MEMORANDUM State of Alaska

DEPARTMENT OF FISH AND GAME

TO: Distribution

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SUBJECT: 2023 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 2022/23 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 2023 (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 13, 2023, in Sitka Sound and ending on May 19, 2023, in Seymour Canal, Northern Stephens Passage, and Hobart-Houghton areas. Surveys or observations were conducted by staff from each area office (Ketchikan, Petersburg, Sitka, Juneau, Haines, and Yakutat) and covered important or traditional herring spawning locations within each management area. Occasionally, private pilots or local residents may report observations of active spawning.

The total documented spawn for major spawning areas in state waters where aerial surveys were conducted in Southeast Alaska and Yakutat in 2023 was 141.1 nmi. This 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 (83.5 nmi) and in the Craig area (29.4 nmi). Spawning observed in other survey areas ranged from 0 nmi in Hoonah Sound to 7.6 nmi for the Tenakee Inlet spawning stock (Table 1).

During spring 2023, spawn deposition dive surveys were conducted only in Sitka Sound and Craig spawning areas. The first survey was conducted April 11-15 in the Sitka Sound area, followed by the Craig area during April 17–18.

Due to low levels of observed spawning, spawn deposition dive surveys were not conducted in 2023 in several historically surveyed areas, including Kah Shakes/Cat Island, Seymour Canal, Tenakee Inlet, Lynn Canal, Hoonah Sound, West Behm Canal, Ernest Sound, and Hobart Bay–Port Houghton. 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 2023 were relatively high, respectively the 4th and 5th highest on record (Figures 3). In Sitka Sound an increase from 14.6 trillion eggs to 19.9 trillion eggs was due primarily to a substantial increase in egg density, which increased from 813,231 eggs/m2 in 2022 to 1,395,411 eggs/m2 in 2023. In Craig, the egg deposition estimate declined from 5.3 trillion to 4.0 trillion eggs, which was attributable to a decrease in spawn zone area (5,836,022 m2 to 4,043,624 m2) despite an increase in egg density, from 817,542 eggs/m2 in 2022 to 887,127 eggs/m2 2023.

Age and Size

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

Samples of the spawning areas 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 2022–2023. Fisheries sampled included Sitka Sound sac-roe, Craig winter bait, and Craig spawn on kelp. Samples were obtained opportunistically from vessels or tenders during, or shortly after, the fishery openings.

The minimum sample goal of 500 aged fish per sampling event (gear-fishery combination) was met or exceeded for most areas/fisheries where samples were obtained but was not achieved for Seymour Canal, Tenakee Inlet, or North Stephen's Passage. Although age and size samples were not obtained for several other traditionally sampled stocks, aerial surveys were completed.

Age Composition

Age composition data were obtained for 7 spawning areas in the region in 2023: Sitka Sound, Craig, Revilla Channel, Seymour Canal, Tenakee Inlet, Northern Stephen's Passage, and Yakutat Bay. Samples were not obtained from Ernest Sound, Hobart Bay-Port Houghton, Hoonah Sound, Lynn Canal, or West Behm Canal due to low levels of observed spawn, or inability to sample due to weather or other circumstances.

Observed age distributions among sampled areas were more variable than in recent years as the dominant 2016 age class has waned and differing recruitment levels were observed among spawning populations in 2023 (Figures 4-6). In some areas the 2016 age class was still very prominent as age-7 in 2023, including Sitka, Craig, Tenakee Inlet, and Northern Stephens Passage. In other areas, the proportion of age-4 herring exceeded age-7 (such as Kah Shakes-Cat Island and Seymour Canal). For several areas, there appears to have been substantial age-3 recruitment, including Sitka, Craig, Kah Shakes-Cat Island, Tenakee Inlet, and Seymour Canal. In some cases, the proportion of age-3 approached or exceeded that of age-7, signifying the decline of the strong 2016 age class, and suggesting another strong year class may be entering the population.

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

Size at Age

Based on cast net samples in 2023, weight at age was generally similar as in 2022 for most sampled spawning areas, although weights in Seymour Canal 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 7-9). 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. Weight at age in 2023 appears to be higher than in 2023 for most stocks and age classes. With the 2023 data, an apparent uptick in weight at age has occurred over the past few years.

To understand whether changes in weight-at-age are due solely to body mass or instead (or also) due to changes in length-at-age, it is helpful to calculate condition factors. Condition factors have been 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 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 declining sharply to 2012. The condition factors calculated for 2023 for stocks where data was available are relatively high, comparable to or exceed those of 2022, and indicate a continued increase over the past few years.

Table 1. Summary of results of herring aerial and spawn deposition surveys in Southeast Alaska and Yakutat for 2023.

