Fishery Data Series No. 15-10

Southeast Alaska 2014 Herring Stock Assessment Surveys

by

Kyle Hebert

May 2015

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

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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. 15-10

SOUTHEAST ALASKA 2014 HERRING STOCK ASSESSMENT SURVEYS

by
Kyle Hebert
Alaska Department of Fish and Game, Division of Commercial Fisheries, Douglas

Alaska Department of Fish and Game
Division of Sport Fish, Research and Technical Services
333 Raspberry Road, Anchorage, Alaska, 99518-1565

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Kyle Hebert
Alaska Department of Fish and Game, Division of Commercial Fisheries,
802 3rd St., Douglas, AK 99811-0024, USA

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ABSTRACT

Pacific herring, *Clupea pallasii*, is important to 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 2014, including summaries of herring spawn deposition surveys and age-weight-length sampling, which are the principle model inputs used to forecast herring abundance. Spawn deposition surveys were conducted in Sitka Sound, Craig, West Behm Canal, Ernest Sound, Hobart Bay-Port Houghton, Hoonah Sound, Tenakee Inlet, and Lynn Canal. The combined total cumulative shoreline where spawn was documented in 2014 for surveyed areas was 91.3 nautical miles. In 2014, post-fishery spawn deposition biomass estimates, combined for all surveyed stocks, totaled 76,915 tons.

During the 2013–2014 season, winter bait fisheries were opened in Craig, Ernest Sound, and Tenakee Inlet with guideline harvest levels totaling 4,351 tons. A gillnet sac-roe fishery was opened in Seymour Canal with a guideline harvest level of 772 tons. A purse seine sac-roe fishery was opened in Sitka Sound with a guideline harvest level of 16,333 tons. Spawn-on-kelp fisheries were open in Craig, Ernest Sound, and Tenakee Inlet. No commercial fisheries were opened in Hobart Bay-Port Houghton, Hoonah Sound, West Behm Canal, Kah Shakes/Cat Island, or Lynn Canal. Herring harvested commercially during the 2013–2014 season totaled over 17,000 tons, not including herring pounded for spawn-on-kelp fisheries; however, a specific value is not available due to confidentiality for some 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 herring research project in 1971 to evaluate 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. 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 Alaskan herring stocks: Sitka, Seymour Canal, Revillagigedo Channel (also called “Revilla Channel,” or the Kah Shakes/Cat Island/Annette Island area), 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 hind casting 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 2013 through spring 2014 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 for the ensuing year. These forecasts are compared to stock-specific threshold biomass levels to determine whether a fishery will be allowed in a particular area. This biomass forecast is coupled with appropriate exploitation rates to determine the allowable harvest 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 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. Since 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 after a 10-day period may 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. 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 transect placement can be subjective and depends 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 broad shallow waters (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] This and subsequent 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 distribution, potentially reduce variance, and efficiently use scheduled vessel time.

The desirable number of transects is estimated as follows:

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

where

n	=	number of transects needed to achieve the specified precision;
S_b^2	=	estimated variance in egg density among transects;
S_2^2	=	estimated variance in egg density among quadrates within transects;
$\overline{M}$	=	estimated mean width of spawn;
$\overline{m}$	=	estimated mean number of 0.1 m quadrates per transect;
x	=	specified precision, expressed as a proportion (i.e., 0.3 = 30%);
$\bar{d}$	=	overall estimated mean egg density;
t_a	=	critical t value for a one-sided, 90% confidence interval; and
N	=	estimated total number of transects possible within the spawning area.

Field Sampling

Transect direction was determined by comparing the dive location to a chart with the spawn shoreline, and 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 sub tidal zone until no further egg deposition was observed, or to a maximum of 21 m (70 fsw) of depth. The portion of transects above the waterline were surveyed by walking until the water reached diving depth (usually 2 to 3 ft), 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 used 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.

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 years 2012, 2013, and 2014 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 brown kelp” correction coefficient was applied when kelp types that fit that description were encountered, and the “eel grass” 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 $\overline{d_i}$ 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

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

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* ($\overline{d_i}$) 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*. Since 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:

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

where

b = estimated total spawning biomass;

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

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

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

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

where

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

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

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

where

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

Sea Temperature

Daily sea surface temperature was recorded in spawning areas for most stocks using submerged Onset Stowaway Tidbit™ temperature loggers. Depth of temperature recorders ranged from about 5 ft MLLW to 10 ft MLLW. Temperature was recorded daily at 6-hour intervals for a minimum of 1 year and up to 10 years, depending on spawning area. Daily mean temperature was calculated and for each spawning area, 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 2012–2013 season, several commercial herring fisheries were conducted in Southeast Alaska. 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, 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 to help alleviate concerns over adequate subsistence opportunities to harvest the resource. For the Tenakee Inlet stock, 25% of 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 2013–2014 season ranged from 1,000 tons (Hoonah Sound) to 25,000 tons (Sitka Sound).

Management Strategy

The following management plan was in place for the 2013–2014 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 principals 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 11, 2014, in Sitka Sound and ending on May 8, 2014, in the Juneau area. Notes of activity related to herring or herring spawning were recorded in logs, which are presented in Appendix C. Surveys were conducted by staff in each area office (Ketchikan, Petersburg, Sitka, Juneau, Yakutat) and covered major and 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 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 documented a total of 2.9 nmi of herring spawn on Annette Island in 2014.

SPAWN DEPOSITION SURVEYS

In 2014, spawn deposition surveys were conducted in Sitka Sound, Craig, West Behm Canal, Ernest Sound, Hobart Bay, Hoonah Sound, Tenakee Inlet, Lynn Canal, and Seymour Canal. Surveys began in Sitka Sound on April 7 and were completed in Seymour Canal on May 10 (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.

A summary of the 2014 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 2014 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 Southeast Alaska in 2014 was 91.3 nmi (Table 5). This did not include spawning in several minor spawning areas, such as around Kah Shakes-Cat Island (1.0 nmi), Annette Island (2.9 nmi), near Yakutat (no estimate), or several other areas (see Appendix C for a detailed accounting of 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 2012 through 2014 for most (8 of 9) estimators. Correction coefficients applied to 2014 spawn deposition visual estimates ranged from 0.603 to 2.827 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 9,616 herring were sampled from all stocks and gear types (cast net, purse seine, and pound) during the 2013–2014 season. Of those, 9,515 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, Ernest Sound, Hobart Bay/Port Houghton, Seymour Canal, Sitka Sound, West Behm Canal, Hoonah Sound, Tenakee Inlet, and Revilla Channel. Samples of the spawning population were collected throughout the geographic extent of the active spawn in most spawning areas (Figures 9-17). For most spawning areas, collection of samples from the spawning population was also distributed throughout the duration of spawning, or was focused on the most intense spawning events (Figure 2).

Samples were obtained from commercial and test fisheries for all areas where fisheries were conducted in 2013–2014. Fisheries sampled included Craig winter bait and spawn on kelp, Sitka sac roe and winter test fishery, Ernest Sound winter bait and spawn on kelp, Tenakee Inlet winter bait and spawn on kelp, and Seymour Canal gillnet sac roe. Samples were obtained opportunistically from vessels or tenders, during or shortly after the fishery openings. Sample locations during fisheries are also shown in Figures 9–19.

The minimum sample goal of 500 aged fish per sampling event (gear-fishery combination) was met or exceeded in nearly all cases (Tables 7 and 8). The sampling goal was not met in three instances: Seymour Canal commercial gillnet sac roe (486 samples obtained), Hobart Bay/Port Houghton cast net (472 samples obtained), and Revilla Channel / Kah Shakes-Cat Island (267 samples obtained).

Age Composition

Age composition data was obtained for all major stocks in the region. Frequency distributions of ages for all stocks are presented in Tables 9–18 and Figures 20–29.

Distributions of ages were very similar among most southern stocks. Ernest Sound, West Behm Canal, and Revilla Channel all had very similar age distributions, with relatively high proportions of age-4 and age-5 herring and lower proportions of age-3 and age-6+ ages. The age distribution of the only other southern stock, Craig, had similarities to other southern stocks, but was not as closely aligned. Like other southern stocks, age composition was comprised of relatively high proportions of age-4 and age-5 herring; however, the proportion of age-6 herring was also substantial.

Age distributions varied among northern stocks, but similarities were observed between some stocks. Most notably, stocks in Seymour Canal and Hobart Bay/Port Houghton were comprised of relatively low proportions of age-3, age-6, and age-7 herring. Age distributions in Hoonah Sound and Tenakee Inlet were similar, with ages 4, 5, and 8+ dominating those spawning populations. The Sitka Sound age distribution resembled other northern stocks; however, a difference was the low proportion of age-5 herring compared to other areas. High proportions of age-4 and age 8+ in Sitka were similar to other northern stocks.

The proportions of age-3 herring entering the mature population each year seem to fluctuate similarly among stocks in the region, with high and low years synchronized in many instances (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 2014 a relatively low level of age-3 herring was observed for all stocks, with the proportion decreasing since 2013 for all stocks.

The relationship between the latitude of spawning stocks and the proportion of mature age-3 herring (Table 19, Figure 42) continues to be relatively strong. The mean proportion of age-3 herring in the mature population is 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=0.69) (Figure 44). A weak correlation exists between the mean proportion of age-3 herring and the mean annual sea surface temperature (r^2=0.49) (Figure 45). Although there is no linear correlation between the mean proportion of age-3 herring and the mean maximum annual sea temperature, there appears to be a curvilinear relationship (dome-shaped), where the highest mean proportion of age-3 fish occurred around 14.5º C, but proportions declined as they approached higher or lower mean maximum temperatures (Figure 46).

Size-at-Age

Based on cast net samples in 2014, there is a clear distinction between mean weight-at-age for all age-classes for Sitka Sound spawning herring, and all other herring stocks in Southeast Alaska (Figure 47). Although herring at age 3 from most stocks are comparable in size, the divergence between Sitka Sound herring weight-at-age and other stocks in the region increases greatly with age. There also appears to be a difference in weight-at-age among major Southeast Alaska stocks other than Sitka Sound. Herring from some stocks appear to have consistently higher mean weights-at-age, across all ages, than others. For example, in 2014 Hoonah Sound, Craig, and Tenakee Inlet herring generally have higher weight-at-age across age groups than other stocks, with Ernest Sound, Seymour Canal, West Behm Canal, and Revilla Channel herring among the lowest weight-at-age. Tests to determine whether differences were statistically significant were not performed as the primary intent of this report is to present 2014 data with general observations of trends and characterization of stocks. Herring samples were not obtained from Yakutat in 2014.

Length-at-age has a similar pattern among stocks as weight-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 ranking of stocks for both mean length-at-age, and mean weight-at-age is very 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 a combination of both.

Trends in weight-at-age are variable among stocks (Figures 49–58). For most stocks, a common pattern is evident: weight-at-age of age-3 herring has been stable, while older ages appear to have steadily declined. The decline appears to be more pronounced for older herring. The exception is Sitka Sound, where weight-at-age appears to have increased over the past 20 years. However, data is presented only back to the late 1980s, which coincided with a period of low weight and condition of Sitka area herring. Another apparent pattern is that weight-at-age of age-4+ herring has 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).

Between 2013 and 2014 weight at age appeared to increase or remain steady for most stocks.

To determine whether changes in weight at age were due to corresponding changes in length at age, condition factors were calculated. Condition factors were calculated to index the physical dimensions of herring (i.e., weight-to-length ratio) over time, to roughly gauge herring health. Condition factors were calculated for all major stocks, which are presented in 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 more complete and consistent time series are available 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 2014 are not substantially different from those observed in 2013. The direction of change was variable among spawning areas, and visually appeared to be within the variability observed within the past few years.

Sitka Sound Winter Test Fishery

Winter sampling was conducted in Sitka Sound by the department during February 22–23, 2014 using a purse seine. The purpose of the Sitka winter sampling is to provide data to update the estimates of weight-at-age that are used in the preliminary forecast of the population, thereby allowing calculation of the final ASA-model forecast. The Sitka winter test fishery does not cover a wide geographical area or sample from a large number of herring schools, and therefore is not expected to provide an accurate estimate of age composition. However, winter estimates of weight-at-age are thought to increase accuracy of forecasts. Department analysis has shown that using weight-at-age from the winter immediately preceding the spring of the forecast results in the most accurate forecasts. The preliminary forecast for 2014 was 87,958 tons, and following the updated weight-at-age estimates from the winter test fishery, the final forecast was decreased to 81,663 tons.

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 ranged 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

Commercial sac roe fisheries were announced for the Sitka Sound and Seymour Canal in 2014. There were no sac roe fisheries announced for West Behm Canal, Hobart Bay-Port Houghton, Kah Shakes/Cat Island, or Lynn Canal areas because spawning biomass was estimated to be below threshold.

Seymour Canal

The Seymour Canal commercial gillnet fishery was placed on two-hour notice at 9:00 PM on May 6. The fishery was opened at 3:00 PM on April 30 and closed on May 9, although active fishing was completed by May 4. The guideline harvest level (GHL) was 772 tons, but total harvest is confidential due to fewer than three processors participating in the fishery.

Sitka Sound

The sac roe fishery was placed on two-hour notice on March 20 at 8:00 AM. The GHL was 16,333 tons. Four competitive openings were held during the 2014. The first opening was on

March 20 from 1:45 PM until 4:20 PM in the northern part of Sitka Sound near Starrigavin and Katlian Bays. Approximately 5,000 tons were harvested during the first opening. The second opening occurred on March 23 from 1:30 PM until 3:10 PM using the same boundaries as for the first opening. Approximately 5,300 tons were harvested during the second opening. The third opening occurred on March 26 from 2:30 PM until 3:40 PM in the waters of Eastern Channel. Approximately 3,700 tons were harvested during this opening. The fourth and final opening occurred on March 29 from 1:30 PM to 2:15 PM in the Crescent Bay and Eastern Channel areas. Approximate harvest during this opening was 3,900 tons.

The total harvest for the season was 16,957 tons, which exceeded the GHL of 16,333 tons by 624 tons, or 3.8% of the GHL.

West Behm Canal

There were no commercial fisheries in the West Behm Canal area during the 2013–2014 season, as the stock was below threshold.

Hobart Bay-Port Houghton

There were no commercial fisheries in the Hobart Bay-Port Houghton area during the 2013–2014 season, as the stock was below threshold.

Winter Bait Fisheries

During the 2013–2014 season, winter food and bait fisheries were opened near Craig and Ernest Sound on October 15, 2013, and in Tenakee Inlet on November 30, 2013. Fisheries in all 3 areas were closed by regulation on February 28, 2014. Harvest information is confidential for all areas as there were fewer than 3 participants in the fishery.

Spawn-on-Kelp Pound Fisheries

Three areas were open to the commercial harvest of spawn on kelp (SOK) during the 2013–2014 season: Craig, Ernest Sound, and Tenakee Inlet. The other SOK area in the region, Hoonah Sound was not opened during the 2013–2014 season as the forecasted spawning biomass was below threshold.

Craig

A total of 75 closed pounds were actively fished, of which 27 were single-permit pounds, 35 were double-permit pounds, and 13 were triple-permit pounds. A total of 138 permits registered and participated in the fishery. Total harvest and value are confidential due to fewer than 3 processors participating in the fishery.

Ernest Sound

A total of 76 closed pounds were actively fished, of which 25 were single-permit pounds, and 51 were double-permit pounds. A total of 129 permits participated in the fishery. Total harvest and value are confidential due to fewer than 3 processors participating in the fishery.

Tenakee Inlet

In Tenakee Inlet the GHL fell within the range of 300–499 tons. The actual GHL could not be released because by regulation the spawn-on-kelp fishery is allocated any remaining harvestable surplus after the winter bait fishery, which was also confidential due to fewer than 3 participants.

There was harvest during the fishery; however, the amount is confidential due to fewer than 3 processors participating in the fishery.

Bait Pound (Fresh Bait and Tray Pack) Fisheries

During the 2013–2014 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 2013–2014 season was in Sitka Sound, for bait, using purse seine gear during February 22 and 23, 2013. A total of 66 tons of herring were harvested the Siginaka and Gavanski Island groups in the northern part of Sitka Sound.

DISCUSSION

Spawn Deposition

After a period of building since about the late 1990s, herring spawning biomass in Southeast Alaska is now in a period of decline, apparent over the past few years. The spawning biomass estimated in 2014 for Southeast Alaska is at a level similar to that of the late 1990s prior to the increase in herring biomass. Spawning population biomass estimates, as calculated from spawn deposition estimates, decreased between 2013 and 2014 for 7 of 9 stocks that were surveyed in Southeast Alaska. For all 7 of these areas the decreases were substantial (defined here as 20% change at least). The spawning areas where decreases were observed include Sitka, Craig, Seymour Canal, Ernest Sound, Tenakee Inlet, Lynn Canal, and Hobart Bay-Port Houghton. Although the error surrounding biomass estimates was not calculated, the magnitudes of the decreases were large enough that they probably reflect meaningful changes in the spawning population levels. For a perspective on the relative size of each stock in the region, along with relative proportion of harvest, see Figure 69.

The only area where biomass apparently increased between 2013 and 2014 was West Behm Canal. The increase was substantial, with the 2014 estimate about three-fold that of 2013. There was one area, Hoonah Sound, where biomass did not appear to change between 2013 and 2014. However, biomass in this spawning area has been at very low levels over the past few years, relative to the peak years during 2008-2011.

The decrease in estimated spawning biomass for most stocks over the past year may be due to actual changes in the herring population; however, 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. However, the consistency of the decrease in biomass observed for several stocks around there region, each determined through an independent survey, make it unlikely that estimate error could be the major cause for the general decline of herring in the region.

Estimates of spawning biomass presented in this report are based primarily on egg deposition estimates (as opposed to model-derived results), which though useful for providing a general view of trends in mature herring biomass, 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.

Although the overall herring biomass in Southeast Alaska over the period 1980 to 2014 still indicates an increasing trend, short-term trends indicate a decline over the past few years (Figure 8). This is true whether or not the largest stock in the region, Sitka Sound, is included. The regional spawning biomass estimated for 2014 is 76% of the long-term average (1980–2013), for all stocks combined, and 65% for all stocks combined excluding Sitka Sound. The long-term trend of spawning biomass for the majority of individual spawning areas where data is available in Southeast Alaska is still increasing due principally to many years of high biomass levels in the most recent decade; however, the long-term trend is decreasing for a few areas (Figures 3–7). Biomass levels in some areas have fluctuated widely over the past few decades and are currently at low levels. This is true for Hoonah Sound, Hobart Bay-Port Houghton, Tenakee Inlet, Seymour Canal, Lynn Canal, and Revilla Channel. Biomass level is less clear in the Revilla Channel area, comprised of the Kah Shakes-Cat Island and Annette Island Reserve areas. Significant spawn has not been observed in the Kah Shakes-Cat Island area since 2001; however, since stock assessment surveys are not conducted around the Annette Island Indian Reserve—an area where substantial herring spawning occurs that is adjacent to the Kah Shakes-Cat Island area—the trend in spawning stock size for this greater area is less clear. Spawning biomass estimates for the Annette Island area, based on conversions from observed miles of spawn, suggest that herring biomass has also peaked in the early to mid-2000s and has declined to a relative low level since then.

Overall, spawn deposition estimates for 2014 suggest that herring spawning biomass in Southeast Alaska is at a moderately low level relative to the period 1980–2013.

Age Composition

For all stocks, estimates of age composition in 2014 continued to follow patterns that are generally expected; that is to say that 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. These patterns lend support to the assumption that the method of aging scales from 2014 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 relatively low for all stocks in 2014 and less than those observed in 2013. This is not an unusual occurrence as similar low levels have been observed several times in the past. However, the low level of age-3 herring observed in

2014 offers some insight to future biomass levels, which are likely to decrease further unless there is strong recruitment into the mature population in 2015.

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 greater 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 2 areas within the region where the mean proportion of age-3 herring is similar. For stocks south of latitude 56 degrees (Craig, West Behm Canal, Ernest Sound, and Kah Shakes), the mean proportion of age-3 herring is relatively high (range of 21-29%), 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 11-16%). The latitudinal split is further supported by age compositions observed in 2014, which were very similar among all southern stocks, and somewhat similar among several northern stocks (Seymour Canal, Hobart Bay, Tenakee Inlet, and Lynn Canal). Two stocks where age compositions do not closely match either southern or northern stocks, or each other, are Sitka Sound and Hoonah Sound.

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 an optimal maximum sea temperature exists around 14.5 °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 2014 herring spawn deposition surveys.

	Estimated Target Transects per Nautical Mile of Spawn[a]			
Area	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 2014 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 2014 herring spawn deposition surveys conducted in Southeast Alaska.

Survey area	Survey Leg	Survey Dates
Sitka Sound	I	April 7–11, 24–26
Craig	I	April 13
West Behm Canal	I	April 15
Ernest Sound	I	April 22
Hobart Bay/Port Houghton	II	May 1
Lynn Canal	II	May 9
Tenakee Inlet	II	May 7
Hoonah Sound	II	May 8
Seymour Canal	II	May 10

Table 4.–Summary of herring egg estimates (in thousands) by transect for 2014 spawn deposition surveys conducted in Sitka Sound.

	Sitka Sound 1st Survey		Sitka Sound 2nd Survey	
Transect Number	Egg estimate	Frame count	Egg estimate	Frame count
1	840	22	753	16
2	876	17	494	11
3	143	11	142	6
4	278	12	226	7
5	311	11	196	4
6	461	24	300	6
7	19	9	0	1
8	726	42	21	6
9	2,605	28	26	11
10	303	18	173	9
11	1,360	35	871	22
12	636	15	466	7
13	362	7	63	3
14	414	15	0	1
15	588	18	111	4
16	456	25	0	1
17	841	28	0	1
18	1,267	56	0	1
19	258	16	0	1
20	1339	29	809	7
21	140	12	50	5
22	4372	50	193	4
23	460	22	242	5
24	597	21	0	1
25	1,153	20	123	6
26	1644	21	413	7
27	3,099	34	258	6
28	2441	12	0	1
29	496	23	214	9
30	4777	35	2014	20
31	307	15	0	1
32	1372	25	24	5
33	1,160	12	—	—
34	773	13	—	—
35	420	5	—	—
36	872	9	—	—
37	3,850	13	—	—
38	1637	20	—	—
39	2,729	22	—	—
40	1244	17	—	—
41	1,720	7	—	—
42	914	9	—	—
43	116	8	—	—
44	1949	24	—	—
45	142	5	—	—
46	972	11	—	—
47	203	7	—	—
48	311	12	—	—
49	721	6	—	—
50	432	10	—	—

Note: Em-dashes indicate no survey transects planned.

Table 5.–Summary of herring egg estimates (in thousands) by transect for 2014 spawn deposition surveys conducted in Southeast Alaska (excluding Sitka Sound).

	Craig		Ernest Sound		Hobart/Houghton		Hoonah Sound		Seymour Canal		Tenakee Inlet		West Behm		Lynn Canal	
Transect Number	egg estimate	frame count	egg estimate	frame count	egg estimate	frame count	egg estimate	frame count	egg estimate	frame count	frame count	frame count	egg estimate	frame count	egg estimate	frame count
1	202	7	0	1	23	12	158	8	0	1	137	12	109	3	317	9
2	228	8	666	11	19	13	41	4	324	26	2	3	78	2	446	7
3	1,124	10	186	13	1	2	115	4	51	23	232	8	65	5	4	4
4	441	15	61	9	26	9	68	4	23	17	0	1	362	11	266	19
5	3,431	51	2,672	46	0	1	0	1	26	13	433	18	1,393	11	484	26
6	3,014	13	332	26	0	1	417	6	610	37	0	1	678	14	274	33
7	2,027	14	119	13	0	1	116	4	947	13	156	7	310	7	89	10
8	3,088	18	705	11	0	1	300	7	785	16	22	11	294	6	744	32
9	4,523	51	278	18	0	1	715	9	1	1	108	11	572	7	745	24
10	477	14	1,325	13	0	1	0	1	389	26	10	8	0	1	185	13
11	696	22	525	18	0	1	0	1	0	1	139	8	158	3	184	8
12	1,530	17	188	7	0	1	5	1	0	1	897	18	147	5	185	12
13	1,629	31	38	5	73	16	0	1	0	1	54	19	323	3	650	7
14	1,843	22	81	5	0	1	558	18	0	1	83	27	1,309	19	0	1
15	953	8	415	11	0	1	5	5	29	8	262	26	598	12	229	5
16	217	7	222	11	23	8	0	1	320	5	244	17	598	7	247	6
17	3	7	3	3	0	1	31	4	391	6	9	7	515	8	74	3
18	641	23	78	5	32	12	0	1	403	7	0	1	684	9	0	1
19	487	17	63	6	1	1	0	1	361	6	75	24	1,221	15	11	2
20	1,648	26	0	1	2	9	0	1	44	5	25	15	1,226	7	0	1
21	547	8	—	—	—	—	—	—	577	14	—	—	288	9	—	—
22	1,337	13	—	—	—	—	—	—	0	1	—	—	204	6	—	—
23	0	3	—	—	—	—	—	—	—	—	—	—	—	—	—	—
24	1,025	15	—	—	—	—	—	—	—	—	—	—	—	—	—	—
25	183	4	—	—	—	—	—	—	—	—	—	—	—	—	—	—
26	0	1	—	—	—	—	—	—	—	—	—	—	—	—	—	—
27	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
28	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
29	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
30	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

Note: Em-dashes indicate no survey transects planned.

Table 6.–Summary of results of herring spawn deposition surveys in Southeast Alaska for 2014.

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	26	82	13.6	2,058,569	736,340	1.684	100.9	20,150	167,170,948	18,596
Ernest Sound	20	58	3.7	399,152	341,493	0.151	70.5	13,752	22,027,035	1,712
Hobart/Houghton	20	23	3.4	146,401	21,465	0.003	75.9	15,315	455,990	38
Hoonah Sound	20	21	3.2	121,491	308,312	0.042	99.0	20,444	4,071,455	444
Seymour Canal	22	52	4.8	462,663	230,675	0.119	81.9	16,637	14,255,238	1,287
Sitka Sound total	82	62	50.0	5,784,311	574,308	3.879	120.7	20,964	370,107,409	49,248
[a]Sitka Sound – 1st	50	74	36.5	5,022,531	631,526	3.524	—	—	—	--
[a]Sitka Sound – 2nd	32	30	13.5	761,780	419,607	0.355	—	—	—	--
Tenakee Inlet	20	61	1.9	212,887	119,443	0.028	95.8	16,011	3,529,171	373
West Behm Canal	22	39	7.2	515,193	654,897	0.375	75.1	14,713	50,958,933	4,218
Lynn Canal	20	56	3.5	361,372	230,385	0.093	86.1	17,575	10,526,730	999
Total	252	—	91.3	10,062,039	--	6.374	—	—	643,102,910	76,915
Average	28	51	—	2,012,408	357,480	1.275	89.5	17,285	—	—

[a] Two separate surveys were conducted in 2014 because of two spawning events, so final estimates of egg deposition were calculated by summing estimates from each survey.

Table 7.–Correction coefficients used for herring spawn deposition estimates in Southeast Alaska in 2013. Data was combined for years 2012 through 2014 unless otherwise noted.

	Estimator initials								
Kelp type	BM	DG	JB	JM	KH	SD	TT[a]	EC	SK
Eelgrass	1.063	1.019	1.307	1.336	1.036	0.681	1.631	2.818	0.946
n =	32	32	32	32	32	32	20	31	32
Fucus	1.200	1.115	1.279	0.964	1.256	0.603	1.761	2.813	1.087
n =	29	29	29	29	29	29	18	29	29
Fir kelp	1.206	0.736	0.947	0.978	1.067	0.834	1.749	2.827	0.724
n =	26	26	26	25	26	26	18	26	26
Hair kelp	1.219	1.016	1.486	1.105	0.917	0.839	1.753	2.253	1.162
n =	37	37	37	37	37	37	26	37	36
Large brown kelp[b]	0.654	1.074	0.988	0.806	1.058	0.626	1.750	1.974	1.116
n =	26	26	24	26	26	26	15	26	26
Average[c]	0.993	0.926	1.132	0.983	1.053	0.690	1.548	2.229	0.885

[a] Data from years 2013 and 2014.

[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 2013–14.

	Commercial Fishery			Survey	Test Fishery	
Stock	Herring gillnet	Pound	Purse seine	Cast net	Purse seine	Total
Craig	–	532	532	530	–	1,594
Ernest Sound	–	528	525	530	–	1,583
Hobart/Houghton	–	–	–	472	–	472
Hoonah Sound	–	–	–	519	–	519
Lynn Canal	–	–	–	–	–	0
Seymour Canal	486	–	–	528	–	1,014
Sitka Sound	–	–	532	995	528	2,055
Tenakee Inlet	–	528	528	526	–	1,582
West Behm Canal	–	–	–	530	–	530
Revilla Channel	–	–	–	267	–	267
Yakutat[a]	–	–	–	–	–	0
Total	486	1,588	2,117	4,897	528	9,616

[a] Survey gear was beach seine.

Table 9.–Summary herring samples aged for Southeast Alaska stocks in 2013–14.

	Commercial Fishery			Survey	Test Fishery	
Stock	Herring gillnet	Pound	Purse seine	Cast net	Purse seine	Total
Craig	–	528	531	517	–	1,576
Ernest Sound	–	513	522	517	–	1,552
Hobart/Houghton	–	–	–	467	–	467
Hoonah Sound	–	–	–	504	–	504
Lynn Canal	–	–	–	–	–	0
Seymour Canal	486	–	–	527	–	1,013
Sitka Sound	–	–	532	990	524	2,046
Tenakee Inlet	–	521	527	521	–	1,569
West Behm Canal	–	–	–	528	–	528
Revilla Channel	–	–	–	260	–	260
Yakutat[a]	–	–	–	–	–	525
Total	486	1,562	2,112	4,831	524	9,515

[a] Survey gear was beach seine.

Table 10.–Summary of age, weight, and length for the Sitka Sound herring stock in 2013–14.

		Age Category						
Gear type/season	Parameter	3	4	5	6	7	8+	Total
survey cast net–spring	number of fish	12	384	96	80	152	266	990
	Percent age composition	1%	39%	10%	8%	15%	27%	100%
	average weight (g)	77.1	93.0	117.3	137.7	161.2	182.8	128.2
	standard dev. of weight (g)	10.0	21.8	27.7	30.2	28.3	31.4	24.9
	average length (mm)	187	194	206	219	228	236	212
	variance of length (mm)	46	150	169	164	85	107	120
commercial purse seine–spring	number of fish	3	167	35	44	105	178	532
	percent age composition	1%	31%	7%	8%	20%	33%	100%
	average weight (g)	71.0	109.4	151.1	174.5	191.5	216.9	152.4
	standard dev. of weight (g)	9.2	23.9	31.8	29.1	25.0	29.6	24.7
	average length (mm)	174	196	215	225	230	238	213
	variance of length (mm)	26	142	209	111	71	102	110
test fishery purse seine–winter	number of fish	4	301	43	27	48	101	524
	percent age composition	1%	57%	8%	5%	9%	19%	100%
	average weight (g)	54.8	87.2	108.6	131.1	172.4	201.1	125.9
	standard dev. of weight (g)	8.1	20.1	37.5	39.8	32.0	39.3	29.4
	average length (mm)	166	186	197	210	227	237	204
	variance of length (mm)	31	137	333	368	189	284	223

Table 11.–Summary of age, weight, and length for the Craig herring stock in 2013–14.

Gear type/season	Age category	Age Category 3	4	5	6	7	8+	Total
survey cast net – spring	number of fish	15	172	106	108	79	37	517
	percent age composition	3%	33%	21%	21%	15%	7%	100%
	average weight (g)	58.7	74.6	91.1	104.3	112.1	123.8	94.1
	standard dev. of weight (g)	10.6	13.6	16.3	19.7	21.4	28.5	18.3
	average length (mm)	168	181	192	200	203	209	192.2
	variance of length (mm)	59	81	70	92	85	222	101.4
commercial pound – spring	number of fish	11	200	102	129	57	29	528
	percent age composition	2%	38%	19%	24%	11%	5%	100%
	average weight (g)	63.6	80.7	98.5	111.0	124.1	138.3	102.7
	standard dev. of weight (g)	9.3	13.9	16.3	18.5	19.4	18.6	16.0
	average length (mm)	171	182	192	199	205	213	193.7
	variance of length (mm)	41	70	78	77	64	56	64.4
commercial seine– winter	number of fish	16	190	127	132	42	24	531
	percent age composition	3%	36%	24%	25%	8%	5%	100%
	average weight (g)	76.5	91.5	107.6	122.5	131.6	139.0	111.5
	standard dev. of weight (g)	8.3	13.4	16.8	18.0	17.9	21.0	15.9
	average length (mm)	173	182	191	199	202	206	192.1
	variance of length (mm)	28	59	77	93	59	63	63.2

Table 12.–Summary of age, weight, and length for the Hobart Bay/Port Houghton herring stock in 2013–14.

Gear type/season	Parameter	Age Category 3	4	5	6	7	8+	Total
survey cast net– spring	number of fish	12	131	253	6	11	54	467
	percent age composition	3%	28%	54%	1%	2%	12%	100%
	average weight (g)	41.4	56.3	80.1	83.8	98.4	106.2	77.7
	standard dev. of weight (g)	7.3	13.5	20.5	26.0	26.9	27.6	20.3
	average length (mm)	153	167	184	188	195	201	181
	variance of length (mm)	50	102	161	389	217	198	186
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 2013–14.

Gear type/season	Parameter	Age Category 3	4	5	6	7	8+	Total
survey cast net–spring	number of fish	42	210	128	73	58	6	517
	percent age composition	8%	41%	25%	14%	11%	1%	100%
	average weight (g)	56.0	63.7	74.1	78.9	85.4	88.4	74.4
	standard dev. of weight (g)	9.4	9.5	11.3	11.9	13.7	8.5	10.7
	average length (mm)	167	174	183	186	190	195	182
	variance of length (mm)	53	35	49	45	54	19	42
commercial pound–spring	number of fish	48	220	128	61	49	7	513
	percent age composition	9%	43%	25%	12%	10%	1%	100%
	average weight (g)	59.4	69.2	81.4	83.3	88.9	93.9	79.3
	standard dev. of weight (g)	10.3	10.1	12.5	14.6	17.5	14.6	13.3
	average length (mm)	169	176	184	186	188	193	183
	variance of length (mm)	47	40	49	62	99	30	55
commercial seine–winter	number of fish	33	216	155	59	59	0	522
	percent age composition	6%	41%	30%	11%	11%	0%	100%
	average weight (g)	71.4	79.7	91.8	93.8	96.6	–	86.7
	standard dev. of weight (g)	9.9	10.4	10.2	8.9	12.6	–	10.4
	average length (mm)	172	177	184	186	187	–	181
	variance of length (mm)	42	47	40	31	49	–	42

Table 14.–Summary of age, weight, and length for the Hoonah Sound herring stock in 2013–14.

Gear type/season	Parameter	Age Category 3	4	5	6	7	8+	Total
survey cast net–spring	number of fish	4	191	110	18	54	127	504
	percent age composition	1%	38%	22%	4%	11%	25%	100%
	average weight (g)	56.0	81.8	94.5	111.6	112.2	122.7	96.5
	standard dev. of weight (g)	10.4	15.6	18.3	16.2	17.8	18.2	16.1
	average length (mm)	172	188	196	208	207	212	197
	variance of length (mm)	46	85	81	55	65	60	65
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 2013–14.

		Age Category						
Gear type/season	Parameter	3	4	5	6	7	8+	Total
survey cast net–spring	number of fish	21	138	160	19	52	131	521
	percent age composition	4%	26%	31%	4%	10%	25%	100%
	average weight (g)	58.5	80.4	92.0	99.6	103.1	119.2	92.1
	standard dev. of weight (g)	11.9	16.1	17.9	17.3	20.8	22.0	17.7
	average length (mm)	167	185	192	202	201	210	193
	variance of length (mm)	84	86	117	58	101	72	86
commercial pound–spring	number of fish	12	167	160	19	39	124	521
	percent age composition	2%	32%	31%	4%	7%	24%	100%
	average weight (g)	64.2	88.5	100.7	108.0	119.4	135.9	102.8
	standard dev. of weight (g)	13.3	14.7	18.4	20.8	19.6	20.8	17.9
	average length (mm)	169	186	193	200	204	211	194
	variance of length (mm)	97	77	89	107	113	72	92
commercial seine–winter	number of fish	4	194	162	20	52	95	527
	percent age composition	1%	37%	31%	4%	10%	18%	100%
	average weight (g)	72.6	96.2	110.3	123.2	126.8	146.3	112.6
	standard dev. of weight (g)	17.9	14.7	18.9	21.0	26.1	23.5	20.3
	average length (mm)	171	186	193	199	201	210	193
	variance of length (mm)	121	67	82	103	130	89	99

Table 16.–Summary of age, weight, and length for the Seymour Canal herring stock in 2013–14.

		Age category						
Gear type/season	Parameter	3	4	5	6	7	8+	Total
survey cast net–spring	number of fish	10	70	225	26	41	155	527
	percent age composition	2%	13%	43%	5%	8%	29%	100%
	average weight (g)	43.7	68.7	73.8	78.2	92.9	99.8	76.2
	standard dev. of weight (g)	9.8	13.9	17.3	17.9	20.4	21.6	16.8
	average length (mm)	152	174	178	181	191	194	178
	variance of length (mm)	128	114	119	134	136	119	125
commercial gillnet–spring	number of fish	0	8	112	32	52	282	486
	percent age composition	0%	2%	23%	7%	11%	58%	100%
	average weight (g)	–	104.1	104.8	108.1	110.6	116.8	108.9
	standard dev. of weight (g)	–	14.2	12.1	14.8	15.0	18.6	15.0
	average length (mm)	–	193	194	196	197	203	197
	variance of length (mm)	–	80	40	86	76	81	72

Table 17.–Summary of age, weight, and length for the West Behm Canal herring stock in 2013–14.

Gear type/season	Parameter	Age category 3	4	5	6	7	8+	Total
survey cast net–spring	number of fish	61	216	149	61	35	6	528
	percent age composition	12%	41%	28%	12%	7%	1%	100%
	average weight (g)	56.0	69.0	80.7	88.8	94.2	97.7	81.1
	standard dev. of weight (g)	12.3	11.0	14.6	16.3	16.2	28.6	16.5
	average length (mm)	166	176	184	190	194	196	184
	variance of length (mm)	100	52	80	78	102	166	96
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 2013–14.

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)							
	variance of length (mm)							

Table 19.–Summary of age, weight, and length for the Revilla Channel herring stock in 2013–14.

Gear type/season	Parameter	Age category 3	4	5	6	7	8+	Total
survey cast net–spring	number of fish	47	95	92	14	10	2	260
	percent age composition	18%	37%	35%	5%	4%	1%	100%
	average weight (g)	55.5	67.4	72.6	83.4	81.5	101.6	77.0
	standard dev. of weight (g)	12.3	13.1	14.2	17.4	20.5	2.3	13.3
	average length (mm)	167	177	181	188	187	196	182
	variance of length (mm)	96	93	80	98	143	85	99

Table 20.–Summary of age, weight, and length for the Yakutat herring stock in 2013–14.

		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 21.–Proportion of mature age-3 herring (cast net, 1988–2014), latitude, and sea temperature (2000–2013) 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 (^{0}C)	Mean minimum annual sea temperature (^{0}C)	Mean maximum annual sea temperature (^{0}C)
Kah Shakes	55.0300	23%	29%	8.6	5.9	14.7
Craig	55.4770	17%	21%	9.0	4.7	14.1
WBC	55.4846	26%	29%	8.8	5.3	14.3
Ernest Sound	55.8307	25%	29%	—	—	—
Sitka	57.0079	10%	16%	8.6	4.9	13.8
Hobart Bay	57.4308	5%	14%	7.1	3.9	12.9
Seymour Canal	57.5923	9%	15%	6.7	3.0	13.3
Hoonah Sound	57.6001	7%	16%	7.9	2.0	15.0
Tenakee Inlet	57.7381	11%	11%	7.8	1.9	15.0
Lynn Canal	58.6402	9%	12%	7.1	2.6	15.4

Table 22.–Summary of Southeast Alaska herring target levels for the 2013–14 season.

Area	Minimum spawning biomass threshold (tons)	Forecast (tons)	Target Exploitation Rate (%)	Guideline harvest level (tons)[a]
Craig	5,000	26,085	18.4	4,808
Ernest Sound	2,500	7,613	14.1	1,073
Hobart Bay/Port Houghton	2,000	1,110	—	—
Hoonah Sound	1,000	679	—	—
Seymour Canal	3,000	6,320	12.2	772
Sitka Sound	25,000	81,663	20.0	16,333
Tenakee Inlet	3,000	7,525	13.0	980
West Behm Canal	6,000	1,687	—	—
Lynn Canal	5,000	—	—	—
Kah Shakes	6,000	—	—	—

[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.

Table 23.–Summary of commercial herring harvest during the 2013–14 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	15-Oct-13	28-Feb-14	–[d]
Winter food and bait	Purse seine	Tenakee Inlet	12	15-Oct-13 28-Feb-14		–[d]
Winter food and bait	Purse seine	Ernest Sound	7	15-Oct-13	28-Jan-14	–[d]
Winter food and bait	Purse seine	Hobart Bay	10	Not Open		–
Sub-total						–[d]
Sac roe	Purse seine	Sitka Sound	13	20-Mar-14	29-Mar-14	16,957
Sac roe	Purse seine	Lynn Canal	11	Not Open		–
Sac roe	Gillnet	Seymour Canal	11	30-Apr-14	9-May-14	–[d]
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						–[d]
Spawn on kelp	Pound	Hoonah Sound	13	Not Open	–	–
Spawn on kelp	Pound	Tenakee Inlet	12	6-Apr-14	4-May-14	–[d]
Spawn on kelp	Pound	Ernest Sound	7	1-Apr-14	21-Apr-14	189
Spawn on kelp	Pound	Craig	3	17-Mar-14	8-Apr-14	–[d]
Sub-total						–[d]
Test fishery - bait	Purse seine	Sitka	13	22-Feb-14	23-Feb-14	66

[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.

Figure 1.–Locations of major herring spawning areas in Southeast Alaska, where surveys or sampling of herring was conducted during 2013–14.

