MEMORANDUM State of Alaska

DEPARTMENT OF FISH AND GAME

TO: Distribution

DATE: December 26, 2023

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FROM: Kyle Hebert,

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Division of Commercial Fisheries

SUBJECT: 2022 Region 1 Herring Stock Assessment Survey Summary

This memorandum provides a summary of results of Southeast Alaska herring stock assessment surveys conducted by the Alaska Department of Fish and Game during the 2021/22 fishery season. This summary is intended to provide only a brief recap of the primary data collection for herring egg deposition, age, and size. To view data collection methods and to provide context for these results, full reports of previous years should be read, such as "Southeast Alaska 2020 Herring Stock Assessment Surveys" (Fishery Data Series No. 22-21). Results are presented only for herring stocks for which data was collected in 2022 (Figure 1). Estimates of biomass reported in this memo are based on spawn deposition estimates (i.e. not model-based) and therefore are intended only to provide the general magnitude of stock size and depict trends. In general, survey results indicate that outer coastal stocks (Sitka and Craig) remain at the highest levels observed since the inception of stock assessment surveys in the late 1970s, and all stocks found in inside waters remain at low or very low levels.

Aerial and Spawn Deposition Surveys

Aerial and skiff surveys of herring activity, herring spawn, and marine mammal/bird activity were conducted at major stock locations beginning on March 9, 2021, in Sitka Sound and ending on June 2, 2022, in Seymour Canal. Surveys or observations were conducted by ADF&G staff from each area office (Ketchikan, Petersburg, Sitka, Juneau, Haines, and Yakutat) and covered major or traditional herring spawning locations within each management area. Occasionally, private pilots or local residents may report observations of active spawning.

The total documented spawn for major spawning areas in state waters where aerial surveys were conducted in Southeast Alaska and Yakutat in 2022 was 146.3 nmi. This did not include spawning around Annette Island Reserve, or numerous

minor spawning areas in Southeast Alaska or Yakutat. The highest levels of spawn were observed in the Sitka Sound area (91.5 nmi) and in the Craig area (36.4 nmi). Spawning observed in other survey areas ranged from 0 nmi in Hoonah Sound to 6.6 nmi in Kah Shakes-Cat Island (i.e. Revilla Channel) (Table 1).

During spring 2022, spawn deposition dive surveys were conducted only in Sitka Sound, Craig, and Revilla Channel. The first survey was conducted April 9 in the Revilla Channel area, followed by the Sitka Sound area during April 13–16, and finishing in Craig during April 17-18.

Due to a combination of low levels of observed spawning and funding constraints, spawn deposition dive surveys were not conducted in 2022 in several historically surveyed areas, including Seymour Canal, Tenakee Inlet, Lynn Canal, Hoonah Sound, West Behm Canal, Ernest Sound, or Hobart Bay–Port Houghton. Although aerial surveys were conducted in several other minor spawning areas, no spawn deposition dive surveys were completed in these areas due to the low level of spawning (Figure 2).

In the Sitka Sound and Craig areas, egg deposition estimates in 2022 were substantially lower than those from 2021, though still the 4th and 3rd highest, respectfully, on record (Figures 3 and 4). In Sitka Sound a decrease from 27.3 trillion eggs to 14.6 trillion eggs was due primarily to a substantial decrease in egg density, which declined from 1,426,809 eggs/m2 in 2021 to 813,231 eggs/m2 in 2022. In Craig, the egg deposition estimate declined from 8.4 trillion to 5.3 trillion eggs, which was also attributable to a large decrease in egg density, from 1,447,064 eggs/m2 in 2021 to 817,542 eggs/m2. Despite the decline, the egg density estimate for Craig in 2022 was one of the highest on record. For Sitka and Craig, the estimated spawning biomass in 2022 differed from 2021 in similar proportion to egg estimates.

Age and Size

A combined total of 6,219 herring were sampled from all stocks and gear types (cast net, purse seine, and pound) during the 2021–2022 season. Of those, 5,954 herring were processed to determine age, weight, length, and sex, for those herring age-3 or greater. The reduction of sample size was due to exclusion of age-1 and age-2 herring, fish that could not be aged due to regenerated scales, or data that was otherwise unusable.

Samples of the spawning areas were taken using cast nets. Samples from Craig and Sitka Sound were collected throughout the geographic extent of the active spawning, and throughout the duration of spawning, focusing on the most intense spawning events when feasible. All other spawning areas were sampled more sporadically, as weather and time permitted, but may not have captured the full spatial or temporal range of spawning.

Samples were also obtained from all commercial fisheries that were conducted in 2021–2022. Fisheries sampled included Sitka Sound sac-roe, Craig winter bait, and Craig spawn on kelp. Samples were obtained opportunistically from vessels or tenders during, or shortly after, the fishery openings.

The minimum sample goal of 500 aged fish per sampling event (gear-fishery combination) was exceeded for most areas/fisheries where samples were obtained but was not achieved for Ernest Sound or Hobart Bay-Port Houghton. Although age and size samples were not obtained for several other traditionally sampled stocks, aerial surveys were completed.

Age Composition

Age composition data from spawning populations were obtained for seven spawning areas in the region in 2022: Sitka Sound, Craig, Revilla Channel, Seymour Canal, Hobart Bay-Port Houghton, Ernest Sound, and Northern Stephen's Passage. Samples were not obtained from Tenakee Inlet, Lynn Canal, Hoonah Sound, or West Behm Canal due to reduced funding, low levels of observed spawn, or inability to sample due to weather or other circumstances.

Observed age distributions for most sampled areas were similar in that age-6 herring dominated the spawning populations (Figures 5-7). Two exceptions were Kah Shakes-Cat Island and Ernest Sound, where the highest observed proportion was age-4 herring. The proportions of age-6 herring for these two areas were 32% in Revilla Channel and 23% in Craig. For all other areas sampled, the proportion of age-6 herring in 2022 ranged from 60% to 72%. The similar age compositions of spawning areas in Southeast Alaska, and the dominant age-6 class, are a result of the extremely strong 2016 cohort, which was first observed in 2019 as a very high proportion of age-3 recruitment.

Based on observed proportions of age-3 herring, recruitment in 2022 appears to have been low to moderate. In 2022, age-3 proportions observed in sampled spawning populations ranged from 4-31%.

Size at Age

Based on cast net samples in 2022, weight at age was generally similar as in 2021 for most sampled spawning areas, although weights in Seymour Canal were lower and weights in Revilla Channel were higher. Trends in weight-at-age over time are variable among stocks. For most stocks, a common pattern is evident: weights of age-3 herring have been relatively stable over the past few decades, whereas those of older ages appear to have gradually declined (Figures 8-10). The decline appears to be more pronounced for the oldest age classes. The current range of mean weight among age classes appears narrower than what it was 3 decades ago. Although the mean weight-at-age of herring is less now than it was 30 years ago, weight generally declined during the late 1980s to the early to mid-2000s but then appears to have stabilized over the past 15 years for most stocks. The exception is Sitka Sound, where weight-at-age appears to have remained relatively stable over the past 20 years; however, this followed a period of low weight-at-age in the early 1990s, a time when anecdotally herring had been described as “pencil herring”. The data presented here only date back to the late 1980s, which coincided with the period of low weight and low condition of Sitka area herring.