Spawning Stock	Number of transects completed	Average length of transects (m)	Observed spawn (nmi)	Area of survey (m^2)	Average egg density (eggs/m^2)	Total eggs in survey area (trillions)	Mean fish weight (g)[d]	Estimated fecundity of fish of mean weight	Estimated number of fish	Post-fishery mature biomass (tons)
Craig	34	74	29.40	4,043,624	887,127	3.986	106.7	21,368	373,060,473	43,878
Sitka Sound (total)	60	248	83.84	12,837,517	1,395,411	19.904	118.2	20,456	1,946,020,845	253,468
Kruzof stratum	20	197	17.80	6,485,982	2,147,453	15.476	–	–	–	–
Eastern stratum	40	51	57.10	5,432,865	675,916	4.080	–	–	–	–
post survey-Kruzof[a]	–	20	0.04	1,458	2,147,453	0.003	–	–	–	–
post survey-Eastern[a]	–	51	9.64	917,212	337,958	0.344	–	–	–	–
Kah Shakes/Cat Is.	–	–	4.60	–	–	–	–	–	–	–
Seymour Canal[b]	–	–	4.60	–	–	–	–	–	–	–
Ernest Sound[b]	–	–	1.90	–	–	–	–	–	–	–
Hobart/Houghton[b]	–	–	1.30	–	–	–	–	–	–	–
Hoonah Sound[b,c]	–	–	0.00	–	–	–	–	–	–	–
Lynn Canal[b]	–	–	0.70	–	–	–	–	–	–	–
Tenakee Inlet[b]	–	–	7.60	–	–	–	–	–	–	–
West Behm Canal[be]	–	–	3.00	–	–	–	–	–	–	–
Yakutat Bay[b]	–	–	4.21	–	–	–	–	–	–	–
Total	94	–	141.15	16,881,141	–	23.890	–	–	2,319,081,317	297,346
Average	47	161	–	8,440,570	1,141,269	11.945	112.4	20,912	–-	–

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

[a] Not surveyed, but for Kruzof post survey spawn 10% of transect length and 100% average egg density from Kruzof Stratum survey were applied to estimate spawn area and egg. deposition, and for Eastern post-survey spawn 100% of transect length and 50% of average egg density from Eastern Stratum survey were applied.

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

[c] Observed spawn nm represents the total unique shoreline with spawn; sum of 84.58 nm includes overlapping spawn between strata or post-survey.

