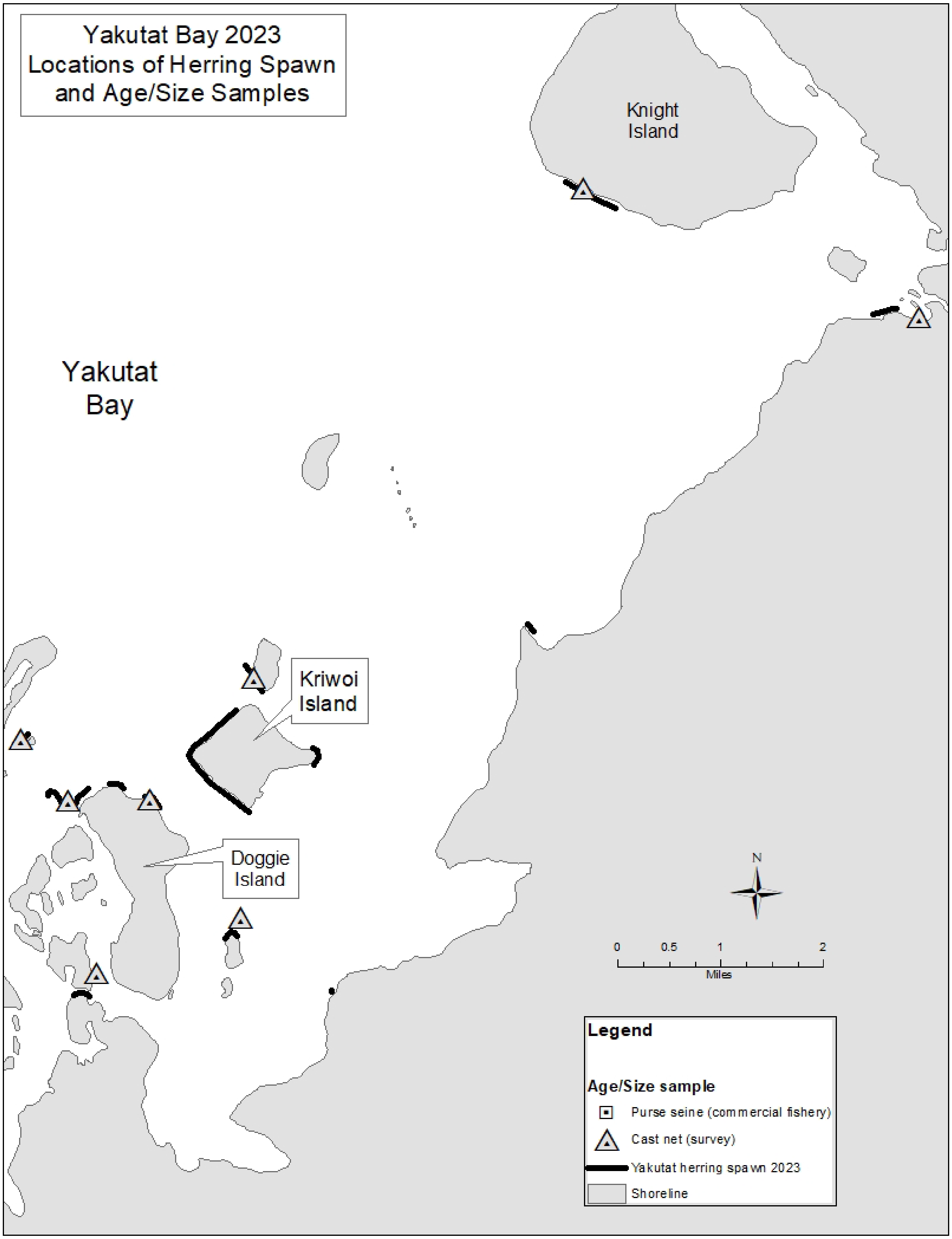

Figure 32.–Locations of herring observed for the Yakutat Bay herring stock for the 2022–2023 season. Cumulative herring spawn denoted by thick black line along shoreline.

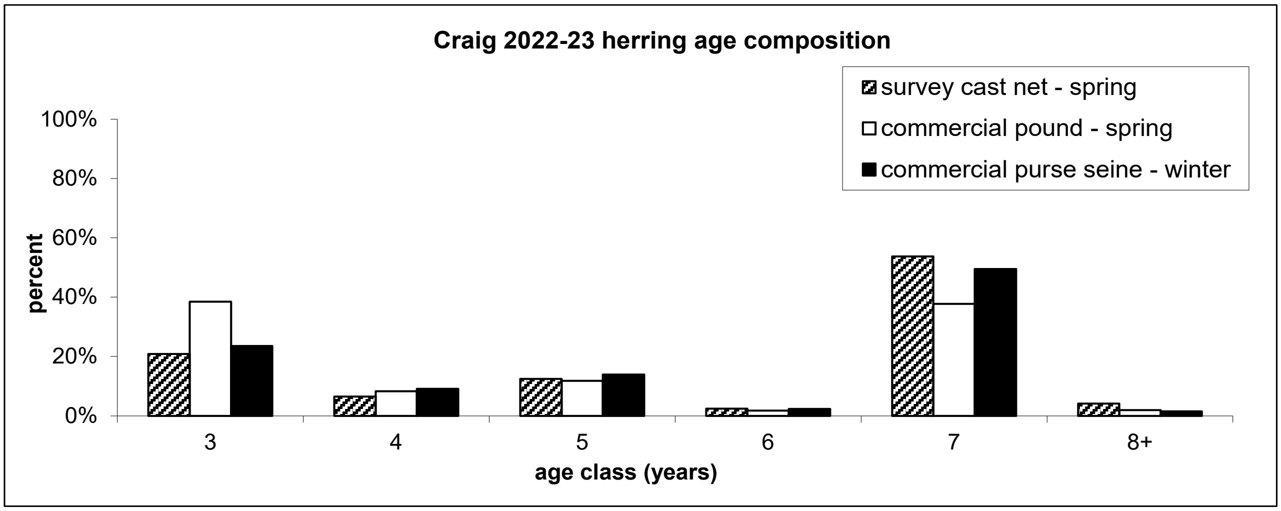

Figure 33.–Observed age composition for Craig herring stock in 2022–2023.

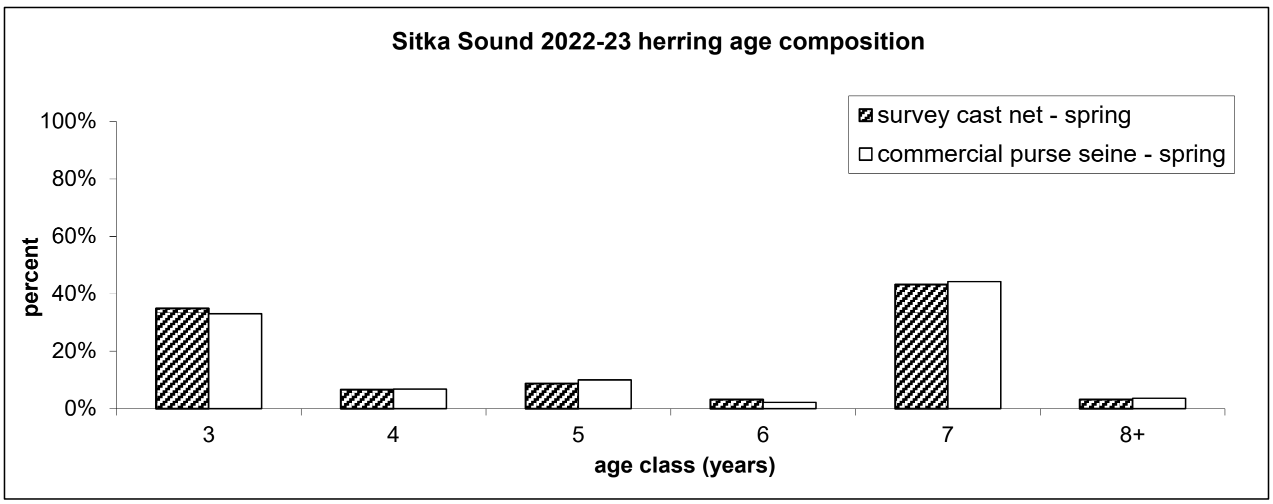

Figure 34.–Observed age composition for Sitka herring stock in 2022–2023.

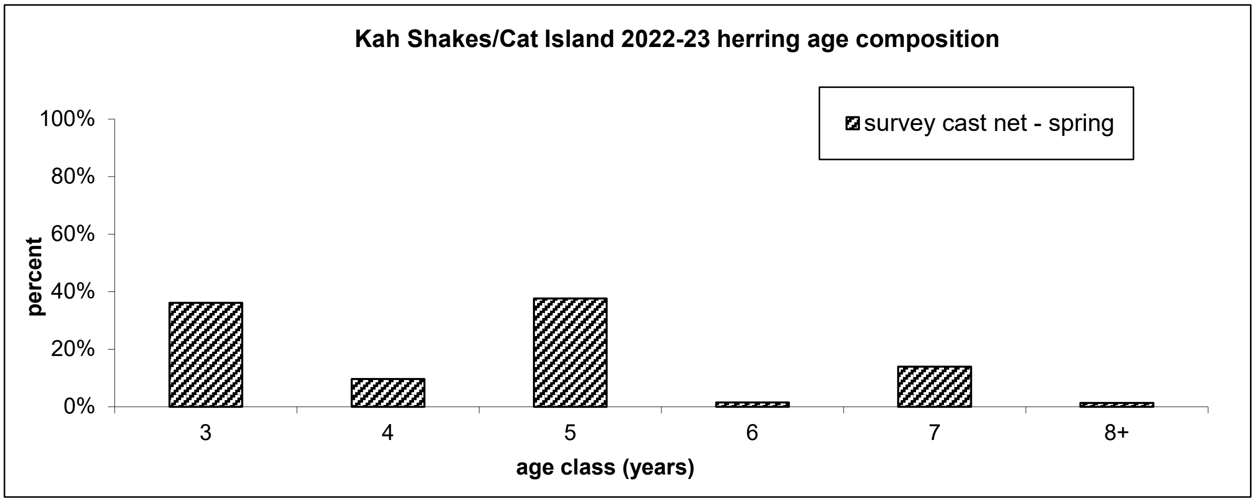

Figure 35.–Observed age composition for Kah Shakes/Cat Island (Revilla Channel) herring stock in 2022–2023.

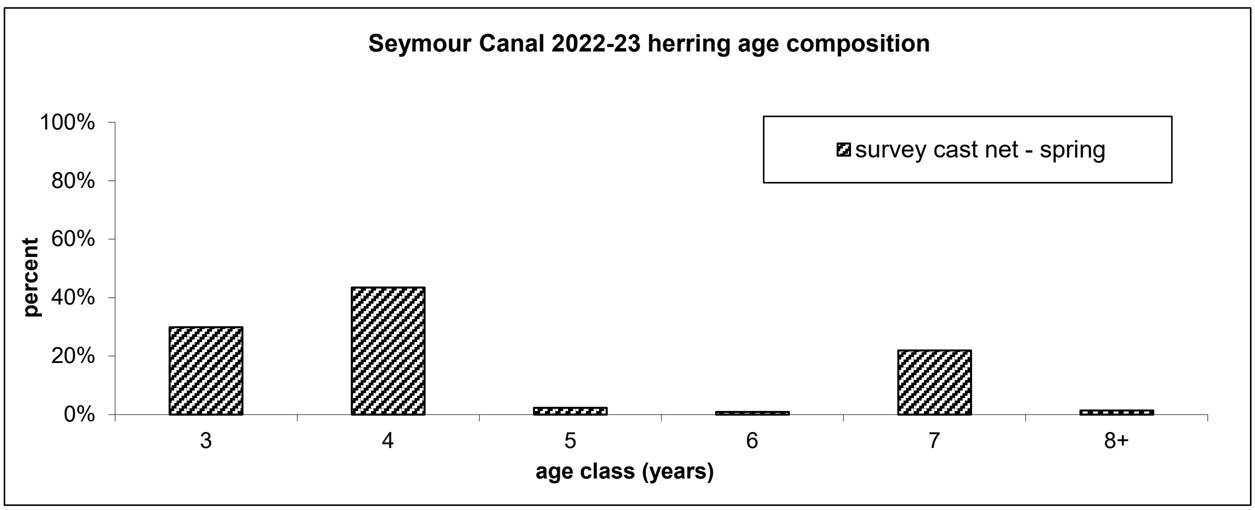

Figure 36.–Observed age composition for Seymour Canal herring stock in 2022–2023. Sample size was 214 herring, which is below the minimum of 511 needed to meet the age composition precision goal.

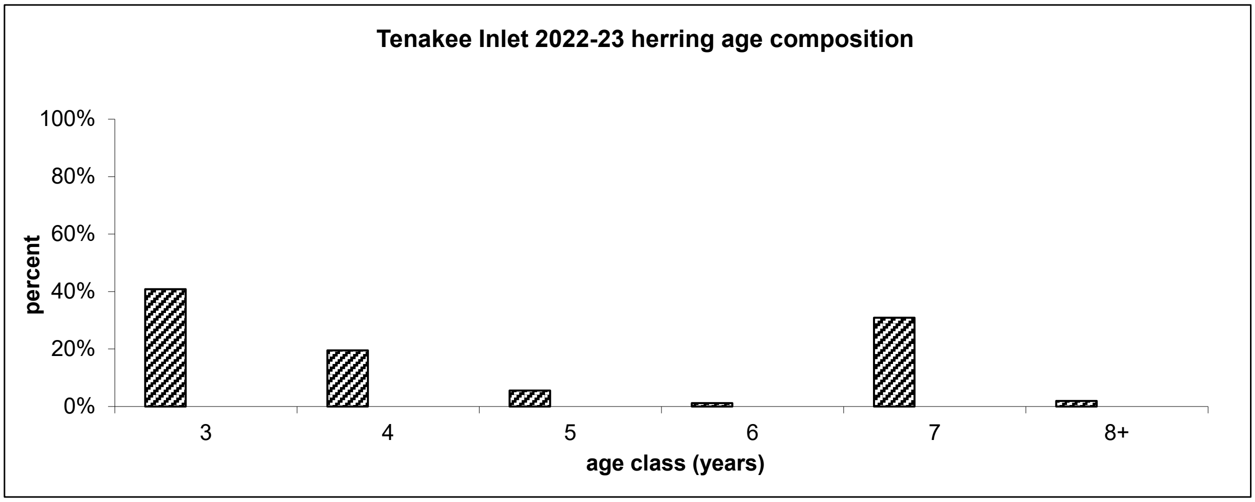

Figure 37.–Observed age composition for Tenakee Inlet herring stock in 2022–2023. Sample size was 414 herring, which is below the minimum of 511 needed to meet the age composition precision goal.

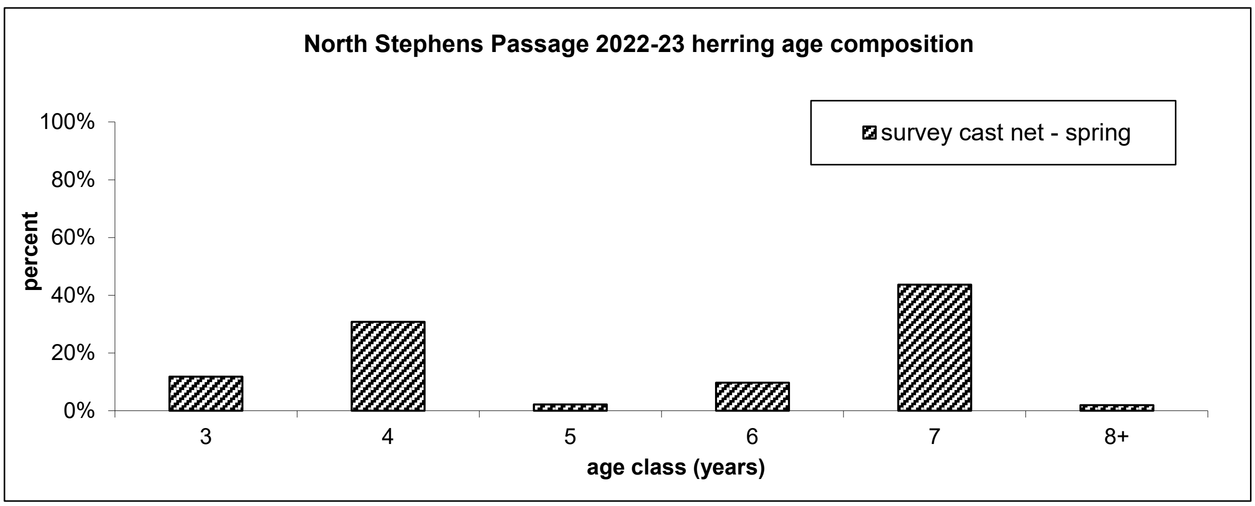

Figure 38.–Observed age composition for North Stephens Passage herring spawning area in 2022–2023. Sample size was 465 herring, which is below the minimum of 511 needed to meet the age composition precision goal.

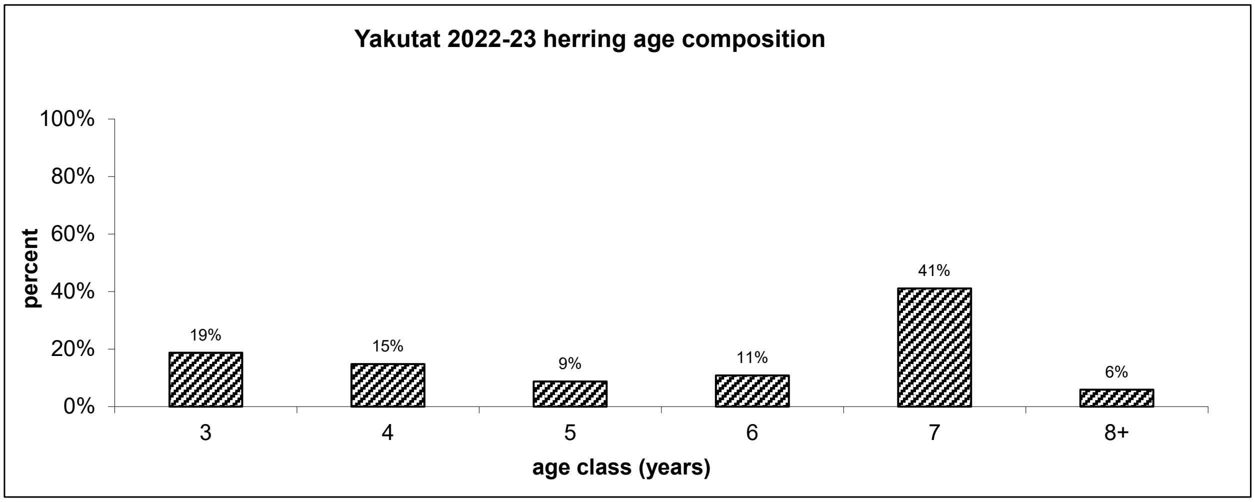

Figure 39.–Observed age composition for Yakutat Bay herring spawning area in 2022–2023.

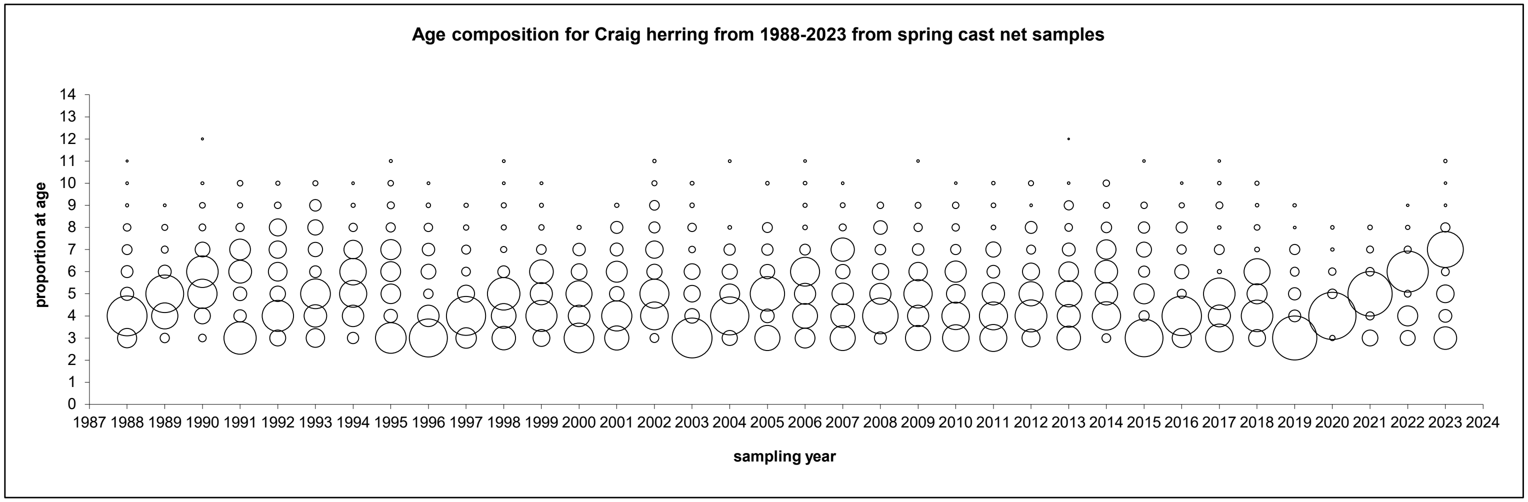

Figure 40.–Observed age compositions from sampling data for the Craig herring stock. Ages presented for 2000 may be biased slightly high due to misinterpretation of scale annuli. For reference, the largest circle represents 93% (2020).