To understand whether changes in weight-at-age are due solely to body mass or instead (or also) due to changes in length-at-age, condition factors were calculated to roughly gauge herring health using the physical dimensions of herring (i.e., weight-to-length ratio) over time. Data obtained from cast net samples during active spawn events were used to calculate condition factors, because a more complete and consistent data set exists for cast net samples than commercial samples, allowing easier comparison among stocks. 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. Mean condition factors of herring from most stocks in Southeast Alaska continue to follow the same general pattern observed 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 declining sharply to 2012. The condition factors calculated for 2022 for stocks where data was available are not notably different from those observed over the past 3 decades.

Table 1. Summary of results of herring aerial and spawn deposition surveys in Southeast Alaska and Yakutat for 2022.

Spawning Stock	Number of transects completed	Average length of transects (m)	Observed spawn (nmi)	Area of survey (m^2)	Average egg density (eggs/m^2)	Total eggs in survey area (trillions)	Mean fish weight (g)[d]	Estimated fecundity of fish of mean weight	Estimated number of fish	Post-fishery mature biomass (tons)
Craig	35	87	36.4	5,836,022	817,542	5.301	92.8	18,452	574,592,512	58,809
Sitka Sound (total)	50	97	91.5	16,125,602	813,231	14.571	120.5	20,928	1,392,469,025	185,013
Kruzof stratum	15	293	10.9	5,914,732	707,221	4.648	–	–	–	–
Eastern stratum	35	66	67.3	8,190,602	970,663	8.834	–	–	–	–
post survey[a]	–	66	16.6	2,020,267	485,332	1.089	–	–	–	–
Kah Shakes/Cat Is.	20	69	6.6		272,479	0.253	75.2	13,889	36,502,193	3,026
Seymour Canal[b]	–	–	1.4	837,289	–	–	–	–	–	–
Ernest Sound[b]	–	–	2.6	–	–	–	–	–	–	–
Hobart/Houghton[b]	–	–	3.0	–	–	–	–	–	–	–
Hoonah Sound[b,c]	–	–	0.0	–	–	–	–	–	–	–
Lynn Canal[b]	–	–	1.4	–	–	–	–	–	–	–
Tenakee Inlet[b]	–	–	0.2	–	–	–	–	–	–	–
West Behm Canal[b]	–	–	1.4	–	–	–	–	–	–	–
Yakutat Bay[b]	–	–	1.8	–	–	–	–	–	–	–
Total	105	–	146.3	22,798,914	–	20.126	–	–	2,003,563,730	246,849
Average	35	84	–	7,599,638	634,417	6.709	96.2	17,757	–	–

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

[a] Not surveyed, but average transect length and 50% average egg density from Eastern Stratum survey were applied to estimate spawn area and egg deposition.

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

[c] Observed spawn nm represents the total unique shoreline with spawn; sum of 94.8 nm includes overlapping spawn between strata or post-survey.

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

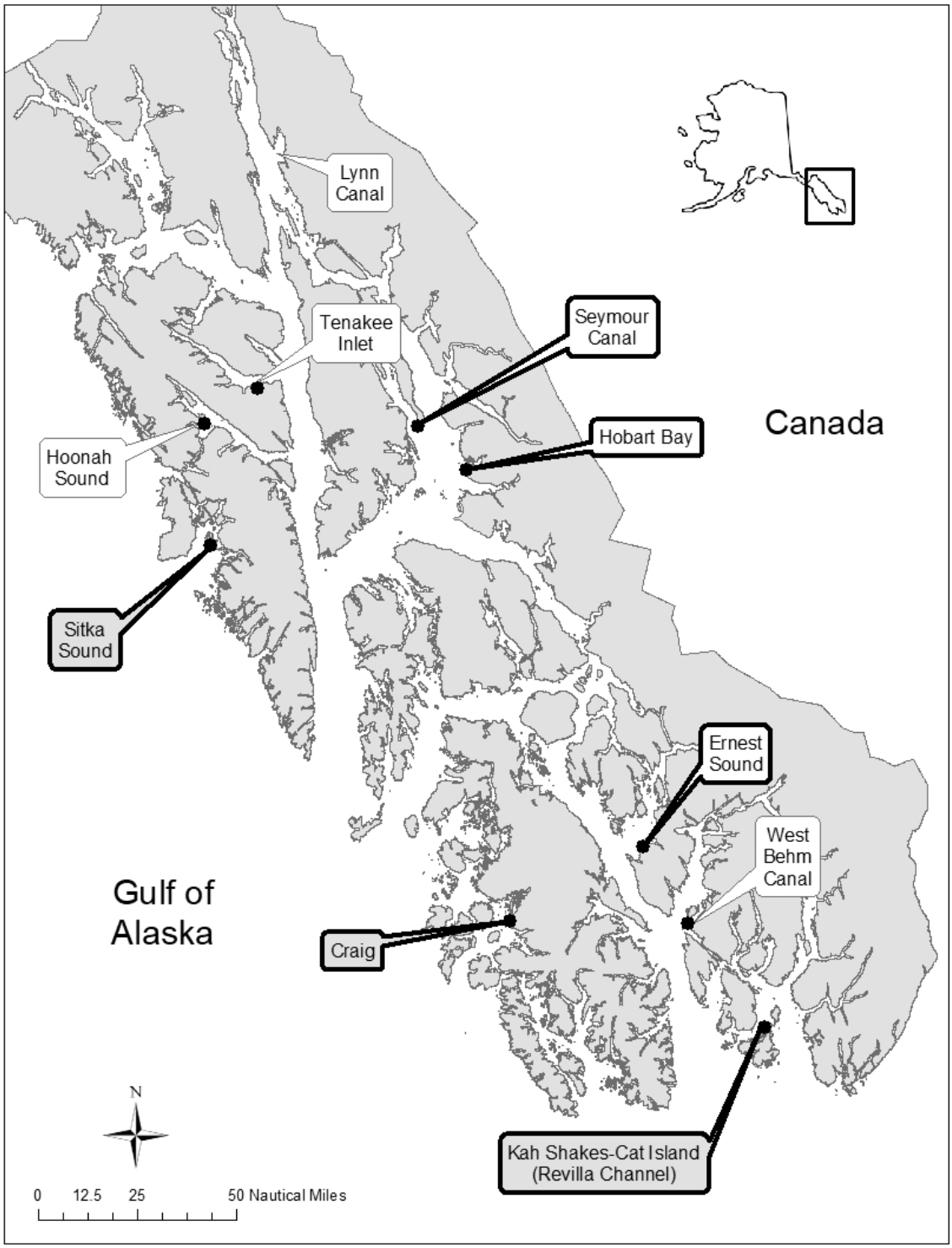


Figure 1. - Locations of monitored traditional herring spawning areas in Southeast Alaska. Labels with shading and bold outline indicate areas where spawn deposition surveys and age-size sampling were conducted during the 2022 spawning season; labels with only bold outline indicate only age-size sampling of herring was completed during the 2022 spawning season; no sampling other than aerial surveys were conducted in areas where labels have no shading or bolding.