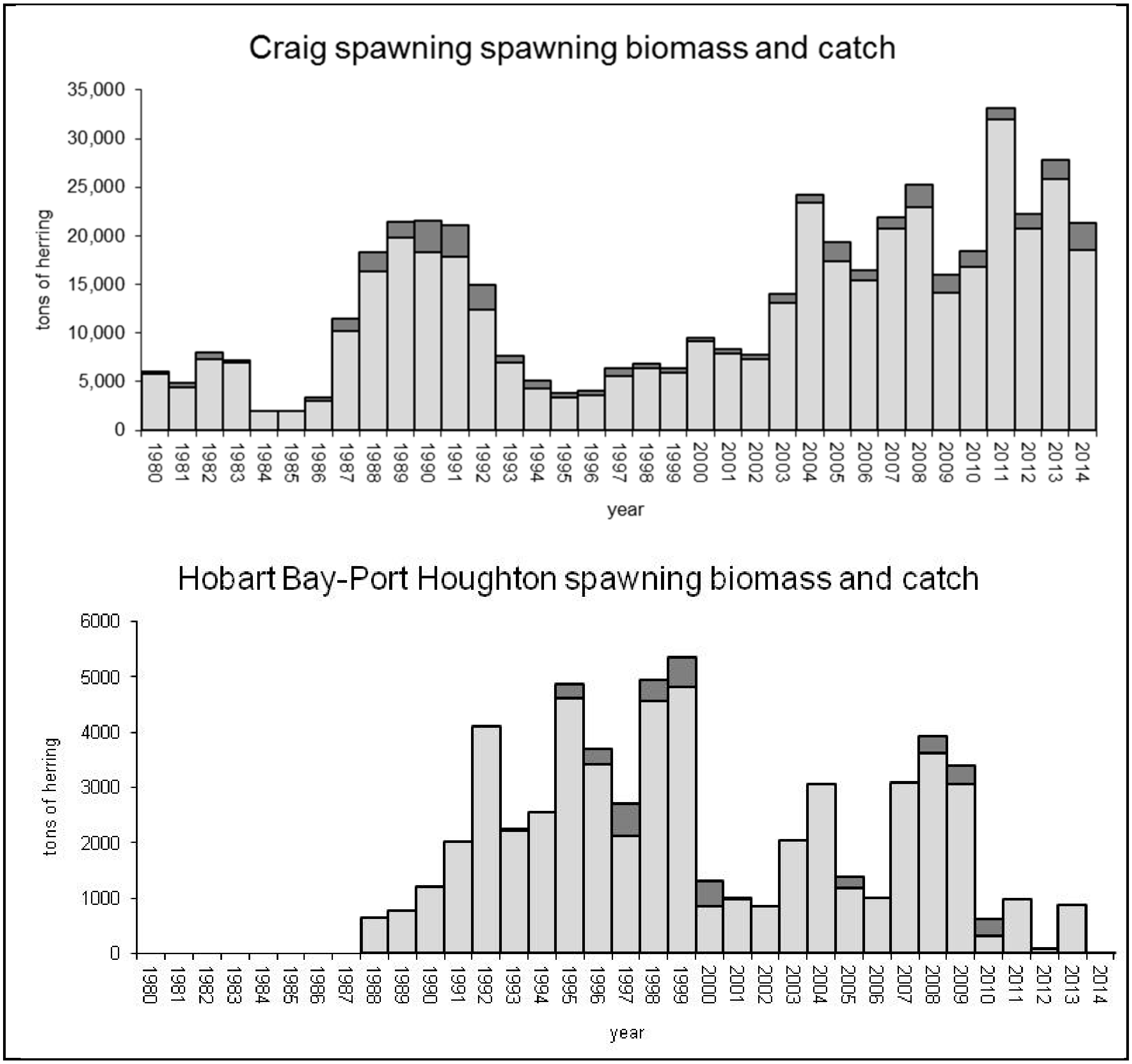
Stock	25-Mar	26-Mar	27-Mar	28-Mar	29-Mar	30-Mar	31-Mar	1-Apr	2-Apr	3-Apr	4-Apr	5-Apr	6-Apr	7-Apr	8-Apr	9-Apr	10-Apr	11-Apr	12-Apr	13-Apr
Craig								2.0	3.6	8.0	11.4	0.1								
Sitka Sound	0.4	0.5	0.6	3.8	7.7	12.6	21.8	25.1	13.4	4.5	0.9	ns	ns	ns			ns	0.1	1.5	2.8
West Behm Canal																	0.1		2.0	3.0
Revilla Channel																				
Ernest Sound																				
Hoonah Sound																				
Tenakee Inlet																				
Hobart/Houghton																				
Seymour Canal																				
Lynn Canal																				
Yakutat																				

Stock	14-Apr	15-Apr	16-Apr	17-Apr	18-Apr	19-Apr	20-Apr	21-Apr	22-Apr	23-Apr	24-Apr	25-Apr	26-Apr	27-Apr	28-Apr	29-Apr	30-Apr	1-May	2-May	3-May
Craig																				
Sitka Sound	2.9	5.6	ns	2.5		ns	ns		ns		ns				ns					
West Behm Canal	2.0	1.5	0.1																	
Revilla Channel	0.1	0.6	0.8	3.0	2.0	0.5														
Ernest Sound	0.1	1.0	0.3	1.6		0.5														
Hoonah Sound																				
Tenakee Inlet															0.2	1.9	0.2	0.1		
Hobart/Houghton													0.1			ns		0.8	1.0	
Seymour Canal																	1.0	1.3	0.3	0.3
Lynn Canal														0.2	0.7	1.4	1.0	0.9		
Yakutat																				

continued	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
Sitka Sound		0.3	0.2																	
Hoonah Sound		2.5		0.5	0.2															
Seymour Canal	0.1	0.1	0.7																	
Yakutat																				

continued	24-May	25-May	26-May	27-May	28-May	29-May	30-May	31-May	1-Jun	2-Jun	3-Jun	4-Jun	5-Jun	6-Jun	7-Jun	8-Jun	9-Jun	10-Jun	11-Jun	12-Jun
Sitka Sound																				
Hoonah Sound																				
Seymour Canal																				
Yakutat																				

Figure 2.–Spawn timing of herring stocks in Southeast Alaska during spring 2014. 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). Daily spawn mileage for Yakutat was approximated.


Craig spawning spawning biomass and catch
tons of herring
year
Hobart Bay-Port Houghton spawning biomass and catch
tons of herring
year

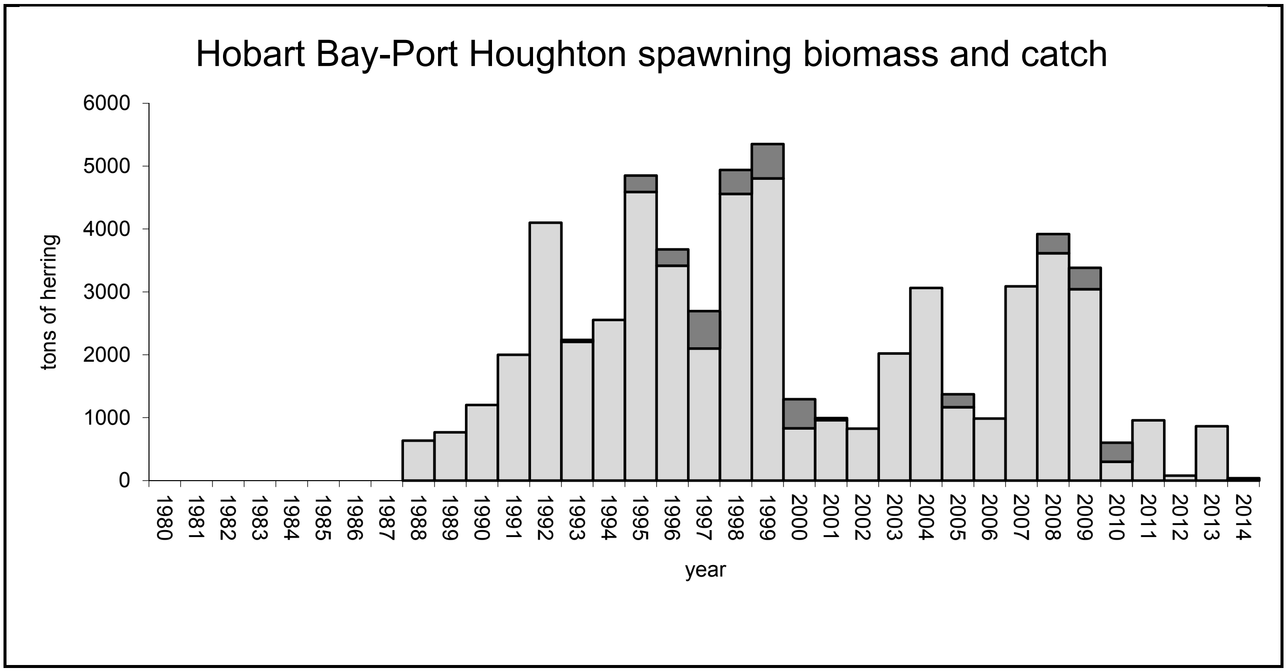


Figure 3.–Herring post-fishery spawning biomass (light gray bars), based on spawn deposition surveys, and catch (dark gray bars) for stocks in the Craig and Hobart Bay-Port Houghton areas, during 1980–2014.

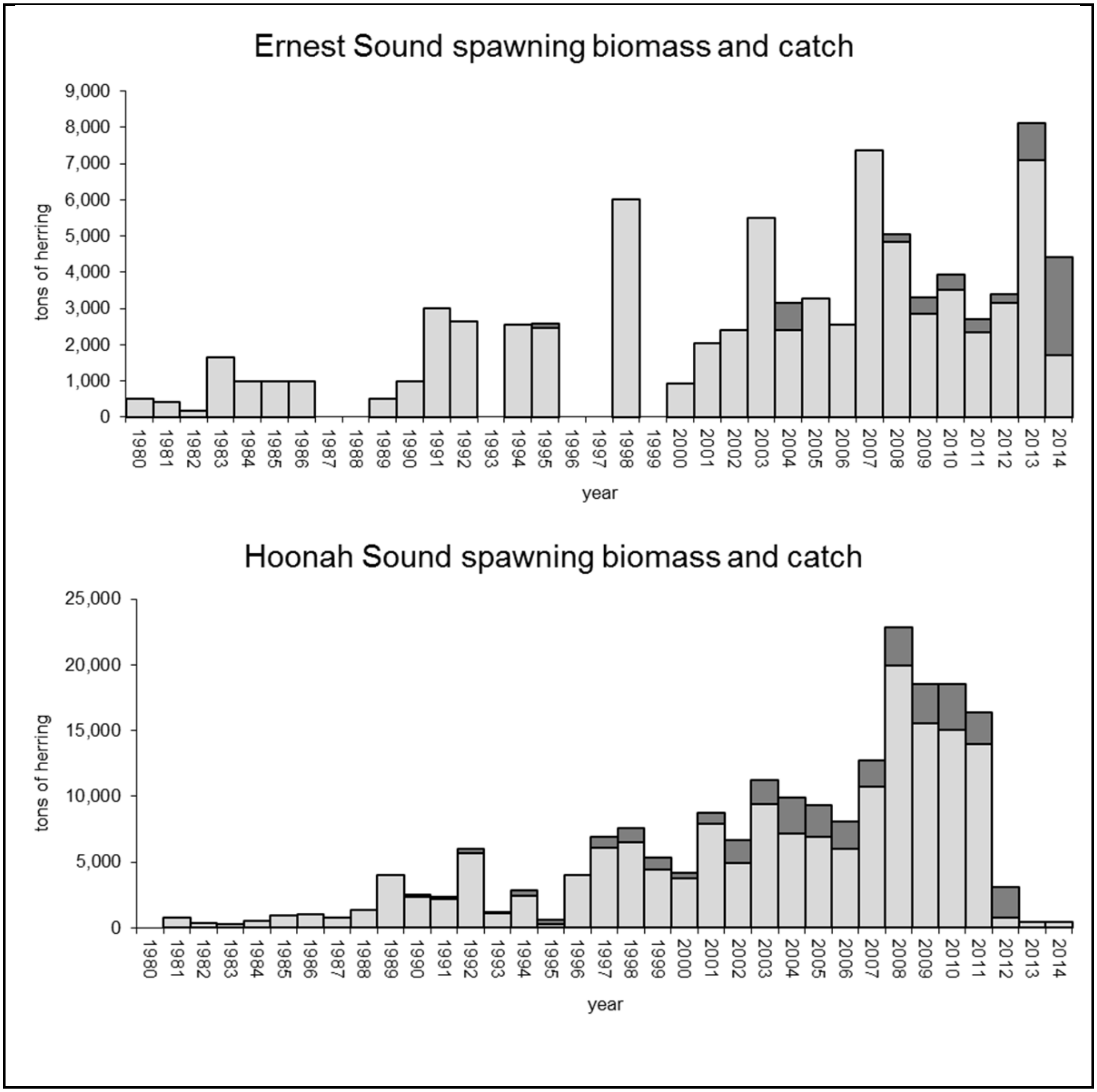


Figure 4.–Herring post-fishery spawning biomass (light gray bars), based on spawn deposition surveys, or hydro-acoustic surveys, and catch (dark gray bars) for stocks in the Ernest Sound and Hoonah Sound areas, during 1980–2014.

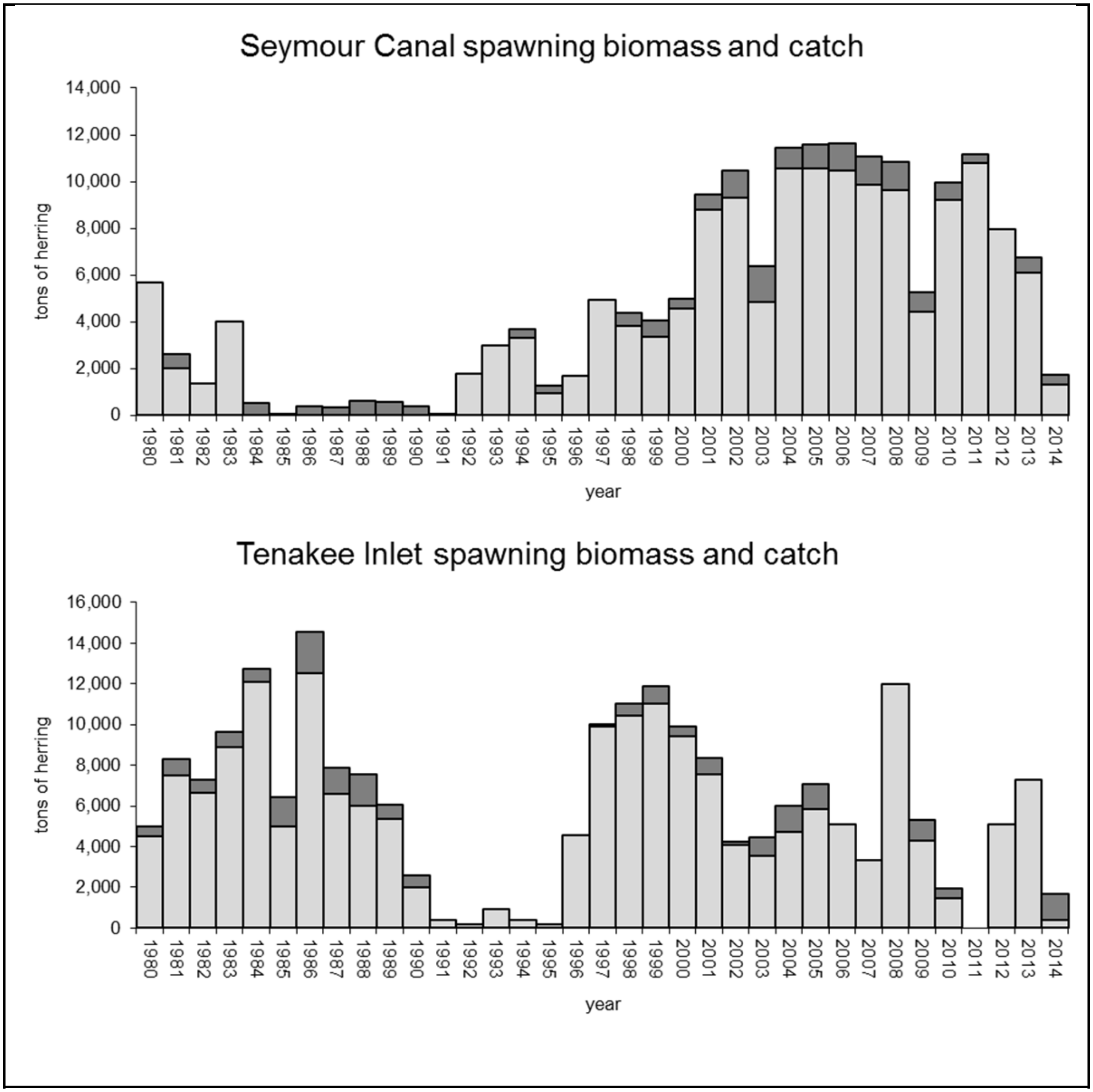


Figure 5.–Herring post-fishery spawning biomass (light gray bars), based on spawn deposition surveys, or hydro-acoustic surveys, and catch (dark gray bars) for stocks in the Tenakee Inlet and Seymour Canal areas, during 1980–2014.

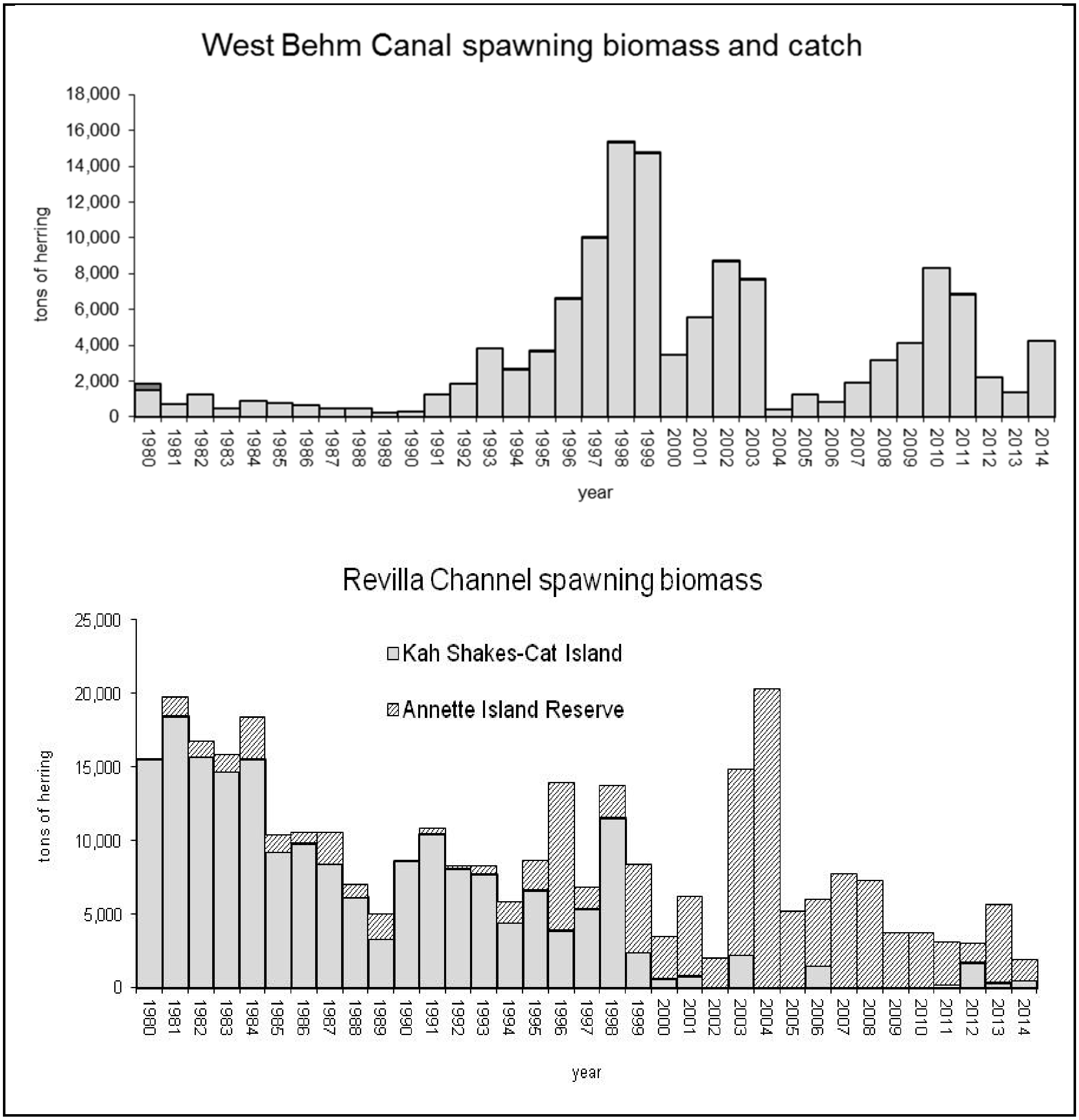


Figure 6.–Herring post-fishery spawning biomass, based on spawn deposition surveys, or hydro-acoustic surveys for stocks in the West Behm Canal and Revilla Channel (Kah Shakes-Cat Island-Annette Island) areas, during 1980–2014. Annette Island spawning biomass estimates were made as the product of the length of observed linear shoreline spawn mileage and a fixed value of 500 tons of herring per nautical mileage of shoreline, based on the estimated mean value over the period 1991-2000.

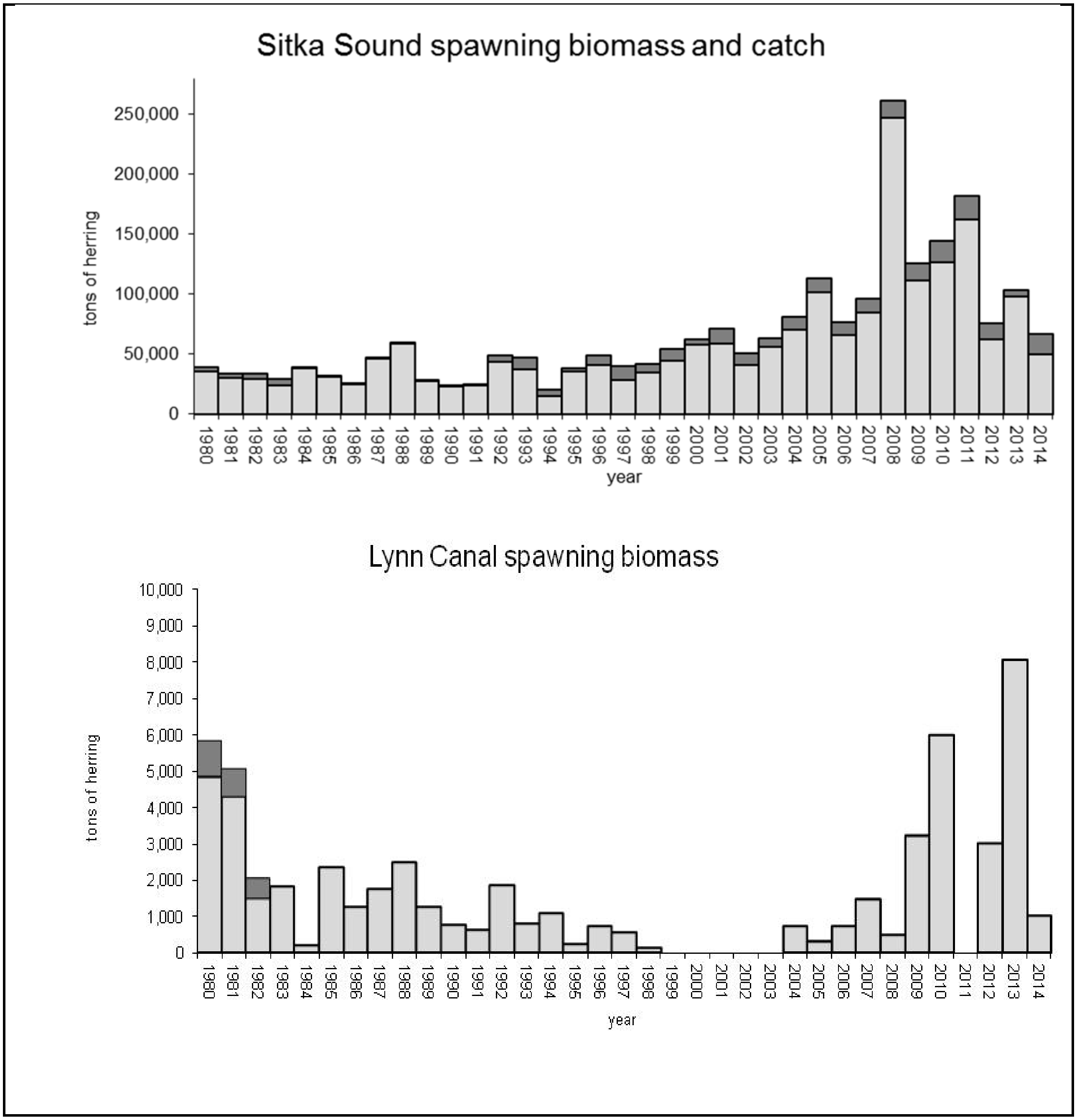


Figure 7.–Herring post-fishery spawning biomass (light gray bars), based on spawn deposition surveys, and catch (dark gray bars) for stock in the Sitka Sound and Lynn Canal areas, during 1980–2014. Estimates of spawning biomass for Lynn Canal prior to 2004 were made using a variety of methods (e.g. hydroaccoustics or visual estimates of spawn density converted to biomass), and results should be viewed as approximations.

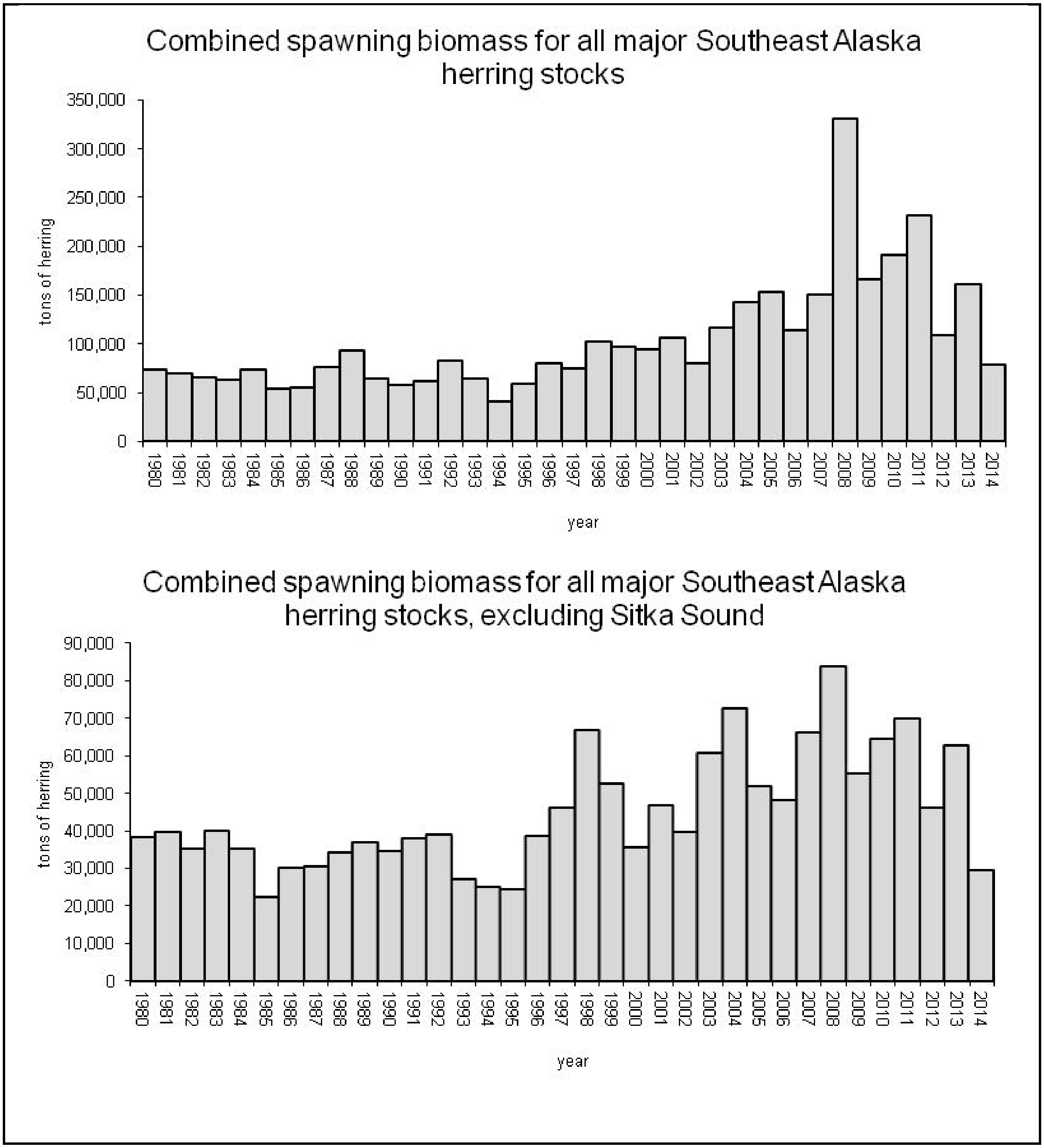


Figure 8.–Combined post-fishery spawning biomass, based on spawn deposition surveys, or hydro-acoustic surveys, for major herring stocks in Southeast Alaska, during 1980–2014.

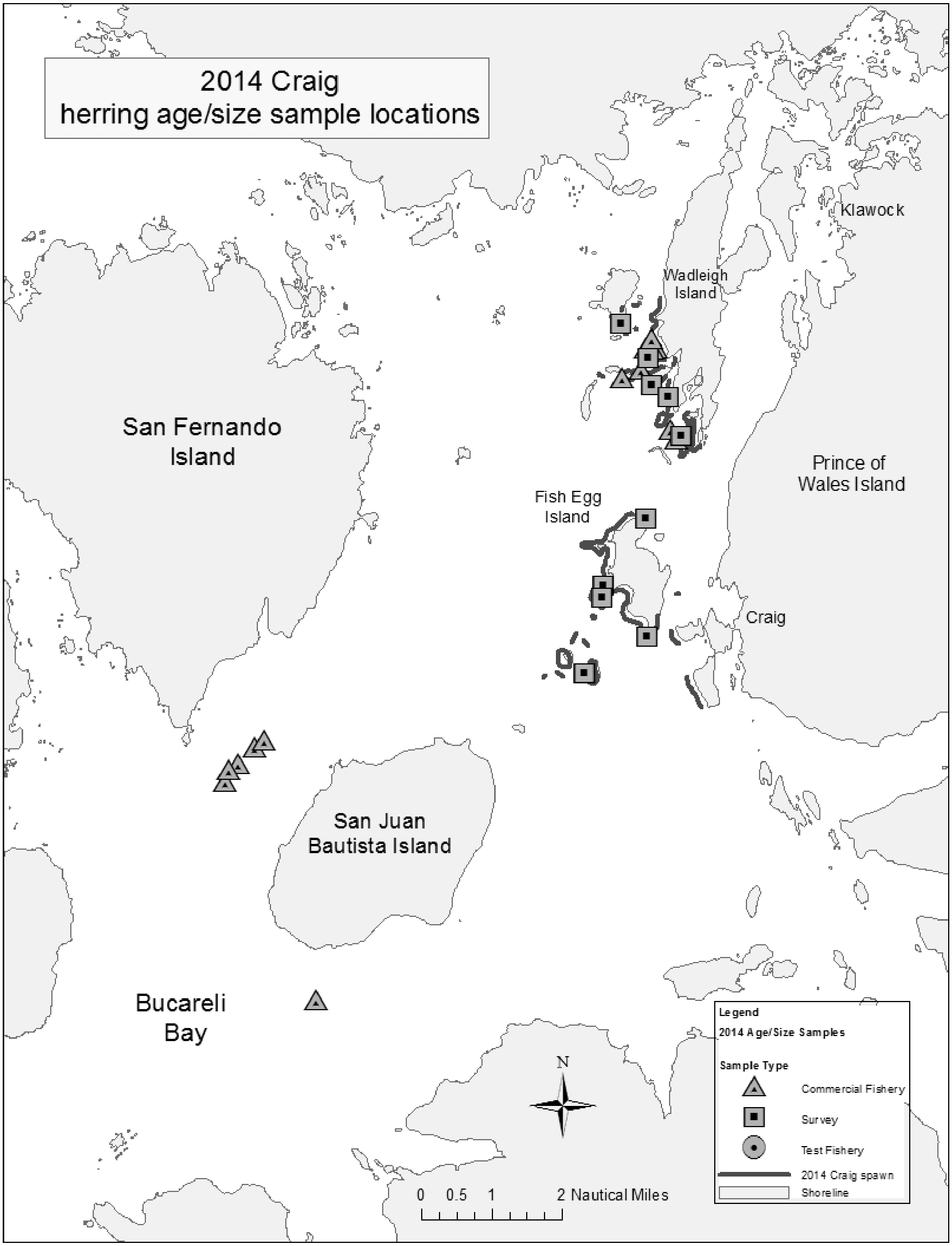


Figure 9.–Locations of herring samples collected for estimates of age and size for the Craig herring stock, 2013/2014. Cumulative herring spawn denoted by thick gray line along shoreline.

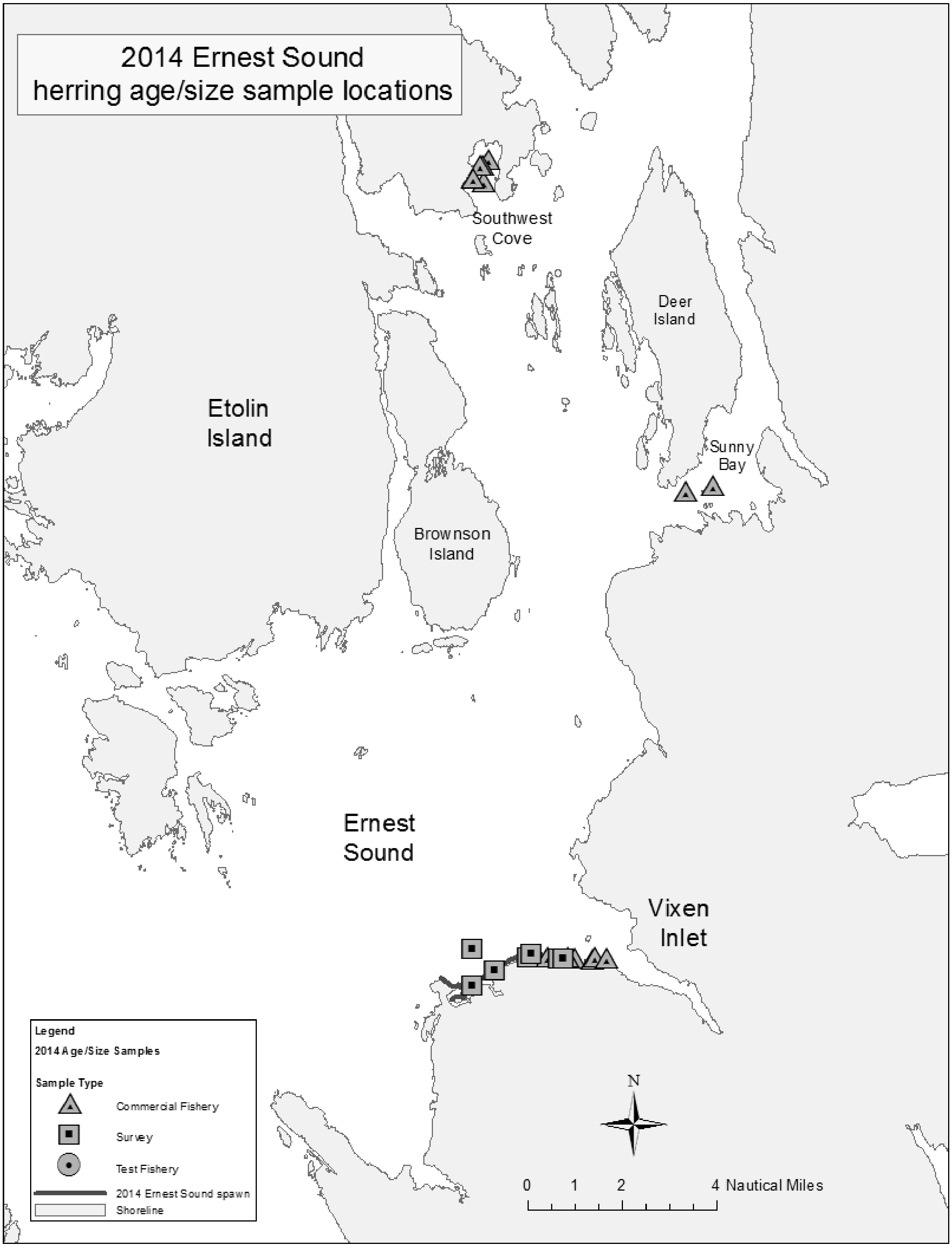


Figure 10.–Locations of herring samples collected for estimates of age and size for the Ernest Sound herring stock, 2013/2014. Cumulative herring spawn denoted by thick gray line along shoreline.

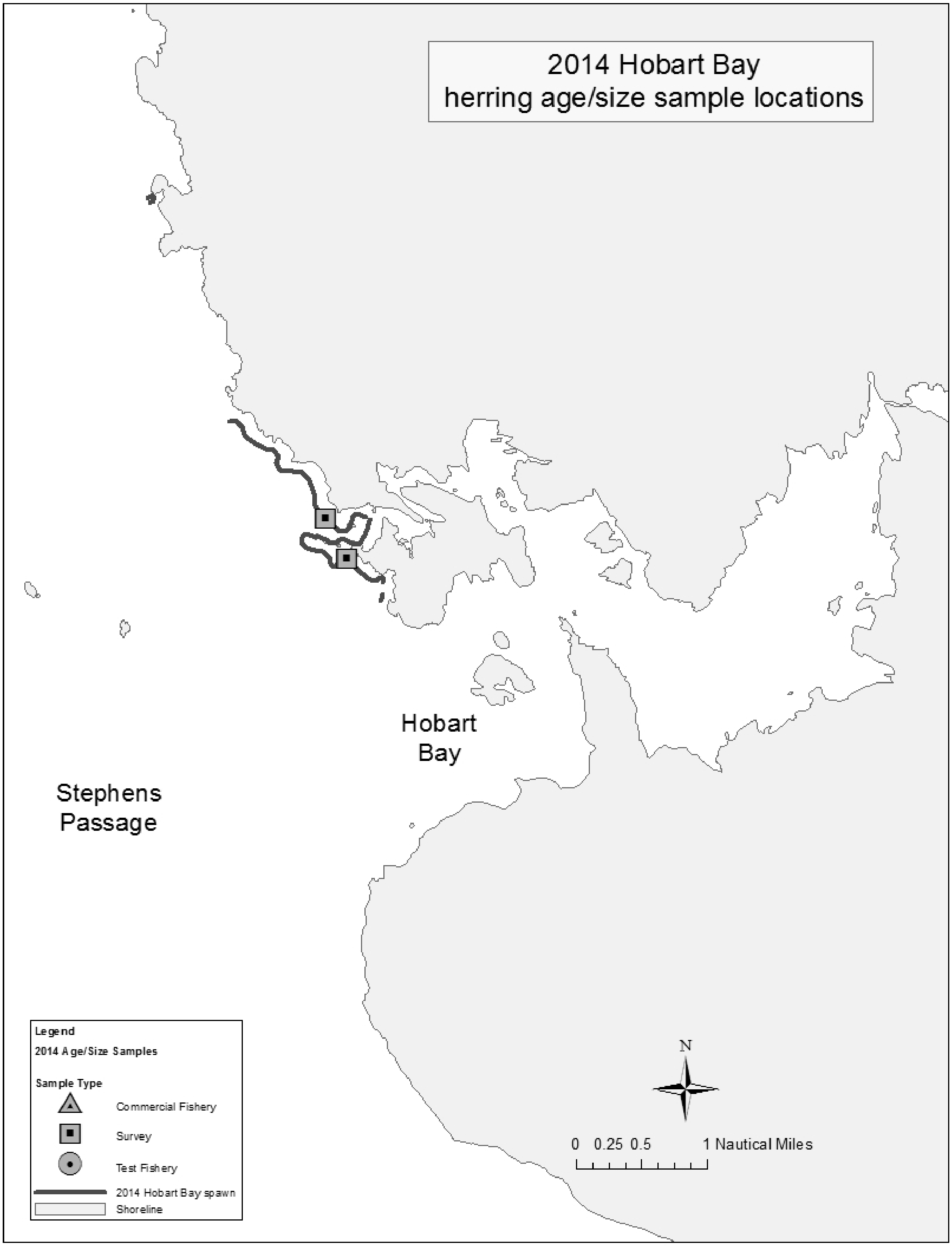


Figure 11.–Locations of herring samples collected for estimates of age and size for the Hobart bay-Port Houghton herring stock, 2014. Cumulative herring spawn denoted by thick gray line along shoreline.

