Fishery Data Series No. 17-49

Southeast Alaska 2017 Herring Stock Assessment Surveys

by

Kyle Hebert

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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. 17-49

SOUTHEAST ALASKA 2017 HERRING STOCK ASSESSMENT SURVEYS

by
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ABSTRACT

Pacific herring, *Clupea pallasii*, is important prey for many marine species found in Southeast Alaska and is also harvested in fisheries for commercial bait, commercial sac roe, commercial spawn-on-kelp, subsistence spawn-on-branches, subsistence spawn-on-kelp, personal use, and research/cost-recovery 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 2017, including summaries of herring spawn deposition surveys and age-weight-length sampling, which are the principle model inputs used to forecast herring abundance. In 2017 spawn deposition surveys were conducted in Sitka Sound, Craig, and Seymour Canal. Spawn deposition surveys were not conducted in several other major spawning areas in 2017, primarily due to lack of funding resulting from cuts to state budgets. The shoreline in state waters where spawn was documented during aerial surveys in 2017, combined for all areas, was 107.5 nautical miles. In 2017, post-fishery spawn deposition biomass estimates, combined for all surveyed stocks, totaled 71,011 tons.

During the 2016–2017 season, a commercial winter bait fisheries was opened in Craig with a guideline harvest level of 523 tons. A commercial purse seine sac-roe fishery was opened in Sitka Sound with a guideline harvest level of 14,649 tons. A commercial spawn-on-kelp fishery was open in Craig, with an allocation of 349 tons. There were no commercial gillnet fisheries opened in 2017. No commercial fisheries were opened in Seymour Canal, Hobart Bay-Port Houghton, Hoonah Sound, Tenakee Inlet, West Behm Canal, Kah Shakes/Cat Island, or Lynn Canal. Herring harvested commercially during the 2016–2017 season totaled just over 14,450 tons, not including herring pounded for spawn-on-kelp fisheries.

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

INTRODUCTION

The Alaska Department of Fish and Game (ADF&G) instituted a research project in 1971 to evaluate Pacific herring *Clupea pallasii* 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 is to provide the biological data necessary for the scientific 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, 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 input into one of two different stock assessment models used to estimate spawning biomass and to forecast mature herring abundance. These models include an age-structured analysis (ASA) model and a biomass accounting model.

Historically 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 ASA 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. These two models are not mutually exclusive of the spawn deposition method. Spawn deposition data is an important element of ASA and biomass accounting models. A primary difference between the two approaches is the amount of data required to conduct the respective analyses. 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 ASA model uses a time series of age compositions and weight at age in conjunction with estimates of spawn deposition to estimate biomass. 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. A more detailed explanation of the ASA and biomass accounting models and how the objective estimates are used in these models are provided by Carlile et al. (1996).

Since 1993, and when data has allowed, the ASA model has been used to estimate and forecast the abundance of herring for four major Southeast Alaska herring stocks: Sitka, Seymour Canal, Revillagigedo Channel (also called "Revilla Channel," which refers to the greater Kah Shakes/Cat Island and Annette Island spawning areas), and Craig. The ASA model was used for Tenakee Inlet beginning in 2000. For these five potential commercial harvest areas or spawning populations, the time series of data has been sufficient to permit the use of ASA for hindcasting historical biomass and forecasting future biomass. Other areas, which may support significant herring fisheries but lack data time series suitable for ASA, 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. Age-structured analysis 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. The primary intent of this report is to document data collected during winter 2016 through spring 2017 and to provide historical perspective by presenting general trends in Southeast Alaska herring populations.

The principal outputs from all models are forecasts of mature herring biomass and age compositions for the ensuing year. 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 to determine the allowable harvests, and allocations for commercial quotas for each fishery are determined by the appropriate regulations and management plans.

METHODS AND PROCEDURES

AERIAL AND SKIFF SURVEYS

A combination of aerial and skiff surveys were used to record spawning activities during the spring, to document spawn timing, and estimate the distance of shoreline that received herring spawn for all major spawning areas (Figure 1), and for many minor spawning areas in Southeast Alaska. Aerial surveys typically commenced prior to the historical first date of spawning for each stock. 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, generally indicating presence of herring, aerial and skiff surveys were conducted more frequently (i.e., daily or 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 during each survey and then later transferred to computer mapping software to measure shoreline receiving spawn. A chart containing the cumulative shoreline that received spawn 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 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. To account for egg loss from the study site prior to the survey, a 10% correction factor is applied to inflate the estimate of total egg deposition. This value 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-b]) and in Prince William Sound. These studies found that the extent of egg loss due to predation and physical environmental stresses 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; however, some more recent studies suggest that 25–35% may be more appropriate. Because length of time since egg deposition is key to the extent of egg loss, a serious attempt was made to conduct surveys within 10 days; however, at times surveys were delayed to balance survey schedule times for other spawning areas, or to accommodate schedules of survey participants. Surveys conducted substantially after the 10-day period may tend to result in underestimates of egg deposition and mature biomass.

Shoreline Measurement

Spawn documented during aerial surveys was transcribed in ArcGIS (version 10)[1] over raster images of nautical charts published by the National Oceanic and Atmospheric Administration, using the NAD 1983 datum. 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 required that shoreline features be smoothed without adhering closely to the shore on a small scale, but also without drawing sweeping 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. Conversely, spawn may closely follow a convoluted shoreline, requiring finer resolution of measurements, and 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 steep sloped shoreline with a narrow band of spawn habitat (e.g., some areas of Sitka Sound) requires much finer 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.

Although the same procedure and patterns of drawing spawn were followed as in past years, the process requires that judgment be used based on knowledge and experience of the local spawning areas. The intent of drawing a smoothed spawn line is to produce a survey area that is

[1] Use of product names in this publication are included for completeness but do not constitute product endorsement.

oriented along the spawn and is such that transects laid perpendicularly to the spawn line will sample egg density throughout the entire width of the spawn, without biasing the estimate. 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.

Once the spawn shoreline was established, a single linear measurement of the shoreline was made using XTools Pro, a measuring tool extension used within ArcGIS. 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 relative to each other.

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 1. Sampling rates in Table 1 were estimated using data from previous surveys. The statistical objective of the spawn deposition sampling was to estimate herring egg densities (per quadrate) so that the lower bound of a 90% confidence interval was at least within 30% of the mean egg density. This would also achieve the objective of estimating the total spawn deposition at a particular location with the specified precision. A one-sided confidence interval was used because there is more of a concern with avoiding overestimating, rather than avoiding underestimating the densities of spawn deposition. The number of transects were frequently increased beyond the minimum suggested rate to increase transect spatial distribution, potentially reduce variance, and efficiently use scheduled vessel time.

The minimum target number of transects is estimated as follows:

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

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 a depth in the subtidal zone where no further egg deposition was observed, or to a maximum of 21 m (70 fsw) 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. Dives were limited to 21 m because deeper dives severely limit total bottom time for scuba divers and pose safety risks when conducting repetitive dives over several days. All diving was conducted in compliance with procedures and guidelines outlined in the ADF&G Dive Safety Manual (Hebert 2006). Normally, little if any herring egg deposition occurs deeper than 21 m.

A two-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 two-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. To help estimate the number of eggs, estimators used a 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. Addition data recorded included substrate type, primary vegetation type upon which eggs were deposited (Appendices A and B, respectively), percent vegetation coverage within the sampling frame, and 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

Since visual estimates rather than actual counts of eggs within the sampling frame are recorded, 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 estimators tendency to underestimate or overestimate. Correction coefficients were estimated by double sampling (Jessen 1978) frames independent of those estimates obtained along regular spawn deposition transects. 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 of the eggs within the frame for later more precise estimation in a laboratory. To collect the eggs, divers removed the vegetation (e.g., kelp) along with the eggs and preserved them with 100% salt brine solution. Approximately ten samples each (of varying egg density) of five vegetation categories were collected. Vegetation categories included eelgrass (ELG), fir kelp (FIR), leafy brown kelp (LBK), rockweed (FUC), and hair kelp (HIR) (see Appendix A.1 for species within each category). Samples were transported to the ADF&G Mark, Tag and Age Laboratory, 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 two or three subsamples (typically about 1,000 eggs), and then measuring the volume of subsamples and samples to calculate total eggs by proportion.

Correction coefficients were calculated as the ratio of sums of laboratory estimates to an estimator's visual estimates. To reduce potential of highly variable correction coefficients, minimum sample size guidelines were used. Data from the last three years were used if there were at least a total of 6 samples for each estimator and kelp type, with at least three samples in at least two 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.

Estimator/kelp-specific correction coefficients were applied to egg estimates when the appropriate kelp type matched. For example, the "large/leafy brown kelp" correction coefficient was applied when kelp types that fit that description were encountered, and the "eelgrass" correction coefficient was applied when eelgrass was encountered. When loose eggs or eggs adhering to bare rock were encountered within the frame, an estimator-specific correction coefficient based on the average of all estimator/kelp-specific correction coefficients was applied.

ESTIMATES OF TOTAL EGG DEPOSITION

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

$$t_i = a_i \bar{d}_i, \tag{2}$$

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

$$a_i = l_i \bar{w}_i, \tag{3}$$

where l_i is the total length of shoreline receiving spawn (determined from aerial and skiff surveys); and w_i is the mean width of spawn, 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 kelp type *k*. The c_{hk} term refers to a diver-specific, kelp-specific correction factor to adjust visual estimates made by estimator *h* on kelp 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. Estimator/kelp-specific correction factors (c_{hk}) are calculated as follows:

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

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

SPAWNING BIOMASS ESTIMATION

The total number of eggs per spawning area is a key element used in forecasting herring spawning biomass. Although estimated spawning biomass is not an input for the ASA or biomass accounting models, it does provide a static value in a given year (unlike ASA-derived estimates, which change with each model run), which is useful for comparison among years to track broad, relative changes in abundance.

The conversion of eggs to spawning biomass is calculated either using the stock-specific fecundity-to-weight relationship for the areas where fecundity estimates are available (Sitka Sound, Seymour Canal, Craig, Kah Shakes/Cat Island), or for all other stocks, the fecundity-to-weight relationship from the closest spawning stock where fecundity estimates are available (Table 2). The estimate for each area is calculated as follows:

$$b = h_{\bar{g}} * \bar{g}\ , \qquad (6)$$

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:

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

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 2.

AGE AND SIZE

Herring samples were collected from a combination of skiff surveys, aerial surveys, research surveys, commercial fisheries, and test fisheries from major stocks located throughout Southeast Alaska. Collection gear varied with location and may have included purse seines, gillnets, cast nets, or bottom 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 assure 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 chances of rejecting a true value is about 10 percent). The minimum sampling goal was set at about 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 five-gallon buckets and frozen for later processing in the laboratory. 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 tenth 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 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 optimum image of the annuli. Ages from 1999 to present were determined by mounting scales on a microfiche reader to project a larger scale image to more easily see annuli. Each fish was assigned an anniversary date for each completed growing season. All samples were 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, 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. 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. For a detailed description of aging methods see Oxman and Buettner (*In prep*).

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:

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

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 submerged Onset Stowaway Tidbit temperature loggers. Depth of temperature recorders ranged from about 10 ft mean lower low water (MLLW) to 20 ft MLLW. Temperature was recorded daily at 6-hour intervals for a minimum of 1 year and up to 16 years, depending on spawning area. Daily mean temperature was calculated and for each spawning area, and mean, minimum and maximum sea temperature values were calculated for each year using datasets that spanned an entire year (365 consecutive days). Overall annual mean temperature was calculated as the mean of all 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.

COMMERCIAL FISHERIES

During the 2016–2017 season, only three commercial herring fisheries were conducted in Southeast Alaska, from two spawning areas: Sitka Sound and Craig. Products resulting from these fisheries included food and bait, sac roe, and spawn on kelp. Threshold biomass levels have been established for each commercially exploited stock in Southeast Alaska, which 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 25% of estimated average unfished biomass as determined through simulation models (Carlile 1998a, 2003). In the case of Sitka Sound, the threshold was subsequently increased by the Board of Fisheries on two 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; however, because the value was lower than the existing threshold of 3,000 tons, the existing threshold was retained (Carlile 1998b). For all other stocks in Southeast Alaska, thresholds were established after considering estimates of abundance, historical knowledge of stock size and distribution, and manageability of minimum quotas. Threshold levels during the 2016–2017 season ranged from 2,000 tons (Hoonah Sound and Hobart Bay) to 25,000 tons (Sitka Sound).

Management Strategy

The following management plan was in place for the 2015–2016 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 STATISTICAL AREA A.* For the management of herring fisheries in Statistical Area A, 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.

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 with which all herring fisheries must comply in the region.

RESULTS

AERIAL AND SKIFF SURVEYS

Aerial and skiff surveys of herring activity, herring spawn, and marine mammal/bird activity were conducted at major stock locations beginning on March 10, 2017, in Sitka Sound and ending on May 18, 2017, in Lynn Canal. Notes of activity related to herring or herring spawning were recorded in logs, which are presented in Appendix C. Surveys or observations were conducted by staff in each area office (Ketchikan, Petersburg, Sitka, Juneau, Haines, Yakutat) and covered major or traditional herring spawning locations within each management area. Occasionally, private pilots or local residents reported observations of active spawning. Spawning timing for each major spawning area, including dates of first, last, and major spawning events, is summarized in Figure 2. Aerial surveys were conducted in several minor spawning areas, but no spawn deposition surveys were completed in these areas due to the low level of spawning, or in the case of some areas (e.g., Bradfield Canal), because surveys conducted in previous years revealed that only a narrow band of spawning habitat exists resulting in relatively low egg deposition (see Appendix C). ADF&G also completed aerial surveys of Annette Island Reserve while en route to other spawning areas located in state waters.

SPAWN DEPOSITION SURVEYS

During spring 2017, spawn deposition surveys were conducted in Sitka Sound, Craig, and Seymour Canal. Surveys began in Craig on April 7 and were completed in Seymour Canal on May 15 (Table 3). Survey site locations, spawn, and transect locations are presented in Appendix D. Egg estimates by transect for each spawning area are presented in Table 4. Due to budget reductions in 2017, spawn deposition surveys were not conducted in Tenakee Inlet, Lynn Canal, Hoonah Sound, West Behm Canal, Revilla Channel, Ernest Sound, or Hobart Bay/Port Houghton areas

Total herring spawning biomass, combined for all areas, was similar in 2017 to the prior three years. This relative stability of total biomass in the region was largely influenced by the two largest spawning areas, Sitka Sound and Craig. Spawning biomass rebounded substantially in 2017 in two of the three surveyed areas, Craig and Seymour Canal. A summary of the 2017 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 2017 spawning stock abundance to prior years, estimates of historical spawning biomass are presented in Figures 3–8.

The total documented spawn for major spawning areas in state waters where aerial surveys were conducted in Southeast Alaska in 2017 was 107.5 nmi (Table 5). This 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).

Visual Estimate Correction

Minimum sample size guidelines (at least 3 samples per kelp type for the most recent 3 years) were met using data from 2015 through 2017 for all (9 of 9) estimators. Correction coefficients applied to 2017 spawn deposition visual estimates ranged from 0.566 to 1.606 and are presented in Table 6.

Visual review of plots depicting observed versus laboratory estimates of eggs suggest there exist linear relationships for some estimators, but a non-linear relationship for others caused by a tendency to underestimate when egg numbers in sample frames are high. A similar non-linear pattern has been observed for aerial estimates of salmon in streams (see Jones et al. 1998), although correction coefficients were calculated as a straight ratio 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, although values may be biased low due to the non-linear relationship.

AGE AND SIZE

A combined total of 3,203 herring were sampled from all stocks and gear types (cast net, purse seine, and pound) during the 2016–2017 season. Of those, 3,202 herring were processed to determine age, weight, length and sex. The reduction of sample size was due to fish that could not be aged due to regenerated scales, or due to data that was otherwise unusable.

Samples of the spawning population were taken using cast nets from Craig, Seymour Canal, Sitka Sound, and Tenakee Inlet. Samples of the spawning population were collected throughout the geographic extent of the active spawn (Figures 9–17), and throughout the duration of spawning or was focused on the most intense spawning events (Figure 2).

Samples were obtained from commercial fisheries for all areas where commercial fisheries were conducted in 2016–2017. Fisheries sampled included Craig winter bait and spawn on kelp, and Sitka sac roe. Samples were obtained opportunistically from vessels or tenders, during or shortly after the fishery openings. Sample locations during fisheries are shown in Figures 9–19.

The minimum sample goal of 500 aged fish per sampling event (gear-fishery combination) was met or exceeded for nearly every area/fishery, with the sole exception of Tenakee Inlet, where only 95 fish were sampled from the spawning population, 52 of them aged as age-2 (Tables 7 and 8).

Age Composition

Age composition data from spawning populations was obtained for only three stocks in the region due to reduced budgets in 2017. Herring samples adequate to estimate age distribution were obtained from Sitka Sound, Craig, and Seymour Canal. Although a small sample was obtained from Tenakee Inlet, the sample size fell far below the minimum needed to confidently estimate age distribution. Samples were not obtained from Lynn Canal, Hoonah Sound, Ernest Sound, Hobart Bay/Port Houghton, West Behm Canal, or Revilla Channel due to reduced budgets. Frequency distributions of herring ages from sampled spawning areas are presented in Tables 9–18 and Figures 20–29.

Observed age distributions for Sitka Sound and Craig areas had some similarities, with age-3 through age-5 herring making up a very large proportion of each distribution. Older age classes totaled less than 10% combined for each area. The observed age distribution of Seymour Sound was considerably different thank Sitka or Craig, with a large proportion of age-8+ herring. The similar age distributions of Craig and Sitka Sound may be due to the effects of similar outer coastal marine environments influencing the populations.

The proportions of age-3 herring entering the mature population each year seem to fluctuate 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 39). When northern and southern stocks are viewed separately, the synchronized pattern is even more apparent within each group (Figures 40 and 41). In 2015 a very high proportion of age-3 herring was observed for all stocks; however, in 2016 a relatively low to moderate proportion of mature age-3 herring were observed in most spawning areas. Although samples were obtained for only a few areas in 2017, it appears that for most areas sampled, age-3 proportions were higher than in 2016.

The relationship between the latitude of spawning stocks and the proportion of mature age-3 herring continues to be relatively strong (Table 19, Figure 42). The mean proportion of age-3 herring in the mature population has been consistently lower for higher latitude stocks and higher for lower latitude stocks, and the coefficient of determination suggests a strong correlation at $r^2 = 0.82$ (Figure 43). There is also a moderate correlation between the mean proportion of age-3 mature herring and the mean minimum annual sea temperature ($r^2 = 0.65$) (Figure 44). A weak relationship exists between the mean proportion of age-3 herring and the mean annual sea surface temperature ($r^2 = 0.53$) (Figure 45). Although there is no linear correlation between the mean proportion of age-3 herring and the mean maximum annual sea temperature, graphic display reveals a possible curvilinear relationship (dome-shaped), suggesting the possibility of an optimal temperature for recruitment of mature age-3 herring, around 16.5º C (Figure 46).

Size at Age

Based on cast net samples in 2017, there is a clear distinction between mean weight at age for Sitka Sound spawning herring and all other herring spawning areas in Southeast Alaska (Figure 47). Although herring at age 3 from some areas are comparable in size, the divergence between Sitka Sound herring weight at age and other stocks in the region increases greatly with age, as Sitka Sound herring attain a substantially higher average weight by age 8 and typically by age 6. Excluding Sitka Sound, there also appears to be a difference in weight at age among other major Southeast Alaska stocks. Herring from some stocks appear to have consistently higher mean weights at age, across all ages, than others. For example, in 2017 Craig herring had consistently higher weight at age across age groups than other Seymour Canal. Tests to determine whether differences were statistically significant were not performed as the primary intent of this report is to present 2017 data with general observations of trends and characterization of stocks.

Mean length at age among spawning areas has a pattern similar to weights at age. Although the distinction between Sitka Sound herring mean length at age and other Southeast Alaska stocks is clear, it is not as great as observed for mean weight at age (Figure 48). The rankings of stocks both for mean length at age, and mean weight at age are similar. This is not surprising as weight is highly correlated with length. The separation gap between Sitka Sound and other stocks (for both length and weight) increases with age. This is likely an indication that growth rate for Sitka Sound herring is greater than for other stocks in the region. The differences could be a result of different environmental conditions, genetic composition, or an interaction between the two.

Trends in weight at age over time are variable among stocks (Figures 49–58). For most stocks, a common pattern is evident: weight of age-3 herring has been stable over the past few decades, while those of older ages appear to have gradually declined. The decline appears to be more pronounced for older age classes. 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. The exception is Sitka Sound, where weight at age appears to have slightly increased over the past 20 years, following a period of low weight at age in the early 1990s. However, data presented here only date back to the late 1980s, which coincided with the period of low weight and condition of Sitka area herring. Another pattern that is apparent is that weight at age of age-4+ herring may have declined more in the southernmost stocks (e.g., Craig, West Behm Canal, Revilla Channel) than in northernmost stocks (e.g., Tenakee Inlet, Lynn Canal, Hoonah Sound).

To understand whether changes in weight at age are due solely to body mass or instead (or also) due to changes in length at age, it is helpful to calculate condition factors. Condition factors were calculated to index the physical dimensions of herring (i.e., weight-to-length ratio) over time, to roughly gauge herring health (Figures 59–68). Data obtained from cast net samples during active spawn events were used to calculate condition factors. Weight estimates derived from samples taking 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. Other benefits of using data from cast net samples are that they provide a more complete and consistent time series and bias is expected to be lower than for fishery-dependent data that may be influenced by targeting larger fish.

Mean condition factors of herring from most stocks on Southeast Alaska follow the same general pattern over the last two decades: relatively low in the early 1990s, 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 for 2017 are variable among areas and not substantially different from those observed in 2016. An exception is Sitka Sound, where condition factors in 2017 were notably lower than in 2016 across all ages; however, this follows unusually high values from 2016.

Sitka Sound Winter Test Fishery

A test fishery was prosecuted in Sitka Sound during the winter of 2016-17; however, no samples were collected for estimating size or age.

COMMERCIAL FISHERIES

Commercial harvest was permitted in an area only if the forecasted spawning biomass met or exceeded a minimum threshold (Table 20). If that threshold was met or exceeded, then a sliding-scale harvest rate of between 10 and 20 percent of the forecasted spawning biomass was 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. A summary of locations, harvest levels, and periods of harvest is presented in Table 21.

Sac Roe Fisheries

The only commercial sac roe fishery that was announced in 2017 was for the Sitka Sound area. There were no sac roe fisheries announced for Seymour Canal, West Behm Canal, Hobart Bay–Port Houghton, Kah Shakes–Cat Island, or Lynn Canal areas because spawning biomass was estimated to be below threshold.

Sitka Sound

The sac roe fishery was placed on two-hour notice on March 17 at 8:00 AM. The GHL was 14,649 tons. This season the fishery was conducted as a competitive derby-style fishery for the first three openings, followed by two days of controlled (non-competitive) fishery openings. There were five days when openings were held during the 2017 fishery. The first opening was on March 19 from 2:30 PM until 5:50 PM in the northern part of Sitka Sound, in the waters of Hayward Strait and Krestof Sound. Estimated harvest was approximately 3,500 tons during the first opening. The second opening occurred on March 22 from 1:00 PM until 1:15 PM in the waters of Krestof Sound. Approximately 4,500 tons were harvested during the second opening. The third day of the fishery occurred on March 25 in northern Sitka Sound, Hayward Strait, and Krestof Sound from 12:00 PM until 3:20 PM. Approximately 5,200 tons were harvested during this opening. After three competitive openings, 995 tons of the GHL remained unharvested and the decision was made to conduct controlled fisheries to meet the GHL. Controlled fisheries were opened on March 27 and 28. The 2016–17 season was announced closed on March 28 at 12:00 PM.

The total harvest for the season was 13,923 tons, which fell short the GHL of 14,649 tons by about 700 tons.

Seymour Canal

There was no commercial fishery in the Seymour Canal area during the 2016–2017 season, as no forecast was generated due to inability of the current age-structured model to fit the data. However, due to the extremely low 2016 Seymour survey estimate, all modeling efforts indicated that the Seymour forecast for 2017 would be below threshold.

West Behm Canal

There were no commercial fisheries in the West Behm Canal area during the 2016–2017 season, as the biomass was assumed to be below threshold.

Hobart Bay-Port Houghton

There were no commercial fisheries in the Hobart Bay-Port Houghton area during the 2016–2017 season, as the forecast was below threshold.

Kah Shakes-Cat Island

There were no commercial fisheries in the Kah Shakes-Cat Island area during the 2016–2017 season, as the biomass was assumed to be below threshold.

Lynn Canal

There were no commercial fisheries in the Lynn Canal area during the 2016–2017 season, as the biomass was assumed to be below threshold

Winter Bait Fisheries

During the 2016–2017 season, the only winter food and bait fishery was in the Craig area. Other winter bait areas were closed as forecasts were below threshold.

Craig

The fishery was opened in the Craig area on October 17, 2016 and was closed by emergency order on February 3, 2017. The bait allocation was 523 tons, which was by regulation 60% of the total GHL of 872 tons. A total of 527 tons of herring were harvested.

Ernest Sound

There were no commercial fisheries in Ernest Sound during the 2016–17 season as the forecast was below threshold.

Tenakee Inlet

There were no commercial fisheries in Tenakee Inlet during the 2016–17 season as the forecast was below threshold.

Spawn-on-Kelp Pound Fisheries

In the spawn–on–kelp (SOK) fisheries, *closed-pound fishing* involves capturing sexually mature herring and releasing them into a net impoundment in 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 are allowed to 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 one 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 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 1 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 conducted in Southeast Alaska, this conversion is used to approximate herring usage for Southeast Alaska pound fisheries, particularly when reporting estimates over time, to ensure consistency. 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% of herring that are placed into pounds is assumed.

The only area open to the commercial harvest of SOK during the 2016–2017 season was Craig. The other SOK areas in the region, Hoonah Sound, Ernest Sound, and Tenakee Inlet, were not opened during the 2016–2017 season because the forecasted mature biomass was below threshold.

Craig

A total of 19 closed pounds were actively fished, each of which combined six permit holders. Two open pounds were also fished. In the past, the fishery has been dominated by single-permit pounds or double-permit closed pounds. However, the low GHL in 2017 required that a low number of closed pounds be used to avoid exceeding the GHL. Therefore the department limited the number of closed pounds to 20, which required that permit holders team up in groups of six. A total of 116 permit holders participated in the fishery. Total harvest was 70 tons of spawn on kelp.

Hoonah Sound

There was no commercial fishery in Hoonah Sound during the 2016–17 season as the forecast was below threshold.

Ernest Sound

There were no commercial fisheries in Ernest Sound during the 2016–17 season as the forecast was below threshold.

Tenakee Inlet

There were no commercial fisheries in Tenakee Inlet during the 2016–17 season as the forecast was below threshold

Bait Pound (Fresh Bait and Tray Pack) Fisheries

During the 2016–2017 season, no herring were harvested for fresh bait pounds or tray-pack in Southeast Alaska.

Test Fisheries

The sole herring test fishery conducted in Southeast Alaska during the 2016–2017 season was in Sitka Sound, for bait, using purse seine gear to harvest during November 6, 2016, March 5, 2017 and March 10, 2017. A total of 133 tons of herring were harvested.

DISCUSSION

Spawn Deposition

After a period of building since about the late 1990s and peaking during 2008–2011, herring spawning biomass in Southeast Alaska has undergone a period of decline, but shows signs of stabilizing over the past few years. The total combined spawning biomass estimated in 2017 for all of Southeast Alaska is at a level similar to that of the late 1990s, which proceeded the period of building herring biomass. For those areas surveyed in 2017, the combined estimated spawning biomass in Southeast Alaska, as calculated from spawn deposition estimates, was 68,848 tons, a decrease of 26% relative to 2016. The decrease was largely driven by a decline in Sitka Sound, but also due to the total estimate not including several herring stocks in the region that were not surveyed in 2017 but were surveyed in 2016. The apparent stability in the region between 2016 and 2017 is largely attributable to changes in the two largest stocks, Sitka Sound and Craig, which typically account for about 80% of the spawning biomass in Southeast Alaska. Sitka Sound decreased by 41% between 2016 and 2017, but Craig increased sharply by more than doubling. Additionally, Seymour Canal increased multifold to 2,668 tons, following a very low estimate of only 117 tons in 2016. Although the error surrounding biomass estimates was not calculated, the magnitudes of the changes were large enough that they probably reflect actual and meaningful changes in the spawning population levels. No estimates of spawning biomass were made for other spawning areas in 2017, making it difficult to gauge possible regional environmental effects. For a perspective on the relative spawning biomass at each area where a spawn deposition survey was conducted in the region, along with relative proportion of harvest, see Figure 69.

Changes in estimated spawning biomass over the past year may be due to actual changes in the herring population; however, it must be acknowledged that it could also be a function of estimate variation, 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 spawning biomass presented in this report are based primarily on egg deposition estimates (as opposed to model-derived results), which are useful for providing a general, broad brush view of trends in mature herring biomass but should not necessarily be considered the most accurate estimate of biomass in any given year. For all major herring stocks in Southeast Alaska, the results of ASA 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 ASA model provides more reliable estimates is that it incorporates other sources of data (primarily age composition), and 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, as opposed to ASA hind cast estimates derived from single model runs, which may be less intuitive since 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, which may leave gaps in the time series of estimates. Since spawn deposition surveys are conducted annually, biomass estimates derived from egg deposition provide a consistent and comparable time series to gauge trends.

Combined, spawn deposition estimates for 2017 suggest that herring spawning biomass in Southeast Alaska is at a moderate level relative to the period 1980–2016. The 2017 combined estimate of surveyed areas of 68,848 tons is about 67% of the mean spawning biomass (1980-2016), which is an underestimate for the region because many areas were not surveyed in 2017. However, when spawning areas are considered separately, based on spawning biomass or in many cases spawn mileage alone, most areas appear to remain at a low or very low level.

Age Composition

For all stocks where minimum sampling goal were met, estimates of age composition in 2017 continued to follow patterns that are generally expected; that is, the proportion of cohort sizes either grew or declined as a result of increases due to maturation or decreases due to natural mortality and that no surprising or abrupt changes were observed in relative cohort strength (see Figures 30–39). These patterns lend support to the assumption that the method of aging scales from 2017 samples was consistent with those methods used in prior years, which has been a concern in prior years (see Hebert 2012a and 2012b).

The observed proportions of mature age-3 herring were variable among stocks but relatively high for the few stocks sampled in 2017, which follows a year of generally low age-3 proportions in 2016. The relatively high proportion of mature age-3 herring observed in 2017 for Sitka Sound and Craig offers some insight to future biomass levels, and increases the likelihood that these populations could increase as this cohort matures. However, increasing mature biomass is not a foregone conclusion, because it is possible that survival rates could decline, or recruitment may decline in coming years, which could negate increases expected from a maturing young cohort.

The proportion of age-3 herring in the mature population typically fluctuates widely for most stocks in the region, but some patterns are evident. Although the proportion of mature age-3 herring is different among stocks in any given year, it is common for the direction of change to be the same from year to year. In other words, in years when the proportion of age-3 fish is high or low for one stock, it is usually relatively high or low for all or most stocks. This suggests that age-3 recruitment into the mature segment of each stock is influenced by a common factor (e.g., biological or physical conditions in the marine environment). The scale of influence may be broader than Southeast Alaska, as time periods have been observed in the past when Sitka Sound and Prince William Sound displayed very similar recruitment patterns (Carls and Rice 2007).

Patterns of age composition, and in particular proportions of age-3 herring over time are also evident among stock groups within the region, which suggest that similar marine conditions may be present among certain areas within the region (Figure 70). The proportion of mature age-3 herring within each stock appears to be related to the latitude of the spawning stock. There appear to be two 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), the mean proportion of age-3 herring is relatively high (range of 23–31%), but for stocks at 57 degrees and northward (Sitka, Hobart Bay, Seymour Canal, Hoonah Sound, Tenakee Inlet, and Lynn Canal) the proportions are relatively low (range of 14–17%). The latitudinal split continues to be supported by age compositions observed in 2017. In 2017 the similarity of age composition between Sitka Sound and Craig suggest that there may be a common influence on herring by the outer coastal marine environment that these two areas share.

There continues to be an inverse relationship between latitude and sea surface temperature in Southeast Alaska, which is somewhat expected. The mean proportion of age-3 herring is generally highest where mean annual temperature and mean minimum temperature are highest; however, since the correlation is weak, other factors linked to latitude may play a role as well. Interestingly, the mean maximum sea temperature appears to have a non-linear relationship to the mean proportion of age-3 herring. This relationship suggests that perhaps an optimal maximum sea temperature exists around 16.5°C and at higher or lower sea temperature, the mean proportion of mature age-3 herring is less. It is beyond the scope of this report to further explore if an actual relationship exists between recruitment success and sea temperature, or consider biological explanations of such a relationship; however, the patterns in the data are suggestive enough to warrant additional investigation.

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TABLES AND FIGURES

Table 1.–Transect sampling rates used for 2017 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	3.5	3.5
Hoonah Sound	2.9	1	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 2.–Fecundity relationships used for estimating 2017 herring spawning biomass for stocks in Southeast Alaska.

Sampling year	Stock sampled	Fecundity equation	Stocks to which Fecundity Equation was applied in 2011
2005	Sitka Sound	fecundity = -3032.0 + 198.8*weight	Sitka, Tenakee Inlet, Hoonah Sound
1996	Seymour Canal	fecundity = -1573.3 + 222.4*weight	Seymour Canal, Hobart Bay/Port 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 3.–Dates of 2017 herring spawn deposition surveys conducted in Southeast Alaska.

Survey area	Survey Leg	Survey Dates
Kah Shakes/Cat Island	NA	No Survey
West Behm Canal	NA	No Survey
Craig	I	April 7–8
Sitka Sound	I, II	April 12–14, 28
Ernest Sound	NA	No Survey
Hobart Bay/Port Houghton	NA	No Survey
Hoonah Sound	NA	No Survey
Tenakee Inlet	NA	No Survey
Lynn Canal	NA	No Survey
Seymour Canal	III	May 15

Table 4.–Summary of herring egg estimates (in thousands) by transect for 2017 spawn deposition surveys conducted in Sitka Sound.

Transect Number	Sitka Sound 1st survey			Sitka Sound 2nd survey		
	egg estimate	frame count	Avg. eggs per frame	egg estimate	frame count	Avg. eggs per frame
1	2,189	56	39	219	6	37
2	42	8	5	60	4	15
3	6,102	98	62	232	6	39
4	2,278	51	45	0	1	0
5	0	1	0	0	1	0
6	552	9	61	526	12	44
7	2,775	8	347	0	1	0
8	47	5	9	--	--	--
9	2,868	20	143	0	1	0
10	--	--	--	0	1	0
11	0	1	0	171	12	14
12	726	19	38	0	1	0
13	0	1	0	164	15	11
14	1,382	24	58	0	1	0
15	1,686	8	211	0	1	0
16	279	12	23	0	1	0
17	741	33	22	0	1	0
18	497	21	24	210	4	53
19	1,004	16	63	122	5	24
20	433	14	31	538	3	179
21	0	1	0	230	9	26
22	932	11	85	415	8	52
23	302	8	38	76	4	19
24	978	9	109	—	—	—
25	3,612	15	241	—	—	—
26	892	10	89	—	—	—
27	54	10	5	—	—	—
28	268	7	38	—	—	—
29	160	5	32	—	—	—
30	255	12	21	—	—	—
31	1	5	0	—	—	—
32	7	1	7	—	—	—
33	1,117	13	86	—	—	—
34	429	9	48	—	—	—
35	100	5	20	—	—	—
36	224	5	45	—	—	—
37	398	6	66	—	—	—
38	481	8	60	—	—	—
39	0	1	0	—	—	—
40	0	1	0	—	—	—
41	217	3	72	—	—	—
42	137	4	34	—	—	—
43	5	3	2	—	—	—
44	994	13	76	—	—	—
45	903	7	129	—	—	—
46	6	3	2	—	—	—
47	934	9	104	—	—	—
48	215	23	9	—	—	—
49	35	1	35	—	—	—
50	311	7	44	—	—	—
51	0	1	0	—	—	—
52	0	1	0	—	—	—
Average	737	12	53	135	4	23

Note: Em dashes indicate no survey transects planned or completed.