Stock	8-Mar	9-Mar	10-Mar	11-Mar	12-Mar	13-Mar	14-Mar	15-Mar	16-Mar	17-Mar	18-Mar	19-Mar	20-Mar	21-Mar	22-Mar	23-Mar	24-Mar	25-Mar	26-Mar	27-Mar	28-Mar	29-Mar	30-Mar	31-Mar	1-Apr	2-Apr	3-Apr	4-Apr	5-Apr	6-Apr	7-Apr	8-Apr	9-Apr	10-Apr	11-Apr	12-Apr	13-Apr	14-Apr	15-Apr
Sitka Sound	0.0	ns	ns	ns	0.0	ns	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.6	8.0	1.3	5.3	11.9	12.9	15.1	3.4	19.1	6.7	5.5	3.5	5.6	8.6	6.2	0.8	1.8	5.7	7.9	11.9
Revilla Channel														ns	0.0	ns	ns	ns	1.8	5.8	4.0	1.3	0.0	0.0	ns	ns	ns	0.0	ns										
Craig											0.0	ns	ns	ns	ns	ns	ns	ns	0.0	ns	ns	ns	ns	0.0	ns	ns	ns	0.0	ns	ns	0.1	4.1	13.2	26.4	ns	ns	1.6	0.2	0.2
West Behm Canal																														ns	0.0	0.4	0.2	0.0	ns	ns	0.0	0.0	0.0
Ernest Sound																																					ns	1.2	0.0
Seymour Canal																																						ns	0.0
N. Stephens Pass.																																						ns	0.0
Tenakee Inlet																																						ns	0.0
Lynn Canal																																						ns	0.0

continued	16-Apr	17-Apr	18-Apr	19-Apr	20-Apr	21-Apr	22-Apr	23-Apr	24-Apr	25-Apr	26-Apr	27-Apr	28-Apr	29-Apr	30-Apr	1-May	2-May	3-May	4-May	5-May	6-May	7-May	8-May	9-May	10-May	11-May	12-May	13-May	14-May	15-May	16-May	17-May	18-May	19-May	20-May	21-May	22-May	23-May	24-May
Sitka Sound	0.5	0.0	0.0	ns	ns	0.0	0.0	ns	ns	0.3	ns	ns	0.1																										
Craig	0.1	ns																																					
West Behm Canal	0.0	active spawn not observed but 1.0 nmi reported sometime Apr 17-28.																																					
Ernest Sound	ns	ns	0.0	ns	ns	0.0	0.0	ns																															
Hoonah Sound		ns	0.0	ns	ns	0.0	ns	ns	ns	0.0	ns	ns	0.0	ns																									
Seymour Canal	ns	ns	ns	ns	0.0	ns	ns	ns	ns	0.0	ns	ns	0.0	ns	ns	ns	0.0	ns	ns	ns	0.0	ns	ns	0.0	ns	ns	0.0	ns	ns	ns	0.0	ns	0.0	ns	0.0	0.1	0.1	0.0	ns
N. Stephens Pass.	ns	ns	ns	ns	0.0	ns	ns	ns	ns	0.0	ns	ns	0.0	ns	ns	ns	0.0	ns	ns	ns	0.0	ns	ns	0.0	ns	ns	0.0	ns	ns	ns	0.0	ns	0.0	ns	0.1	1.7	0.4	2.4	0.0
Tenakee Inlet	ns	ns	ns	ns	0.0	ns	ns	ns	ns	0.0	ns	ns	0.1	ns	ns	ns	0.0	ns	ns	ns	0.0	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	0.0	ns						
Lynn Canal	ns	ns	ns	ns	0.0	ns	ns	ns	ns	0.0	ns	ns	0.0	ns	ns	ns	0.0	ns	0.0	ns	0.0	ns	ns	1.3	ns	0.1	0.0	ns	ns	ns	ns	ns	0.0	ns					
Hobart/Houghton						ns	0.0	ns	ns	0.0	ns	0.3	0.0	ns	0.0	ns	ns	ns	0.0	ns	ns	0.0	ns	1.0	0.0	ns	1.0	0.0	ns										
Haines													0.1																										
Yakutat Bay			1.8 nmi observed over this time period																																				

continued	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	13-Jun	14-Jun	15-Jun	16-Jun	17-Jun	18-Jun	19-Jun	20-Jun	21-Jun	22-Jun	23-Jun	24-Jun	25-Jun	26-Jun	27-Jun	28-Jun	29-Jun	30-Jun	1-Jul	2-Jul
Seymour Canal	0.0	ns	0.0	ns	ns	ns	1.3	0.04	0.1	ns																													
N. Stephens Pass.	0.0	ns	0.0	ns	ns	ns	0.0	0.0	0.0	ns																													

Figure 2. - Spawn timing of herring stocks in Southeast Alaska during spring 2022. Values indicate daily measurements of nautical miles of active spawn recorded during aerial surveys. Shaded area depicts dates when cast-net samples were taken. Boxed areas indicate duration of spawning (first to last dates of observed spawn). Dates with no survey are depicted by "ns". Blank dates indicate dates that are outside of historical spawning timing and so surveys had not commenced or were concluded.