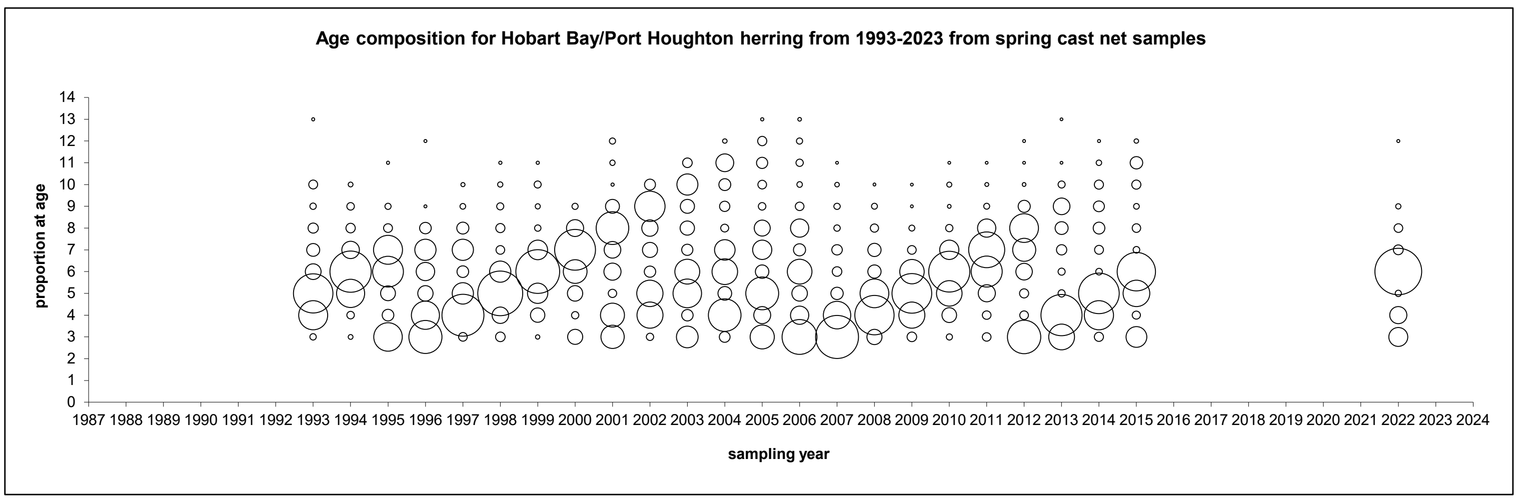

Figure 41.–Observed age compositions from sampling data for the Hobart Bay–Port Houghton herring stock. Ages presented for 2000 may be biased slightly high due to misinterpretation of scale annuli. For years with blanks, data were either not collected or not available. For reference, the largest circle represents 72% (2022).

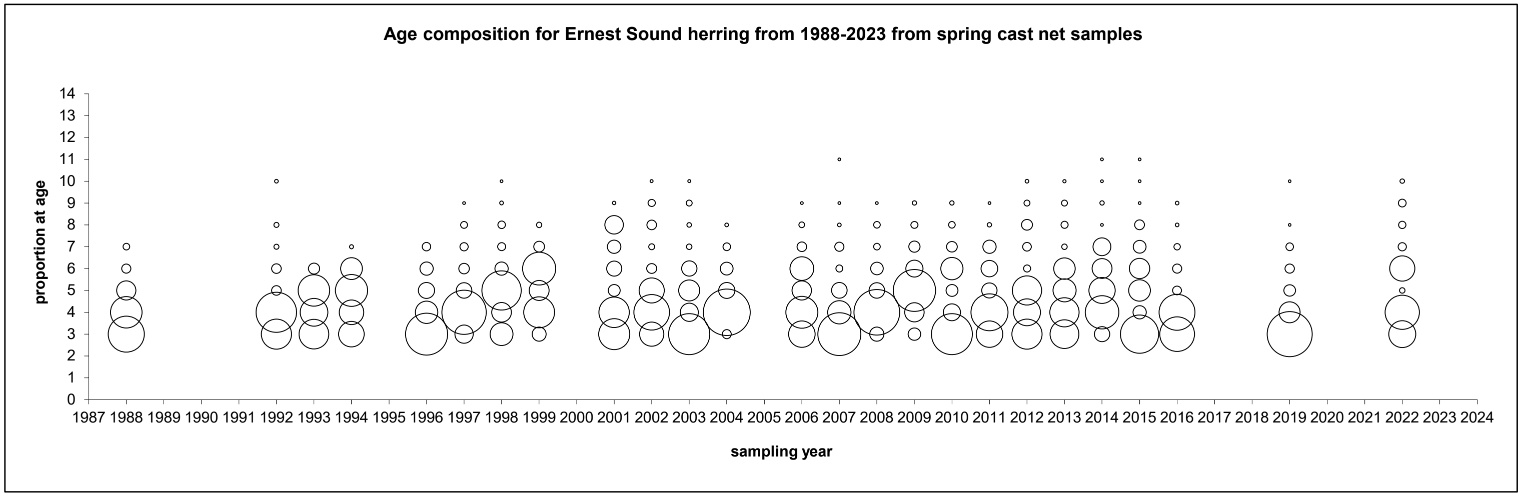

Figure 42.–Observed age compositions from sampling data for the Ernest Sound herring stock. For years with blanks, data were either not collected or not available. For reference, the largest circle represents 80% (2004).

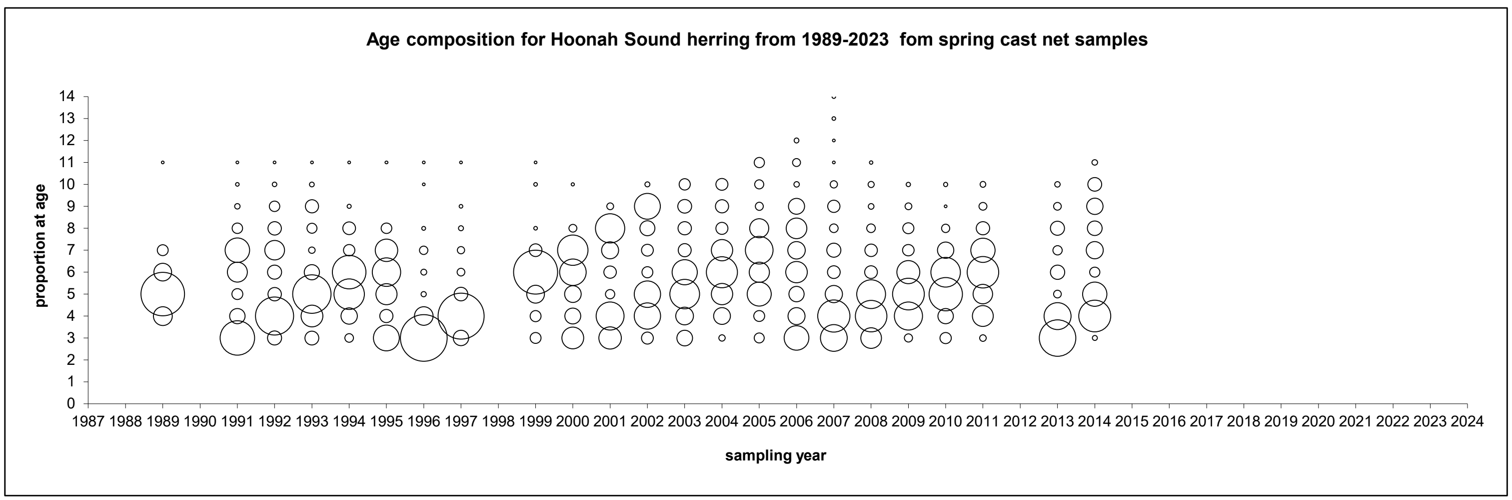

Figure 43.–Observed age compositions from sampling data for the Hoonah Sound herring stock. Ages presented for 2000 may be biased slightly high due to misinterpretation of scale annuli. For years with blanks, data were either not collected or not available. For reference, the largest circle represents 82% (1996).

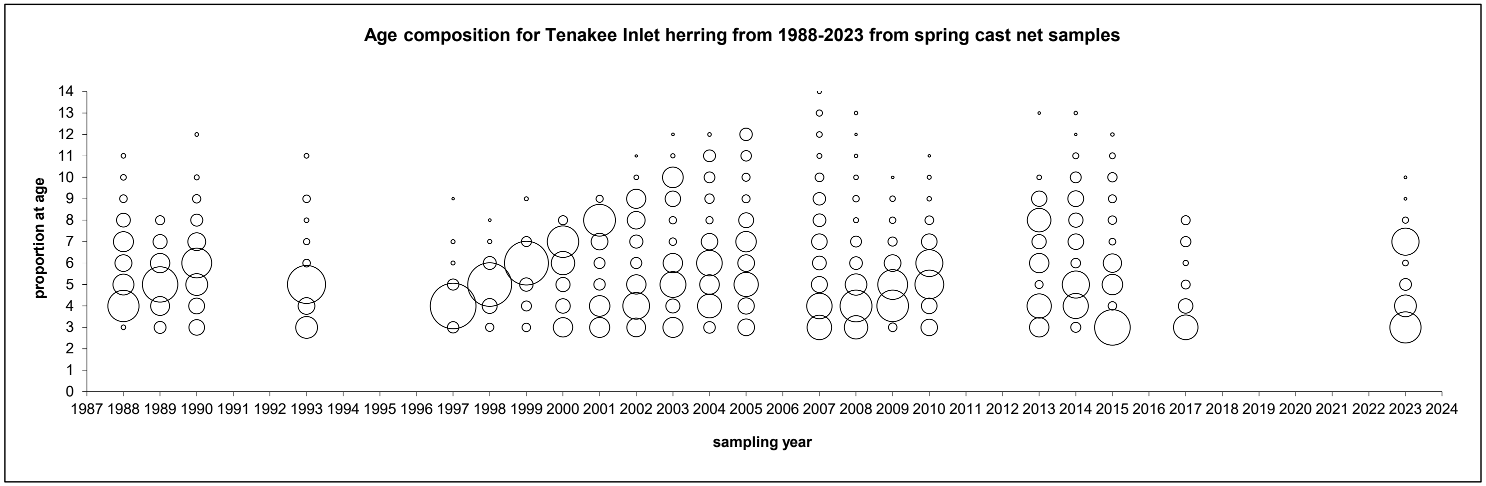

Figure 44.–Observed age compositions from sampling data for the Tenakee Inlet herring stock. Ages presented for 2000 may be biased slightly high due to misinterpretation of scale annuli. For years with blanks, data were either not collected or not available. For reference, the largest circle represents 88% (1997).

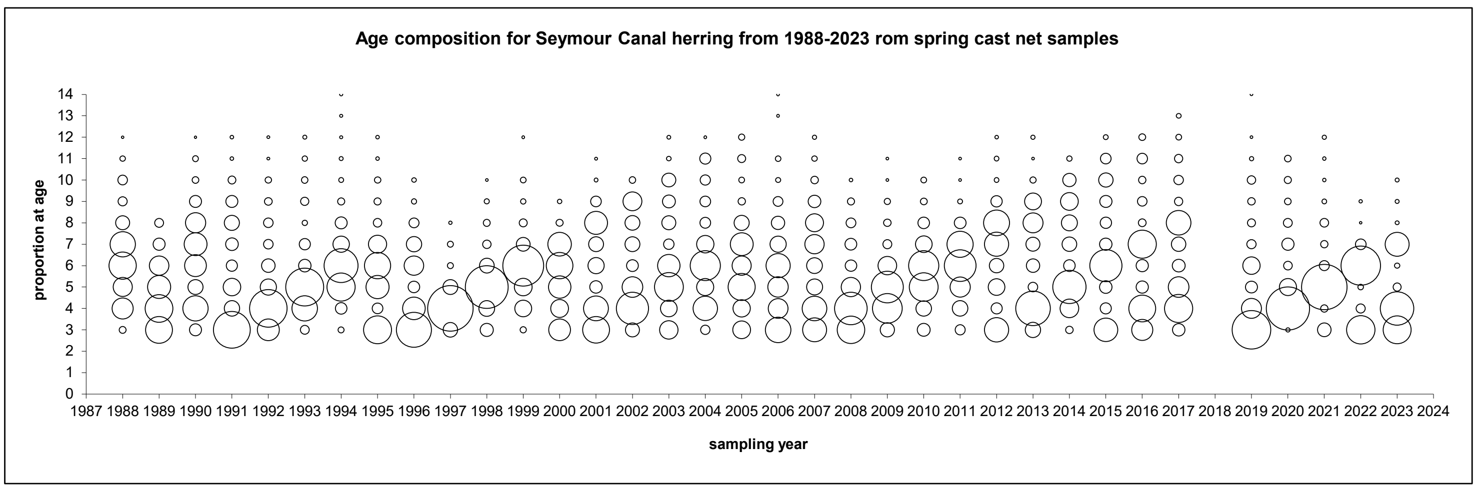

Figure 45.–Observed age compositions from sampling data for the Seymour Canal herring stock. Ages presented for 2000 may be biased slightly high due to misinterpretation of scale annuli. For years with blanks, data were either not collected or not available. For reference, the largest circle represents 81% (2021 and 1997).

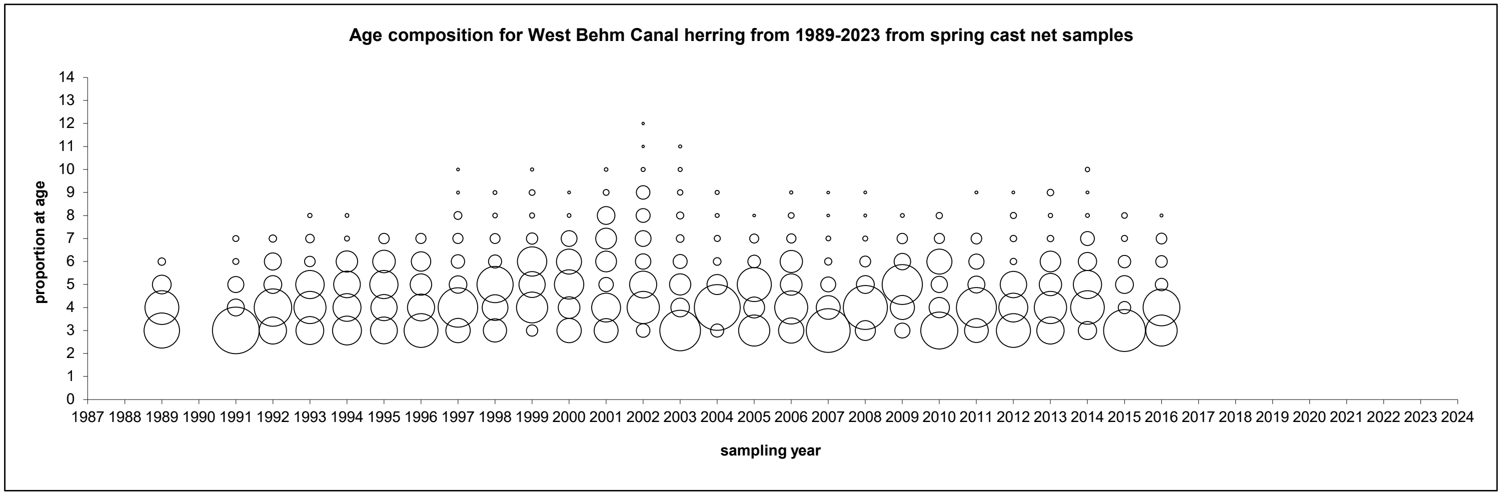

Figure 46.–Observed age compositions from sampling data for the West Behm Canal herring stock. Ages presented for 2000 may be biased slightly high due to misinterpretation of scale annuli. For years with blanks, data were either not collected or not available. For reference, the largest circle represents 79% (1991).

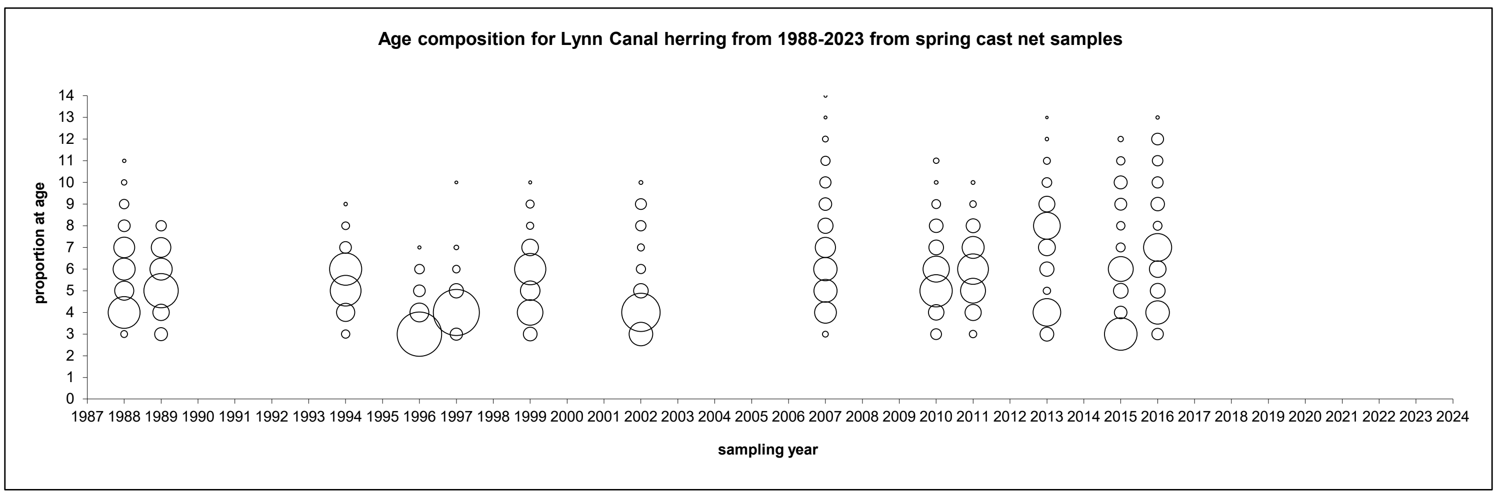

Figure 47.–Observed age compositions from sampling data for the Lynn Canal herring stock. For years with blanks, data were either not collected or not available. For reference, the largest circle represents 84% (1997).

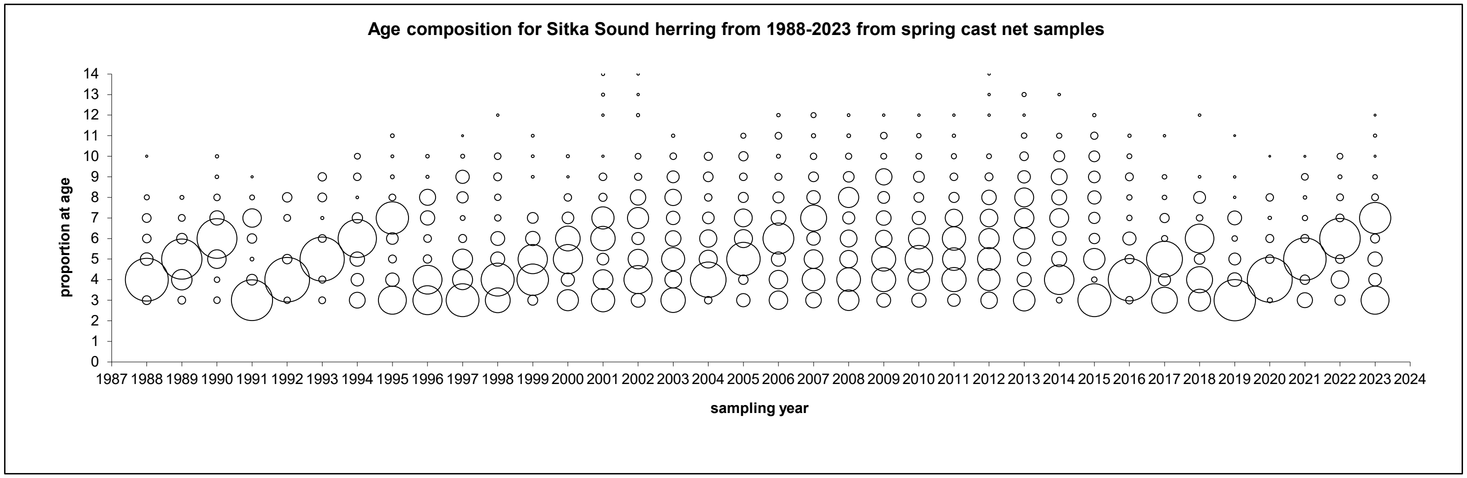

Figure 48.–Observed age compositions from sampling data for the Sitka Sound herring stock. Ages presented for 2000 may be biased slightly high due to misinterpretation of scale annuli. For reference, the largest circle represents 91% (2020).

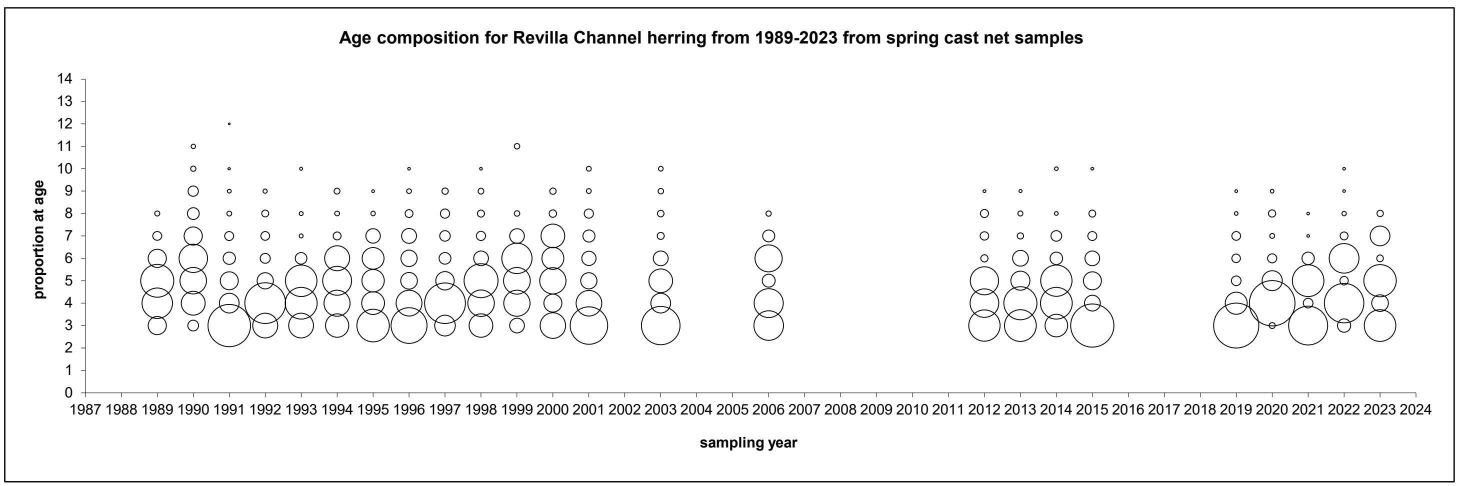

Figure 49.–Observed age compositions from sampling data for the Kah Shakes/Cat Island (Revilla Channel) herring stock. Ages presented for 2000 may be biased slightly high due to misinterpretation of scale annuli. For years with blanks, data were either not collected or not available. For reference, the largest circle represents 75% (2020).