Table 5.–Summary of herring egg estimates (in thousands) by transect for 2017 spawn deposition surveys conducted in Southeast Alaska (excluding Sitka Sound).

	Craig			Seymour Canal		
Transect Number	egg estimate	frame count	average eggs per frame	egg estimate	frame count	average eggs per frame
1	549	27	20	1,399	22	64
2	399	15	27	801	18	45
3	2,287	47	49	1,503	19	79
4	281	14	20	460	11	42
5	0	1	0	1,245	22	57
6	117	5	23	340	25	14
7	1,056	28	38	106	15	7
8	531	21	25	14	4	4
9	591	21	28	0	1	0
10	4	4	1	408	8	51
11	291	11	26	576	7	82
12	2,922	43	68	264	17	16
13	817	12	68	59	5	12
14	1,708	30	57	998	11	91
15	781	10	78	0	1	0
16	479	9	53	1,013	11	92
17	308	5	62	2	3	1
18	1,492	18	83	1,585	31	51
19	0	1	0	799	18	44
20	159	20	8	49	4	12
21	251	14	18	—	—	—
22	351	23	15	—	—	—
23	8	5	2	—	—	—
24	272	12	23	—	—	—
25	146	7	21	—	—	—
26	979	17	58	—	—	—
27	1,611	15	107	—	—	—
28	0	1	0	—	—	—
29	164	9	18	—	—	—
30	286	6	48	—	—	—
31	461	17	27	—	—	—
32	7,694	35	220	—	—	—
33	0	1	0	—	—	—
34	150	8	19	—	—	—
35	219	11	20	—	—	—
36	622	23	27	—	—	—
37	228	13	18	—	—	—
—	—	—	—	—	—	—
—	—	—	—	—	—	—
—	—	—	—	—	—	—
—	—	—	—	—	—	—
—	—	—	—	—	—	—
—	—	—	—	—	—	—
—	—	—	—	—	—	—
—	—	—	—	—	—	—
—	—	—	—	—	—	—
—	—	—	—	—	—	—
—	—	—	—	—	—	—
—	—	—	—	—	—	—
—	—	—	—	—	—	—
—	—	—	—	—	—	—
—	—	—	—	—	—	—
Average	763	15	37	581	13	38

Note: Em dashes indicate no survey transects planned or completed.

Table 6.–Summary of results of herring spawn deposition surveys in Southeast Alaska for 2017.

Spawning Stock	Number of Transects Completed	Average Length of Transects (m)	Nautical Miles of Spawn Observed	Area of Survey (m^2)	Average Egg Density ($eggs/m^2$)	Total eggs in survey area (trillions)	Mean weight (g) (weighted by age composition) of fish in spawning population	Estimated fecundity of fish of mean weight	Estimated number of fish	Post-fishery mature biomass (tons)
Craig	37	76	22.8	3,189,745	521,901	1.850	85.9	16,987	217,778,458	20,618
Ernest Sound[b]	—	—	4.4	—	—	—	—	—	—	—
Hobart/Houghton[b]	—	—	1.2	—	—	—	—	—	—	—
Hoonah Sound[b]	—	—	0.0	—	—	—	—	—	—	—
Seymour Canal	20	63	4.1	480,270	489,012	0.261	79.2	15,579	33,499,887	2,925
Sitka Sound total	73	48	64.4	5,715,091	521,042	3.714	115.3	19,879	373,624,438	47,468
[a]Sitka Sound – 1st	51	60	44.0	4,873,609	631,512	3.420	—	—	—	—
[a]Sitka Sound – 2nd	22	22	20.4	841,481	314,341	0.294	—	—	—	—
Tenakee Inlet[b]	—	—	2.1	—	—	—	—	—	—	—
Kah Shakes/Cat Is [b]	—	—	6.4	—	—	—	—	—	—	—
West Behm Canal[b]	—	—	0.7	—	—	—	—	—	—	—
Lynn Canal[b]	—	—	1.4	—	—	—	—	—	—	—
Total	130	—	107.5	9,385,105	—	5.824	—	—	624,902,783	71,011
Average	43	55	—	3,128,368	513,985	1.941	93.4	17,482	—	—

[a] Two separate surveys were conducted in Sitka in 2017 because of two distinct spawning events, so final estimates of egg deposition were calculated by summing estimates from each survey.

[b] No spawn deposition survey conducted due to lack of funding available.

[c] Very infrequent aerial surveys conducted.

Note: Em 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.

Table 7.–Correction coefficients used for herring spawn deposition estimates in Southeast Alaska in 2017.

	Estimator[a]									
Kelp type	A	B	C	D	E	F	G	H	I	Average
Eelgrass	1.12	1.48	1.08	0.85	0.83	0.87	0.97	0.88	1.03	1.01
n =	28	28	22	28	28	28	28	28	28	27
Fucus	1.23	1.61	1.10	1.35	0.77	1.32	1.02	0.85	1.47	1.19
n =	28	28	22	28	27	28	28	28	28	27
Fir kelp	0.78	1.25	0.93	0.59	0.72	0.80	0.75	0.77	0.94	0.84
n =	29	27	23	27	26	27	27	27	27	27
Hair kelp	1.31	1.55	1.13	1.01	0.87	0.79	1.03	0.87	1.27	1.09
n =	32	29	25	29	28	29	29	29	29	29
Large brown kelp[b]	0.88	1.38	0.76	0.84	0.57	1.04	0.80	0.67	1.16	0.90
n =	24	27	21	28	27	28	28	28	28	27
Average[c]	1.06	1.45	1.00	0.93	0.75	0.96	0.91	0.81	1.17	1.01

[a] All data from years 2015 through 2017; identity of estimators is withheld to minimize future changes in estimating behavior.

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

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

Table 8.–Summary of samples collected from Southeast Alaska herring stocks in 2016–17.

	Commercial Fishery			Survey	Test Fishery	
Stock	Herring gillnet	Pound	Purse seine	Cast net	Purse seine	Total
Craig	–	517	527	526	–	1,570
Ernest Sound	–	–	–	–	–	–
Hobart/Houghton	–	–	–	–	–	–
Hoonah Sound	–	–	–	–	–	–
Lynn Canal	–	–	–	–	–	–
Seymour Canal	–	–	–	522	–	522
Sitka Sound	–	–	528	539	–	1,067
Tenakee Inlet	–	–	–	95	–	95
West Behm Canal	–	–	–	–	–	–
Revilla Channel	–	–	–	–	–	–
Yakutat	–	–	–	–	–	–
Total	–	517	1,055	1,682	–	3,254

Note: Em dashes indicate that no samples were collected in 2016, either due to lack of funding or observed spawning.

Table 9.–Summary herring samples aged for Southeast Alaska stocks in 2016–17.

	Commercial Fishery			Survey	Test Fishery	
Stock	Herring gillnet	Pound	Purse seine	Cast net	Purse seine	Total
Craig	–	517	528	526	–	1,571
Ernest Sound	–	–	–	–	–	–
Hobart/Houghton	–	–	–	–	–	–
Hoonah Sound	–	–	–	–	–	–
Lynn Canal	–	–	–	–	–	–
Seymour Canal	–	–	–	522	–	522
Sitka Sound	–	–	528	539	–	1,067
Tenakee Inlet	–	–	–	43	–	43
West Behm Canal	–	–	–	–	–	–
Revilla Channel	–	–	–	–	–	–
Yakutat	–	–	–	–	–	–
Total	–	517	1,056	1,630	–	3,203

Note: Em dashes indicate that no samples were collected in 2016, either due to lack of funding or observed spawning.

Table 10.–Summary of age, weight, and length for the Sitka Sound herring stock in 2016–17.

		Age Category						
Gear type/season	Parameter	3	4	5	6	7	8+	Total
survey cast net–spring	number of fish	160	33	310	8	19	9	539
	percent age composition	30%	6%	58%	1%	4%	2%	100%
	average weight (g)	67.3	77.1	95.2	103.9	116.0	156.0	102.6
	standard dev. of weight (g)	12.7	11.5	16.4	24.5	23.0	42.4	21.8
	average length (mm)	180	185	199	206	210	230	202
	std. dev. of length (mm)	9.1	8.9	8.8	9.3	12.5	19.7	11.4
commercial purse seine–spring	number of fish	118	33	332	14	20	11	528
	percent age composition	22%	6%	63%	3%	4%	2%	100%
	average weight (g)	77.2	88.2	117.1	124.8	137.1	174.6	119.8
	standard dev. of weight (g)	11.9	15.3	16.6	27.8	26.8	21.6	20.0
	average length (mm)	180	186	202	207	210	230	202
	std. dev. of length (mm)	7.8	8.8	7.8	12.2	12.2	12.7	10.2
test fishery purse seine–winter	number of fish							
	percent age composition							
	average weight (g)			NO SAMPLES OBTAINED				
	standard dev. of weight (g)							
	average length (mm)							
	std. dev. of length (mm)							

Table 11.–Summary of age, weight, and length for the Craig herring stock in 2016–17.

		Age Category						
Gear type/season	Age category	3	4	5	6	7	8+	Total
survey cast net spring	number of fish	167	105	217	3	20	14	526
	percent age composition	32%	20%	41%	1%	4%	3%	100%
	average weight (g)	69.4	81.3	96.2	98.5	109.5	133.2	98.0
	standard dev. of weight (g)	12.8	13.9	17.5	11.2	21.6	24.3	16.9
	average length (mm)	175	184	192	193	203	212	193
	std. dev. of length (mm)	8.5	8.5	8.6	5.2	7.0	10.5	8.1
commercial pound – spring	number of fish	217	116	162	4	12	6	517
	percent age composition	42%	22%	31%	1%	2%	1%	100%
	average weight (g)	70.5	81.9	93.9	91.1	118.5	128.1	97.3
	standard dev. of weight (g)	13.8	16.7	15.8	11.3	20.0	11.7	14.9
	average length (mm)	174	182	191	196	202	209	192
	std. dev. of length (mm)	9.3	9.8	7.8	8.9	8.3	5.1	8.2
commercial seine–winter	number of fish	128	100	234	16	31	19	528
	percent age composition	24%	19%	44%	3%	6%	4%	100%
	average weight (g)	79.4	96.0	111.7	118.8	131.6	150.9	114.7
	standard dev. of weight (g)	12.6	15.7	15.1	23.8	17.8	14.0	16.5
	average length (mm)	173	183	192	194	201	210	192
	std. dev. of length (mm)	8.9	9.6	8.4	14.0	7.7	8.6	9.5

Table 12.–Summary of age, weight, and length for the Hobart Bay/Port Houghton herring stock in 2016–17.

		Age Category						
Gear type/season	Parameter	3	4	5	6	7	8+	Total
survey cast net–spring	number of fish	NO SAMPLES OBTAINED						
	percent age composition							
	average weight (g)							
	standard dev. of weight (g)							
	average length (mm)							
	variance of length (mm)							
commercial gillnet–spring	number of fish	NO FISHERY						
	percent age composition							
	average weight (g)							
	standard dev. of weight (g)							
	average length (mm)							
	variance of length (mm)							

Table 13.–Summary of age, weight, and length for the Ernest Sound herring stock in 2016–17.

Gear type/season	Parameter	Age Category 3	4	5	6	7	8+	Total
survey cast net–spring	number of fish							
	percent age composition							
	average weight (g)			NO SAMPLES OBTAINED				
	standard dev. of weight (g)							
	average length (mm)							
	std. dev. of length (mm)							
commercial pound–spring	number of fish							
	percent age composition							
	average weight (g)							
	standard dev. of weight (g)			NO FISHERY				
	average length (mm)							
	variance of length (mm)							
commercial seine–winter	number of fish							
	percent age composition							
	average weight (g)			NO FISHERY				
	standard dev. of weight (g)							
	average length (mm)							
	variance of length (mm)							

Table 14.–Summary of age, weight, and length for the Hoonah Sound herring stock in 2016–17.

Gear type/season	Parameter	Age Category 3	4	5	6	7	8+	Total
survey cast net–spring	number of fish							
	percent age composition			NO SAMPLES OBTAINED				
	average weight (g)							
	standard dev. of weight (g)							
	average length (mm)							
	variance of length (mm)							
commercial pound –spring	number of fish							
	percent age composition							
	average weight (g)			NO FISHERY				
	standard dev. of weight (g)							
	average length (mm)							
	variance of length (mm)							

Table 15.–Summary of age, weight, and length for the Tenakee Inlet herring stock in 2016–17.

Gear type/season	Parameter	Age Category 3	4	5	6	7	8+	Total
survey cast net–spring	number of fish	24	8	3	1	4	3	43
	percent age composition	56%	19%	7%	2%	9%	7%	100%
	average weight (g)	69.4	80.2	113.7	81.7	94.9	88.1	88.0
	standard dev. of weight (g)	10.3	13.9	10.8		26.4	14.5	15.2
	average length (mm)	174	181	201	187	195	189	188
	variance of length (mm)	9.1	13.5	6.8		18.7	4.6	10.6
commercial pound–spring	number of fish	NO FISHERY						
	percent age composition							
	average weight (g)							
	standard dev. of weight (g)							
	average length (mm)							
	variance of length (mm)							
commercial seine–winter	number of fish	NO FISHERY						
	percent age composition							
	average weight (g)							
	standard dev. of weight (g)							
	average length (mm)							
	variance of length (mm)							

Table 16.–Summary of age, weight, and length for the Seymour Canal herring stock in 2016–17.

Gear type/season	Parameter	Age category 3	4	5	6	7	8+	Total
survey cast net–spring	number of fish	30	160	86	32	40	174	522
	percent age composition	6%	31%	16%	6%	8%	33%	100%
	average weight (g)	66.0	66.6	80.2	78.9	86.5	92.6	78.4
	standard dev. of weight (g)	16.9	11.5	17.0	12.4	19.1	16.8	15.6
	average length (mm)	173	173	184	184	189	193	183
	variance of length (mm)	12.5	10.4	12.7	10.0	11.1	10.5	11.2
commercial gillnet–spring	number of fish	NO FISHERY						
	percent age composition							
	average weight (g)							
	standard dev. of weight (g)							
	average length (mm)							
	variance of length (mm)							

Table 17.–Summary of age, weight, and length for the West Behm Canal herring stock in 2016–17.

		Age category						
Gear type/season	Parameter	3	4	5	6	7	8+	Total
survey cast net–spring	number of fish							
	percent age composition							
	average weight (g)[a]	NO SAMPLES OBTAINED						
	standard dev. of weight (g)							
	average length (mm)							
	std. dev. of length (mm)							
commercial gillnet–spring	number of fish							
	percent age composition							
	average weight (g)	NO FISHERY						
	standard dev. of weight (g)							
	average length (mm)							
	variance of length (mm)							

Table 18.–Summary of age, weight, and length for the Lynn Canal herring stock in 2016–17.

		Age category						
Gear type/season	Parameter	3	4	5	6	7	8+	Total
survey cast net–spring	number of fish							
	percent age composition							
	average weight (g)	NO SAMPLES OBTAINED						
	standard dev. of weight (g)							
	average length (mm)							
	std. dev. of length (mm)							

Table 19.–Summary of age, weight, and length for the Revilla Channel herring stock in 2016–17.

		Age category						
Gear type/season	Parameter	3	4	5	6	7	8+	Total
survey cast net–spring	number of fish							
	percent age composition							
	average weight (g)	NO SAMPLES OBTAINED						
	standard dev. of weight (g)							
	average length (mm)							
	variance of length (mm)							

Table 20.–Summary of age, weight, and length for the Yakutat herring stock in 2016–17.

		Age category						
Gear type/season	Parameter	3	4	5	6	7	8+	Total
survey cast net–spring	number of fish percent age composition average weight (g) standard dev. of weight (g) average length (mm) variance of length (mm)	NO SAMPLES OBTAINED						

Table 21.–Proportion of mature age-3 herring (cast net, 1988–2017), latitude, and sea temperature (2000–2016) of herring spawning stocks in Southeast Alaska.

Stock	Latitude (decimal degrees)	Median proportion of mature age-3 herring	Mean proportion of mature age-3 herring	Mean annual sea temperature (°C)	Mean minimum annual sea temperature (°C)	Mean maximum annual sea temperature (°C)
Kah Shakes	55.0300	23%	31%	8.6	5.9	14.7
Craig	55.4770	20%	23%	9.3	3.5	16.6
WBC	55.4846	26%	31%	9.0	4.9	15.0
Ernest Sound	55.8307	30%	31%	—	—	—
Sitka	57.0079	11%	17%	8.7	4.2	15.7
Hobart Bay	57.4308	7%	14%	7.1	3.1	15.2
Seymour Canal	57.5923	10%	15%	6.8	2.4	14.2
Hoonah Sound	57.6001	7%	16%	8.0	1.0	18.0
Tenakee Inlet	57.7381	11%	15%	7.8	1.0	17.8
Lynn Canal	58.6402	6%	14%	7.2	2.6	15.4

Table 22.–Summary of Southeast Alaska herring target levels for the 2016–17 season.

Area	Minimum spawning biomass threshold (tons)	Forecast (tons)	Target Exploitation Rate (%)	Guideline harvest level (tons)[a]
Craig	5,000	7,833	11.1	872
Ernest Sound	2,500	724	0.0	0
Hobart Bay/Port Houghton	2,000	—	0.0	—
Hoonah Sound	2,000[b]	—	0.0	—
Seymour Canal[c]	3,000	—	0.0	—
Sitka Sound	25,000	73,245	20.0	14,649
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 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] Threshold increased in 2016 from 1,000 tons to 2,000 tons to bring into line with the minimum threshold applied to all other stocks in Southeast Alaska.

[c] Published GHL was reduced to zero as a conservative measure, due to forecast of predominantly young/small fish that would be inaccessible to gillnets.

Table 23.–Summary of commercial herring harvest during the 2016–17 season. Blacked out values signify confidential data due to fewer than three participants (either permit holders or processors).

Fishery	Gear	Area	District	Opening[a]	Closing[b]	Harvest (tons)[c]
Winter food and bait	Purse seine	Craig	3/4	17-Oct-16	3-Feb-17	527
Winter food and bait	Purse seine	Tenakee Inlet	12	Not Open		–
Winter food and bait	Purse seine	Ernest Sound	7	Not Open		–
Winter food and bait	Purse seine	Hobart Bay	10	Not Open		–
Sub-total						527
Sac roe	Purse seine	Sitka Sound	13	19-Mar-17	27-Mar-17	13,923
Sac roe	Purse seine	Lynn Canal	11	Not Open		–
Sac roe	Gillnet	Seymour Canal	11	Not Open		–
Sac roe	Gillnet	Hobart Bay	10	Not Open		–
Sac roe	Gillnet	Kah Shakes	1	Not Open		–
Sac roe	Gillnet	West Behm Canal	1	Not Open		–
Sub-total						13,923
Spawn on kelp	Pound	Hoonah Sound	13	Not Open		–
Spawn on kelp	Pound	Tenakee Inlet	12	Not Open		–
Spawn on kelp	Pound	Ernest Sound	7	Not Open		–
Spawn on kelp	Pound	Craig	3	17-Mar-17	10-Apr-17	70
Sub-total						70
Test fishery-bait	Purse seine	Sitka	13	6-Nov-16	10-Mar-17	133

[a] For spawn-on-kelp fisheries, represents start of seining and transferring herring into pounds.

[b] For spawn-on-kelp fisheries, represents end of removing SOK from pounds.

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

[d] Confidential data due to fewer than three processors participating in the fishery.

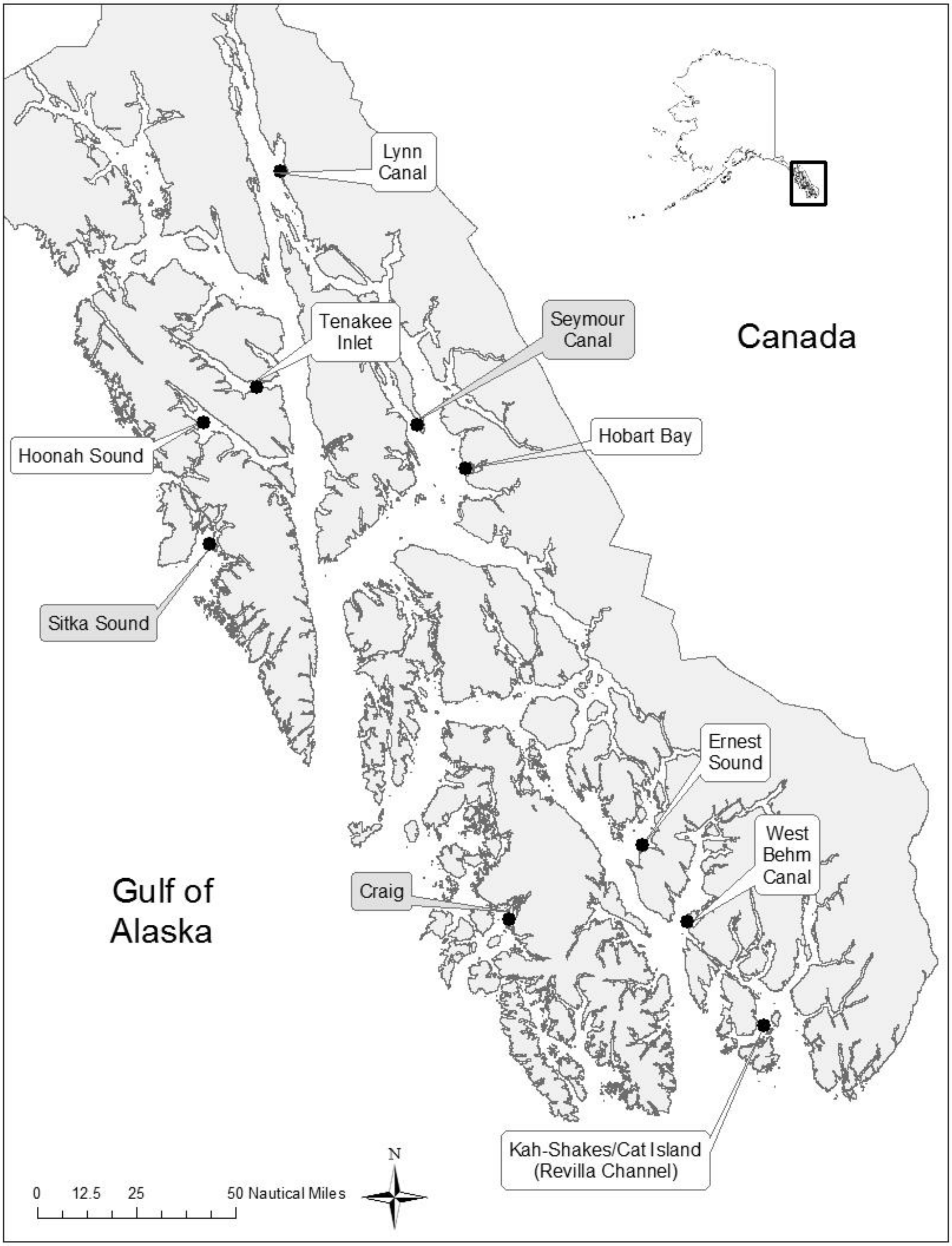

Figure 1.–Locations of major herring spawning areas in Southeast Alaska. Labels with shading indicate areas where spawn deposition surveys were conducted and age-size sampling of herring was completed during the 2016–17 fishery season.

Stock	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	16-Apr
Craig								0.0	ns	ns	ns	0.0	ns	ns	11	0.3	2.0	6.0	##	6.5	0.3	ns	0.5	0.1	0.0	ns	ns	ns	ns	3.8	2.0	0.0	ns					
Sitka Sound	0.0	ns	ns	ns	ns	ns	0.0	0.0	0.0	0.0	0.1	0.0	0.0	0.1	0.0	0.0	0.3	0.0	0.0	11	4.6	2.3	4.6	3.6	7.4	12.5	0.3	0.0	7.4	18.9	3.3	2.5	8.4	15	15	15	10	6.7
Hoonah Sound																															0.0							
West Behm Canal																								ns	0.0	ns	ns	0.0	ns	0.0	ns	ns	ns	0.0	ns	0.0	0.0	ns
Revilla Channel								0.0	ns	ns	ns	0.0	ns	ns	ns	0.0	ns	ns	0.0	ns	0.0	ns	ns	ns	0.3	2.0	ns	3.0	0.7	0.0	`							
Ernest Sound																															0.0	ns	ns	ns	ns	0.0	0.0	0.1
Yakutat																																		0.1				

continued	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	3.0	3.5	2.4	0.8	0.0	ns	ns	18	0.0																													
West Behm Canal	ns	0.2	0.0	0.0	ns																																	
Ernest Sound	0.8	0.2	0.0	ns	0.0	ns	ns	ns	0.0																													
Hobart/Houghton								0.2																														
Tenakee Inlet	0.0	ns	ns	0.0	ns	ns	ns	0.0	ns	ns	ns	0.0	ns	ns	0	ns	ns	0.0	ns	ns	ns	0.0	ns	ns	0.5	0.0	0.7	0.1	0.1	0.6	0.0							
Seymour Canal	0.0	ns	ns	0.0	ns	ns	ns	0.0	0.0	0.0	ns	0.0	ns	ns	0.0	ns	ns	0.0	ns	0.0	ns	0.3	3.1	0.8	0.0	ns	0.0											
Lynn Canal	0.0	ns	ns	0.0	ns	ns	ns	0.0	ns	ns	ns	0.9	0.5	0.3	0.0	ns	ns	0.0	ns	ns	ns	0.0	ns	ns	ns	0.0	ns	ns	ns	ns	ns	0.0						
Hoonah Sound	0.0																																					
Yakutat										10									0.7			No aerial surveys completed in 2017																
Haines											0.5											No aerial surveys completed in 2017																

Figure 2.–Spawn timing of herring stocks in Southeast Alaska during spring 2017. Values indicate daily measurements of nautical miles of active spawn recorded during aerial surveys. Shaded area depict dates when cast-net samples were taken. Boxed areas indicate duration of spawning (first to last dates of observed spawn).

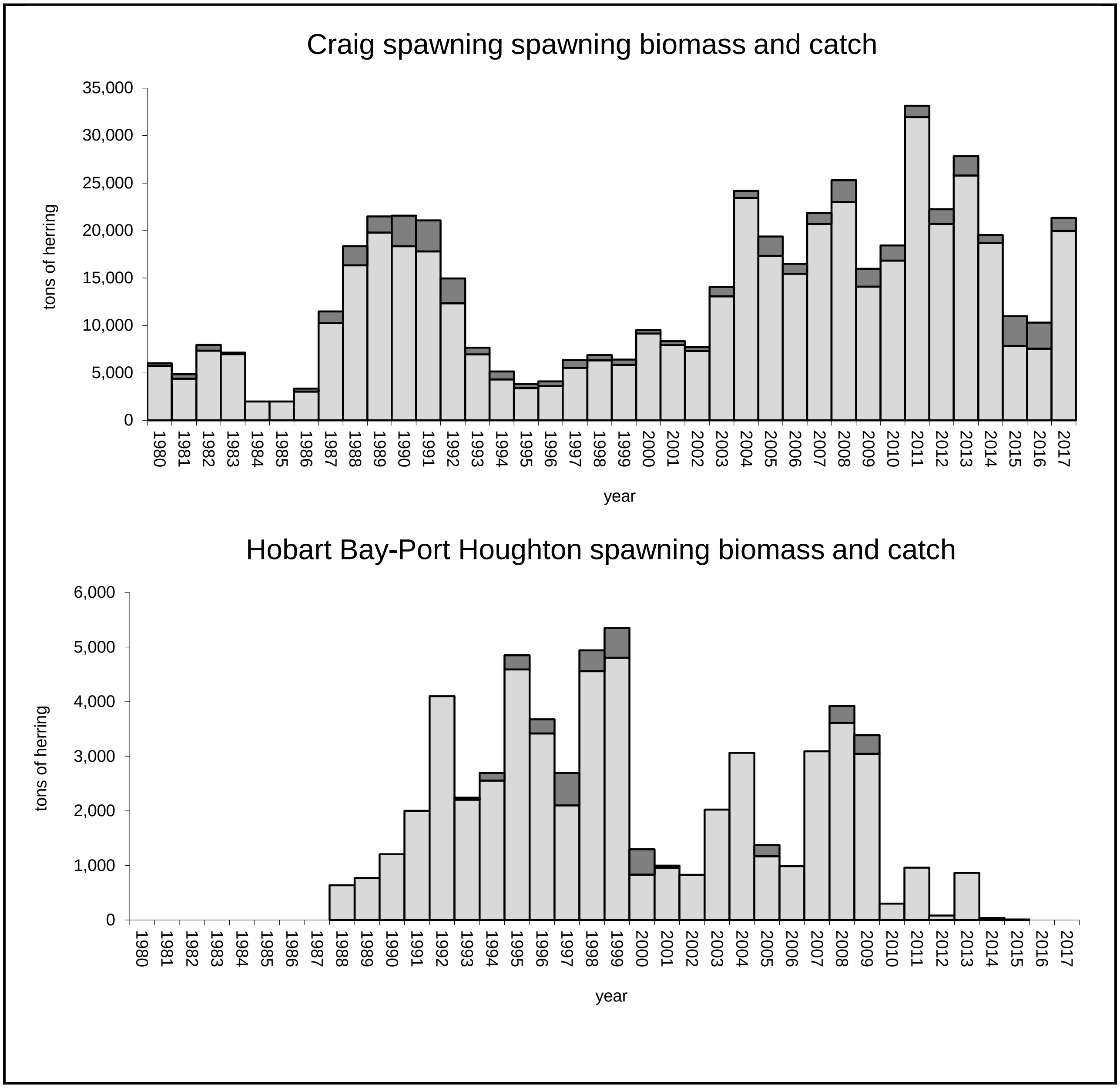

Figure 3.–Herring post-fishery spawning biomass (light gray bars), based on spawn deposition surveys, and catch (dark gray bars) for stocks in the Craig and Hobart Bay-Port Houghton areas, during 1980–2017. Spawn deposition surveys were not conducted in Hobart Bay-Port Houghton in 2016 or 2017.

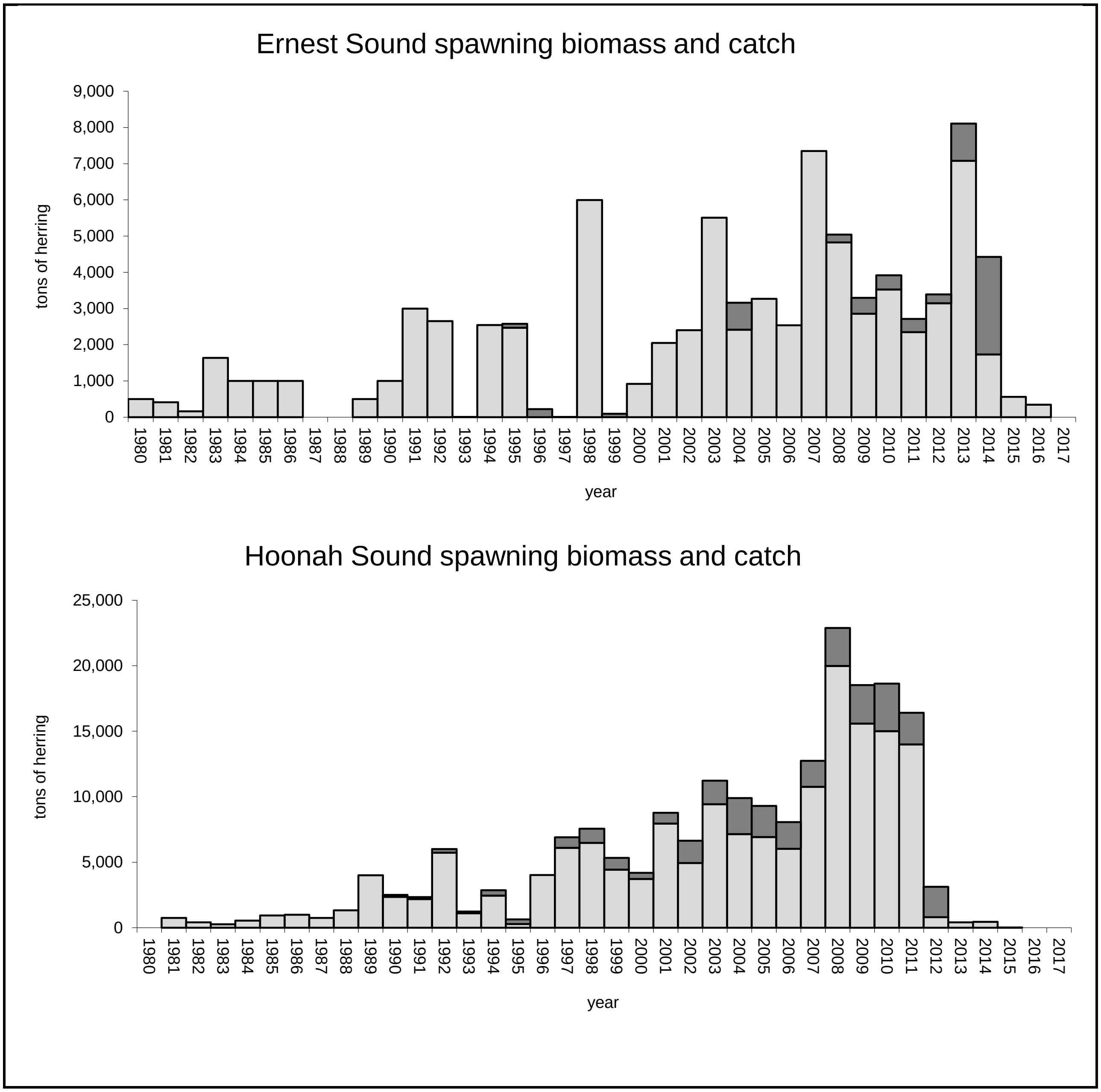

Figure 4.–Herring post-fishery spawning biomass (light gray bars), based on spawn deposition surveys or hydroacoustic surveys, and catch (dark gray bars) for stocks in the Ernest Sound and Hoonah Sound areas, during 1980–2017. Spawn deposition surveys were not conducted in Ernest Sound in 2017 or in Hoonah Sound in 2016 or 2017.