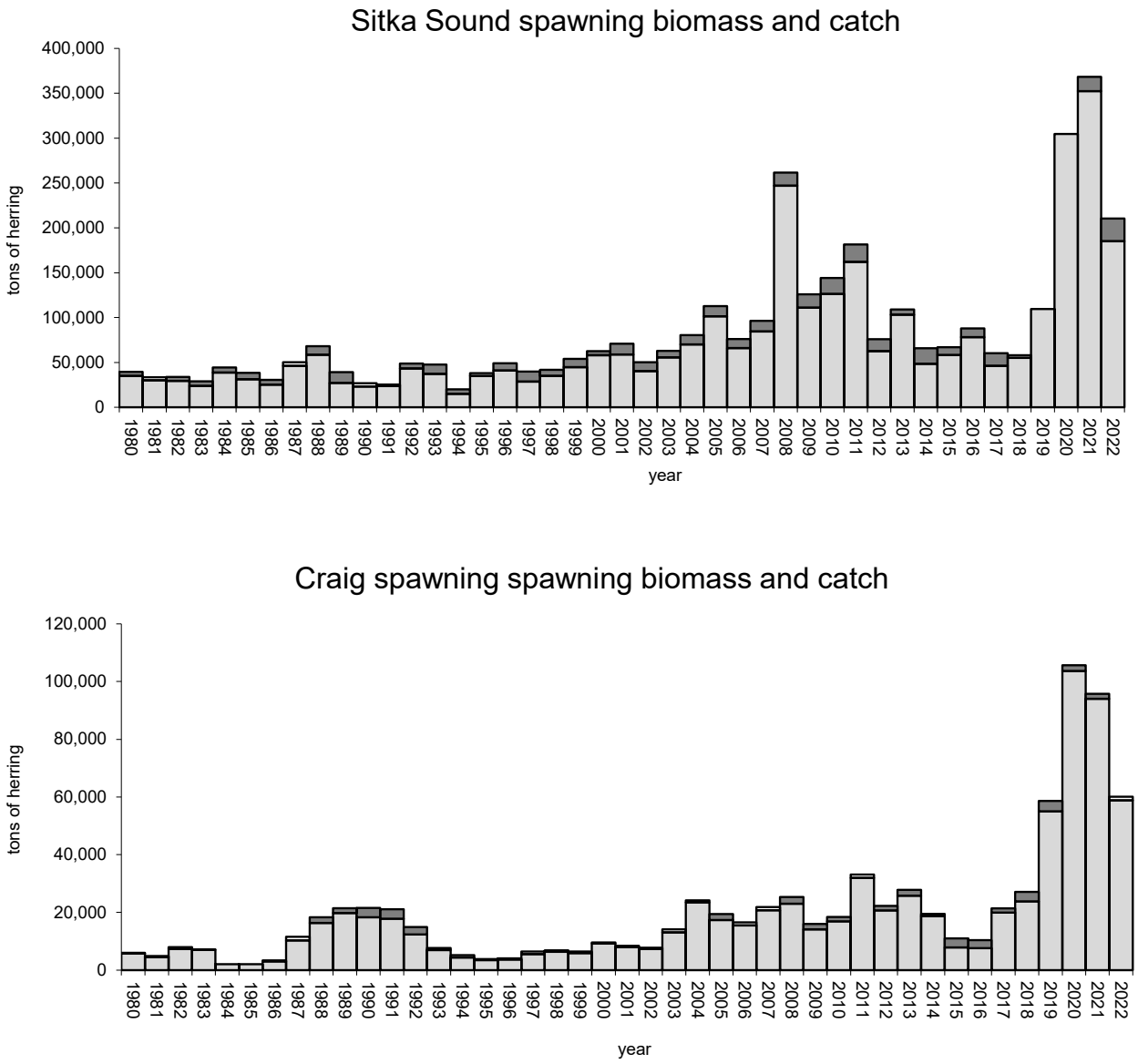


Figure 3. - Observed herring post-fishery spawning biomass (light gray bars), based on spawn deposition surveys, and catch (dark gray bars) for stocks in the Sitka and Craig areas, during 1980–2022.

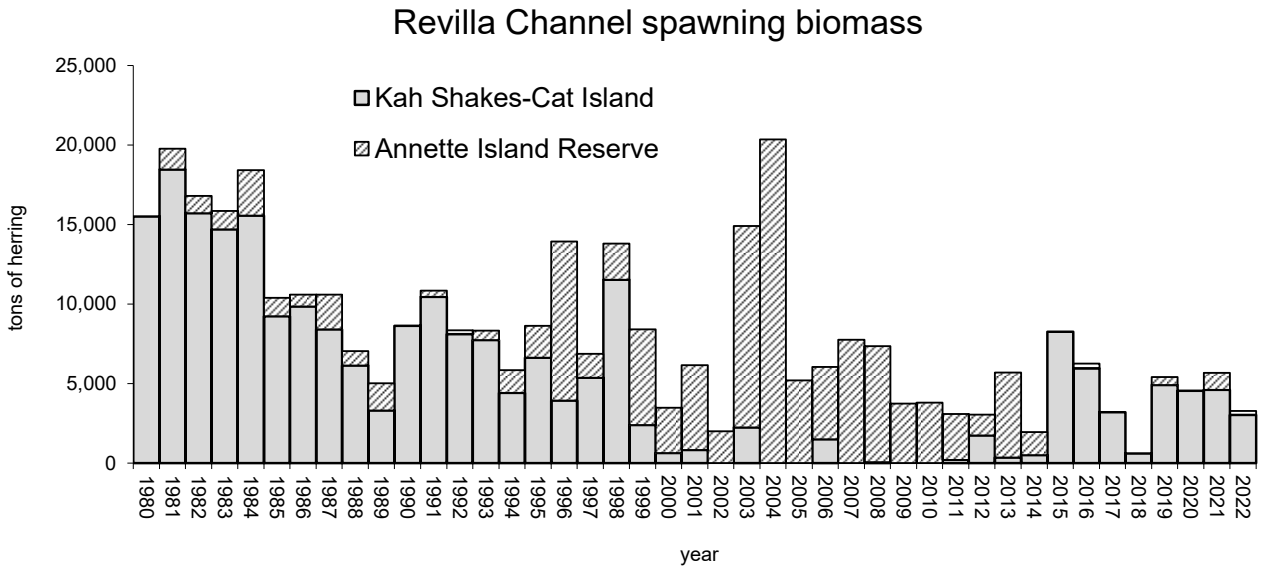
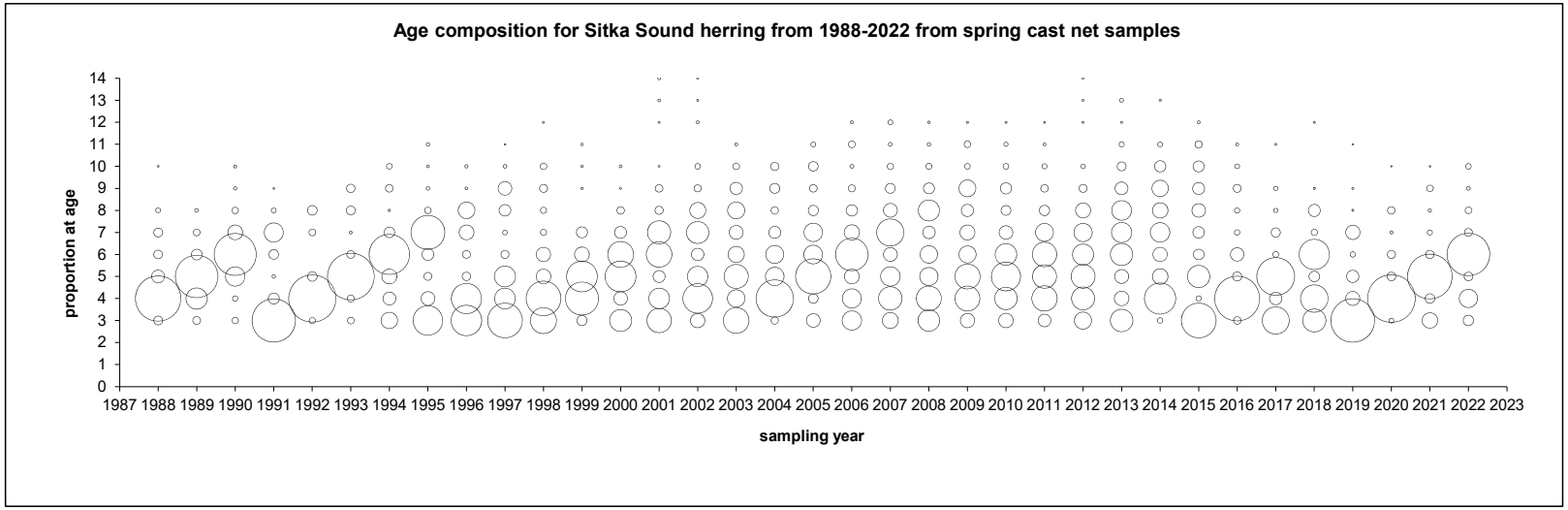