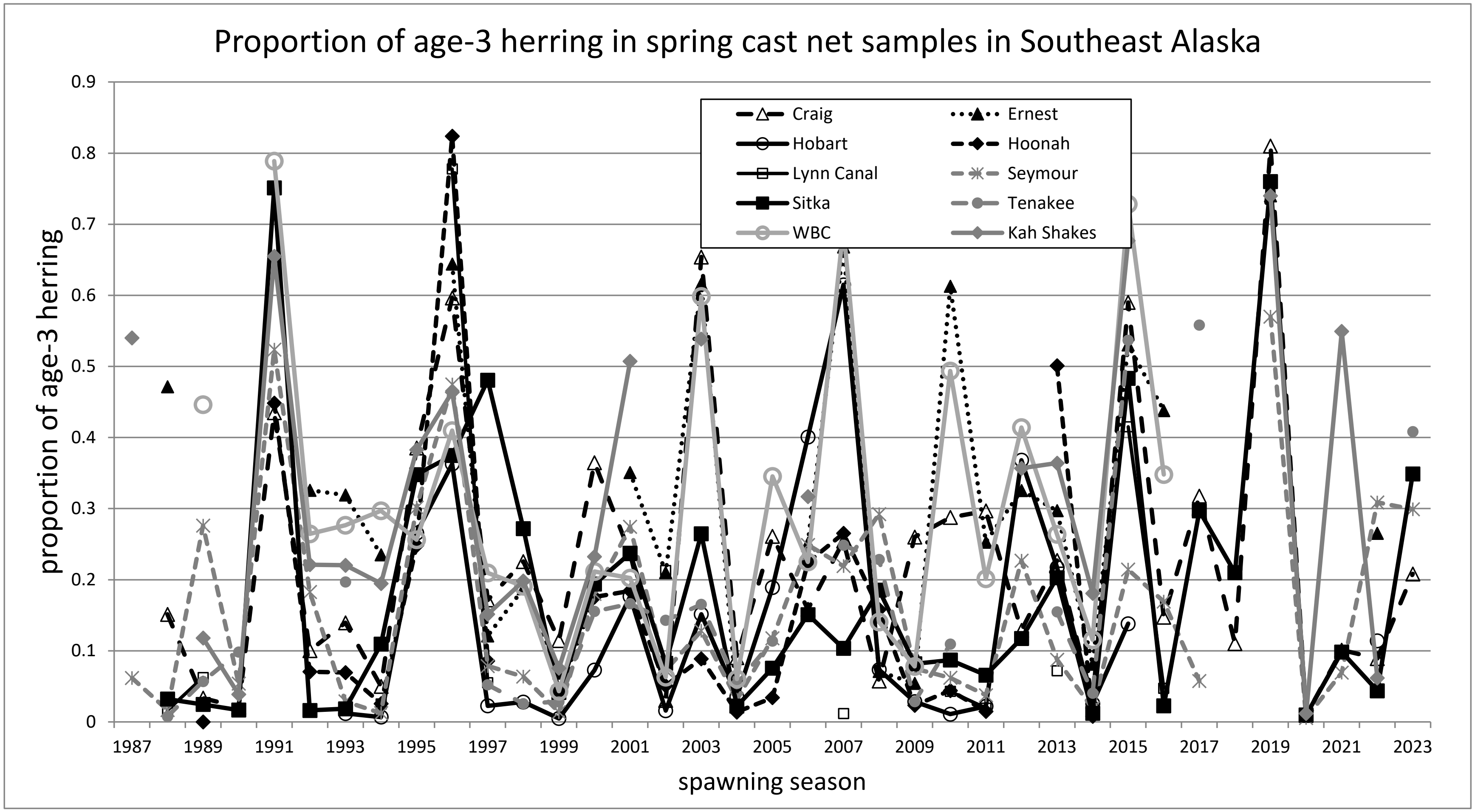

Figure 50.–Proportions of observed age-3 herring in spring cast nest samples of spawning populations for stocks in Southeast Alaska.

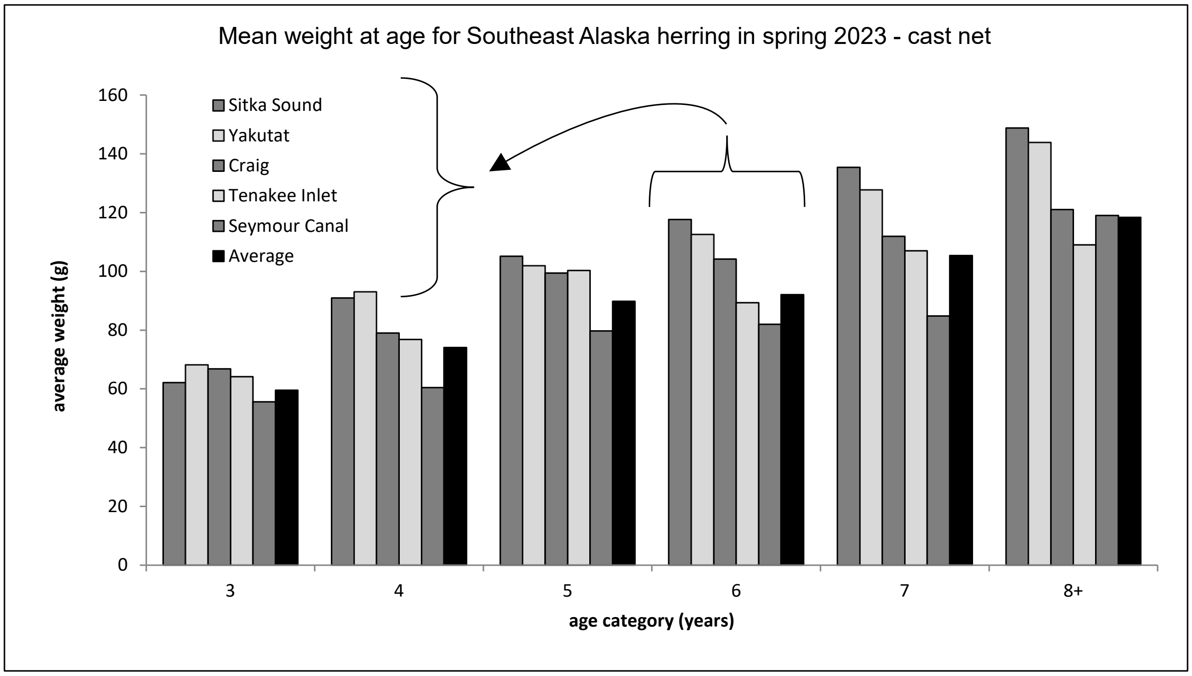

Figure 51.–Mean observed weight-at-age for Southeast Alaska herring stocks surveyed in spring 2023, sorted by age-6. The order of bars within age (left to right) is the order of the list of stocks, and shade of bars is only to aid in visual separation of stocks.

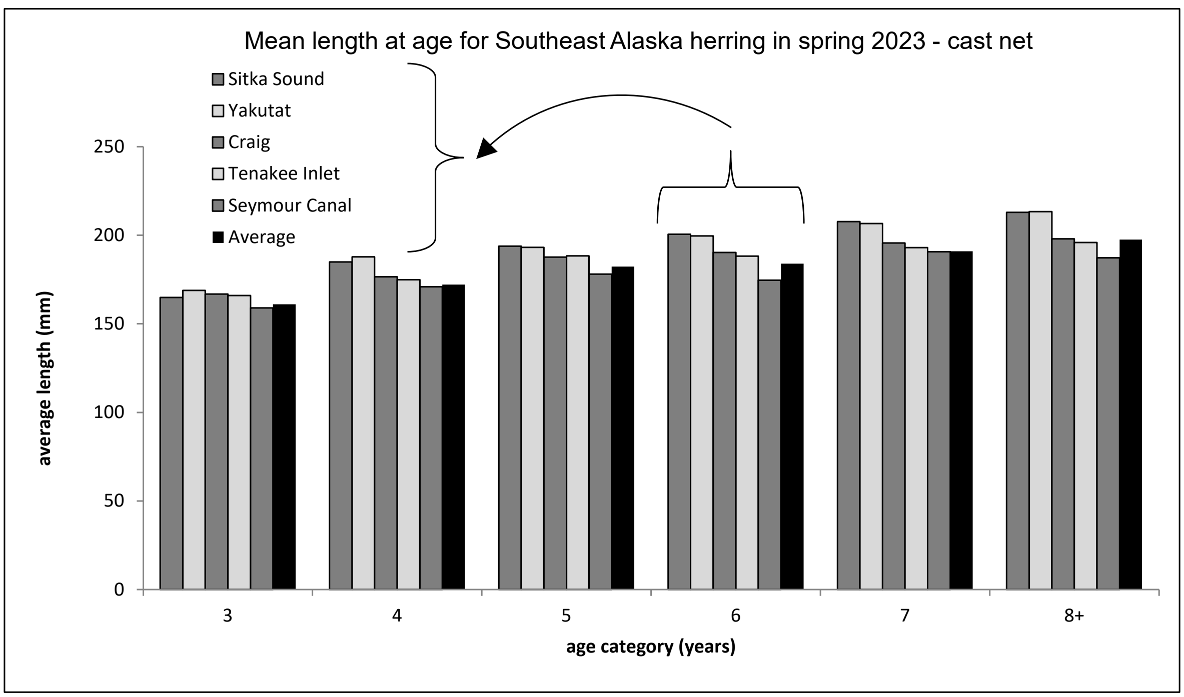

Figure 52.–Mean observed length-at-age for Southeast Alaska herring stocks surveyed in spring 2023, sorted by age-6. The order of bars within age (left to right) is the order of the list of stocks, and shade of bars is only to aid in visual separation of stocks.

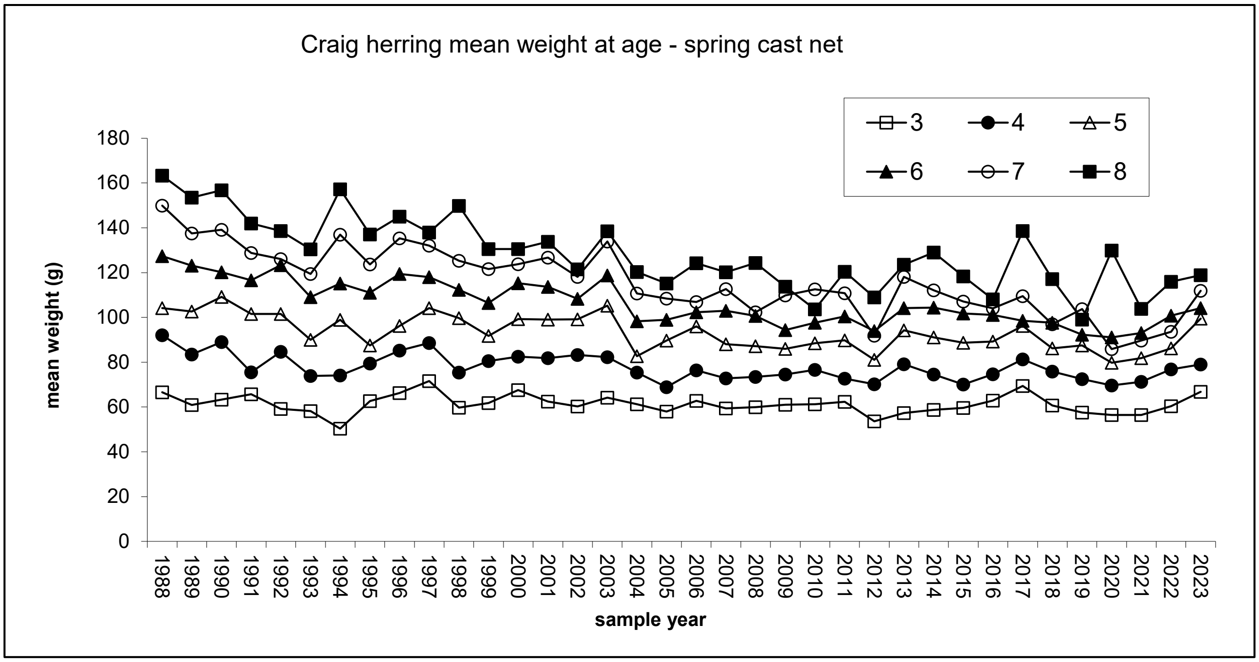

Figure 53.–Mean observed weight-at-age of the Craig herring spawning population. Weights presented for 2000 may be biased slightly high due to misinterpretation of scale annuli.

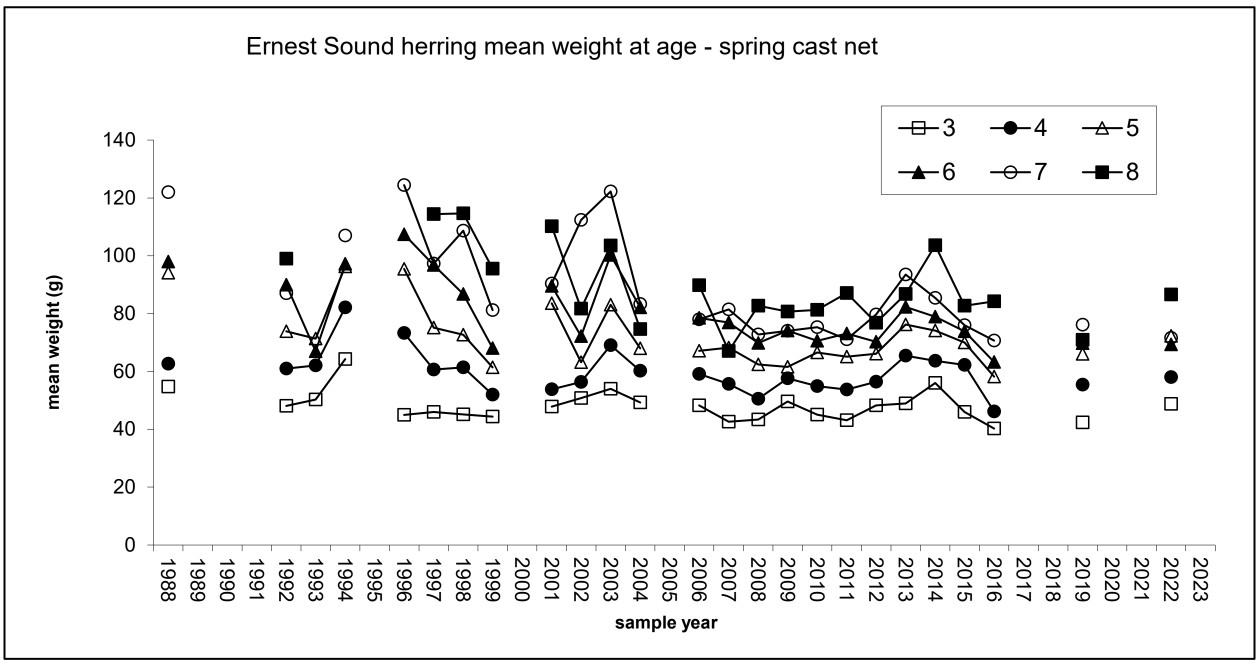

Figure 54.–Mean observed weight-at-age of the Ernest Sound herring spawning population. For years with blanks, data were either not collected or was not available.

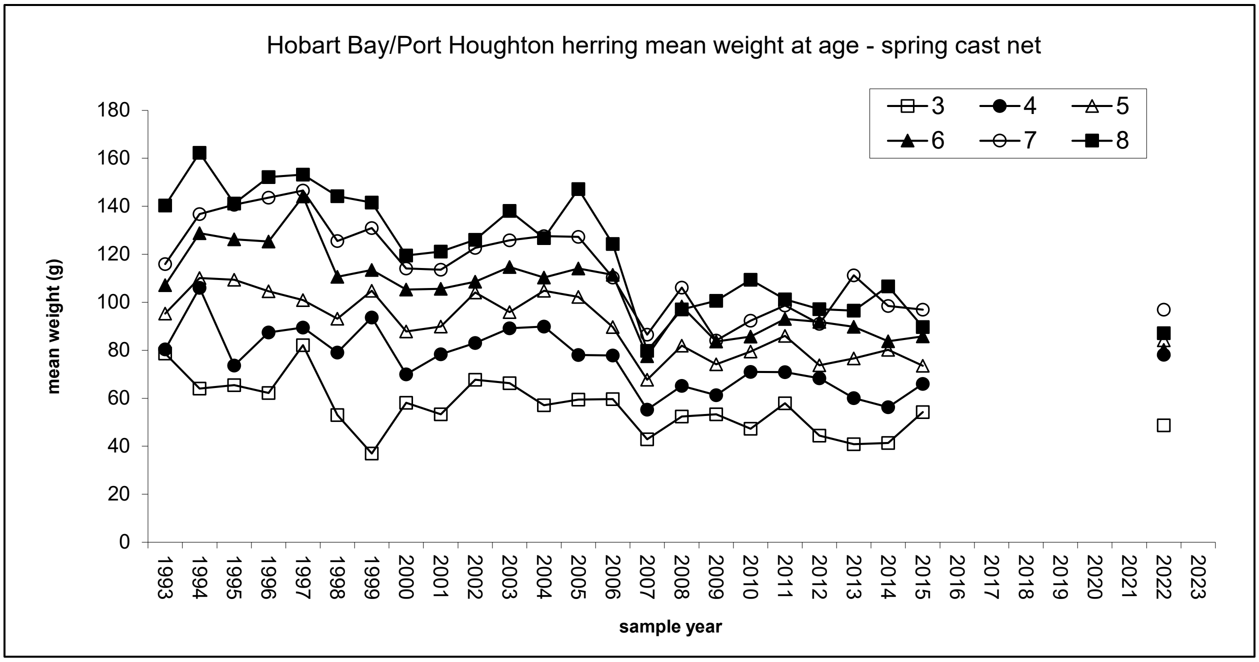

Figure 55.–Mean observed weight-at-age for the Hobart Bay–Port Houghton herring spawning population. For years with blanks, data were either not collected or was not available.

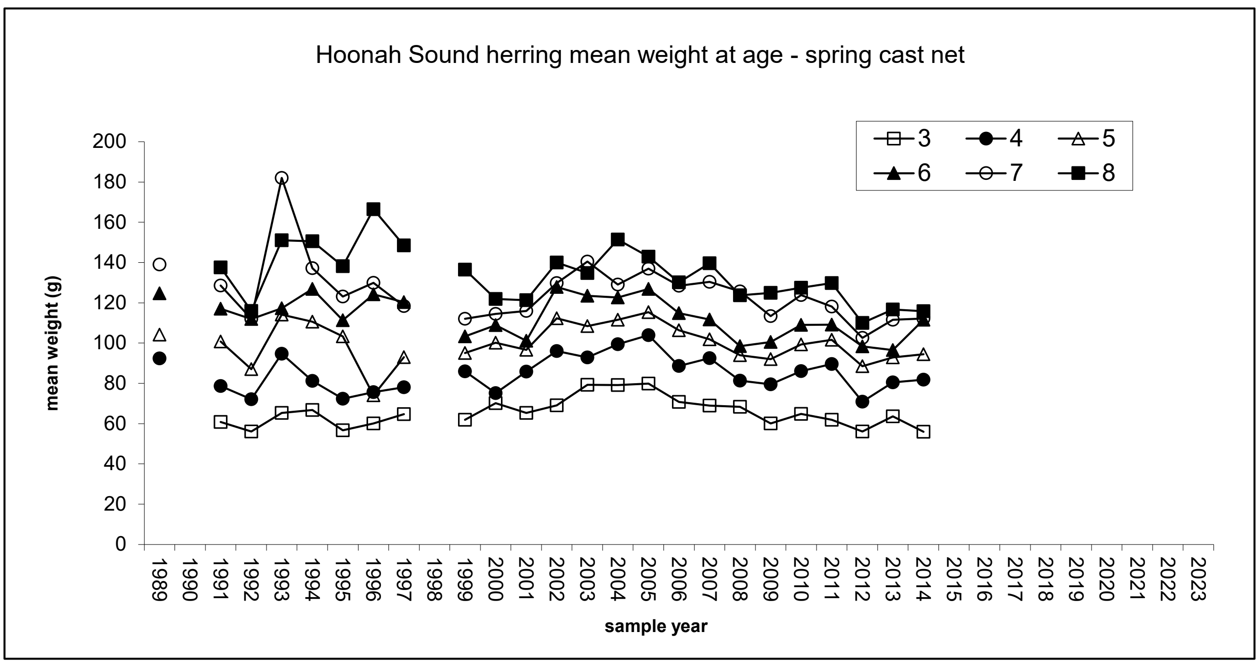

Figure 56.–Mean observed weight-at-age for the Hoonah Sound herring spawning population. Weights presented for 2000 may be biased slightly high due to misinterpretation of scale annuli. For years with blanks, data were either not collected or not available.