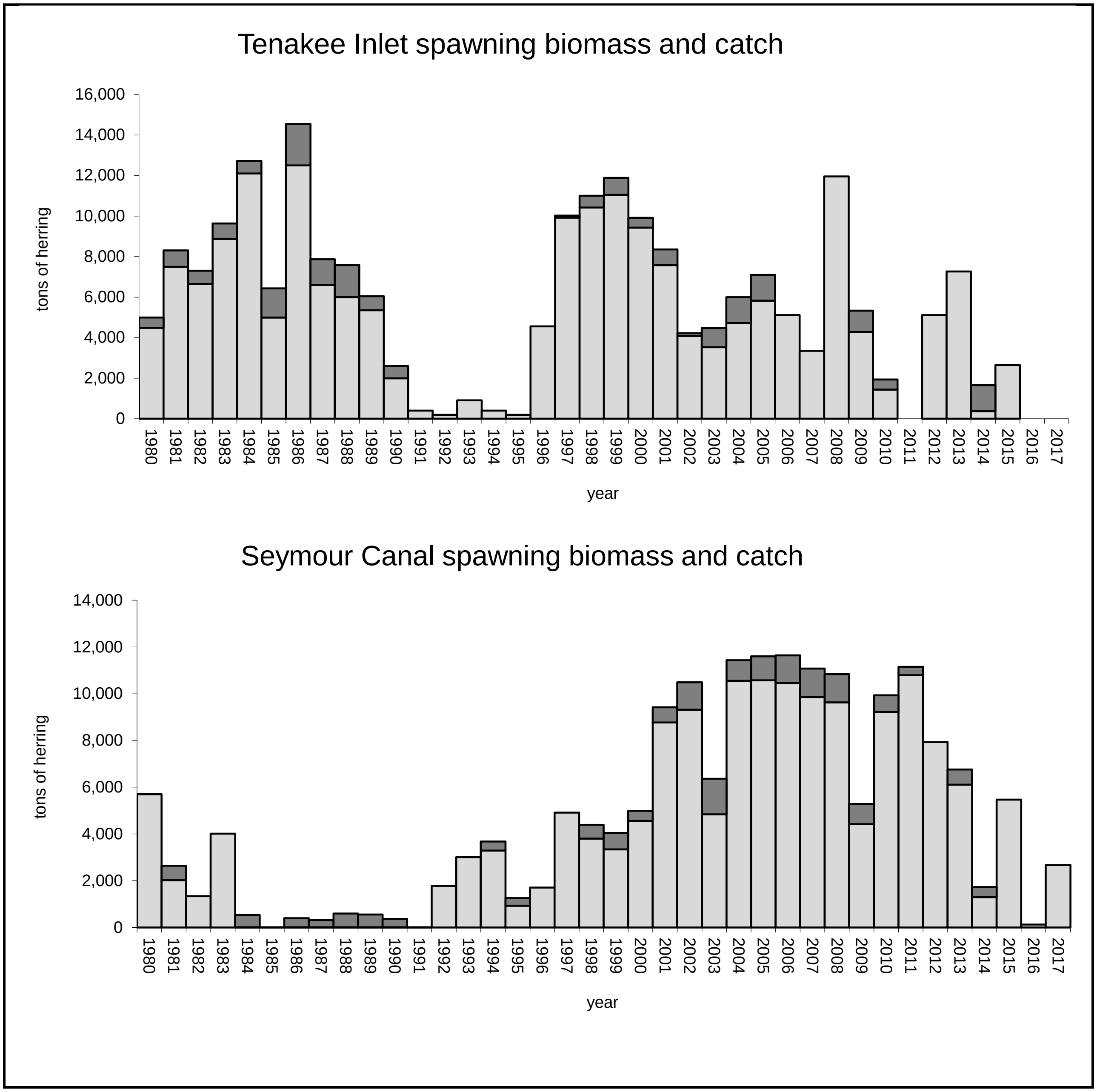

Figure 5.–Herring post-fishery spawning biomass (light gray bars), based on spawn deposition surveys or hydroacoustic surveys, and catch (dark gray bars) for stocks in the Tenakee Inlet and Seymour Canal areas, during 1980–2017. Spawn deposition surveys were not conducted in Tenakee Inlet in 2016 or 2017.

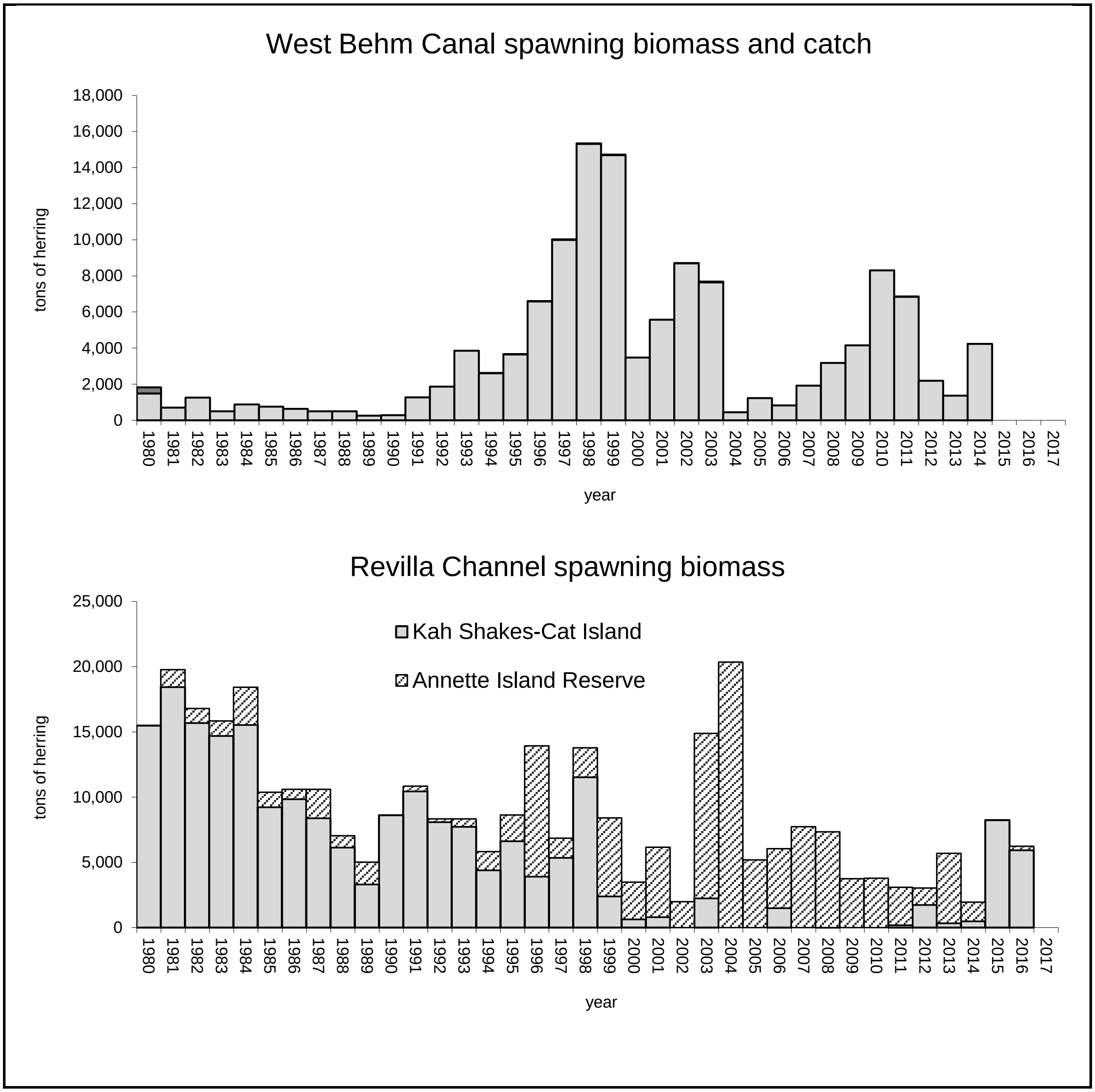

Figure 6.–Herring post-fishery spawning biomass, based on spawn deposition surveys or hydroacoustic surveys for stocks in the West Behm Canal and Revilla Channel (Kah Shakes-Cat Island-Annette Island) areas, during 1980–2017. Annette Island spawning biomass estimates were made as the product of the length 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. Spawn deposition surveys were not conducted in West Behm Canal during 2015–2017 or at Kah-Shakes/Cat Island in 2017.

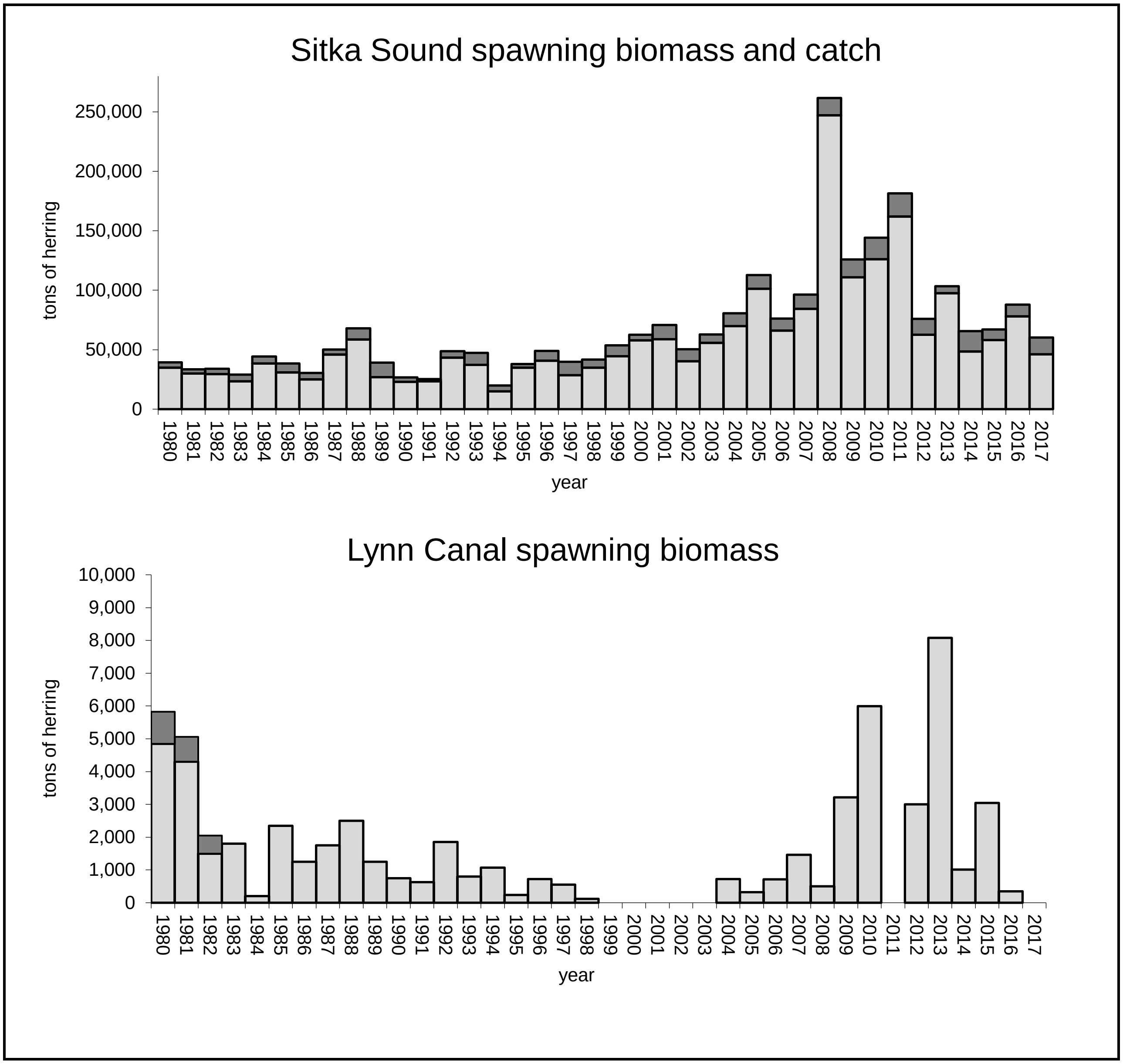

Figure 7.–Herring post-fishery spawning biomass (light gray bars), based on spawn deposition surveys, and catch (dark gray bars) for stock in the Sitka Sound and Lynn Canal areas, during 1980–2016. Estimates of spawning biomass for Lynn Canal prior to 2004 were made using a variety of methods (e.g., hydroacoustics or visual estimates of spawn density converted to biomass), and results should be viewed as approximations. Spawn deposition surveys were not conducted in Lynn Canal in 2017.

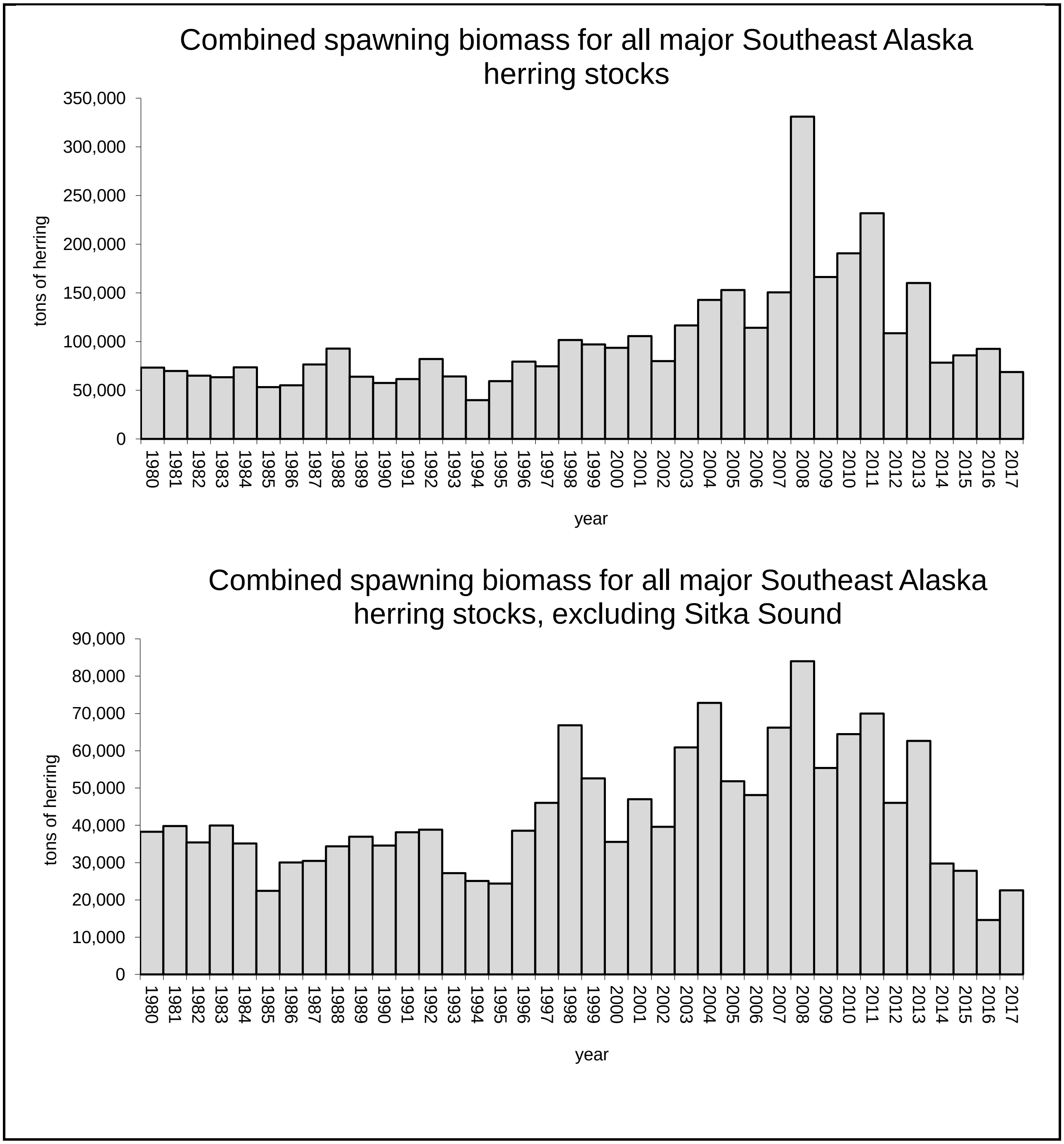

Figure 8.–Combined post-fishery spawning biomass, based on spawn deposition surveys or hydroacoustic surveys, for major herring stocks in Southeast Alaska, during 1980–2017. Spawn deposition surveys were not conducted in four of ten major spawning areas in 2016, and were conducted in seven of ten major spawning areas in 2017.

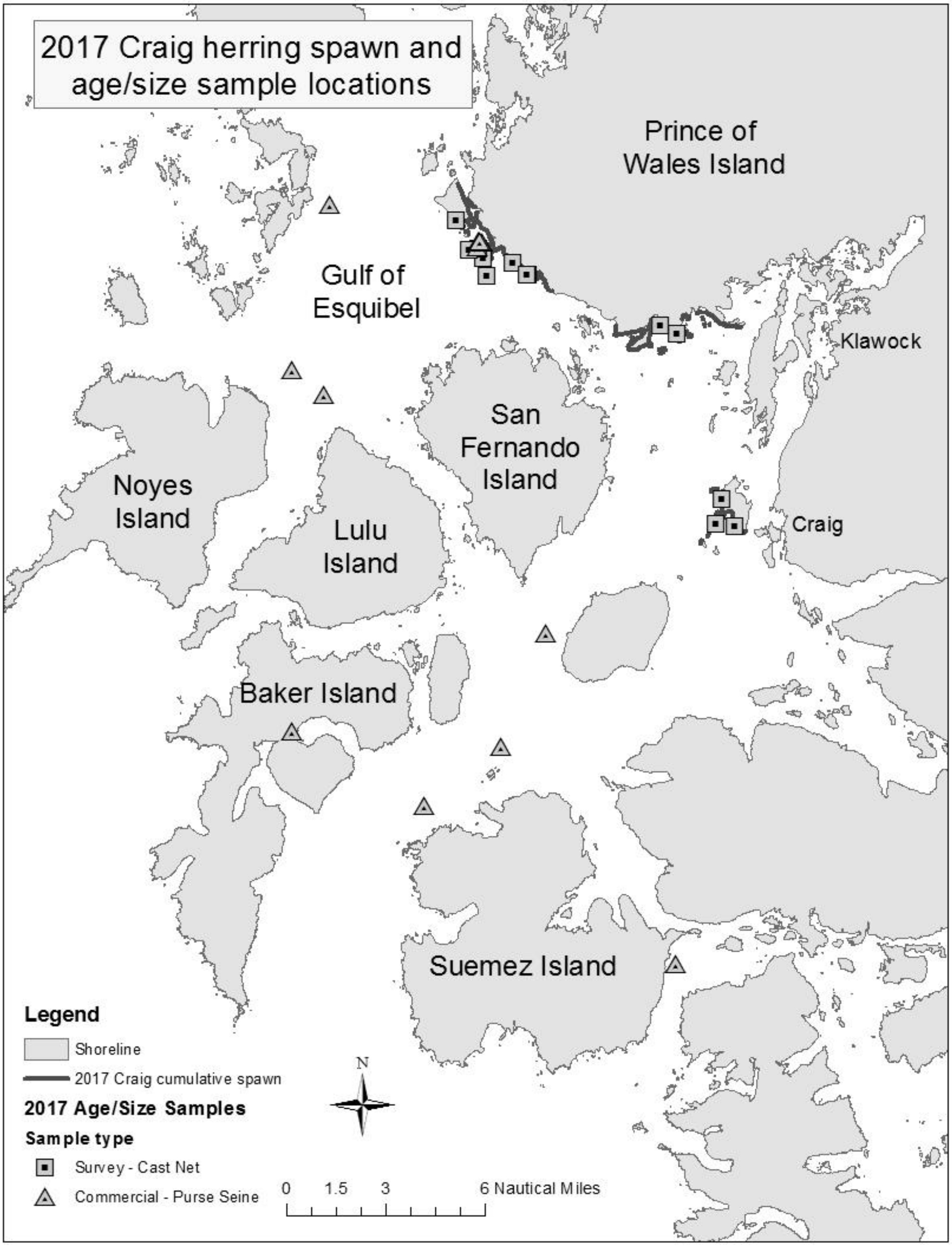

Figure 9.–Locations of herring samples collected for estimates of age and size for the Craig herring stock, 2016/2017. Cumulative herring spawn denoted by thick gray line along shoreline.

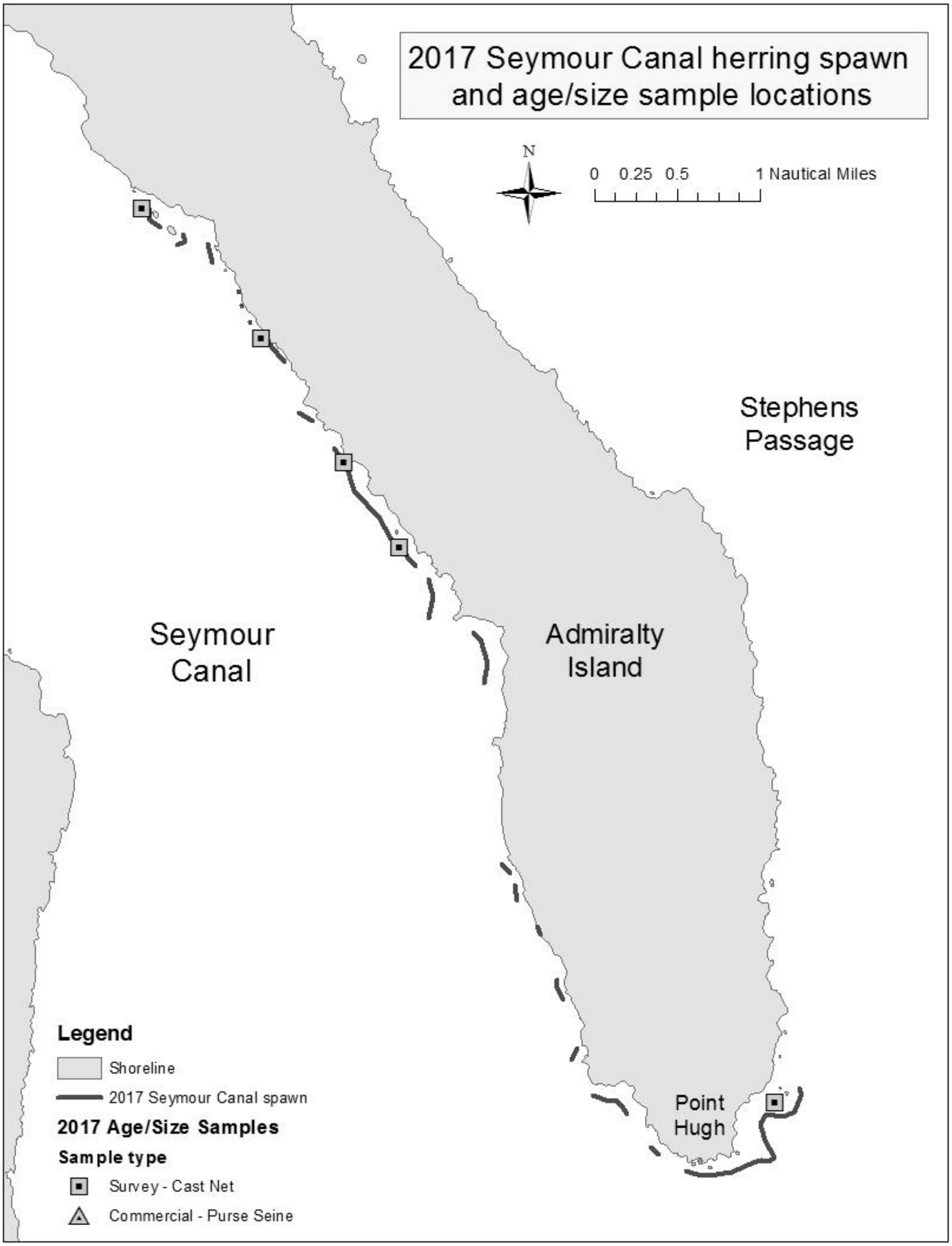

Figure 10.–Locations of herring samples collected for estimates of age and size for the Seymour Canal herring stock, 2017. Cumulative herring spawn denoted by thick gray line along shoreline.

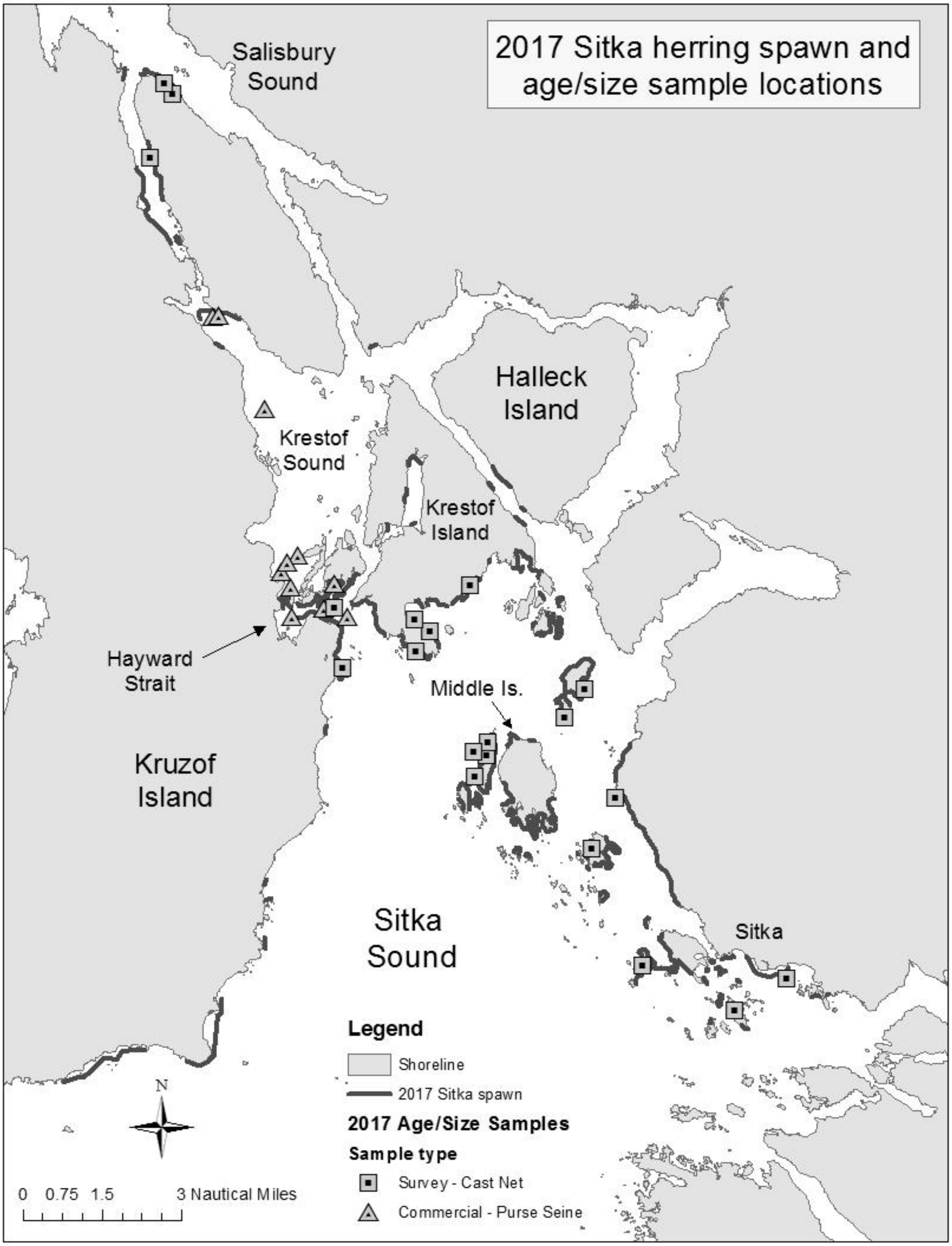

Figure 11.–Locations of herring samples collected for estimates of age and size for the Sitka Sound herring stock, 2017. Cumulative herring spawn denoted by thick gray line along shoreline.

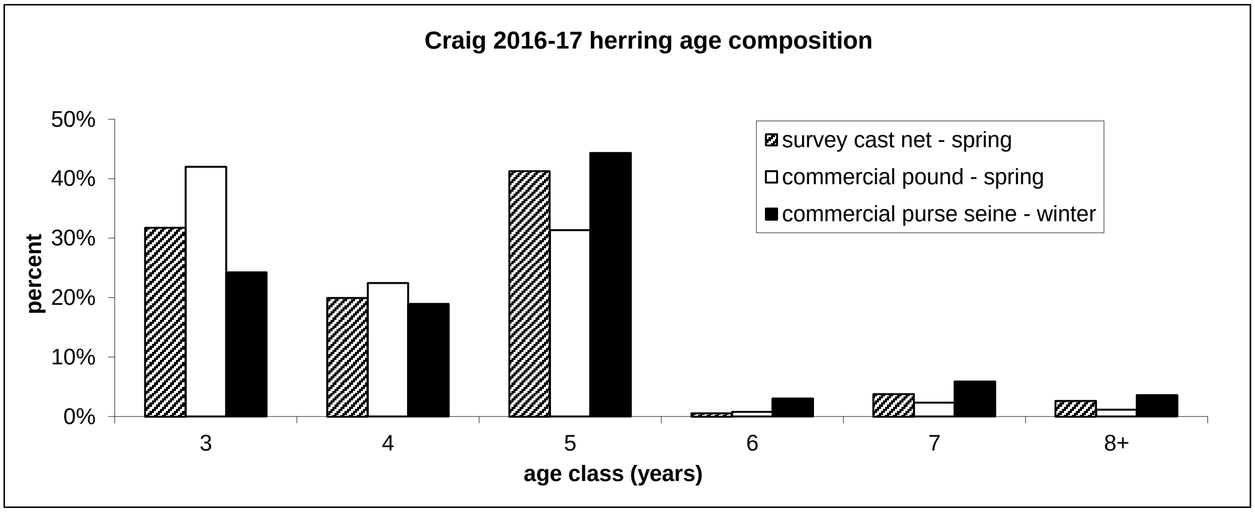

Figure 12.–Age composition for Craig herring stock in 2016–17.

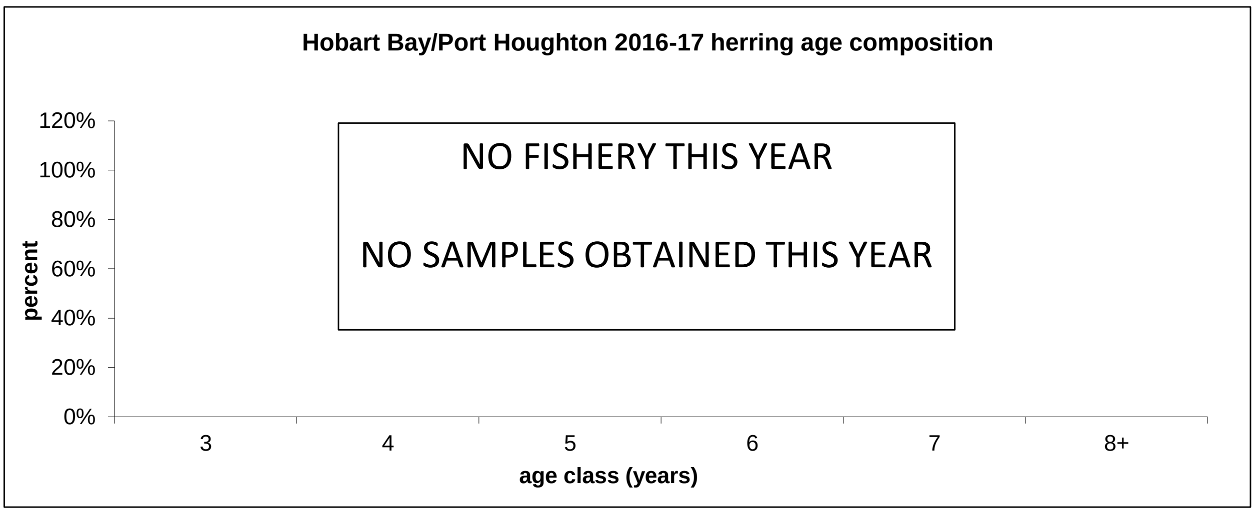

Figure 13.–Age composition for Hobart Bay/Port Houghton herring stock in 2016–17. No samples were obtained 2016–17.

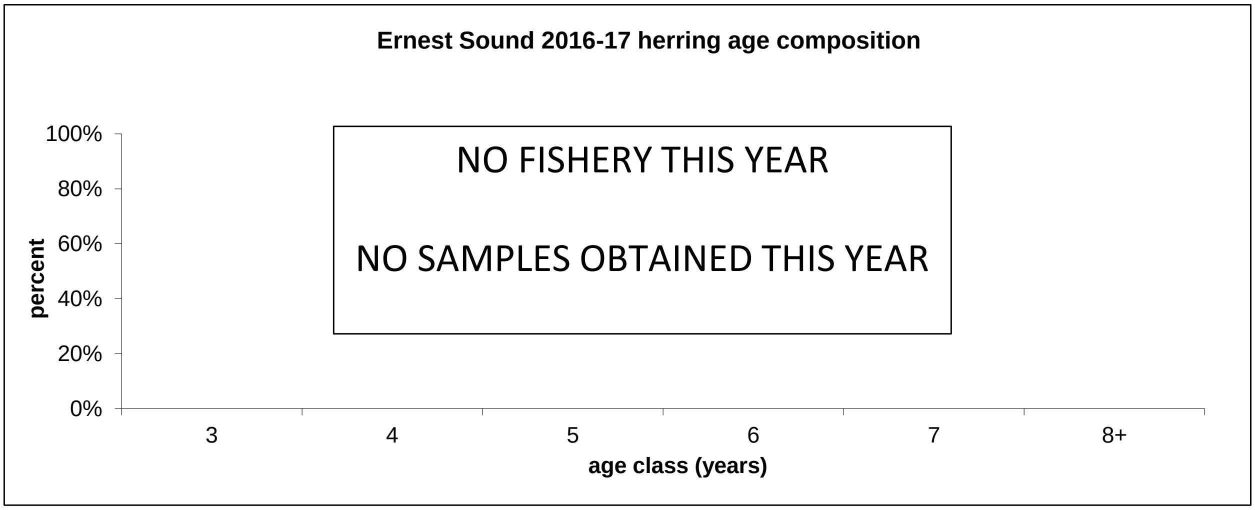

Figure 14.–Age composition for Ernest Sound herring stock in 2016–17. No commercial fishery samples obtained as no commercial fishery was opened in 2016–17.

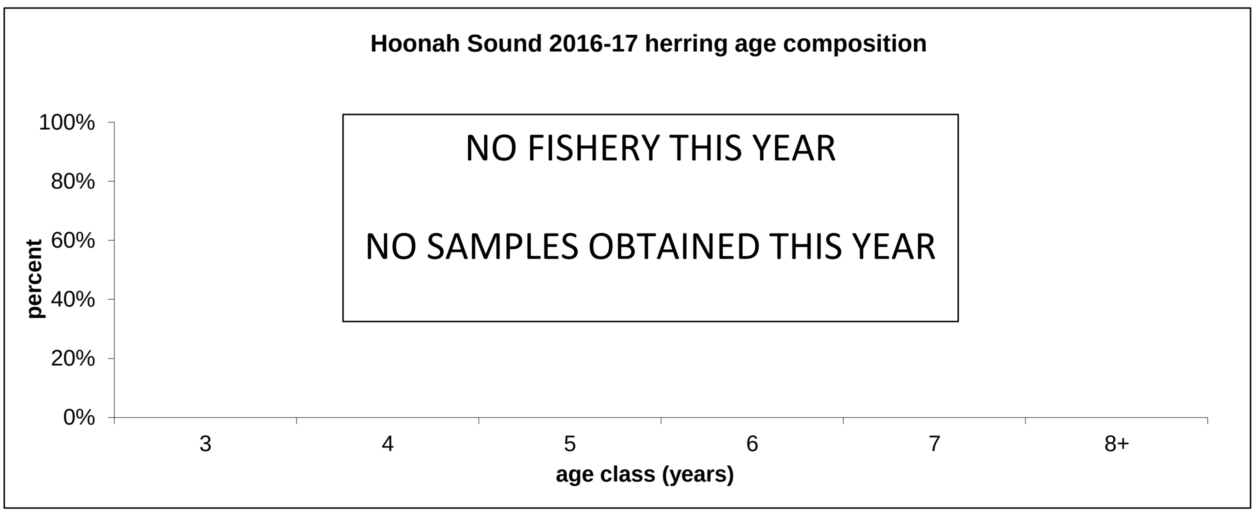

Figure 15.–Age composition for Hoonah Sound herring stock in 2016–17. No samples were obtained in 2016–17.