Figure 4. - Observed herring post-fishery spawning biomass, based on spawn deposition surveys or hydroacoustic surveys for stocks in the West Behm Canal and Revilla Channel (Kah Shakes–Cat Island–Annette Island) areas, during 1980–2022. Annette Island spawning biomass estimates between 1981 and 2016 were made as the product of the length of observed linear shoreline spawn mileage and a fixed approximated value of 500 tons of herring per nautical mileage of shoreline, based on the estimated mean value over the period 1991–2000.



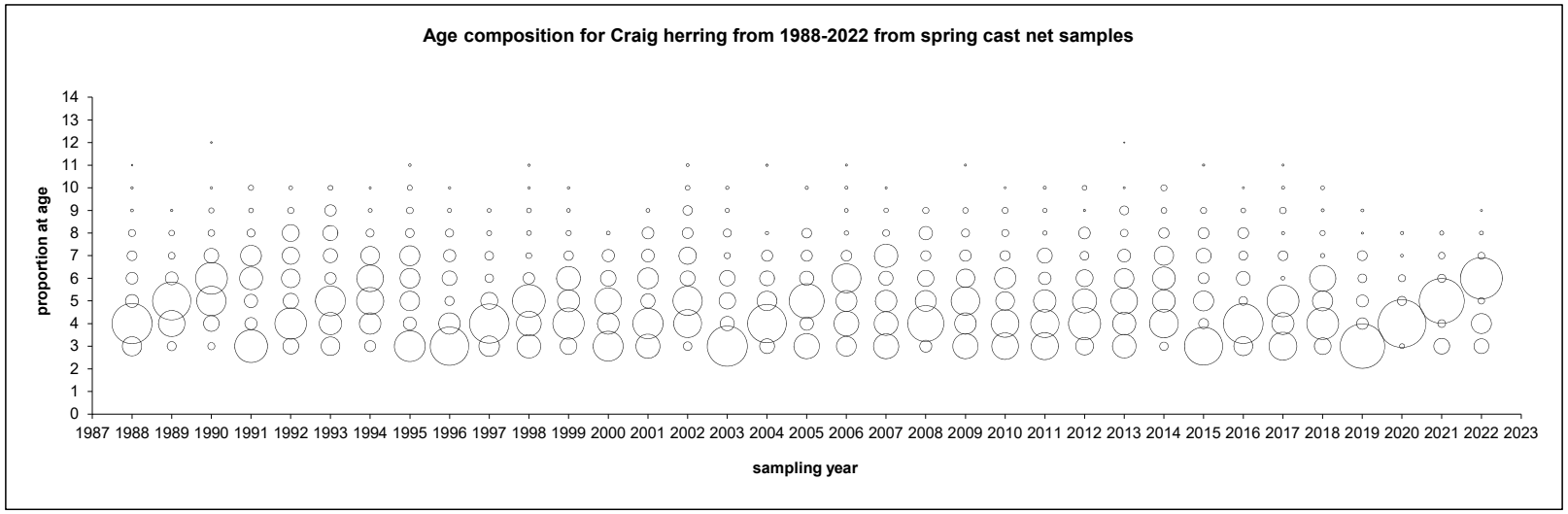
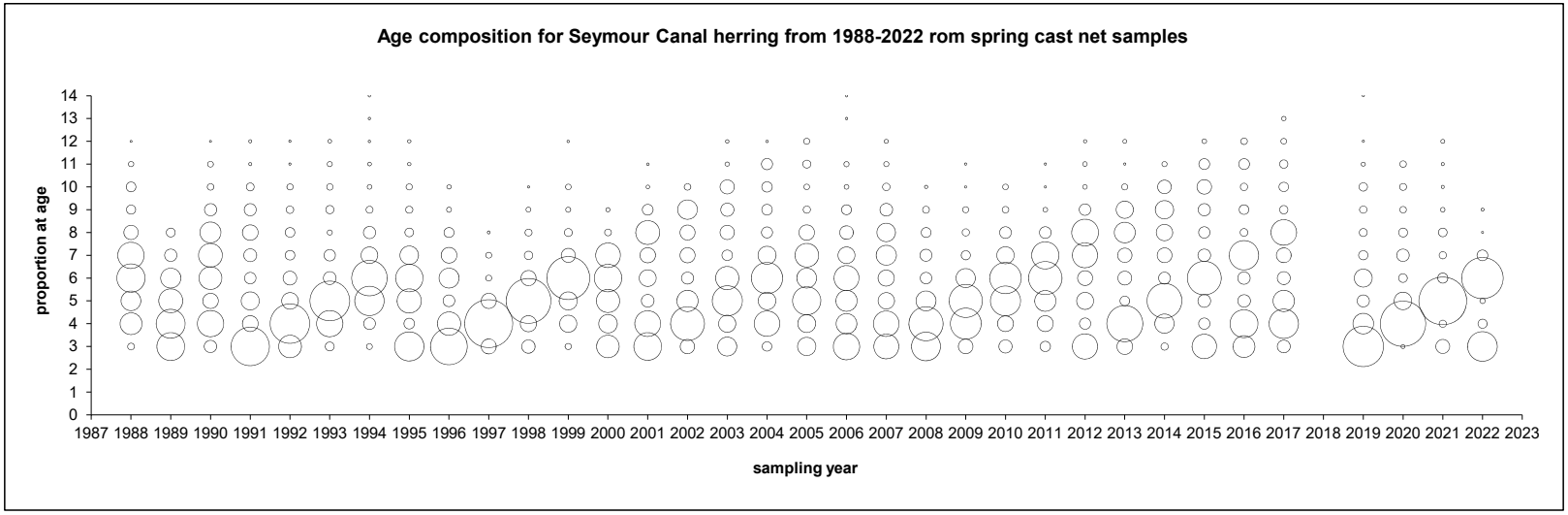


Figure 5. - Observed age compositions from sampling data for the Sitka Sound and Craig herring stocks. Ages presented for 2000 may be biased slightly high due to misinterpretation of scale annuli. For years with blanks, data was either not collected or is not available. For reference, Sitka's largest circle represents 89% and Craig's largest circle represents 93%.