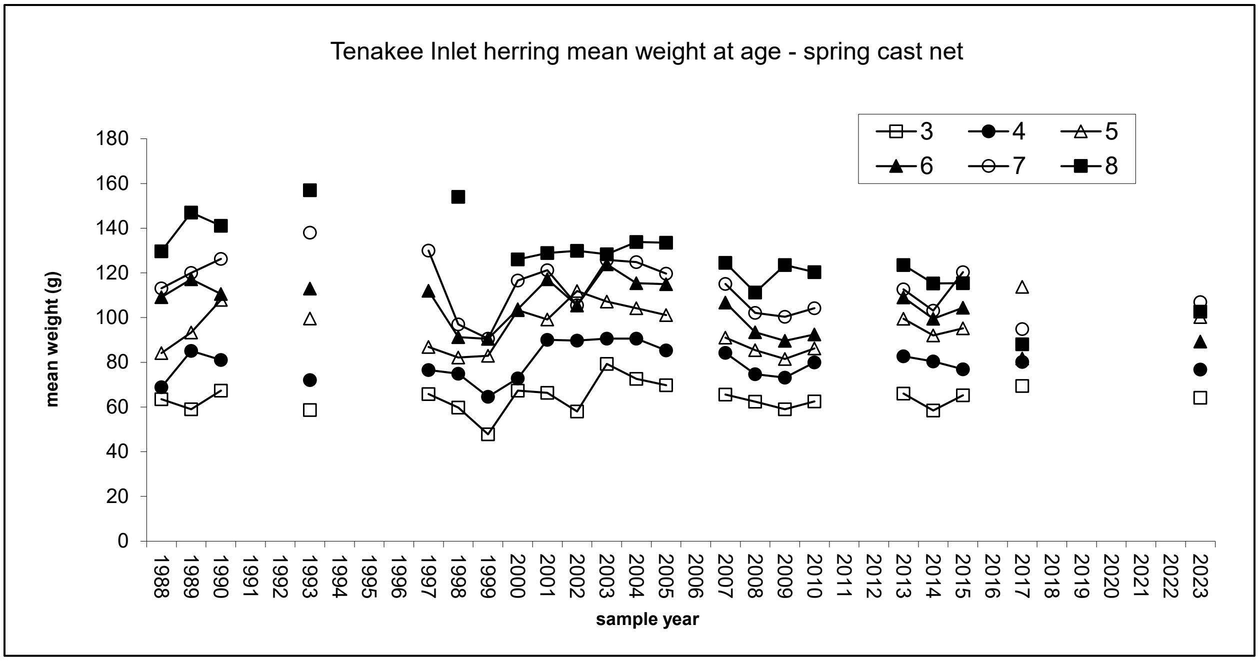

Figure 57.–Mean observed weight-at-age for the Tenakee Inlet herring stock. Weights presented for 2000 may be biased slightly high due to misinterpretation of scale annuli. For years with blanks, data were either not collected or not available.

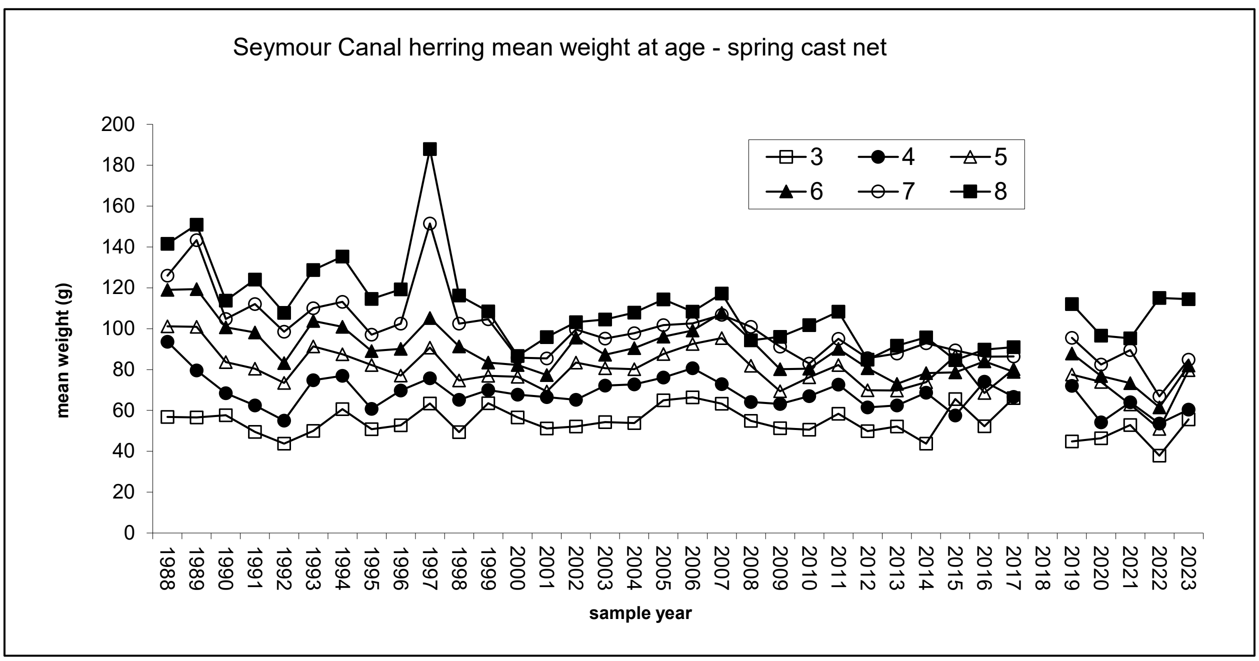

Figure 58.–Mean observed weight-at-age for the Seymour Canal herring stock. Weights presented for 2000 may be biased slightly high due to misinterpretation of scale annuli. For years with blanks, data were either not collected or not available.

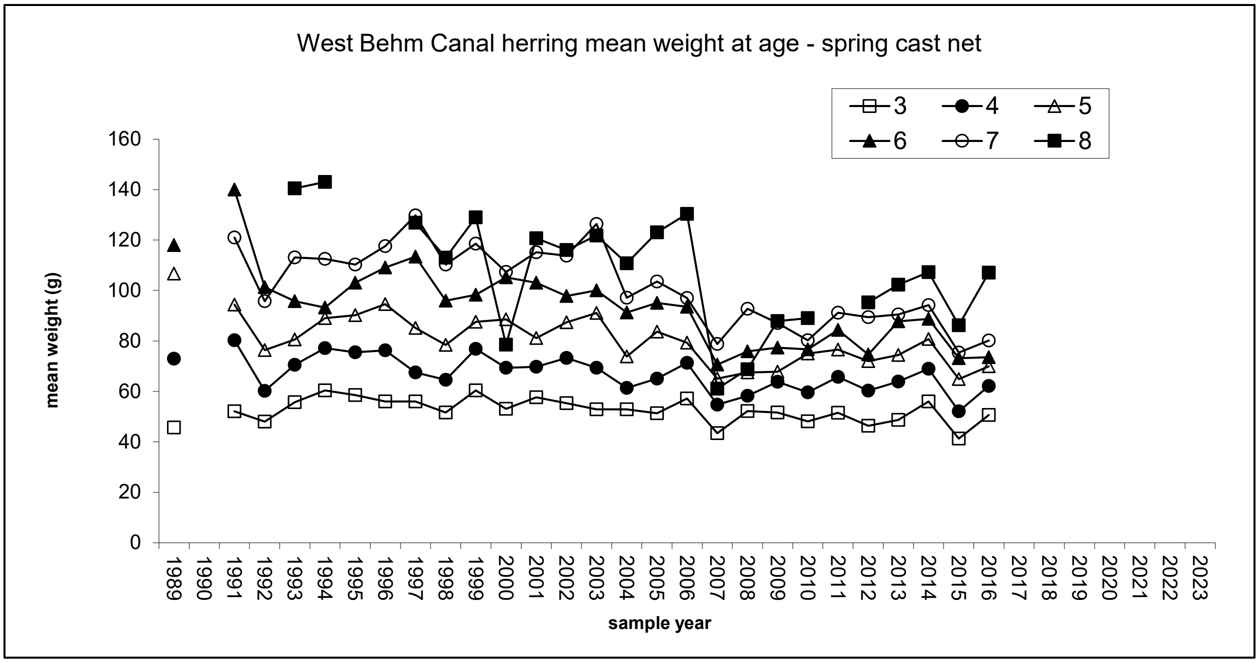

Figure 59.–Mean observed weight-at-age for the West Behm Canal herring spawning population. Weights presented for 2000 may be biased slightly high due to misinterpretation of scale annuli. 2015 weights are likely biased low due to required additional sample handling that resulted in loss of weight. For years with blanks, data were either not collected or not available.

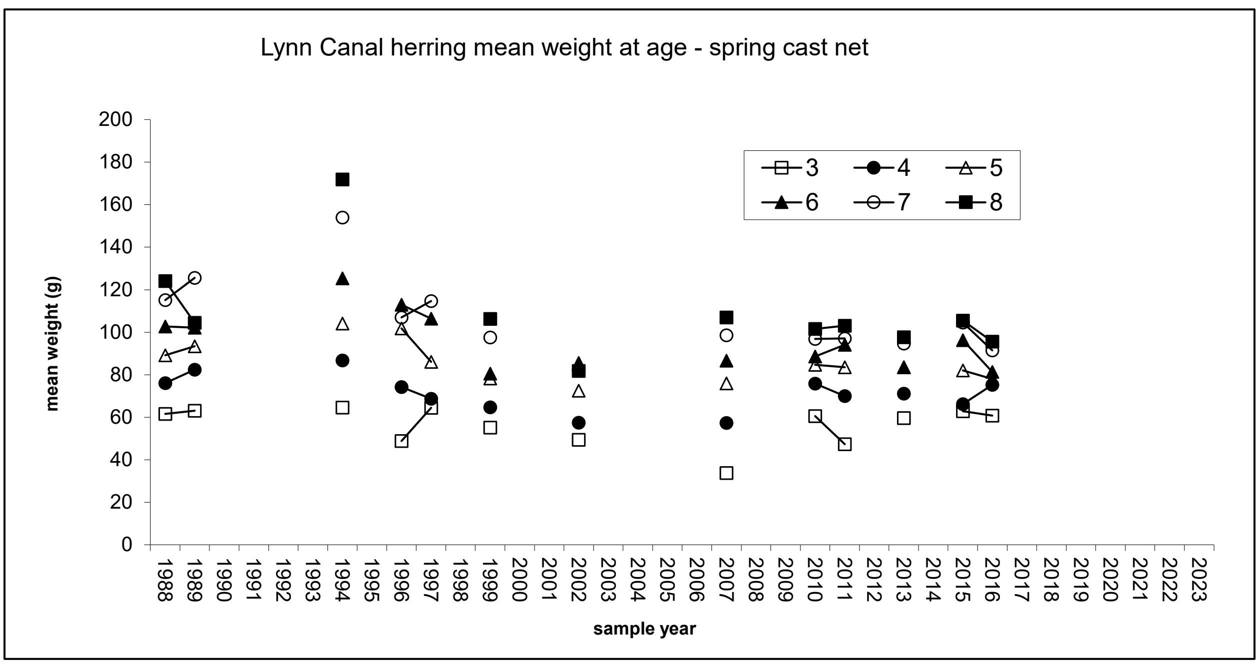

Figure 60.–Mean observed weight-at-age for the Lynn Canal herring spawning population. For years with blanks, data were either not collected or not available.

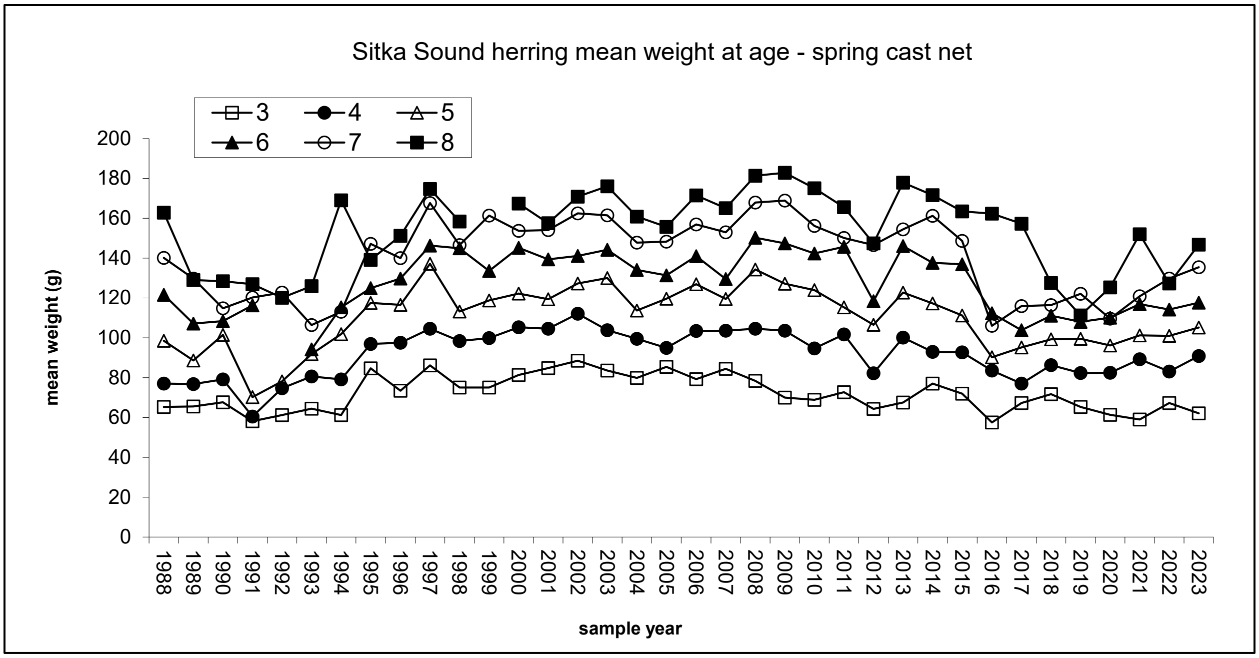

Figure 61.–Mean observed weight-at-age for the Sitka Sound herring spawning population. Weights presented for 2000 may be biased slightly high due to misinterpretation of scale annuli.

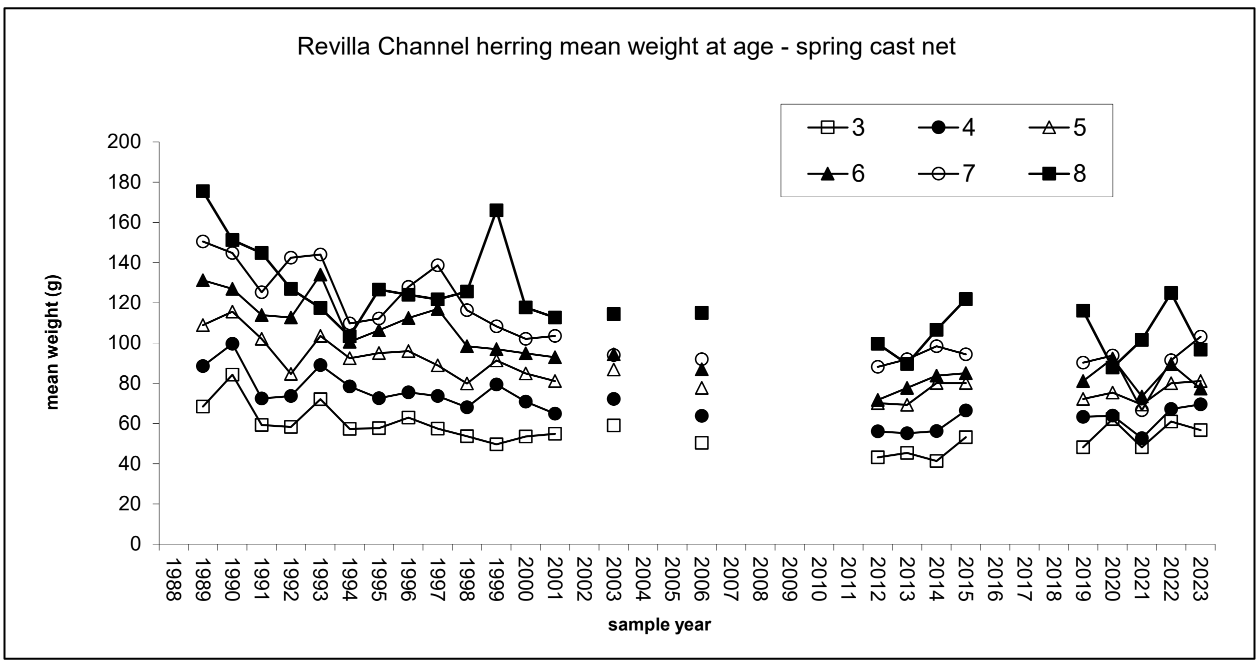

Figure 62.–Mean observed weight-at-age for the Revilla Channel herring spawning population. Weights presented for 2000 may be biased slightly high due to misinterpretation of scale annuli. For years with blanks, data were either not collected or not available.

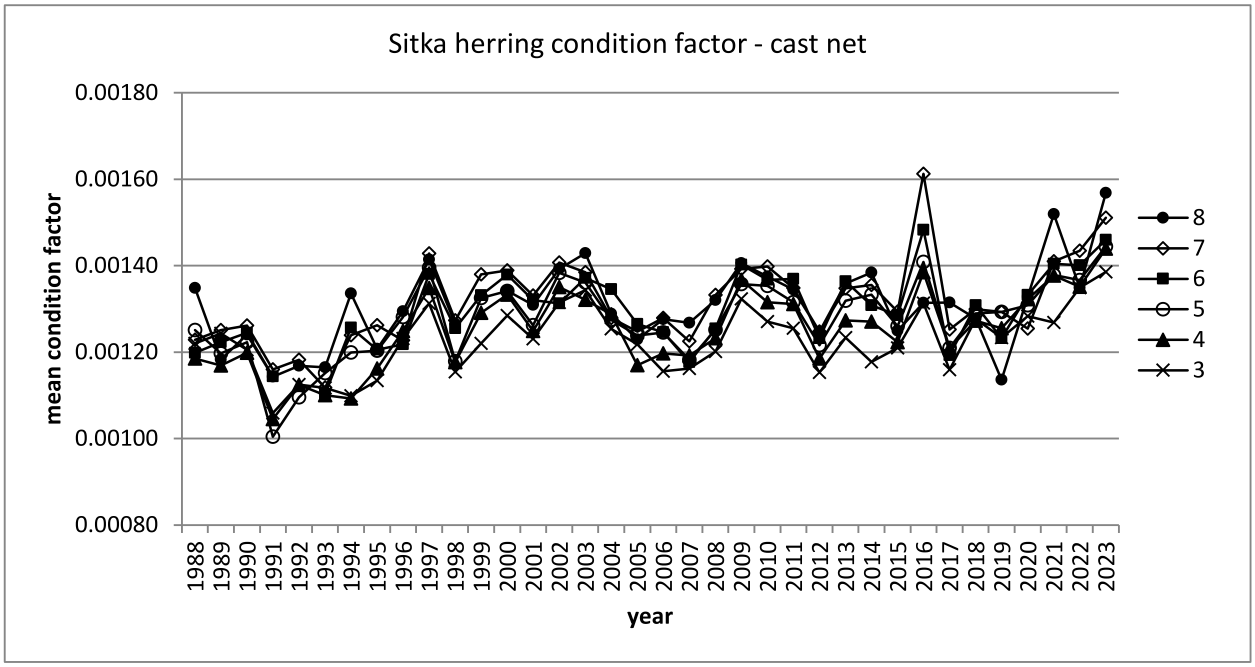

Figure 63.–Mean condition factors of age-3 through age-8 herring for the Sitka Sound spawning population, based on spring cast net samples taken during active spawning. 2016 values may be biased high due to length measurements that were likely underestimated.

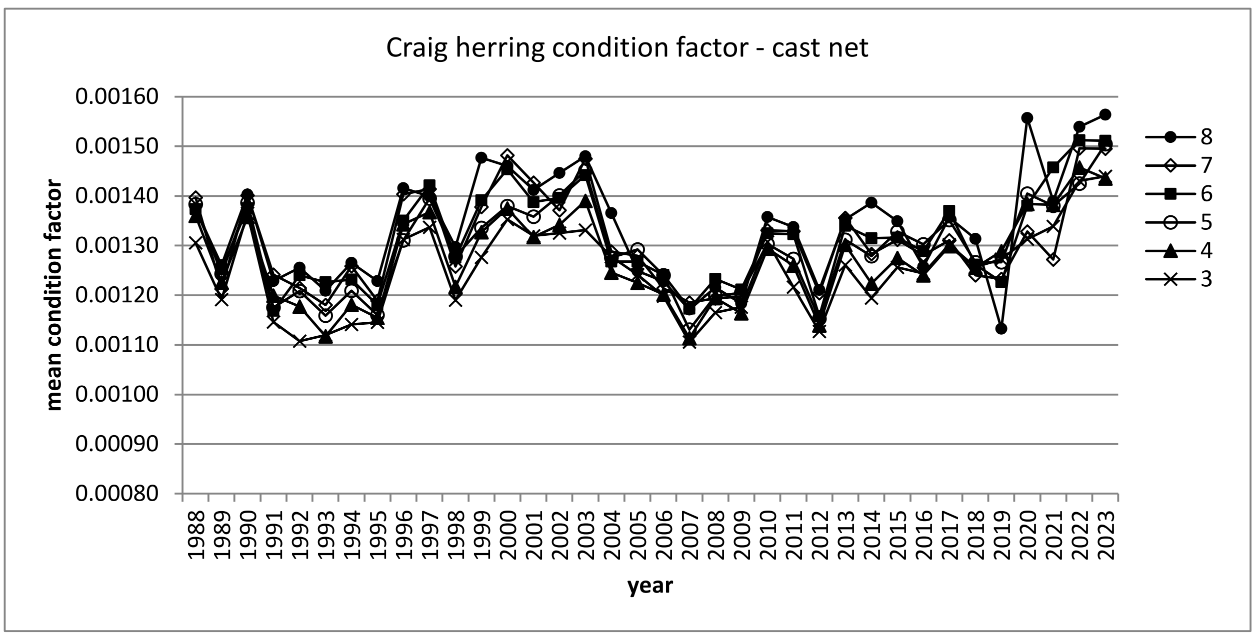

Figure 64.–Mean condition factors of age-3 through age-8 herring for the Craig spawning population, based on spring cast net samples taken during active spawning.