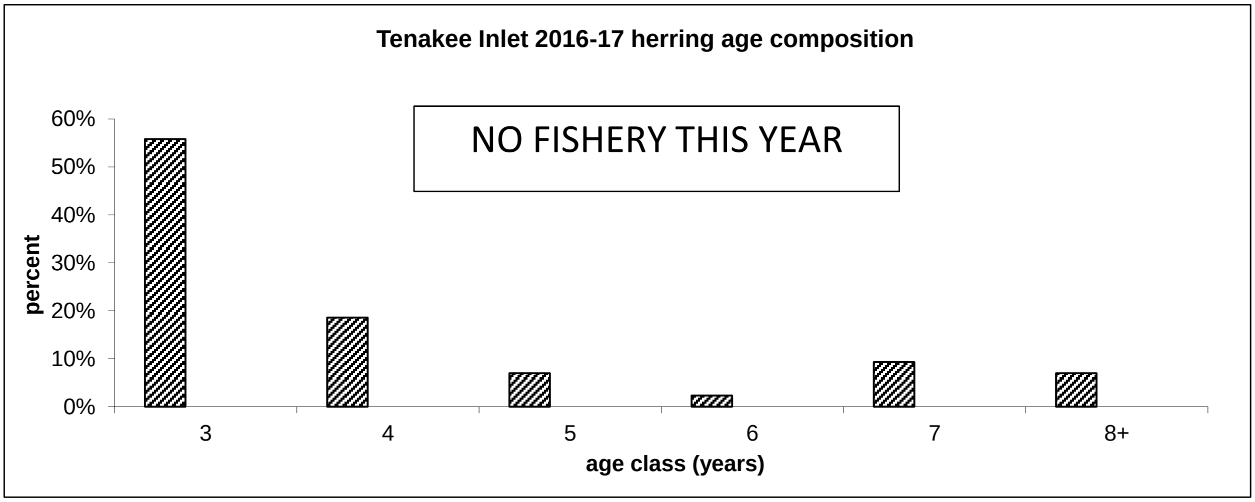

Figure 16.–Age composition for Tenakee Inlet herring stock in 2016–17.

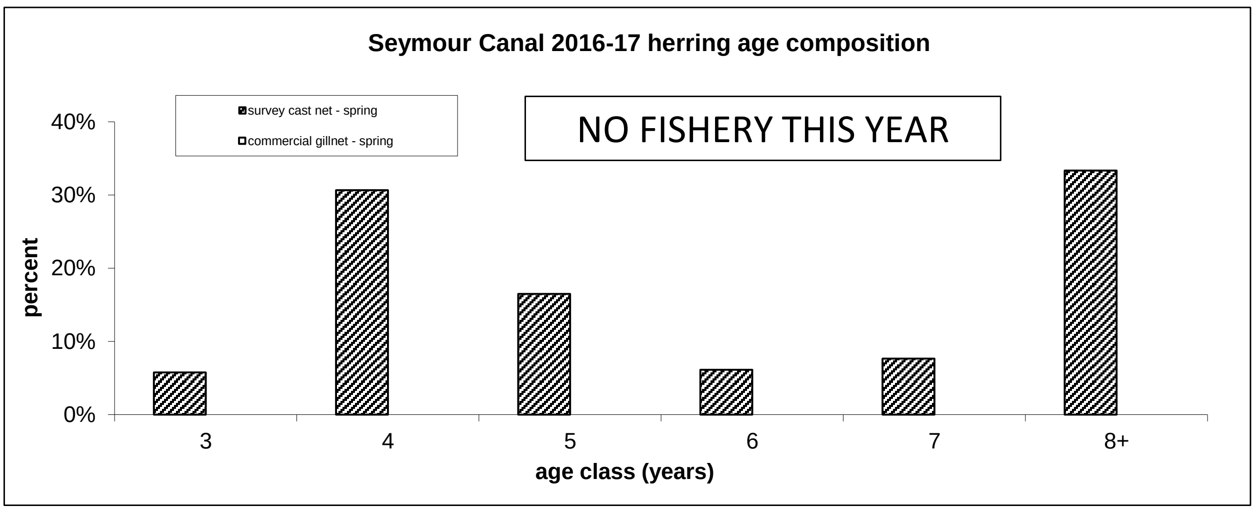

Figure 17.–Age composition for Seymour Canal herring stock in 2016–17. No commercial fishery samples were obtained 2016–17.

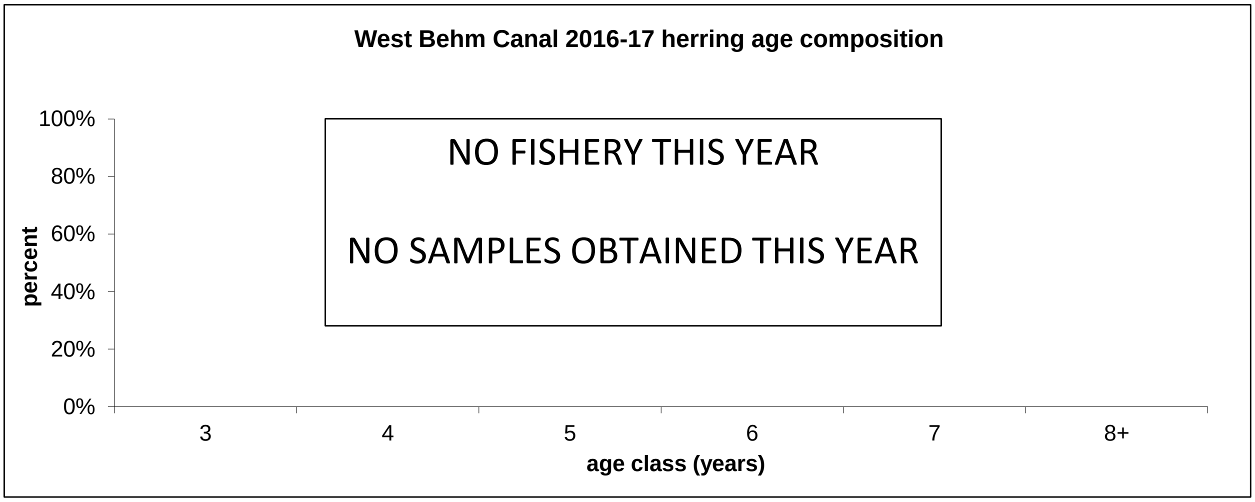

Figure 18.–Age composition for West Behm Canal herring stock in 2016–17. No commercial fishery samples were obtained in 2016–17.

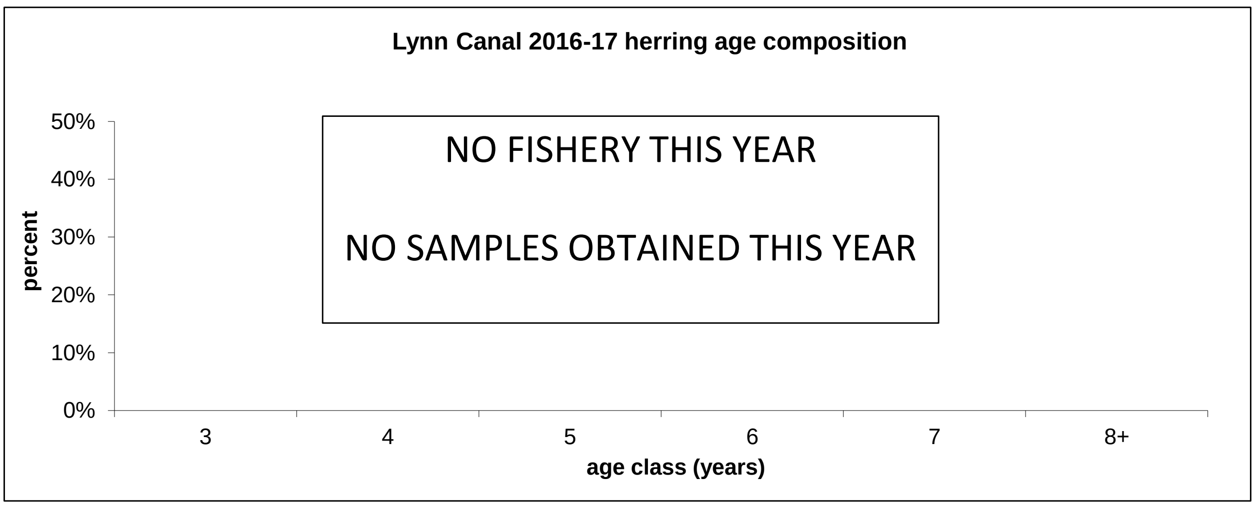

Figure 19.–Age composition for Lynn Canal herring stock in 2016–17. No commercial fishery samples obtained in 2016–17.

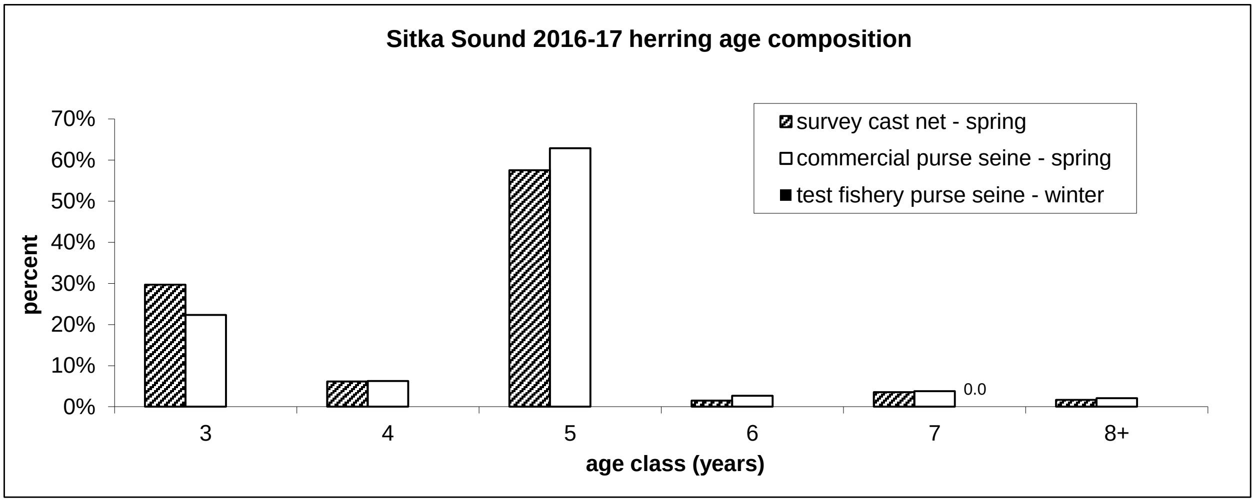

Figure 20.–Age composition for Sitka Sound herring stock in 2016–17.

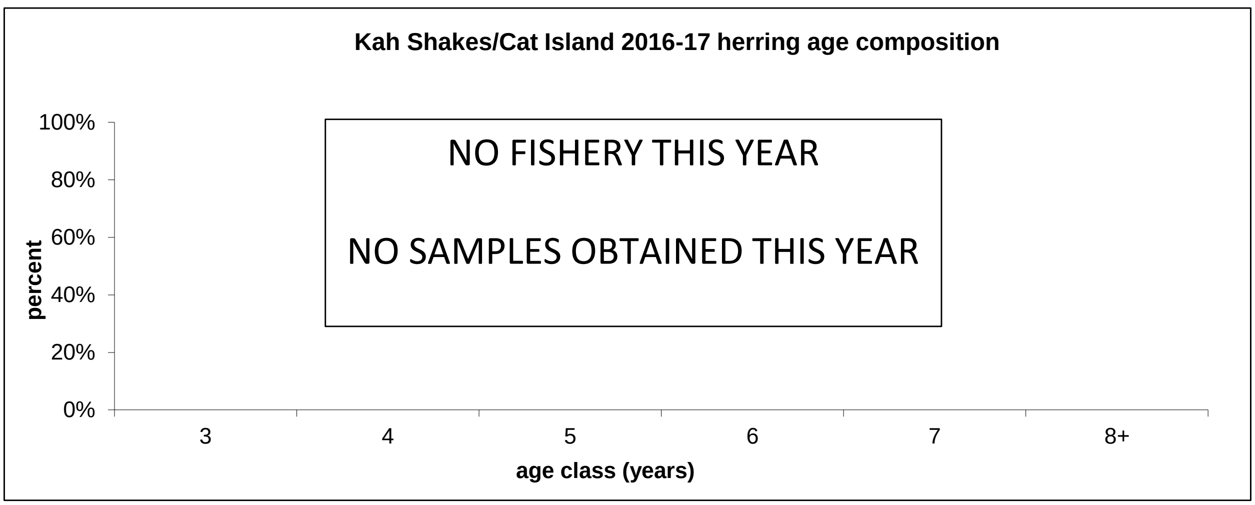

Figure 21.–Age composition for Revilla Channel herring stock (state waters only) in 2016–17. No samples obtained in 2016–17.

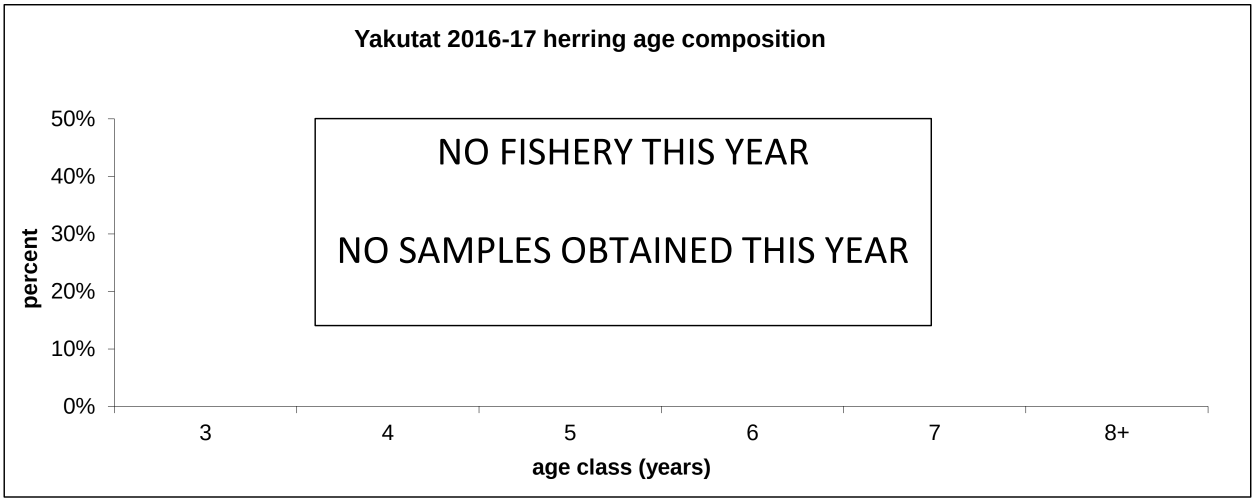

Figure 22.–Age composition for Yakutat Bay herring stock in 2016–17. No samples were obtained in 2016–17.

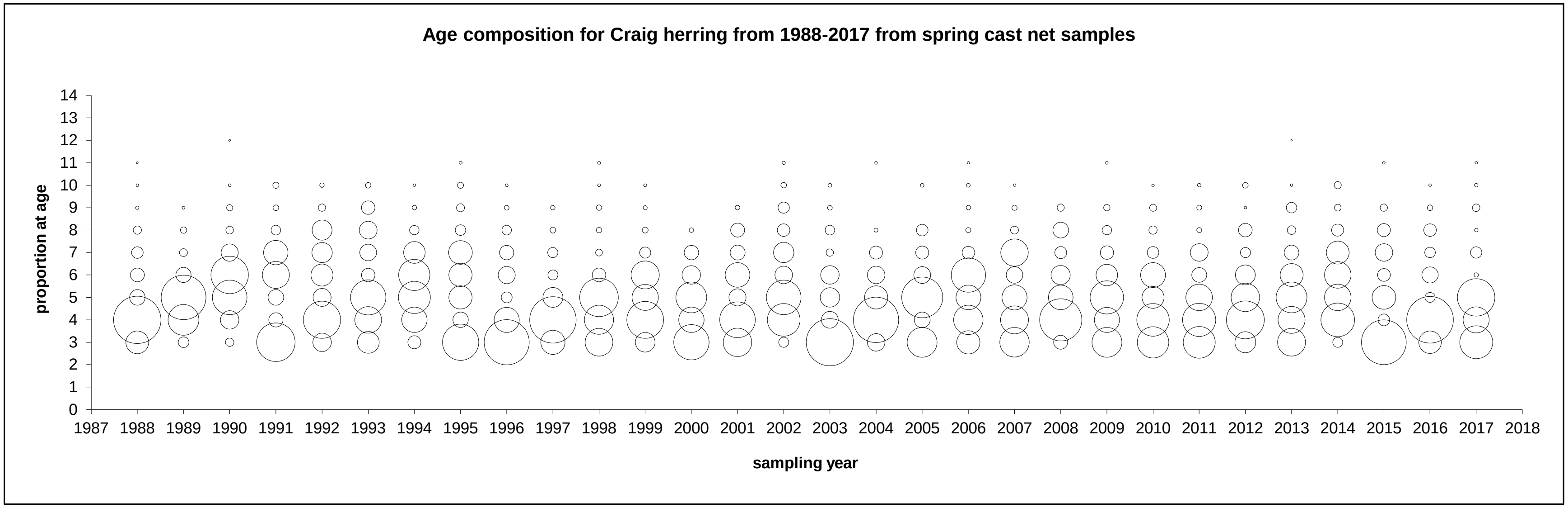

Figure 23.–Age composition from sampling data for the Craig herring stock. Ages presented for 2000 may be biased slightly high due to misinterpretation of scale annuli.

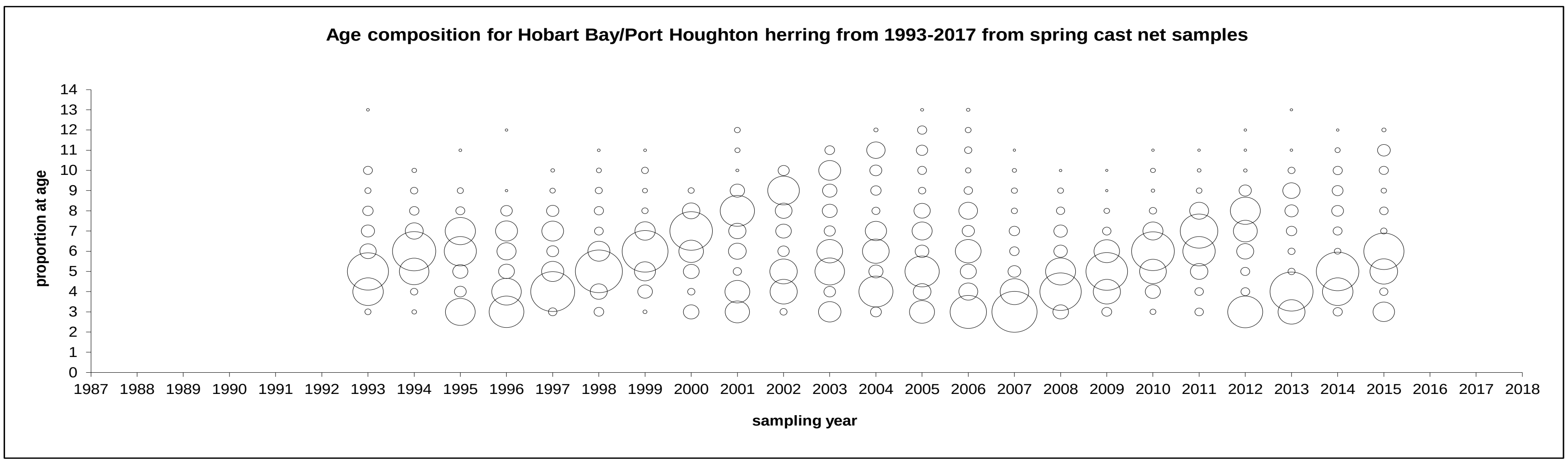

Figure 24.–Age composition from sampling data for the Hobart Bay/Port Houghton herring stock. Ages presented for 2000 may be biased slightly high due to misinterpretation of scale annuli.

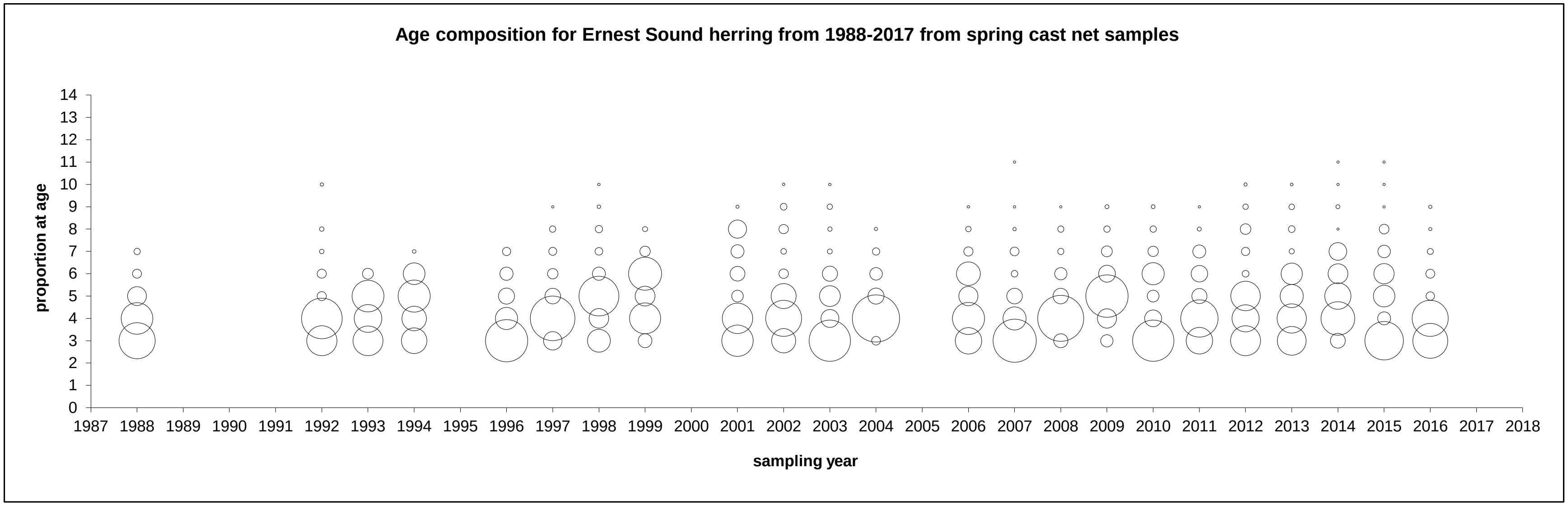

Figure 25.–Age composition from sampling data for the Ernest Sound herring stock.

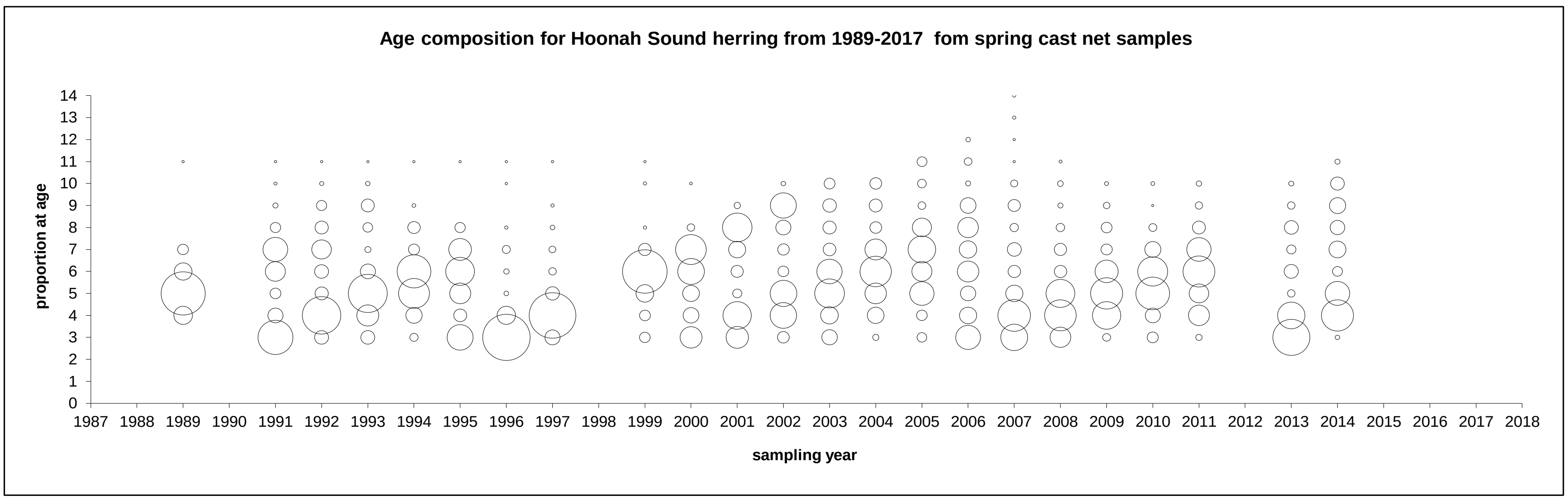

Figure 26.–Age composition from sampling data for the Hoonah Sound herring stock. Ages presented for 2000 may be biased slightly high due to misinterpretation of scale annuli.

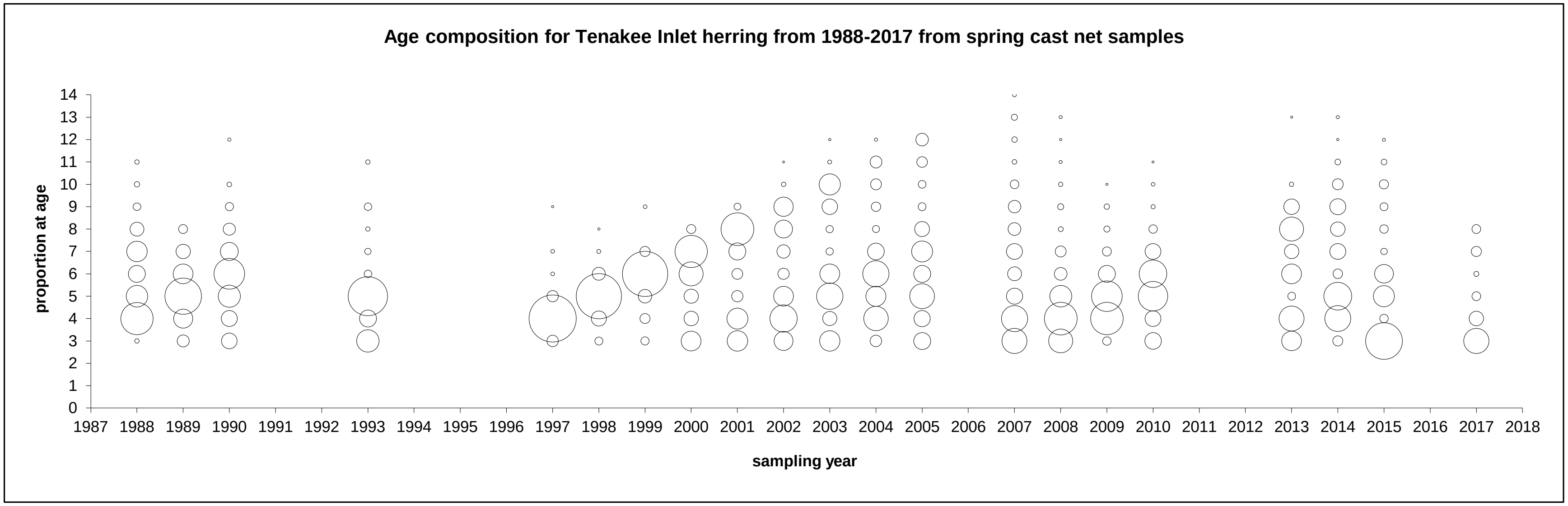

Figure 27.–Age composition from sampling data for the Tenakee Inlet herring stock. Ages presented for 2000 may be biased slightly high due to misinterpretation of scale annuli.

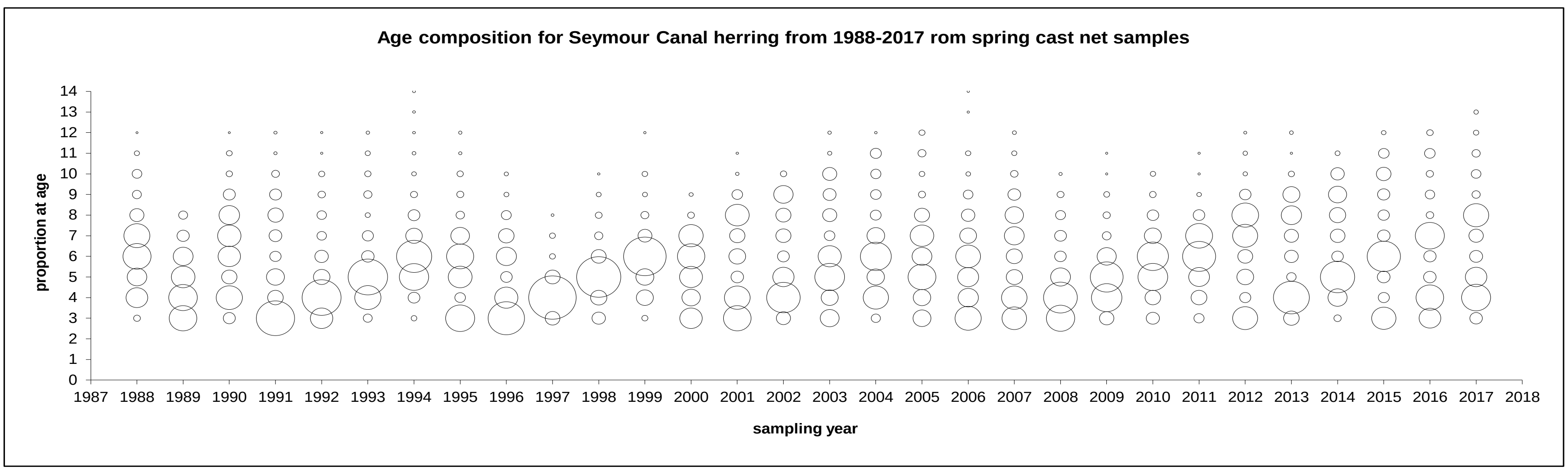

Figure 28.–Age composition from sampling data for the Seymour Canal herring stock. Ages presented for 2000 may be biased slightly high due to misinterpretation of scale annuli.

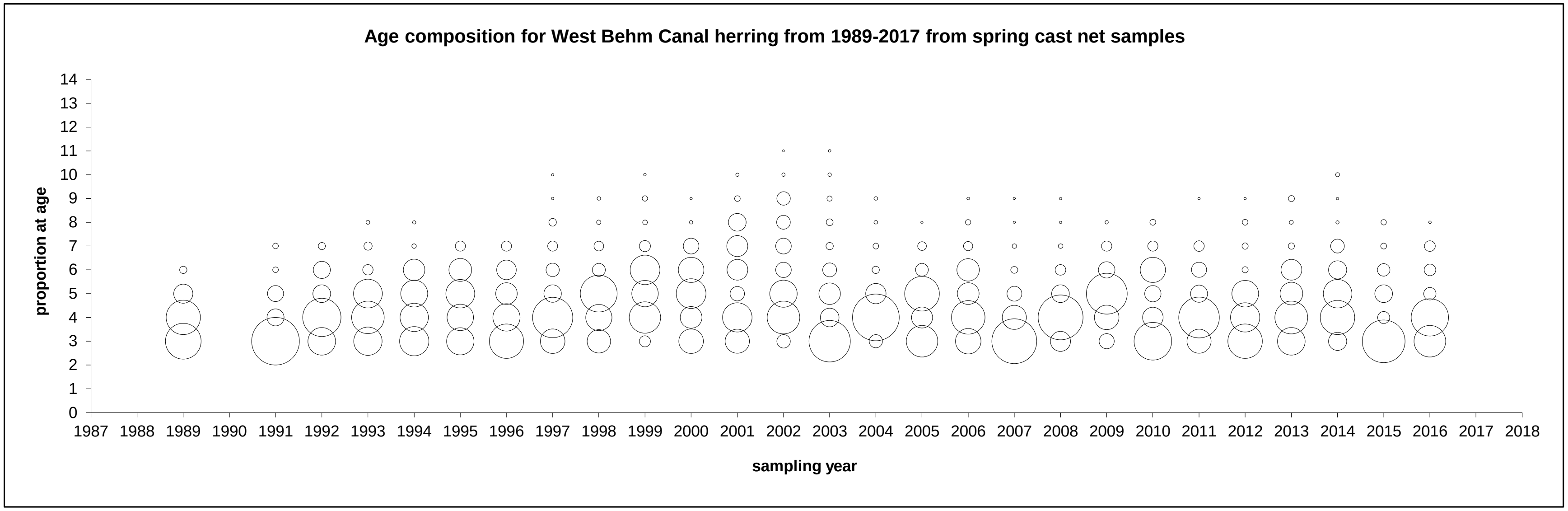

Figure 29.–Age composition from sampling data for the West Behm Canal herring stock. Ages presented for 2000 may be biased slightly high due to misinterpretation of scale annuli.

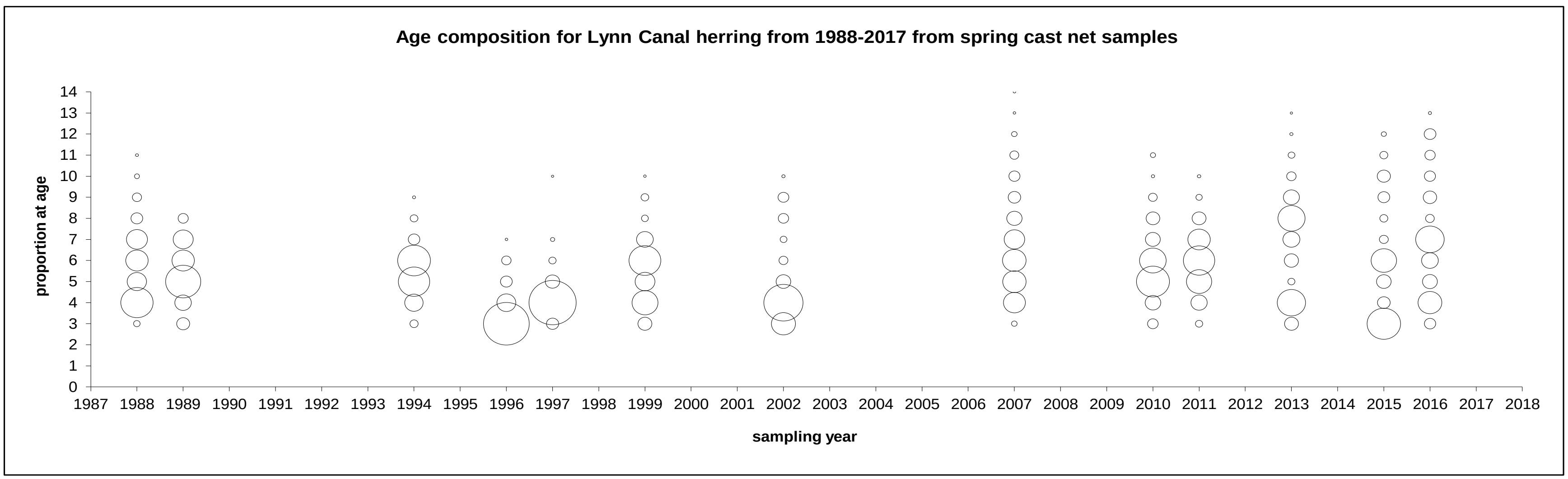

Figure 30.–Age composition from sampling data for the Lynn Canal herring stock.