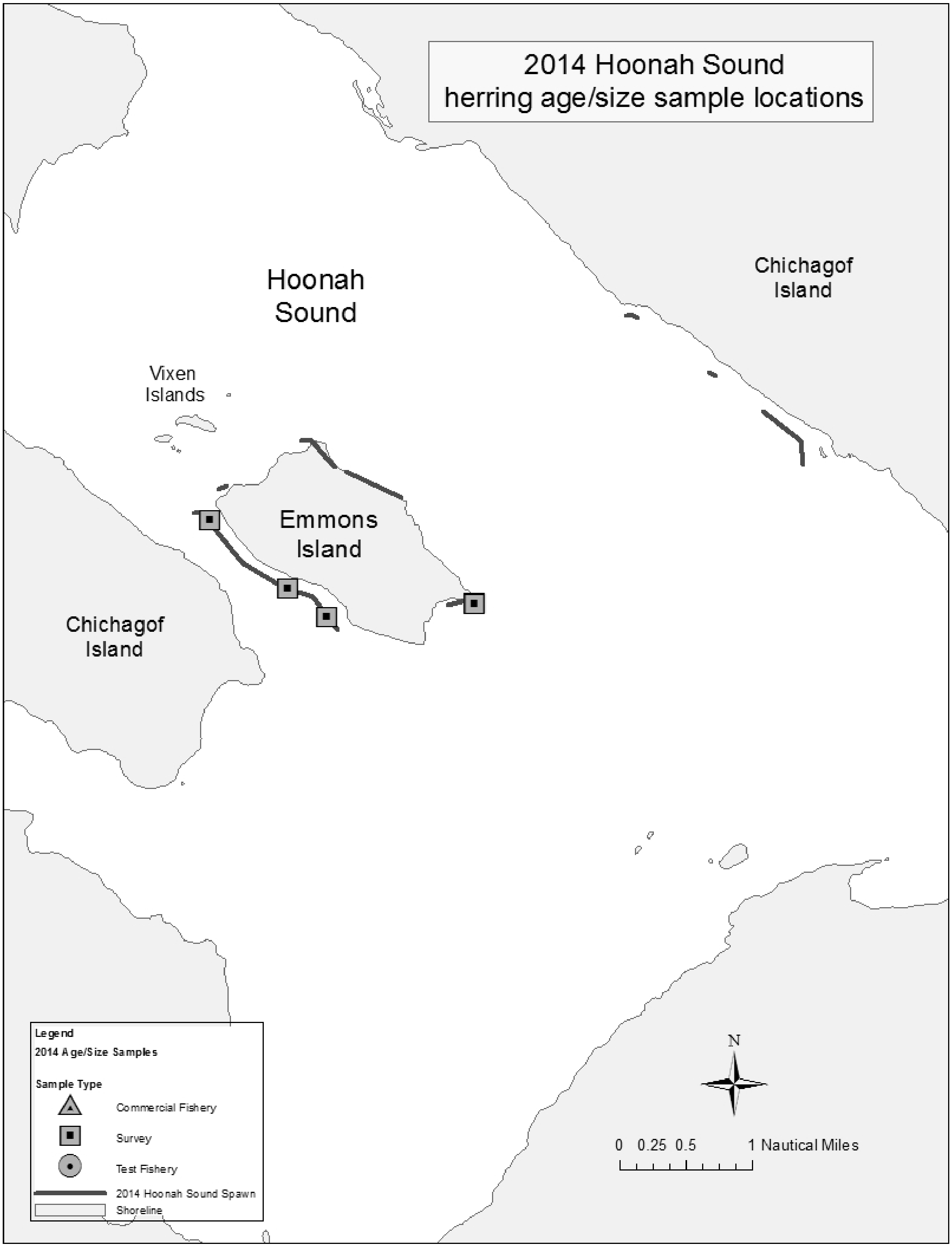


Figure 12.–Locations of herring samples collected for estimates of age and size for the Hoonah Sound herring stock, 2014. Cumulative herring spawn denoted by thick gray line along shoreline.

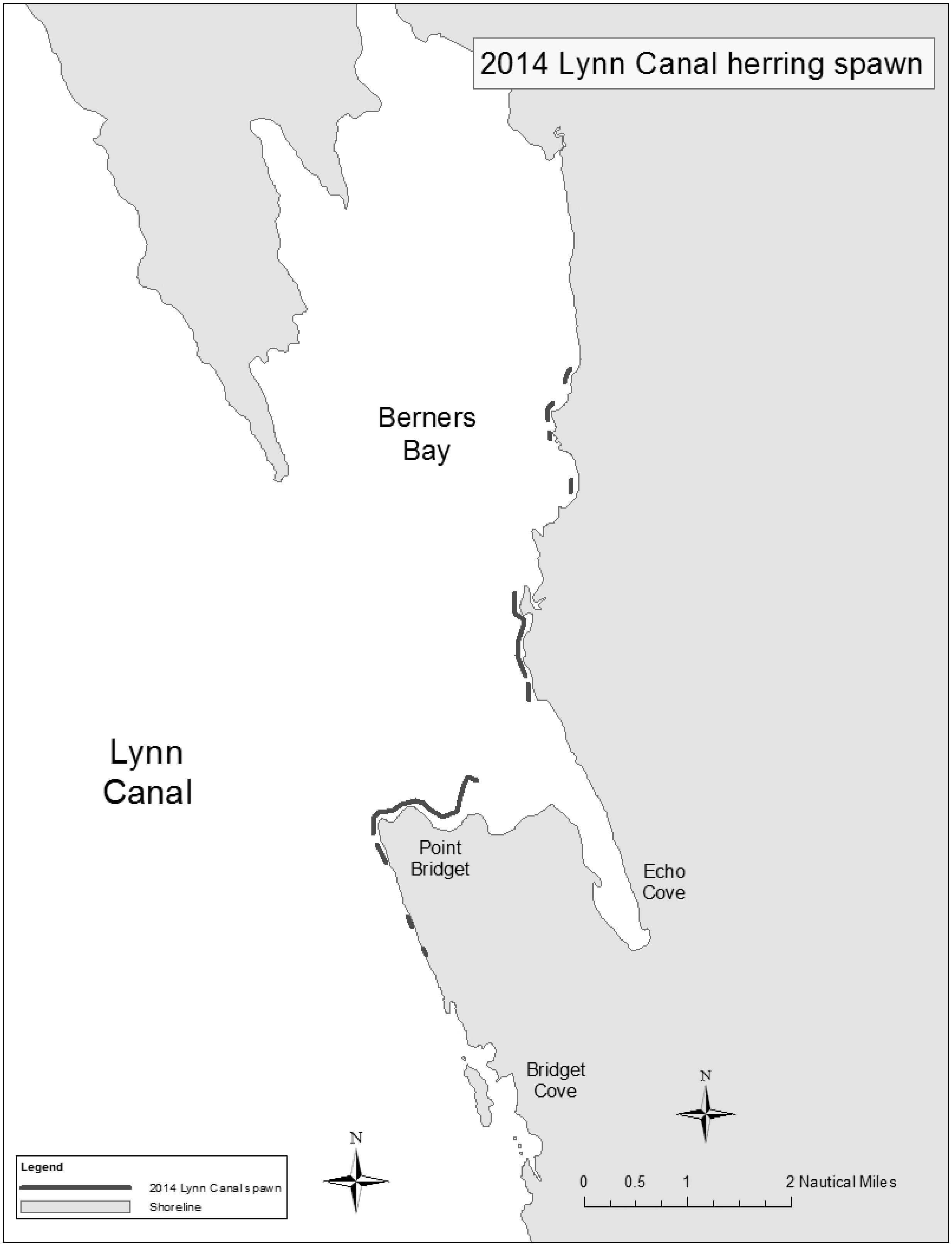


Figure 13.–Location of herring spawn for the Lynn Canal herring stock, 2014. No age/size samples were obtained during 2014. Cumulative herring spawn denoted by thick gray line along shoreline.

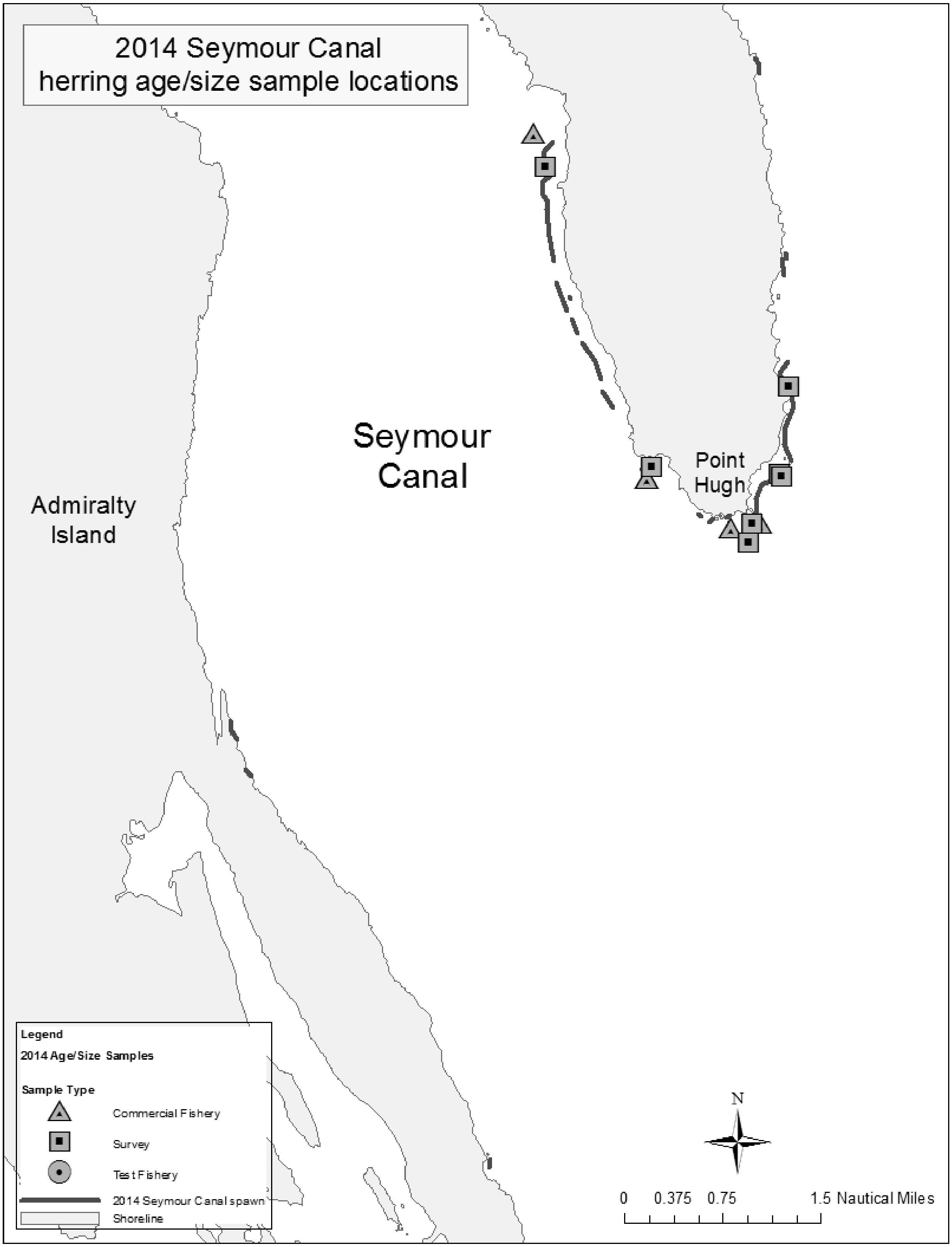


Figure 14.–Locations of herring samples collected for estimates of age and size for the Seymour Canal herring stock, 2014. Cumulative herring spawn denoted by thick gray line along shoreline.

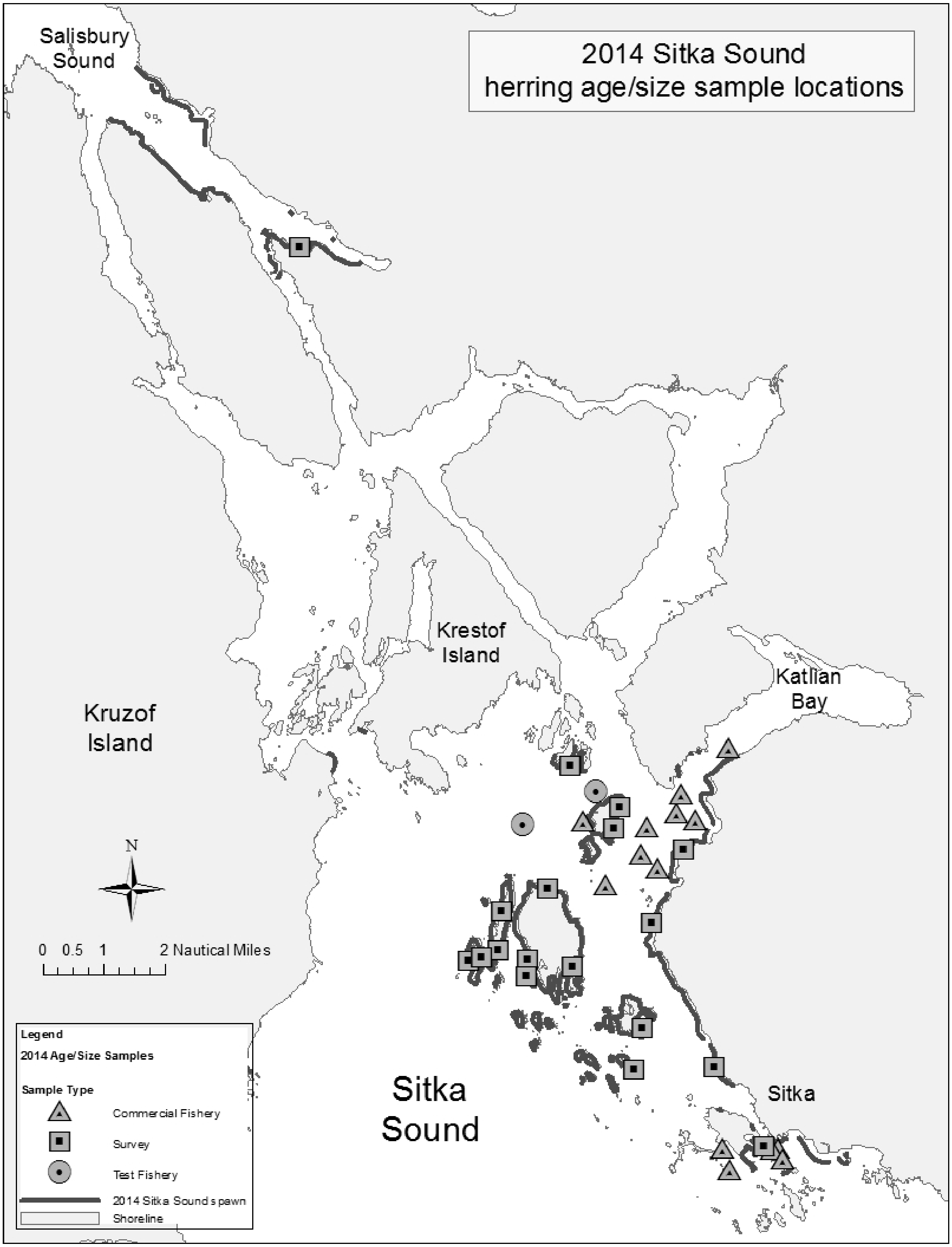


Figure 15.–Locations of herring samples collected for estimates of age and size for the Sitka Sound herring stock, 2013/2014. Cumulative herring spawn denoted by thick gray line along shoreline.

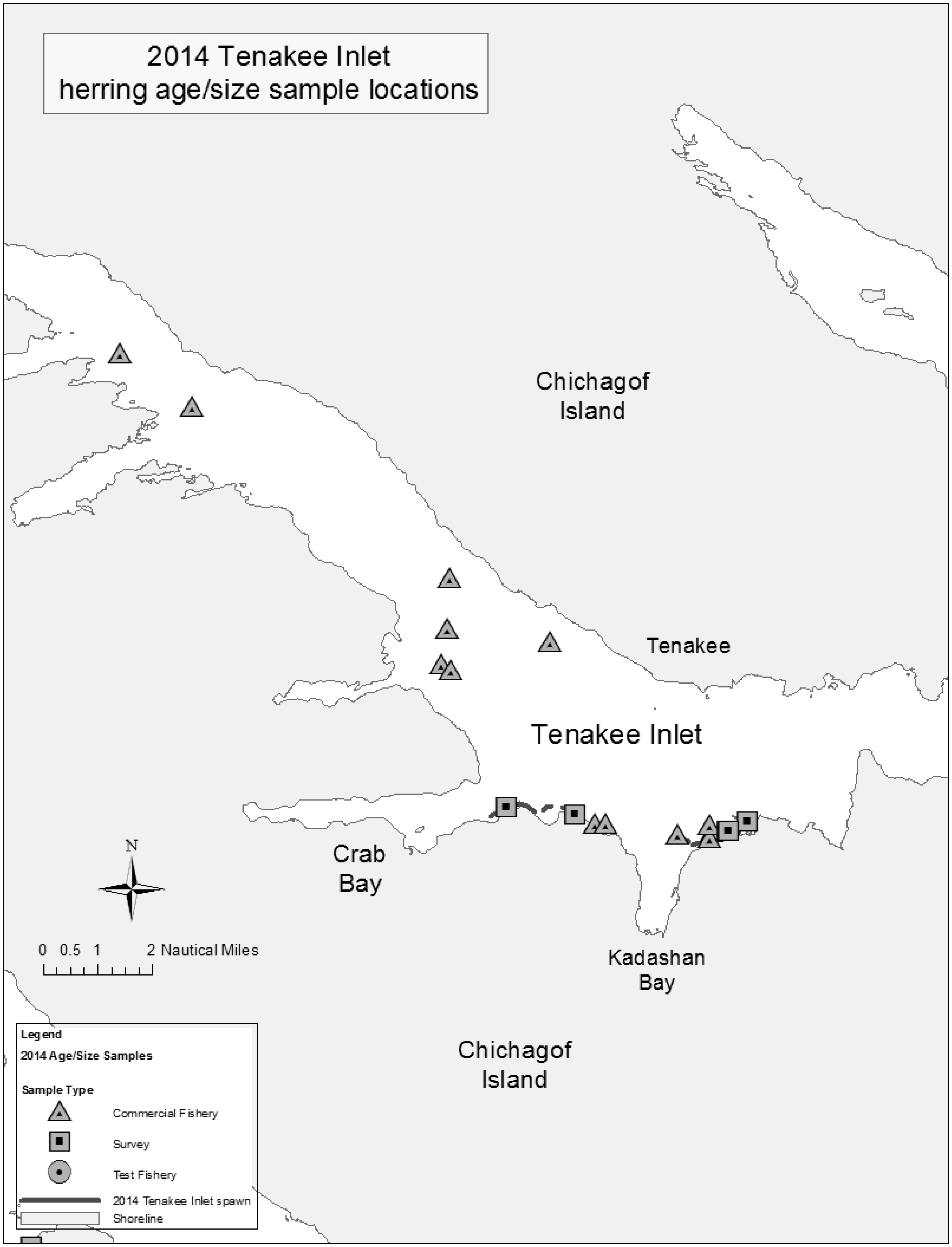


Figure 16.–Location of herring spawn for the Tenakee Inlet herring stock, 2013/2014. Cumulative herring spawn denoted by thick gray line along shoreline.

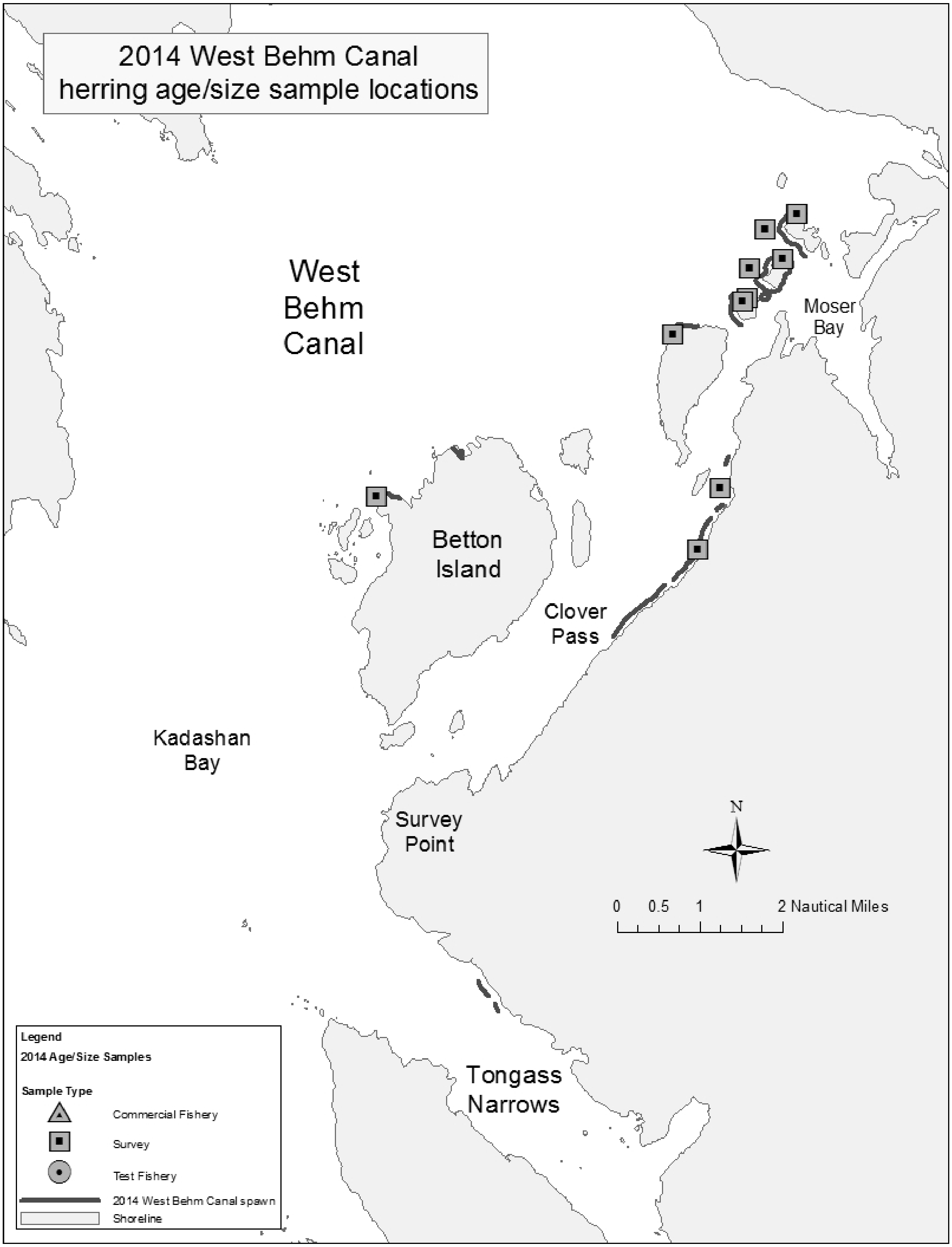


Figure 17.–Locations of herring samples collected for estimates of age and size for the West Behm Canal herring stock, 2014. Cumulative herring spawn denoted by thick gray line along shoreline.

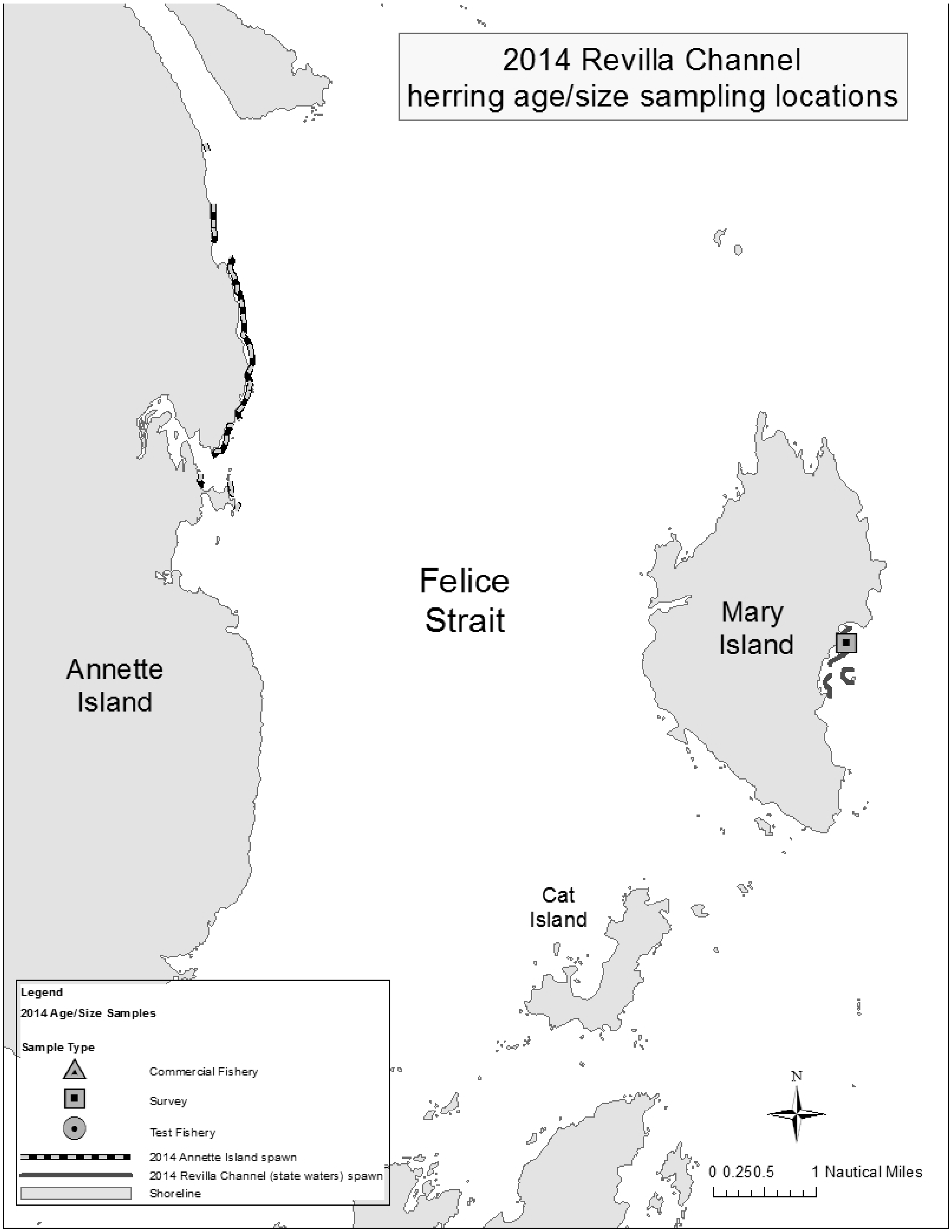


Figure 18.–Locations of herring samples collected for estimates of age and size for the Revilla Channel herring stock, 2014 (including Annette Island Reserve). Cumulative herring spawn denoted by thick gray line along shoreline.

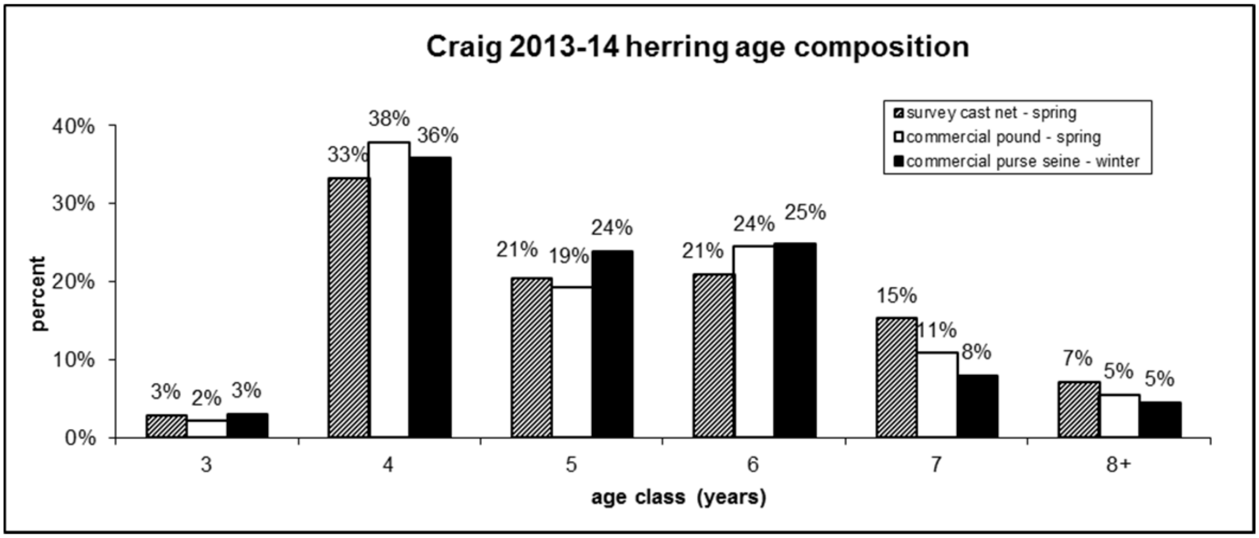


Figure 19.–Age composition for Craig herring stock in 2013–14.

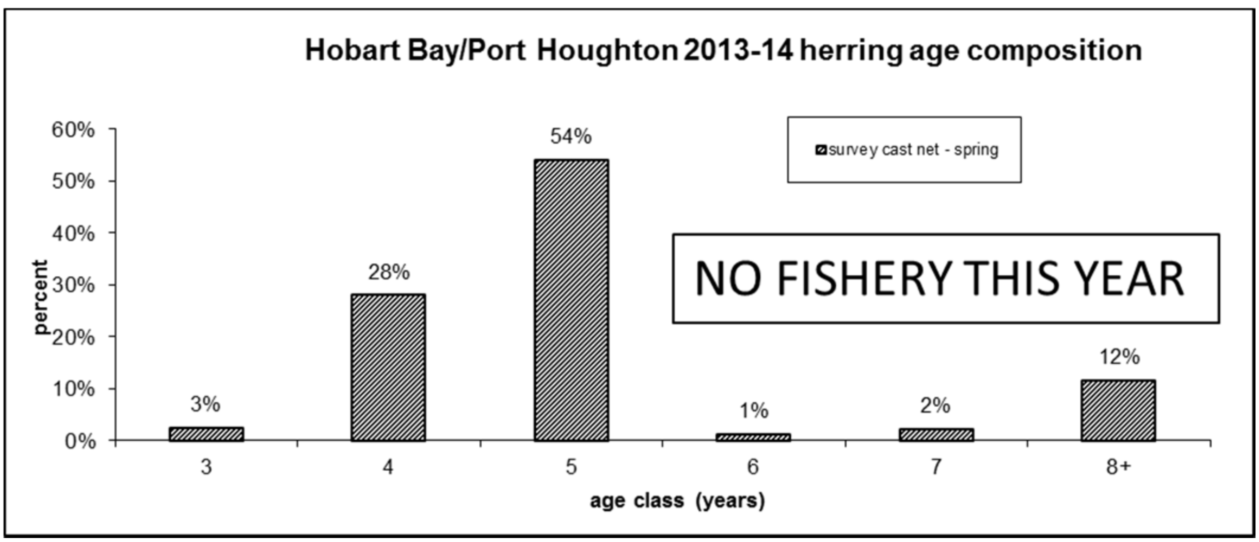


Figure 20.–Age composition for Hobart Bay/Port Houghton herring stock in 2013–14. No commercial fishery samples were obtained as no commercial fishery was opened in 2013–14.

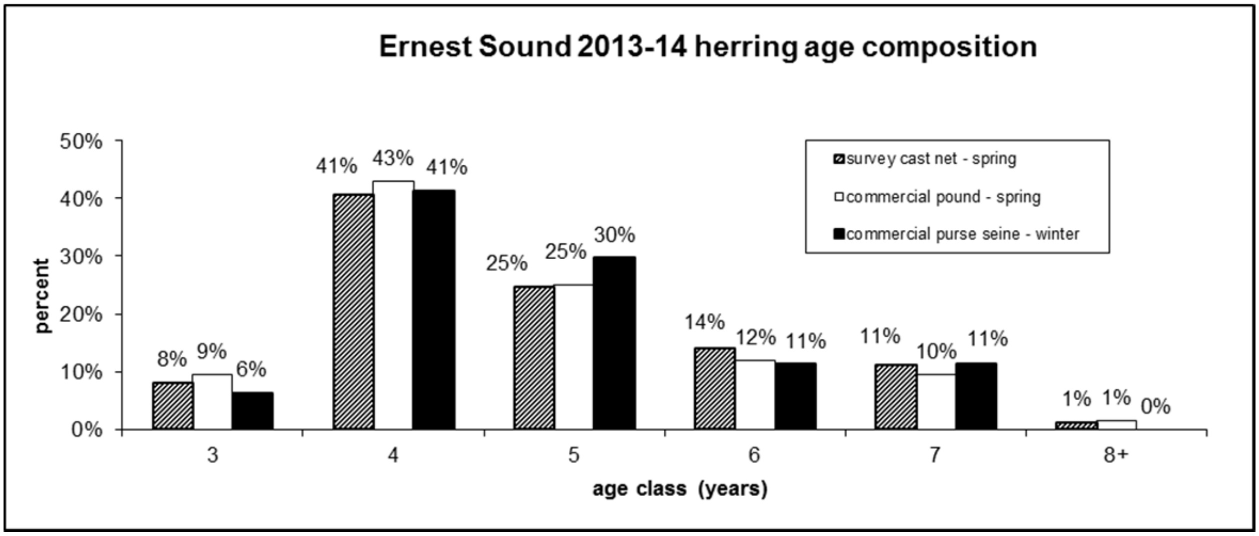


Figure 21.–Age composition for Ernest Sound herring stock in 2013–14.

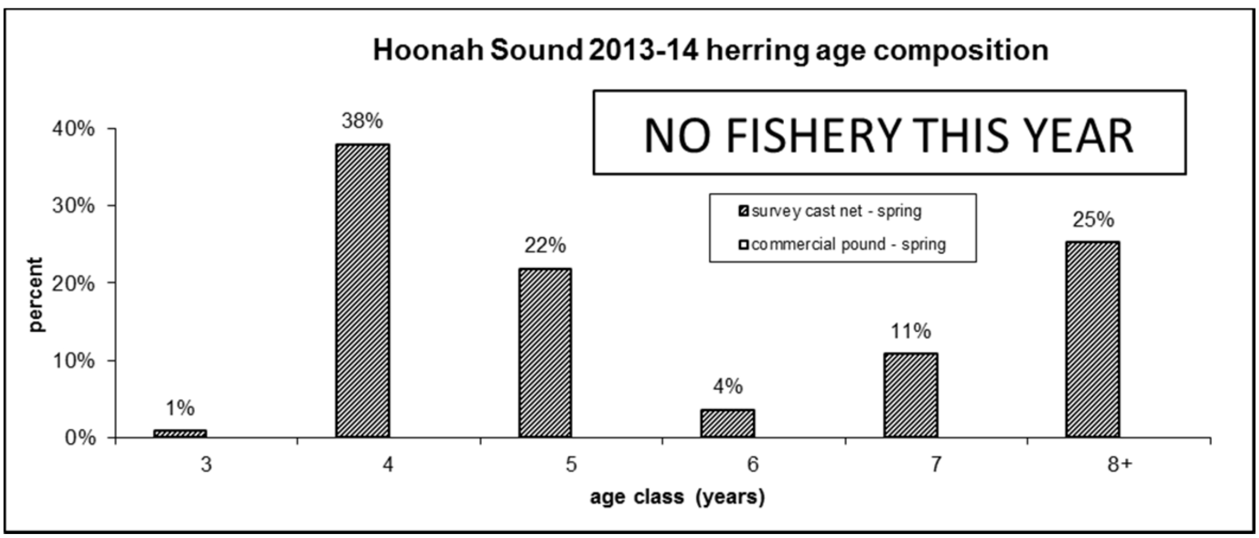


Figure 22.–Age composition for Hoonah Sound herring stock in 2013–14.

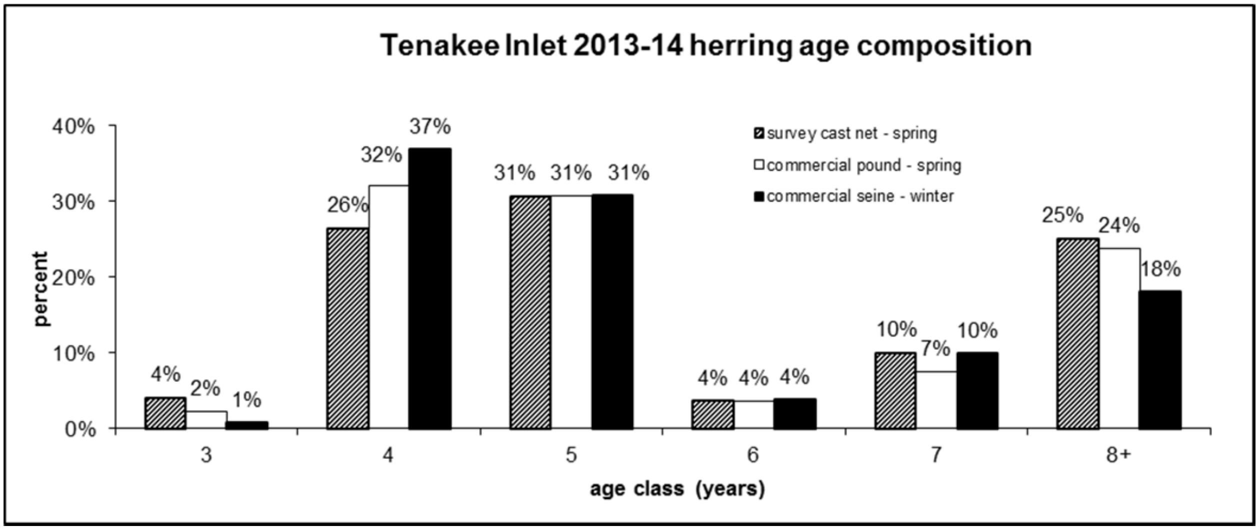


Figure 23.–Age composition for Tenakee Inlet herring stock in 2013–14.

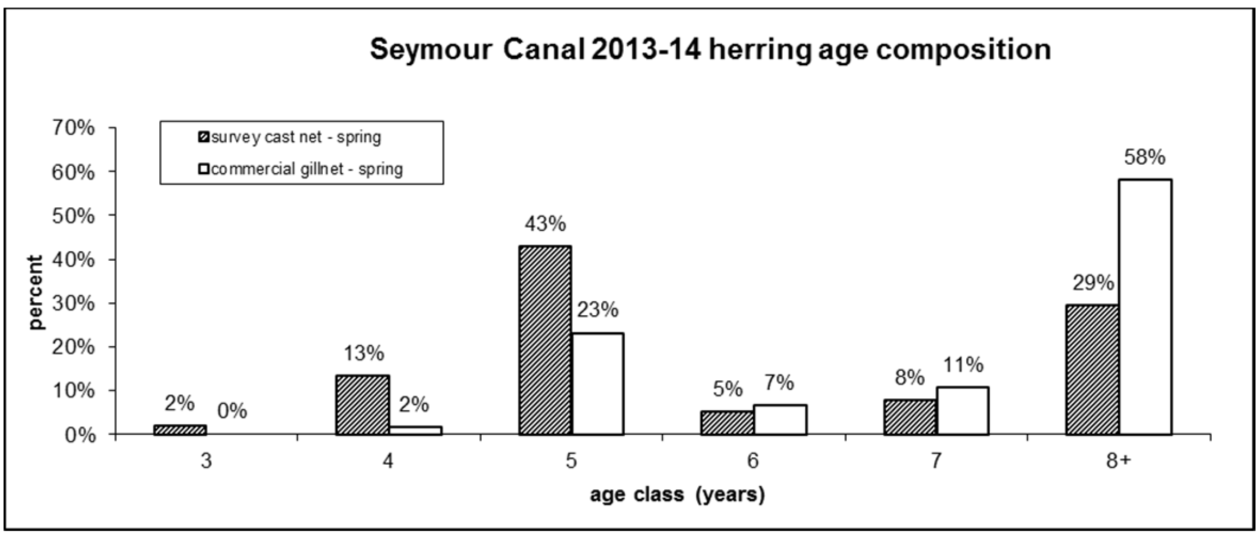


Figure 24.–Age composition for Seymour Canal herring stock in 2013–14.

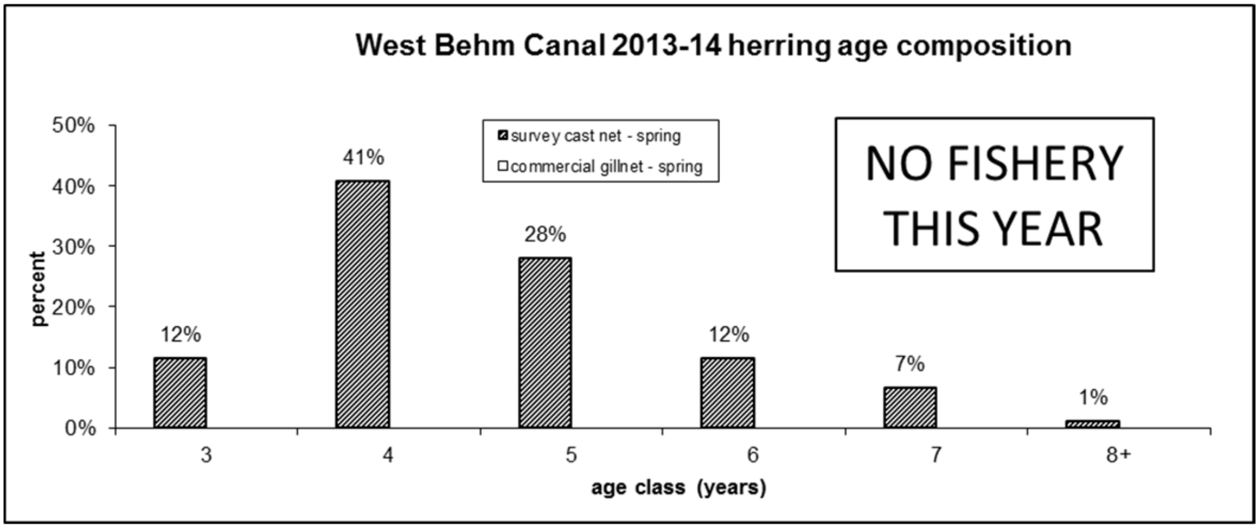


Figure 25.–Age composition for West Behm Canal herring stock in 2013–14. No commercial fishery samples were obtained as no commercial fishery was opened in 2013–14.