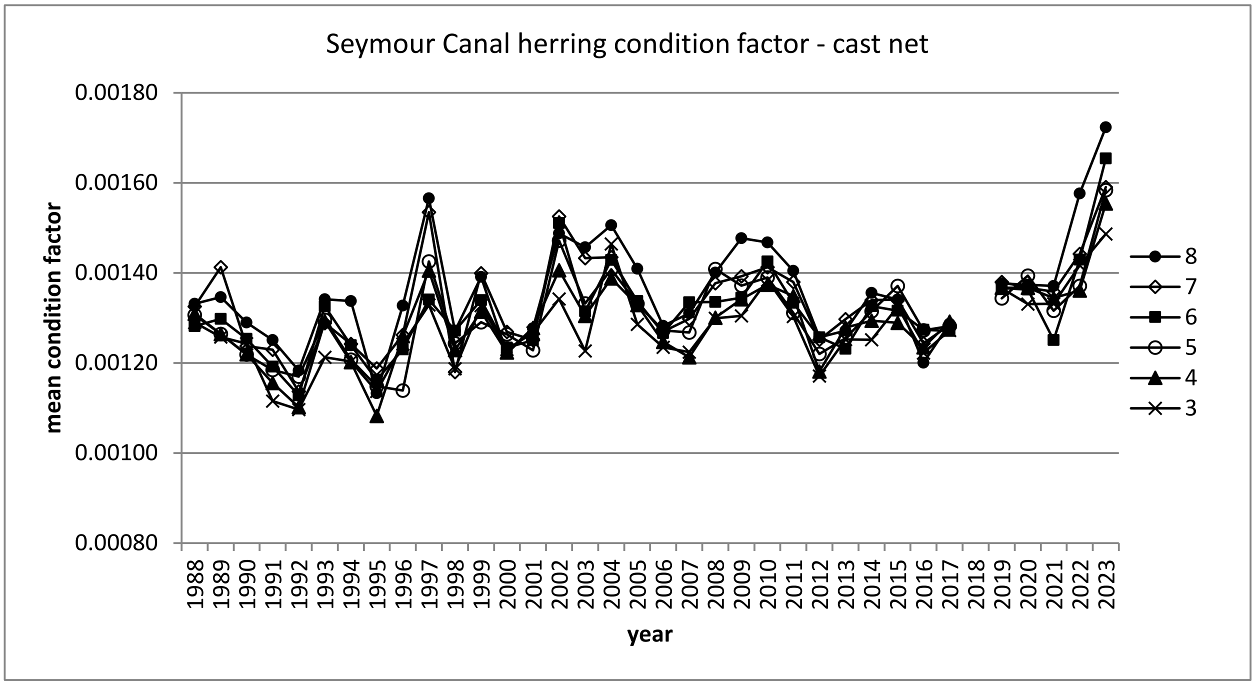

Figure 65.–Mean condition factors of age-3 through age-8 herring for the Seymour Canal spawning population, based on spring cast net samples taken during active spawning.

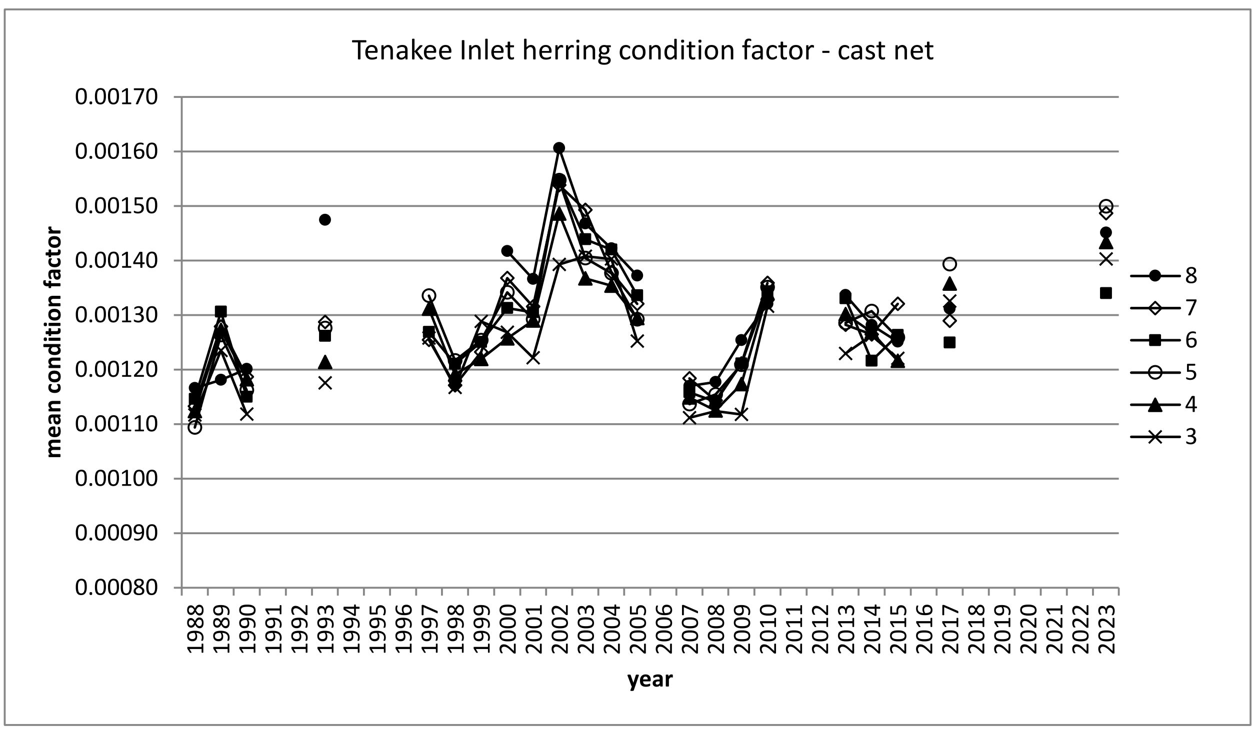

Figure 66.–Mean condition factors of age-3 through age-8 herring for the Tenakee Inlet spawning population, based on spring cast net samples taken during active spawning.

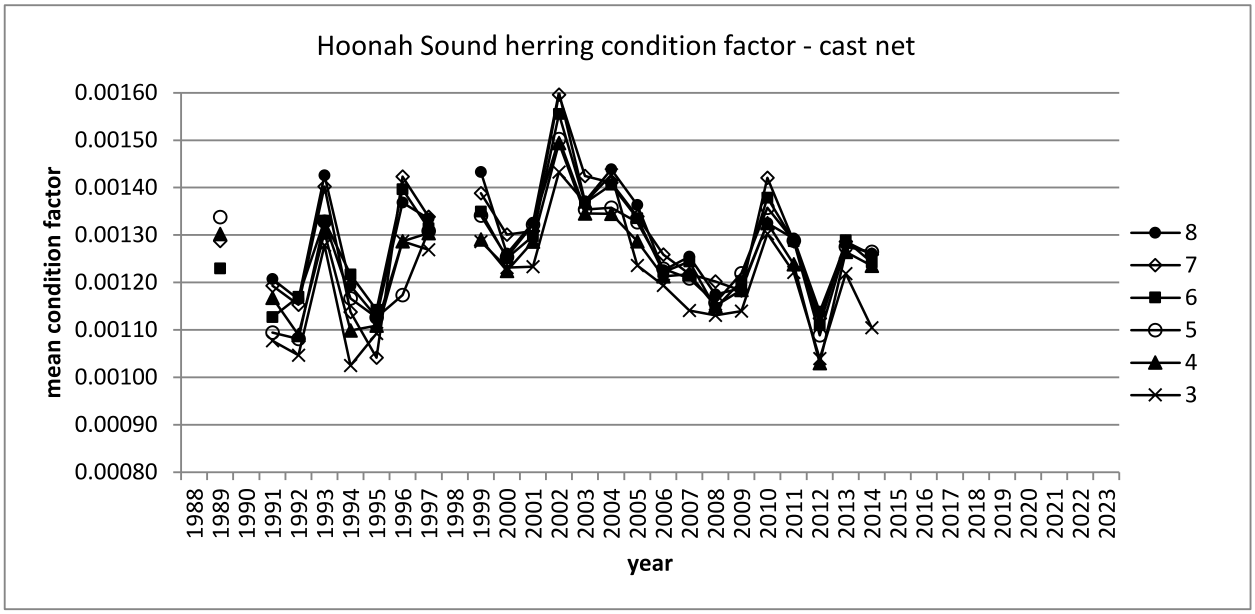

Figure 67.–Mean condition factors of age-3 through age-8 herring for the Hoonah Sound spawning population, based on spring cast net samples taken during active spawning.

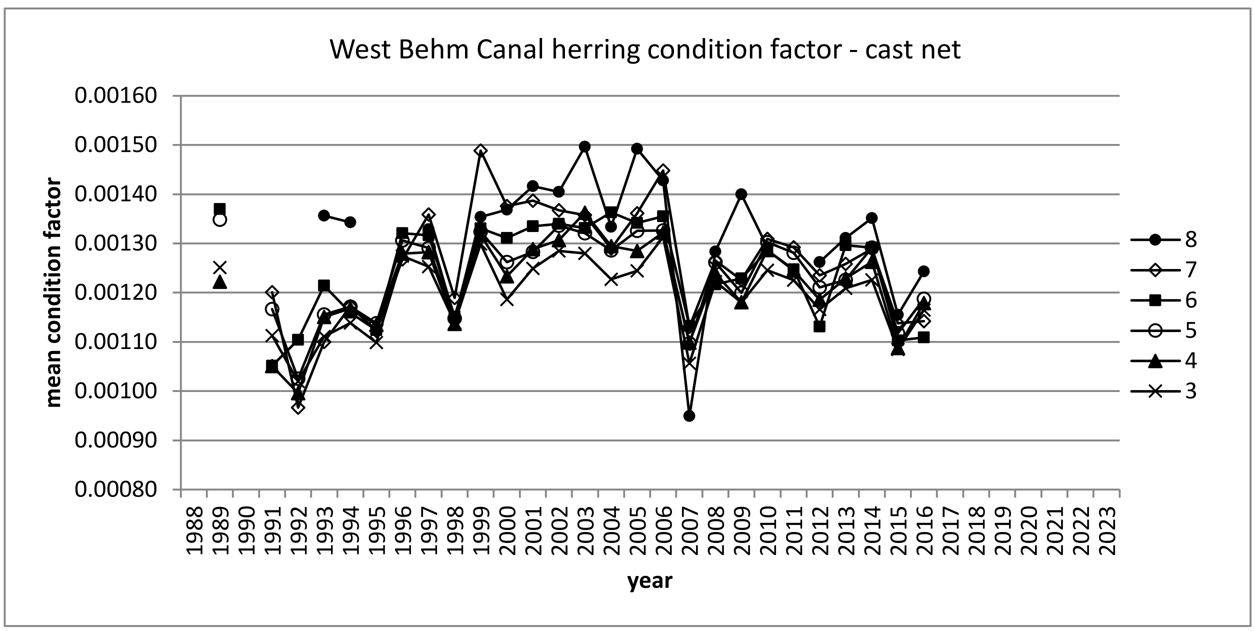

Figure 68.–Mean condition factors of age-3 through age-8 herring for the West Behm Canal spawning population, based on spring cast net samples taken during active spawning. 2015 condition factors are probably biased low due to required additional sample handling that resulted in loss of weight.

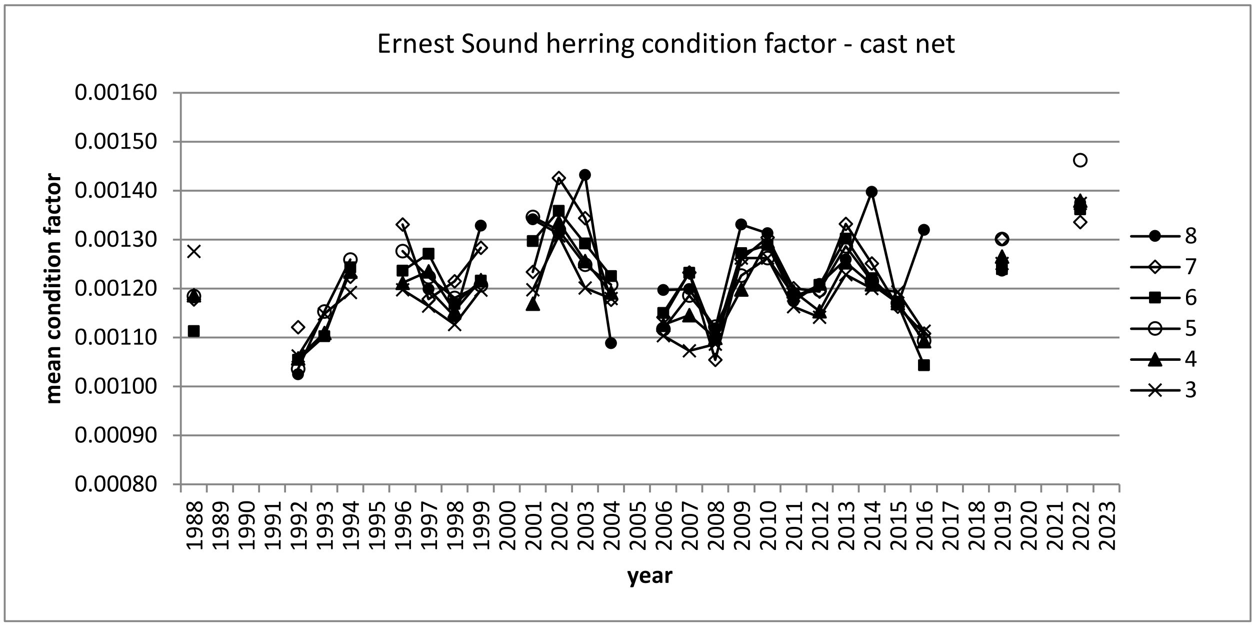

Figure 69.–Mean condition factors of age-3 through age-8 herring for the Ernest Sound spawning population, based on spring cast net samples taken during active spawning.

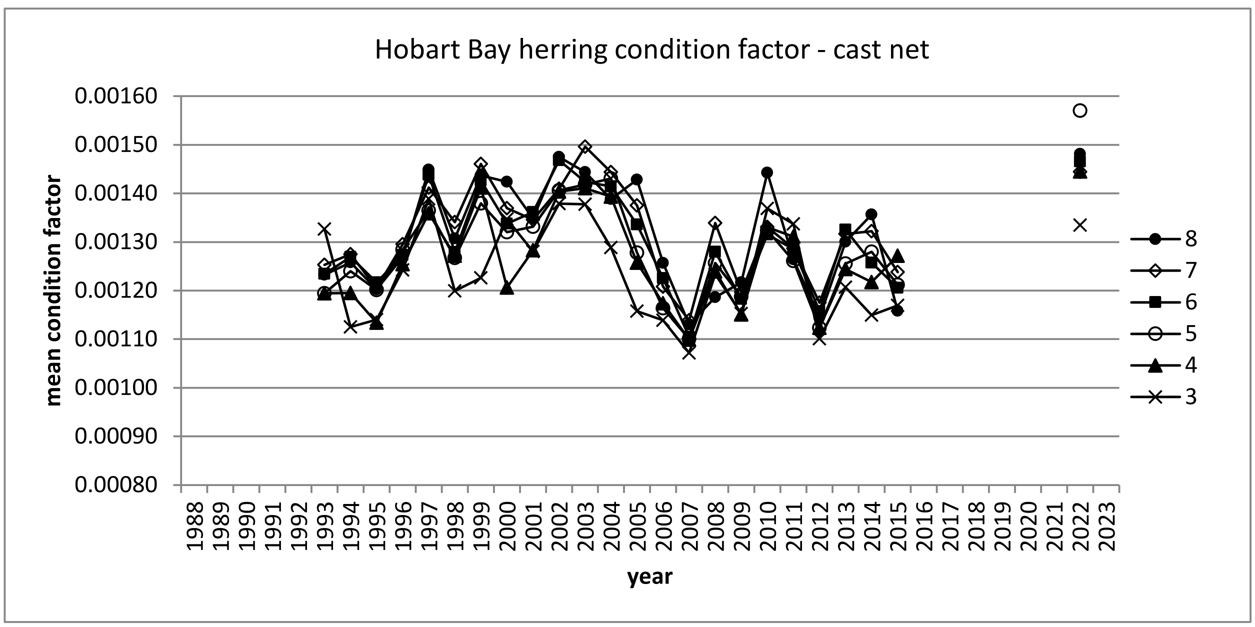

Figure 70.–Mean condition factors of age-3 through age-8 herring for the Hobart Bay spawning population, based on spring cast net samples taken during active spawning.

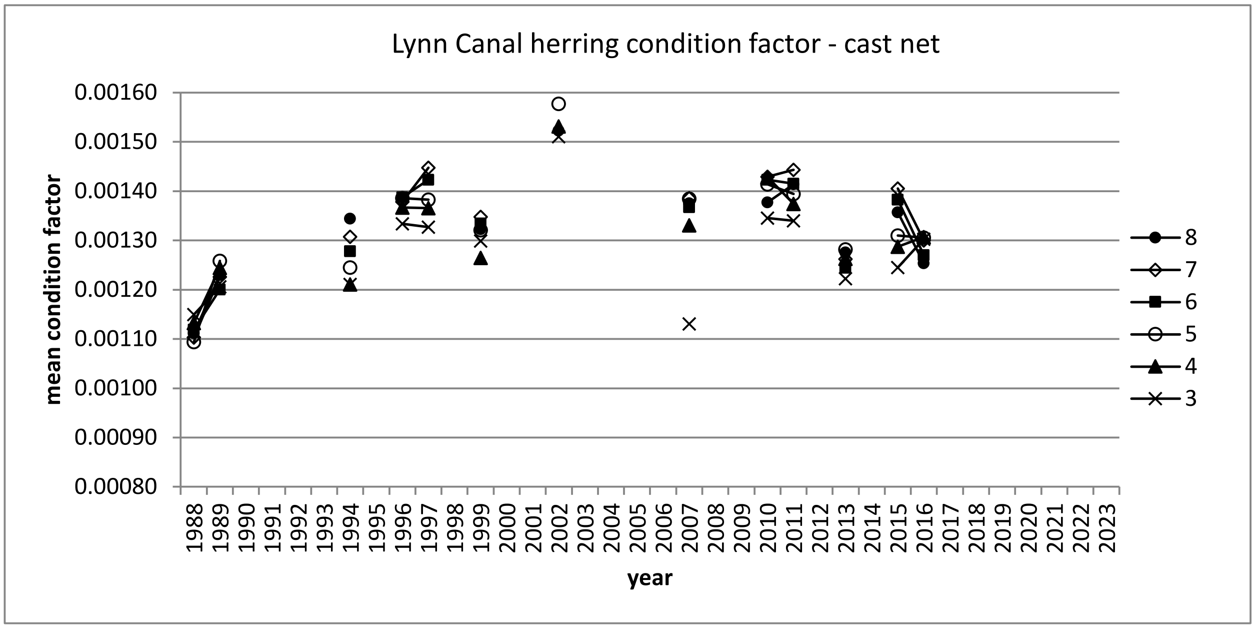

Figure 71.–Mean condition factors of age-3 through age-8 herring for the Lynn Canal spawning population, based on spring cast net samples taken during active spawning.

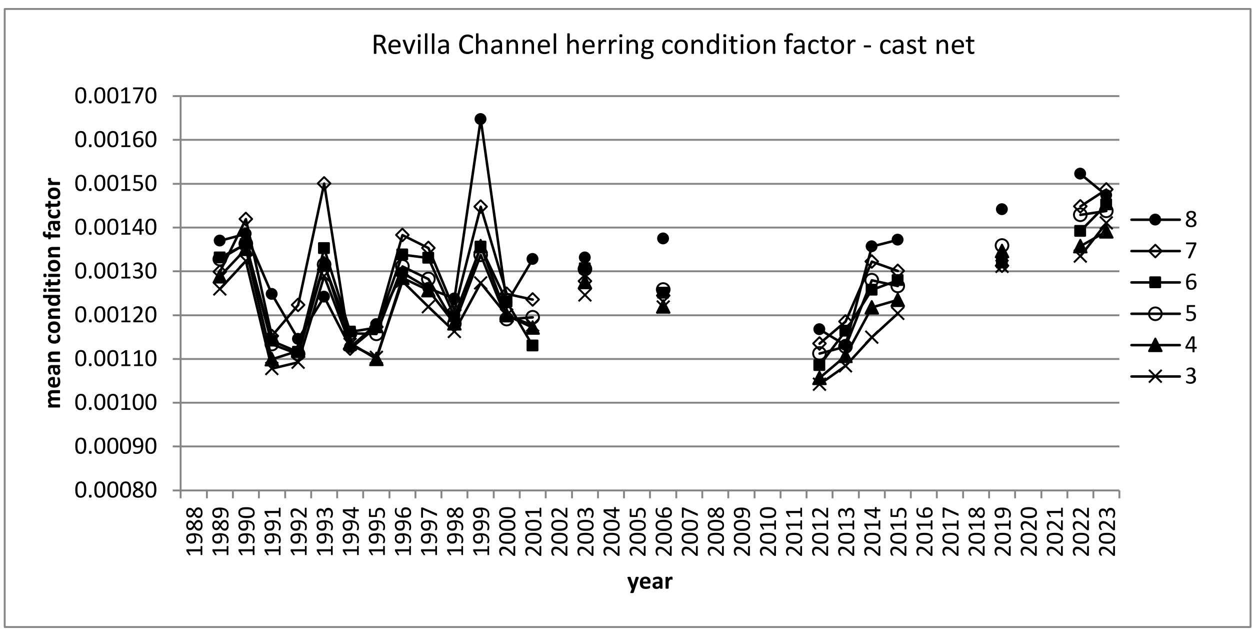

Figure 72.–Mean condition factors of age-3 through age-8 herring for the Revilla Channel spawning population, based on spring cast net samples taken during active spawning.

APPENDIX A: KEY TO VEGETATIVE SUBSTRATE TYPES USED FOR HERRING SPAWN DEPOSITION SURVEY

Appendix A1.–Key to vegetative substrate types used for herring spawn deposition survey.