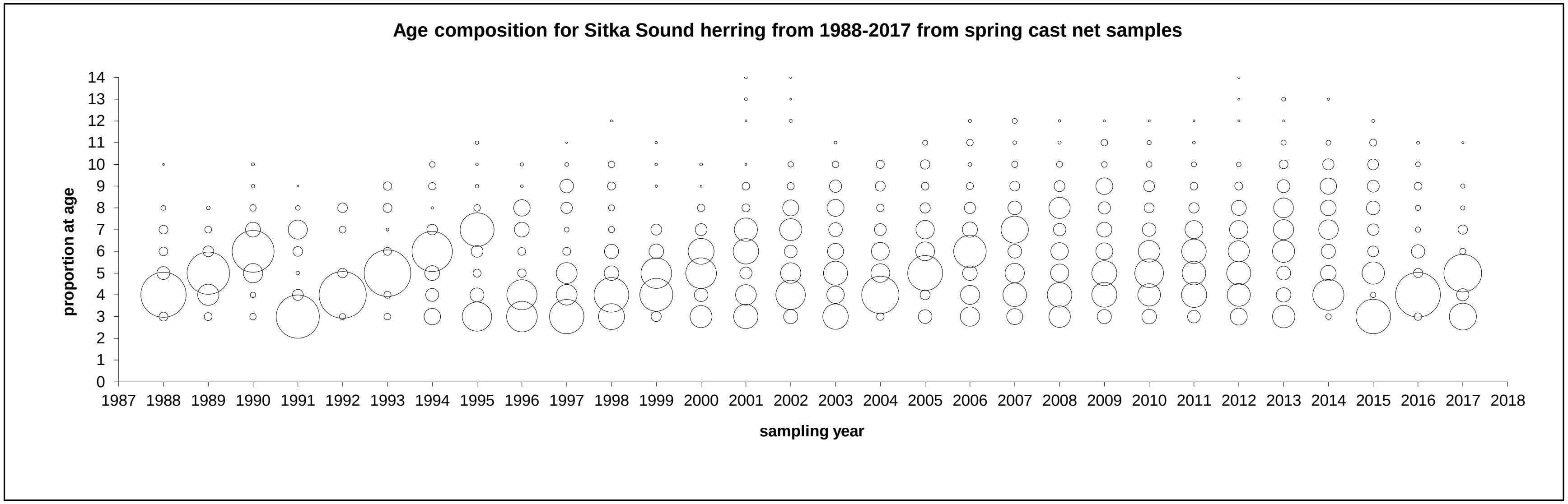

Figure 31.–Age composition from sampling data for the Sitka Sound herring stock. Ages presented for 2000 may be biased slightly high due to misinterpretation of scale annuli.

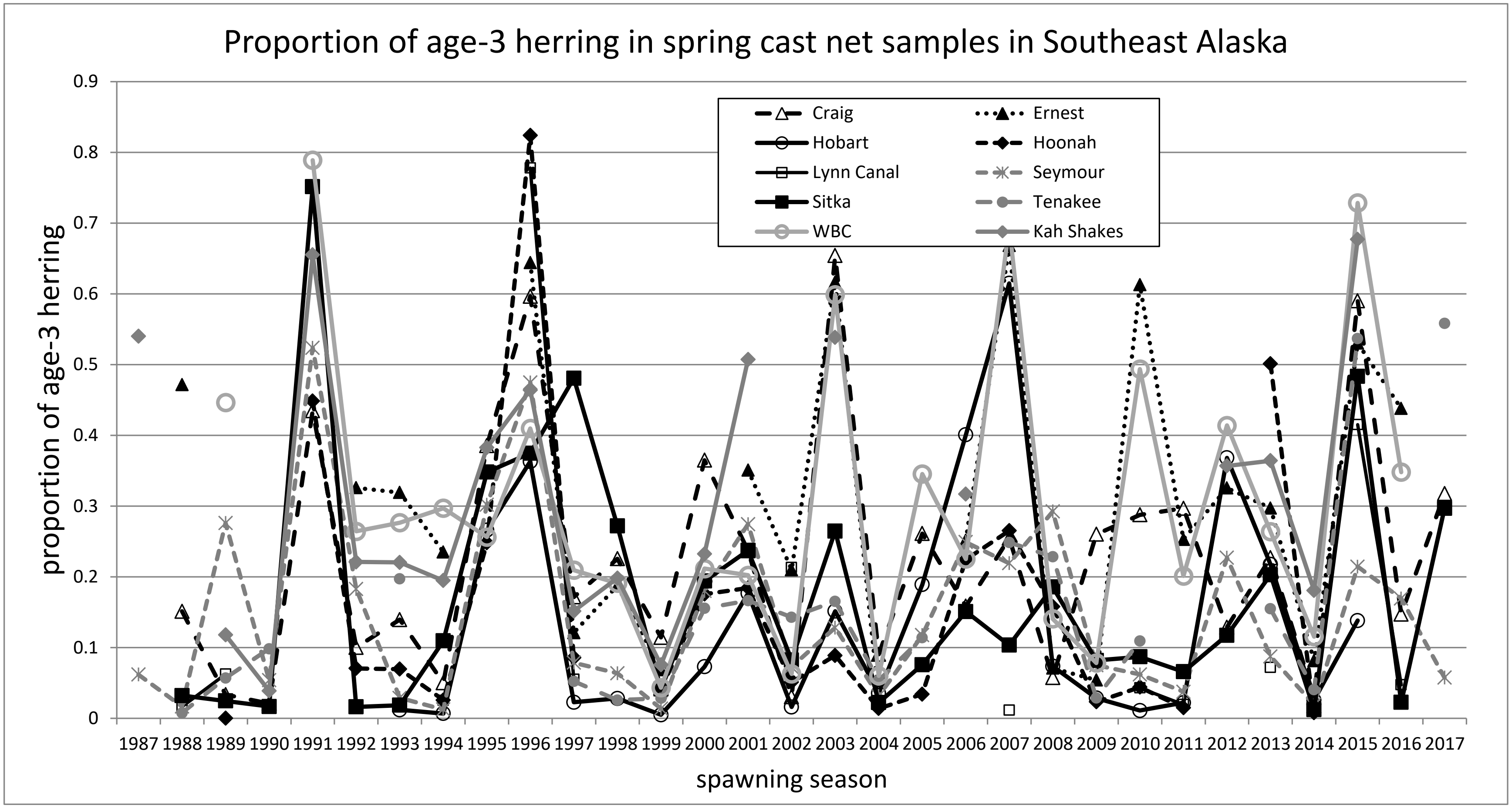

Figure 32.–Proportion of age-3 herring in spring cast nest samples of spawning populations for stocks in Southeast Alaska.

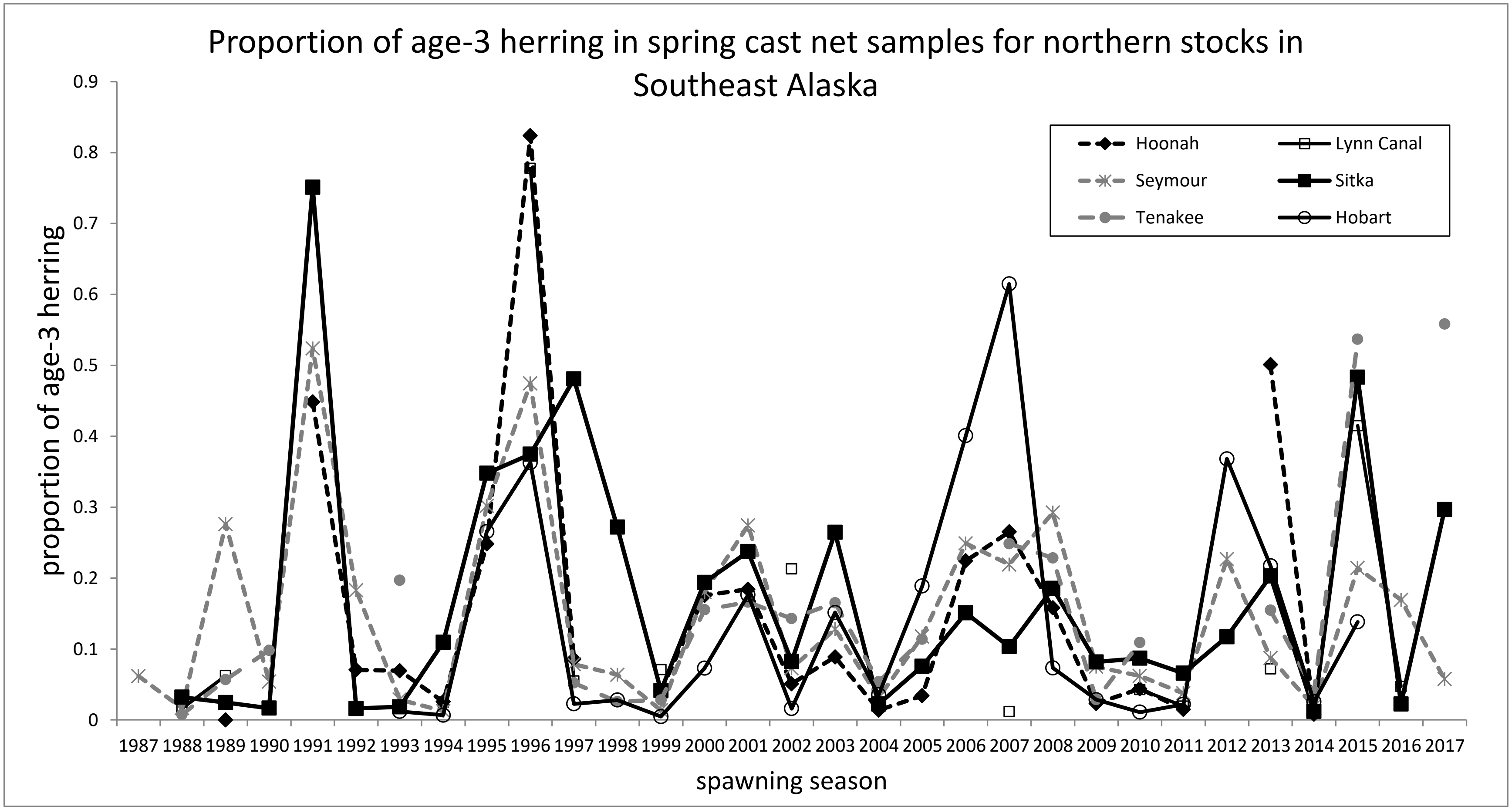

Figure 33.–Proportion of age-3 herring in spring cast nest samples of spawning populations for northern stocks in Southeast Alaska.

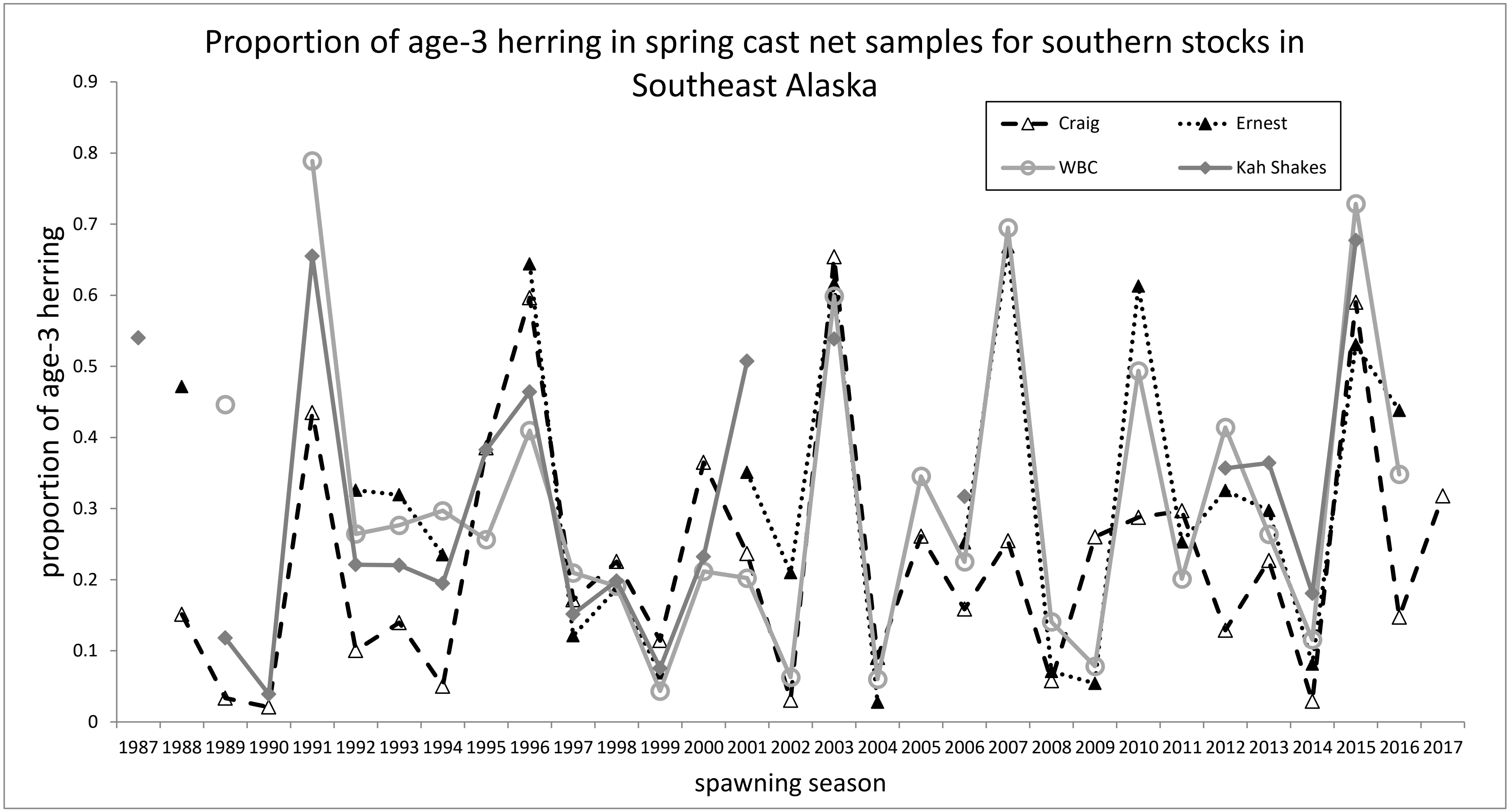

Figure 34.–Proportion of age-3 herring in spring cast nest samples of spawning populations for southern stocks in Southeast Alaska.

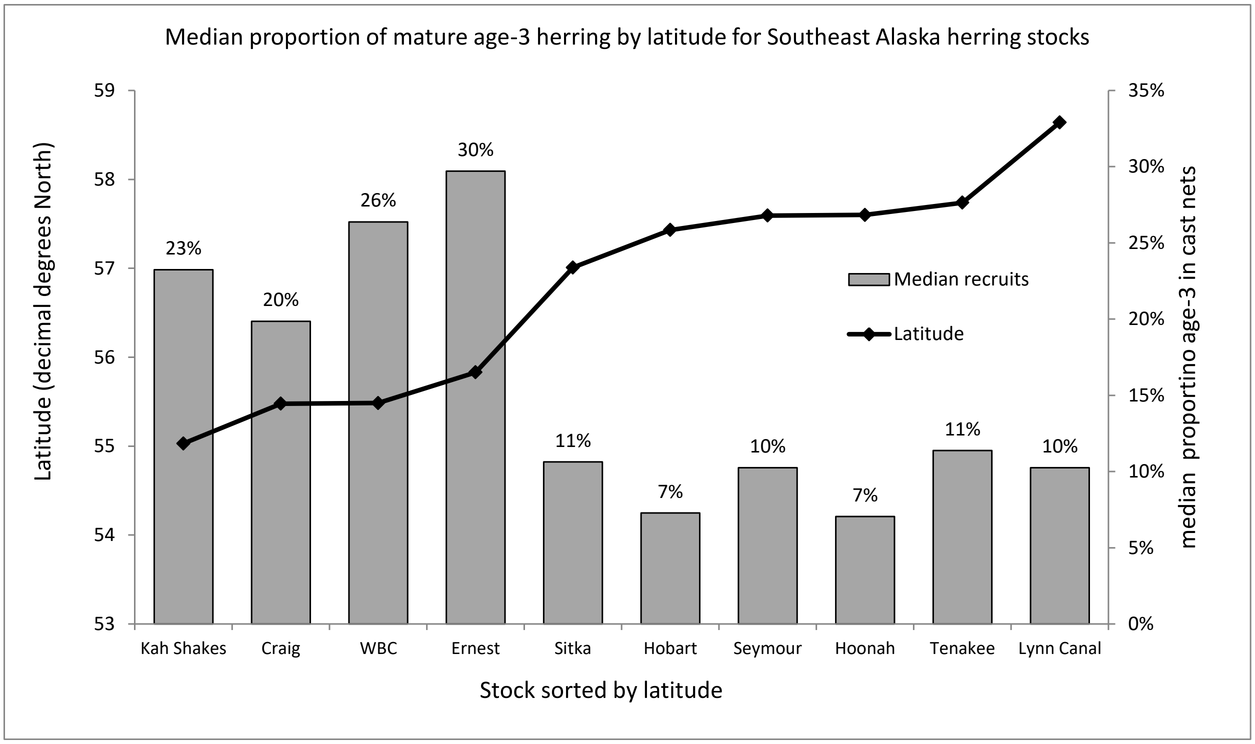

Figure 35.–Mean proportion of age-3 herring in spring cast nest samples (1988–2017) and latitude of spawning populations for stocks in Southeast Alaska.

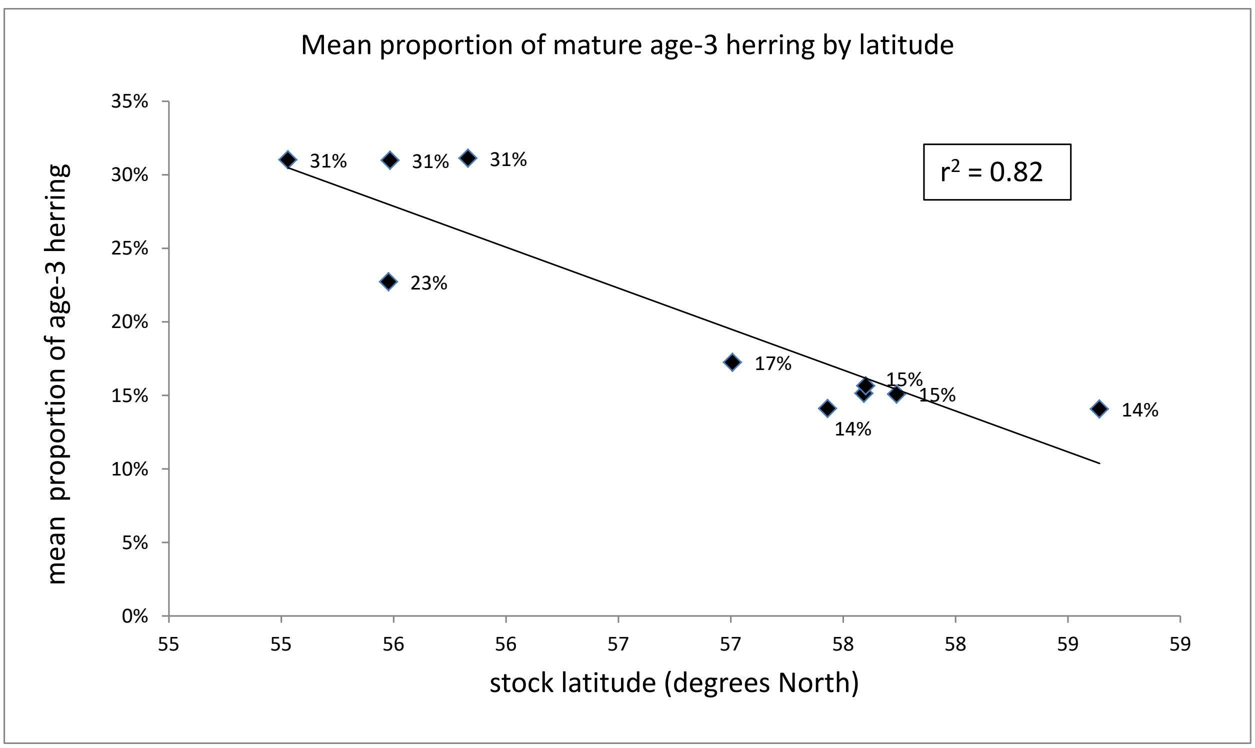

Figure 36.–Mean proportion of age-3 herring in spring cast nest samples versus stock latitude of spawning stocks in Southeast Alaska.

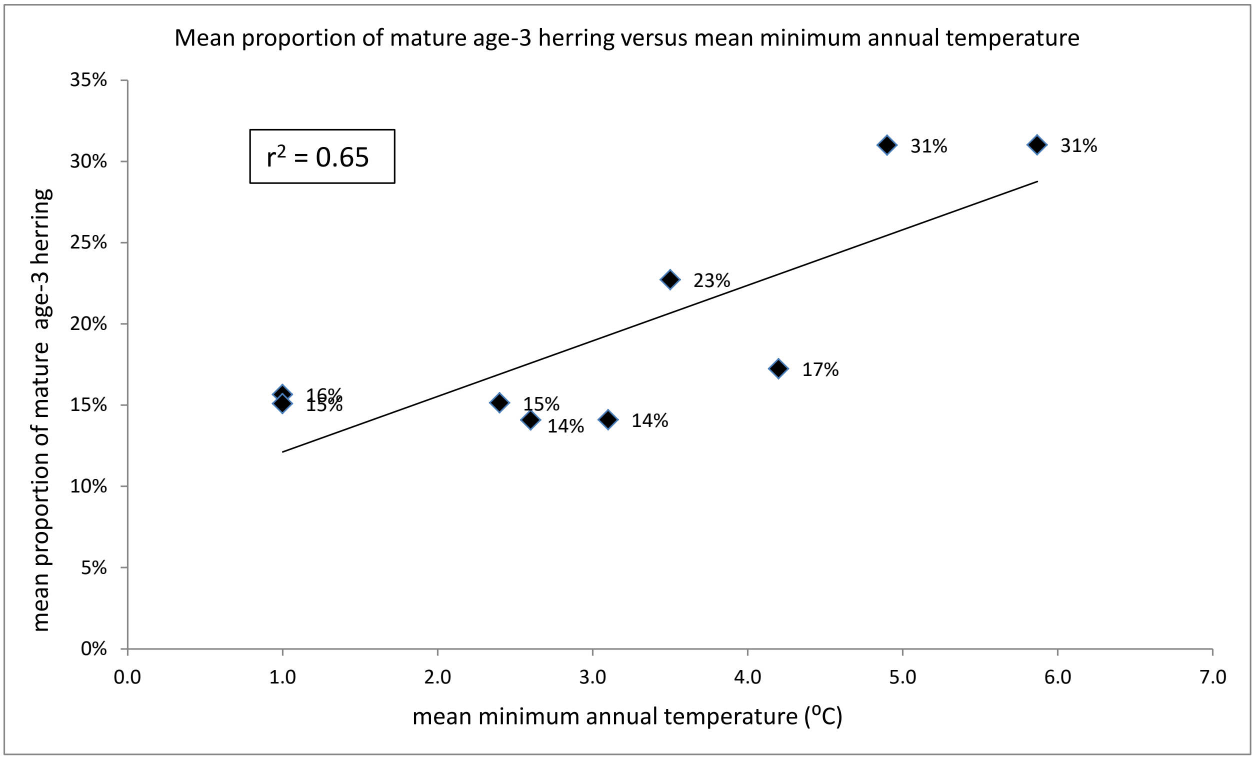

Figure 37.–Mean proportion of age-3 herring in spring cast nest samples versus mean minimum annual sea water temperature at location of spawning stocks in Southeast Alaska.

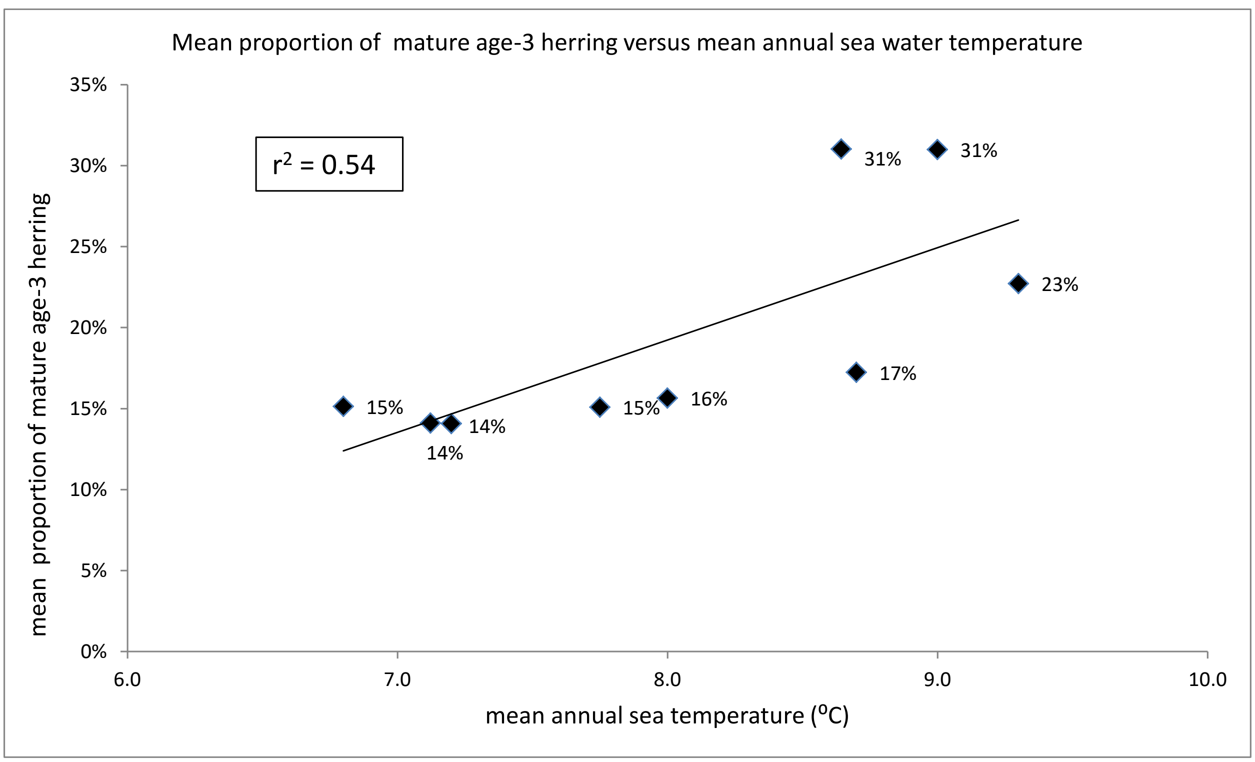

Figure 38.–Mean proportion of age-3 herring in spring cast nest samples versus mean annual sea water temperature at location of spawning stocks in Southeast Alaska.

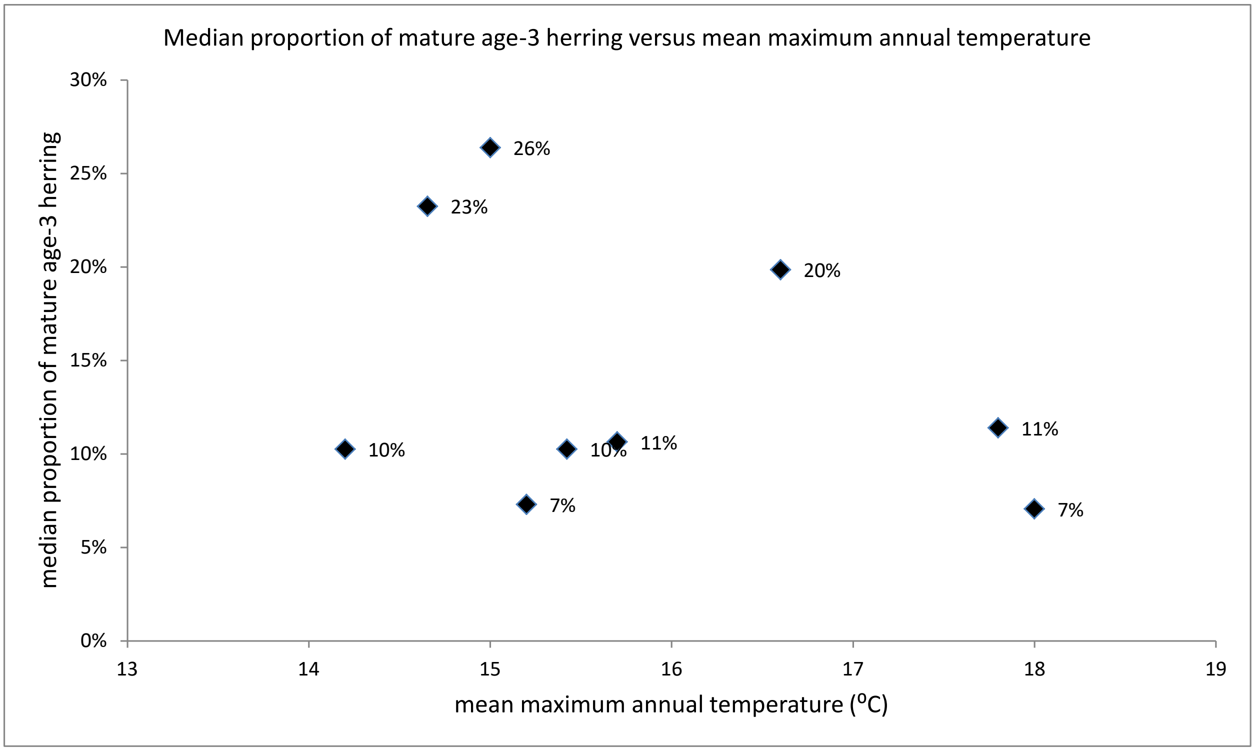

Figure 39.–Mean proportion of age-3 herring in spring cast nest samples versus mean maximum annual sea water temperature at location of spawning stocks in Southeast Alaska.

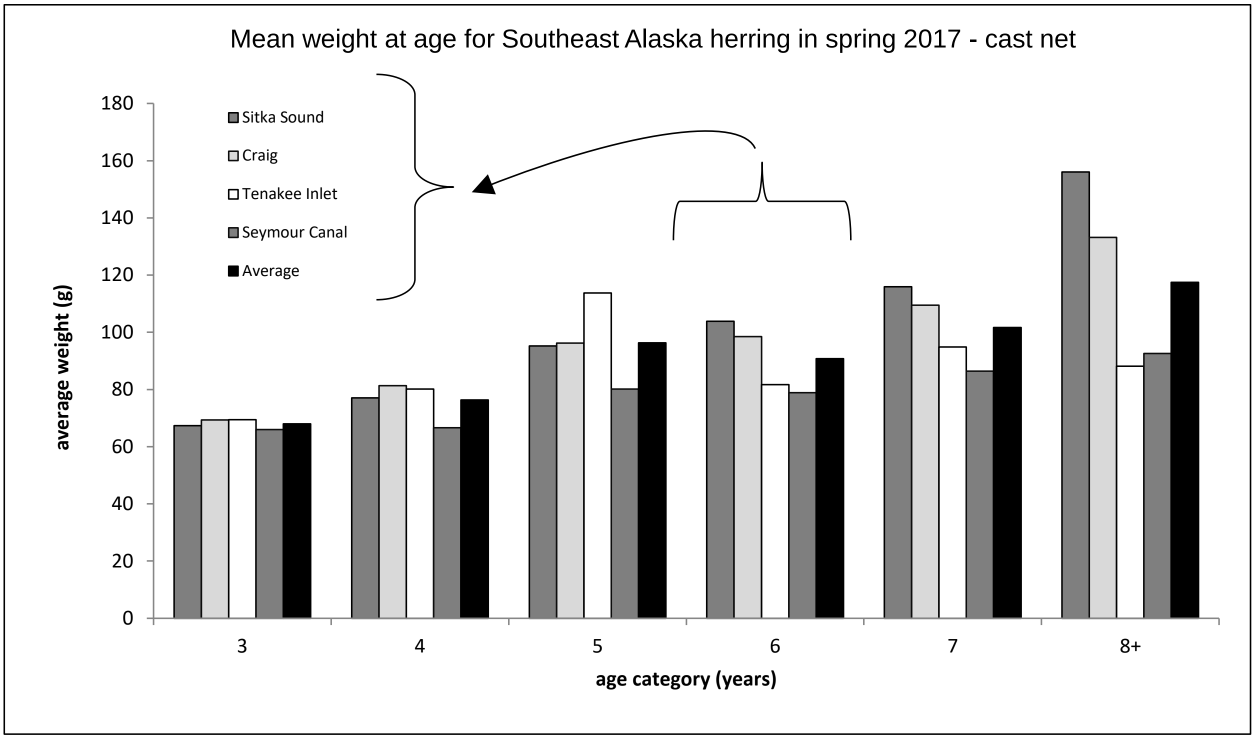

Figure 40.–Mean weight-at-age for Southeast Alaska herring stocks in spring 2017, sorted by age-6.

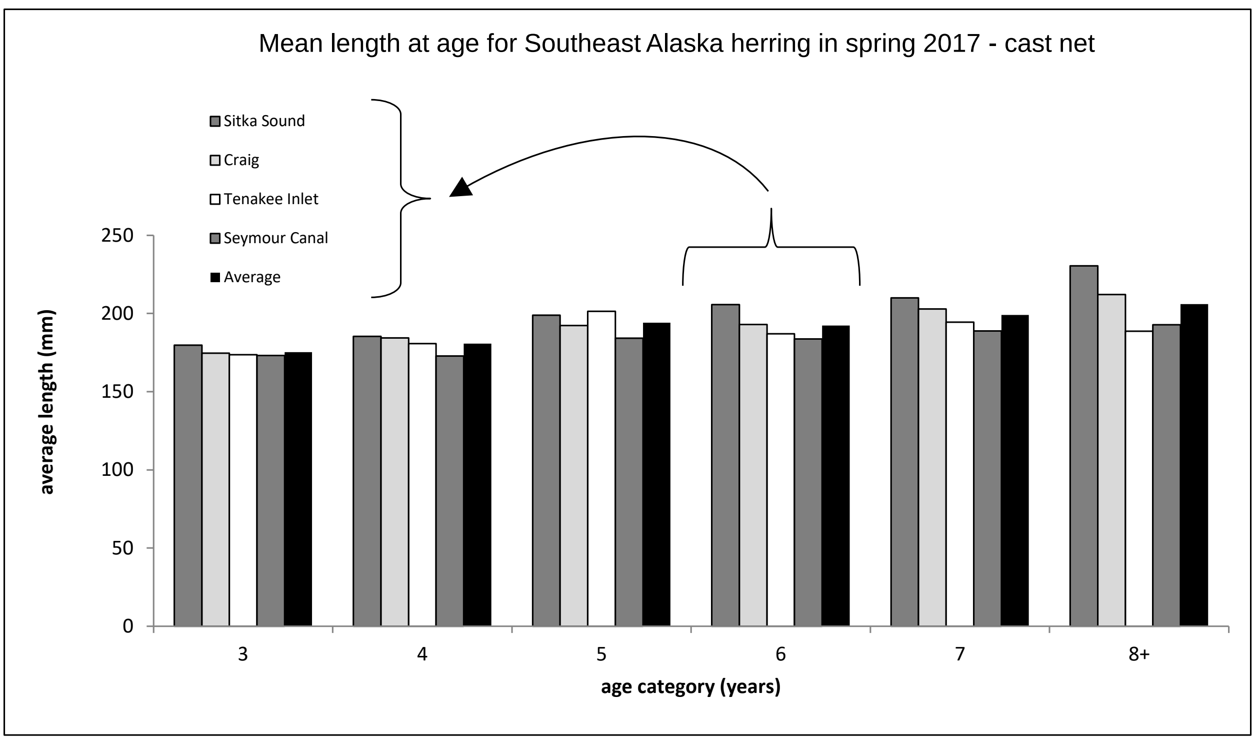

Figure 41.–Mean length at age for Southeast Alaska herring stocks in spring 2017, sorted by age-6.