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

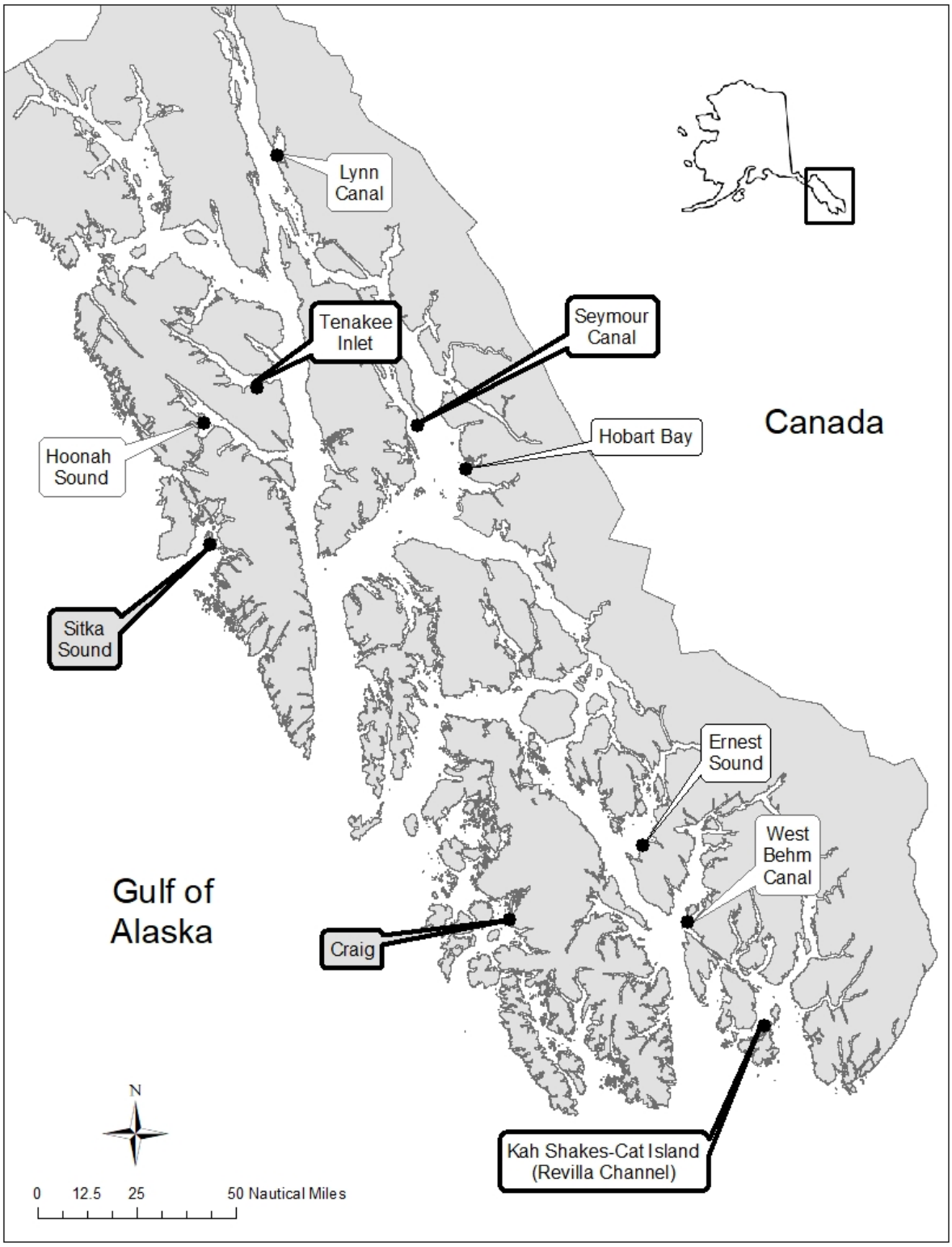


Figure 1. - Locations of monitored traditional herring spawning areas in Southeast Alaska. Labels with shading and bold outline indicate areas where spawn deposition surveys and age-size sampling were conducted during the 2023 spawning season; labels with only bold outline indicate only age-size sampling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

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

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

Figure 2. - Spawn timing of herring stocks in Southeast Alaska during spring 2023. Values indicate daily measurements of nautical miles of active spawn recorded during aerial surveys. Shaded area depicts dates when cast-net samples were taken. Boxed areas indicate duration of spawning (first to last dates of observed spawn). Dates with no survey are depicted by “ns”. Blank dates indicate dates that are outside of historical spawning timing and so surveys had not commenced or were concluded. Dates with "u" signify spawn was reported, but extent of each day is unknown (in Haines approximately 3.5 nm from Battery Point to Mud Bay Point.). In West Behm Canal spawn was reported by public but not confirmed by ADF&G, although eggs were found on beach later.