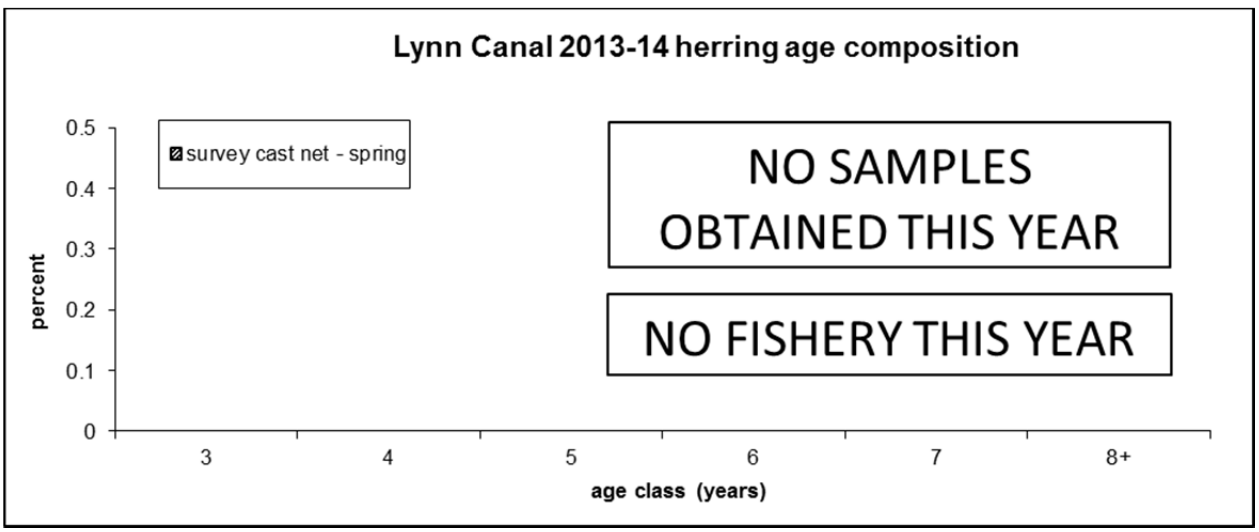


Figure 26.–Age composition for Lynn Canal herring stock in 2013–14. No cast net samples were obtained and no commercial fishery was opened in 2013–14.

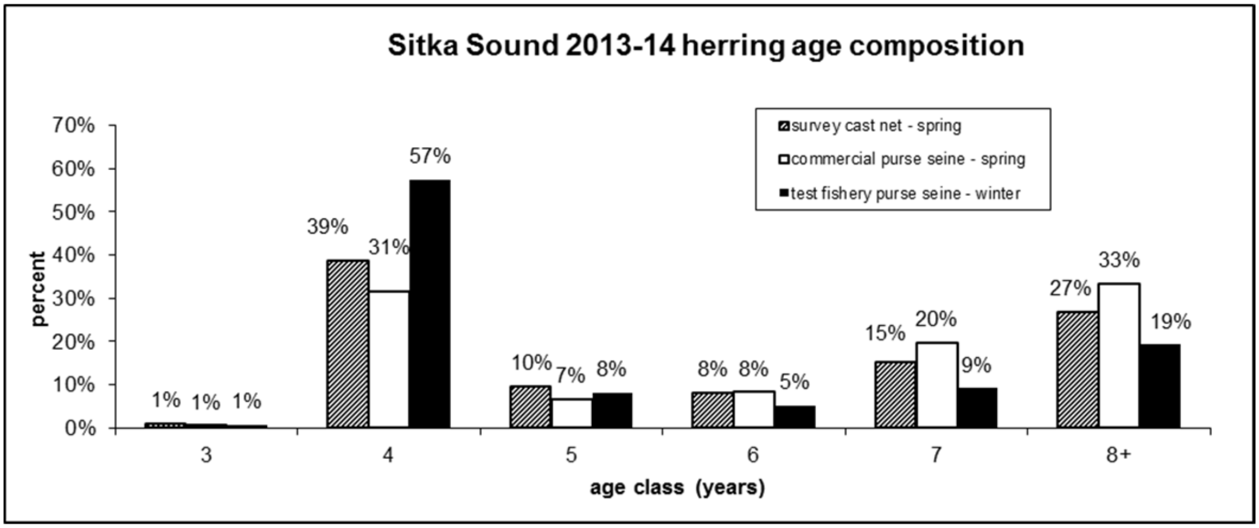


Figure 27.–Age composition for Sitka Sound herring stock in 2013–14.

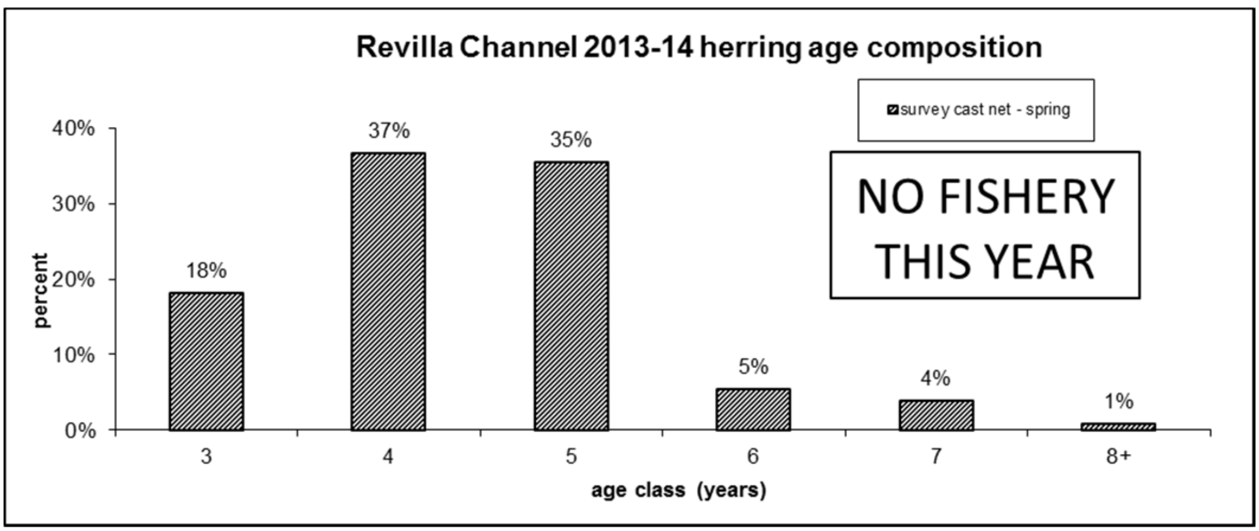


Figure 28.–Age composition for Revilla Channel herring stock (state waters only) in 2013–14.

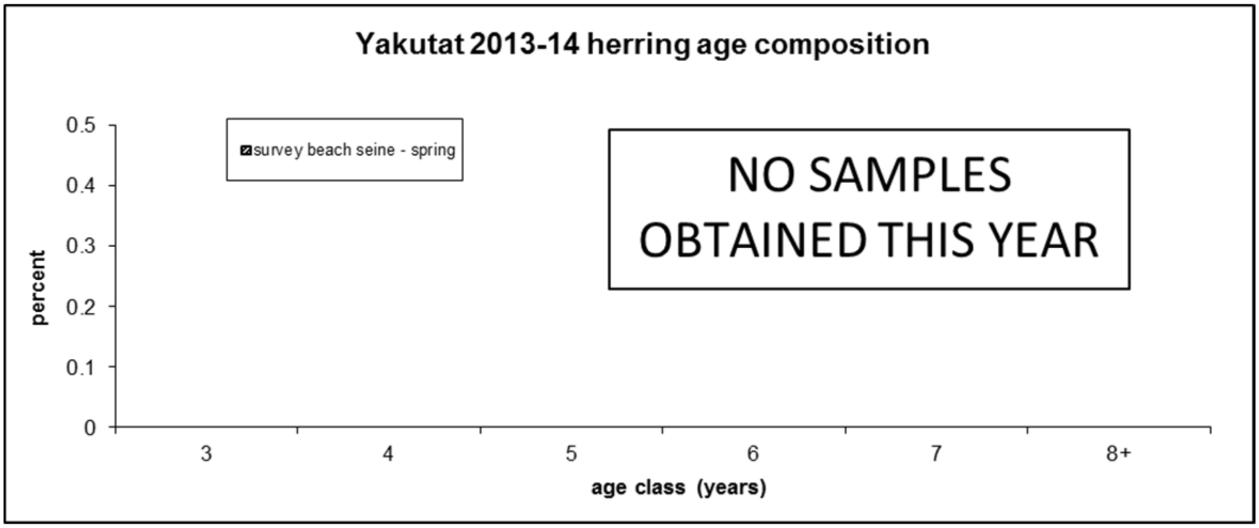


Figure 29.–Age composition for Yakutat Bay herring stock in 2013–14.

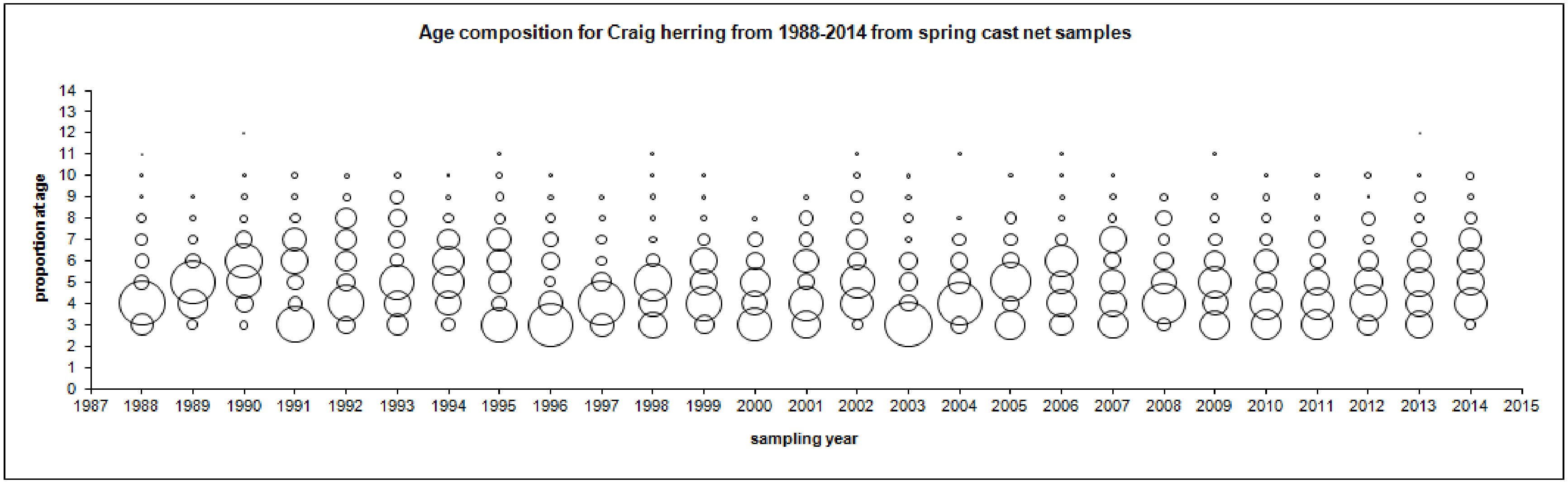


Figure 30.–Age composition from sampling data for the Craig herring stock. Ages presented for 2000 may be biased slightly high due to misinterpretation of scale annuli.

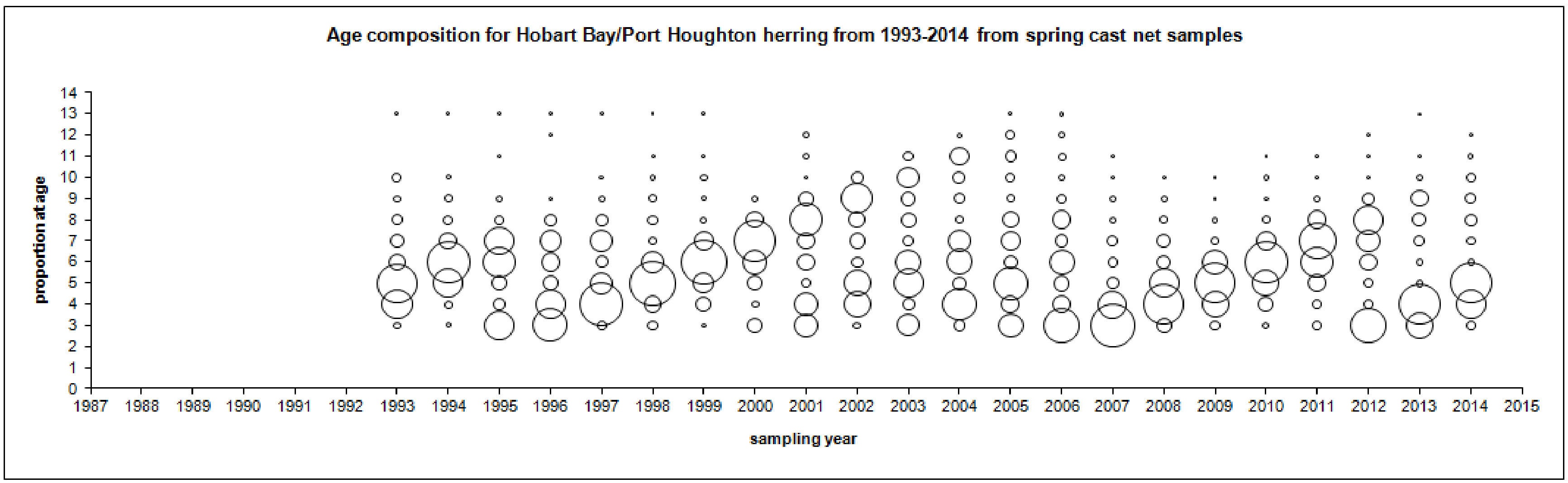


Figure 31–Age composition from sampling data for the Hobart Bay/Port Houghton herring stock. Ages presented for 2000 may be biased slightly high due to misinterpretation of scale annuli.

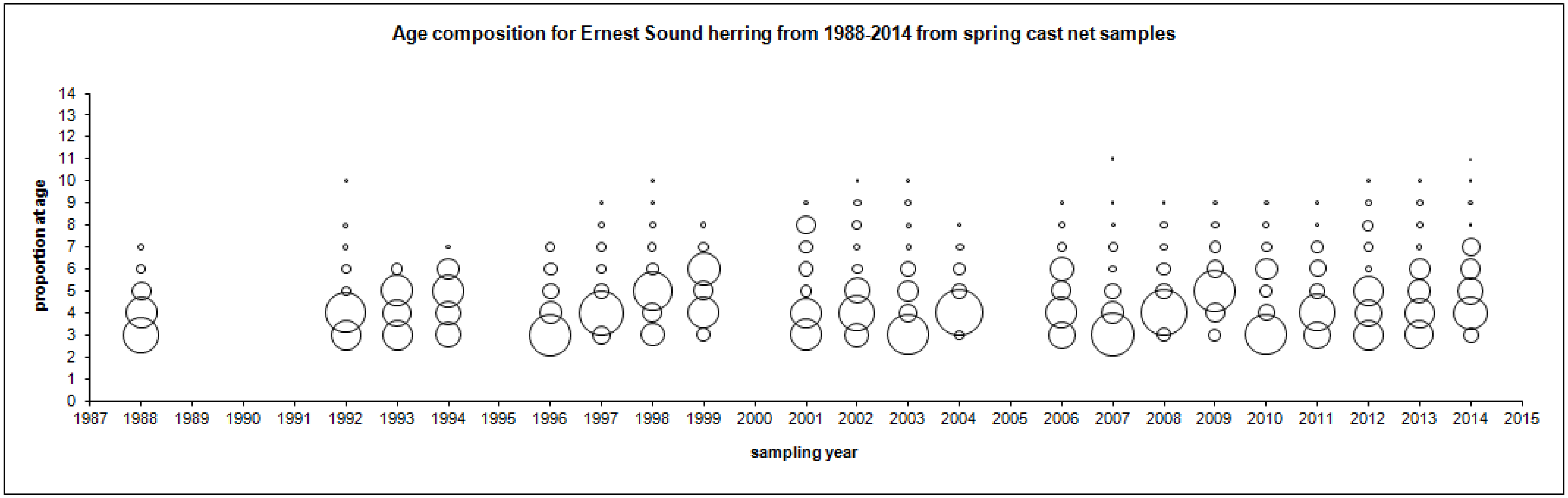


Figure 32.–Age composition from sampling data for the Ernest Sound herring stock.

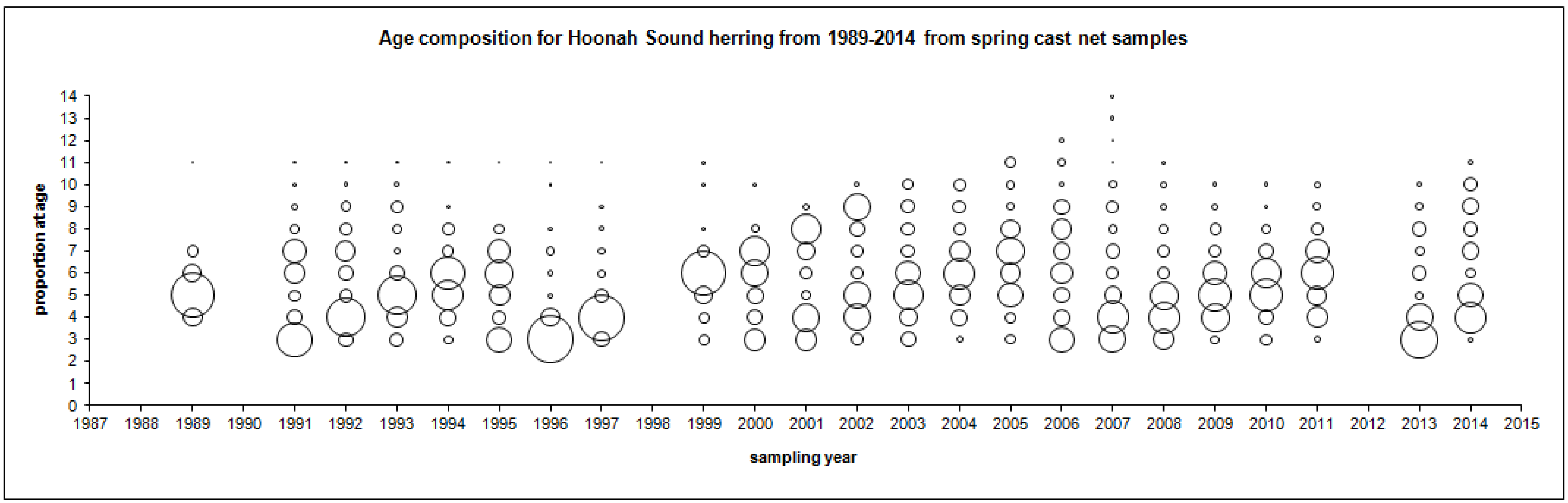


Figure 33.–Age composition from sampling data for the Hoonah Sound herring stock. Ages presented for 2000 may be biased slightly high due to misinterpretation of scale annuli.

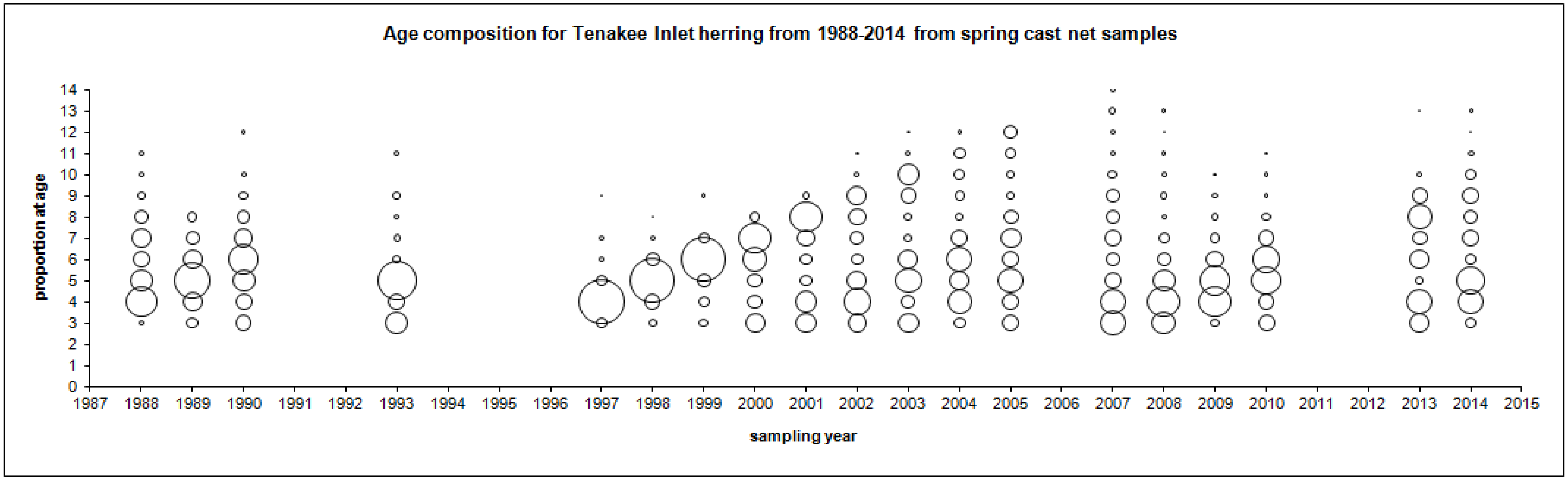


Figure 34.–Age composition from sampling data for the Tenakee Inlet herring stock. Ages presented for 2000 may be biased slightly high due to misinterpretation of scale annuli.

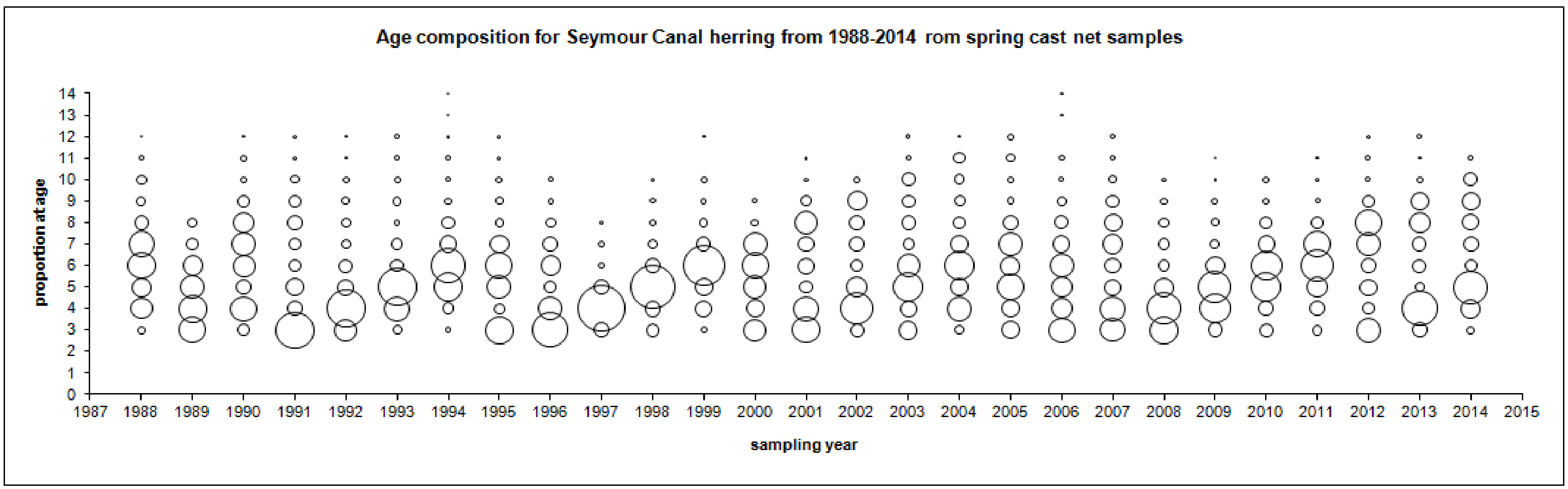


Figure 35.–Age composition from sampling data for the Seymour Canal herring stock. Ages presented for 2000 may be biased slightly high due to misinterpretation of scale annuli.

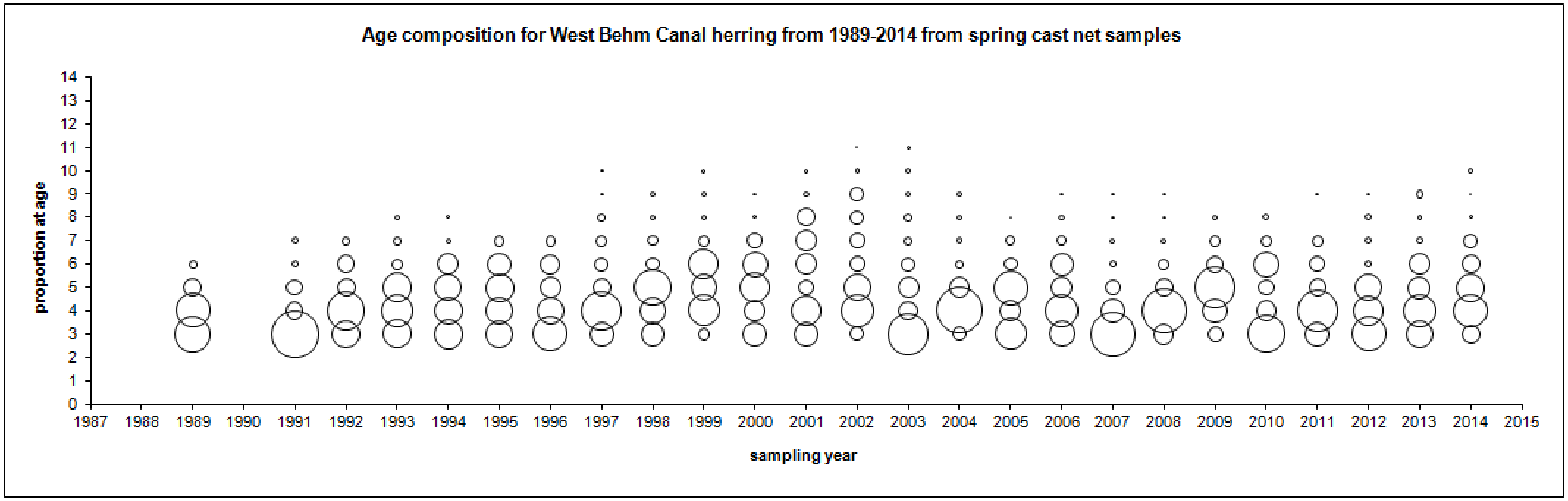


Figure 36.–Age composition from sampling data for the West Behm Canal herring stock. Ages presented for 2000 may be biased slightly high due to misinterpretation of scale annuli.

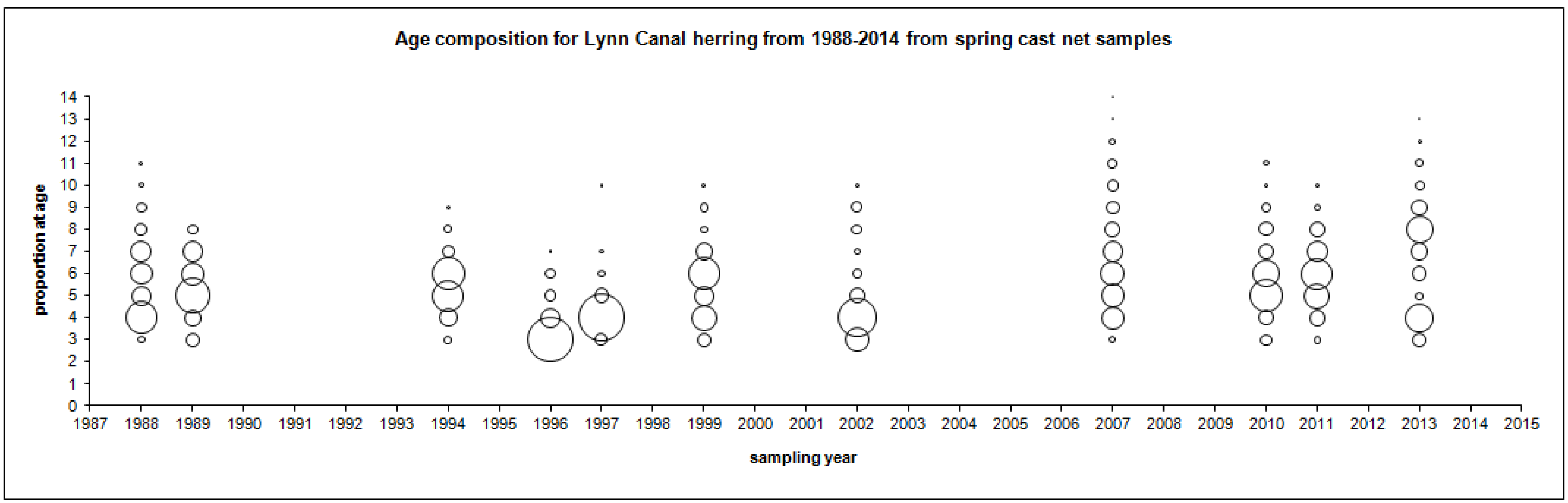


Figure 37.–Age composition from sampling data for the Lynn Canal herring stock.

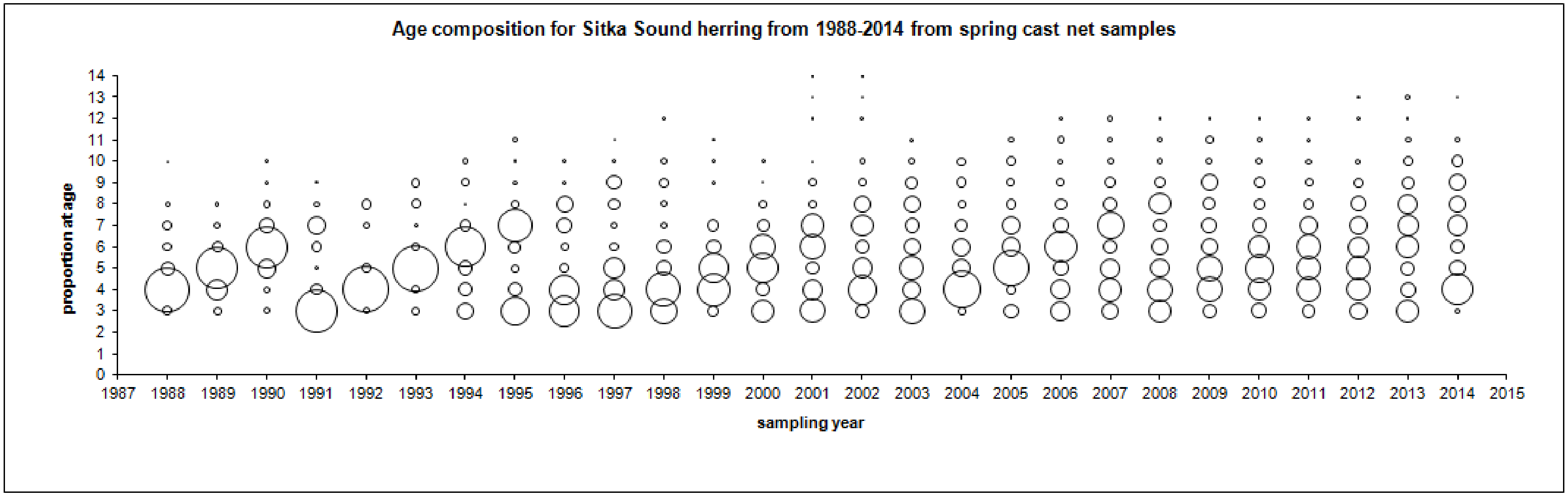


Figure 38.–Age composition from sampling data for the Sitka Sound herring stock. Ages presented for 2000 may be biased slightly high due to misinterpretation of scale annuli.

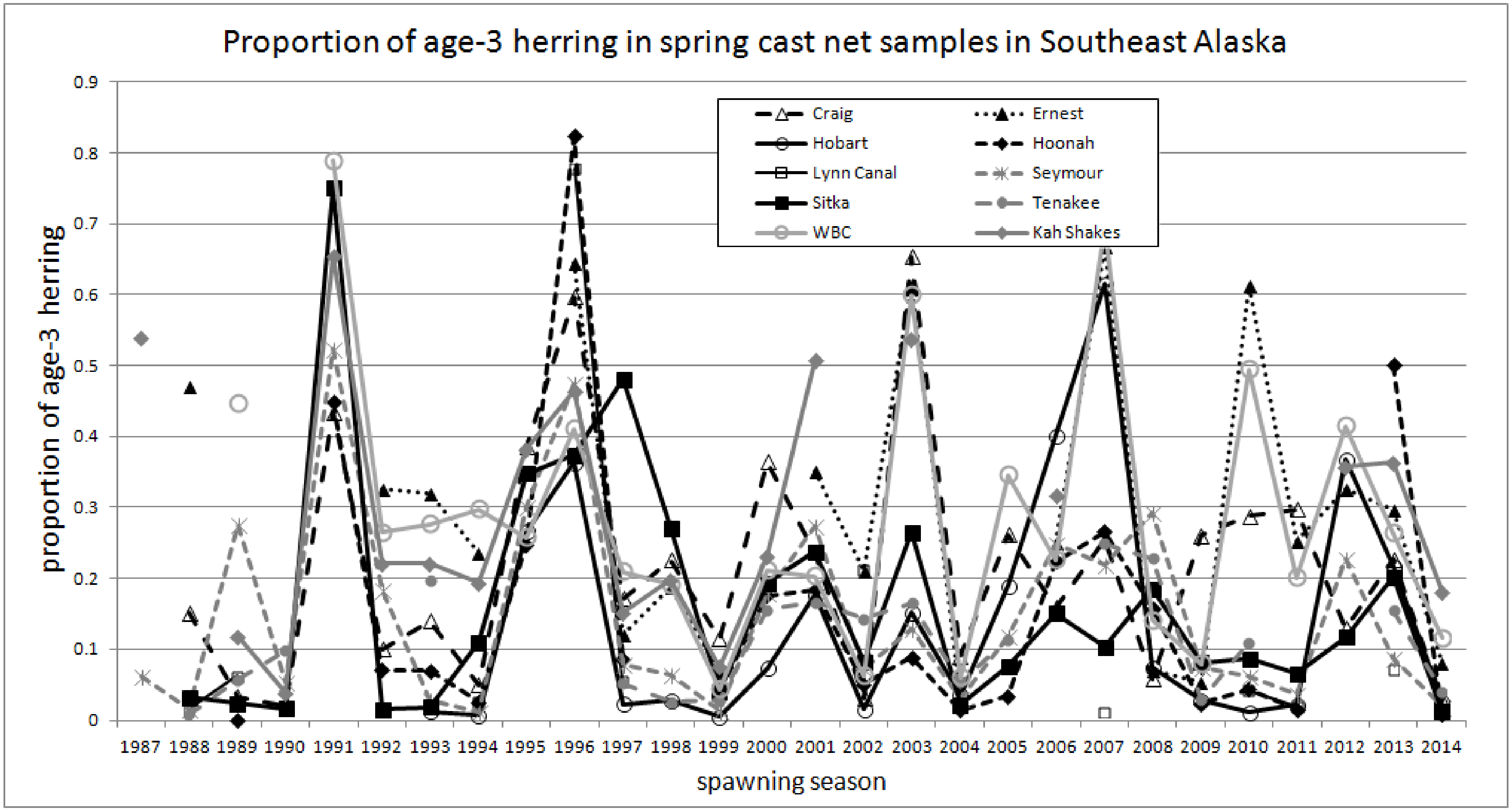


Figure 39.–Proportion of age-3 herring in spring cast nest samples of spawning populations for stocks in Southeast Alaska.

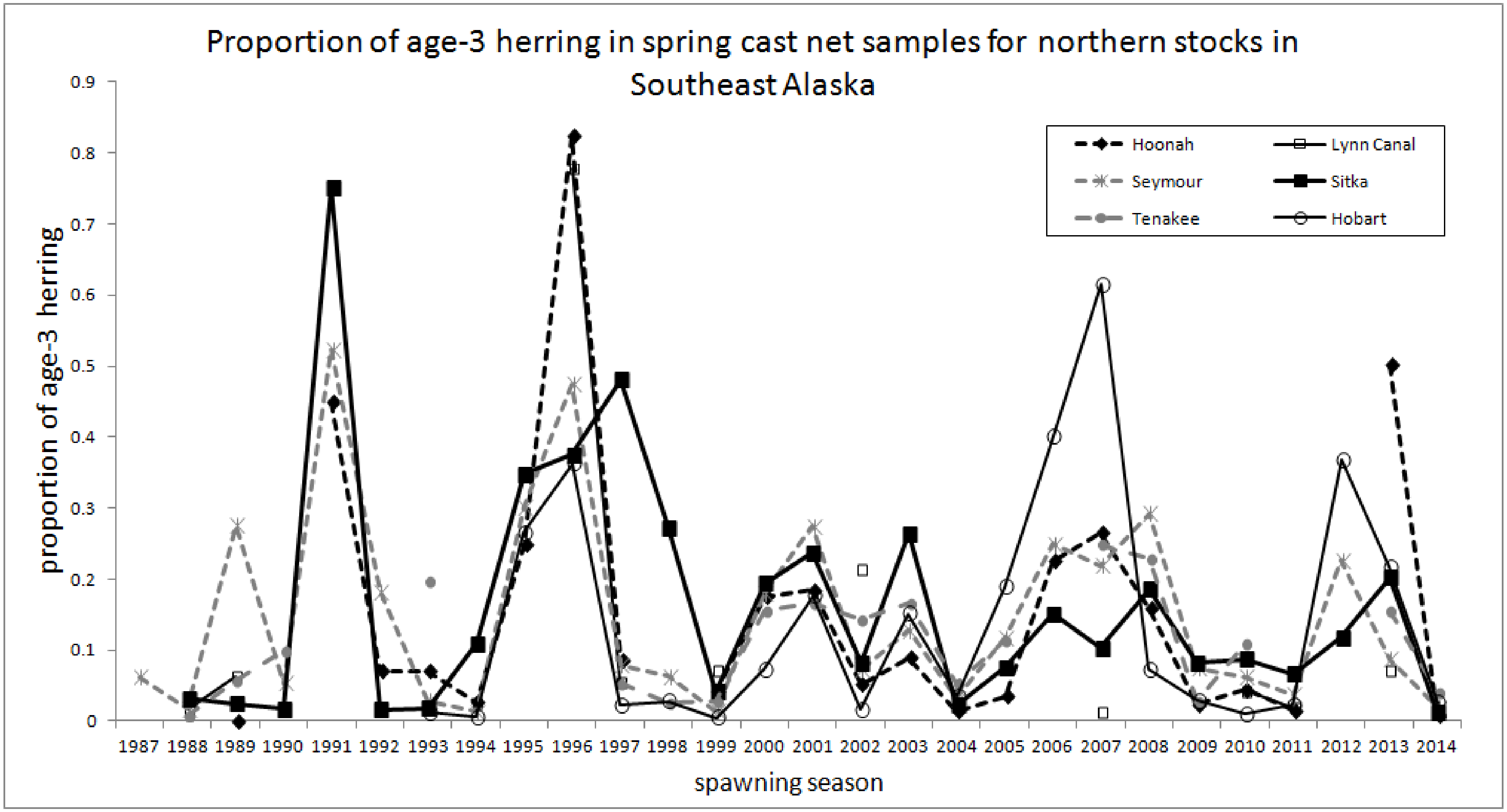


Figure 40.–Proportion of age-3 herring in spring cast nest samples of spawning populations for northern stocks in Southeast Alaska.

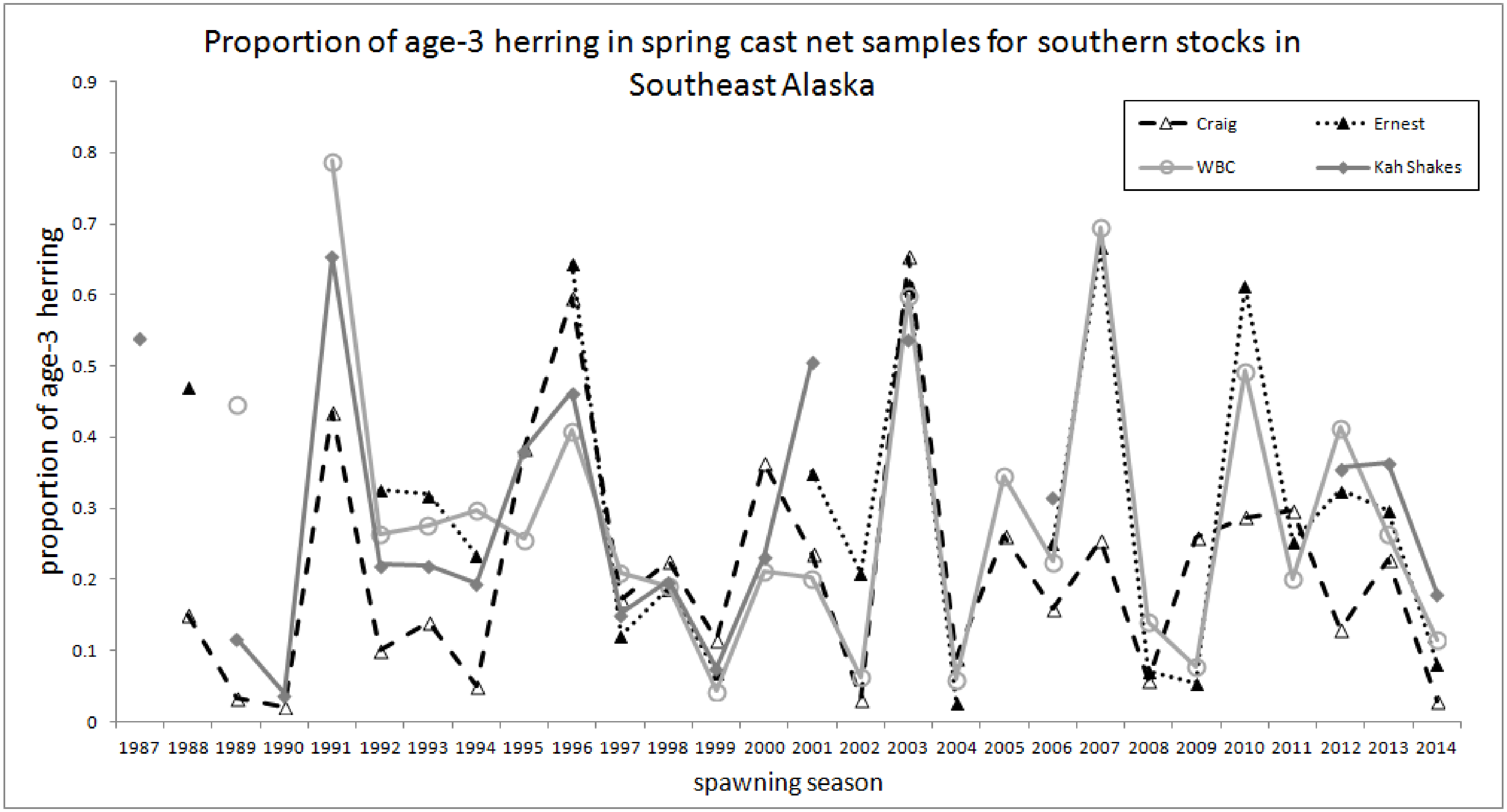


Figure 41.–Proportion of age-3 herring in spring cast nest samples of spawning populations for southern stocks in Southeast Alaska.