Code	Expanded code	Species included	Latin names
AGM	Agarum	Sieve kelp	*Agarum clathratum*
ALA	Alaria	Ribbon kelps	*Alaria marginata*, *A. nana*, *A. fistulosa*
ELG	Eel grass	Eel grass, surfgrasses	*Zostera marina*, *Phyllospadix serrulatus*, *P. scouleri*
FIL	Filamentous algae	Sea hair	*Enteromorpha intestinalis*
FIR	Fir kelp	Black pine, Oregon pine (red algae)	*Neorhodomela larix*, *N. oregona*
FUC	Fucus	Rockweed	*Fucus gardneri*
HIR	Hair kelp	Witch's hair, stringy acid kelp	*Desmarestia aculeata*, *D. viridis*
LAM	Laminaria	split kelp, sugar kelp, suction-cup kelp	*Laminaria bongardiana*, *L. yezoensis* (when isolated and identifiable), *Saccharina latissima* (formerly *L. saccharina)*
LBK	Large leafy brown kelps	5-ribbed kelp, 3-ribbed kelp, split kelp, sugar kelp, sea spatula, sieve kelp, ribbon kelp	*Costaria costata*, *Cymathere triplicata*, *Laminaria* spp., *Pleurophycus gardneri*, *Agarum*, *Alaria* spp.
MAC	Macrocystis	Small perennial kelp	*Macrocystis* spp.
NER	Nereocystis	Bull kelp	*Nereocystis leutkeana*
RED	Red algae	All red leafy algae (red ribbons, red blades, red sea cabbage, Turkish washcloth)	*Palmaria mollis*, *P. hecatensis*, *P. callophylloides*, *Dilsea californica*, *Neodilsea borealis*, *Mastocarpus papillatus*, *Turnerella mertensiana*
ULV	Ulva	Sea lettuce	*Ulva fenestrata*, *Ulvaria obscura*
COR	Coralline algae	Coral seaweeds (red algae)	*Bossiella*, *Corallina*, *Serraticardia*

APPENDIX B: KEY TO BOTTOM TYPES USED FOR HERRING SPAWN DEPOSITION SURVEY

Appendix B1.–Key to bottom types used for herring spawn deposition survey.

Code	Expanded code	Definition
RCK	Bedrock	Various rocky substrates >1 m in diameter
BLD	Boulder	Substrate between 25 cm and 1 m
CBL	Cobble	Substrate between 6 cm and 25 cm
GVL	Gravel	Substrate between 0.4 cm and 6 cm
SND	Sand	Clearly separate grains of <0.4 cm
MUD	Mud	Soft, paste-like material
SIL	Silt	Fine organic dusting (very rarely used)
BAR	Barnacle	Area primarily covered with barnacles
SHL	Shell	Area primarily covered with whole or crushed shells
MUS	Mussels	Area primarily covered with mussels
WDY	Woody debris	Any submerged bark, logs, branches or root systems

APPENDIX C: SPAWN SURVEYS BY DATE

Appendix C1.–Aerial and skiff herring spawn surveys by date, in Craig, West Behm Canal, Revilla Channel, and other areas (Ketchikan Management Area), Southeast Alaska in 2023.

Craig

Date	Activity
17-Mar-23	Limited predator activity.
24-Mar-23	Increased predator activity.
28-Mar-23	Moderate predator activity.
30-Mar-23	Moderate predator activity.
1-Apr-23	1.3 nmi spawn on Wadleigh Island.
2-Apr-23	11.2 nmi spawn on Klawock Reef, Fish Egg, Clam, Alberto, and Wadleigh Islands.
3-Apr-23	19.4 nmi spawn on Ballena, Fish Egg, Clam, Alberto, and Wadleigh Islands and POW shoreline.
4-Apr-23	12.8 nmi spawn on Ballena, Fish Egg, Abbess, and Wadleigh Islands and POW shoreline.
5-Apr-23	.3 nmi of spawn on Ballenas, and San Juan Bautista. Skiff survey.
7-Apr-23	No herring spawn observed.
10-Apr-23	Aerial survey conducted; no herring spawn observed and minimal predator activity.
11-Apr-23	Skiff survey conducted; additional 1.4 nmi of herring spawn recorded.

West Behm Canal

Date	Activity
30-Mar-23	Report of ~3.0 nmi of spawn from Raymond Cove to Pt. Francis.
2-Apr-23	Limited predator activity.
7-Apr-23	Limited predator activity.
10-Apr-23	Limited predator activity.

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Revilla Channel (State waters)

Date	Activity
17-Mar-23	No predator activity.
21-Mar-23	No predator activity.
24-Mar-23	No predator activity.
27-Mar-23	0.3 nmi spawn on Double Island.
28-Mar-23	1.0 nmi spawn on Double Island.
29-Mar-23	2.4 nmi spawn on Double and Dog Islands.
30-Mar-23	3.4 nmi spawn on Double, Dog, and Village Islands.
31-Mar-23	2.0 nmi spawn on Dog and Village Islands.
1-Apr-23	0.5 nmi spawn on Dog Island.

Revilla Channel (Annette Island Reserve waters)

Date	Activity
3-Apr-23	0.1 nmi of spawn at Canoe Cove.

Sea Otter Sound

Date	Activity
13-Apr-23	1.3 nmi of spawn
15-Apr-23	0.7 nmi of spawn
16-Apr-23	0.6 nmi of spawn
19-Apr-23	1.9 nmi of spawn

Appendix C2.–Aerial and skiff herring spawn surveys by date, in Sitka Sound and Hoonah Sound (Sitka Management Area), Southeast Alaska in 2023.

March 13: Dupuis. 0815–0900. Aerial surveys have begun for the 2023 Sitka Sound herring season. The survey flight conducted on March 13 covered Sitka Sound from Biorka Island to Krestof Sound. Survey conditions were good with clear skies, light winds, and excellent visibility. No herring schools or spawn were observed today; however, herring predators were observed along the Kruzof Island shoreline from Inner Point to Kamenoi Point, Guide Island, and west of the Siginaka Islands. Humpback whales were concentrated in the shallower waters of the Kruzof Island shoreline from Inner Point to Hayward Strait and in deeper waters west of the Siginaka Islands. Large numbers of sealions were observed off the rockpiles between Inner Point and Rob Point. Relatively few sea lions were observed hauled out on rocks near Biorka Island. Predator numbers and locations are unusual for this time of year; typically, humpback whales are concentrated in the deeper waters near Bieli Rock and Vistskari Rocks and sealions are mostly concentrated near haul outs near Biorka Island and West Crawfish Inlet.

March 14: Dupuis. 0815–0915. Today's aerial herring survey covered from Povorotni Point in Sitka Sound to Salisbury Sound. Survey conditions were good with partly cloudy skies, light winds, and excellent visibility. No herring schools or spawn were observed today; however, herring predators were observed along the Kruzof Island shoreline from Inner Point to Kamenoi Point, Guide Island, west of the Siginaka Islands, and near Bieli Rock. Humpback whales were mostly concentrated in the shallower waters of the Kruzof Island shoreline from Inner Point to Hayward Strait and in deeper waters west of Bieli Rock. It did appear that some whales have shifted to the deeper waters west of Bieli Rock since yesterday. Large numbers of sea lions were observed off the rockpiles between Inner Point and Rob Point. Additionally, several sea lions were seen traveling north in Neva Strait. Predator numbers and locations are unusual for this time of year; typically, humpback whales are concentrated in the deeper waters near Bieli Rock and Vistskari Rocks and sea lions are mostly concentrated at haul out areas near Biorka Island and West Crawfish Inlet.

Department and industry vessels surveyed the Hayward Strait area yesterday and located several very large schools of herring between Guide Island and Kamenoi Point.

One successful test set was conducted yesterday, the results are as follows:

Time	Area	Tons	Mature roe	Immature roe	Average weight	Female
2:18	Hayward Str	30	0.0 %	8.3 %	115	42.7 %

March 15: Dupuis. 1207–1247. Today's aerial herring survey covered the northern portion of Sitka Sound from St. Lazaria Island to Krestof Sound. Survey conditions were poor with cloudy skies and high winds negatively affecting visibility. No herring schools or spawn were observed today. Herring predators were observed along the Kruzof Island shoreline from Inner Point to Kamenoi

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Point and south of the Siginaka Islands. Humpback whales were observed in the shallower waters of the Kruzof Island shoreline from Inner Point to Hayward Strait and south of the Siginaka Islands. Large numbers of sea lions were again observed off the rockpiles between Inner Point and Kamenoi Point. While it is unusual to observe larger concentrations of herring predators in the shallow waters off the southeastern Kruzof Island shoreline this time of year, predator locations have remained largely unchanged since first observed on March 13.

March 16: No survey

March 17: Dupuis. 0800–0845. Today's aerial herring survey covered the northern portion of Sitka Sound from St. Lazaria Island to Krestof Sound. Survey conditions were adequate with partly cloudy skies, moderate winds, and fair visibility. No herring schools or spawn were observed today. Herring predators were observed along the Kruzof Island shoreline near Inner Point and in the deeper waters south of Guide Island and south of the Siginaka Islands. Humpback whales were concentrated near Inner Point and in the deeper waters southeast of the Siginaka Islands and south of Guide Island. Fewer sea lions were observed today with the largest concentration located at Inner Point. Predator concentrations have shifted from locations of previous surveys to more normal distributions for this time of year.

Department and industry vessels surveyed from Inner Point to Hayward Strait and near the Siginaka Islands today and located several very large schools of herring in both areas. It appeared that the herring previously observed in the shallower waters of Hayward Strait have moved into deeper waters further offshore.

One successful test set was conducted today, the results are as follows:

Time	Area	Tons	Mature roe	Immature roe	Average weight	Female
11:32	E. Siginaka Is	300	0.0 %	6.4 %	110	33.2 %

March 18: Dupuis. 0800–0930.

March 19: Jones. 0815–0900. The aerial herring surveys from March 18 and March 19 covered Sitka Sound from Cape Burunof to Krestof Sound. Survey conditions on March 18 were poor with high winds negatively affecting visibility; conditions on March 19 were fair with light rain and light winds. No herring schools or spawn were observed on either flight. While herring predators were still seen along the Kruzof Island shoreline from Inner Point to Kamenoi Point on both surveys, humpback whales have begun to be observed between Bieli Rock and Makhnati Island and south of Whale Island. A large concentration of sea lions was observed near Inner Point during both surveys.

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Department and industry vessels surveyed from Indian River to Deep Inlet and near Middle Island. Several large schools of herring were located from Indian River to Whale Island, near Long Island, and in Starrigavan Bay. Additionally, several very large schools of herring were located in the deeper waters north of Middle Island and north of Big Gavanski Island.

A small sample of herring collected south of Whale Island with hook and line gear showed, anecdotally, that herring maturity is developing relative to the samples collected early in the week.

March 20: Dupuis. 0800–0845. It was decided that the Sitka Sound herring sac roe fishery will be put on 2-hour notice effective 8:00 a.m., Thursday, March 23, 2023. This means that a fishery could be expected with 2 hours' notice after the effective time.

A 2-hour notice fishery meeting will be conducted via Zoom and is scheduled for Tuesday, March 21, from 5:00 p.m. until 7:00 p.m. on Zoom. The *R/V Kestrel* plans to arrive in Sitka the morning of March 22 and will immediately conduct a vessel survey.

Today's aerial survey covered Sitka Sound from Cape Burunof to St. Lazaria Island. Survey conditions were good with cloudy skies and light winds. No herring schools or spawn were observed on either flight. While herring predators were widely dispersed throughout the survey area, concentrations of humpback whales were observed near Inner Point, north of Middle Island, and south of Galankin Island. Concentrations of sea lions were observed near Inner Point, Mountain Point, and Bieli Rock. Department and industry vessels surveyed from Indian River to Deep Inlet and from Inner Point to Mountain Point. Several very large schools of herring were in both survey areas. Additionally, several large schools of herring were observed southeast of Big Gavanski Island.

Two successful test sets were conducted today, the results are as follows:

Time	Area	Ton	Mature roe	Immature roe	Average weight	Female
10:0	S. Galankin Is.	50	3.37 %	7.87 %	129 g	49.1 %
3:20	Mountain Point	70	0.20 %	5.17 %	91 g	38.3 %

March 21: Dupuis. 0800–0915. Today's aerial survey covered Sitka Sound from West Crawfish Inlet to St. Lazaria Island and as far north as Krestof Sound. Survey conditions were good with partly cloudy skies and light winds. Several large herring schools were visible in shallow water near Shoals Point. No herring spawn was observed today. Concentrations of humpback whales were seen in the deeper waters between Bieli Rock and Crow Pass, near Samsing Cove, and south of the Causeway. Concentration of sea lions were observed from Inner Point to Kamenoi Point. Additionally, several gray whales were seen between Biorka Island and Cape Edgecumbe. No vessel survey was conducted today. A 2-hour pre-fishery meeting was held on Zoom from 5-7pm.

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<u>March 22</u>: Dupuis. 0800–0900. Today's aerial survey covered Sitka Sound from Povorotni Point to St. Lazaria Island and as far north as Krestof Sound. Survey conditions were fair with cloudy skies and 15-knot winds. No herring schools or herring spawn were observed today. Concentrations of humpback whales were seen in the deeper waters between Crow Pass and Big Gavanski Island, near Inner Point, and near Galankin Island. Concentration of sea lions were observed from Inner Point to Kamenoi Point.

The *R/V Kestrel* arrived in Sitka Sound this morning. Department vessels surveyed south of Sitka from Indian River to Deep Inlet and in the northern portion of Sitka Sound from Inner Point to Harbor Point. Several very large schools of herring were located near Mountain Point and from Middle Island to Big Gavanski Island, and from Cannon Island south to Rocky Patch.

The Sitka Sound herring sac roe fishery was placed on 2-hour notice effective 8:00 a.m.

<u>March 23</u>: Jones. 0810–0905. Today's aerial survey covered Sitka Sound from Povorotni Point to St. Lazaria Island and as far north as Krestof Sound. Survey conditions were poor to fair with light rain/snow mix, cloudy skies, and 15-knot winds. No herring schools or herring spawn were observed. Humpback whales were mostly seen along the Kruzof Island shoreline from St. Lazaria Island to Hayward Strait, and north of Crow Island. A large concentration of sea lions was observed at Inner Point, while smaller groups of sea lions were observed in Hayward Strait, Shoals Point, and St. Lazaria Island.

Department vessels surveyed south of Sitka from Indian River to Whale Island and in the northern portion of Sitka Sound from Inner Point to Harbor Point. Several very large schools of herring were located from Inner Point to Kamenoi Point, east of the Siginaka Islands, north of Crow Island and Middle Island, and from Whale Island to Rocky Patch. Smaller schools of herring were located along the eastern shore of Middle Island.

Two successful test sets were conducted today, the results are as follows:

Time	Area	Ton	Mature roe	Immature roe	Average weight	Female
09:1	Whale Island	40	10.1 %	1.8 %	155 g	40.2 %
09:5	Hayward Strait	200	7.8 %	1.7 %	147 g	37.8 %

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March 24: Jones. 0800–0850. Today's aerial survey covered Sitka Sound from Povorotni Point to St. Lazaria Island and as far north as Hayward Strait. Survey conditions ranged from good to poor with scattered snow showers and fog, mostly cloudy skies, and variable winds ranging from 5-30 knots. No herring schools or herring spawn were observed. Predators were widely scattered across Sitka Sound. Rafts of sea lions were seen around southeastern Kruzof, Mountain Point, and south of Hayward Strait. Humpback whales were mostly seen from Inner Point to Hayward Strait, north of Middle Island, and Eastern Channel.

Department and industry vessels surveyed south of Sitka from Indian River to Whale Island and in the northern portion of Sitka Sound from Mountain Point to the Siginaka Islands. Several very large schools of herring were located from Mountain Point to Kamenoi Point, the deeper waters west of the Siginaka Islands, and from Whale Island to Rocky Patch. Several smaller schools of herring were observed between Rocky Patch and Cannon Island.

Three successful test sets were conducted today, the results are as follows:

Time	Area	Ton	Mature roe	Immature roe	Average weight	Female
09:1	Rocky Patch	100	13 %	0.9 %	156 g	53.4 %
09:2	Hayward Strait	150	8.3 %	1.2 %	152 g	39.1 %
11:4	Whale Island	50	9.5 %	2.2 %	123 g	47.8 %

March 25: Jones. 0800–0850. Today's aerial survey covered Sitka Sound from Povorotni Point to St. Lazaria Island and as far north as Krestof Sound. Survey conditions were good with overcast skies and 15-knot winds. No spawn was seen, but herring schools were observed within regulatory closed waters among the Kasiana Islands and just north of Galankin Island. Herring predators were scattered across Sitka Sound. Rafts of sea lions were seen along the Kruzof shoreline from Shoals Point to Kamenoi Point. Humpback whales were seen from St. Lazaria to Low Island, Inner Point to Kamenoi Point, west of Kasiana Islands, and north of Long Island.

Department and industry vessels surveyed south of Sitka from Indian River to Long Island and in the northern portion of Sitka Sound from Fred's Creek to the Siginaka Islands. Several very large schools of herring were located from Fred's Creek to Guide Island, near the Siginaka Islands, and from Makhnati Island to Breast Island. Additionally, several schools of herring were observed within regulatory closed waters from Harbor Point to Makhnati Island and in Crow Pass.

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Five successful test sets were conducted today; the results are as follows:

Time	Area	Ton	Mature roe	Immature roe	Average weight	Female
07:1	Indian River	75	10.1 %	1.7 %	145 g	44.0 %
08:3	Kamenoi Point	150	10.0 %	1.9 %	128 g	43.4 %
08:5	Rockwell Island	300	11.5 %	2.5 %	132 g	55.5 %
10:5	N.Whale Island	75	9.5 %	1.4 %	142 g	40.1 %
14:3	Inner Point	150	7.6 %	3.2%	147 g	42.7 %

March 26: Jones. 0805–0900. Today's aerial survey covered Sitka Sound from Povorotni Point to St. Lazaria Island and as far north as Hayward Strait and the Siganaka Islands. Survey conditions were mostly good with overcast skies and 20-knot winds. No herring schools were seen during the aerial survey, however, approximately 2.0 nmi of herring spawn was seen around Shoals Point (Figure 1). Herring predators were difficult to see with abundant whitecaps, but predators were scattered across Sitka Sound. Sea lions and whales were seen along the eastern Kruzof shoreline from Shoals Point to Hayward Strait. Humpback whales were also seen outside of Deep Inlet, north and south of Long Island.

Department and industry vessels surveyed Sitka Sound from Makhnati Island to Long Island and the eastern Kruzof shoreline from St. Lazaria Island to Hayward Strait. Several very large schools of herring were located on sonar near Inner Point, St. Lazaria Island, and from Makhnati Island to Jamestown Bay. Additionally, several schools of herring were observed within regulatory closed waters in Crow Pass.

Four successful test sets were conducted today; the results are as follows:

Time	Area	Ton	Mature roe	Immature roe	Average weight	Female
07:3	Jamestown Bay	150	9.7 %	1.8 %	136 g	45.3 %
10:1	Inner Point	150	9.2 %	1.7 %	135 g	44.4 %
13:0	Indian River	150	8.3 %	2.0 %	115 g	36.8 %
13:2	E of Passage Isles	150	6.8 %	3.3 %	104 g	43.3 %

March 27: Jones. 0805–0850. An additional aerial survey was conducted yesterday afternoon that added 1 nautical mile (nmi) of additional spawn that expanded on the southern Kruzof Island shoreline, increasing yesterday's spawn estimate to approximately 3 nmi. Today's aerial survey covered Sitka Sound from Redoubt Bay to Cape Edgecumbe and as far north as the Magoun Islands. Survey conditions were good with clear skies and 10-knot winds. Herring schools were seen in Deep Inlet and Redoubt Bay during the aerial survey. Approximately 7.7 nmi of active herring spawn was seen on the southern and southeastern Kruzof Island shoreline from Cape Edgecumbe to around Shoals Point, and south of Fred's Creek (Figure 1). Herring predators were concentrated around Inner Point and west of Cape Burunof and Povorotni Point.

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Department and industry vessels surveyed Sitka Sound from Makhnati Island to Long Island, from Deep Inlet to Peisar Island, and the eastern Kruzof shoreline from Shoals Point to Hayward Strait. Several very large schools of herring were located on sonar from Kamenoi Point to Inner Point, from Makhnati Island to Jamestown Bay, and from Cape Burunof to Peisar Island.

Four successful test sets were conducted today; the results are as follows:

Time	Area	Tons	Mature roe	Immature roe	Average weight	Female
09:15	Inner Point	75	8.8	3.8	141 g	53.5
09:29	Inner Point	150	8.4	3.2	124 g	49.6
11:03	Makhnati Island	150	8.7	1.8	121 g	43.0
13:14	N of Peisar Island	300	8.3	2.1	109 g	47.1

March 28: Jones. 0800–0850. Today's aerial survey covered Sitka Sound from Redoubt Bay to Cape Edgecumbe and as far north as the Magoun Islands. Survey conditions were fair with cloudy skies, 20-knot winds, and scattered snow/rain showers. Approximately 10.1 nmi of active herring spawn was seen on the southern and southeastern Kruzof Island shoreline from Cape Edgecumbe to around Shoals Point, and Fred's Creek (Figure 1). Herring predators were concentrated from Inner Point to Fred's Creek, outside of Deep Inlet, and southwest of Povorotni Point.

Department and industry vessels surveyed Sitka Sound from Harbor Point to Fred's Creek and from Indian River to Deep Inlet. Several very large schools of herring were located on sonar near Inner Point and from Deep Inlet to Leesoffskaia Bay. Numerous smaller schools were observed from Harbor Point to Halibut Point.

Three successful test sets were conducted today; the results are as follows:

Time	Area	Ton	Mature roe	Immature roe	Average weight	Female
9:16	Leesoffskaia Bay	100	10.2	1.2 %	126 g	43.5 %
9:59	Emgeten Island	100	9.9	1.2 %	121 g	45.3 %
10:4	Deep Inlet	200	11.2 %	1.4 %	128 g	49.5 %

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The Sitka Sound herring sac roe fishery opened at 1:15 p.m., March 28, 2023, and closed by field announcement on marine VHF radio. Open waters for this fishery included the waters of Deep Inlet, Aleutkina Bay, and Leesoffskaia Bay south of 57°00.81′ N lat and east of 135°21.93′ W long.