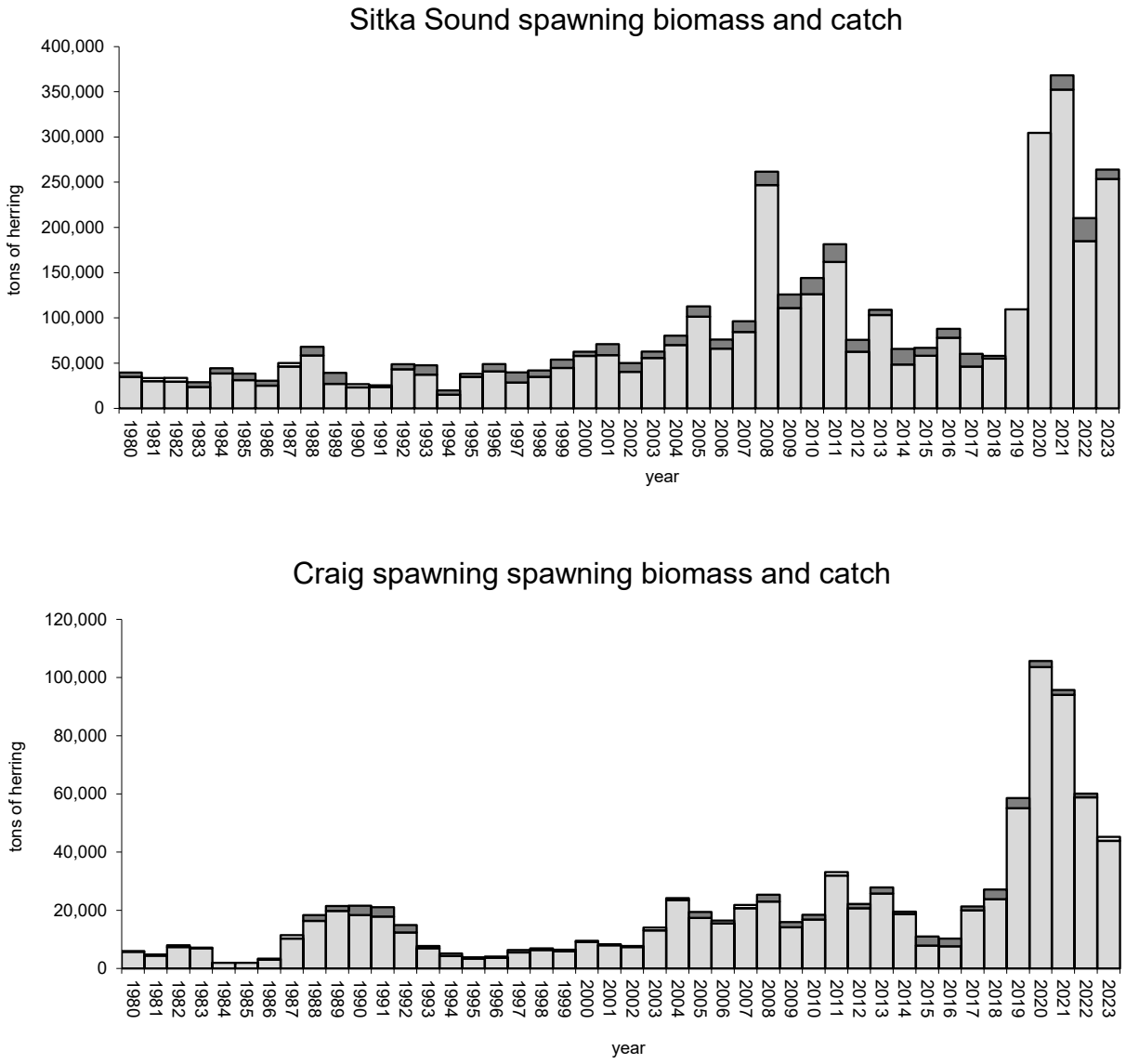


Figure 3. - Observed herring post-fishery spawning biomass (light gray bars), based on spawn deposition surveys, and catch (dark gray bars) for stocks in the Sitka and Craig areas, during 1980–2023.

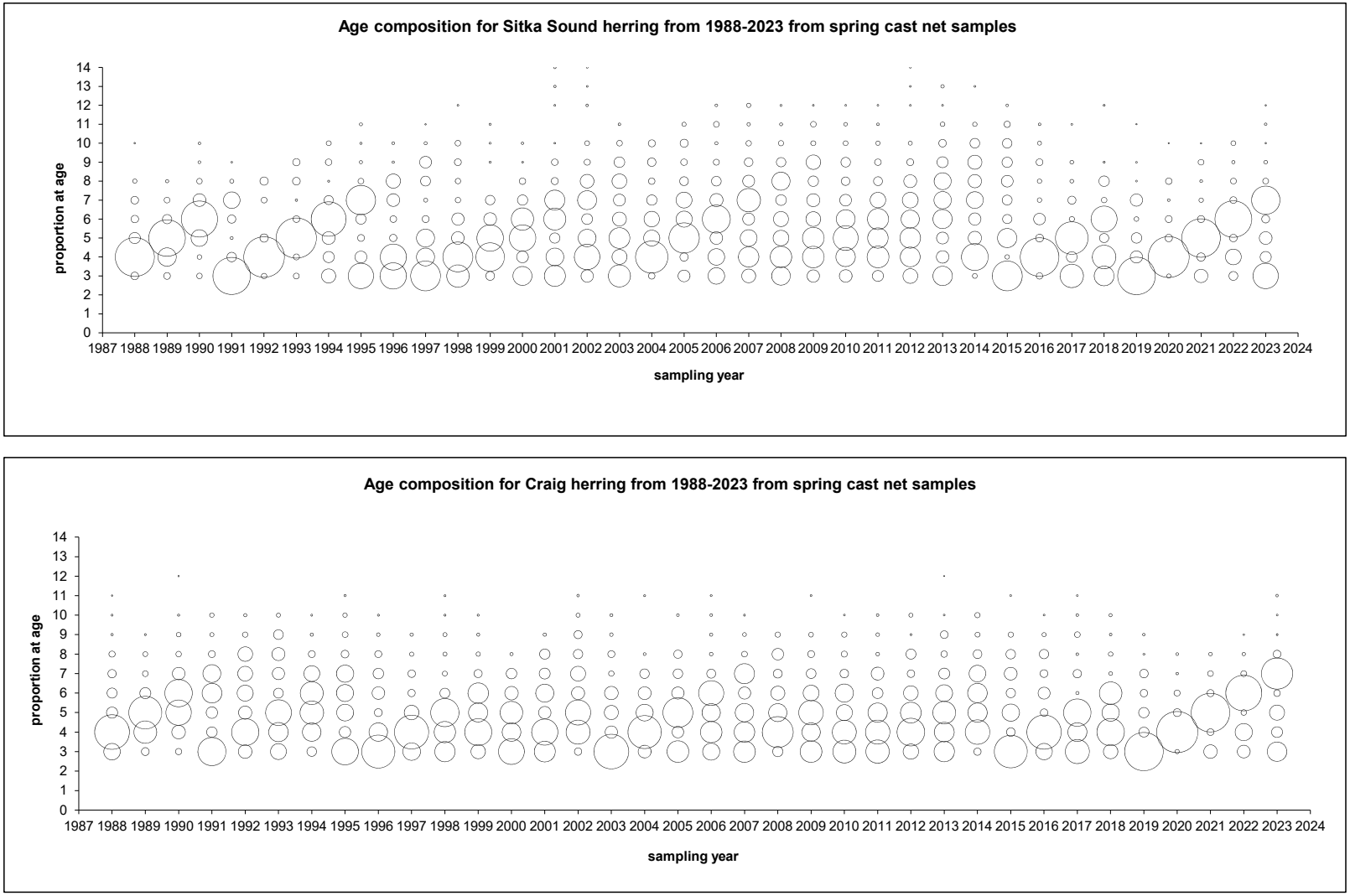


Figure 4. - Observed age compositions from sampling data for the Sitka Sound and Craig herring stocks. Ages presented for 2000 may be biased slightly high due to misinterpretation of scale annuli. For years with blanks, data was either not collected or is not available. For reference, Sitka's largest circle represents 89% and Craig's largest circle represents 93%.