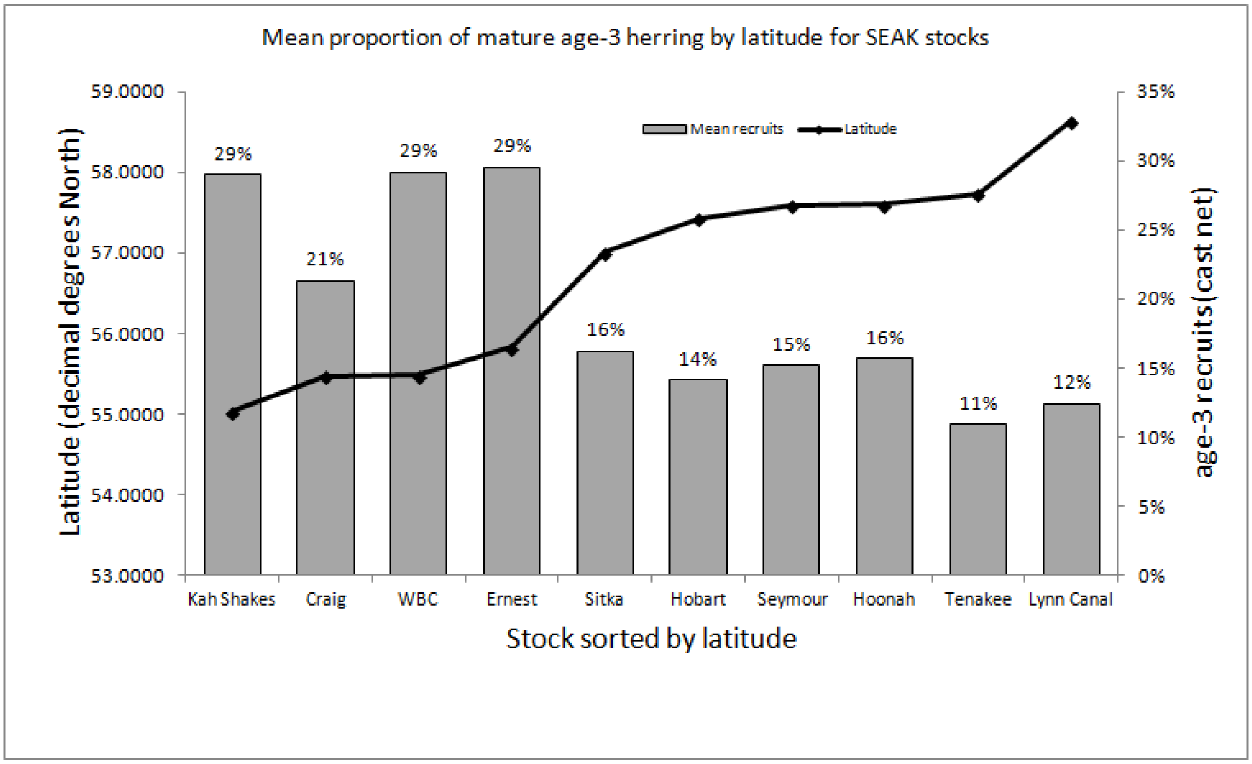


Figure 42.–Mean proportion of age-3 herring in spring cast nest samples (1988–2014) and latitude of spawning populations for stocks in Southeast Alaska.

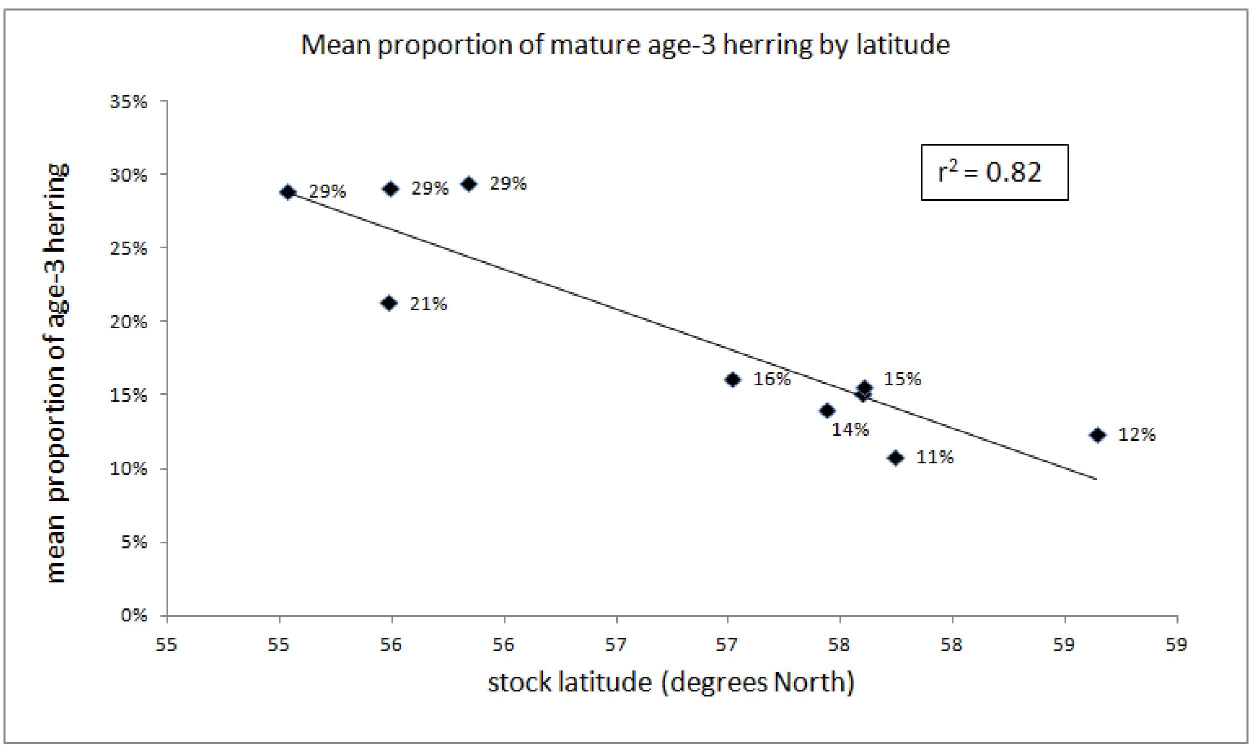


Figure 43.–Mean proportion of age-3 herring in spring cast nest samples versus stock latitude of spawning stocks in Southeast Alaska.

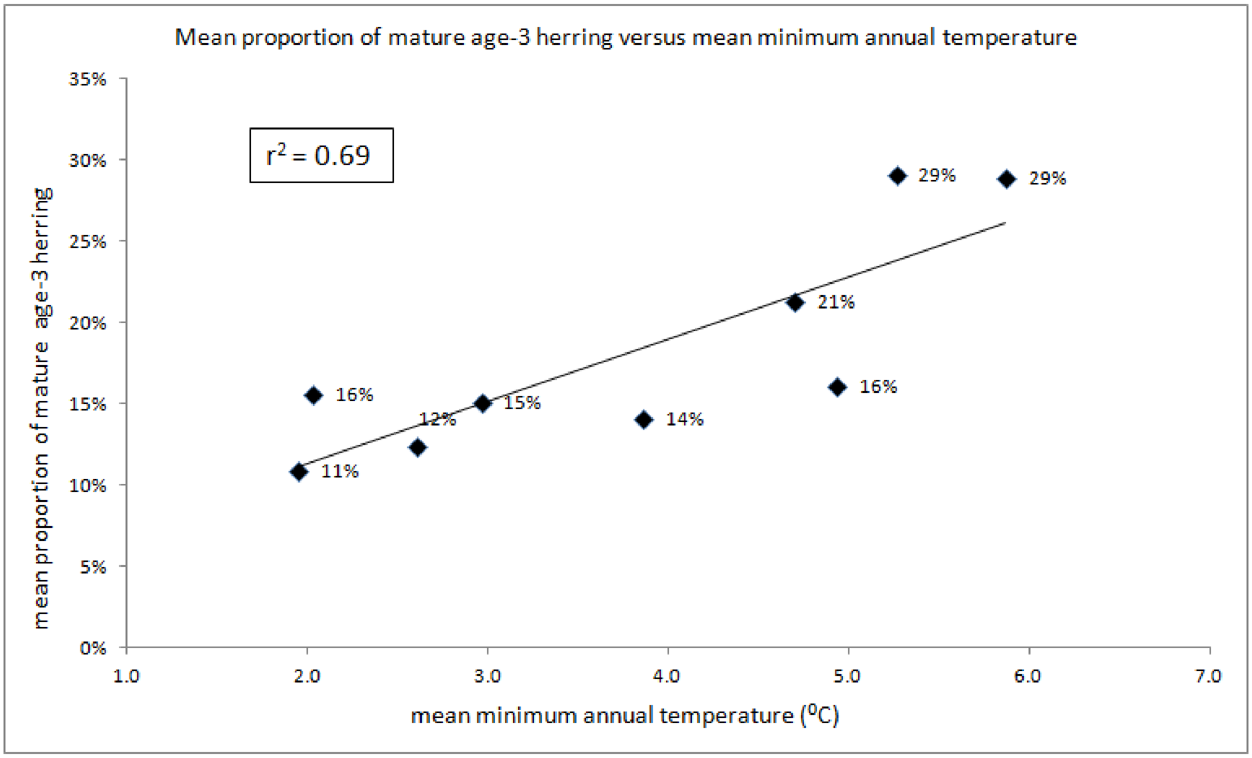


Figure 44.–Mean proportion of age-3 herring in spring cast nest samples versus mean minimum annual sea water temperature at location of spawning stocks in Southeast Alaska.

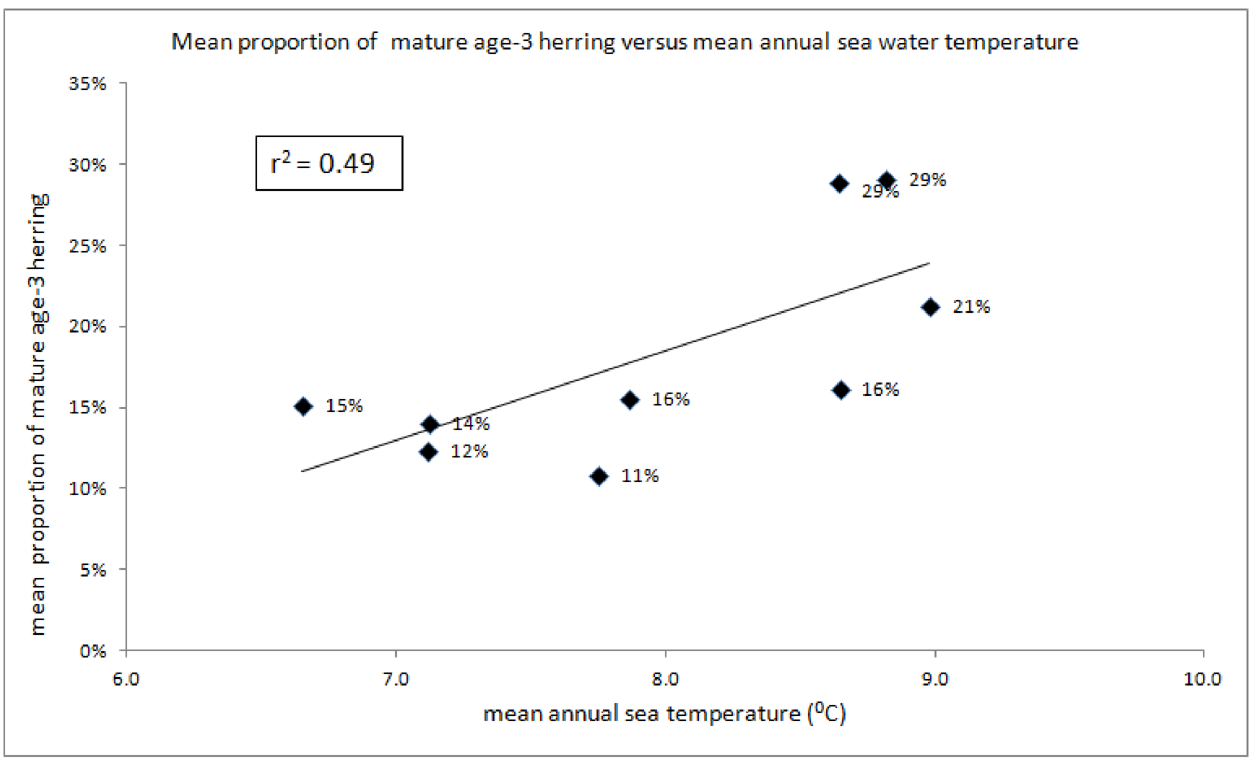


Figure 45.–Mean proportion of age-3 herring in spring cast nest samples versus mean annual sea water temperature at location of spawning stocks in Southeast Alaska.

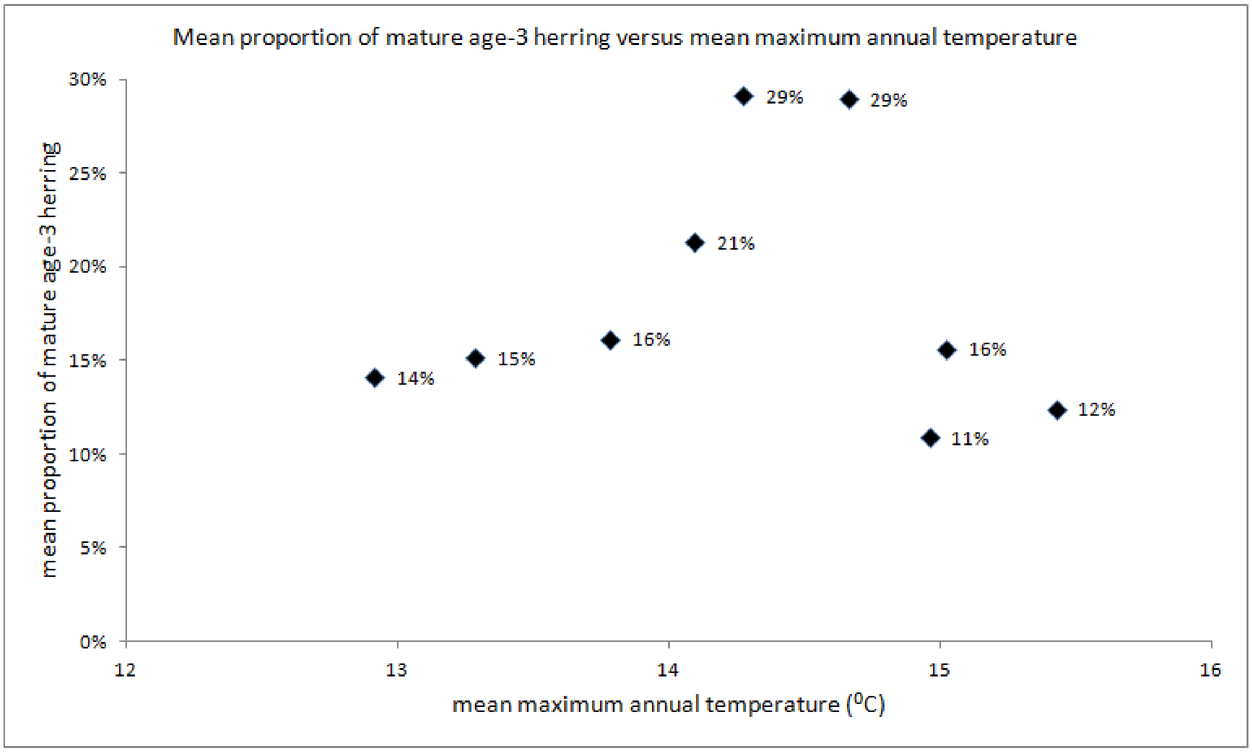


Figure 46.–Mean proportion of age-3 herring in spring cast nest samples versus mean maximum annual sea water temperature at location of spawning stocks in Southeast Alaska.

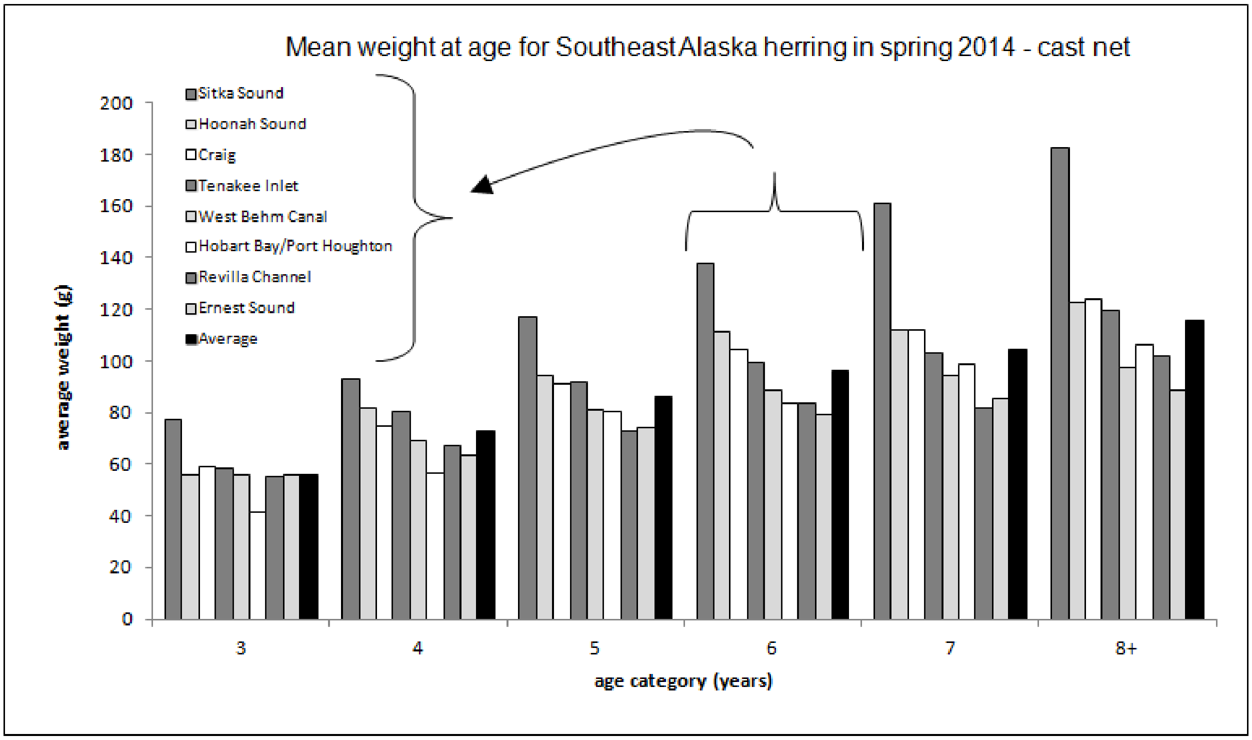


Figure 47.–Mean weight-at-age for Southeast Alaska herring stocks in spring 2014, sorted by age-6.

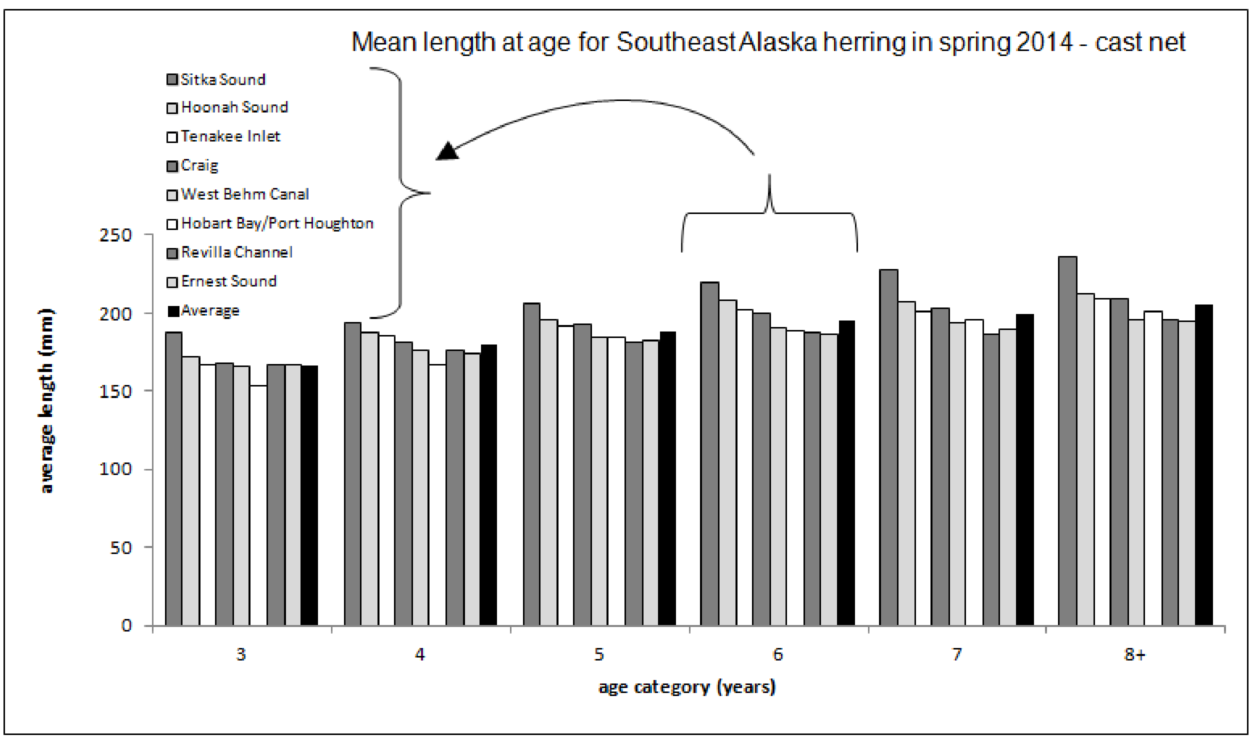


Figure 48.–Mean length at age for Southeast Alaska herring stocks in spring 2014, sorted by age-6.

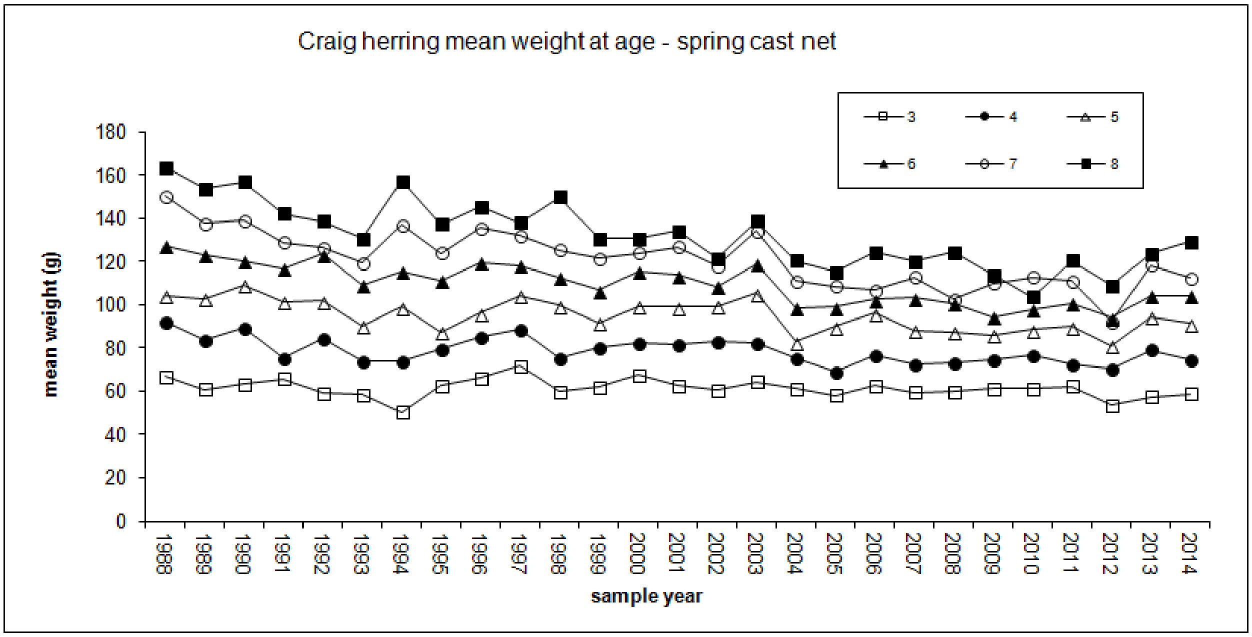


Figure 49.–Mean weight-at-age of the Craig herring spawning population. Weights presented for 2000 may be biased slightly high due to misinterpretation of scale annuli.

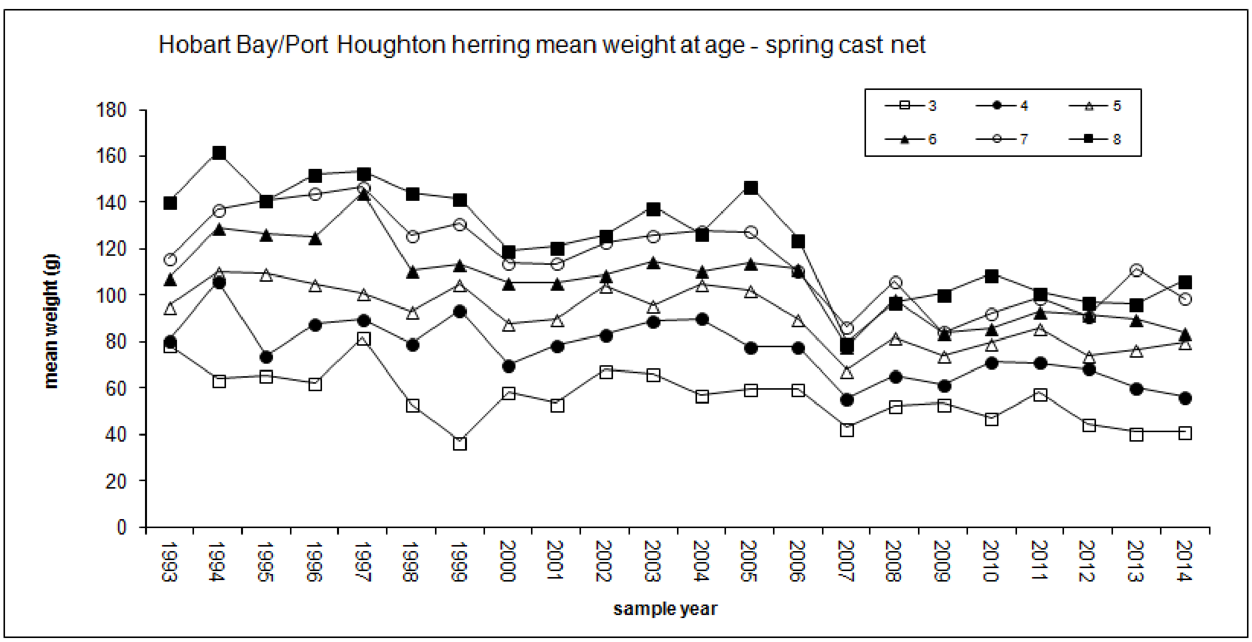


Figure 50.–Mean weight at age of the Hobart Bay/Port Houghton herring spawning population. Weights presented for 2000 may be biased slightly high due to misinterpretation of scale annuli.

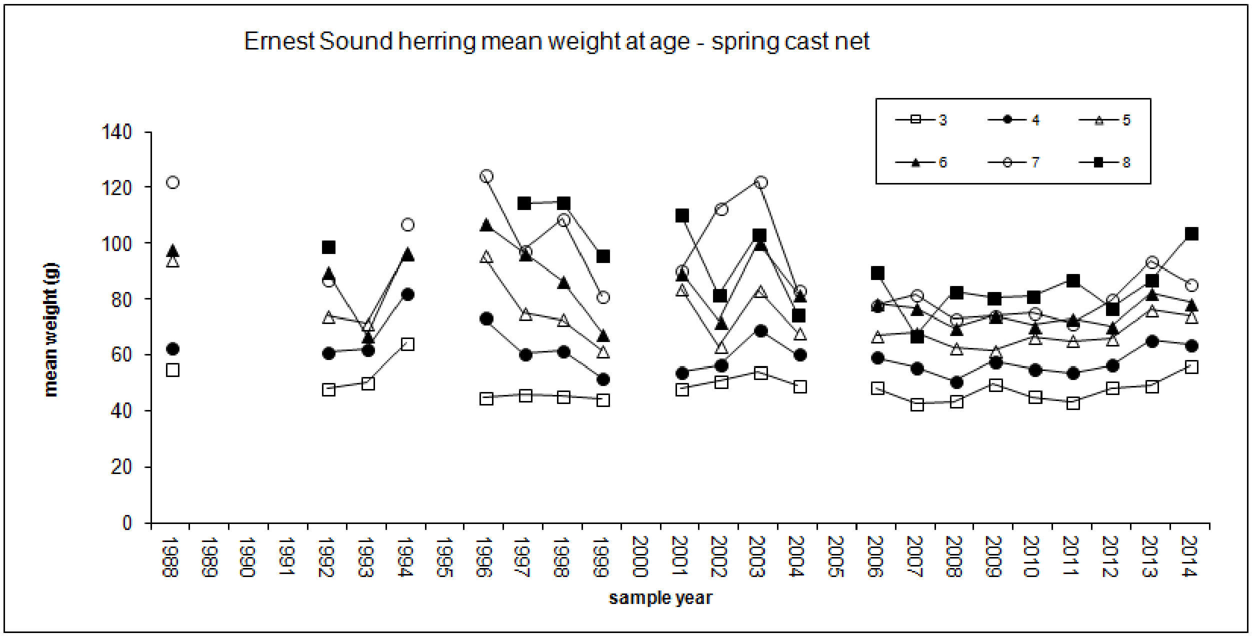


Figure 51.–Mean weight at age for the Ernest Sound herring spawning population.

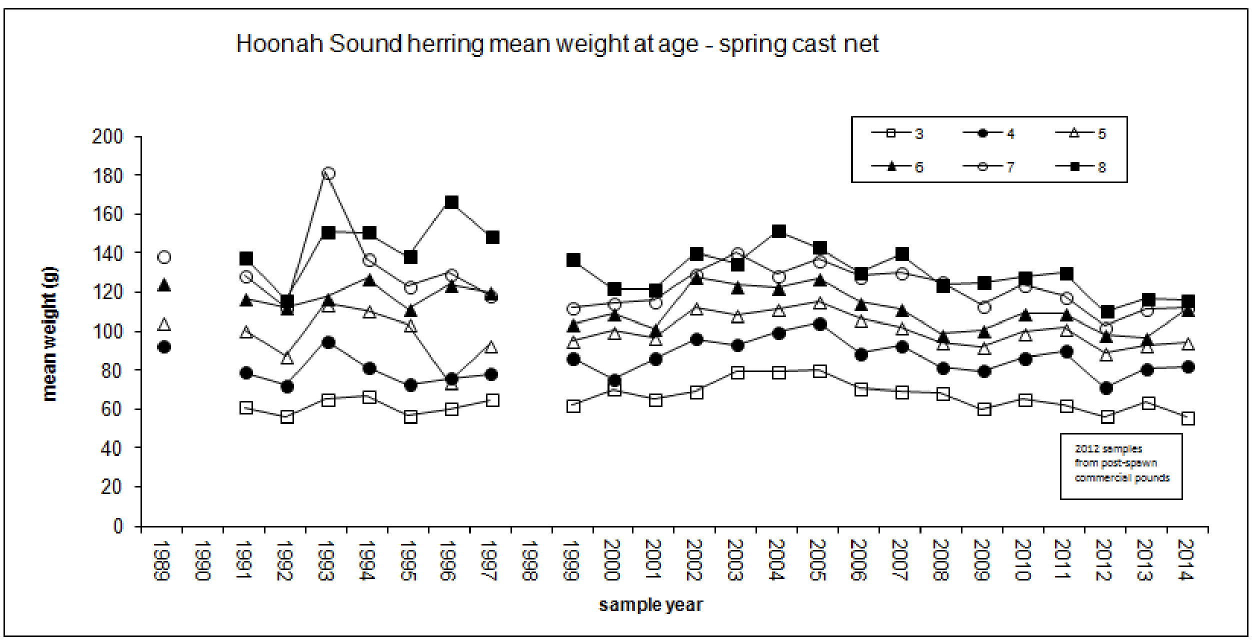


Figure 52.–Mean weight at age for the Hoonah Sound herring spawning population. Weights presented for 2000 may be biased slightly high due to misinterpretation of scale annuli.

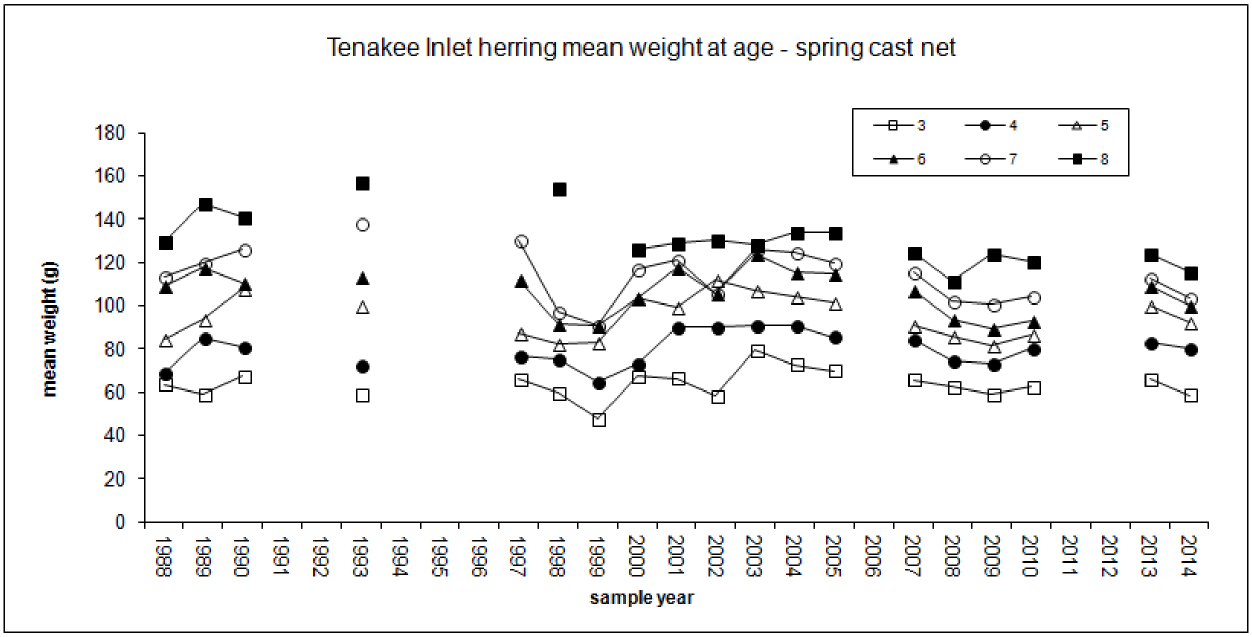


Figure 53.–Mean weight at age for the Tenakee Inlet herring stock. Weights presented for 2000 may be biased slightly high due to misinterpretation of scale annuli.

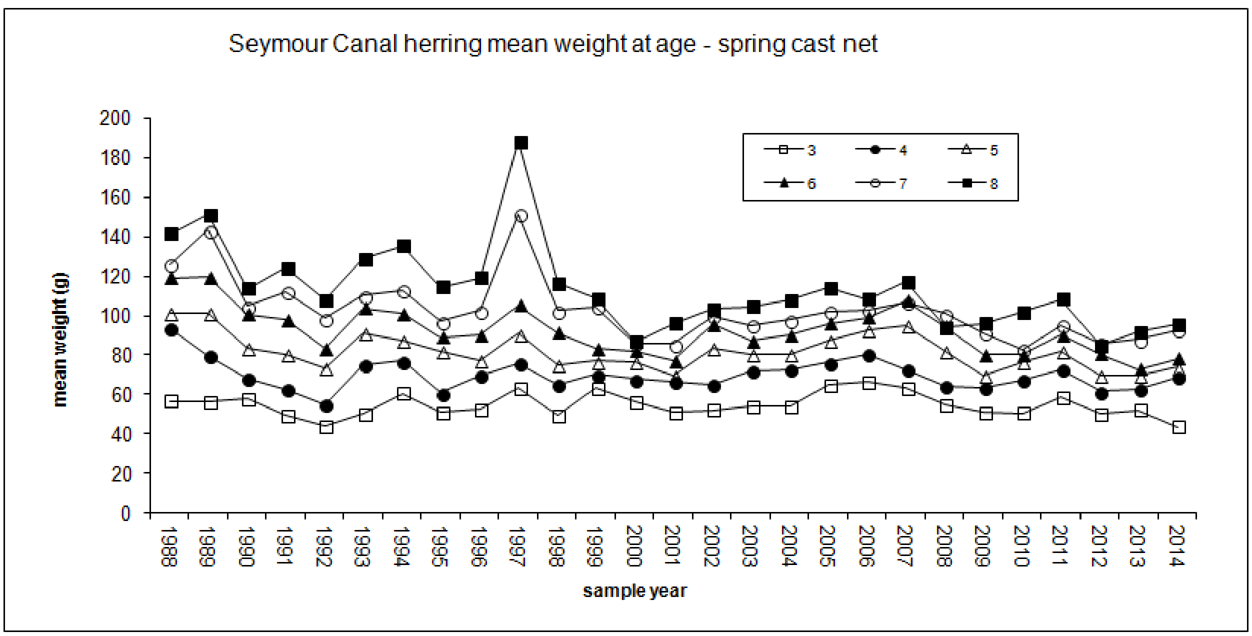


Figure 54.–Mean weight at age for the Seymour Canal herring stock. Weights presented for 2000 may be biased slightly high due to misinterpretation of scale annuli.

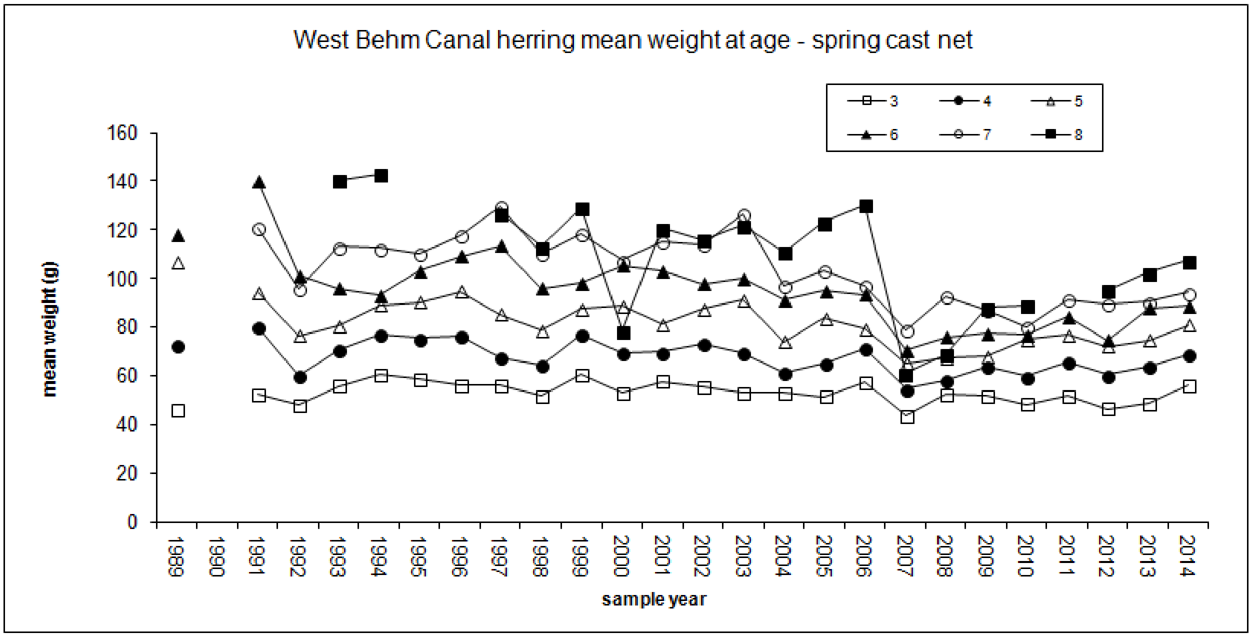


Figure 55.–Mean weight at age for the West Behm Canal herring spawning population. Weights presented for 2000 may be biased slightly high due to misinterpretation of scale annuli.