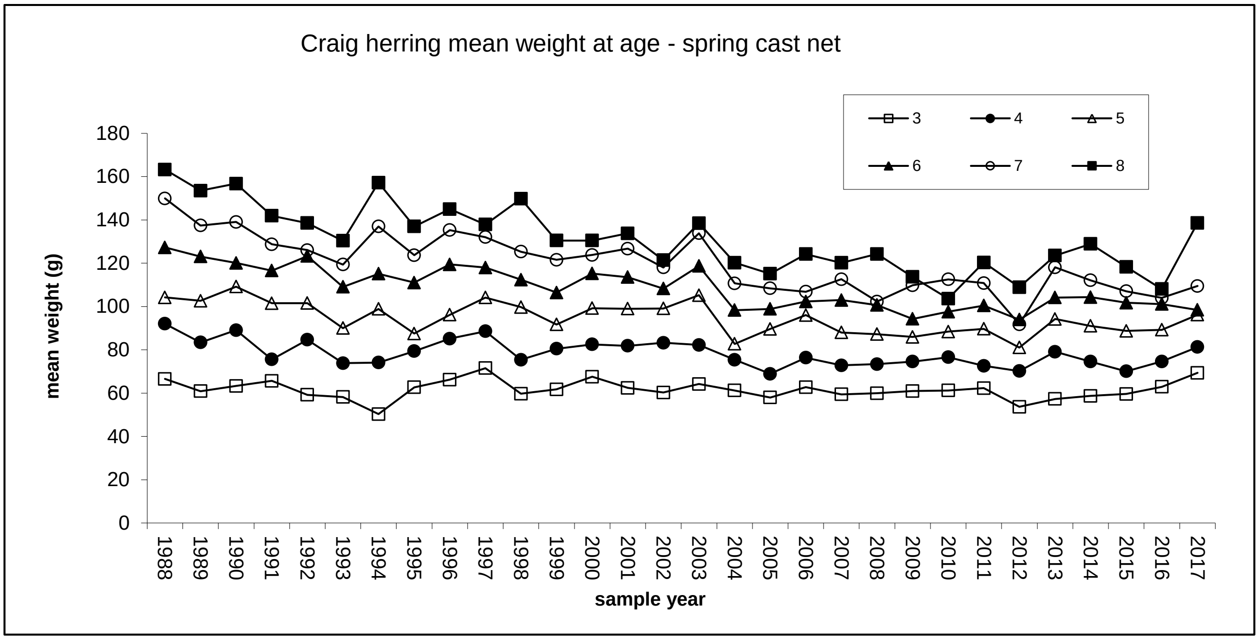

Figure 42.–Mean weight-at-age of the Craig herring spawning population. Weights presented for 2000 may be biased slightly high due to misinterpretation of scale annuli.

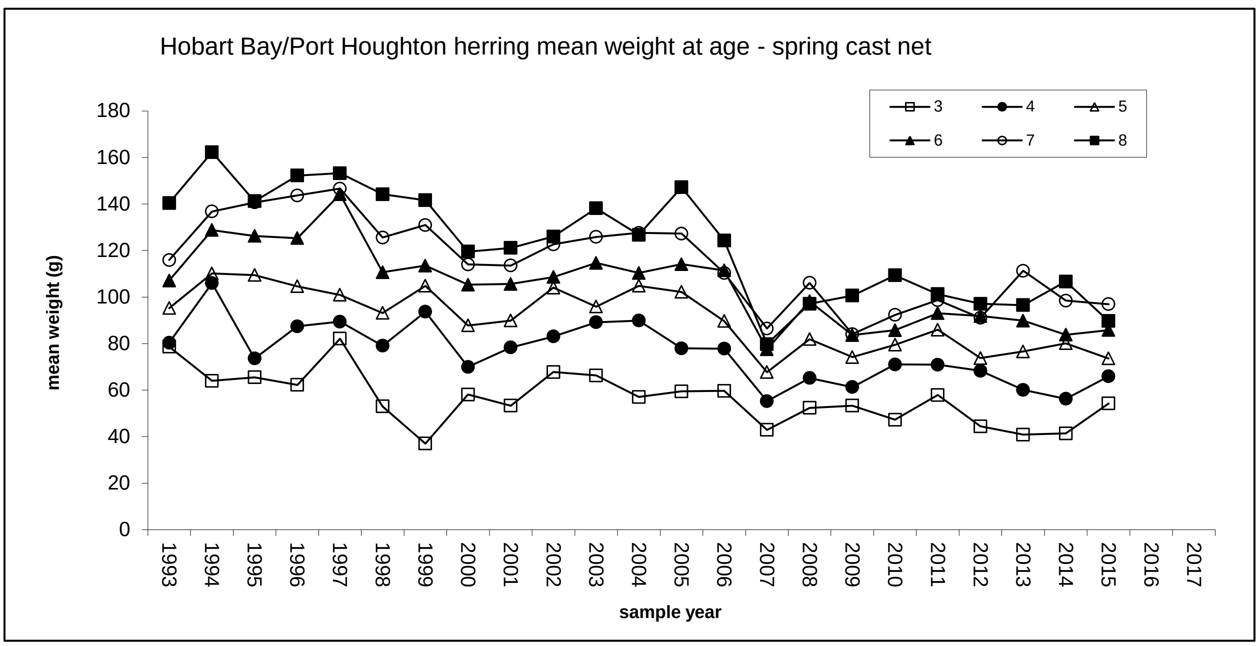

Figure 43.–Mean weight at age of the Hobart Bay/Port Houghton herring spawning population. Weights presented for 2000 may be biased slightly high due to misinterpretation of scale annuli.

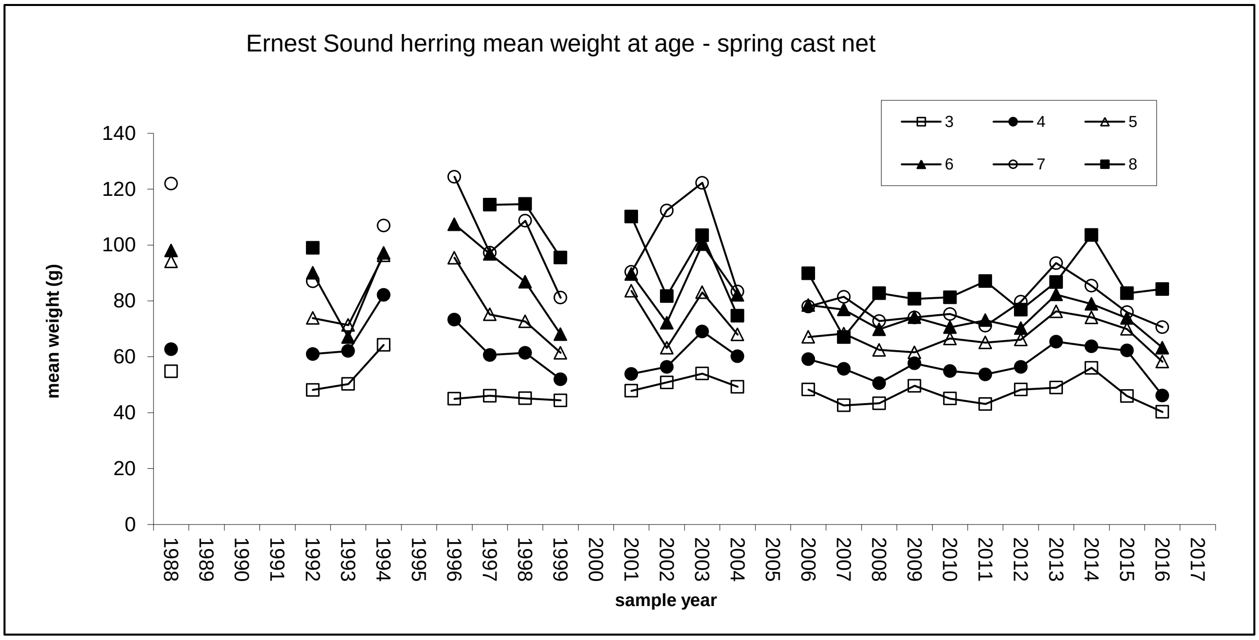

Figure 44.–Mean weight at age for the Ernest Sound herring spawning population.

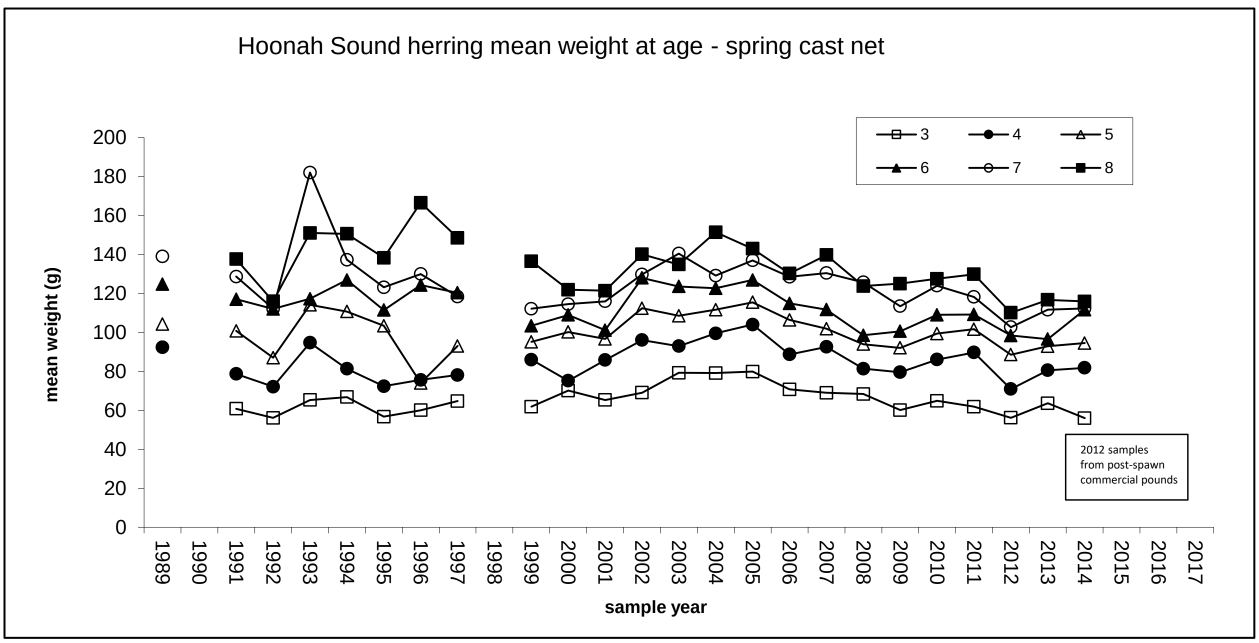

Figure 45.–Mean weight at age for the Hoonah Sound herring spawning population. Weights presented for 2000 may be biased slightly high due to misinterpretation of scale annuli.

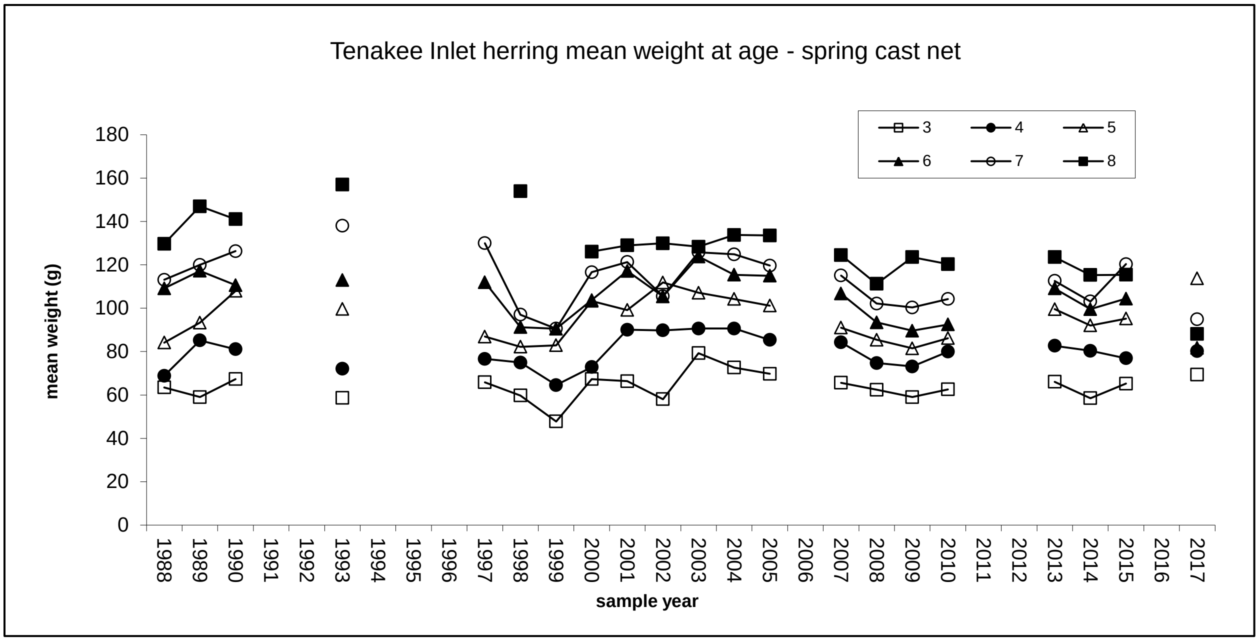

Figure 46.–Mean weight at age for the Tenakee Inlet herring stock. Weights presented for 2000 may be biased slightly high due to misinterpretation of scale annuli.

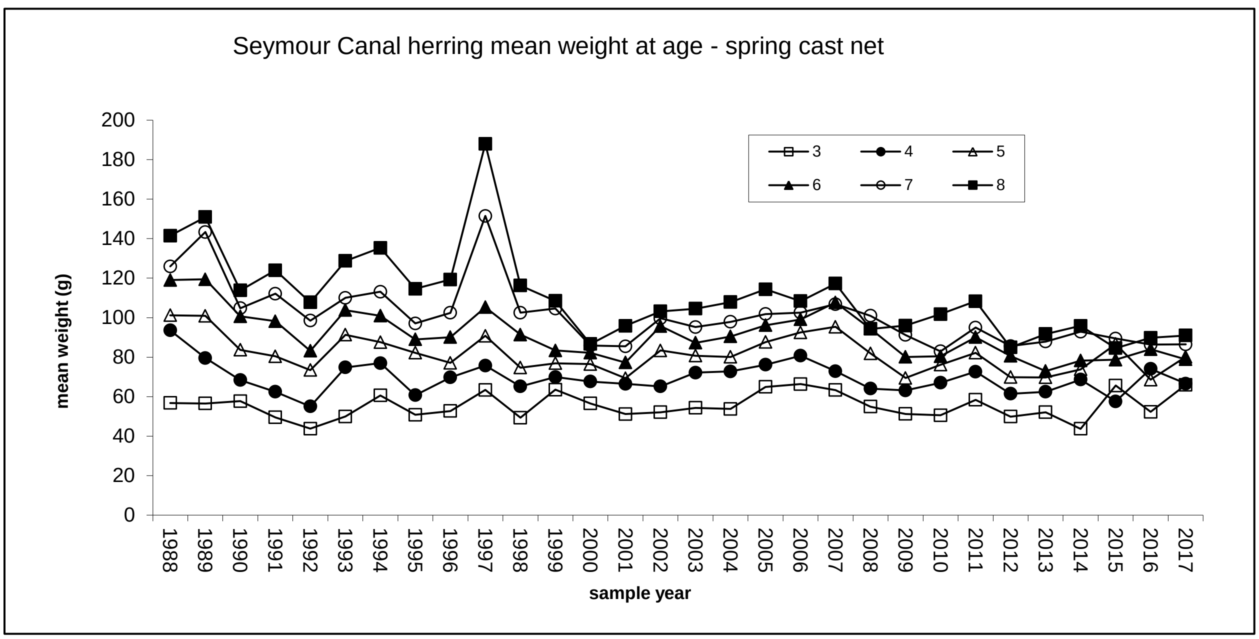

Figure 47.–Mean weight at age for the Seymour Canal herring stock. Weights presented for 2000 may be biased slightly high due to misinterpretation of scale annuli.

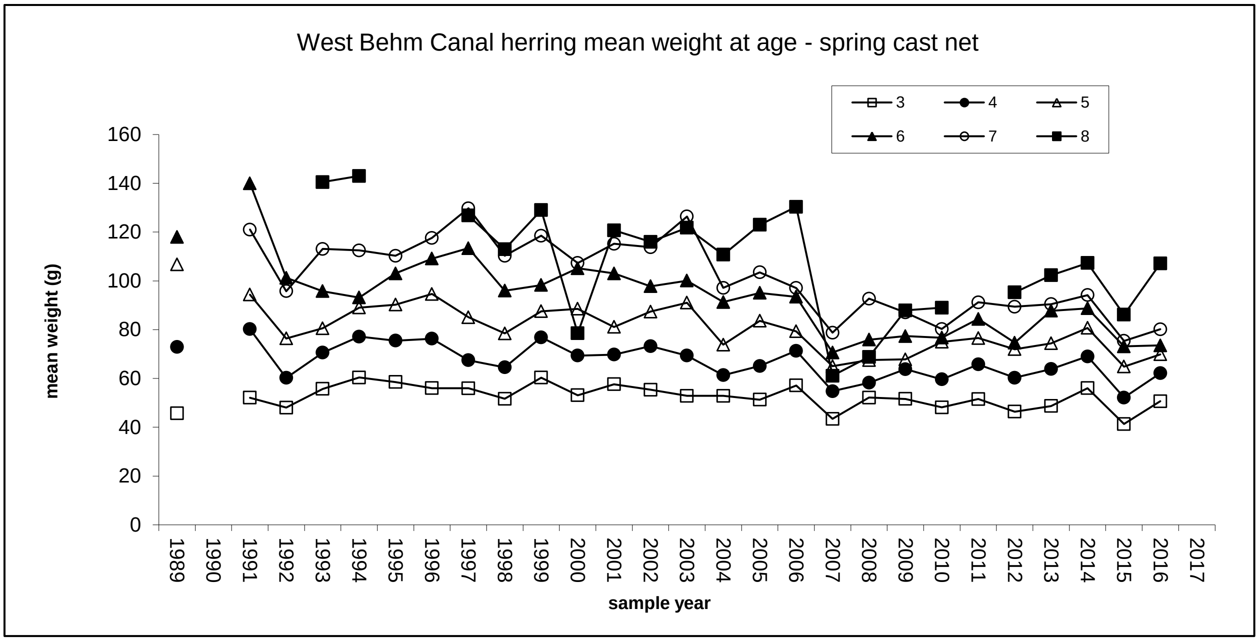

Figure 48.–Mean weight at age for the West Behm Canal herring spawning population. Weights presented for 2000 may be biased slightly high due to misinterpretation of scale annuli. 2015 weights are likely biased low due to required additional sample handling that resulted in loss of weight.

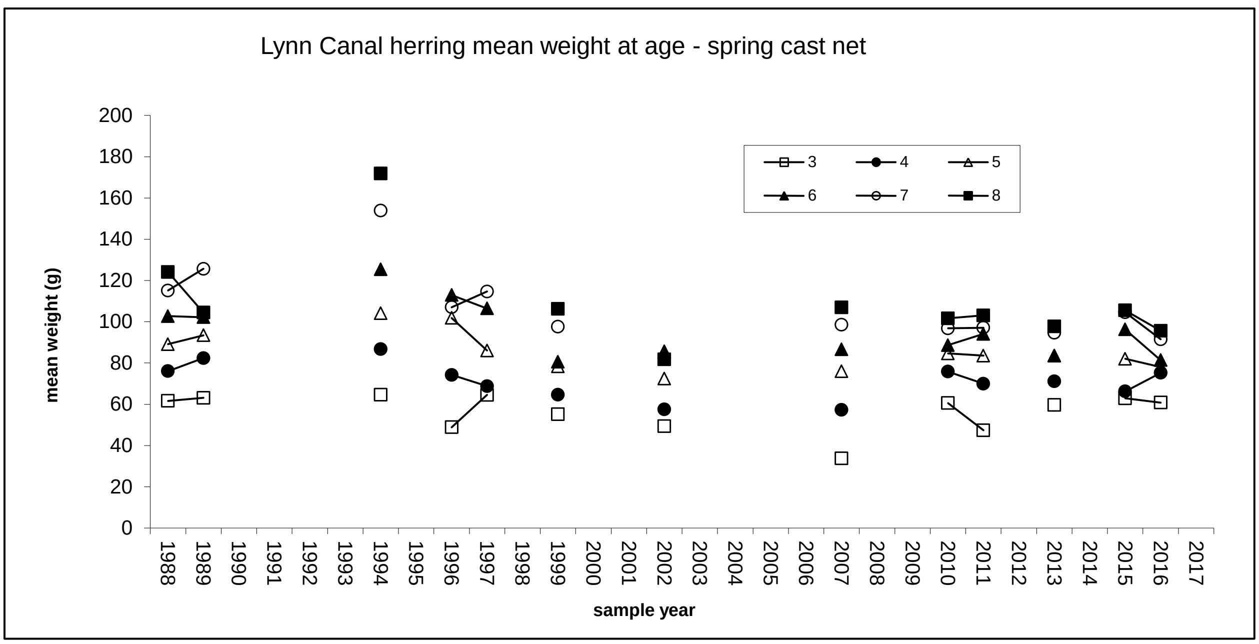

Figure 49.–Mean weight at age for the Lynn Canal herring spawning population.

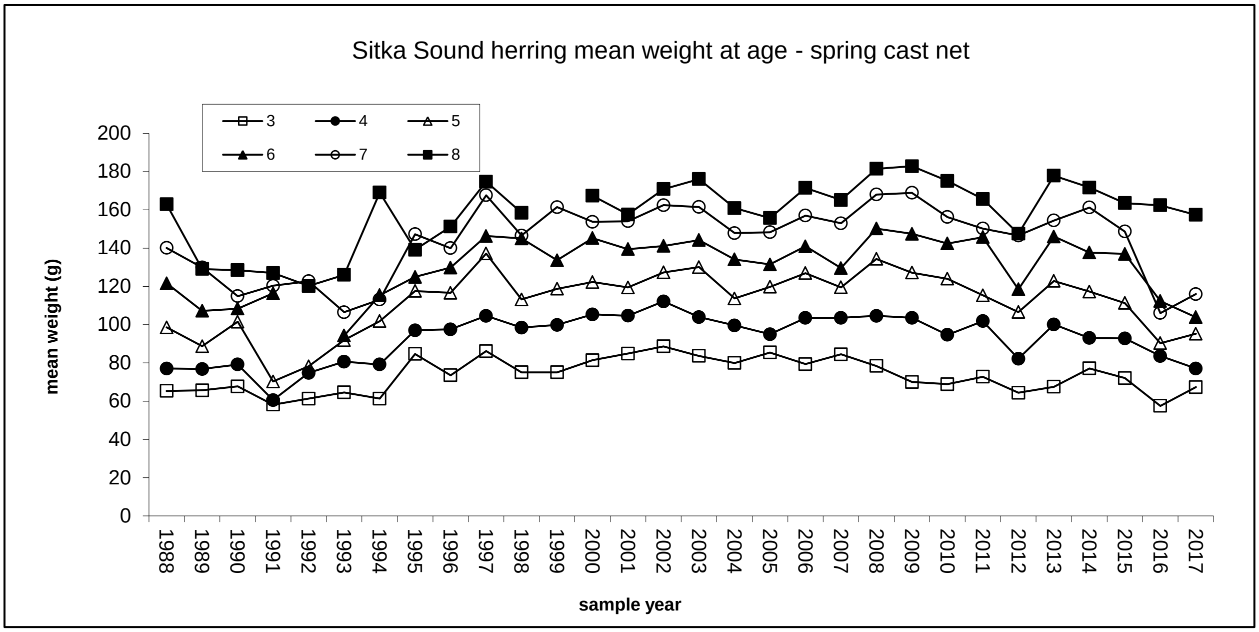

Figure 50.–Mean weight at age for the Sitka Sound herring spawning population. Weights presented for 2000 may be biased slightly high due to misinterpretation of scale annuli.

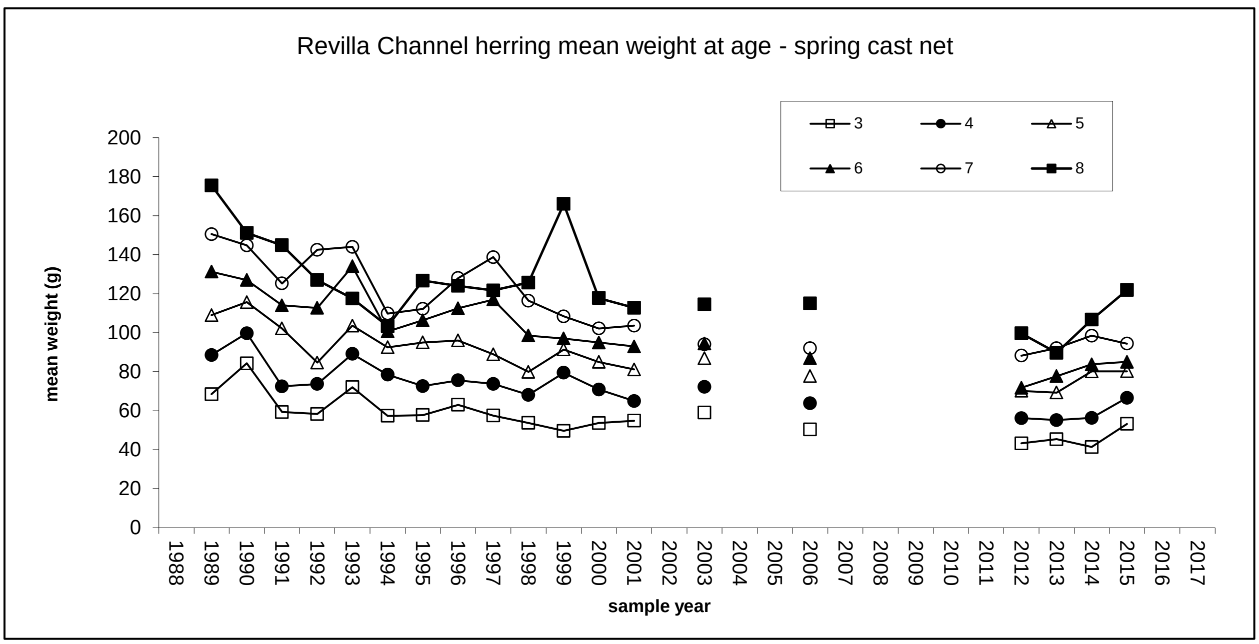

Figure 51.–Mean weight at age for the Revilla Channel herring spawning population. Weights presented for 2000 may be biased slightly high due to misinterpretation of scale annuli.

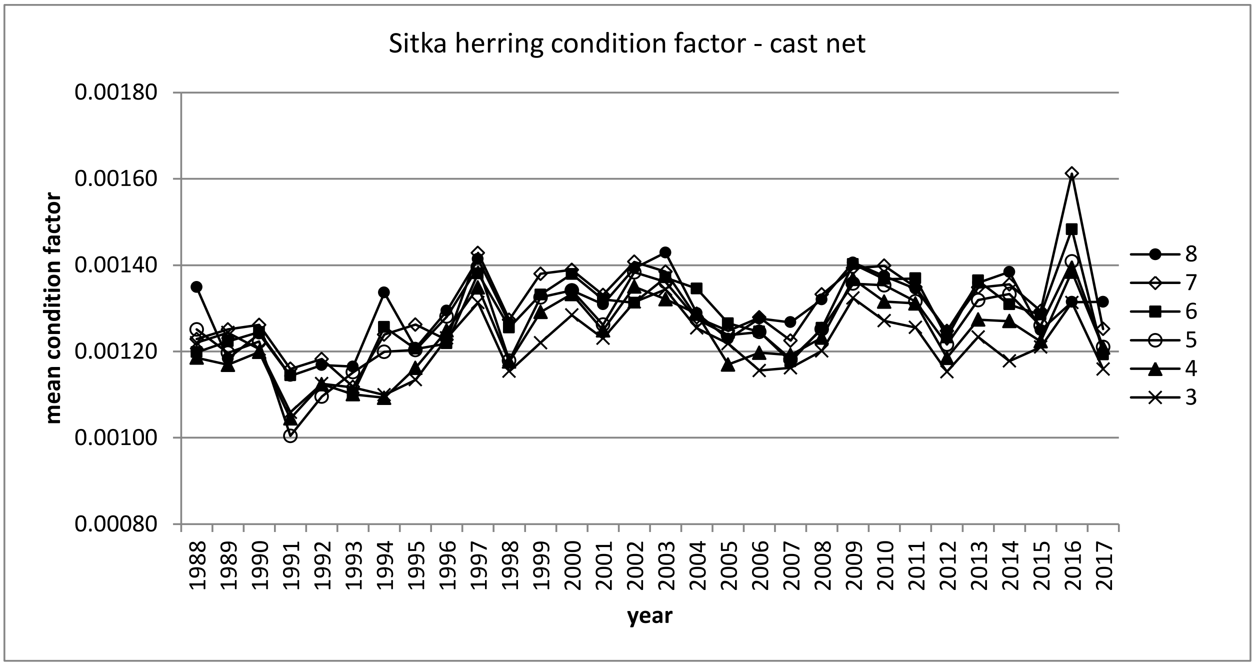

Figure 52.–Mean condition factors of age-3 through age-8 herring for the Sitka Sound spawning population, based on spring cast net samples taken during active spawning. 2016 values may be biased high due to length measurements that were likely underestimated.

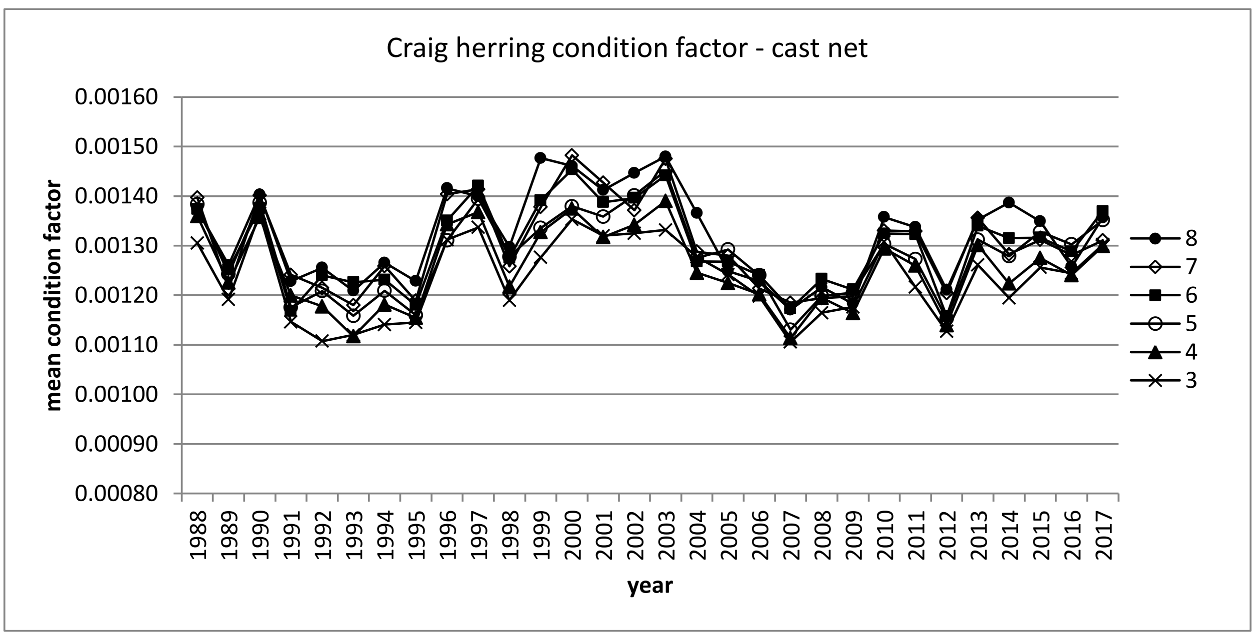

Figure 53.–Mean condition factors of age-3 through age-8 herring for the Craig spawning population, based on spring cast net samples taken during active spawning.

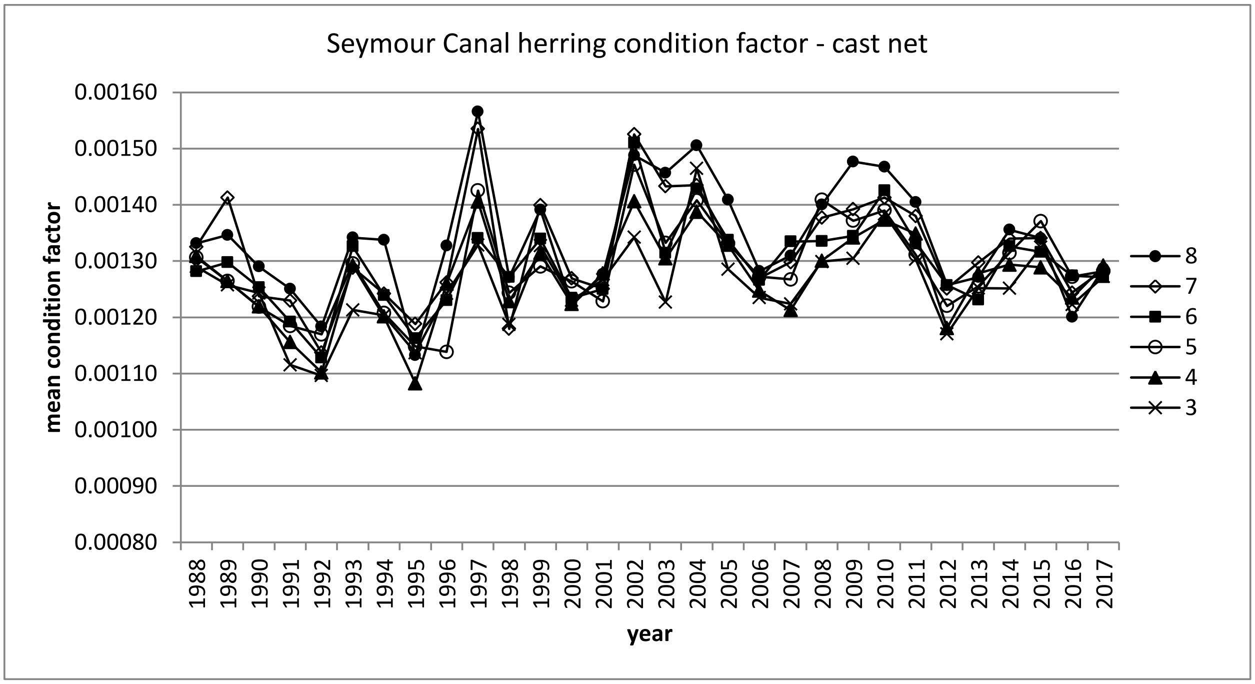

Figure 54.–Mean condition factors of age-3 through age-8 herring for the Seymour Canal spawning population, based on spring cast net samples taken during active spawning.

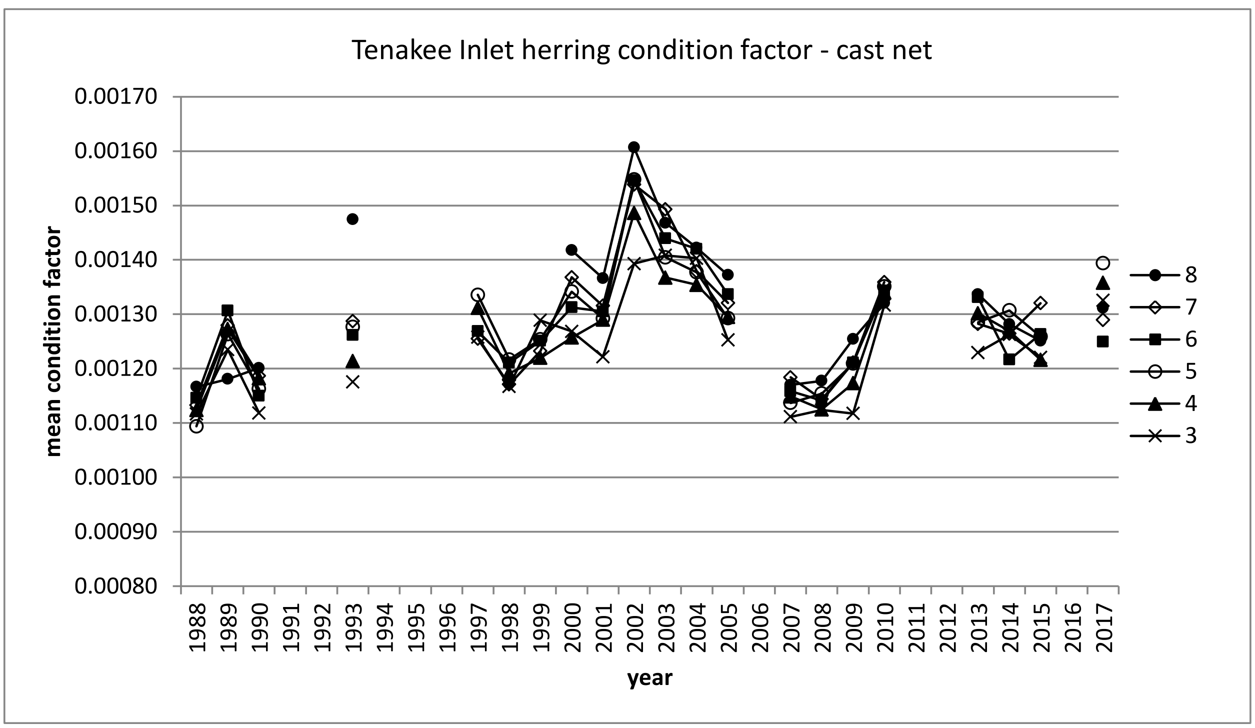

Figure 55.–Mean condition factors of age-3 through age-8 herring for the Tenakee Inlet spawning population, based on spring cast net samples taken during active spawning.