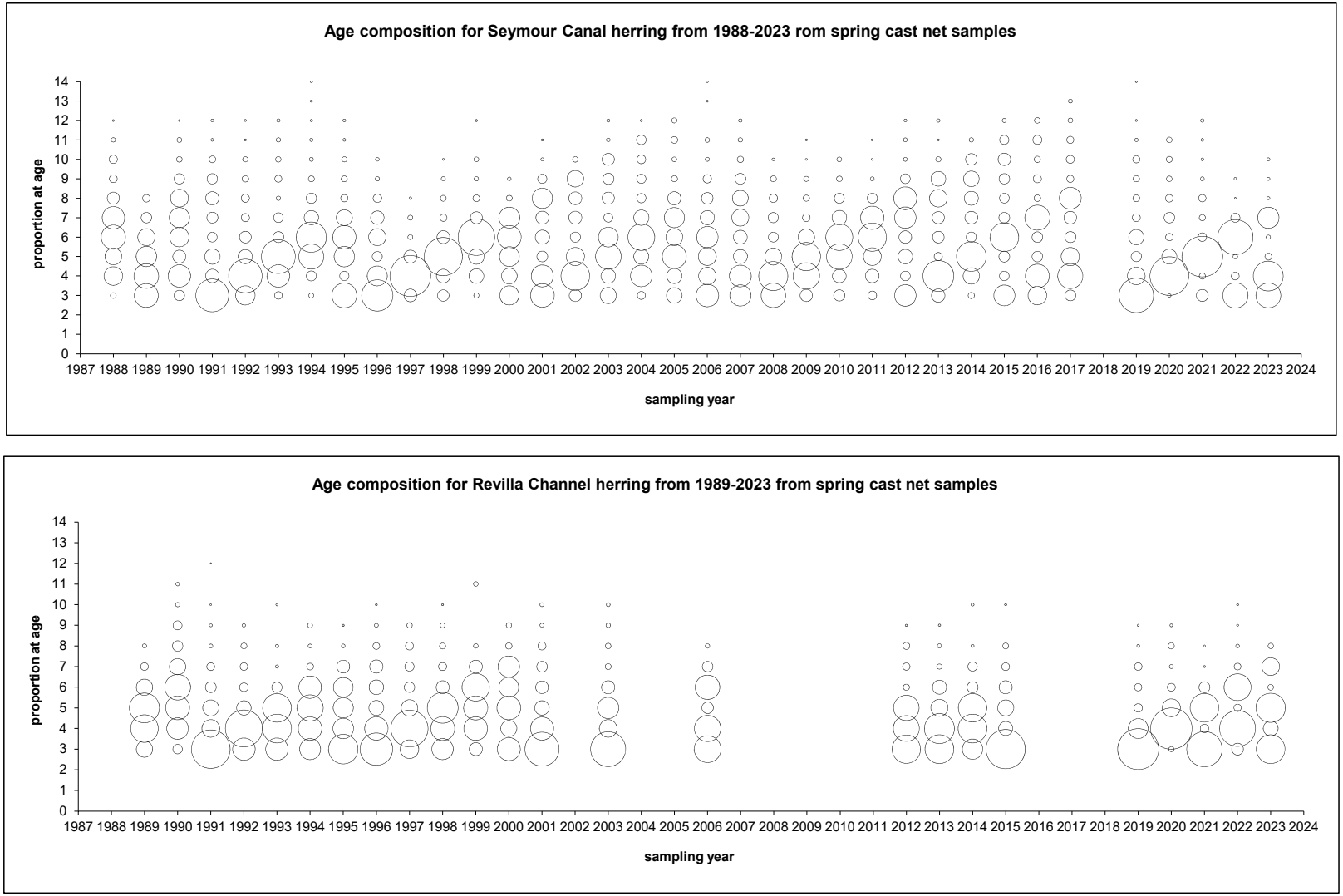


Figure 5. - Observed age compositions from sampling data for the Seymour Canal and Revilla Channel herring stocks. Ages presented for 2000 may be biased slightly high due to misinterpretation of scale annuli. For years with blanks, data was either not collected or is not available. For reference, Seymour Canal's largest circle represents 81% and Revilla Channel's largest circle represents 89%.