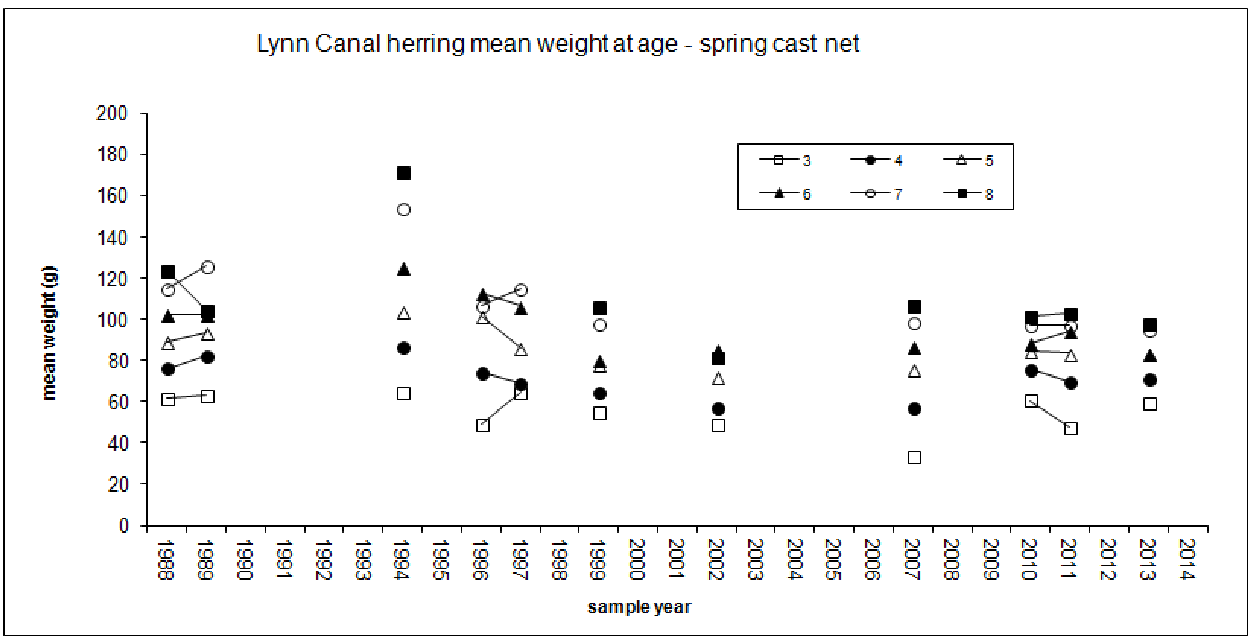


Figure 56.–Mean weight at age for the Lynn Canal herring spawning population.

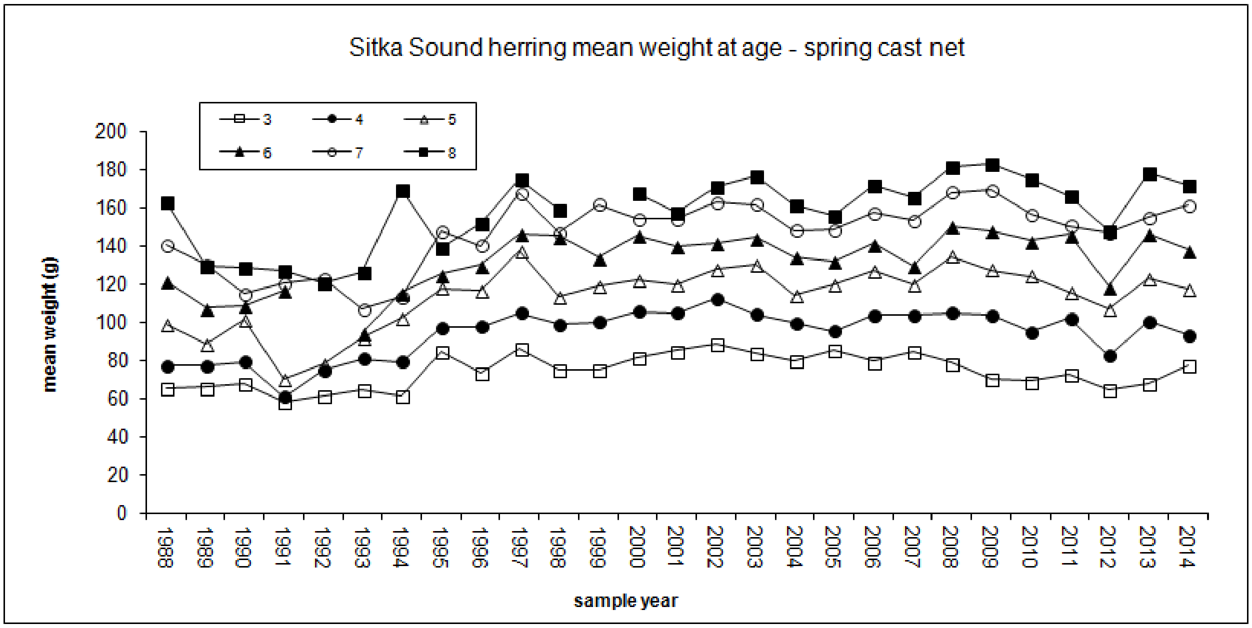


Figure 57.–Mean weight at age for the Sitka Sound herring spawning population. Weights presented for 2000 may be biased slightly high due to misinterpretation of scale annuli.

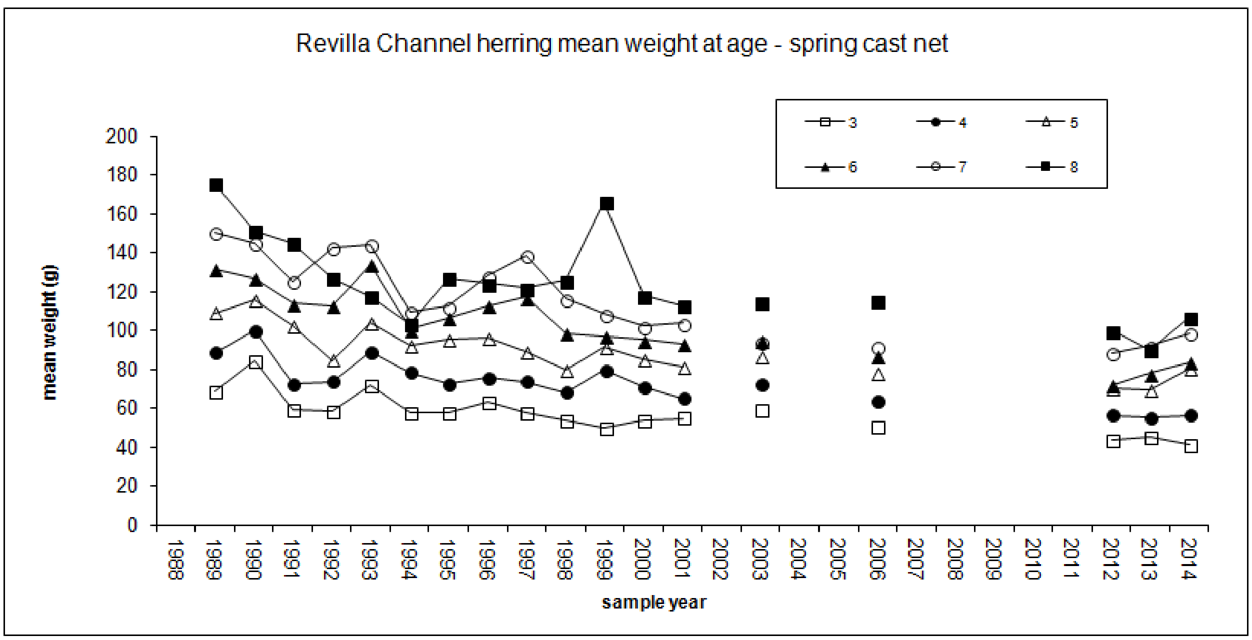


Figure 58.–Mean weight at age for the Revilla Channel herring spawning population. Weights presented for 2000 may be biased slightly high due to misinterpretation of scale annuli.

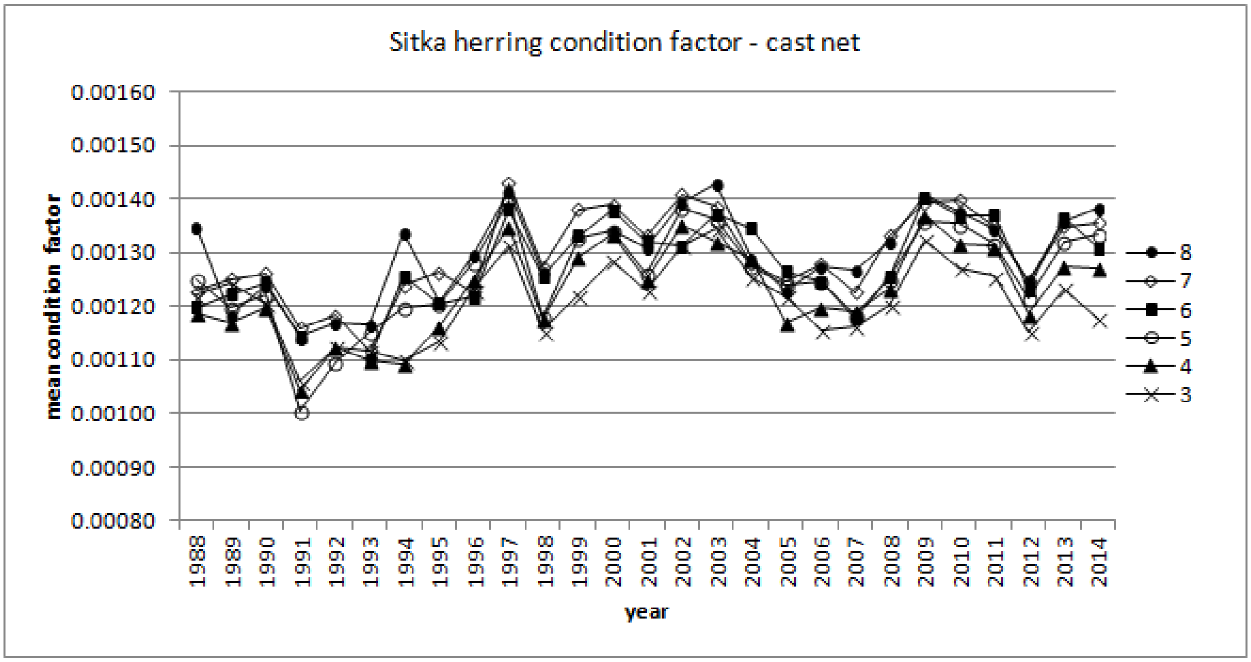


Figure 59.–Mean condition factors of age-3 through age-8 herring for the Sitka Sound spawning population, based on spring cast net samples taken during active spawning.

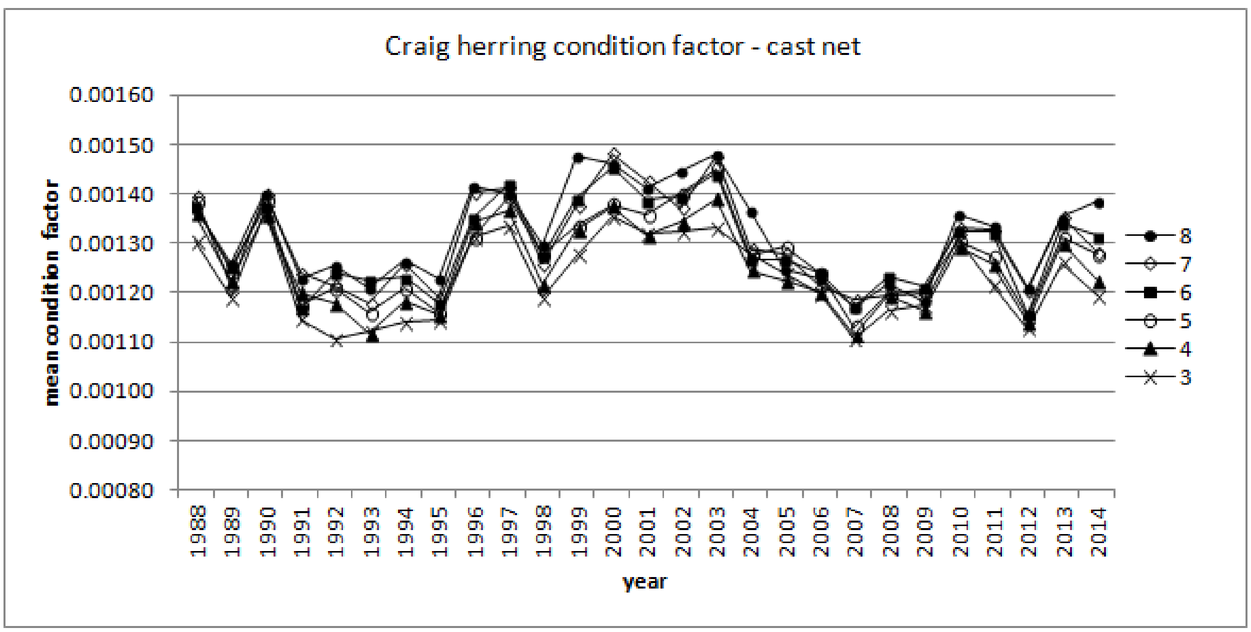


Figure 60.–Mean condition factors of age-3 through age-8 herring for the Craig spawning population, based on spring cast net samples taken during active spawning.

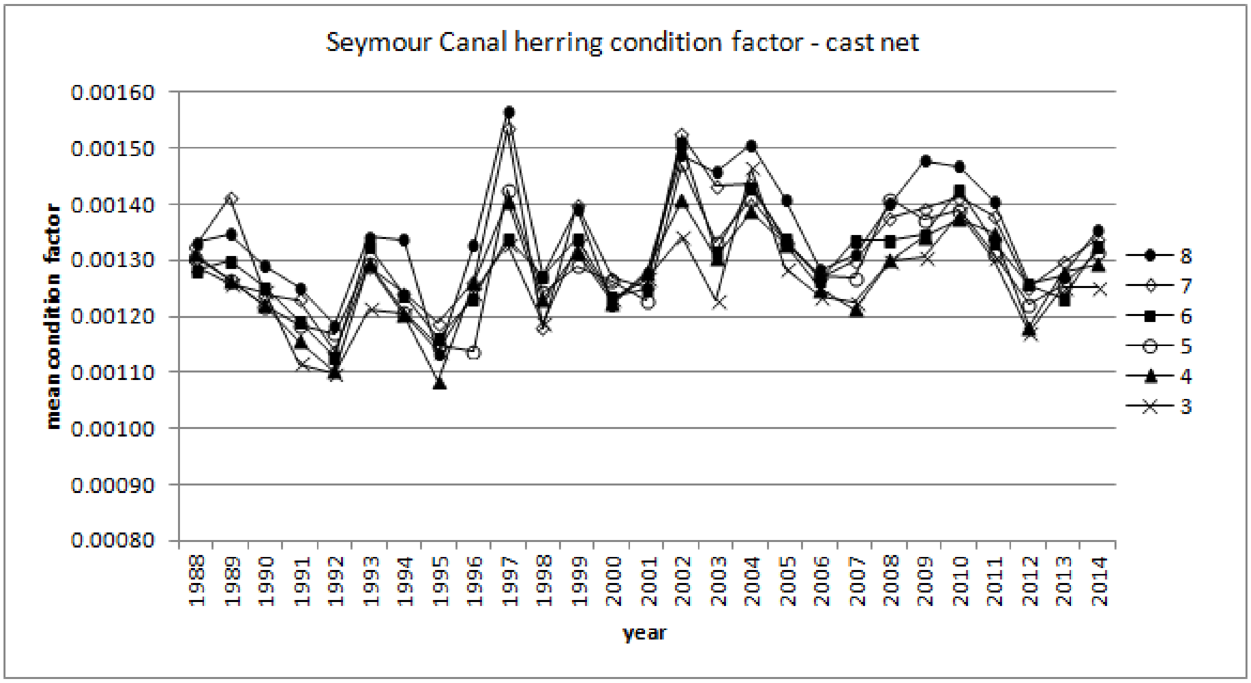


Figure 61.–Mean condition factors of age-3 through age-8 herring for the Seymour Canal spawning population, based on spring cast net samples taken during active spawning.

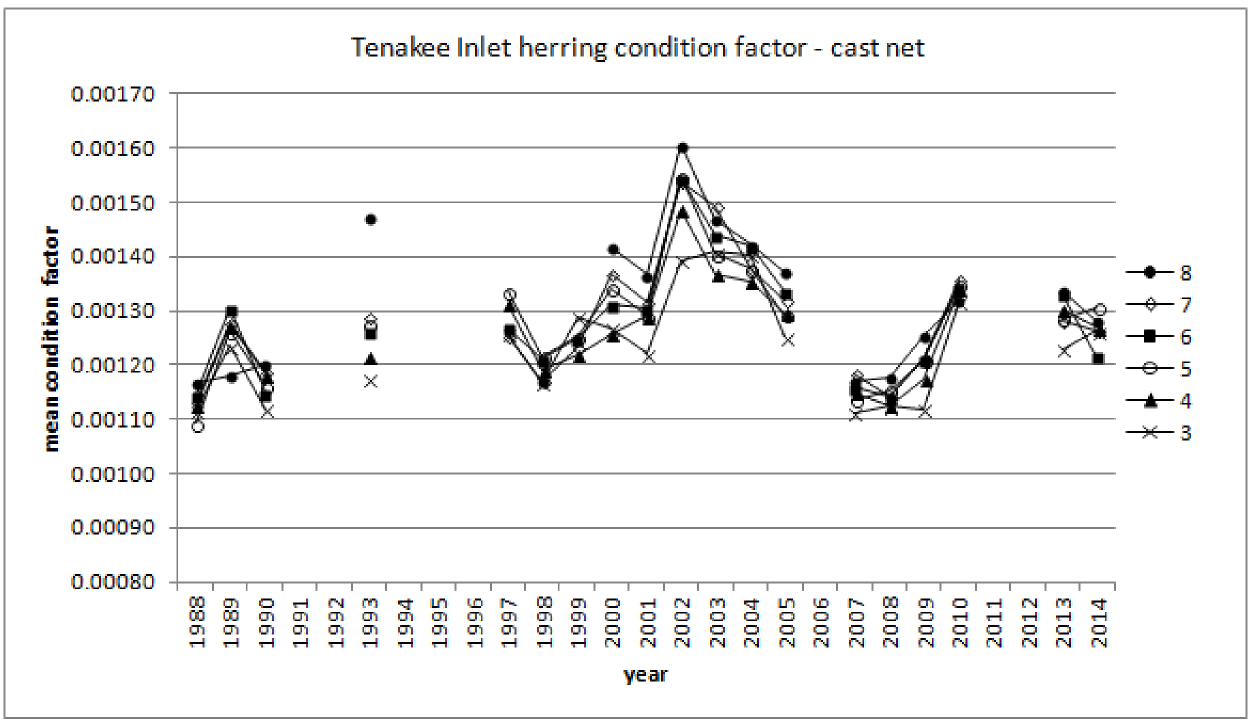


Figure 62.–Mean condition factors of age-3 through age-8 herring for the Tenakee Inlet spawning population, based on spring cast net samples taken during active spawning.

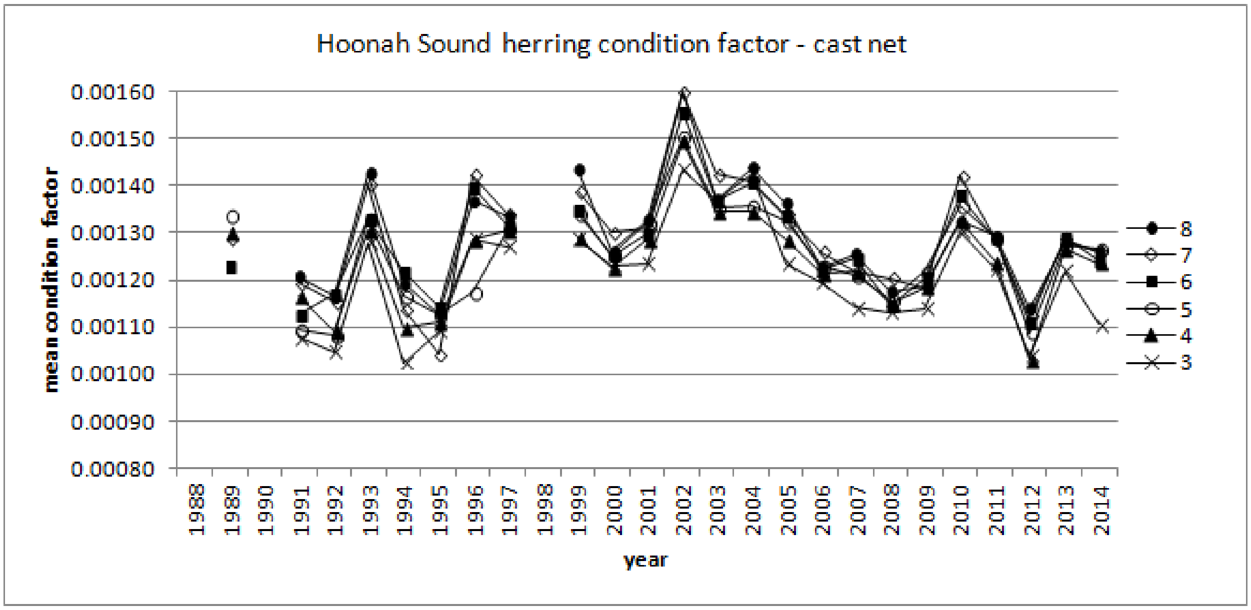


Figure 63.–Mean condition factors of age-3 through age-8 herring for the Hoonah Sound spawning population, based on spring cast net samples taken during active spawning.

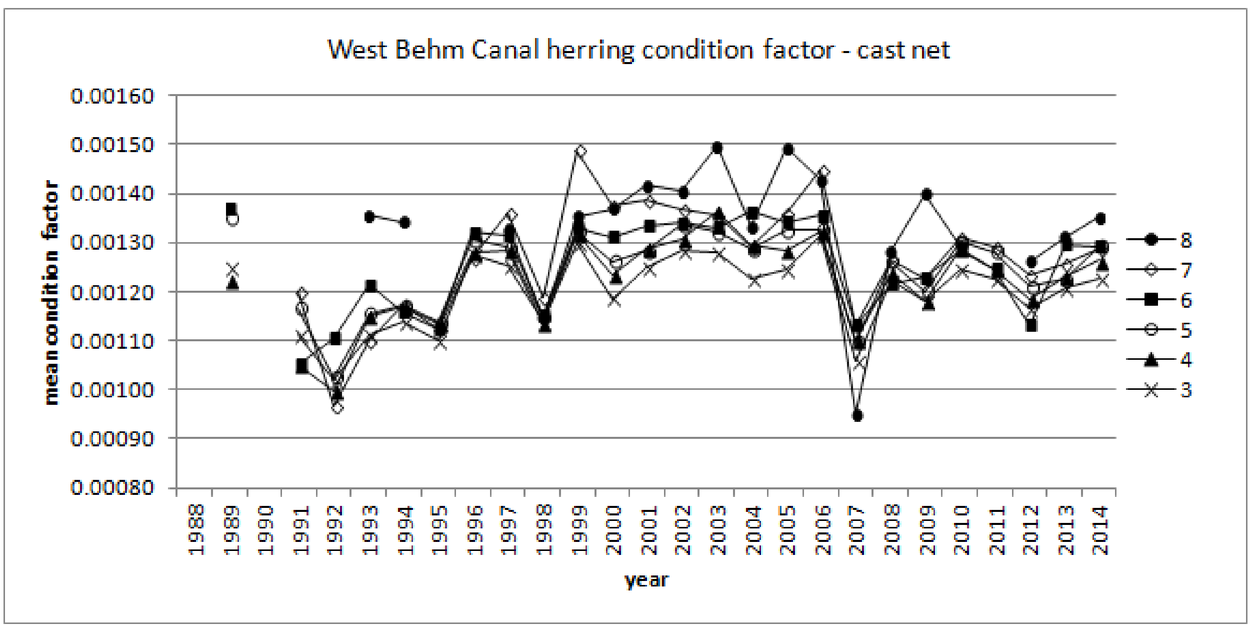


Figure 64.–Mean condition factors of age-3 through age-8 herring for the West Behm Canal spawning population, based on spring cast net samples taken during active spawning.

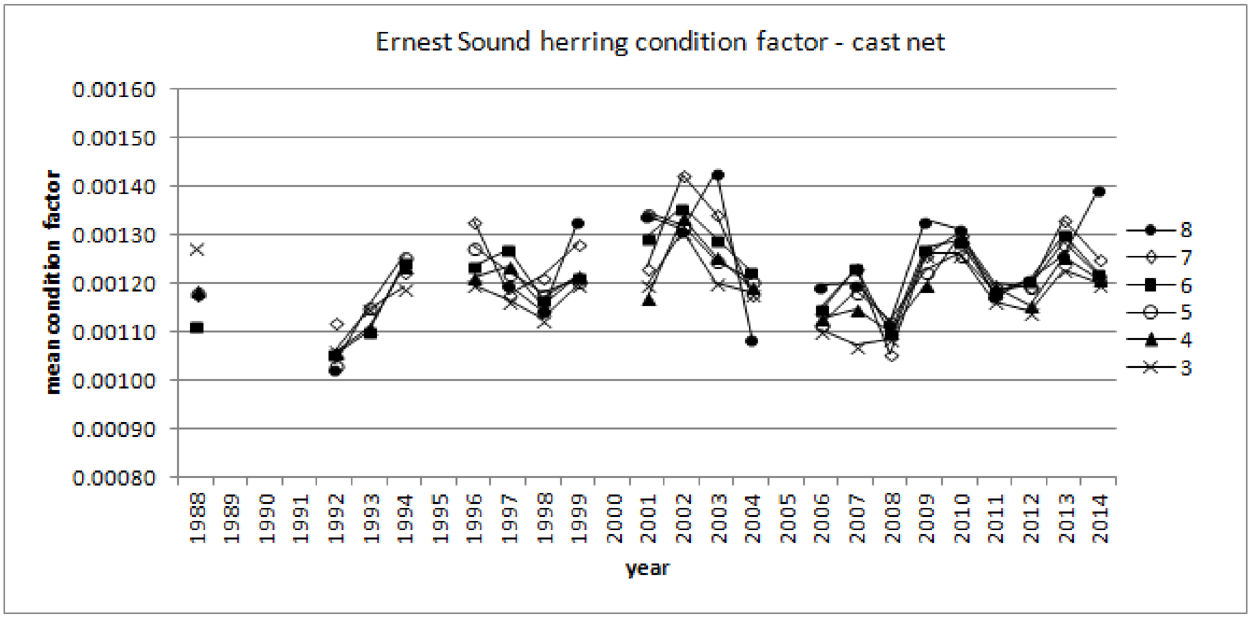


Figure 65.–Mean condition factors of age-3 through age-8 herring for the Ernest Sound spawning population, based on spring cast net samples taken during active spawning.

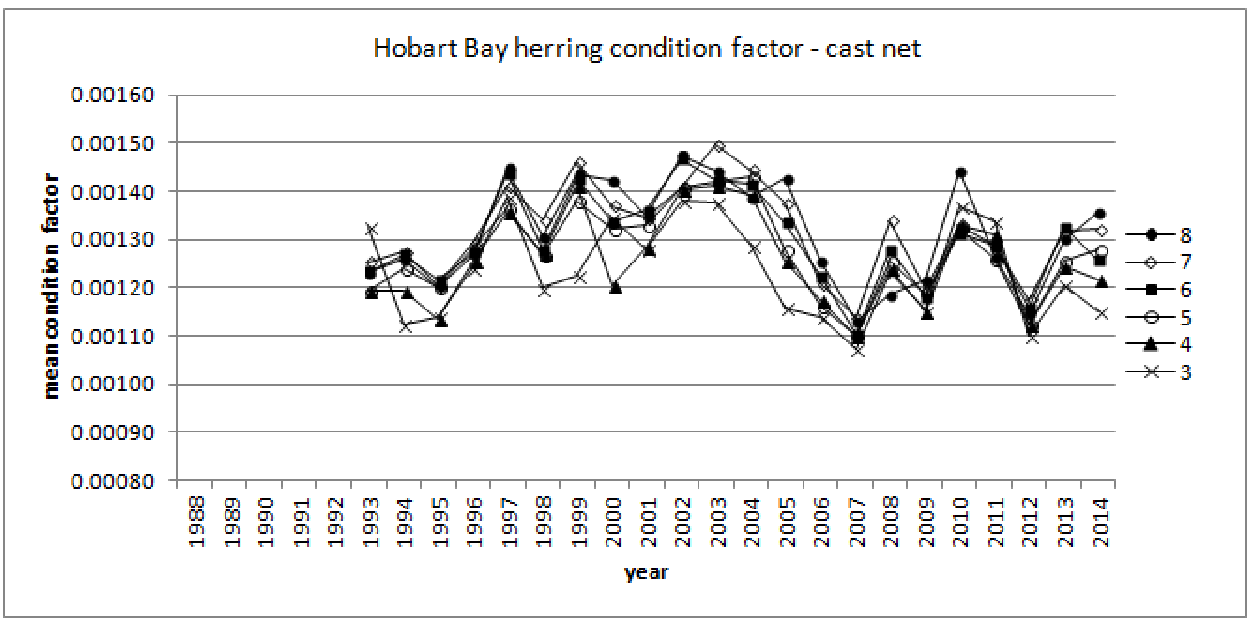


Figure 66.–Mean condition factors of age-3 through age-8 herring for the Hobart Bay spawning population, based on spring cast net samples taken during active spawning.

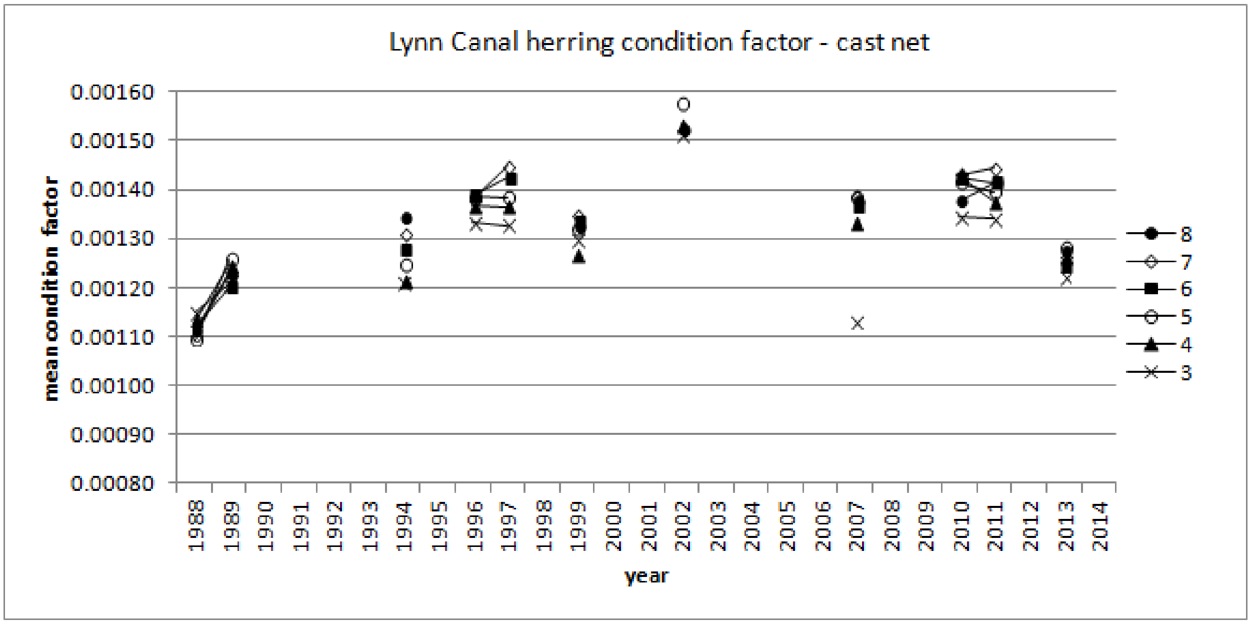


Figure 67.–Mean condition factors of age-3 through age-8 herring for the Lynn Canal spawning population, based on spring cast net samples taken during active spawning.

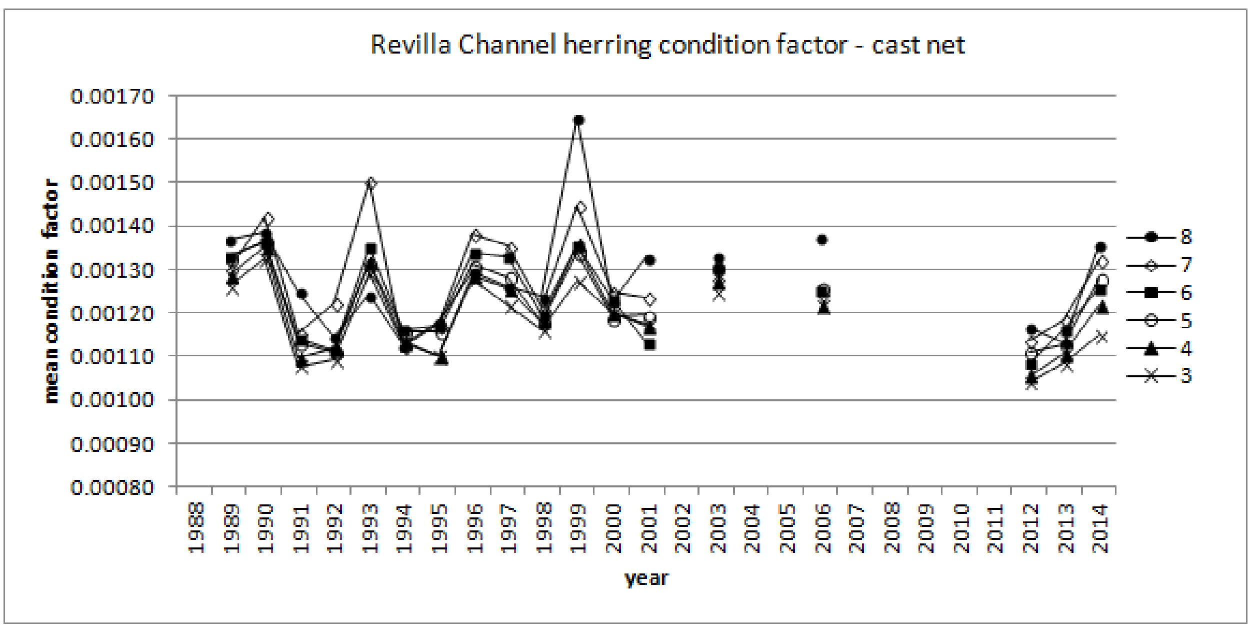


Figure 68.–Mean condition factors of age-3 through age-8 herring for the Revilla Channel spawning population, based on spring cast net samples taken during active spawning.

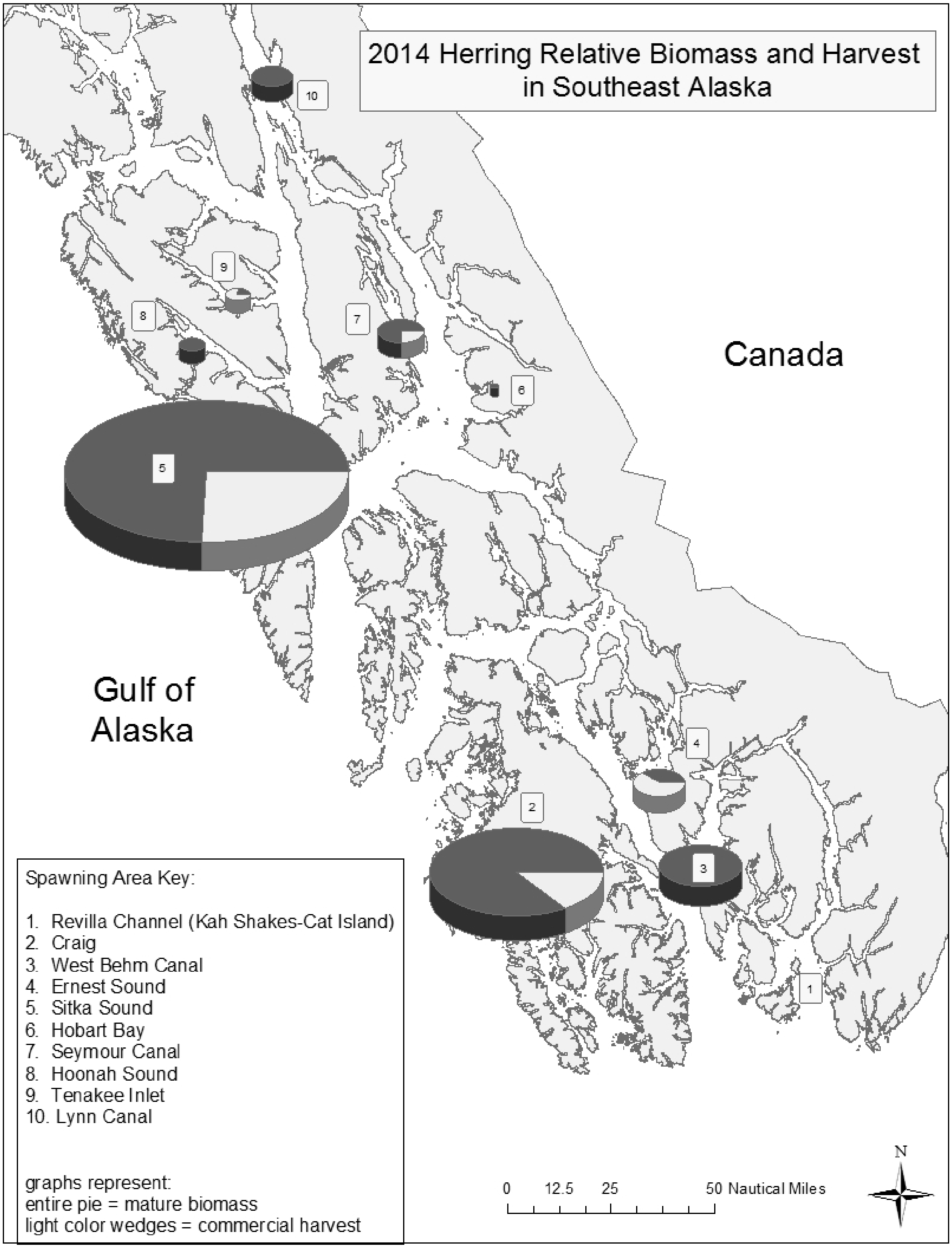


Figure 69.–Relative magnitude of herring spawning stocks and harvest levels in Southeast Alaska, based on biomass estimates converted from spawn deposition estimates. White wedges are intended to provide approximate indication of relative harvest, but do not represent actual exploitation rate.

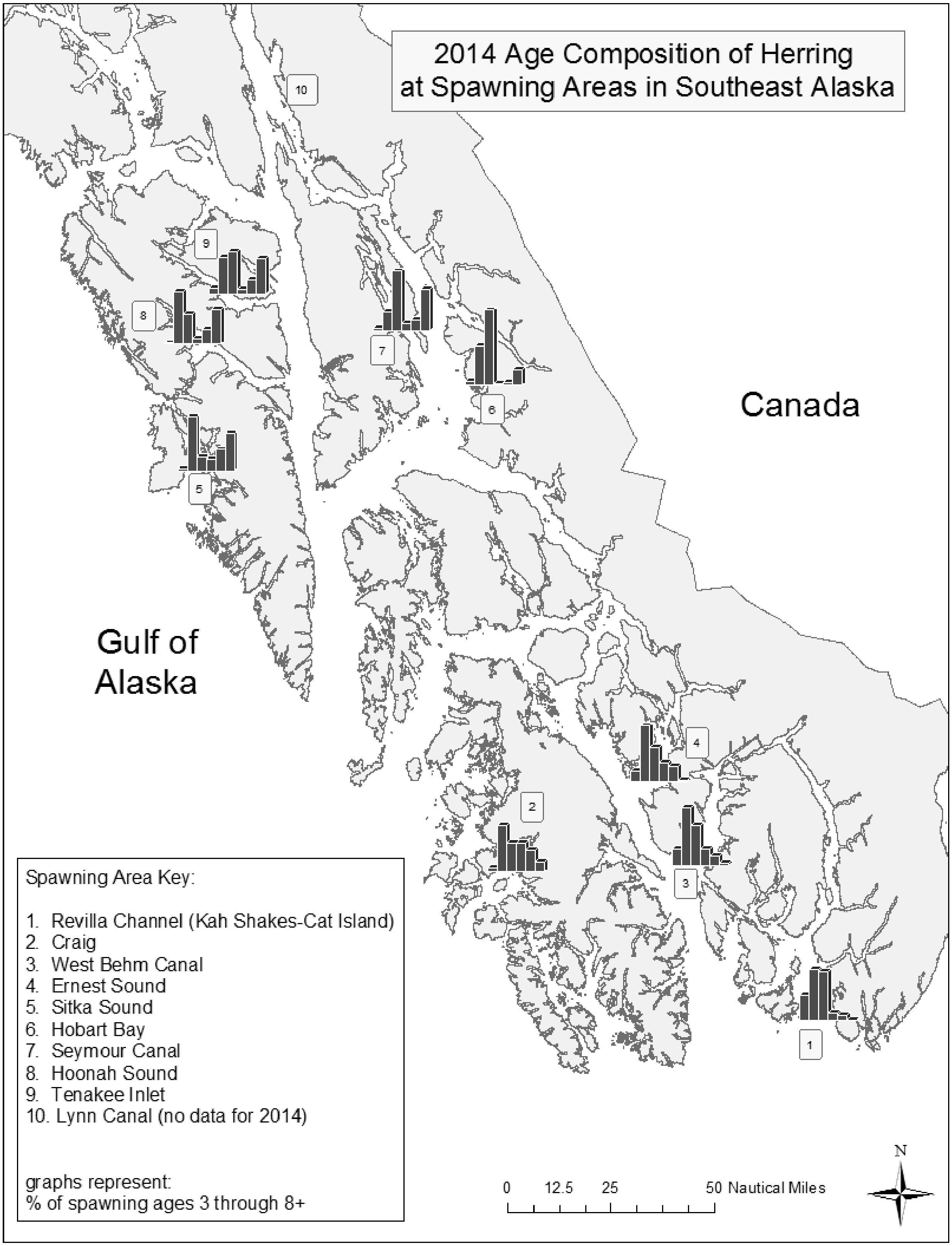


Figure 70.–Summary of age composition of herring spawning stocks in Southeast Alaska from cast net sampling.

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 2014.

Total spawn documented by ADFG in Revilla Channel for 2014 is 3.9 nautical miles, with 2.9 on Annette Island and 1.0 in state waters.