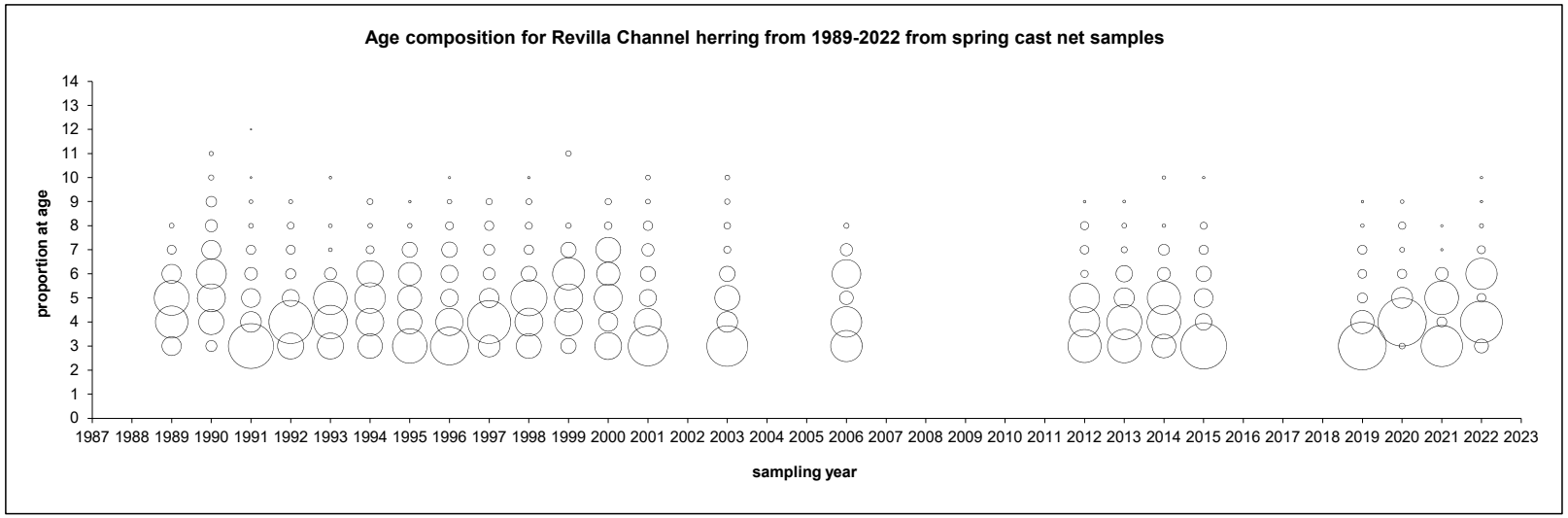


Figure 6. - Observed age compositions from sampling data for the Seymour Canal and Revilla Channel herring stocks. Ages presented for 2000 may be biased slightly high due to misinterpretation of scale annuli. For years with blanks, data was either not collected or is not available. For reference, Seymour Canal's largest circle represents 81% and Revilla Channel's largest circle represents 89%.

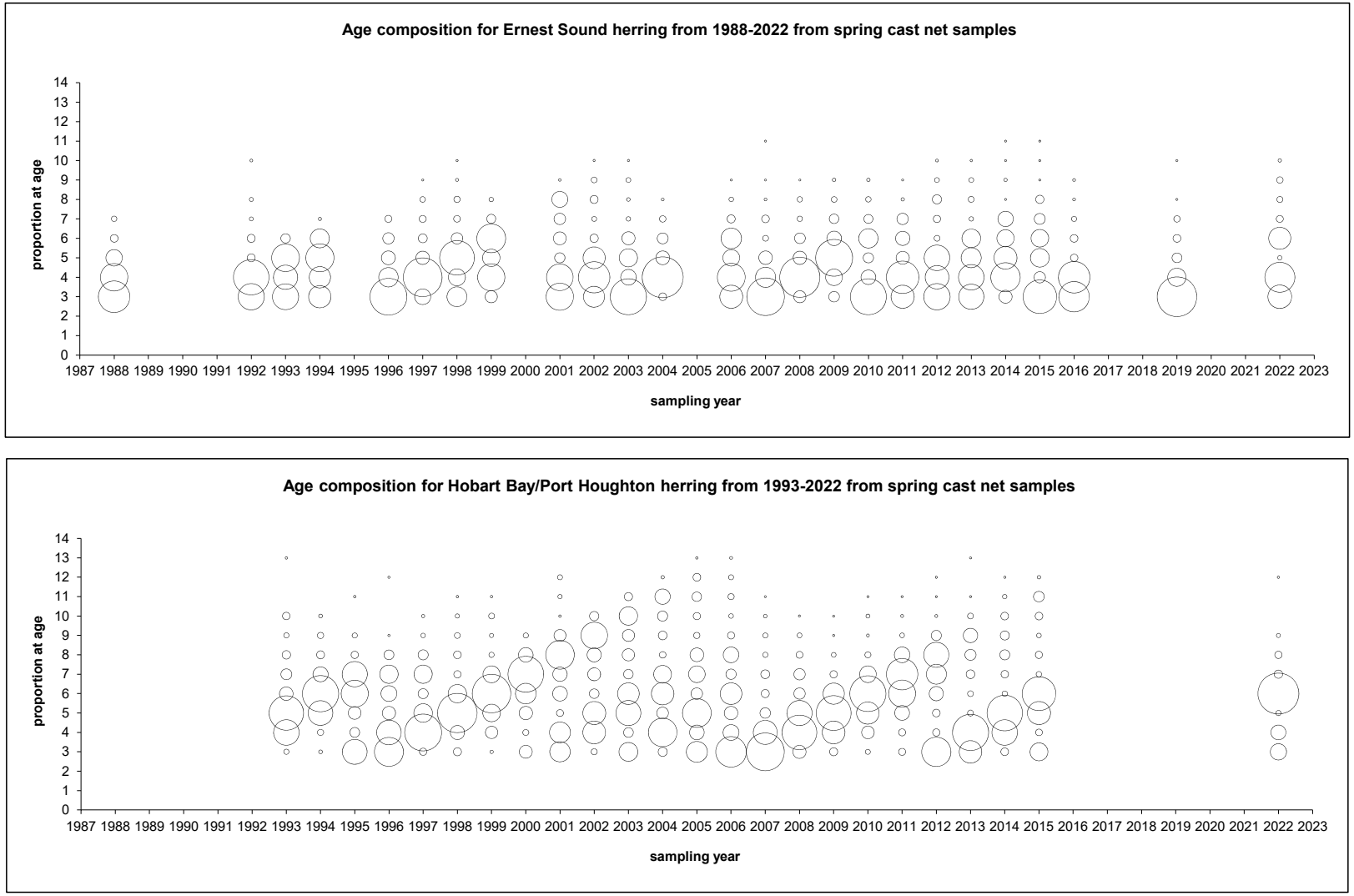


Figure 7. - Observed age compositions from sampling data for the Ernest Sound and Hobart Bay/Port Houghton herring stocks. Ages presented for 2000 may be biased slightly high due to misinterpretation of scale annuli. For years with blanks, data was either not collected or is not available. For reference, Ernest Sound's largest circle represents 80% and Hobart Bay/Port Houghton's largest circle represents 72%.