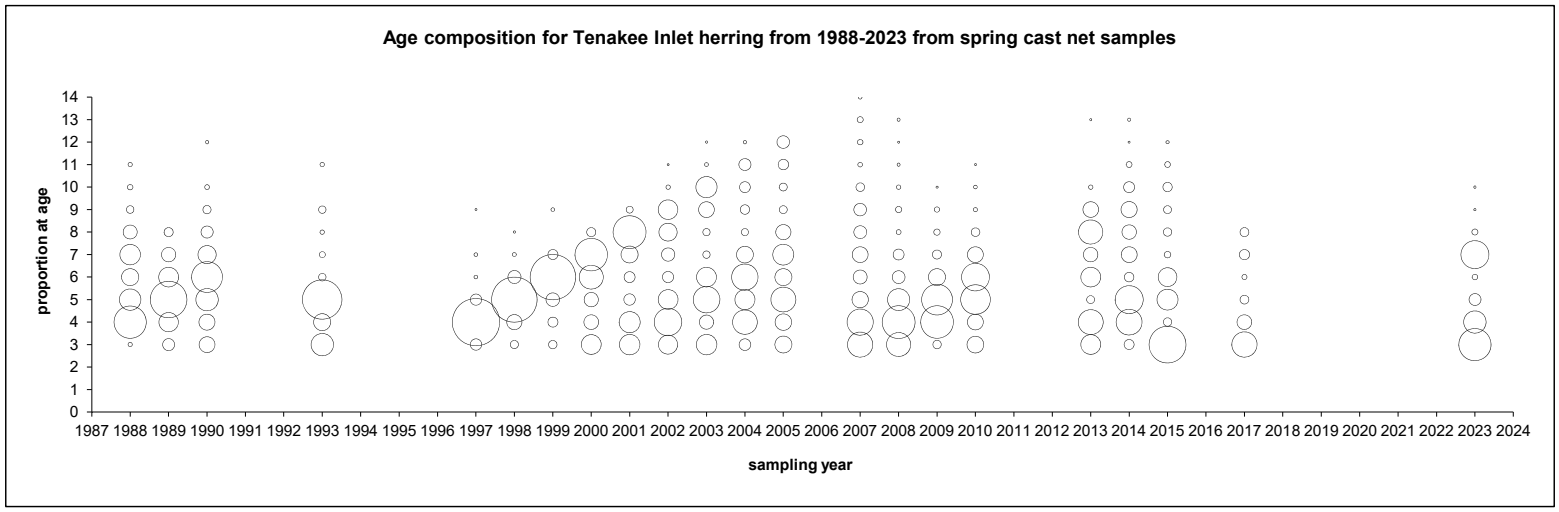


Figure 6. - Observed age compositions from sampling data for the Tenakee Inlet herring stock. Ages presented for 2000 may be biased slightly high due to misinterpretation of scale annuli. For years with blanks, data was either not collected or is not available. For reference, the largest circle represents 88% (1997).