Total spawn documented by ADFG in Craig for 2014 was 13.6 nautical miles.

Total spawn documented by ADFG in West Behm Canal for 2014 is 7.1 nautical miles.

Revilla Channel

March 20, 2014	No herring activity observed. Very little predator activity.
March 25, 2014	No spawn. Predator activity has increased.
March 30, 2014	No spawn. Predator activity on the shore of Annette Island.
April 2, 2014	No spawn. Gillnet fishing observed in Annette Island waters.
April 3, 2014	No spawn. Gillnet fishing observed in Annette Island waters.
April 4, 2014	No spawn. Gillnet fishing observed in Annette Island waters.
April 6,8,10,12	No spawn.
April 14, 2014	**Spot spawn on Mary Island.**
April 15, 2014	**Spot spawn on Annette Island, 0.5 nmi. spawn on Mary Island.**
April 16, 2014	**0.5 nmi. spawn on Annette Isl. 0.25 nmi. spawn on Mary Island.**
April 17, 2014	**3 nmi. of spawn on Annette Island.**
April 18, 2014	**2 nmi. of spawn on Annette Island.**
April 19, 2014	**0.5 nmi of spawn on Annette Island**
April 21, 2014	No herring or spawn observed. Final Survey.

Craig

March 20, 2014	No herring activity. Numerous predators.
March 26, 2014	No Spawn. Numerous predators. Fishing activity.
March 27, 2014	No Spawn. Large numbers of predators. Fishing activity.
March 28&29	No Spawn. Large numbers of predators.
March 30, 31	No Spawn. Large numbers of predators. Fishing activity.
April 1, 2014	**2 nmi. Spawn**. Numerous of predators. Most pounds filled.
April 2, 2014	**3.6 nmi. Spawn**. Large numbers of predators and herring.
April 3, 2014	**8 nmi. Spawn**. Large numbers of predators and herring.
April 4, 2014	**11.4 nmi. Spawn**. Many predators and herring.
April 5, 2014	**Spot Spawn** on Abbess Island. Spawning appears to be over.
April 6, 2014	No spawn. Final survey.

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West Behm Canal	
April 3, 2014	No herring or predator activity observed.
April 8, 2014	No herring and very little predator activity observed.
April 10, 2014	**1/8 nmi. Spawn**. Predators numbers have increased.
April 11, 2014	No Spawn. Predators and fish have increased.
April 12, 2014	**2 nmi. Spawn**. Predators and fish throughout Clover Pass.
April 13, 2014	**3 nmi. Spawn**. Predators and fish throughout Clover Pass.
April 14, 2014	**2 nmi. Spawn.** Predators and fish throughout Clover Pass.

Appendix C2.–Aerial and skiff herring spawn surveys by date, in Sitka Sound and Hoonah Sound (Sitka Management Area), Southeast Alaska in 2014.

March 11: F/V Reiver made a set for personal use bait. Results of sampling those herring are as follows:

- *F/V Reiver*, 20:00 p.m., W Gavanski, 55 tons, 0.0% mature roe; 10.0% immature roe, 188 gm, 46% female.

March 14: 10:45–12:00. Gordon/Coonradt/Case. Spotting conditions were good at times with snow squalls, SE winds 15–25 and cloudy skies. Today's aerial survey covered Sitka Sound north of Cape Burunof and Salisbury Sound. Herring predator activity was as follows: Eastern Channel – 21 sea lions, 2 whales; Bieli Rock – 75 sea lions, 2 whales; Guide Island - 50 sea lions; north of Crow and Middle Islands – 65 sea lions; southern Siginaka Islands – 15 sea lions; west of Big Gavanski Island – 12 sea lions, 4 whales; Outer Salisbury Sound (Point Leo) – 85 sea lions, 15–20 whales. Small surface school of herring seen at mouth to Silver Bay

March 17: 09:00–10:45 Gordon/Gray. Spotting conditions were generally good with a light wind, breezy in places and overcast skies. Today's aerial survey covered Sitka Sound north of Cape Burunof. No herring were visible from the air. Herring predator activity was as follows: Eastern Channel – 10 sea lions, 1 whales; Bieli Rock – 225 sea lions; north of Crow and Middle Islands – 123 sea lions; southern Siginaka Islands – 7 sea lions; west of Big Gavanski Island –126 sea lions.

- *F/V Rose Lee*, 13:50 p.m., Halibut Point, 150 tons, 7.5% mature roe; 5.5% immature roe, 201 gm, 52% female.

Seine vessels surveying the area report that a large biomass of herring can be seen on the sonar holding in the deep water trench between Crow Island and Kruzof Island.

March 18: No aerial survey today.

- *No Test samples were taken today.*

March 19: 08:30–09:15 Gordon/Gray/Case. Today's aerial survey covered Sitka Sound north of Eastern Channel. Snow squalls with light winds. Herring predator activity was as follows: Eastern Channel – 12 sea lions; Crescent Bay – 15 sea lions; Bieli Rock – 180 sea lions, 2 whales; Inner Point - 10 sea lions; Guide Island - 15 sea lions; north Crow and Middle Islands – 30 sea lions, 6 whales; Starrigavin Bay – 22 sea lions; Eastern Point – 20 sea lions; Harbor Point – 60 sea lions; west of Big Gavanski Island – 6 sea lions, 1 whale; Old Sitka Rocks – 50 sea lions, 2 whales; Chaichei and Parker Group – 20 sea lions; Watson Point – 20 sea lions; Western Channel – 18 sea lions. No herring seen.

- *F/V Invincible*, 10:00 p.m., N Old Sitka Rks, 1200 tons, 9.7% mature roe; 1.5% immature roe, 196 gm, 46% female.

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The 2-hr notice meeting took place at 13:00. R/V Kestrel arrived at 10:00. The limited vessel survey is as follows: The *R/V Kestrel* surveyed north Sitka Sound. Scattered schools from Dog Point to Lisianski Point; school in Starrigavin Bay; larger concentration east of Little Gavanski Island, school north Crow Pass; large biomass in deeper water between Bieli Rock and Inner Point; Scattered schools south of Guide Island.

<u>March 20</u>: 08:00–09:10 Gordon/Case. Spotting conditions were good with clear skies and calm winds. Today's aerial survey covered Sitka Sound and south to Windy Pass. Herring predator activity was as follows: Eastern Channel – 10 sea lions; Bieli Rock – 30 sea lions, 7 whales; Inner Point - 20 sea lions, 2 whales; Guide Island - 10 sea lions; north Crow and Middle Islands – 116 sea lions, 2 whales; Starrigavin Bay – 22 sea lions; Katlian Bay – 70 sea lions, 3 whales; Eastern Point – 6 sea lions; Old Sitka Rocks – 28 sea lions, 2 whales; Western Channel – 6 sea lions; south of Eastern Channel to Windy Pass – no activity. No herring seen during survey.

- *F/V Laura Lee, 8*:20 a.m., Starrigavin; 100 tons; 13.2% mature roe; 0.9% immature roe; 210 gram; 55% female.
- *F/V Reiver*, 9:05 p.m., Katlian Bay; 50 tons; 12.6% mature roe; 1.4% immature roe; 203 gram; 52% female.
- *F/V Sequel*, 10:00 a.m., Katlian Bay Head; 100 tons; 13.1% mature roe; 0.8% immature roe; 201 gram; 50% female.
- *F/V Laura Lee*, 10:15 a.m., Old Sitka Rck; 100 tons; 12.5% mature roe; 0.9% immature roe; 195 gram; 51% female.

R/V Kestrel surveyed northeast Sitka Sound and Katlian Bay. Scattered large schools in Starrigavin Bay, large volume of herring at the mouth of Katlian Bay and toward the head of Katlian Bay, scattered large schools between Siginaka Islands and Lisianski Peninsula.

Fishery opened today, 1:45 p.m.–4:20 p.m., Starrigavin and Katlian Bays north of 57°07.18′ N., east of 135°26.63′ W., south of 57°08.96′ N. Preliminary processor hails total 5,000 tons. No fishery planned for today to allow for processing of yesterday's harvest.

<u>March 21</u>: 14:00–15:30 Gordon/Coonradt/Dressel. Today's aerial survey covered Sitka Sound and Salisbury Sound. Spotting conditions were cloudy with northeast winds 15–25 knots. Herring predator activity was as follows: Eastern Channel – 10 sea lions, 2 whales; Bieli Rock – 25 sea lions, 3 whales; Inner Point - 12 sea lions; Guide Island - 40 sea lions; north Crow and Middle Islands – 60 sea lions, 4 whales; Starrigavan Bay – 200 sea lions, 1 whale; Katlian Bay – 30 sea lions; Gavanski Islands – 80 sea lions, 5 whales; Nakwasina Sound – 15 sea lions, 2 whales; Olga Point – 65 sea lions; lower Salisbury Sound – 26 sea lions. Several large schools of herring were seen near Eliason Harbor and several schools were seen southeast of airport runway. No spawn was observed.

- *No Test samples were taken today.*

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The *R/V Kestrel* surveyed northeast Sitka Sound and Katlian Bay. An abbreviated aerial survey was conducted due to a mechanical. Scattered schools of herring were observed in Starrigavan Bay and Katlian Bay, several large schools near Lisianski Point, two larger herring schools and 8 whales along the southeast shoreline of Nakwasina Sound. Little herring activity was observed in the Halibut Point area.

<u>March 22</u>: 08:45–09:30 Gordon/National Geo. Today's aerial survey covered Sitka Sound. Spotting conditions were clear with east winds to 20 knots. Marine mammal concentrations similar to previous survey with large number of sea lions and whales in the areas west of Crow Island, north Middle Island, Border Rocks, and from Halibut Point into Katlian Bay. Herring schools were seen in shallower water inside the Breakwater, south of the Causeway, Inner Point, and between Promisla and Eastern Bay. No spawn was observed.

Vessel survey: The *R/V Kestrel* surveyed northern Sitka Sound and Katlian Bay. A Large biomass of herring was found in shallow and deeper waters west and north of Crow Island. A large biomass of herring was also in the area from Starrigavan Bay to Old Sitka Rocks with large scattered schools in Katlian Bay.

<u>March 23</u>: 07:55–09:15 Coonradt/Gordon. Today's aerial survey covered Sitka Sound north of Windy Pass. Spotting conditions were clear with light winds. Marine mammal concentrations were similar to previous surveys with large number of sea lions and whales in the areas west of Crow Island, north Middle Island, Border Rocks, and from Halibut Point into Katlian Bay. No herring schools were seen on today's flight. No spawn was observed.
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- *F/V Raging Beauty, 8*:30 a.m., Halibut Point; 200 tons; 13.8% mature roe; 0.3% immature roe; 199 gram; 54% female.
- *F/V Miss Roxanne*, 9:25 a.m., Starrigavin Bay; 200 tons; 11.3% mature roe; 0.0% immature roe; 184 gram; 45% female.
- *F/V Defiant*, 10:00 a.m., E Big Gavanski; 100 tons; 13.4% mature roe; 0.2% immature roe; 188 gram; 51% female.

Fishery opened on March 23 from 1:30 p.m. to 3:10 p.m. using the same boundaries that were used for the opening on March 20. Processor hails put the harvest from yesterday's opening at 5,000 tons. With the preliminary harvest estimate of 5,300 from March 20, the total harvest to date is 10,300 tons. There are approximately 6,000 tons remaining of this season's guideline harvest level of 16,333 tons.

<u>March 24:</u> 08:00–08:30 Gordon/KCAW. Today's aerial survey covered Sitka Sound north of Eastern Channel. The survey was brief due to winds. Spotting conditions were overcast skies and wind east 25-35 knots. No herring or spawn was observed. An industry pilot reported seeing schools on the beach on Kasiana Island and Apple Islands, and schools in deeper waters in Crescent Bay.

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- ♠ *No Test samples were taken today.*

Vessel survey: The *R/V Kestrel* surveyed along the Halibut Point Road system and in portions of Eastern Channel and Crescent Bay. A number of large schools were found along the road system from the Breakwater to Old Sitka Rocks. A number of large schools were also seen in the Western Channel area, and south of Whale Island. Two schools were seen in Crescent Bay.

March 25: **07:55–08:35** Coonradt/Gordon. Today's aerial survey covered Sitka Sound north of cape Burunof. Spotting conditions were overcast skies and breezy. The short survey was due to winds. Spawn was observed on southwest Middle Island and in Sitka Channel totaling **0.4 nautical miles**. Numerous whales and sea lions in the vicinity of Kasiana Island, Middle Island, Halibut Point and south of Sitka in the Middle Channel, Crescent Bay area.

- *F/V Defiant*, 10:00 a.m., Tsaritsa Rock; 100 tons; 12.2% mature roe; 0.7% immature roe; 188 gram; 46% female.

Vessel survey: The *R/V Kestrel* surveyed along the Halibut Point Road system to Halibut Point and the Eastern Channel area. A large aggregation of herring was observed east and north of Kasiana Island, in Crescent Bay and in the vicinity of Tsaritsa Rock.

March 26: **08:00–09:10** Coonradt/Gordon. Today's aerial survey covered Sitka Sound and south to Windy Pass. Herring spawning continued on southwest Middle Island totaling **0.5 nautical miles**. There was little expansion of spawning from previous day. Herring predator activity was concentrated in the vicinity of Kasiana Island and Middle Island and the island groups between Western Channel and Crow Pass.

- *F/V Odinata*, 9:40 a.m., SE Airport; 100 tons; 13.3% mature roe; 0.7% immature roe; 167 gram; 54% female.

Vessel survey: The *R/V Kestrel* surveyed the Eastern Channel area and found scattered schools throughout the area. Large concentrations of herring were seen in the island groups between Western Channel and south Middle Island.

Today, the fishery was opened from 2:30 p.m.–3:40 p.m. in the Eastern Channel area. Processors hails put the harvest at approximately 3,700 tons. The total harvest to date for the three open periods is 13,500 tons, leaving approximately 2,800 tons remaining of this season's guideline harvest level.

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<u>March 27:</u> 08:40–09:55 Gordon/Coonradt/Forbes. Today's aerial survey covered Sitka Sound and Salisbury Sound. Herring spawning continued on southwest Middle Island totaling **0.6 nautical miles**. Herring predator activity was concentrated in the vicinity of Kasiana Island and the island groups south of Kasiana Island. Whales and sea lions were also present along the west side of Gagarin and Crow Islands. Numerous whales were observed in the area of Inner Point with additional whales scattered in the Hayward Strait and Promisla Bay areas. A large number of sea lions were seen immediately south of the airport runway. Herring schools were seen on the beach in Promisla Bay and near Brent's Beach. Three whales were seen in Salisbury Sound.

- *F/V Jean C*, 8:00 a.m., Inner Point; 50 tons; 10.5% mature roe; 1.6% immature roe; 117 gram; 51% female.

Vessel survey: The *R/V Kestrel* surveyed north Sitka Sound. Scattered schools were seen throughout the Promisla Bay and Hayward Strait area. A substantial biomass of herring consisting of multiple large schools was seen in the vicinity of Inner Point. These schools were distributed from the beach to the offshore waters between Inner Point and Gagarin Island.

<u>March 28:</u> 07:50–09:00 Gordon/Bachman/Zeitser. Today's aerial surveyed covered Sitka Sound. Spotting conditions were clear with calm winds. Herring spawning expanded in the south Crow Pass area totaling **3.8 nautical miles**. Numerous whales and sea lions in the island groups between Western Channel and south Middle Island in waters closed to commercial fishing. Whales and sea lions present along the west side of Gagarin and Crow Islands. Numerous whales were observed in the area of Inner Point and to the south of Inner Point. Herring schools were seen inside the Breakwater near Eliason Harbor.

- *F/V Morning Thunder, 10:45* a.m., Halibut Point; 100 tons; 13.7% mature roe; 0.2% immature roe; 180 gram; 54% female.
- *F/V Invincible*, 12:00 p.m., S Sitka Bridge; 100 tons; 8.7% mature roe; 3.5% immature roe; 126 gram; 51% female.
- *F/V Invincible*, 12:30 p.m., Crescent Bay; 100 tons; 13.5% mature roe; 0.1% immature roe; 140 gram; 54% female.
- *F/V Devotion, 15*:30 p.m., Offshore Fred's Creek; 163 tons; 12.0% mature roe; 1.0% immature roe; 171 gram; 52% female.

Vessel survey: The *R/V Kestrel* surveyed north Sitka Sound. A substantial biomass of herring consisting of numerous large schools was seen in the vicinity of Inner Point. These schools were distributed from the beach to the offshore waters between Inner Point and Gagarin Island. Schools were also seen west of Crow and Gagarin Island.

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March 29: 09:00–10:20 Coonradt/Gordon. Today's aerial survey covered Sitka Sound north of Cape Burunof and south of Hayward Strait. Spotting conditions were good with partly cloudy skies with light winds. Herring spawning expanded on Middle, Crow and Gagarin Islands totaling **7.7 nautical miles**. Herring Schools were visible in Sitka Channel and east of the south end of the runway. Predators continue to be concentrated in the island groups north of Sitka and in the trench east of Inner Point.

- *F/V Emily Nicole*, Time Unknown, Indian River; 200 tons; 13.7% mature roe; 0.1% immature roe; 171 gram; 53% female.
- *F/V Freedom,* Time Unknown, Galankin Isl.; 50 tons; 13.5% mature roe; 0.5% immature roe; 159 gram; 54% female.

The fishery was opened in the area of Crescent Bay and Eastern Channel from 1:30 p.m. to 2:15 p.m. Two test samples from the opened area had mature roe of 13.7% and 13.5% justifying the opening. Preliminary processor hails show a harvest of approximately 3,935 tons for the opening. This brings the preliminary total harvest for the season to 17,231 tons, above the guideline harvest level of 16,333 tons. Final harvest numbers will be announced when processing is complete.

March 30: 09:00–10:100 Coonradt/Gordon. Today's aerial survey covered Sitka Sound north of West Crawfish Inlet including Salisbury Sound. Spotting conditions were good with partly cloudy skies with light winds. Herring spawning continued to expand on Middle, Crow and Gagarin Islands totaling **12.6 nautical miles**. Herring Schools were visible in Sitka Channel and east of the south end of the runway. Predators continue to be concentrated in the island groups north of Sitka and in the trench east of Inner Point.

March 31: 09:00–10:00 Gordon. Today's aerial survey covered Sitka Sound north of Cape Burunof and south of Hayward Strait. Spotting conditions were good with partly cloudy skies with light winds. Herring spawning expanded on most of the islands north of Sitka totaling **21.8 nautical miles**. Herring Schools were visible in Sitka Channel and east of the south end of the runway. Predators continue to be concentrated in the island groups north of Sitka and in the trench east of Inner Point.

April 1: 09:00–10:20 Gordon/Coonradt. Today's aerial survey covered Sitka Sound north of Windy Pass and south of Hayward Strait. Spotting conditions were good with overcast skies with light winds. Herring spawning expanded in north Sitka Sound totaling **25.1 nautical miles**, including several miles of spawn on the north road system. Herring Schools were visible in Sitka Channel and east of the south end of the runway.

April 2: 09:44–10:30 Coonradt/Gordon. Today's aerial survey covered Sitka Sound north of Cape Burunof and south of Salisbury Sound. Spotting conditions were good with overcast skies with light winds. Herring spawning began contracting today totaling **13.4 nautical miles**. Broken spawn was observed on most of the larger islands in north Sitka Sound today.

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<u>April 3:</u> 08:00–08:30 Coonradt. Today's aerial survey covered Sitka Sound north of Cape Burunof and south of Hayward Strait. Spotting conditions were good with partly cloudy skies with light winds. Broken spawn was observed on many of the larger islands in north Sitka Sound **4.5 nautical miles,** including some spawn south of the bridge.

<u>April 4:</u> No aerial survey was conducted today. A skiff survey was conducted at low tide to determine if herein had spawned in gaps between currently mapped spawn. An **additional 0.9 nmi of sawn** was mapped during this survey.

<u>April 8:</u> 08:30–10:00 Case. Today's aerial survey covered north Sitka Sound and Hoonah Sound. No herring or herring spawn was observed.

<u>April 11:</u> 09:00–10:15 Coonradt. Today's aerial survey covered Sitka Sound north of Windy Pass and south of Salisbury Sound. Spotting conditions were good with clear skies with north winds 15–20 kts. Spawn was observed in Mosquito Cove, totaling **0.1 nautical miles**.

<u>April 12:</u> 09:00–10:00 Gordon. Today's aerial survey covered Sitka Sound north of Cape Burunof and south of Salisbury Sound. Spotting conditions were good with clear skies with light winds. Broken spawn was observed scattered around north Sitka Sound, totaling **1.5 nautical miles,** including some spawn in Salisbury Sound.

<u>April 13:</u> 08:00–09:00 Gordon. Today's aerial survey covered Sitka Sound north of Cape Burunof and south of Salisbury Sound. Spotting conditions were good with clear skies with light winds. Broken spawn was observed scattered around north Sitka Sound, totaling **2.8 nautical miles,** including spawn in Salisbury Sound and on east Kruzof Island.

<u>April 14:</u> 08:30–09:30 Gordon/Coonradt. Today's aerial survey covered Sitka Sound north of Windy Pass and south of Salisbury Sound. Spotting conditions were good with overcast skies with light winds. Spawn was observed in Salisbury Sound, Harbor Point and Fred's Creek, totaling **2.9 nautical miles**.

<u>April 15:</u> 08:30–10:10 Gordon/Coonradt. Today's aerial survey covered Sitka Sound north of Cape Burunof including West Chichigof and Hoonah Sound. Spotting conditions were good with partly cloudy skies with north winds 15 kts. Spawn was observed in Salisbury Sound with a little spawn on the north road system, totaling **5.6 nautical miles**. Spawn was also observed on West Chichigof South of Herbert Graves Island totaling 0.7 nmi.

In Hoonah Sound no herring or herring spawn was observed.

<u>April 17:</u> 08:43–09:20 Gordon/Coonradt. Today's aerial survey covered Sitka Sound north of Cape Burunof and south of Salisbury Sound. Spotting conditions were good with overcast skies with northwest winds 15 kts. Spawn was observed in Salisbury Sound with a little spawn on the north road system, totaling **2.5 nautical miles**.

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<u>April 18:</u> Gordon/Coonradt. No Aerial Survey was conducted today. A skiff survey was conducted to determine if breaks in the total spawn map contained herring spawn. An additional **1.2 nmi of spawn** was mapped today.

<u>April 21:</u> **14:00–15:30** Gordon. The department conducted an aerial survey of the Hoonah Sound area. Spotting conditions were good with overcast skies and light winds. No herring or herring spawn was seen during the survey. A total of 18 sea lions were seen scattered in the Hoonah Sound area including 10 off Emmons Spit and 6 off Pederson Point on Moser Island. Three whales were seen north of Vixen Island and one whale south of Emmons Island.

<u>April 23:</u> Gordon. The department conducted an aerial survey of the Hoonah Sound area. Spotting conditions were good with overcast skies and calm winds. No herring or herring spawn was seen during the survey. Predator activity decreased since the previous survey. Two sea lions were seen off Pederson Point on Moser Island and one whale was seen in South Arm. One whale was observed north of Fick Cove.

<u>April 25:</u> **07:30–09:30** Case. The department conducted an aerial survey of the Hoonah Sound area. Schools of herring were observed in the shallow water south of White Cliff Point. No herring spawn was observed.

<u>April 26:</u> **08:30–10:30** Case. The department conducted an aerial survey of the Hoonah Sound area. No herring or herring spawn was observed.

<u>April 27:</u> Gordon. The department conducted an aerial survey of the Hoonah Sound area. Spotting conditions were good with overcast skies and east winds 20 knots. No herring spawn was seen during the survey. Herring schools were observed east of White Cliff Point. Approximately 20 sea lions were seen in the vicinity of Pedersen Point on Moser Island. No other predator activity was observed.

<u>April 29:</u> Gordon. The department conducted an aerial survey of the Hoonah Sound area. Spotting conditions were fair with gusty winds. No herring or herring spawn was seen during the survey. Approximately 30 sea lions were seen in the vicinity of White Cliff on Moser Island. No other predator activity was observed.

<u>April 30:</u> Gordon/Coonradt. The department conducted an aerial survey of the Hoonah Sound area. Spotting conditions were good with clear skies and light winds. No herring spawn was seen during today’s survey. Several herring schools were observed between Fick Cove and Emmons Island, and north of Finger River. Approximately 15 sea lions were seen in the vicinity of White Cliff on Moser Island and 35 along the Chichigof Island shore south of Finger River. Two whales were observed north of Fick Cove and one whale south of Finger River.

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May 1: The department conducted an aerial survey of the Hoonah Sound area. Spotting conditions were good with clear skies and light winds. No herring or herring spawn was seen during today's survey. Approximately 15 sea lions were seen in the vicinity of White Cliff on Moser Island and 6 off of Rodgers Point. Whale observations are as follows; three east of Emmons Island, five around Ford Rock, two north of Ostoia Island and one east of Pedersen Point.

May 2: Coonradt. The department conducted an aerial survey of the Hoonah Sound area. Spotting conditions were poor with clear skies and gusty northeast winds up to 50 knots. No herring spawn was seen during today's survey. Herring schools were observed west of Vixen Islands and south of Pedersen Point. Approximately 6 sea lions were seen in the vicinity of Pedersen Point and 5 west of Vixen Islands. No whales were observed on today's flight.

May 3: Gordon. The department conducted an aerial survey of the Hoonah Sound area. Spotting conditions were poor with clear skies and gusty northeast winds up to 25 knots. No herring spawn was seen during today's survey. Herring schools were observed in shallow water north of Rodgers Point, north of Emmons Island and south of Ushk Bay. Approximately 15 sea lions were seen in the vicinity of White Cliff on Moser Island and 6 east of Emmons Island. Four whales were observed in the vicinity of Ford Rock.

May 4: Coonradt. The department conducted an aerial survey of the Hoonah Sound area. Spotting conditions were poor with clear skies and gusty northeast winds up to 50 knots. No herring or herring spawn was seen during today's survey. Due to the abbreviated flight and surface conditions no herring predators were observed.

May 5: Coonradt. The department conducted an aerial survey of the Hoonah Sound area. Spotting conditions were good with overcast skies and calm wind. Herring spawn was observed around Emmons Island**, totaling 2.5 nmi**. Herring schools were observed in shallow water west of Vixen and Emmons Islands. Approximately 25 sea lions were seen in the vicinity of White Cliff Point and 5 west of Vixen Islands. Whales were observed in the deeper water around Ford Rock.

In Sitka Sound (Olga Strait) an additional **0.28 nmi of spawn** was observed today.

May 6: Coonradt. The department conducted an aerial survey of the Hoonah Sound area. Spotting conditions were good with overcast skies and calm wind. No herring spawn was observed. Herring schools were observed in shallow water between Vixen and Emmons Islands, and east of Pedersen Point. Approximately 6 sea lions were seen in the vicinity of White Cliff Point, 10 off Rodgers Point, 15 south of Emmons Point and 11 west of Vixen Islands. Whales were observed around Emmons Point and Pedersen Point.

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In Sitka Sound (St. John Baptist Bay) an additional **0.22 nmi of spawn** was observed today.

May 7: Coonradt. The department conducted an aerial survey of the Hoonah Sound area. Spotting conditions were good with overcast skies and calm wind. Approximately **0.5 nmi of herring spawn** was observed south of Finger River. Herring schools were observed in shallow water off Finger River, and south of Pedersen Point. Approximately 36 sea lions were seen in the around Emmons Island, and 5 south of Pedersen Point. Whales were observed around Emmons Point and Ford Rock.

In Sitka Sound (St. John Baptist Bay) an additional **0.05 nmi of spawn** was observed today.

May 8: Coonradt. The department conducted an aerial survey of the Hoonah Sound area. Spotting conditions were good with overcast skies and north winds 10–20 knots. Approximately **0.2 nmi of herring spawn** was observed south of Finger River. Herring schools were observed in shallow water north of Rodgers point and off Finger River. Approximately 30 sea lions were seen in the around Emmons Island, and 5 south and east of Finger river. Whales were observed around Emmons Point and Ford Rock.

May 9: Gray/ Coonradt. The department conducted an aerial survey of the Hoonah Sound area. Spotting conditions were good with clear skies and calm wind. No herring spawn was observed. Herring schools were observed in shallow water between Vixen and Emmons Islands, and east of Finger River. Approximately 36 sea lions were seen in the around Emmons Island, and 15 south and east of Finger River. Whales were observed around Emmons Point and Ford Rock.

Appendix C3.–Aerial and skiff herring spawn surveys by date, at Bradfield Canal, Ernest Sound, Ship Island, Zimovia Strait and Eastern Passage, and Bear Creek, within Petersburg-Wrangell Management Area in Southeast Alaska, 2014.

Bradfield Canal

Total miles of spawn: ~5.8 nm

Spawning dates: unknown, possibly late March or early April

Peak spawning: unknown

4/4 No active spawn, 1 herring school, 31 sea lions, 150 scoters.

4/11 No active spawn or herring observed, 19 sea lions, 600 scoters.

4/15 No active spawn or herring observed, 1 sea lion, 800 scoters.

4/21 No active spawn, marine mammals, or herring observed. Skiff survey.

Vixen Inlet/ Union Bay/Emerald Bay

Total miles of spawn: ~3.7 nm

Spawning dates: 4/14 through 4/19

Peak spawning: 4/17

4/4 No active spawn or herring observed, 29 Sea Lions, 300 Scoters.

4/8 No active spawn or herring observed, 17 Sea Lions; 200 Gulls, 50 Scoters.

4/11 No active spawn or herring observed, 2 Sea Lions, 50 Gulls.

4/14 small **spot spawn** spawn, 2 herring schools observed, 79 Sea Lions; 1 Whale; 50 Gulls.

4/15 **~1.0 nm of active spawn**, 3 herring schools observed; 154 Sea Lions; 700 Gulls.

4/16 **~0.3 nm of active spawn**, 2 herring schools observed; 144 Seas Lions; 200 Gulls.

4/17 **~1.6 nm of active spawn**, 4 herring schools; 214 sea lions, 1 Whale, 400 Scoters.

4/18 No active spawn, one herring school, 132 Sea Lions; 3,000 gulls.

4/19 **~0.5 nm of active spawn**, 2 herring schools; 148 sea lions, 1,000 Scoters, 3,000 Gulls.

4/20 No active spawn or herring observed, 216 Sea Lions; 2,000 Scoters, 6,000 Gulls.

4/22 No active spawn or herring observed, 3 Whales, 70 Sea Lions 2,000 Scoters, 6,000 Gulls.

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Onslow/Stone/Brownson Island/Canoe Pass

Total miles of spawn: 0.0 nm

4/4 No active spawn, herring, or marine mammals observed.

4/8 No active spawn, herring, or marine mammals observed.

4/11 No active spawn, herring, or marine mammals observed.

4/14 No active spawn, herring, or marine mammals observed.

4/15 No active spawn, herring, or marine mammals observed.

4/16 No active spawn, herring, or marine mammals observed.

4/17 No active spawn, herring, or marine mammals observed.

4/18 No active spawn, herring, or marine mammals observed.

4/19 No active spawn, herring, or marine mammals observed.

4/18 No active spawn, herring, or marine mammals observed.

4/22 No active spawn, herring, or marine mammals observed.

Zimovia St. and Eastern Passage

Total miles of spawn: ~8.2 nm

Spawning dates: Sometime between 4/14 and 4/21

Peak spawning: unknown

4/4 No active spawn or herring observed; 14 Sea Lions, 5,000 Scoters.

4/8 No active spawn, 4 herring schools, 18 Sea Lions; and 2,000 Scoters.

4/11 No active spawn or herring observed; 8 Sea Lions, 5,000 Scoters.

4/16 Report of active spawn at 8 mile beach by local pilot.

4/22 No active spawn or herring observed; 2 Sea Lions, 3,900 Gulls 3,600 Scoters.

Bear Creek

Not Surveyed in 2014

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Farragut Bay

Total miles of spawn: No Active Spawn Detected in 2014

Spawning dates: NA

Peak spawning: NA

4/18 No active spawn or herring observed; 16 Sea Lions.

4/21 No active spawn or herring observed; 12 Sea Lions.

4/23 No active spawn or herring observed; 12 Sea Lions.

4/25 No active spawn or herring observed; 18 Sea Lions; 1 Whale.

4/26 No active spawn or herring observed; 47 Sea Lions.

4/27 No active spawn or herring observed; 14 Sea Lions.

4/28 No active spawn or herring observed; 30 Sea Lions.

4/30 No active spawn or herring observed.

5/1 No active spawn or herring observed; 6 Sea Lion.

5/2 No active spawn or herring observed; 6 Sea Lions.

5/3 No active spawn or herring observed; 14 Sea Lions.

5/5 No active spawn or herring observed.

Hobart Bay

Total miles of spawn: ~3.2 nm

Spawning dates: 5/1 through 5/2

Peak spawning: 5/2

4/14 No active spawn or herring observed; 6 Sea Lions.

4/18 No active spawn or herring observed; 40 Sea Lions; 1 Whale.

4/21 No active spawn or herring observed; 4 Sea Lions.

4/23 No active spawn or herring observed; 69 Sea Lions.

4/25 No active spawn or herring observed; 44 Sea Lions; 1 Whale; and 500 Scoters.

4/26 **~0.1 nm active spawn**; 8 herring schools observed; 135 Sea Lions.

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4/27 No active spawn; 1 herring school observed; 72 Sea Lions.

4/28 No active spawn or herring observed; 69 Sea Lions; 300 Scoters.

4/30 No active spawn or herring observed; 28 Sea Lions, 5,000 Scoters.

5/1 **~0.75 nm active spawn**; multiple schools observed; 51 Sea Lions, 4,000 Scoters.

5/2 **~1.0 nm active spawn**; 3 herring schools observed; 55 Sea Lions; 9,000 Scoters.

5/3 No active spawn or herring observed; 16 Sea Lions; 2 Whales, 21,000 Scoters.

5/4 No active spawn or herring observed; 12 Sea Lions; 13 Whales; 100,000 Scoters.

5/5 No active spawn or herring observed; 12 Sea Lions; 47,000 Scoters.

5/5 Skiff survey found ~3.4 nm of spawn on the beach.

Port Houghton

Total miles of spawn: 1.0 nm

Spawning dates: 5/17

Peak spawning: 5/17

4/18 No active spawn or herring observed.

4/21 No active spawn or herring observed.

4/23 No active spawn or herring observed; 6 Sea Lions.

4/25 No active spawn or herring observed.

4/26 No active spawn or herring observed; 1 Sea Lion.

4/27 No active spawn or herring observed.

4/28 No active spawn or herring observed; 2 Sea Lions.

4/30 No active spawn or herring observed.

5/1 No active spawn or herring observed.

5/2 No active spawn or herring observed.

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5/3 No active spawn or herring observed.

5/5 No active spawn or herring observed.

Sunset Cove/Windham Bay

Total miles of spawn: 0.0 nm

4/18 No active spawn or herring observed; 6 Sea Lions; 1 Whale.

4/21 No active spawn or herring observed.

4/23 No active spawn or herring observed; 4 Sea Lions.

4/25 No active spawn or herring observed; 4 Sea Lions.

4/26 No active spawn; 3 herring schools observed; 25 Sea Lions.

4/27 No active spawn;1 herring school observed; 31 Sea Lions.

4/28 No active spawn or herring observed; 36 Sea Lions.

4/30 No active spawn or herring observed.

5/1 No active spawn or herring observed; 2 Sea Lions.

5/2 No active spawn or herring observed.

5/3 No active spawn or herring observed.

5/5 No active spawn or herring observed; 17 Sea Lions.

Gambier Bay/Pybus Bay

No survey was done in 2014.

Port Camden

No survey was done in 2014.

Tebenkof Bay

No survey was done in 2014.

Appendix C4.–Aerial and skiff herring spawn surveys by date, in Seymour Canal (Juneau Management Area), in Southeast Alaska, 2014.

Seymour Canal

Number of times surveyed: 16

Total miles of spawn: 4.8nm

Spawning dates: 4/30–5/7

Peak spawn: 5/1

4/14: No herring or herring spawn observed. 49 sea lions and 1 whale observed. Most sea lions were in small groups <6 on southern end of Pt. Hugh.

4/18: No herring or herring spawn observed. 77 sea lions and 5 whales observed. Predators widely scattered with tow rafts 25-30 animals, one at Pt. Hugh, the other in Stephens opposite Twin Islands.

4/21: (Petersburg staff) No herring or herring spawn observed. 81 sea lions and 3 whales observed. Approximately 20 sea lions rafted at both Pt. Hugh and #9 Rock, the rest scattered.

4/22: No herring or herring spawn observed. 88 sea lions and 1 whale observed. 30 sea lions at Pt. Hugh, the rest scattered on both sides of Glass Peninsula.

4/25: No herring or herring spawn observed. 166 sea lions and 9 whales observed. Predators were more concentrated between Pt. Hugh and the Swimming Pool.

4/26: Industry pilot reported no herring activity

4/27: Schools on the beach north of Pt Hugh light, possible spot spawn on Big Bend shore; 215 sea lions and 7 whales.

4/28: Two schools at Sorethumb, no herring spawn; 241 sea lions, 9 whales.

4/29: No herring or herring spawn observed; 83 sea lions, one whale.

4/30: **1.0 nm spawn**, no herring schools; 128 sea lions, 7 whales.

5/1: **1.3 nm spawn**, schools in Blackjack, small one at top of Big Bend; 120 sea lions, 6 whales.

5/2: Pilot reported continuing spawn at Pt Hugh, and **spot spawns** inside Cloverleaf Rocks and at the Pt Hugh Light. Windy conditions prevented staff from conducting an aerial survey.

5/3: **0.3 nm spawn**, scattered predators.

5/4: **spot spawn**, scattered predators.

5/5: **0.8 nm spawn** along wall N of Pt Hugh, small school south of Sorethumb; widely distributed predators

5/6: **0.7nm spawn**, south of Pleasant Bay and spot on Dorn Is and in Shortfinger Bay; scattered predators.

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5/7: **0.1 nm spawn** south of Pleasant Bay, spot spawn in Winning Cove; few predators.

5/8: 3 small herring schools observed, no spawn; few predators.

Appendix C5.–Aerial and skiff herring spawn surveys by date, in Tenakee Inlet (Juneau Management Area), in Southeast Alaska, 2014.

Tenakee Inlet

Number of times surveyed: 12

Total miles of spawn: 2.0nm

Spawning dates: 4/28–5/1

Peak spawn: 4/29

4/14: No herring or herring spawn observed. 75 sea lions and 5 whales observed. 25 sea lions in a raft near Crab Bay LTF, the rest in small groups from here to Corner Point.

4/18: No herring or herring spawn observed. 63 sea lions and no whale observed. Large raft of 40 near Crab Bay, one of 15 near Saltery, the rest scattered. 3 pound structures on the grounds.

4/22: No herring or herring spawn observed. 28 sea lions and no whale observed. Corner Point to Strawberry Is. obscured by fog. 6 pound structures on the grounds.

4/25: No herring or herring spawn observed. 69 sea lions and 6 whales observed. The majority of the predators were observed from Saltery Bay to just east of Crab Bay.

4/26: Industry pilot reported no herring activity.

4/27: Numerous schools in core area from Strawberry Island to Crab Bay, active seining and fish in some pounds. 46 sea lions and 2 whales.

4/27 pm: no herring or spawn, fish in tow pounds. 20 sea lions. Scott and Mark to Tenakee.

4/28: Two **spot spawns** –east Kadashan and near Crab Bay, school east Kadashan; 62 sea lions and 3 whales.

4/29: **1.9 nm spawn**, no herring schools; 62 sea lions, 3 whales. 30 pounds with herring introduced.

4/30: **0.2 nm spawn**, no herring schools; 34 sea lions, no whale.

5/1: **0.1 nm spawn**, no herring schools; 46 sea lions, 1 whale. 33 pounds with herring introduced.

5/3: No herring or spawn, few predators; harvesting in pounds continuing.

5/5: No herring or spawn; few predators.

Appendix C6.–Aerial and skiff herring spawn surveys by date, in Lynn Canal (Juneau Management Area), in Southeast Alaska, 2014.

Lynn Canal

Number of times surveyed: 13

Total miles of spawn: 3.5nm

Spawning dates: 4/27–5/1

Peak spawn: 4/29

4/14: No herring or herring spawn observed. 85 sea lions and 3 whales observed. ≈70 sea lions observed in Berners Bay, with a group of 15 active in Slate Cove. Possibly indicating eulachon are staging in the area.

4/18: No herring or herring spawn observed. 61 sea lions and 3 whales observed. Most predators in Berners Bay between Sawmill Cove and Point Bridget.

4/:22: No herring or herring spawn observed. 91 sea lions and 3 whales observed. Two thirds of the sea lions and a school of porpoise near the mouth of Eco Cove between Cascade Point and Cowee Creek.

4/25: No herring or herring spawn observed. 115 sea lions and 7 whales observed. 30 sea lions and 4 whales were observed in the vicinity of Bridget Cove. The remaining predators were in Berners Bay spread between Pt Bridget and just north of Sawmill Cove, with a concentration in Slate Cove.

4/27: Wings pilot reported spawn in Bridget Cove or Pt Bridget early this morning. PM survey: two **spot spawns** at Pt Bridget; 86 sea lions 4 whales.

4/28: **0.7 nm active spawn** at Pt Bridget, school in Bridget Cove; 218 sea lions, 7 whales.

4/29: **1.4 nm spawn**, no herring schools; 100 sea lions, 2 whales.

4/30: **1.0 nm spawn**, herring schools by Sawmill Cove; 143 sea lions, no whale.

5/1: **0.9 nm spawn**, 132 sea lions one whale in Slate Cove.

5/3: No herring or spawn, few predators.

5/5: Schools in Auke Bay, Indian Cove and Tee Harbor; predators widely distributed.

5/7: Schools in Auke Bay, numerous schools in Tee Harbor and north along Breadline to the Shrine of St. Therese.

5/8: Numerous schools in Auke Bay, Tee Harbor, and Gastineau Channel, likely juvenile herring.

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Appendix C7.–Aerial and skiff herring spawn surveys by date, in Port Frederick, Oliver Inlet, Taku Harbor, and Stephens Passage (Juneau Management Area), in Southeast Alaska, 2014.