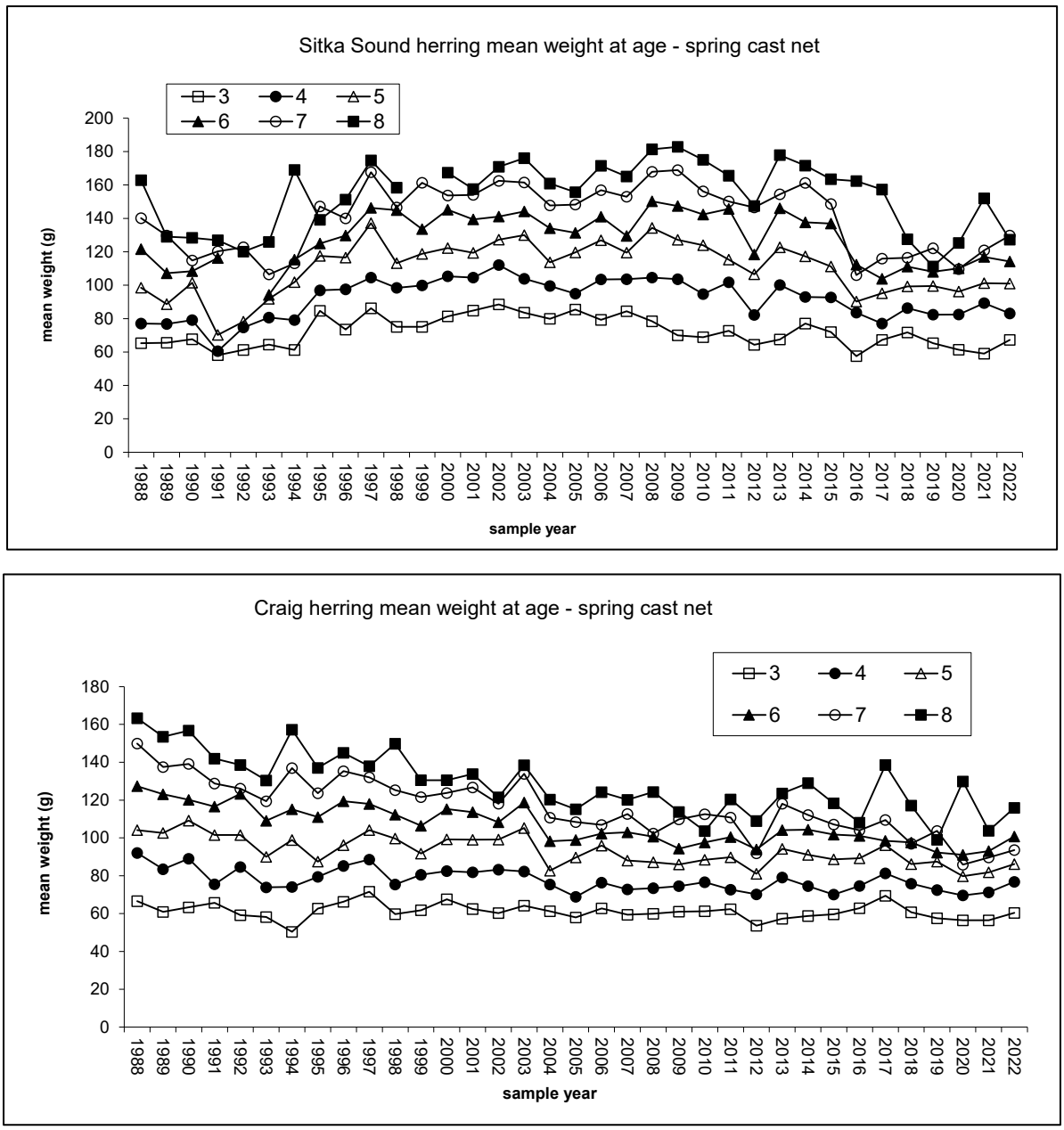
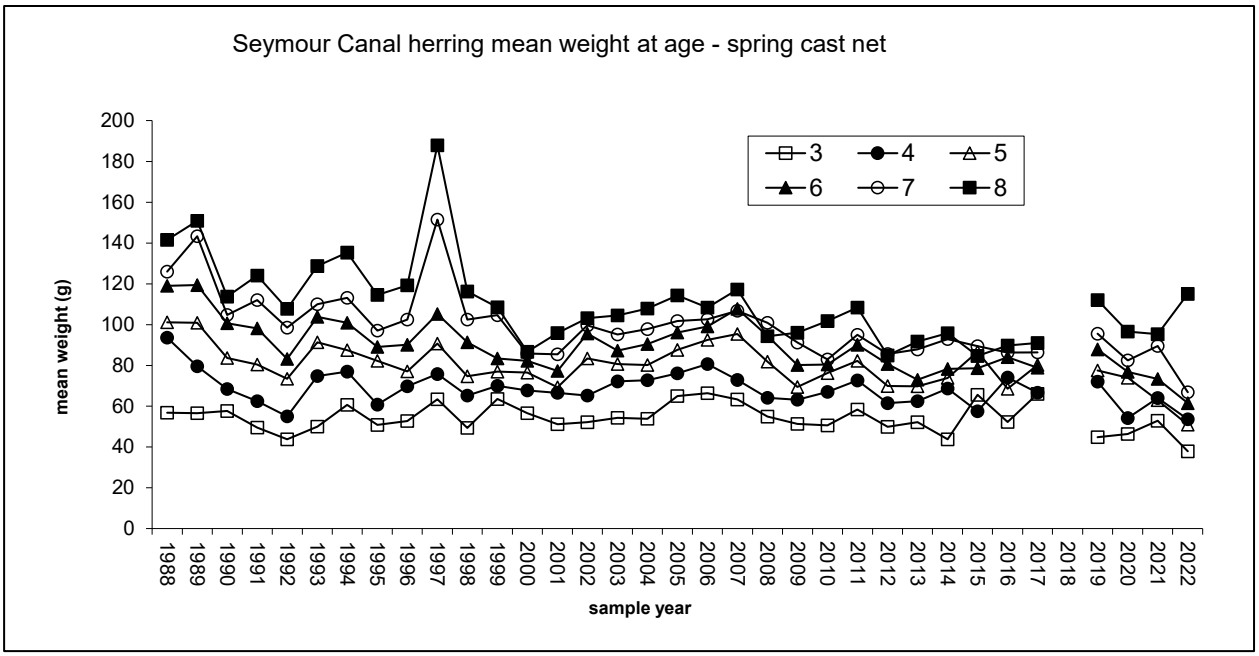


Figure 8. - Mean observed weight-at-age of the Sika and Craig herring spawning populations, from cast net samples. Weights presented for 2000 may be biased slightly high due to misinterpretation of scale annuli.