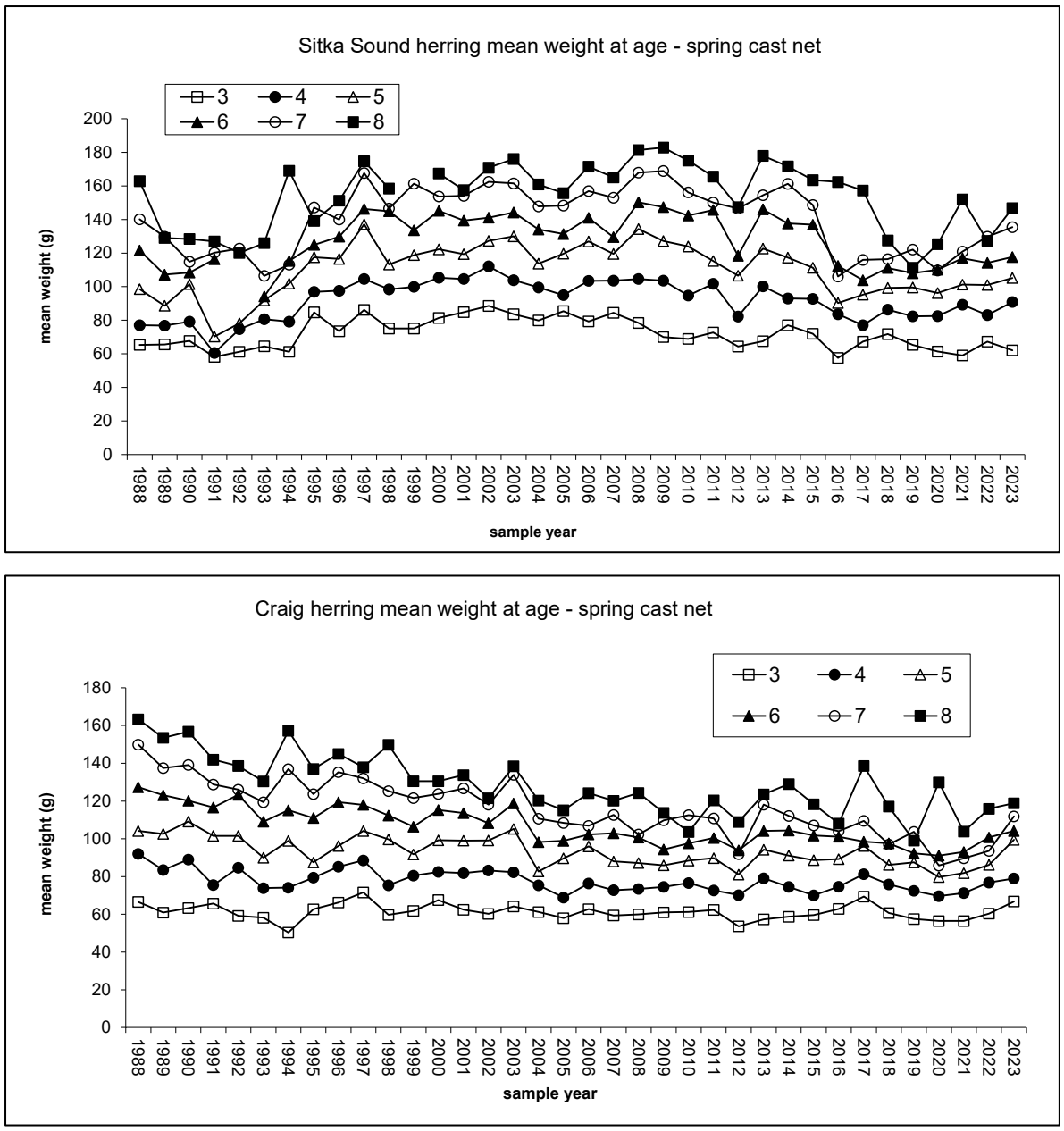
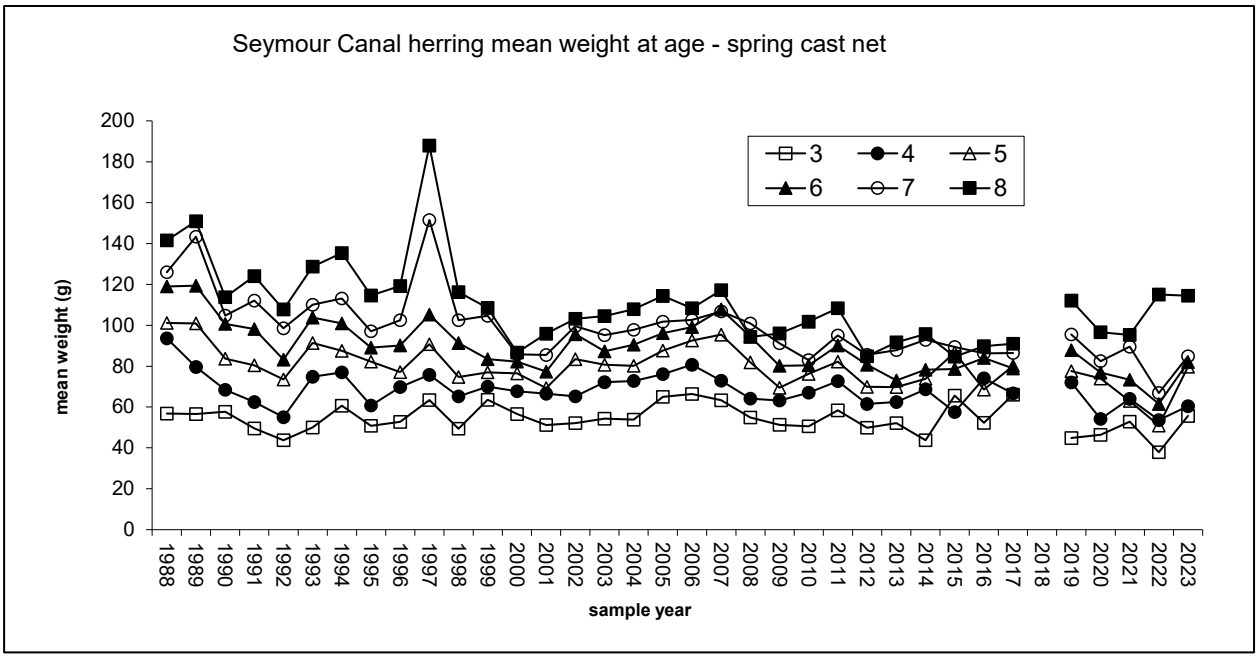


Figure 7. - Mean observed weight-at-age of the Sika and Craig herring spawning populations, from cast net samples. Weights presented for 2000 may be biased slightly high due to misinterpretation of scale annuli.