The attached map shows the boundaries for a Sitka herring sac roe fishery opening as initially announced at approximately 11:45 a.m. on this date by field announcement on marine VHF radio. This map is for informational purposes only.

The department has determined that the opening described above would not harm a reasonable opportunity for participants in the subsistence fishery to harvest the amount of roe necessary for subsistence uses. When making this determination, the department considered: 1) vessel surveys conducted by the department beginning on March 23 indicated that there is a very large biomass of herring distributed within Sitka Sound; 2) there was no herring spawn nor subsistence branch sets observed in the water on the adjacent shoreline of the open area; 3) herring began spawning in Sitka Sound on March 26 and through March 28 the cumulative spawn estimate is 10.3 nautical miles.

March 29: Jones. 0800–0930. Today's aerial survey covered Sitka Sound from as far south as Windy Passage, Shelikof Bay to the west, and as far north as Salisbury Sound. Survey conditions were good with mostly clear skies and 20-knot winds. Herring schools were seen from the aerial survey in Leesoffskaia Bay, Aleutkina Bay, St. John Baptist Bay, and Sukoi Inlet. Approximately 8.3 nmi of active herring spawn was seen including at St. Lazaria Island and the continued spawn on the southern and southeastern Kruzof Island shoreline from Cape Edgecumbe to around Shoals Point and south of Fred's Creek (Figure 1). Herring predators were concentrated around Shoals Point and Low Island, near the Causeway, and south of Peisar Island.

Department and industry vessels surveyed Sitka Sound from Harbor Point to Fred's Creek, in Hayward Strait, and from Indian River to Peisar Island. Several very large schools of herring were located on sonar near Inner Point and near Peisar Island. Numerous other schools of herring were observed from Harbor Point to Middle Island.

Two successful test sets were conducted today; the results are as follows:

Tim	Area	Ton	Mature roe	Immature roe	Average weight	Female
8:35	Inner Point	300	11.2 %	0.93 %	148 g	46.8 %
9:27	Inner Point	100	11.3 %	1.3 %	134 g	52.7 %

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An opening of the Sitka Sound herring sac roe fishery occurred today from 11:45 a.m. until 12:45 p.m., as stated in field announcement on VHF channel 10. The open area for this fishery included the waters of Sitka Sound south of 57°07.20′ N lat, north of 57°02.90′ N lat, and west of 135°31.25′ W long (Figure 2). The emergency order corresponding with today's opening is EO 1H0323. Harvest estimates from today's fishery will be included on the next fishery update. The harvest estimate from the fishery that occurred on March 28 was approximately 650-tons of herring.

The department has determined that the opening described above would not harm a reasonable opportunity for participants in the subsistence fishery to harvest the amount of roe necessary for subsistence uses. When making this determination, the department considered: 1) vessel surveys conducted by the department beginning on March 23 indicated that there is a very large biomass of herring distributed within Sitka Sound; 2) numerous herring schools were observed within regulatory closed waters on today's vessel survey from Harbor Point to Middle Island; 3) while there was herring spawn observed near Fred's Creek today, there were no known subsistence branch sets in that area; 4) herring began spawning in Sitka Sound on March 26 and through March 29 the cumulative spawn estimate is 11.1 nautical miles.

March 30: Jones. 0725–0855. Today's aerial survey covered Sitka Sound from as far south as Goddard, to as far north as Salisbury Sound, and west to Shelikof Bay. Survey conditions were excellent with cloudy skies and 5-knot winds. Herring schools were seen from the aerial survey in Leesoffskaia Bay and Sukoi Inlet. Approximately 5.3 nmi of active herring spawn was seen from Cape Edgecumbe and along the southern and southeastern Kruzof Island shorelines to near Fred's Creek (Figure 1). Herring predators were concentrated around Shoals Point and Low Island, near the causeway, and south of Peisar Island.

Department and industry vessels surveyed Sitka Sound from near Peisar Island, along the eastern shoreline of Kruzof Island, St. John Baptist Bay, and Salisbury Sound. Several very large schools of herring were located on sonar near Inner Point, near Peisar Island, and from St. John Baptist Bay to Scraggy Island. Numerous small schools of herring were observed from Harbor Point to Middle Island.

Four successful test sets were conducted today; the results are as follows:

Tim	Area	Ton	Mature roe	Immature roe	Average weight	Female
7:50	N. Calligan Island	200	6.5 %	1.1 %	101	36.6 %
8:46	St. John Baptist	200	11.9 %	1.1 %	150	49.0 %
9:27	Gilmer Cove	200	12.7 %	1.3 %	156	55.7 %
9:51	S. Frosty Reef	200	11.3 %	0.5 %	137	46.1 %

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An opening of the Sitka Sound herring sac roe fishery occurred today from 1:30 p.m. until 6:00 p.m., as stated in field announcement on VHF channel 10. The open area for this fishery included the waters of St. John Baptist Bay, Sukoi Inlet and a portion of Salisbury Sound, south of 57°20.26′ N lat, north of 57°16.91’ N lat (Figure 2). The emergency order corresponding with today’s opening is EO 1H0423. Harvest estimates from today’s fishery will be included on the next fishery update. The harvest estimate from the fishery that occurred on March 29 was approximately 560-tons of herring.

The department has determined that the opening described above would not harm a reasonable opportunity for participants in the subsistence fishery to harvest the amount of roe necessary for subsistence uses. When making this determination, the department considered: 1) vessel surveys conducted by the department beginning on March 23 indicated that there is a very large biomass of herring distributed within Sitka Sound; 2) no herring spawn nor known subsistence branch sets were observed in the area; 3) herring have been spawning in Sitka Sound since March 26 through today, March 30, and the cumulative spawn estimate is 11.6 nautical miles.

<u>March 31</u>: Jones. 0725–0840. Today’s aerial survey covered Sitka Sound from as far south as Elovoi Island, to as far north as Salisbury Sound, and west to Cape Edgecumbe. Survey conditions today were poor with limited visibility from a wintry mix, overcast skies, and 20-knot winds. Herring schools were seen from the aerial survey in Aleutkina Bay. Only a small area of active spawn was observed today near Fred’s Creek. Herring predators were concentrated between Frosty Reef and Goddard. Through March 31, the cumulative spawn estimate is approximately 11.6 nautical miles.

Department and industry vessels surveyed Sitka Sound and Salisbury Sound, from Sukoi Inlet to St. John Baptist Bay, the southeastern Kruzof Island shoreline from Fred’s Creek to Rob Point, Deep Inlet and Eastern Channel, and near Frosty Reef. Several schools of herring were located on sonar in St. John Baptist Bay, Leesoffskaia and Aleuketna Bays. Several very large schools of herring were observed on sonar near Frosty Reef and Torsar Island. There was no opening for the Sitka Sound herring sac roe fishery today. The harvest estimate from the fishery that occurred on March 30 was approximately 1,860-tons of herring. An estimated 3,080-tons of herring have been harvested to date.

Three successful test sets were conducted today; the results are as follows:

Time	Area	Ton	Mature roe	Immature roe	Average weight	Female
7:43	Leesoffskaia Bay	200	10.8 %	1.2 %	113 g	50.2 %
11:3	N.Torsar Island	50	6.4 %	1.5 %	102 g	37.6 %
11:5	Frosty Reef	75	7.7 %	1.2 %	106 g	43.2 %

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April 1: Jones. 0735–0850. Today's aerial survey covered Sitka Sound from as far south as Aspid Cape, to as far north as Magoun Islands, and west to Cape Edgecumbe. Survey conditions today were fair to poor with limited visibility from snow showers, partly cloudy skies, and 10-knot winds. Approximately 1.3 nautical miles (nmi) of active spawn was observed today around Inner Point, near Kresta Point, and by southern Crow Island. Herring predators were concentrated between Frosty Reef and Goddard. Through April 1, the cumulative spawn estimate is approximately 13.0 nmi.

Department and industry vessels surveyed Sitka Sound and Salisbury Sound, from Sukoi Inlet to St. John Baptist Bay, the southeastern Kruzof Island shoreline from Fred's Creek to Rob Point, and Deep Inlet and Eastern Channel. Several schools of herring were located on sonar in St. John Baptist Bay, Leesoffskaia and Aleuketna Bays. Several very large schools of herring were observed on sonar from Inner Point to Mountain Point.

One successful test set was conducted today; the results are as follows:

Time	Area	Ton	Mature roe	Immature roe	Average weight	Female
10:0	Mountain Point	20	1.3 %	3.5 %	73 g	36.4 %

An opening of the Sitka Sound herring sac roe fishery occurred today as stated in field announcement on VHF channel 10. The 2 open areas for this fishery included areas north and south of Sitka. South of Sitka included the area of Leesofskaia Bay and Aleutkina Bay east of 135°17.56′ N long and was opened from 2:00 p.m. until 3:15 p.m (Figure 2). The area north of Sitka included the waters of Neva Strait, St. John Baptist Bay, and Salisbury Sound north of 57°16.91′ N lat, south of 57°21.00′ N lat, and east of 135°45.82′ W long and was opened from 2:00 p.m. until 6:00 p.m. (Figure 3). The emergency order corresponding with today's opening is EO 1H0523. Harvest estimates from today's fishery will be included on the next fishery update.

The department has determined that the opening described above would not harm a reasonable opportunity for participants in the subsistence fishery to harvest the amount of roe necessary for subsistence uses. When making this determination, the department considered: 1) vessel surveys conducted by the department beginning on March 23 indicated that there is a very large biomass of herring distributed within Sitka Sound; 2) no herring spawn nor known subsistence branch sets were observed in either area; 3) herring have been spawning in Sitka Sound since March 26 through today, April 1, the cumulative spawn estimate is 13.0 nautical miles; and 4) approximately 0.6 nmi of herring spawn was observed today within regulatory closed waters.

April 2: Jones. 0805–0940. Today's aerial survey covered Sitka Sound from as far south as Aspid Cape, to as far north as Krestof Sound, and west to Shelikof Bay. Survey conditions today were excellent with good visibility, clear skies, and 5-knot winds. Approximately 9 nautical miles

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(nmi) of active spawn was observed today from around Inner Point, Mountain Point, Hayward Strait, Promisla and Eastern Bays, and within closed waters on the north and west shorelines of Middle Island, and on west Crow Island. Herring predators were seen scattered around southern Kruzof Island, in Aleutkina Bay, and south of Povorotni Point to Goddard. The cumulative spawn estimate through today is approximately 20.6 nmi.

Department and industry vessels surveyed Sitka Sound from St. John Baptist Bay, Hayward Strait, the eastern shore of Kruzof Island, Aleutkina and Leesoffskaia Bays, Deep Inlet, and Kanga Bay. Scattered schools of herring were located on sonar throughout the surveyed area; however, very large schools of herring were located near Frosty Reef.

One successful test set was conducted today; the results were:

Time	Area	Ton	Mature roe	Immature roe	Average weight	Female
12:2	Kanga Bay	100	8.4 %	1.5 %	90 g	38.7 %
15:0	Deep Inlet	100	9.4 %	0.1 %	90 g	47.5 %

<u>April 3</u>: Jones. 0800–0940. Today's aerial survey covered Sitka Sound from as far south as Windy Passage, to as far north as Salisbury Sound, and west to St. Lazaria Island. Survey conditions today were excellent with good visibility, partly cloudy skies, and 10-knot winds. Herring schools were observed off of Indian River, in Leesoffskaia Bay, in Krestof Sound, and Sukoi Inlet. Approximately 17.9 nautical miles (nmi) of active spawn was observed today along the southern and eastern Kruzof shoreline to Hayward Strait, Proisla and Eastern Bays, around Middle and Crow Islands. Herring predators were seen concentrated off of Povorotni Point scattered along southern Kruzof Island, and from Povorotni Point to Goddard.

Department and industry vessels surveyed Sitka Sound from St. John Baptist Bay, Krestof Sound, the eastern shore of Kruzof Island, Aleutkina and Leesoffskaia Bays, Deep Inlet, Redoubt Bay, Kanga Bay, and Redoubt Bay. Scattered schools of herring were located on sonar throughout the surveyed area; however, very large schools of herring were located near Calming Island and Windy Passage.

Harvest from the fishery that occurred on April 1 was approximately 1,100-tons of herring. No fishery occurred today. Approximately 4,200-tons of herring have been harvested so far this season.

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Three successful test sets were conducted today; the results were:

Time	Area	Ton	Mature roe	Immature roe	Average weight	Female
11:0	Redoubt Bay	200	11.8 %	0.1 %	146 g	46.6 %
12:1	Windy Passage*	50	-	-	-	-
14:1	Calming Island	100	8.4 %	1.6 %	93 g	44.4 %

Note: En dash indicates results from this test sample were not available at the time this advisory announcement was published.

April 4: Jones. 0735–0840. Today's aerial survey covered Sitka Sound from as far south as Windy Passage, to as far north as Krestof Sound, and west to St. Lazaria Island. Survey conditions today were adequate with good visibility, cloudy skies, and 30-knot winds. Herring schools were observed in Leesoffskaia Bay and Redoubt Bay. Approximately 29.3 nautical miles (nmi) of active spawn was observed today along the southern and eastern Kruzof Island shoreline to Hayward Strait, Promisla and Eastern Bays, Siginaka Islands, Big and Little Gavanski Islands, around Middle and Crow Islands, the Kasiana Islands, and from Old Sitka Rocks to Sandy Beach. Herring predators were seen concentrated from Povorotni Point to Frosty Reef. The cumulative spawn estimate through today is approximately 47.1 nmi.

Department and industry vessels surveyed Sitka Sound from Crescent Bay to Redoubt Bay. Several schools of herring were located on sonar throughout the surveyed area. The largest concentration of herring schools was located between Pirates Cove and Redoubt Bay.

Three successful test sets were conducted today; the results were:

Time	Area	Ton	Mature roe	Immature roe	Average weight	Female
8:35	Redoubt Bay	150	11.1%	0.1 %	126 g	44.9 %
8:52	Kidney Cove	50	10.7 %	0.0 %	119 g	45.2 %
10:2	Cape Burunof	100	11.8 %	0.2 %	129 g	50.0 %

An opening of the Sitka Sound herring sac roe fishery occurred today from 12:15 p.m. until 5:00 p.m. as stated in field announcement on VHF channel 10. The open area for this fishery included the waters of Sitka Sound, Redoubt Bay, Pirates Cove, and Samsing Cove north of 56°54.68′ N long, south of 56°54.68′ N long, east of 135°25.51′ W long, and west of 135°21.12′ W long (Figure 2). For clarification, the open area included all waters of Redoubt Bay. The emergency order corresponding with today's opening is EO 1H0623. Harvest estimates from today's fishery will be included on the next fishery update.

The department has determined that the opening described above would not harm a reasonable opportunity for participants in the subsistence fishery to harvest the amount of roe necessary for subsistence uses. When making this determination, the department considered: 1) vessel surveys conducted by the department beginning on March 23 indicated that there is a very large biomass of herring distributed within Sitka Sound; 2) no herring spawn nor known subsistence branch sets were observed within the area opened today; 3) herring have been spawning in Sitka Sound since

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March 26 through today, April 4, the cumulative spawn estimate is 47.1 nmi; and 4) a cumulative estimate of approximately 15.6 nmi of herring spawn has been observed within regulatory closed waters this season.

April 5: Jones. 0715–0840. Today's aerial survey covered Sitka Sound from as far south as Frosty Reef, to as far north as St. John Baptist Bay, and west to St. Lazaria Island. Survey conditions today were fair with variable visibility, cloudy skies with rain/snow mix, and 30-knot winds. Approximately 17 nautical miles (nmi) of active spawn was observed today, mostly concentrated in the Magoun Islands, Promisla and Eastern Bays, Olga Strait, Siganaka Islands, Big and Little Gavanski Islands, south Middle Island, and Kasiana Islands. The cumulative spawn estimate through today is approximately 55.5 nmi.

Department and industry vessels surveyed Sitka Sound from Crescent Bay to Hotsprings Bay. Several schools of herring were located on sonar throughout the surveyed area. The largest concentration of herring schools was located between Frosty Reef and Hotsprings Bay.

Three successful test set was conducted today; the results were:

Time	Area	Ton	Mature roe	Immature roe	Average weight	Female
11:2	N. Calligan Island	100	11.2%	0.2 %	125 g	45.2 %
13:0	S. Calligan Island	100	10.6%	0.4 %	129 g	44.6 %
12:0	S. Calligan Island	10	8.3 %	0.8 %	99 g	41.8 %

An opening of the Sitka Sound herring sac roe fishery occurred today from 4:00 p.m. until 7:00 p.m. as stated in field announcement on VHF channel 10. The open area for this fishery included the waters of Sitka Sound north of 56°50.20′ N lat, south of 56°52.21′ N lat, and east of 135°25.09′ W long. The emergency order corresponding with today's opening is EO 1H0723. Approximately, 800 tons of herring were harvested during the fishery that occurred on April 4. Approximately 5,000-tons of herring have been harvested this season. Harvest estimates from today's fishery will be included on the next fishery update.

The department has determined that the opening described above would not harm a reasonable opportunity for participants in the subsistence fishery to harvest the amount of roe necessary for subsistence uses. When making this determination, the department considered: 1) vessel surveys conducted by the department beginning on March 23 indicated that there is a very large biomass of herring distributed within Sitka Sound; 2) no herring spawn nor known subsistence branch sets were observed within the area opened today; 3) herring have been spawning in Sitka Sound since March 26 through today, April 5, and the cumulative spawn estimate is 55.5 nmi; and 4) a cumulative estimate of approximately 16.2 nmi of herring spawn has been observed within regulatory closed waters this season.

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April 6: Jones. 0735–0855. Today's aerial survey covered Sitka Sound from as far south as West Crawfish Inlet, to as far north as St. John Baptist Bay, and west to St. Lazaria Island. Survey conditions today were fair with variable visibility, cloudy skies with rain, and 20-knot winds. Approximately 5.6 nautical miles (nmi) of active spawn was observed today, mostly concentrated in the Magoun Islands, Promisla and Eastern Bays, Siganaka Islands, south Middle Island, and Kasiana Islands. Smaller areas of spawn were located in St. John Baptist Bay and Hotsprings Bay. The cumulative spawn estimate through today is approximately 57.7 nmi.

Department and industry vessels surveyed Sitka Sound from Crescent Bay to West Crawfish Inlet. Several schools of herring were located on sonar throughout the surveyed area. Several large schools of herring schools were located between Frosty Reef and Hotsprings Bay. Very large schools of herring were also observed on sonar in the mouth of Windy Passage. No test sets were conducted today.

An opening of the Sitka Sound herring sac roe fishery occurred today from 11:15 a.m. until 7:00 p.m. as stated in field announcement on VHF channel 10. The open area for this fishery included the waters of Sitka Sound north of 56°50.20′ N lat, south of 56°52.21′ N lat, and east of 135°25.09′ W long. The emergency order corresponding with today's opening is EO 1H0823. Approximately, 2,180-tons of herring were harvested during the fishery that occurred on April 5. Approximately 7,200-tons of herring have been harvested this season. Harvest estimates from today's fishery will be included on the next fishery update.

The department has determined that the opening described above would not harm a reasonable opportunity for participants in the subsistence fishery to harvest the amount of roe necessary for subsistence uses. When making this determination, the department considered: 1) vessel surveys conducted by the department beginning on March 23 indicated that there is a very large biomass of herring distributed within Sitka Sound; 2) no herring spawn nor known subsistence branch sets were observed within the area opened today; 3) herring have been spawning in Sitka Sound since March 26 through today, April 6, and the cumulative spawn estimate is 57.7 nmi; and 4) a cumulative estimate of approximately 17.1 nmi of herring spawn has been observed within regulatory closed waters this season.

April 7: Jones. 0735–0915. Today's aerial survey covered Sitka Sound from as far south as Lodge Island, to as far north as Sukoi Inlet and St. John Baptist Bay, and west to Shoals Point. Survey conditions today were fair with variable visibility from passing showers, cloudy skies with rain, and calm winds. Approximately 3.9 nautical miles (nmi) of active spawn was observed today, mostly concentrated in the Magoun Islands, Eastern Bay, Olga Strait, Middle Island, Kasiana Islands, and Goddard area. The cumulative spawn estimate through today is approximately 59.3 nmi.

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Department and industry vessels surveyed Sitka Sound from Crescent Bay to West Crawfish Inlet. Several schools of herring were located on sonar throughout the surveyed area. Several large schools of herring schools were located between Frosty Reef and Hotsprings Bay, near Dorothy Narrows, and in Big Bay.

Two successful test set was conducted today; the results were:

Time	Area	Ton	Mature roe	Immature roe	Average weight	Female
13:3	Big Bay	100	7.1 %	0.4 %	110 g	48.6 %
14:1	Windy Passage	100	11.1 %	0.5 %	125 g	48.7 %

Two openings of the Sitka Sound herring sac roe fishery occurred today. The first opening occurred from 9:45 a.m. until 1:15 p.m. in the waters of Sitka Sound north of 56°50.20′ N lat, south of 56°52.21′ N lat, and east of 135°25.09′ W long as stated in field announcement on VHF channel 10. The second opening occurred from 4:00 p.m. until 5:15 p.m. in the waters of Windy Passage north of 56°48.23′ N lat, south of 56°49.08′ N lat, east of 135°23.64′ W long, and west of 135°21.34′ W long as stated in field announcement on VHF channel 10. The emergency order corresponding with today's openings is EO 1H0923. Approximately, 2,095-tons of herring were harvested during the fishery that occurred on April 6. Approximately 9,300-tons of herring have been harvested this season. Harvest estimates from today's fishery will be included on the next fishery update.

The department has determined that the opening described above would not harm a reasonable opportunity for participants in the subsistence fishery to harvest the amount of roe necessary for subsistence uses. When making this determination, the department considered: 1) vessel surveys conducted by the department beginning on March 23 indicated that there is a very large biomass of herring distributed within Sitka Sound; 2) while herring spawn was observed in the area near Calligan Island today no know subsistence branch sets were observed within the area opened today; 3) herring have been spawning in Sitka Sound since March 26 through today, April 7, and the cumulative spawn estimate is 59.3 nmi; and 4) a cumulative estimate of approximately 17.1 nmi of herring spawn has been observed within regulatory closed waters this season.