Port Frederick

Number of times surveyed: 11

Total miles of spawn: 0nm

4/14: No herring or herring spawn observed. 11 sea lions observed near the north end of the Narrows.

4/18: No herring or herring spawn observed. 6 sea lions and no whale observed. All predators near Cannery Point.

4/22: One small school of herring in the deep at N end of the Narrows, no herring spawn. 5 sea lions and no whales observed.

4/25: Herring observed inside the Hoonah boat harbor breakwater, no herring spawn. 6 sea lions and no whales observed.

4/27: No herring or spawn observed, poor visibility

4/28: Schools by ferry terminal and Shaman Island; no predators.

4/29: No herring or herring spawn observed. No sea lions or whales observed.

4/30: School of herring by Cold Storage, no spawn observed; 4 sea lions and no whale observed.

5/1: No herring or herring spawn observed. No sea lions or whales observed.

5/3: No herring or herring spawn observed. No sea lions or whales observed.

5/5: No herring or herring spawn observed. No sea lions or whales observed.

Oliver Inlet

Number of times surveyed: 13

Total miles of spawn: 0nm

4/14: No herring or herring spawn observed. No sea lions or whales observed.

4/18: No herring or herring spawn observed. No sea lions or whales observed.

4/22: No herring or herring spawn observed. No sea lions or whales observed.

4/25: Several schools of herring in the entrance to the inlet, no herring spawn observed. No sea lions or whales observed.

-continued-

4/27: No herring or herring spawn observed. No sea lions or whales observed.

4/28: No herring or herring spawn observed. No sea lions or whales observed.

4/29: No herring or herring spawn observed. No sea lions or whales observed.

4/30: No herring or herring spawn observed. No sea lions or whales observed.

5/3: No herring or herring spawn observed. No sea lions or whales observed.

5/5: No herring or herring spawn observed. No sea lions or whales observed.

5/6: No herring or herring spawn observed. No sea lions or whales observed.

5/7: No herring or herring spawn observed. No sea lions or whales observed.

5/8: No herring or herring spawn observed. No sea lions or whales observed.

Taku Harbor

Number of times surveyed: 1

Total miles of spawn: 0nm

5/6: No herring or herring spawn observed. No sea lions or whales observed.

Port Snettisham

Number of times surveyed: 3

Total miles of spawn: 0nm

5/6: Schools of herring observed at Pt Anmer, and between the Whiting River and Sweetheart Creek in Gilbert Bay; few predators.

5/7: Numerous small schools of herring observed in Gilbert Bay along shoreline just north of Sweetheart Creek

5/8: No herring or spawn observed; 2 small schools observed on northeast side of Grand Island, 2 small schools observed near Point Arden

Hawk Inlet

6/1 - Randy K. reported observing around **0.25nm of active spawn** in the small cove just north of the mine dock inside Hawk Inlet (a floathouse is anchored in this cove).

Appendix C 8.–Aerial and skiff herring spawn surveys by date, in the Yakutat Management Area, in Southeast Alaska, 2014.

Yakutat Bay

There were no aerial surveys or boat surveys conducted and no samples were collected this year. Total miles of spawn are unknown. Anecdotal observations from residents were as follows:

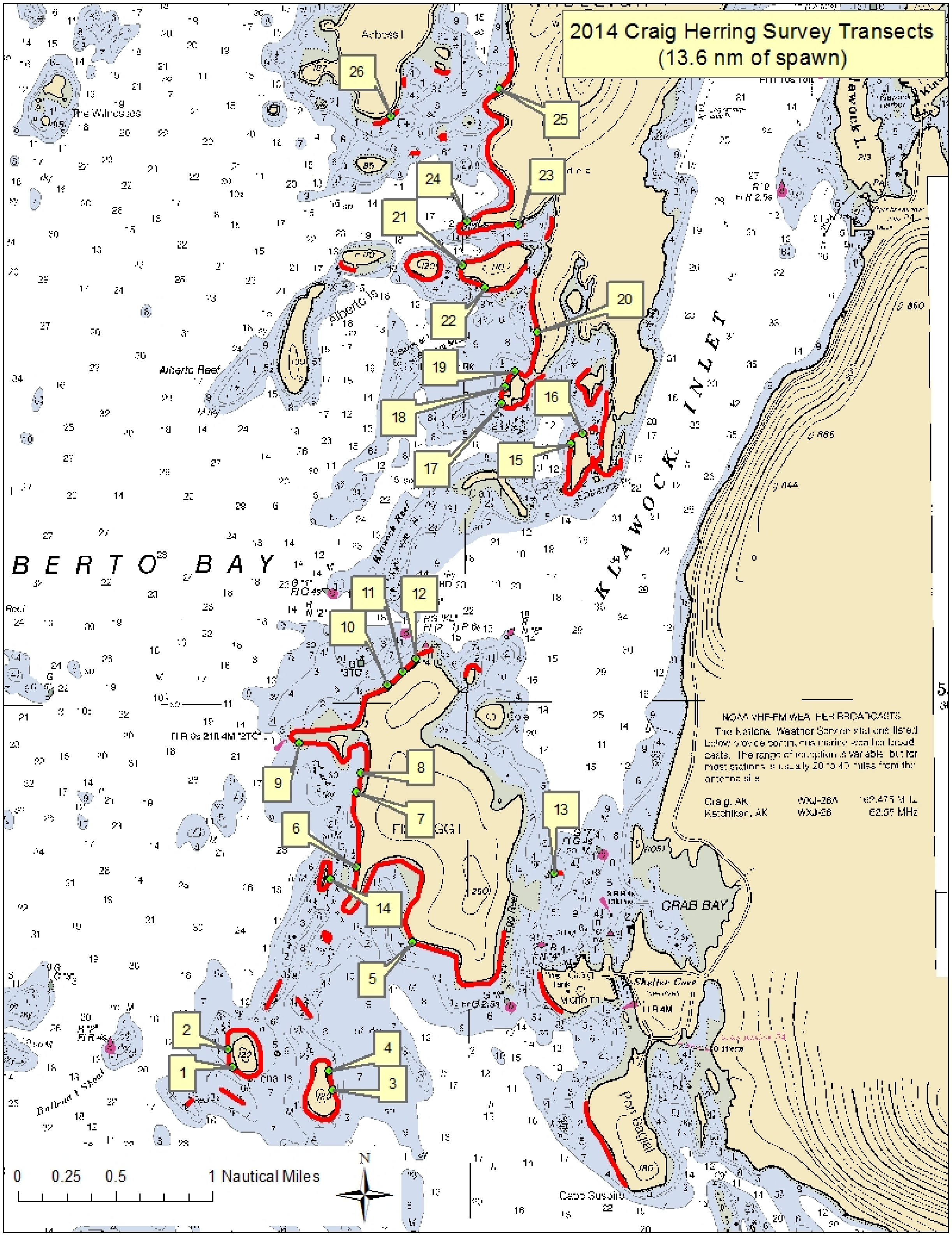
-First spawn was reported on April 3 in Canoe Pass, described as “really thick spawn”.

-Whales were seen feeding in Monti Bay and the boat harbor area on April 5 and April 6. This is unusual as it is very close to shore with lots of traffic.

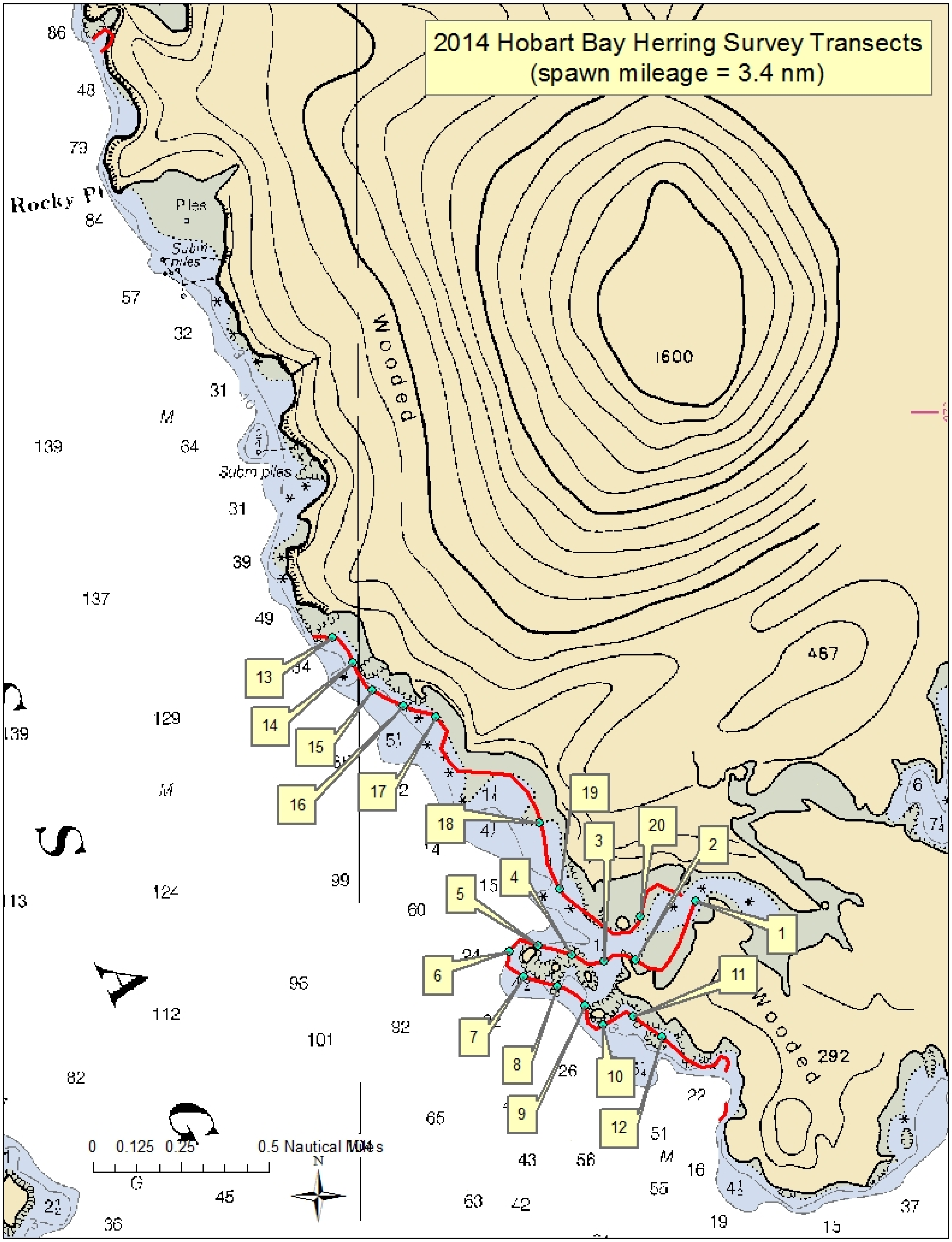
-Second reported spawn was seen near Humpy Creek on April 17th. “Thick spawn for several hundred yards”.

APPENDIX D: SPAWN AND SPAWN DEPOSITION SURVEY TRANSECT LOCATIONS

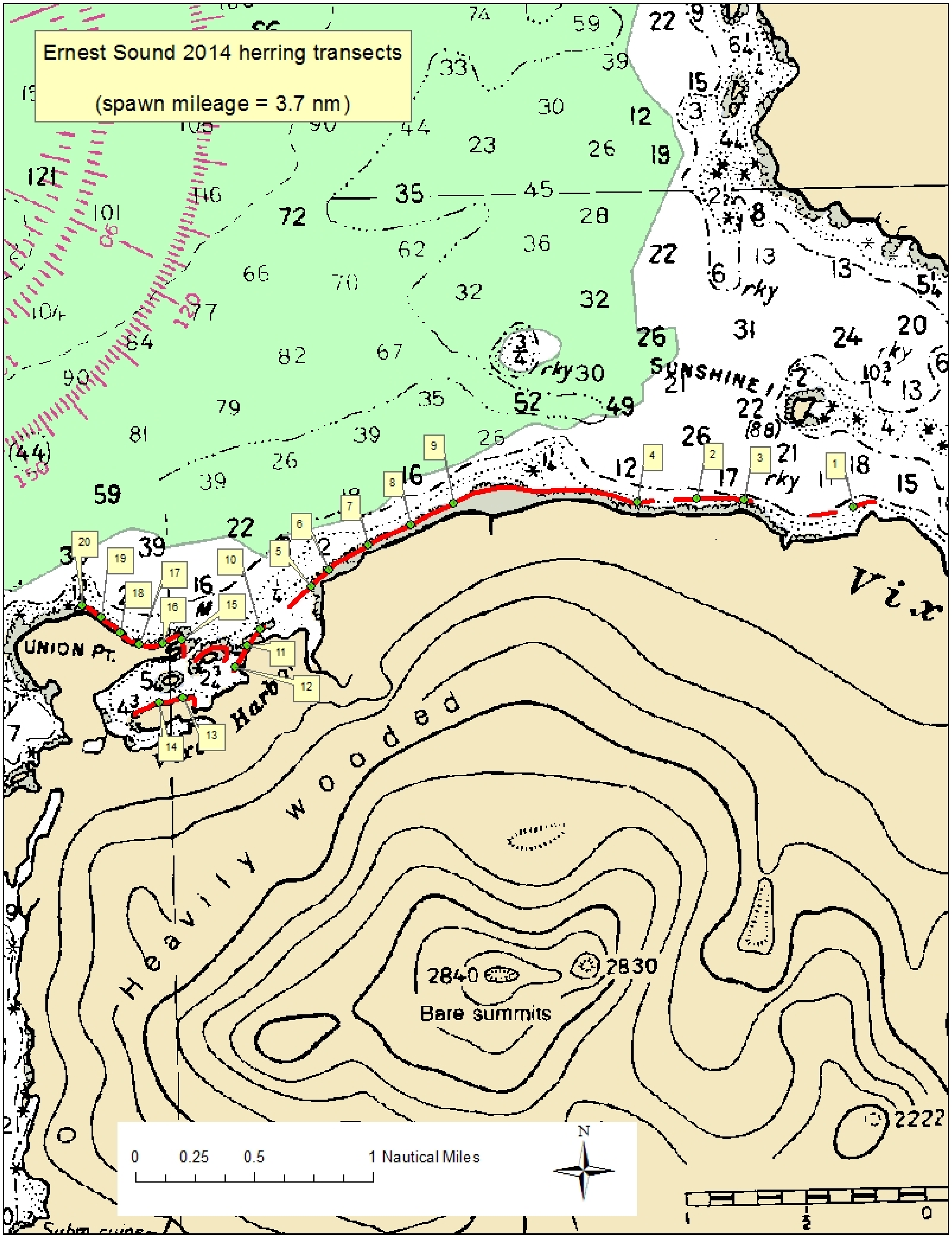
Appendix D1.–Spawn (heavy gray line) and spawn deposition survey transect locations (numbered labels) for the Craig herring stock in 2014.



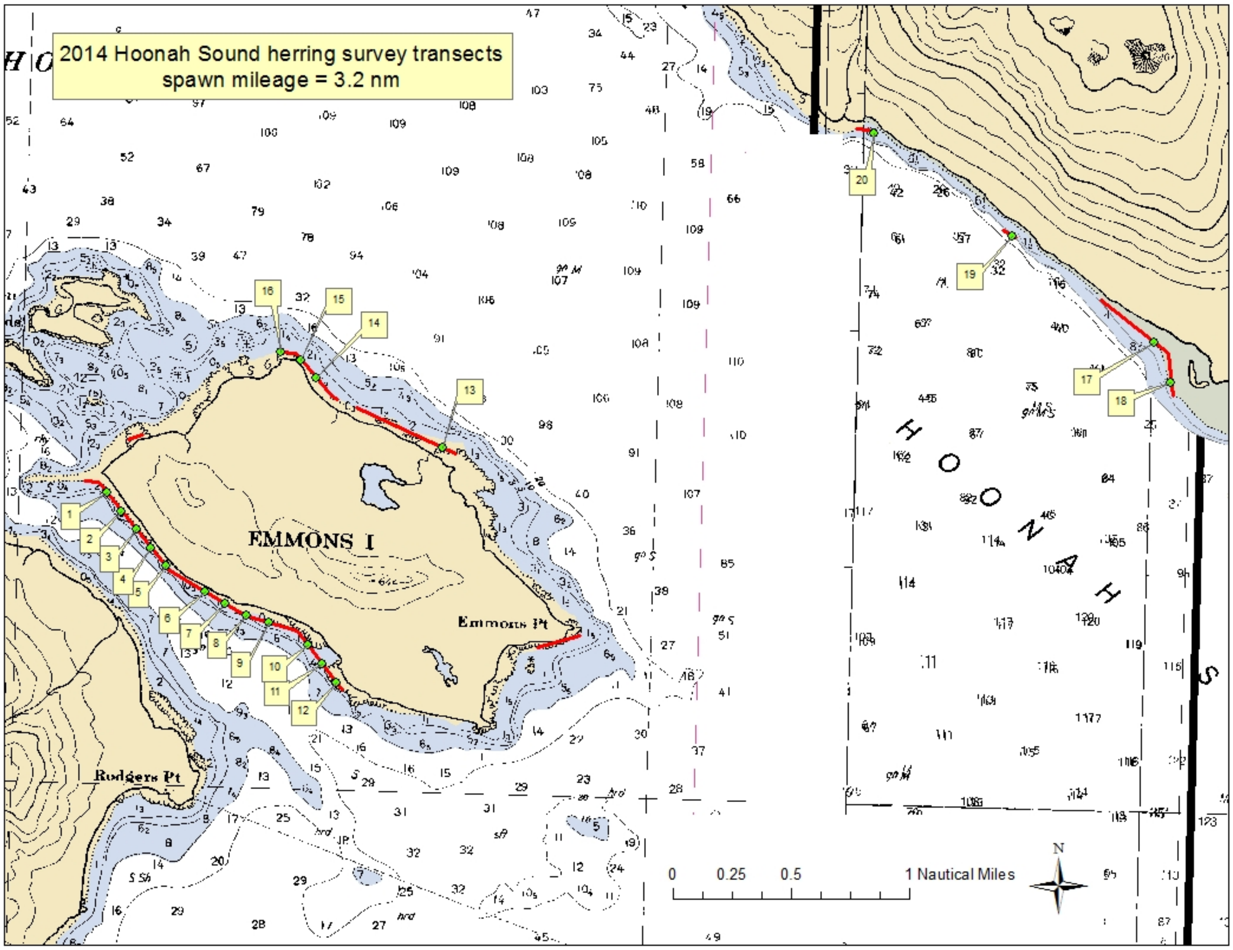
Appendix D2.–Spawn (heavy gray line) and spawn deposition survey transect locations (numbered labels) for the Hobart Bay/Port Houghton herring stock in 2014.



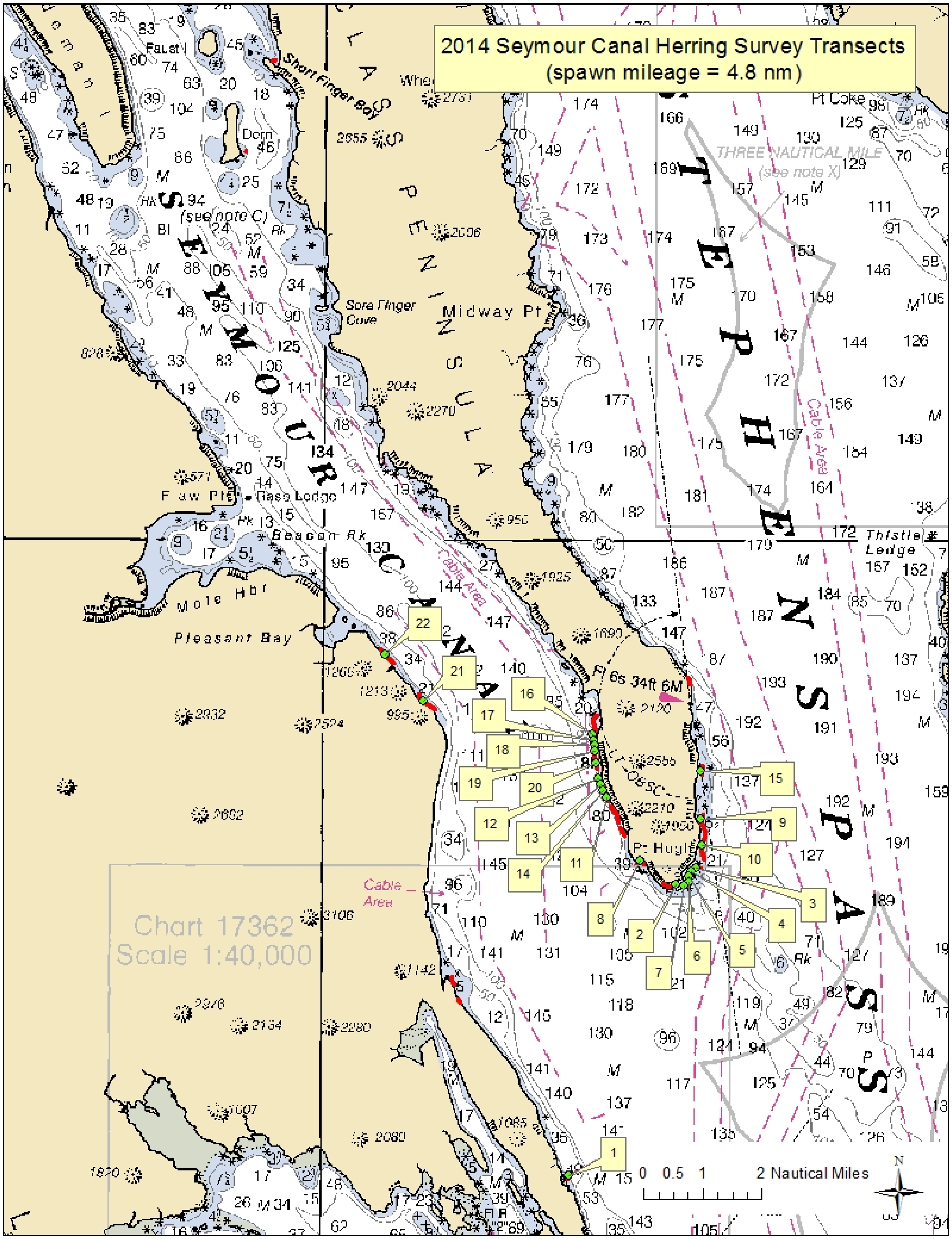
Appendix D3.–Spawn (heavy gray line) and spawn deposition survey transect locations (numbered labels) for the Ernest Sound herring stock in 2014.



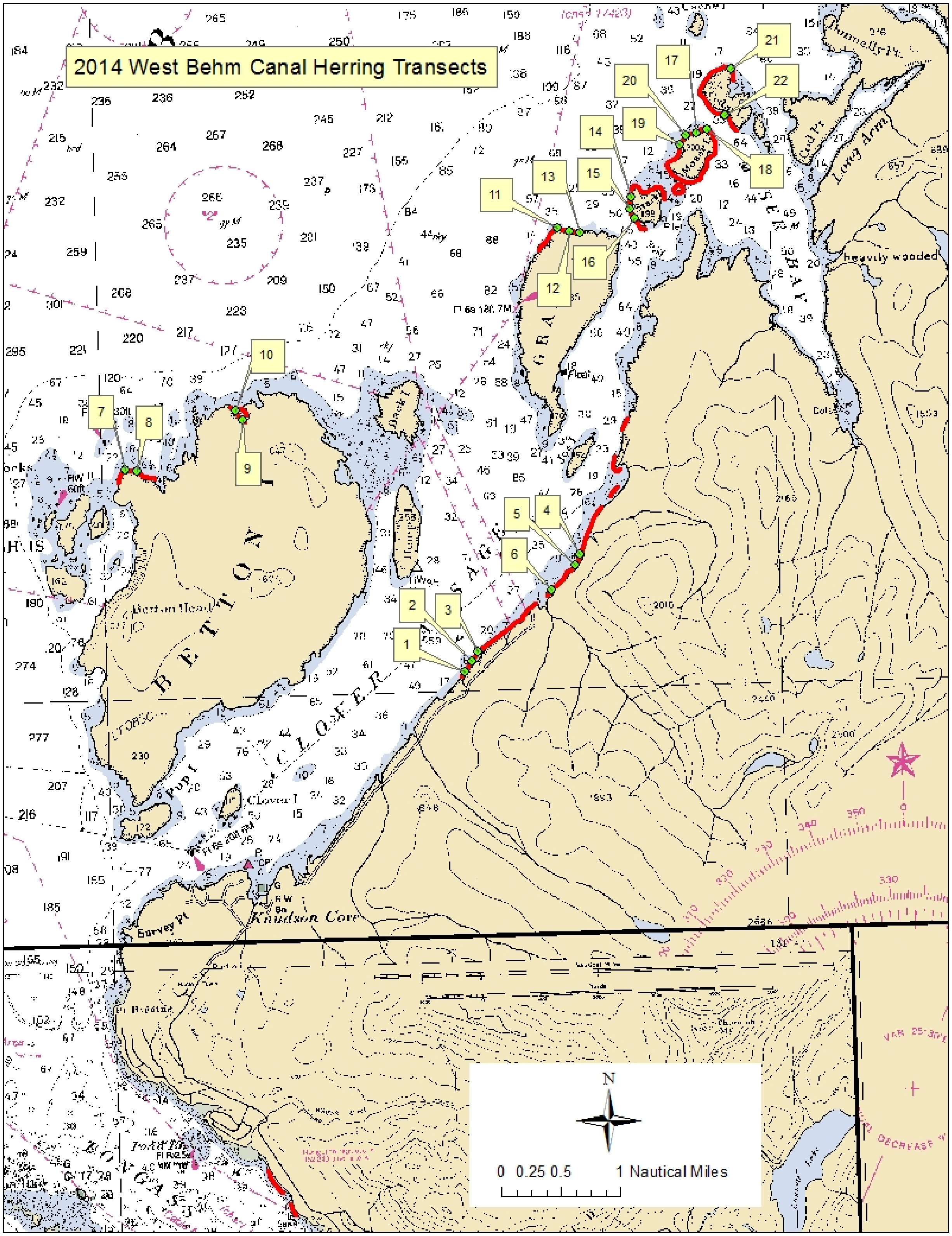
Appendix D4.–Spawn (heavy gray line) and spawn deposition survey transect locations (numbered labels) for the Hoonah Sound herring stock in 2014.



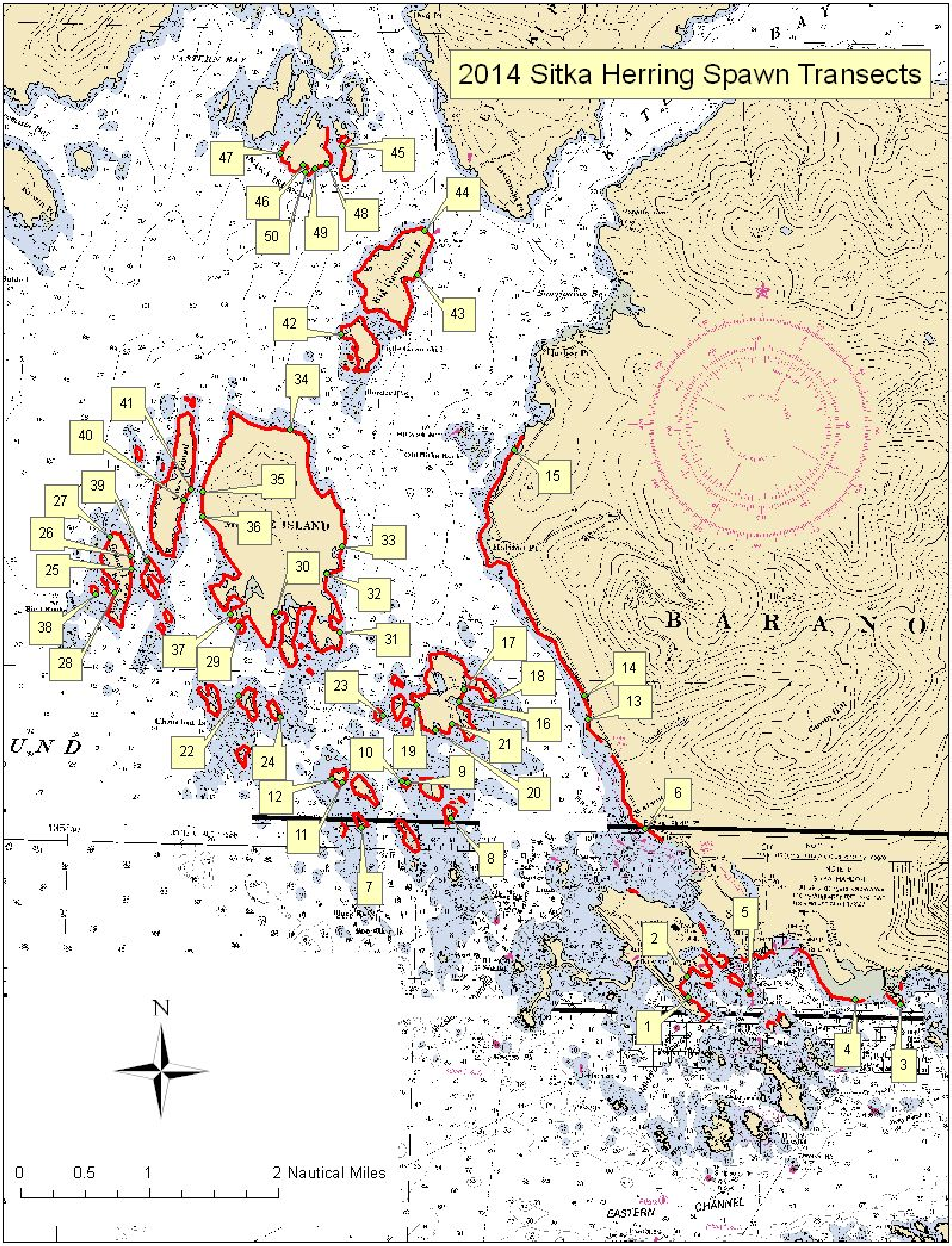
Appendix D5.–Spawn (heavy gray line) and spawn deposition survey transect locations (numbered labels) for the Seymour Canal herring stock in 2014.



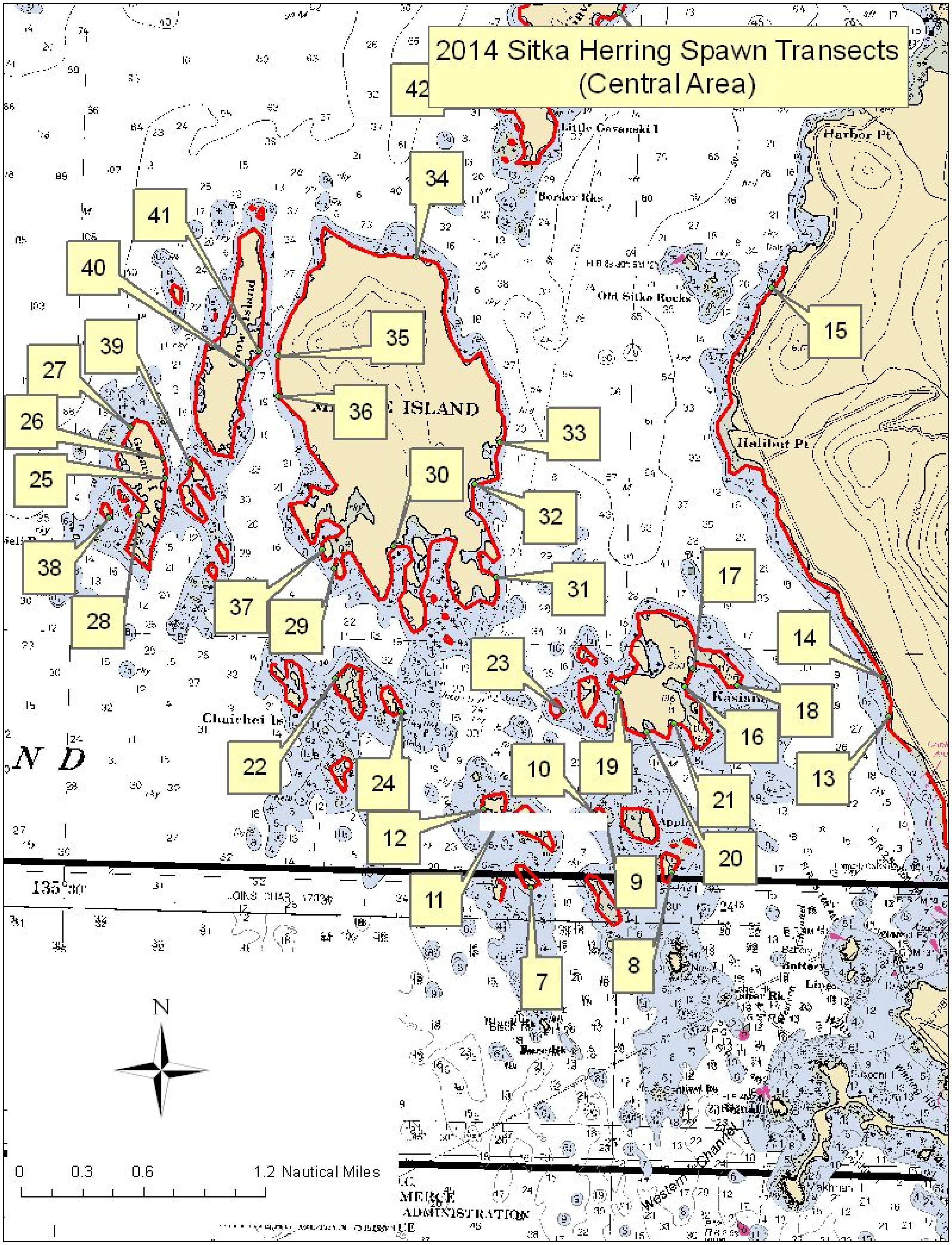
Appendix D6.–Spawn (heavy gray line) and spawn deposition survey transect locations (numbered labels) for the West Behm Canal herring stock in 2014.



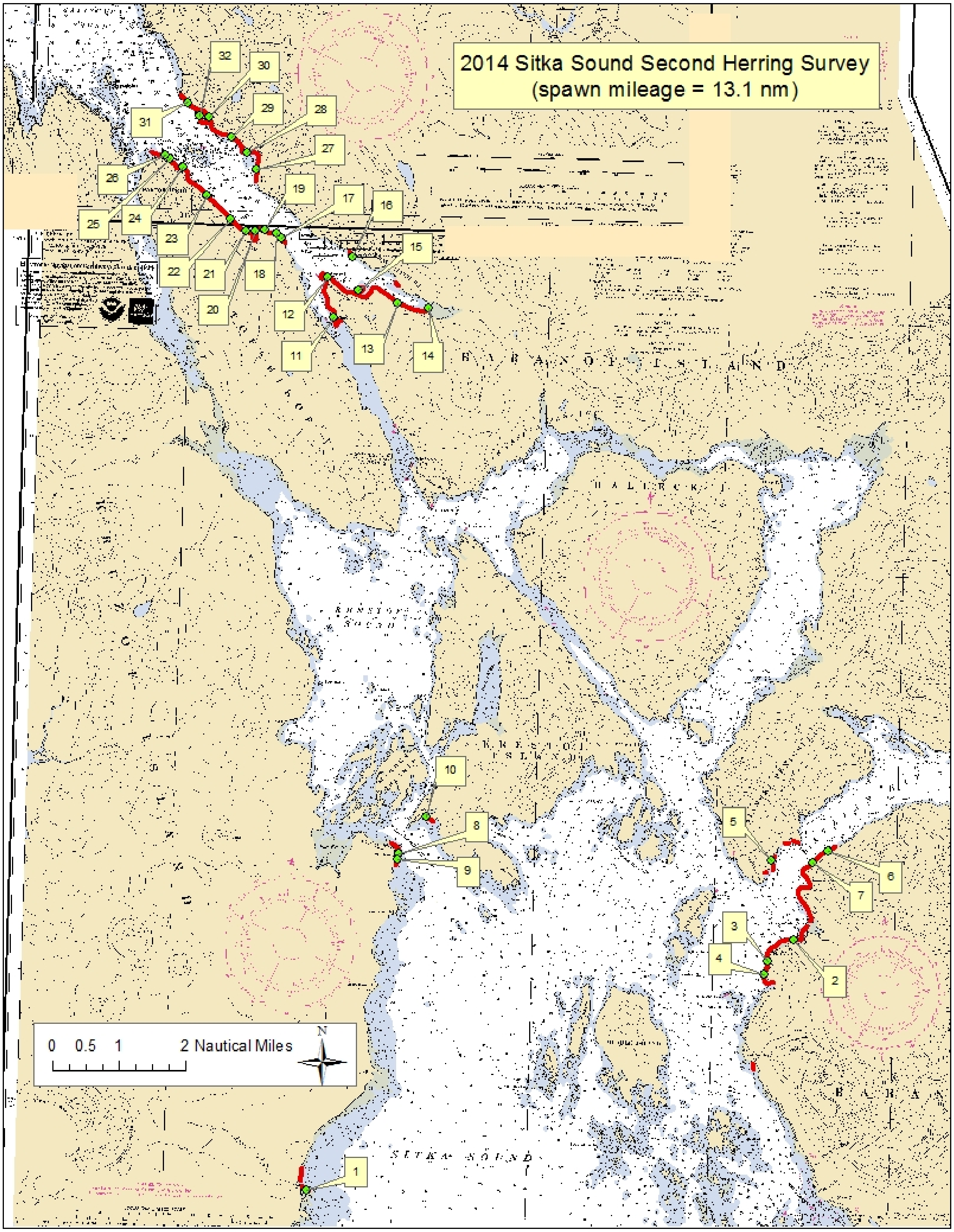
Appendix D7.–Spawn (heavy gray line) and spawn deposition survey transect locations (numbered labels) for the Sitka Sound herring stock first survey in 2014.



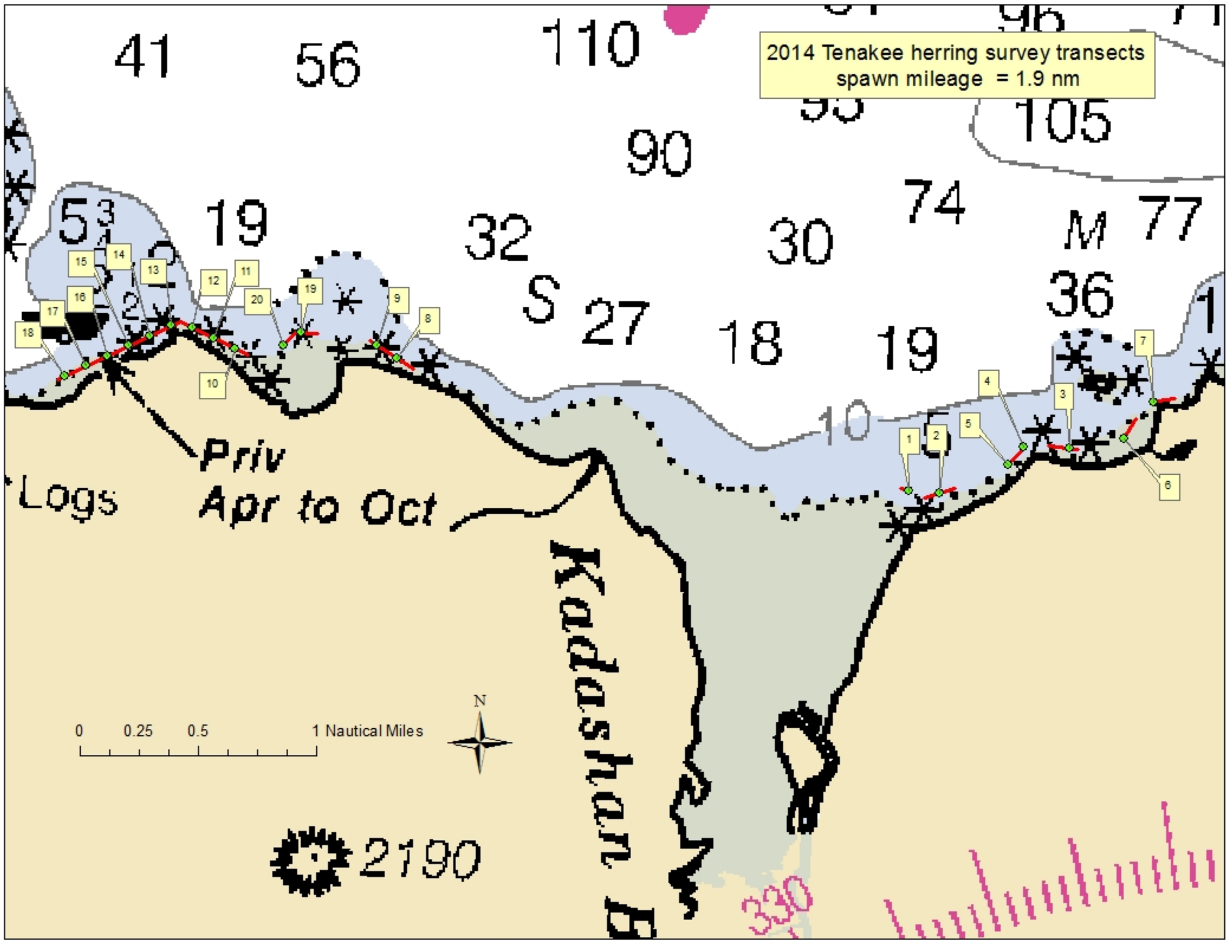
Appendix D8.–Spawn (heavy gray line) and spawn deposition survey transect locations (numbered labels) for the Sitka Sound herring stock first survey in 2014 (central Sitka Sound transects only).



Appendix D9.–Spawn (heavy gray line) and spawn deposition survey transect locations (numbered labels) for the Sitka Sound herring stock second survey in 2014.



Appendix D10.–Spawn (heavy gray line) and spawn deposition survey transect locations (numbered labels) for the Tenakee Inlet herring stock in 2014.



Appendix D11.–Spawn (heavy gray line) and spawn deposition survey transect locations (numbered labels) for the Lynn Canal herring stock in 2014.