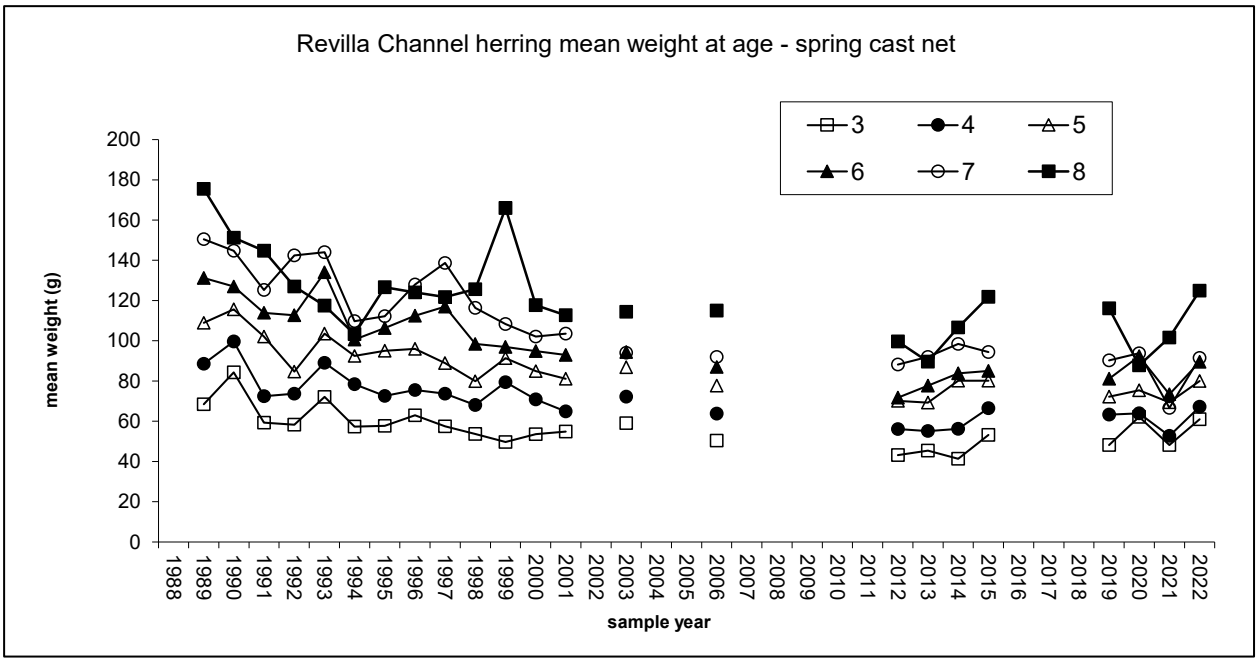


Figure 9.- Mean observed weight-at-age for the Seymour Canal and Revilla Channel herring spawning populations, based on cast net samples. Weights presented for 2000 may be biased slightly high due to misinterpretation of scale annuli. For years with blanks, data was either not collected or is not available.

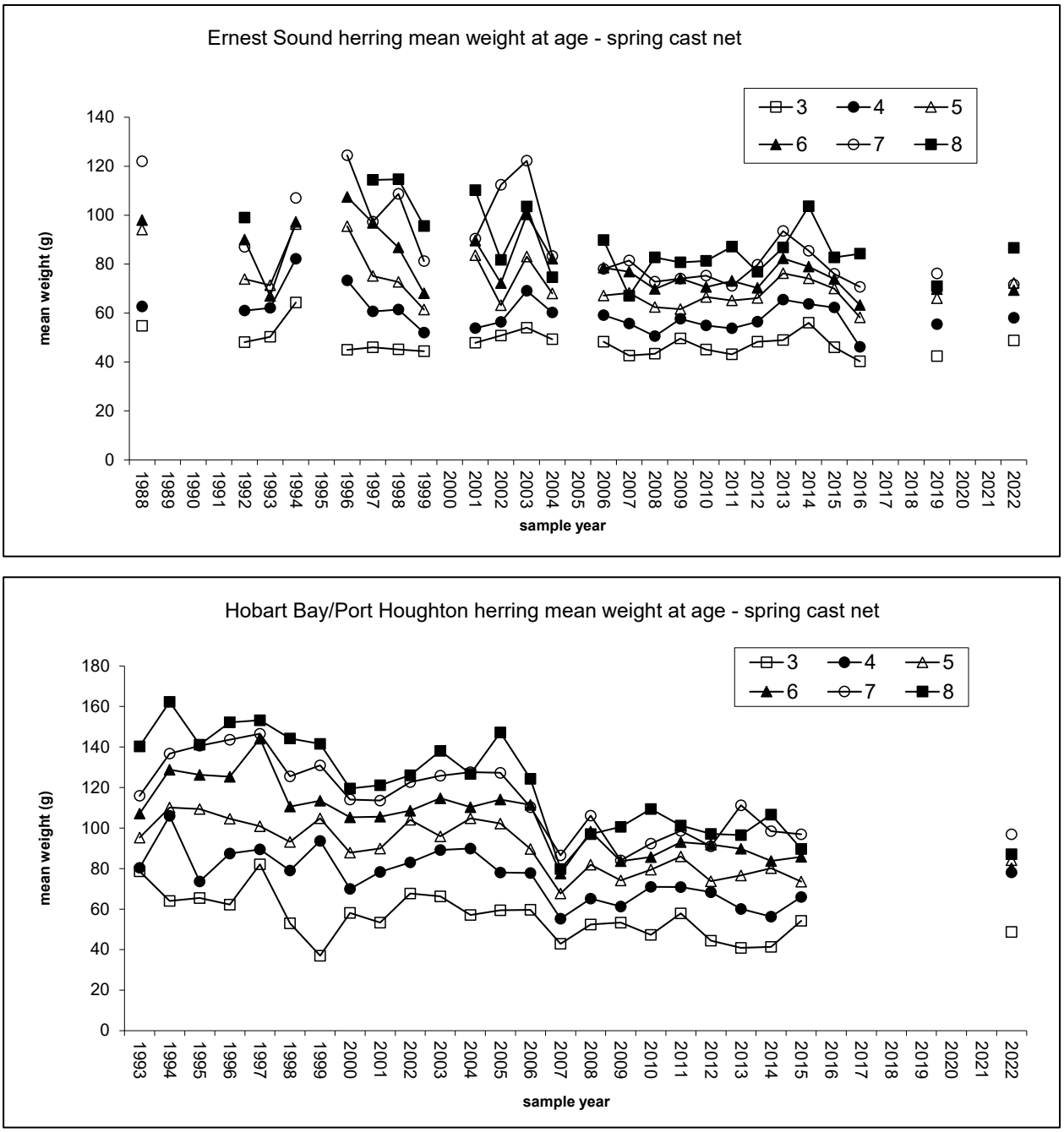


Figure 10.- Mean observed weight-at-age for the Ernest Sound and Hobart Bay/Port Houghton herring spawning populations, based on cast net samples. Weights presented for 2000 may be biased slightly high due to misinterpretation of scale annuli. For years with blanks, data was either not collected or is not available.