April 8: Jones. 0700–0730. Today's aerial survey covered Sitka Sound from as far south as Hot Springs Bay, to as far north as Middle Island, and west to Vitskari Rocks. Survey conditions today were poor with turbulence affecting and ultimately ending the survey with 30kt east winds and partly cloudy skies, although the visibility was excellent. Of the area surveyed, approximately 1.7 nautical miles (nmi) of active spawn was observed at Middle Island, Kasiana Islands, and the Goddard area. The cumulative spawn estimate is approximately 60.0 nmi.

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Department and industry vessels surveyed Sitka Sound from Crescent Bay to West Crawfish Inlet. Several schools of herring were located on sonar throughout the surveyed area, most notably in Big Bay and throughout Windy Passage.

Two successful test sets were conducted today; the results were:

Tim	Area	Ton	Mature roe	Immature roe	Average weight	Female
8:30	Big Bay	50	10.7 %	0.8 %	92 g	51.7 %
8:35	Dorothy Narrows	75	8.6 %	0.6 %	100 g	41.7 %

Approximately 1,600-tons of herring were harvested during the fishery that occurred on April 7. Approximately 10,900 tons of herring have been harvested this season. No fishery occurred today.

<u>April 9</u>: Jones. 0800–0910. Today's aerial survey covered Sitka Sound from Windy Passage to St. John Baptist Bay, and west to Shoals Point. Survey conditions today were fair with scattered showers occasionally affecting visibility, with 20 kt southeast winds, and cloudy skies. Approximately 6.6 nautical miles (nmi) of active spawn was observed from Dorothy Narrows to around the Goddard area, and at Middle Island. The cumulative spawn estimate is approximately 64.8 nmi.

Department and industry vessels surveyed Sitka Sound from Crescent Bay to West Crawfish Inlet. Several schools of herring were located on sonar throughout the surveyed area. However, very large schools of herring were observed throughout Windy Passage.

Two successful test sets were conducted today; the results were:

Time	Area	Tons	Mature roe	Immature roe	Average weight	Female
10:00	Dorothy Narrows	50	7.2 %	1.7 %	82 g	-
12:00	Golf Island	50	6.8 %	1.2 %	88 g	-

<u>April 10</u>: Jones. 0730–0830. Today's aerial survey covered Sitka Sound from Walker Channel to Eastern Bay, and west to Shoals Point. Survey conditions today were good with 20-kt south winds, and partly cloudy skies but visibility was occasionally obstructed with scattered showers. Approximately 1.7 nautical miles (nmi) of active spawn was observed from Dorothy Narrows to around the Goddard area during this flight. A department vessel survey was conducted today to map additional spawn not observed during the daily aerial surveys. The vessel survey covered the area from Eastern Bay to the Kasiana Islands and mapped an additional 4.6 nmi of spawn. The cumulative spawn estimate (including vessel mapped spawn) is approximately 70.0 nmi.

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Department and industry vessels surveyed Sitka Sound from Crescent Bay to West Crawfish Inlet. Several schools of herring were located on sonar throughout the surveyed area. No test sets or fishery occurred today.

April 11: Jones. 0730–0845. Today's aerial survey covered Sitka Sound from Jamboree Bay to Salisbury Sound, and west to Shelikof Bay. Survey conditions today were good with 5-kt north winds, and clear skies. Approximately 1.3 nautical miles (nmi) of active spawn was observed from Dorothy Narrows to around the Goddard area during this flight. A department vessel survey was conducted today to map additional spawn not observed during the daily aerial surveys. The vessel survey covered the area from Hayward Strait to the Magoun Islands and near Dorothy Narrows that mapped an additional 3.0 nmi of spawn. The cumulative spawn estimate (including vessel mapped spawn) is approximately 73.6 nmi.

Department and industry vessels surveyed Sitka Sound from Crescent Bay to Windy Passage. Several schools of herring were located on sonar throughout the surveyed area. No fishery occurred today.

One successful test set was conducted today; the results were:

Time	Area	Tons	Mature roe	Immature roe	Average weight	Female
10:51	Windy Pass	100	8.4 %	2.4 %	84 g	-

April 12: Jones. 0725–0752. Today's aerial survey covered Sitka Sound from Eastern Channel to Middle Channel. Survey conditions today were good with 15-kt south winds, and cloudy skies. Approximately 0.2 nautical miles (nmi) of active spawn was observed in Kluichvoi Bay and Gornoi Island during this flight (Figure 1). The cumulative mapped spawn is approximately 73.8 nmi.

A department vessel surveyed Sitka Sound from Crescent Bay to Windy Passage. Several schools of herring were located on sonar throughout the surveyed area. As of today, the department will no longer be assessing Sitka Sound for commercial harvest opportunity for the remainder of the 2023 season.

This was the last fishery update of the 2023 season. A season summary advisory announcement will be issued following the conclusion of aerial, vessel, and dive surveys. Aerial surveys will continue, weather permitting, to monitor for additional herring spawn in Sitka Sound and Hoonah Sound until it is determined that spawning activity has ended for the 2023 season. The data collected and corresponding images will continue to be posted online immediately after each flight or vessel survey.

April 13: Jones. 0815-0900. Weather slightly delayed departure of aerial survey with a low ceiling and showers affecting visibility. Survey conditions were poor but covered the area from Walker Channel to Crescent Bay. Small areas of spot spawn were seen by Goddard in Klieuchevoi and Hot Springs Bays, accounting for 0.3 nmi of active spawn. No herring schools were seen, but herring predators (humpbacks and sealions) were south of Dorothy Narrows and around Frosty Reef.

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<u>April 14</u>: Jones. 0730–0815 (South). Coltharp. 0820-1000 (Hoonah Sound). Today's aerial surveys covered as far south as Walker Channel and up to Hoonah Sound. No spawn was observed today, but herring schools were seen in the North Arm of Hoonah Sound. Few herring predators were observed but whales were seen nearby the herring schools.

<u>April 15</u>: Dupuis. 0815–0850. Today's aerial survey covered as far south as Walker Channel up to Eastern Channel. No spawn nor herring schools were observed today.

<u>April 16</u>: Jones. 0800–0950. Today's aerial survey covered the area from Walker Channel to the North Arm of Hoonah Sound. Viewing conditions were excellent with mostly cloudy skies and only occasional snow flurries, and moderate turbulence from 10 kt east winds. No spawn was observed today. Humpback whales were seen north of Biorka Island and in Windy Passage. Grey whales lined the Kruzoff shoreline with over 25 seen just at Shoal's Point. Compared to the last survey in Hoonah Sound, it seemed quiet with no herring schools, no herring predators, nor spawn was observed. This will likely be the last aerial herring survey of the season, but have plans to sonar around for herring schools in Hoonah Sound later this week.

<u>April 17</u>: No aerial survey was conducted today. However, Reports of spawn in the vicinity of Indian River and Jamestown Bay from community members and aerial photographs taken by a pilot guided a department vessel survey to the area. Today's vessel survey covered the area between Crescent Harbor and Ring Island. Approximately 2.0 nmi of active spawn was mapped between the Sheldon Jackson Hatchery and Ring Island. Total cumulative spawn to date is 75.8 nmi.

<u>April 18</u>: Dupuis/Coonradt. 0800–0900. Today's aerial survey with Mulligan on the Cessna 185 covered the area from Jamboree Bay to Crescent Harbor. Approximately 0.8 nmi of active spawn was observed between Crescent Harbor and Ring Island.

<u>April 18-19</u>: Dupuis/Jones. A department vessel surveyed the waters of Hoonah Sound north and west from Emmons Island and included both the North and South Arms of Hoonah Sound. Several small schools of herring were located using sonar throughout the area but were mostly concentrated within the North and Sound Arms. No herring schools were located in the vicinity of Emmons Island nor near the Vixen Islands. A small number of whales were seen in the South Arm, north of Emmons Island, and west of Emmons Island.

<u>April 21:</u> Dupuis/Smith. 0950–1200. Today's aerial survey with Mulligan on the Cessna 185 covered Sitka Sound from Crescent Bay to Jamboree Bay and from Shoals Point to Krestof Sound. Approximately 1.4 nmi of herring spawn was observed in Jamestown Bay, Redoubt Bay, and Hotsprings Bay. Total cumulative spawn mileage to date is 77.2 nmi.

Today's aerial survey also covered Hoonah Sound and Peril Strait from the northwest end of Moser Island to Point Hayes and included the Catherine Island shoreline from Pt. Thatcher to Lull Pt. No herring, spawn, nor predators were observed in Hoonah Sound or Peril Strait.

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April 22: Jones/Pallister. 0900–1000. Today's aerial survey with Mulligan on the Cessna 185, covered the area from Walker Channel to Jamestown Bay. Survey conditions were good with great visibility, cloudy skies and 20kt east winds. Small areas of active spawning was seen, accounting for 1.7 nmi were observed at Harris Island, outside of Kanga Bay, Hotsprings Bay, south Elovoi Island, Big Bay, Windy Passage, south Gornoi Island, and Middle channel. Total cumulative spawn mileage to date is 78.9 nmi. Humpback whales were observed north and south of Peisar Island and south of Windy Passage outside of West Crawfish Inlet.

April 23: Dupuis. 0700–0800. Today's aerial survey, with Mulligan on the Cessna 185, covered the area from Walker Channel to Crescent Bay. Survey conditions were fair with cloudy skies, 5 knot winds, and areas of fog that affected visibility in places. Approximately 1.3 nmi of active spawn was seen in Jamestown Bay, Hotsprings Bay, near Golf Island, Elovoi Island, and Tava Island.

April 24: Jones. 0910–0955. Today's aerial survey covered the area from Walker Channel to Jamestown Bay. Survey conditions were fair with continuous rain/snow and cloudy skies. Areas of spot spawn were observed near Tava Island and near Jamestown Bay, accounting for 0.1 nmi of spawn, with the cumulative total at 79.8 nmi. No herring predators were seen throughout the survey area.

Scott Forbes (JNU AMB) flew the area near Point Hayes and noted that no herring predators, herring schools, nor spawn was seen in that area.

April 25: Dupuis. 0845–0945. Today's aerial survey covered the area from Walker Channel to Jamestown Bay. Survey conditions were good with overcast skies and light winds. Areas of spot spawn were observed near Jamestown Bay, accounting for 0.1 nmi of spawn, with the cumulative total at 79.8 nmi. No herring predators were seen throughout the survey area.

Scott Forbes (JNU AMB) flew Hoonah Sound and Peril Strait from Fick Cove to Point Hayes and noted that no herring predators, herring schools, nor spawn was seen in that area.

April 29: Dupuis. 0845–0945. Today's aerial survey covered the area from Crescent Harbor to Salisbury Sound and from Moser Island to Catherine Island and Sitkoh Bay. Survey conditions were good with overcast skies and light winds. 2.3 nmi of active herring spawn was observed in Salisbury Sound and northern Krestof Sound. No herring or herring spawn was seen in Hoonah Sound or Peril Strait.

Appendix C3.–Aerial and skiff herring spawn surveys by date, at Bradfield Canal, Ernest Sound, Ship Island, Zimovia Strait and Eastern Passage, Bear Creek, Hobart Bay, and other areas within Petersburg-Wrangell Management Area in Southeast Alaska, 2023.

Bradfield Canal
Not surveyed in 2023.

Vixen Inlet/ Union Bay/Emerald Bay
Total miles of spawn: ~0.54
Spawning dates: likely sometime before 4/23
Peak spawning: unknown

4/13 No herring spawn or schools observed, 55 sea lions.
4/17 No herring spawn or schools observed, 30 sea lions, very few birds.
4/23 No herring spawn or schools observed, 10 sea lions, 3,000 scoters, 3,000 gulls.
5/8 Skiff survey: ~0.54 nmi of eggs observed on the beach. Spawn likely occurred the day prior (5/7)
5/15 No herring spawn or schools observed, 5 sea lions, very few birds.

Onslow/Stone/Brownson Island/Canoe Pass
Total miles of spawn: ~1.44
4/13 No herring spawn or schools observed, 20 scoters.
4/17 No herring spawn or schools observed, no sea lions, no birds.
4/23 No herring spawn or schools observed, no sea lions, no birds.
5/8 Skiff survey: ~1.44 nmi of eggs observed on the beach. S[awn likely occurred 1 week prior.
5/15 No herring spawn or schools observed, 5 sea lions, very few birds.

Ship Island
Not surveyed in 2023

Zimovia St. and Eastern Passage
4/13 No herring spawn or schools observed, 7 sea lions, 1 whale.
4/17 No herring spawn or schools observed, no sea lions, 3,000 scoters.
4/23 No herring spawn or schools observed, no sea lions, 3,000 scoters, 1,200 Gulls.
5/15 No herring spawn or schools observed, 5 sea lions, very few birds.
5/6 Skiff survey: ~3.14 nmi of eggs observed on the beach. Spawn likely occurred 1 – 2 weeks prior.

Bear Creek
Report on social media about spawn observations on 4/28.

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Farragut Bay
Total miles of spawn: unknown
Spawning dates: unknown
Peak spawning: unknown

4/29 No herring spawn observed, 2 schools, 20 sea lions, 2 humpback whales.
5/3 No herring spawn observed, 4 herring schools, 24 sea lions, 1 humpback whale.
5/10 No herring spawn observed, 2 schools of herring, 5,000 scoters, 19 sea lions, 1 humpback whale, 500 gulls.
5/14 No herring spawn or schools observed, 5 sea lions
5/16 No herring spawn observed, 2 schools of herring.

Hobart Bay
Total miles of spawn: ~0.15
Spawning dates: 5/18 and possibly before and after surveying
Peak spawning: unknown

4/29 No herring spawn observed, 1 herring school, 13 sea lions, 1 humpback whale, 1000 scoters.
5/3 No herring spawn or schools observed, 20 sea lions, 1 humpback whale, 4,000 scoters, 2,000 gulls.
5/8 No herring spawn or schools observed, 16 sea lions, 1 humpback whale.
5/10 No herring spawn observed, 2 schools, 24 sea lions, 1 humpback whale, 8,000 scoters, 100 gulls.
5/14 No herring spawn or schools observed, 36 sea lions.
5/16 No herring spawn or schools observed, 6 sea lions.
5/18 ~0.15 nmi of herring spawn, 30 schools of herring, 22 sea lions, 3 humpback whales
5/19 No spawn observed, 9 schools of herring, 4 sea lions.

Port Houghton
Total miles of spawn: ~0.77 nm
Spawning dates: 4/27 and possibly after final survey
Peak spawning: unknown

4/29 No herring or herring spawn observed, 13 sea lions, 1300 gulls, 1500 scoters.
5/3 No herring or herring spawn observed, 47 sea lions, 1 humpback, 1,000 scoters, 400 gulls.
5/8 No herring spawn or schools observed, 5 sea lions, 5,000 scoters, 1 humpback whale.
5/10 No herring spawn or schools observed, 27 sea lions, 501 gulls.
5/14 No herring spawn or schools observed, 19 sea lions, 1500 scoters.
5/16 No herring spawn observed, 4 schools of herring, 3 sea lions, 100 scoters.
5/18 ~0.76 mile of active spawn observed, 18 schools herring, 24 sea lions, 1 humpback whale
5/19 ~0.01 mile of spawn, 11 schools of herring, 15 sea lions, 2,000 scoters.

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Sunset Cove/Windham Bay

Total miles of spawn: ~0.4 nm
Spawning dates: 5/18
Peak spawning: 5/18

4/29 No herring spawn or schools observed, 7 sea lions.
5/3 No herring spawn or schools observed, 40 sea lions, 20 gulls.
5/10 No herring spawn or schools observed, 43 sea lions, 200 scoters
5/14 No herring spawn or schools observed.
5/16 No herring spawn observed, numerous herring schools observed.
5/18 ~0.4 nmi of spawn (2 small spot spawns), 2 schools of herring, 31 sea lions.
5/19 No herring spawn or schools observed, 1 humpback whale, 24 sea lions.

Appendix C4.–Aerial and skiff herring spawn surveys by date, in Juneau Management Area, in Southeast Alaska, 2023.

Seymour Canal

Number of times surveyed: 13
Total miles of spawn: 4.6 nmi
Spawning dates: 5/8 – 5/18
Peak spawn: 5/8 – 5/10

4/18: No staging herring or herring spawn, 1 ball near Winning Cove; 26SL, 6W; Good vis.
4/24: No staging herring or herring spawn; 7SL, 4W; Poor to fair vis.
4/28: No staging herring or herring spawn, 1 ball on outside of GP; 21SL, 2W; good vis
5/3: No herring or herring spawn; 111SL, 3W; excellent vis
5/8: 0.9 nmi of active spawn from Pt Gambier north; 84SL, 7W; good vis; also surveyed Hobart/Houghton
5/9: 0.7 nmi of active spawn in same area; 81SL, 10W; good vis
5/10: 1.2 nmi of active spawn in same area, multiple schools on shoreline north of spawn; 106SL, 11W; survey flown by T. Kowalske
5/11: 0.4 nmi of active spawn in same area; 103SL, 11W; good vis
5/14: 0.5 nmi of active spawn extending slightly north; 58SL, 3W; survey flown by K. Taylor
5/15: 0.2 nmi of active spawn above Point Gambier plus a spot spawn near Point Hugh; 11SL, 10W; good vis
5/16: multiple small schools, no spawn; 58SL, 7W; good vis
5/18: 0.1nmi of active spawn near Point Hugh, multiple small schools; 24SL, 1W; good vis
5/19: multiple small schools; 24SL, 0W; good vis

Tenakee Inlet (Tenakee Inlet and south along Chatham Strait shoreline to Point Moses in Peril Strait)

Number of times surveyed: 7
Total miles of spawn: 7.6 nmi
Spawning dates: 4/24 – 4/25, 5/3 – 5/7
Peak spawn: 4/24, 5/3 – 5/4

4/18: No staging herring or herring spawn, 1 ball south of South Passage Pt; 29SL (plus 14SL on Catherine Island shoreline and 35 SL at Cannery Point haulout), 3W; Good vis.
4/24: 1.2 nmi of active spawn south and west of South Passage Point; 2SL, 0W; Fair vis
4/25: 0.1 nmi of active spawn in same area south of South Passage Point; 72SL, 2W; Good vis; also surveyed Hoonah Sound and saw nothing.
5/3: 0.6 nmi of active spawn north of Basket Bay, 0.2 nmi of active spawn inside Peninsular Pt, 1.2 nmi of active spawn from Pt Craven north into Florence Bay, small schools at Corner Pt and Trap Bay, lots of herring on beach extending west on Peril Strait shoreline from Pt Craven;

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65SL, 17W; excellent vis.
5/4: 3.4 nmi of active spawn mostly in Florence Bay; 77SL, 3W; good vis
5/7: ~ 1.0 nmi of active spawn at Point Hayes documented by Ward Air pilot
5/8: No herring or herring spawn; 66SL, 2W; good vis
5/15: Multiple small schools; 16SL, 1W; good vis
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Lynn Canal

Number of times surveyed: 8
Total miles of spawn: 0.7 nmi
Spawning dates: 5/1 – 5/2
Peak spawn: 5/1

4/18: No herring or herring spawn; 12SL, 3W; Good vis; Benjamin Is. SL haulout half full
4/24: No staging herring or herring spawn, 1 ball in Auke Bay; 104SL, 2W (all but 4SL on Berners River flats); Fair vis.
4/28: No herring or herring spawn; 23SL, 1W; Fair vis; eulachon on Berners River flats
5/1: ~ 0.7 nmi of active spawn documented by A. Crupi returning from bear den aerial survey in Michael's Beach area
5/2: active spot spawn; 16SL, 0W; good vis
5/3: No herring or herring spawn; 86SL, 1W; good vis
5/4: No staging herring or herring spawn; 3SL, 0W; good vis
5/8: No staging herring or herring spawn, couple small schools in Auke Bay; 15SL, good vis

Oliver Inlet/Stink Creek

Number of times surveyed: 12
Total miles of spawn: 2.4 nmi
Spawning dates: 5/8 – 5/10
Peak Spawn: 5/9 – 5/10

4/18: No herring or herring spawn; 0SL, 0W; Good vis.
4/24: No herring or herring spawn; 0SL, 0W; Poor vis.
4/28: No herring or herring spawn; 0Sl, 1W; fair vis
5/3: No herring or herring spawn; 5SL, 0W; good vis
5/8: 0.1nmi of active spawn inside Oliver Inlet, herring staging near entrance to OI; 15SL, 2W; good vis
5/9: 1.3 nmi of active spawn east and west of OI entrance, small school in Greens Cove; 6SL, 2W; good vis
5/10: 1.3 nmi of active spawn in same area, small schools in Greens Cove and Oliver Inlet; 22SL, 1W; good vis
5/11: No herring or spawn; 30SL, 0W, fair vis
5/15: No herring or spawn; 0SL, 0W; good vis

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5/16: 2 small schools; 0SL, 0W; good vis
5/18: No herring or spawn; 0SL, 0W, good vis
5/19: No herring or spawn; 0SL, 0W, good vis

Port Frederick
Number of times surveyed: 5
Total miles of spawn observed: 0.8 nmi
Spawning dates: 5/15

4/18: No herring or spawn; 0SL, 0W; Good vis.
4/25: No staging herring or spawn, a few small schools; 0SL, 0W; Good vis.
5/3: No staging herring of spawn, small school near The Narrows; 0SL, 0W; good vis
5/8: No staging herring or spawn, multiple small schools; 5SL, 0W; good vis
5/15: 0.8 nmi of active spawn at Game Point; 6SL, 0W; multiple small schools; good vis

Taku Harbor
Number of times surveyed: 1
Total miles of spawn observed:
Spawn dates:
5/15: No herring or spawn; good vis

Appendix C5.–Aerial and skiff herring spawn surveys by date, in the Yakutat Management Area, in Southeast Alaska, 2023.

Yakutat Bay

Boat surveys were conducted during April 7 to 16, 2023, in the areas of Doggie Island, Khantaak Island, Kriwoi Island, and Knight Island. Cumulative spawn mileage totaled 4.21 nmi .