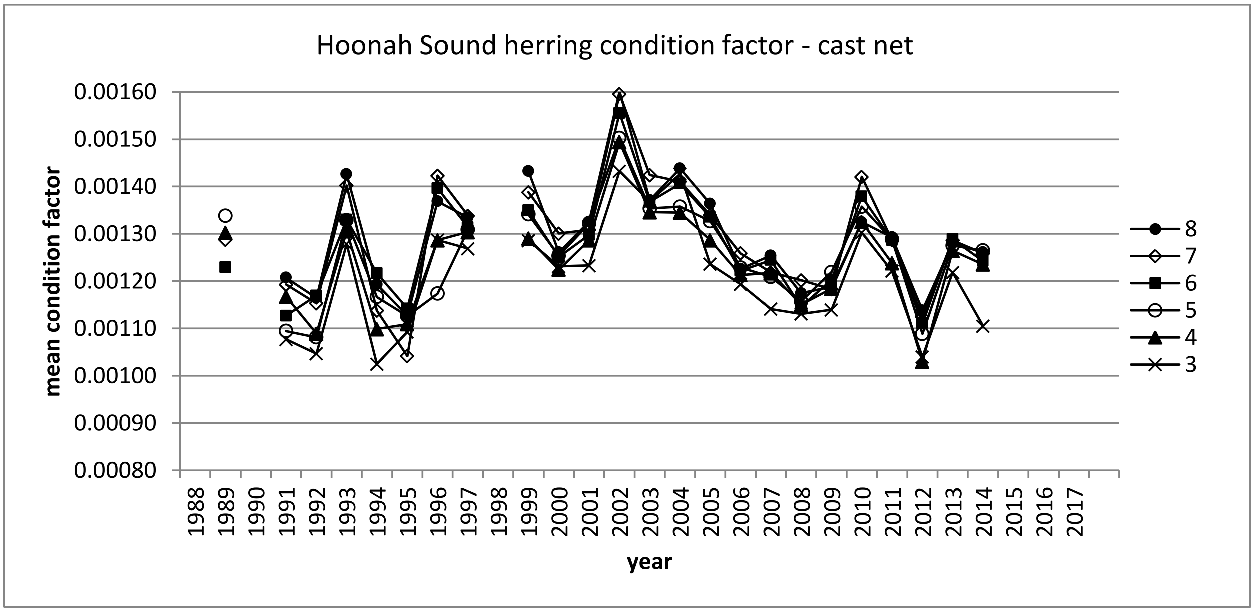

Figure 56.–Mean condition factors of age-3 through age-8 herring for the Hoonah Sound spawning population, based on spring cast net samples taken during active spawning.

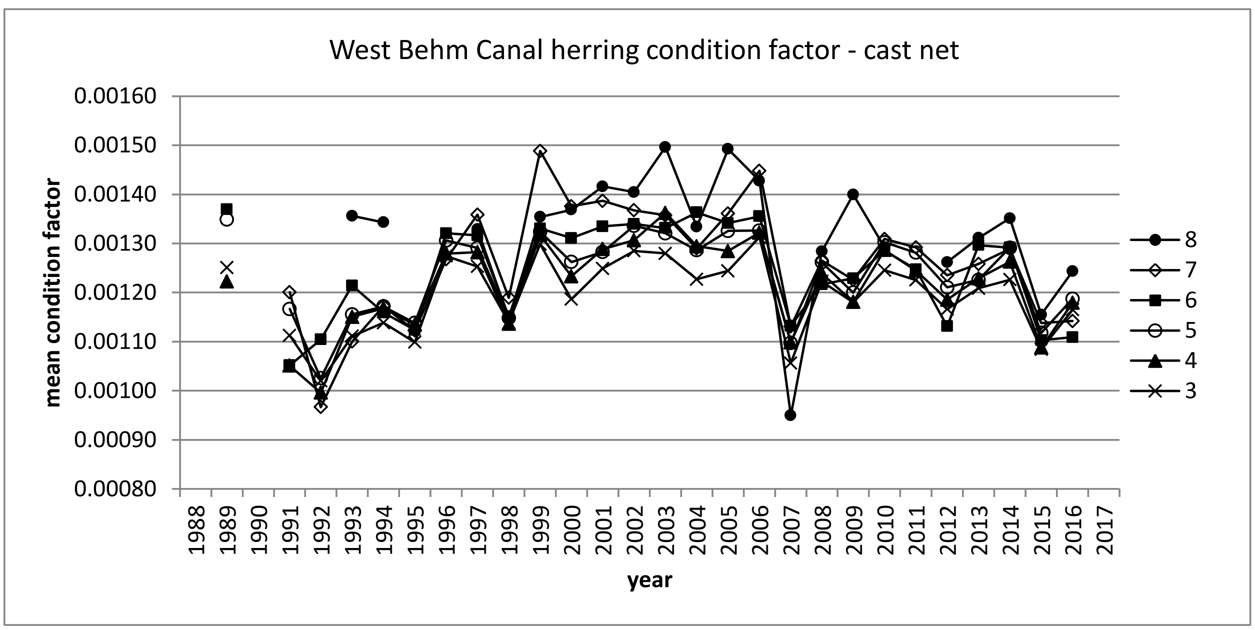

Figure 57.–Mean condition factors of age-3 through age-8 herring for the West Behm Canal spawning population, based on spring cast net samples taken during active spawning. 2015 condition factors are probably biased low due to required additional sample handling that resulted in loss of weight.

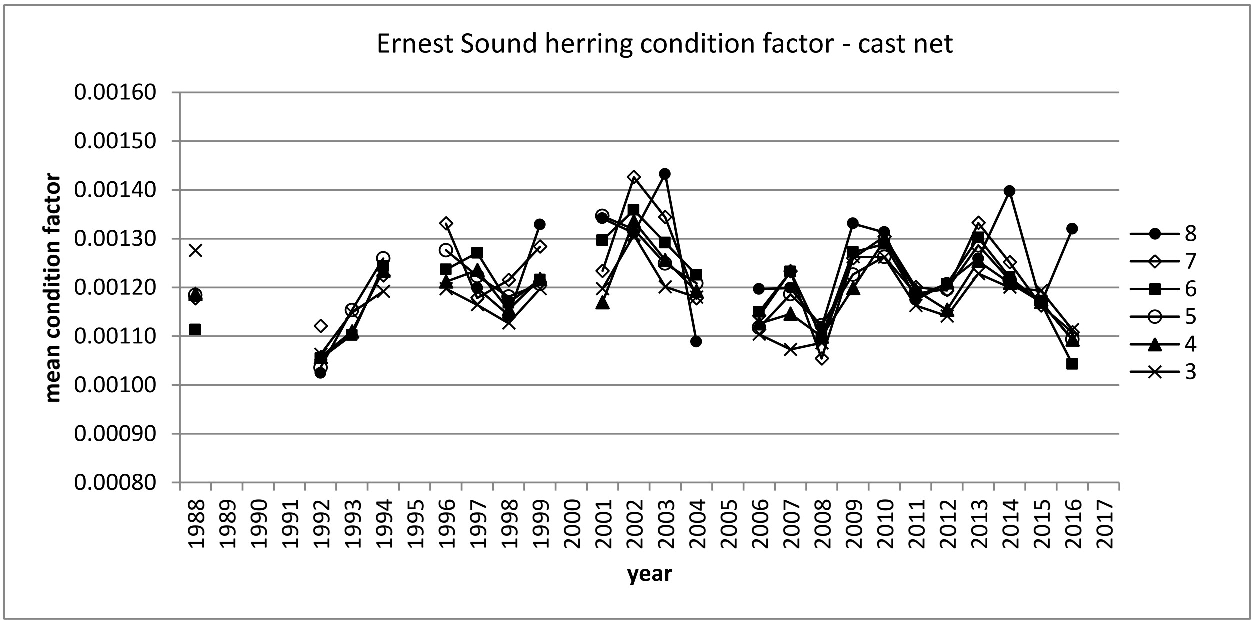

Figure 58.–Mean condition factors of age-3 through age-8 herring for the Ernest Sound spawning population, based on spring cast net samples taken during active spawning.

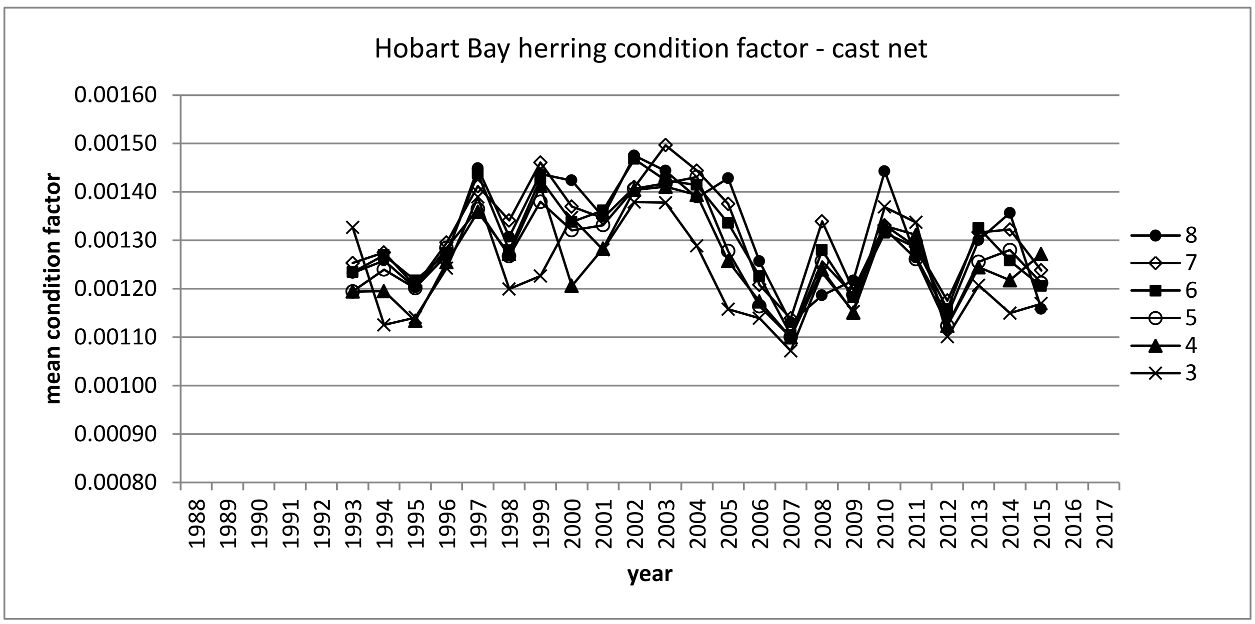

Figure 59.–Mean condition factors of age-3 through age-8 herring for the Hobart Bay spawning population, based on spring cast net samples taken during active spawning.

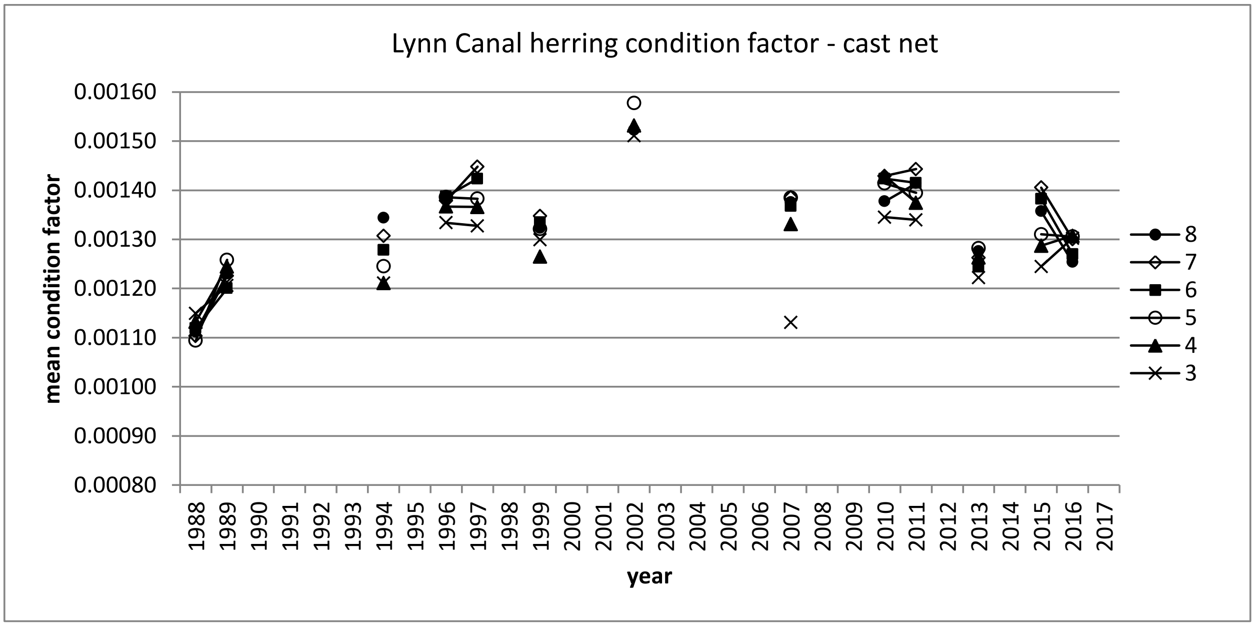

Figure 60.–Mean condition factors of age-3 through age-8 herring for the Lynn Canal spawning population, based on spring cast net samples taken during active spawning.

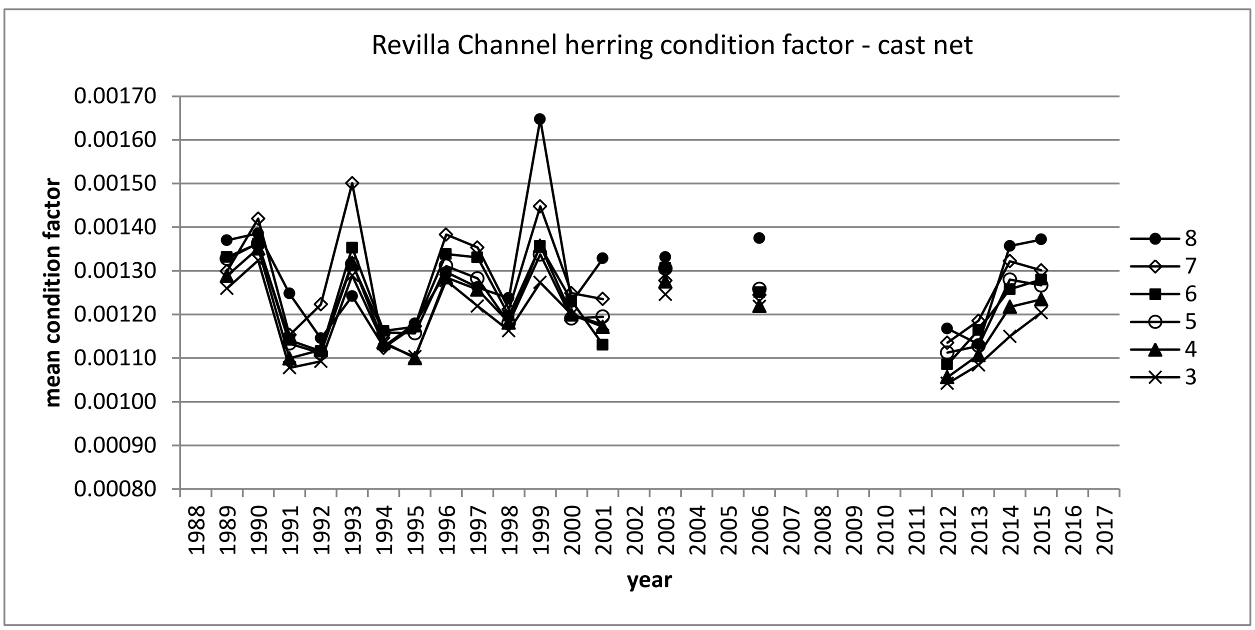

Figure 61.–Mean condition factors of age-3 through age-8 herring for the Revilla Channel spawning population, based on spring cast net samples taken during active spawning.

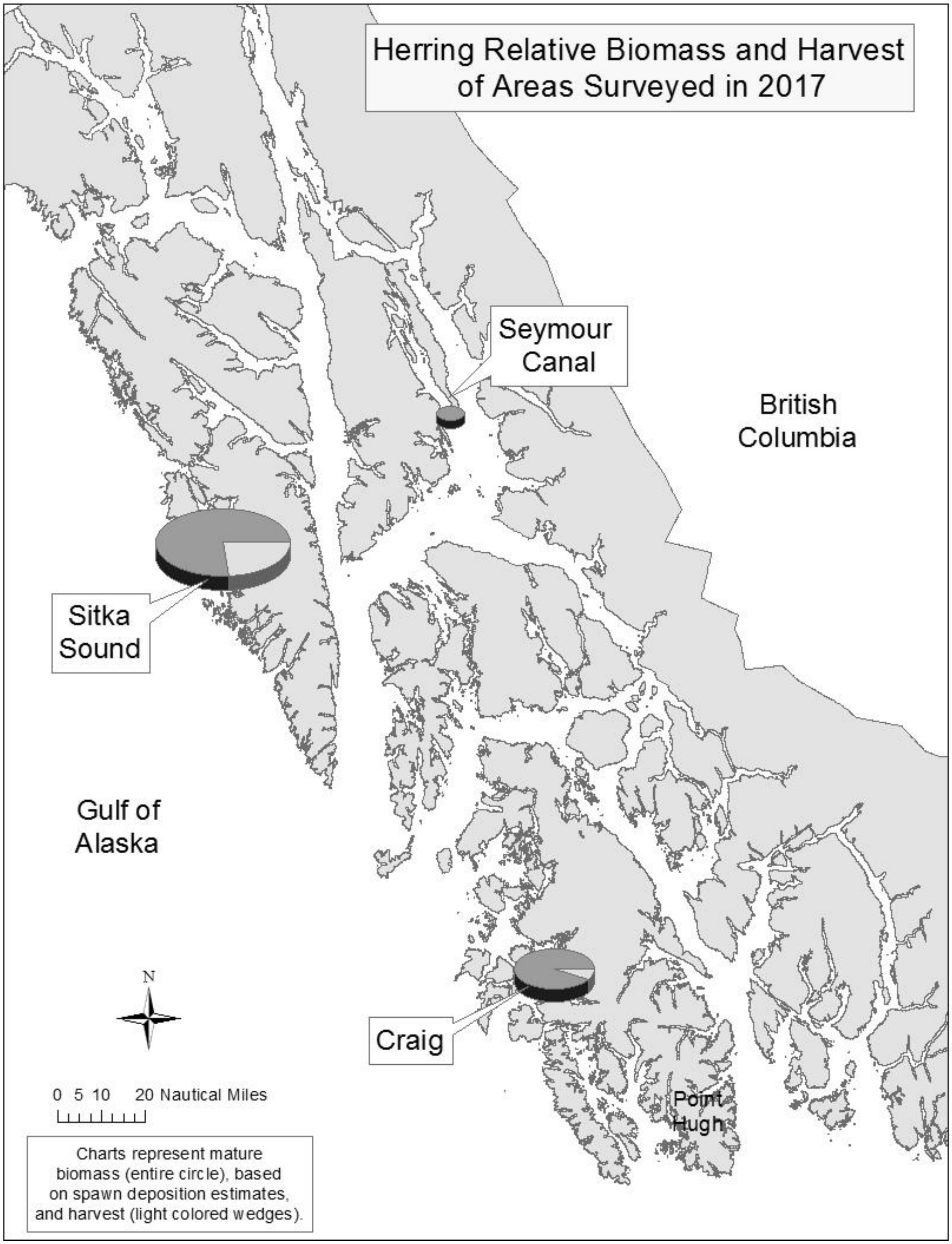

Figure 62.–Relative magnitude of herring spawning stocks and harvest levels in Southeast Alaska, based on biomass estimates converted from spawn deposition estimates. White wedges are intended to provide approximate indication of relative harvest but do not represent actual exploitation rate.

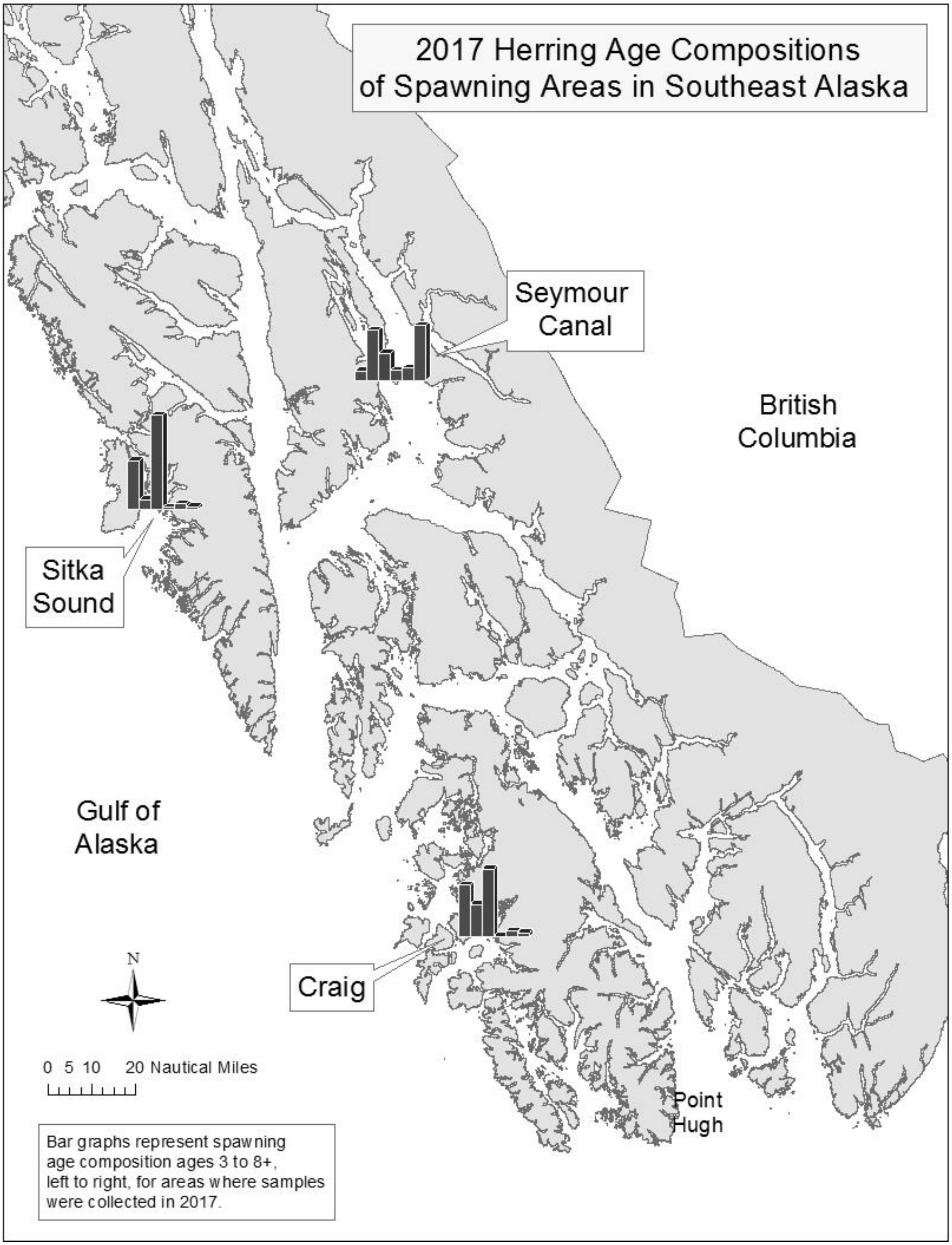

Figure 63.–Regional comparison of age composition of herring spawning stocks in Southeast Alaska from cast net sampling.

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. saccharina, L. yezoensis (when isolated and identifiable)*
LBK	Large Brown Kelps	Five-ribbed kelp, three-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 sp.*
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 Revilla Channel, Craig, and West Behm Canal (Ketchikan Management Area), Southeast Alaska in 2017.

Total spawn documented by ADFG in Craig for 2017 was 22.8 nautical miles.

Total spawn documented by ADFG in Revilla Channel for 2017 is 6.4 nautical miles. All observed spawn was in state waters (none on Annette Island).

Total spawn documented by ADFG in West Behm Canal for 2017 is 0.7 nautical miles.

Craig	
March 17, 2017	First aerial survey. Little herring activity in the Craig area.
March 21, 2017	No spawn. Large numbers of predators in the Craig area.
March 24, 2017	**Spot spawn at Fish Egg Island and 1 nmi. of spawn near Blanquizal Point**. **20** pounds are estimated to be in fishing conditions.
March 25, 2017	**0.25 nmi. spawn near Blanquizal Point.** Predator activity continues in the Craig area.
March 26, 2017	**1 nmi. of spawn near Blanquizal Point. 1 nmi. of spawn near Point Ildefonso.** Predator activity continues in the Craig area.
March 27, 2017	**2 nmi. of spawn near Blanquizal Point. 2.5 nmi. of spawn near Point Ildefonso. 1.5 nmi. of spawn on Fish Egg Island.**
March 28, 2017	**3 nmi. of spawn near Blanquizal Point. 5 nmi. of spawn near Point Ildefonso. 4 nmi. of spawn on Fish Egg Island.** Hours are expanded for fishery.
March 29, 2017	**1.5 nmi. of spawn near Blanquizal Point. 1 nmi. of spawn at fish Egg Island. 4 nmi. of spawn near Point Ildefonso.** Boundary expands for fishery.
March 30, 2017	**0.25 nmi spawn at Blanquizal Point.** Predator and herring activity are diminishing throughout the area.
April 1, 2017	**0.5 nmi. spawn at Blanquizal Point.**
April 2, 2017	**Small spawn at Blanquizal Point.**
April 3, 2017	No activity observed
April 8, 2017	**3.8 nmi. spawn at St Phillips Island.**
April 9, 2017	**2 nmi. spawn at St Phillips Island.**
April 10, 2017	No activity observed

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Revilla Channel	
March 17, 2017	Partial survey. No activity observed.
March 21, 2017	Predator activity on east shore of Annette Island
March 25, 2017	No activity seen
March 28, 2017	Predator activity on East shore of Annette Island.
March 30, 2017	Little herring activity in the area.
April 3, 2017	**0.25 miles of spawn at Cat Island.**
April 4, 2017	**2 miles of spawn on Mary, Cat and Dog Islands and on Grave Point**.
April 5, 2017	GALE – No survey **– Spawn Assumed**
April 6, 2017	**3 miles of spawn at Cat, Dog and Village Island and on Grave Point.**
April 7, 2017	**0.75 nmi. spawn on Cat Island.**
April 8, 2017	No activity observed.

West Behm	
April 3, 2017	First aerial survey. No activity observed.
April 6, 2017	No activity observed. Few predators.
April 8, 2017	No activity observed.
April 12, 2017	No activity observed.
April 14, 2017	Increase in predator activity
April 15, 2017	No activity observed
April 18, 2017	**Spot Spawns observed in Tongass Narrows**
April 19, 2017	No activity observed
April 21 2017	No activity observed

Appendix C2.–Aerial and skiff herring spawn surveys by date, in Sitka Sound and Hoonah Sound (Sitka Management Area), Southeast Alaska in 2017.

<u>March 10:</u> 1000–1115. Dupuis/Coonradt. Today's aerial survey covered Sitka Sound north of Povorotni Point, including Salisbury Sound. No herring or herring spawn was observed. The highest concentration of herring predators was seen between Bieli Rock and Inner Point. Numerous whales were seen working in deeper waters west of Bieli Rock and approximately 400 sea lions in several large groups holding off the rock piles. Additionally, two whales were observed in deeper waters between the Siginaka Islands and Promisla Bay; two whales were seen near Vitskari Rocks. In Salisbury Sound, two whales were seen in the vicinity of Kakual Narrows and numerous small groups of sea lions were heading north in Neva Strait. South of Sitka, there were two whales in Eastern Channel and one small group of sea lions. The observed distribution of herring predators was normal for this date.

<u>March 14:</u> 0900–1130. Dupuis/Coltharp. There was no aerial survey today due to weather. Today's boat survey covered Nakwasina Sound, Krestof Sound, Magoun Islands, Hayward Strait, and the waters around Bieli Rock. No predators were observed until Hayward Strait. Approximately 50 sea lions were holding off Guide Island and about 100 were in the vicinity of Bieli Rock (some were to the north by Crow Island). The whale activity appeared to be concentrated in the area west of Bieli Rock. Two whales were seen just to the west of Gagarin Island.

<u>March 15:</u> 0800–1400. Dupuis/Coltharp. There was no aerial survey today due to weather. Two test fishing vessels made sets today. The F/V Perseverance and F/V Reiver were located west of Bieli Rocks near Kamenoi Pt. F/V Reiver had a water haul and then proceeded north into Krestof Sound. The vessel did not detect herring until it arrived at Neva Point where it made a set, but all the fish in the set were small and likely immature. The F/V Perseverance detected a large mass of herring in the waters off Kamenoi Pt. and attempted a set. The vessel caught a small number of fish, which were sampled. It appeared that the large body of fish was too deep for successful fishing.

- *F/V Perseverance*: Kamenoi Pt. 0.5 ton set @ 1130 hrs. 8.9% mature roe; 133 grams.

The Alaska Department of Fish and Game announced that the Sitka Sound sac roe herring fishery will be on 2-hour notice effective 8:00 a.m., Friday, March 17, 2017, based on today's sample.

<u>March 16:</u> 0800–1100. Coonradt. Today's aerial survey covered Sitka Sound from W. Crawfish Inlet to Hayward Strait. Whales were observed working in the waters off Makhnati Island northwest to Bieli Rocks. Dupuis/Coltharp took the state boat to the waters west of Biele Rocks to rendezvous with the F/V Invincible and F/V Defiant. Both vessels saw a large amount of fish, but the fish were too deep to set. No samples were taken today. The two hour notice meeting occurred at Centennial Hall at 2:00 pm.

<u>March 17:</u> 0800–0930. Coonradt. Today's aerial survey covered W. Crawfish Inlet to Hayward Strait. Herring predators were concentrated west of Bieli Rock, Crow Pass, and east of Middle Island. There was an abundance of fish in Crow Pass and to the south of the Chaichei Islands, and west of Bieli Rock. Several test sets were made by the F/V Invincible, F/V Revival, and F/V Pacific Fisher.

- *F/V Invincible*: N. Crow Pass. 40 ton set @ 0800 hrs. 8.7% mature roe; 1.6% immature roe; 47.5% female; 153 grams.
- *F/V Invincible*: W. Gagarin. 10 ton set @ 1030 hrs. 0.13% mature roe; 8.23% immature roe; 57.3% female; 75 grams.
- *F/V Revival*: N. Middle. 35 ton set @ 1315 hrs. 8.7% mature roe; 1.03% immature roe; 40.3% female; 138 grams.

The *R/V Kestrel* arrived in Sitka today. The vessel survey detected large numbers of herring in Crow Pass and off the northeast side of Middle Island.

March 18: 0800–0900. Coonradt/Dupuis. Today's aerial survey covered Sitka Sound from 3 Entrance Bay to the Magoun Islands. Herring predators were concentrated around the Chaichei Islands, Gagarin Island, Crow Island, and Middle Island. Whales were still working deep waters west of Bieli Rock. A few whales were observed working east of Promisla Bay and south of The Siginaka Islands. Large amounts of herring were observed by the R/V Kestrel and the commercial fleet in the waters south of Bieli Rock and the Chaichei Islands. A test set indicated that herring maturity was increasing. Herring were moving fast and were deep. Furthermore, the fish were just to the south of the closure line and department staff were concerned that the flood tide would push fish in to closed waters by the time a fishery would be open.

- F/V El Dorado: South of Bieli Rock. 200 ton set @ 1100 hrs. 9.5% mature roe; 0.57% immature roe; 39% female; 138 grams.

March 19: 0830–0900. Coonradt/Dupuis. Today's aerial survey covered Sitka Sound north of 3 Entrance Bay to the Magoun Islands. Poor light conditions made spotting difficult during the flight. The number of whales observed working the deeper waters west of Bieli Rock appeared to be smaller than in previous days. Several groups of sea lions were seen near Hayward Strait, Gagarin Island, Chaichei Islands, and the Siginaka Islands. The R/V Kestrel detected a large mass of fish Hayward Strait and along the Kruzof Island shoreline near Mountain Point. The F/V Shadowfax, F/V Crimson Beauty, F/V Pillar Bay, and F/V Wind Walker made test sets. The test fishery samples indicated quality fish.

- F/V Shadowfax: Mt. Point. 300 ton set @ 0800 hrs. 11.27% mature roe; 1.07% immature roe; 50.64% female; 128 grams.
- F/V Pillar Bay: Rob Point. 300 ton set. 10.9% mature roe; 0.4% immature roe; 37% female; 130 grams.
- F/V Wind Walker: Hayward Strait. 30 ton set. 10.7% mature roe; 1.6% immature roe; 42% female; 112 grams.

The decision to open the fishery was made at 1300 hrs for an open period beginning at 1430 hrs. Open waters for the fishery were north of a line from Kresta Point to Inner Point and south of a line from Olga Point to Partof Point; these are the waters of Hayward Straight and Krestof Sound. An announcement at 1730 hrs advised the fleet that the fishery would close at 1750 hrs. The estimated harvest from this open period was 3,500 tons of herring.

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<u>March 20</u>: 0800–0915. Coonradt/Dupuis. Today's aerial survey covered from Sitka Sound from Eastern Channel to Salisbury Sound. Concentrations of herring predators were found around Middle Island, the Siginakas, Magoun Islands, and Mt. Point and Inner Point on the Kruzof

shoreline. A small amount of spot spawn was observed by a private dock on the southern end of Middle Island. **Total spawn was 0.08 nmi.**

March 20 was a stand down day for the fishery due to the level of harvest on the March 19.

<u>March 21:</u> 0730–0830. Coonradt/Dupuis. Today's aerial survey covered the area from Eastern Channel to Krestof Sound. The largest concentration of whales was observed in the deeper waters west of Bieli Rock. Large concentrations of sea lions were observed in Hayward Strait and around the Magoun Islands. Several whales were observed near the Chaichei Islands and the Old Sitka Rocks.

Large numbers of fish were detected by the R/V Kestrel in the Hayward Strait area. The fishing vessels Sequel, Infinite Grace, Perseverance, Revival, and Pacific Fisher all made test sets during the early afternoon but were unable to capture enough fish for a sample. The decision was made at 1500 hrs to stand down for the day.

<u>March 22:</u> 0730–0900. Dupuis/Jensen. Today's aerial survey covered Sitka Sound from Eastern Channel to Salisbury Sound, and included Deep Inlet, Katilan Bay, Nakwasina Sound, Krestof Sound, and the Kruzof shore from Hayward Strait to Inner Point. Light conditions made for difficult spotting of herring predators; concentrations of whales and sea lions were observed in the Hayward Strait area and in the deeper waters west of Bieli Rock. Additionally, herring predators were observed on the Kruzof Island shoreline from Hayward Strait to Inner Point. Little predator activity was observed south of Sitka. The R/V Kestrel detected large numbers of herring in Hayward Strait, the Magoun Islands, and the southern end of Krestof Sound.

- F/V Pillar Bay: Hayward Strait. 300 ton set @ 0930 hrs. 11.4% mature roe; 2.2% immature roe; 59% female; 115 grams.
- F/V Invincible: Port Krestof. Unknown set size @ 1000 hrs. 10.4% mature roe; 3.7% immature roe; 46.6% female; 115 grams.
- F/V Revival: Mud Bay. 300 ton set @ 1015 hrs. 12.7% mature roe; 0% immature roe; 57.7% female; 122 grams.

Based on the results of the test samples and the large volume of fish in the area, the Sitka Sound sac roe fishery was opened for a 15 minutes today from 1300–1315 hrs. The short opening was due to the large number of fish in the area. The open area for today's fishery was the waters of Krestof Sound south of line between Partof Point and Olga Point and North of the latitude of Rob Point. Approximately 4,500 tons of herring was harvested today.

<u>March 23:</u> 0800–0900. Dupuis/Coonradt. Today's aerial survey covered Sitka Sound from Redoubt Bay to Salisbury Sound. Large concentrations of herring predators were observed in Eastern and Promisla bays, Hayward Strait, and the southern Magoun Islands. Several sea lions

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were seen in Neva Strait as well. Spot spawn was observed on south Kasiana Island and Pt. Brown. **Total spawn was 0.14 nmi**.

Today was a stand-down day for the fishery to allow industry time to process the previous day's harvest.

The R/V Kestrel did not leave port today.

March 24: 0800–0915. Dupuis/Coonradt. Today's aerial survey covered Sitka Sound from Eastern Channel to Krestof Sound. Concentrations of herring predators were again observed in Eastern Bay, Hayward Strait, and the Magoun Islands. Predator distribution was similar to that observed on the previous flight.

Today was a stand-down day for the fishery.

March 25: 0800–0915. Dupuis/Jensen. Today's aerial survey covered Sitka Sound from Eastern Channel to dry pass (northern Krestof Sound). The largest concentration of whales was in Eastern Bay and several whales appeared to be leaving Eastern Bay headed for Olga Strait. Concentrations of sea lions were seen in the Magoun Islands. While whales were observed in Hayward Strait and near the Magoun Islands, the concentrations seemed to be smaller than in the previous two days.

- F/V Invincible: Mud Bay. 100 ton set @ 0820 hrs. 11.63% mature roe. 0.27% immature roe; 51.37% female; 118 grams.
- F/V Infinite Grace: Dry Pass. Unknown set size @ 0930 hrs. 10.9% mature roe; 1.1% immature roe; 116 grams.

The Sitka Sound sac roe fishery was opened from 1200–1520 hrs. The open area was the waters of Hayward Strait, north of 57° 08.71′ N latitude; and Krestof Sound west of a line from Partof Point at 57° 13.69′ N latitude 135° 34.15′ W longitude, to Olga Point at 57° 13.72′ N latitude 135° 32.19′ W longitude. An estimated 5,200 tons of herring were harvested in this open period. This harvest brought the total cumulative herring harvest to 13,543 tons, leaving 995 tons remaining. The remaining GHL was too small to allow for a competitive opening. It was announced that the remaining GHL could only be harvested in a controlled fishery.

March 26: 0830–0930. Dupuis/Coonradt. Today's aerial survey covered Sitka Sound north of Eastern Channel. Spawn was observed west of Kresta Point and at Fred's Creek. **Total spawn was 0.33 nmi**.

March 27: 0800–0900. Dupuis/Coonradt. Today's aerial survey covered Sitka Sound north of Eastern Channel. No herring spawn was observed.

The Sitka Sound sac roe fishery was opened for a controlled fishery today from 1000–1800 hrs. The harvest from this open period was 1,050 tons of herring.

March 28: 0800–0915. Dupuis/Coonradt. Today's aerial survey covered Sitka Sound north of West Crawfish Inlet. No herring spawn was observed.

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The Sitka Sound sac roe fishery was opened for a controlled fishery today from 1000–1200 hrs. The harvest from today's period was 40 tons. The commercial fishery is now closed for the 2017 season.

March 29: **0800–0900**. Dupuis/Coonradt. Today's aerial survey covered Sitka Sound north of East Channel. Active spawn was observed on southwestern Middle Island, southern Crow Island, and eastern Gagarin Island. **Total spawn was 1.1 nmi**.

March 30: **0800–0900**. Dupuis/Coonradt. Today's aerial survey covered Sitka Sound north of Eastern Channel to Salisbury Sound. Active spawn was observed on Middle, Crow, and Gagarin islands, as well as the southern Kruzof Island shoreline. **Total spawn was 4.6 nmi**. The majority of spawn was from southern Kruzof between Sitka Point and Shoals Point.

March 31: **0800–0900**. Dupuis/Coonradt. Today's aerial survey covered Sitka Sound north of Eastern Channel to Krestof Sound. Active spawn was observed on Middle and Crow islands, the Kruzof Island shoreline north of Shoals Point, and a small area near Sandy Beach on Halibut Point Road. **Total spawn was 2.3 nmi**.

April 1: Coonradt flight. Today's aerial survey covered Sitka Sound from Eastern Channel to Hayward Strait. Active spawn was observed on Middle and Crow islands, the Kruzof Island shoreline north of Shoals Point, and in Promisla Bay. **Total spawn was 4.6 nmi**.

April 2: Coonradt flight. Today's aerial survey covered Sitka Sound from Eastern Channel to Hayward Strait. Active spawn was observed on Middle, Crow, and Gagarin islands, and on the Kruzof Island shoreline north of shoals point. **Total spawn was 3.6 nmi**.

April 3: **1015–1115**. Dupuis/Coonradt. Today's aerial survey covered Sitka Sound north of Eastern Channel to Salisbury Sound. Active spawn was observed on southern Middle Island, Crow and Gagarin islands, two Islands in the Chaichei group, southern Kasiana Island, and the Kruzof Island shoreline north of shoals point. **Total spawn was 7.4 nmi**.

April 4: **0800–0830**. Coonradt. Today's aerial survey was brief due to weather and covered Sitka Sound north of Eastern Channel to Krestof Sound. Small amounts of spawn were observed on southern Middle Island, southern Kasiana Island, and on the small island immediately south of Crow Island. An additional small area of spawn was seen on the Kruzof Island shoreline north of Shoals Point. **Total spawn was 0.8 nmi**. **Cumulative spawn through this date is 12.5 nmi**.

April 5: **1200–1300**. Coonradt. Today's aerial survey covered Sitka Sound north of Eastern Channel to Salisbury Sound. A small amount of spawn was observed on southern Middle Island. **Total spawn was 0.3 nmi.**

April 6: **0800–0900.** Dupuis/Coonradt. Today's aerial survey covered Sitka Sound from Windy Pass to Salisbury Sound. A few schools of herring were observed around Middle Island and Crow Island, but no herring spawn was seen.

April 7: **0800–0900**. Dupuis/Coonradt. Today's aerial survey covered Sitka Sound from Makhnati Island to Salisbury Sound. Herring predators were observed in Krestof Sound, Salisbury Sound, and along the Kruzof Island shoreline from Hayward Strait to Fred's Creek.

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Herring spawn was observed in several locations in Sitka Sound from the Makhnati Island to theuthern Magoun Islands. The Siginaka Islands, Big Gavinski Island, and Point Brown had the largest amounts active spawn. **Total spawn was 7.4 nmi**.

April 8: 0900–1000. Coonradt. Today's aerial survey covered Sitka Sound from Eastern Channel to Salisbury Sound. Herring predator activity was observed in Krestof Sound, Salisbury Sound, and from Hayward Strait to Fred's Creek. Active herring spawn was observed in a widespread area from Jamestown Bay to the Magoun Islands. **Total spawn was 18.9 nmi. Cumulative spawn mileage to date is 33.4 nmi.**

April 9: 0900–1030. Dupuis/Coonradt. Today's aerial survey covered Sitka Sound from Eastern Channel to Salisbury Sound. Herring predators were observed in Salisbury Sound and from Hayward Strait to Fred's Creek. **Total spawn was 3.3 nmi**. Additionally, a portion of Hoonah Sound was covered in the survey. No herring or herring spawn were observed in Hoonah Sound.

April 10: 0800–0900. Coonradt/Jensen. Today's aerial survey covered Sitka Sound north of Eastern Channel to Salisbury Sound. Spawn was observed in Degroff Bay. **Total spawn was 0.5 nmi**. Skiff crews from the R/V Kestrel mapped approximately **2.0 nmi of spawn** in addition to what was mapped by aerial surveys.

April 11: 0800–0900. Dupuis/Jensen. Today's aerial survey covered Sitka Sound north of Eastern Channel to Salisbury Sound. Active spawn was observed in Eastern and Promisla bays and in Hayward Strait near Brent's Beach. **Total spawn was 1.4 nmi**. Skiff crews from the R/V Kestrel mapped an additional **7.0 nmi of spawn** in addition to what was mapped by aerial surveys.

April 12: 0800–0900. Dupuis/Jensen. Today's aerial survey covered Sitka Sound north of Eastern Channel to Salisbury Sound. Active spawn was observed in Eastern and Promisla bays, Middle Island, the Siginaka Islands, and in Hayward Strait near Kresta Point. **Total spawn was 1.5 nmi**.

April 13: 0800–0900. Dupuis/Jensen. Today's aerial survey covered Sitka Sound north of Three Entrance Bay to Salisbury Sound. Active spawn was observed in Promisla Bay, Middle Island, Kasiana Island, in Hayward Strait near Kresta Point and Brent's Beach, and near Mountain Point. **Total spawn was 1.5 nmi**.

April 14: 0800–0900. Dupuis/Jensen. Today's aerial survey covered Sitka Sound north of Three Entrance Bay to Salisbury Sound. Active spawn was observed in Hayward Strait near Kresta Point and Brent's Beach, and in northern Krestof Sound. **Total spawn was 1.5 nmi**.

April 15: 0730–0830. Dupuis. Today's aerial survey covered Sitka Sound north of Three Entrance Bay to Salisbury Sound. Active spawn was observed in Sukoi Inlet and west of Shoals Point. Total spawn was 1.0 nmi.

April 16: Coonradt. Today's aerial survey covered Sitka Sound north of Three Entrance Bay to Salisbury Sound. Active spawn was observed in multiple locations including: west of Shoals Point, Hayward Strait, Sukoi Inlet, Kasiana Island, the Apple Islands, and Galakin Island. **Total spawn was 6.7 nmi.**

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April 17: **0800–0900.** Coonradt/Dupuis. Today's aerial survey covered Sitka Sound north of Three Entrance Bay to Salisbury Sound. Active spawn was observed in Sukoi Inlet, Salisbury Sound, and Olga Strait. **Total spawn was 3.0 nmi.**

April 18: **0800–0900.** Coonradt/Dupuis. Today's aerial survey covered Sitka Sound from Crawfish Inlet to Salisbury Sound. Active spawn was observed near Sevenfathom Bay, Dorothy Narrows, Goddard Hot Springs, Fred's Creek, Neva and Olga strait, and in Salisbury Sound. **Total spawn was 3.5 nmi**.

April 19: **0800–0930.** Coonradt/Dupuis. Today's aerial survey covered Sitka Sound from Crawfish Inlet to Salisbury Sound. Active spawn was observed near Dorothy Narrows and Sevenfathom Bay, Hayward Strait, and Salisbury Sound. **Total spawn was 2.4 nmi**.

April 20: **0800–0930.** Dupuis**.** Today's aerial survey covered Sitka Sound from Crawfish Inlet to Salisbury Sound. Active spawn was observed in Salisbury Sound. **Total spawn was 0.8 nmi**.

April 21: **0800–0930**. Coonradt/Dupuis. Today's aerial survey covered Sitka Sound from Crawfish Inlet to Salisbury Sound. A small amount of active spawn was observed in Salisbury Sound. No estimates of spawn mileage were made.

April 24: Coonradt/Dupuis. Today's skiff survey covered the northern half of Sitka Sound Olga Strait to Salisbury Sound. Approximately **1.8 nmi of spawn** was added to the cumulative mileage in Sitka Sound.

April 25: Coonradt/Dupuis. Today's skiff survey covered the southern half of Sitka Sound from Sevenfathom Bay to Galankin Island. No new spawn was added to the cumulative spawn mileage for Sitka Sound.

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, 2017.

Bradfield Canal

Not surveyed in 2017.

Vixen Inlet/ Union Bay/Emerald Bay

Total miles of spawn: ~4.4 nm

Spawning dates: 4/14 through 4/19

Peak spawning: 4/17

4/9 No active spawn, one school of herring observed, 12 sea lions, one whale.

4/14 Two small areas of older milt, one herring school, 37 sea lions.

4/15 One herring school, 54 sea lions, 1,000 scoters.

4/16 Three small areas of older milt, 10 schools of herring, 86 sea lions, 1,500 scoters.

4/17 **0.75 nm of active spawn**, seven schools of herring, 77 sea lions.

4/18 Two spot spawns, five herring schools, 55 sea lions, 4.4nm egg deposition by skiff survey.

4/19 No active spawn, three herring schools, 35 sea lions, 1,000s of scoters and gulls.

4/21 No herring spawn or schools observed, five sea lions, 1,000s of scoters and gulls.

4/25 No herring spawn or schools observed, 51 sea lions, 1,000s of scoters and gulls.

Onslow/Stone/Brownson Island/Canoe Pass

Total miles of spawn: 0.0 nm

4/9 No herring spawn or schools observed, 25 scoters.

4/14 No herring spawn or schools observed, one sea lion.

4/15 No herring spawn or schools observed.

4/16 No herring spawn or schools observed.

4/18 No herring spawn or schools observed.

4/19 No herring spawn or schools observed.

4/21 No herring spawn or schools observed.

4/25 No herring spawn or schools observed.

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Zimovia St. and Eastern Passage

Total miles of spawn: ~6.3 nm

Spawning dates: 4/4 through 4/14

Peak spawning: 4/5

4/9 No herring spawn or schools observed, 160 scoters.

4/14 **2.0 nm of active**, two areas of older milt, 11 herring schools, 12 sea lions, one whale.

4/15 No herring spawn, 10 herring schools, 17 sea lions, 5,000 scoters.

4/16 Several dozen schools of herring, 1,000s of scoters.

4/17 One dozen schools of herring, 1,000s of scoters.

4/18 No herring spawn or schools observed, 1,000s of scoters.

4/19 No active spawn, six herring schools, 1,000s of scoters and gulls.

4/21 No active spawn, a dozen herring schools, 1,000s of scoters and gulls.

4/25 No active spawn, six herring schools, 1,000s of scoters and gulls.

Bear Creek

Not surveyed in 2017.

Farragut Bay

4/24 No herring spawn or schools observed.

4/25 No herring spawn or schools observed.

Hobart Bay

Total miles of spawn: ~0.2 nm

Spawning dates: 4/24

Peak spawning: 4/24

4/24 **0.2 nm of active spawn**.

4/25 No herring spawn or schools observed.

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Port Houghton

4/24 No herring spawn or schools observed.

4/25 No herring spawn or schools observed.

Sunset Cove/Windham Bay

4/24 No herring spawn or schools observed.

4/25 No herring spawn or schools observed.

Gambier Bay/Pybus Bay

Not surveyed in 2017.

Port Camden

Not surveyed in 2017.

Tebenkof Bay

Not surveyed in 2017.

Appendix C4.–Aerial and skiff herring spawn surveys by date, in Seymour Canal (Juneau Management Area), in Southeast Alaska, 2017.

Number of times surveyed: 14

Total miles of spawn: 4.2

Spawning dates: 5/8 – 5/10

Peak spawn: 5/9

4/17: No herring or herring spawn; 58 SL, most between Blackjack and Pt Hugh, 2 whale. Good vis.

4/20: No herring or herring spawn; 89 SL, most between BlackJack and Pt Hugh, 6 whales. Good vis.

4/24: Herring on beach from Cloverleaf Rks to Dogleg. No spawn. 115 SL, 3 whales. Good vis.

4/25: No herring or herring spawn; 106 SL, 8 whales. Excellent vis.

4/26: No herring or herring spawn; 97 SL, 5 whales. Good vis. Survey conducted by Petersburg staff.

4/28: No herring or herring spawn; 50 SL, 4 whales. Good vis.

5/1: No herring or herring spawn; 87 SL, no whale. Good to fair vis.

5/4: No herring or herring spawn; 110 SL, 9 whales. Excellent vis.

5/6: No herring or herring spawn; 90 SL, 4 whales. Excellent vis.

5/8: 0.3nm of active spawn, 5 spot spawns between D10/11 boundary and Pt Hugh; 102 SL, 10 whales. Schools of fish observed on beach NW and NE of Pt Hugh, 3 small schools also observed on beach on south end of Faust Island. Good vis.

5/9: 3.1nm of active spawn concentrated around Pt Hugh and shoreline a bit north of Swimming Pool south to Blackjack Cove; remnant spawn still visible from yesterday; no herring observed; excellent vis.

5/10: 0.8nm of active spawn concentrated at Twin Islands and a bit farther south; no herring observed; excellent vis.

5/11: No herring or herring spawn; 32 SL and no whales observed. No remnant spawn observed. Good vis.

5/13: No herring or herring spawn; 63 SL, no whales observed. Good vis.

Appendix C5.–Aerial and skiff herring spawn surveys by date, in Tenakee Inlet (Juneau Management Area), in Southeast Alaska, 2017.

Number of times surveyed: 14

Total miles of spawn: 2.1

Spawning dates: 5/13–5/16

Peak spawn: 5/13; 5/16

4/17: No herring or herring spawn; 95 SL – most in 3 large inactive groups, one near Crab Bay, one off Kadashan, and on near Cannery Point haulout. 1 whale observed N of Basket Bay in Chatham. Excellent vis.

4/20: No herring or herring spawn; 112 SL – same two groups with more at the haulout. No whale observed. Good vis.

4/24: No herring or herring spawn; 51 SL no whales. Excellent vis.

4/28: No herring or herring spawn; 40 SL 1 whale. Good vis.

5/1: No herring or herring spawn; 76 SL, 2 whale. Good vis.

5/4: No herring or herring spawn; 8 SL, no whales. Excellent vis.

5/8: No herring or herring spawn; 10SL, no whales. Excellent vis.

5/11: reported 0.5nm of active spawn inside of Strawberry Islands (Randy called in report)

5/12: Four major schools of herring pressed up against the beach on the west side of the Kadashan River flats extending west towards Crab Bay, one small school on the east side of Kadashan flats and one school north of Saltery Bay. 2 SL, 2 whales. Excellent vis.

5/13: Approximately 0.7nm of active spawn on both sides of Kadashan River flats, west side had very light spawn and east side was heavier with more mileage; two schools of herring on beach on west side observed; 6 SL, no whales observed. Good vis (low light due to low cloud ceiling).

5/14: One spot spawn occurring right off the LTF at the south entrance to Crab Bay; three small school and one larger school in the shallows just east of the active spawn; 3 SL, no whales observed. Good vis (low light but very clear water).

5/15: One small spot spawn west of Kadashan River flats with remnant spawn observed in the water about a half-mile further west around an off-shore reef; two good-sized schools on the beach on the east side of the flats near Strawberry Island; 1 SL, no whales between Corner and Crab bays; and 7SL, 1 whale between Corner Point and South Passage Point. Excellent vis.

5/16: Approximately 0.6nm of active spawn in two sections: one on the west side of the Kadashan River flats and one west of Corner Bay; no schools of fish observed; 1 SL, no whales between Crab and Corner bays and 1 SL, no whales between Corner and South Passage points. Excellent vis.

5/17: No herring or herring spawn; 2 SL, no whales. Excellent vis.

Appendix C6.–Aerial and skiff herring spawn surveys by date, in Lynn Canal (Juneau Management Area), in Southeast Alaska, 2017.

Number of times surveyed: 11

Total miles of spawn: 1.4

Spawning dates: 4/28 – 4/30

Peak spawn: 4/28

4/17: No herring or herring spawn; 34 SL in Berners Bay, few in Lynn Canal no whales, no eulachon activity. Good vis, but much brown water.

4/20: No herring or herring spawn; 70 SL and 1 whale in Berners Bay, no eulachon activity, good vis.

4/24: No herring or herring spawn; 37 SL and 3 whale; no eulachon activity.

4/28: 0.9 nm active spawn between Pt Bridget and Cowee Creek; 30 SL, no whales or herring schools; 1000s of scoters; no eulachon activity.

4/29: 0.5 nm active spawn between Pt Bridget and Cowee Creek; 107 SL, 3 whales. Predators in Slate Cove suggestion eulachon present. Good vis.

4/30: 0.25 nm active spawn between Pt Bridget and Cowee Cree; 60 SL, 3 whales. Seal and birds at edge of flats. Good vis.

5/1: No herring or herring spawn; 28 SL and no whale; still aggregation of seal at edge of flats.

5/4: No herring or herring spawn; 9 SL, 3 whales. Excellent vis

5/8: No herring spawn; 9 SL, 0 whales. Good vis. Several small schools observed in Auke Bay and one in north arm of Tee Harbor.

5/12: No herring spawn; 23 SL, no whales. Good vis except in northern Berners Bay. Many schools observed in Auke Bay and Indian Cove had an impressive concentration of fish in the shallows.

5/18: No herring spawn observed, schools of herring in Tee Harbor and at the mouths of Stink Creek and the creek to the north.

Appendix C7.–Aerial and skiff herring spawn surveys by date, in Port Frederick, Oliver Inlet, and Stephens Passage (Juneau Management Area), in Southeast Alaska, 2017.

Port Frederick

Number of times surveyed: 9

Total miles of spawn observed: 0

4/17: No herring or herring spawn; 1 SL no whale. Many small schools of baitfish.

4/20: No herring or herring spawn; no predators observed. Only 2 schools of bait.

4/24: No herring or herring spawn; no predators observed.

4/28: No herring or herring spawn; no predators observed.

5/1: No herring or herring spawn; no predators observed.

5/4: Herring schools near Burnt Point. 4 SL and 2 whales observed.

5/8: One school off Long Island. 10 SL, 3 whales (including 2 outside Cannery Point) observed.

5/12: A few schools of fish observed from south of Burnt Point to Long Island – not sure if they were herring; no herring spawn. No SL, no whales. Excellent vis.

5/15: Several schools of fish near Hoonah harbor and inside Long Island; 1 SL, 1 whale near Cannery Point. Excellent vis. Also saw several schools of herring in Spasski Bay.

Oliver Inlet

Number of times surveyed: 11

Total miles of spawn: 0

4/17: No herring or herring spawn; no predator activity.

4/20: No herring or herring spawn; no predator activity.

4/24: No herring or herring spawn; no predator activity.

4/25: No herring or herring spawn; 8 SL.

4/28: No herring or herring spawn; no predator activity.

5/1: No herring or herring spawn; no predator activity.

5/4: No herring or herring spawn; no predators.

5/8: No herring or herring spawn; no predators.

5/9: No herring or herring spawn; no predators.

5/11: No herring or herring spawn; no predators.

5/13: No herring or herring spawn; no predators.

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Taku Harbor

5/6: No herring or herring spawn; no predator activity.

Stephens Passage

4/25: No herring or herring spawn; no predator activity.

5/6: No herring or herring spawn; no predator activity.

5/9: No herring or herring spawn; no predator activity.

5/17: Approximately 2.0 nm of active spawn west of Stink Creek; 2 whales in vicinity. Excellent vis.

5/18: Fish on beach near Stink Creek and smaller creek to the west.

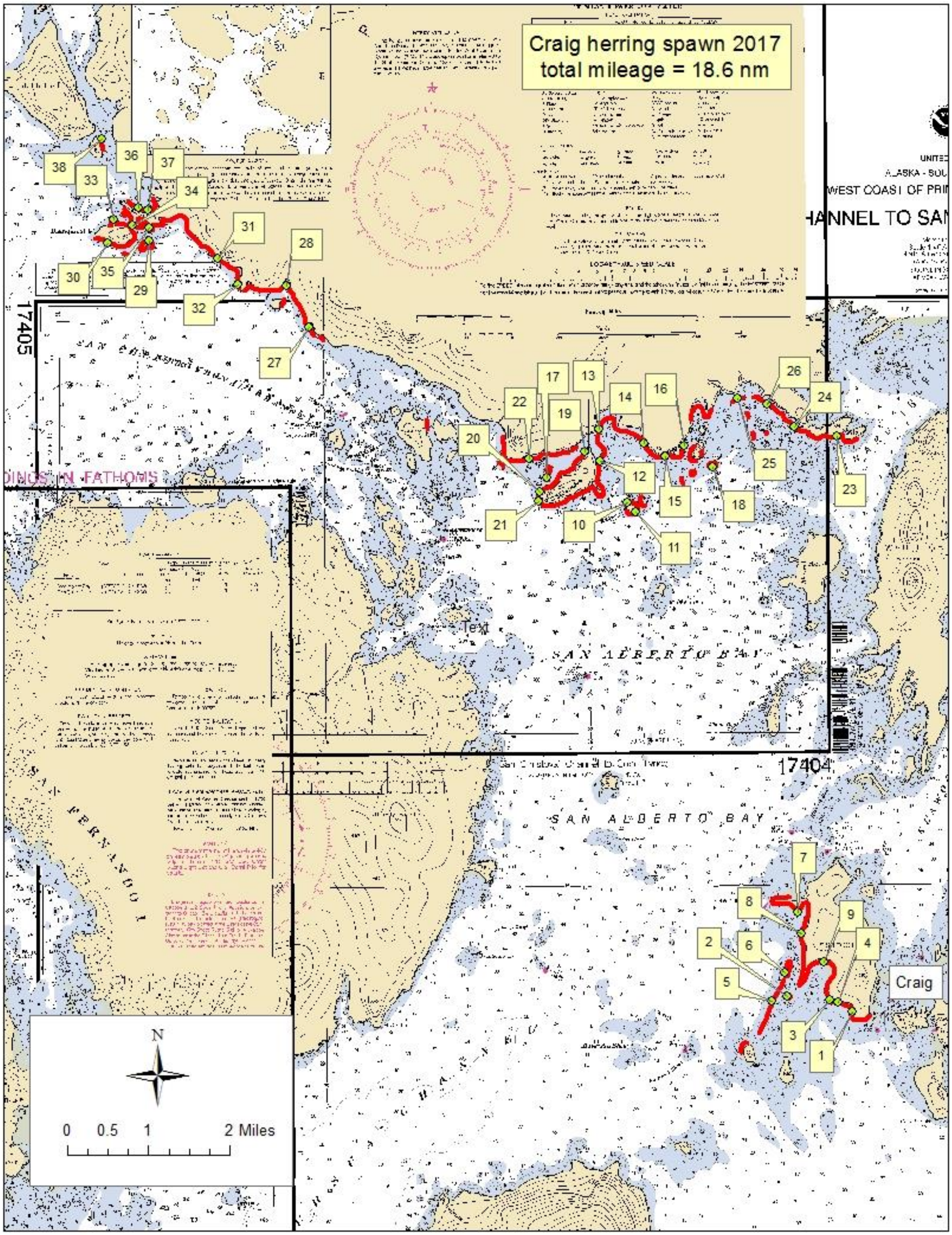
Appendix C8.–Aerial and skiff herring spawn surveys by date, in the Yakutat Management Area, in Southeast Alaska, 2017.

Yakutat Bay

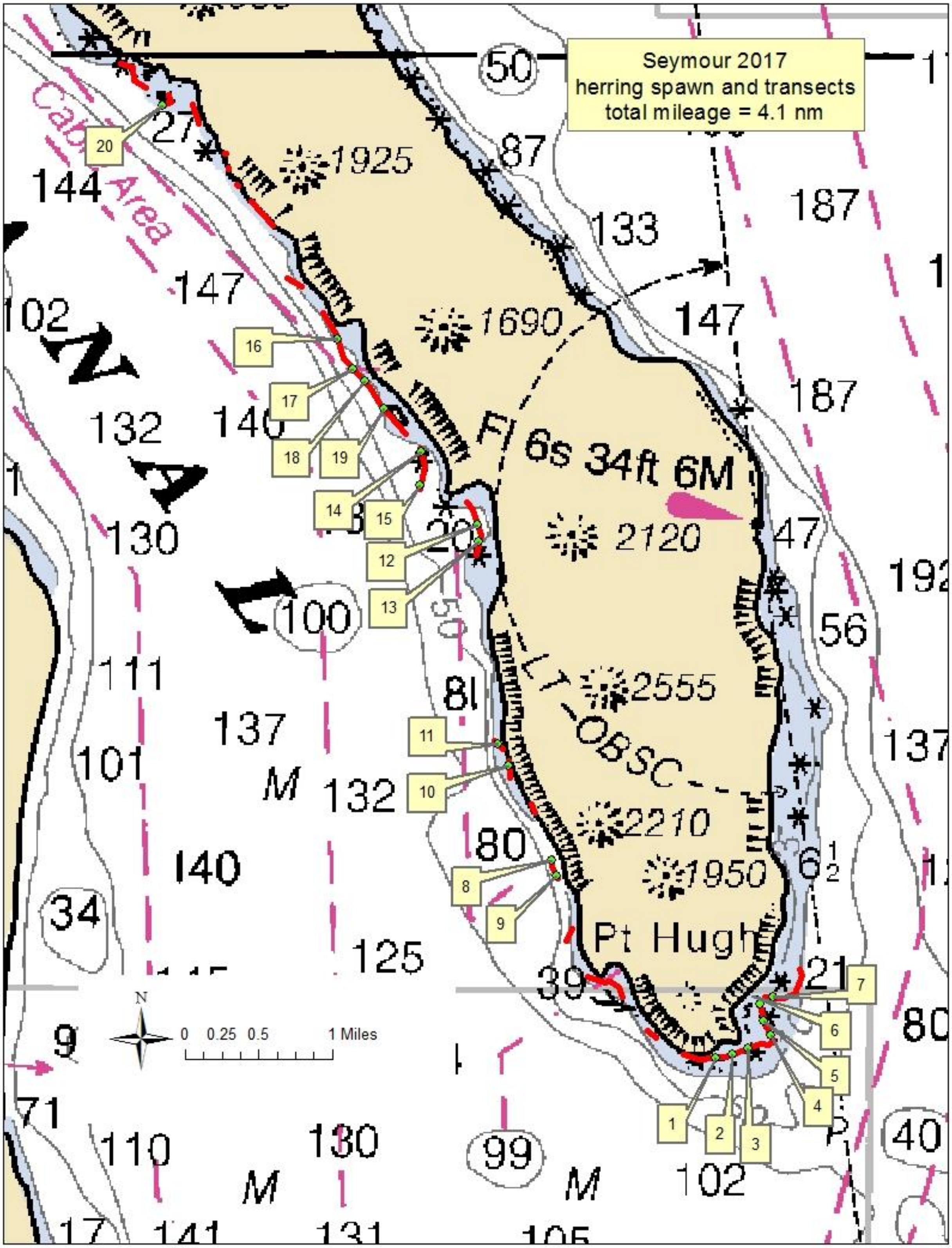
There were no aerial survey flights conducted in 2017. Total miles of spawn for the season are unknown.

APPENDIX D: SPAWN AND SPAWN DEPOSITION SURVEY TRANSECT LOCATIONS

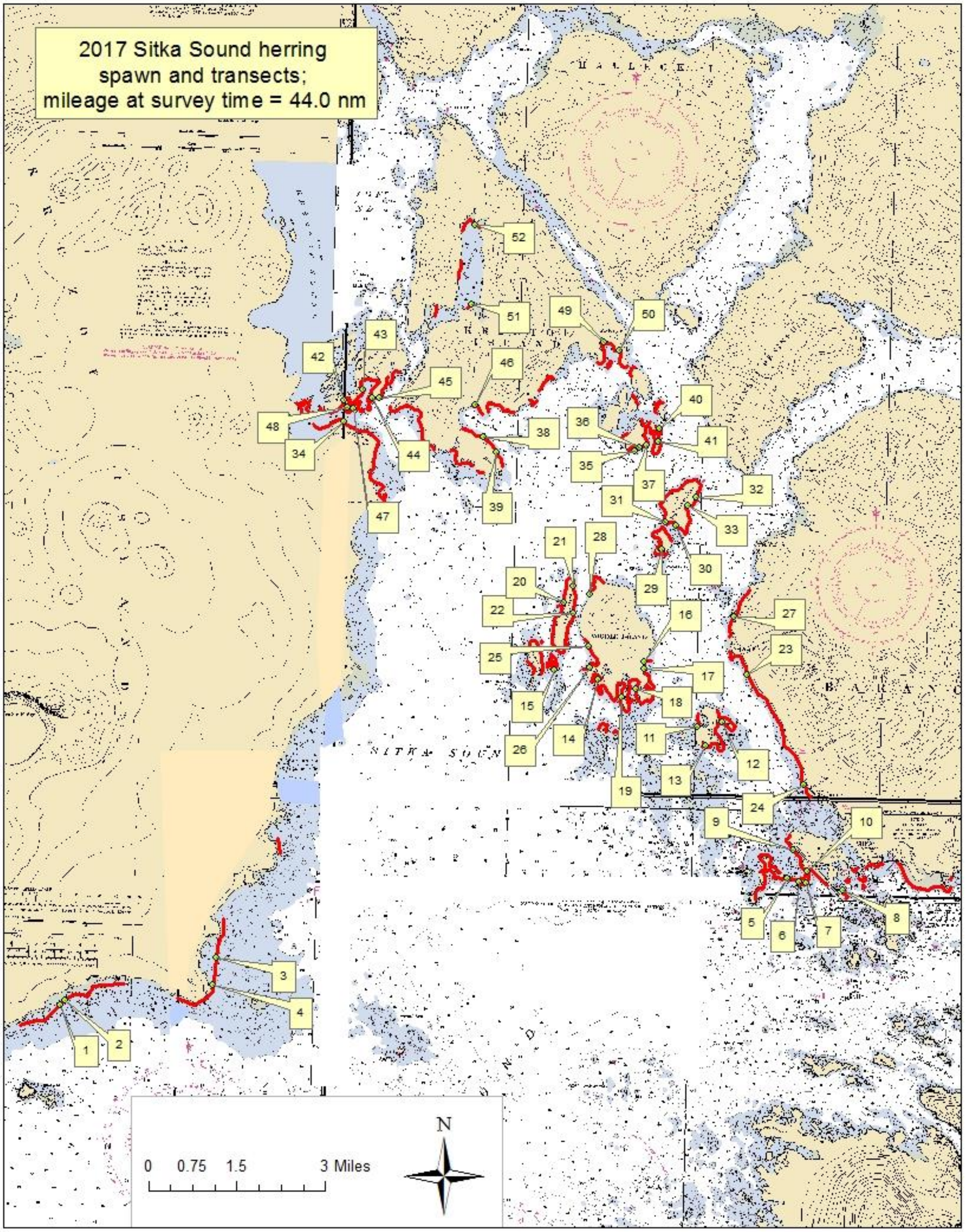
Appendix D1.–Spawn (heavy gray line) and spawn deposition survey transect locations (numbered labels) for the Craig herring stock in 2017. Spawn mileage up to date of dive survey.



Appendix D2.–Spawn (heavy gray line) and spawn deposition survey transect locations (numbered labels) for the Seymour Canal herring stock in 2017.



Appendix D3.–Spawn (heavy gray line) and spawn deposition survey transect locations (numbered labels) for the Sitka Sound herring stock first survey in 2017.



Appendix D4.–Spawn (heavy gray line) and spawn deposition survey transect locations (numbered labels) for the Sitka Sound herring stock second survey in 2017.