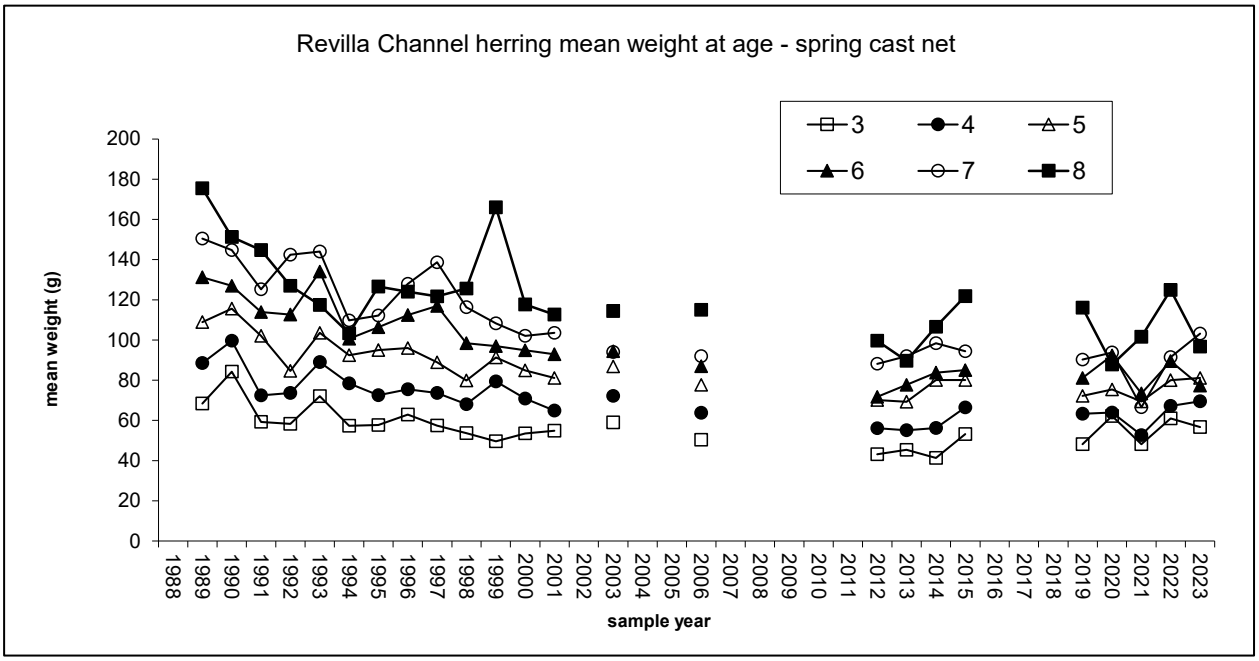


Figure 8.- Mean observed weight-at-age for the Seymour Canal and Revilla Channel herring spawning populations, based on cast net samples. Weights presented for 2000 may be biased slightly high due to misinterpretation of scale annuli. For years with blanks, data was either not collected or is not available.

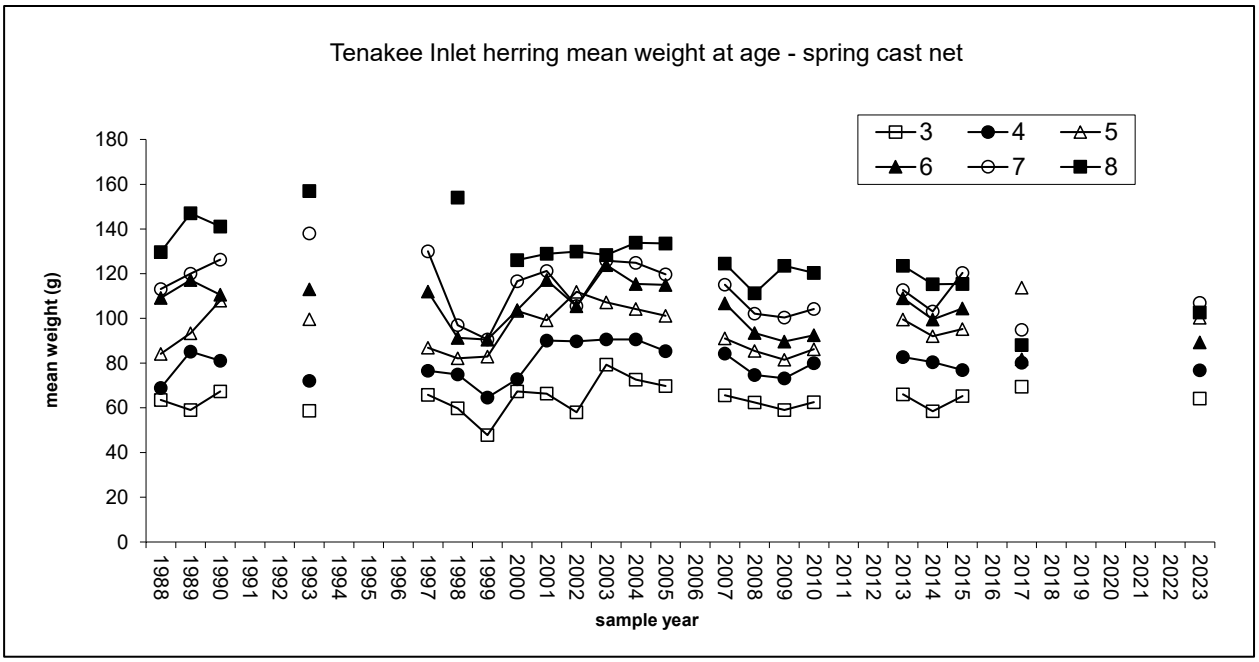


Figure 9.- Mean observed weight-at-age for the Tenakee Inlet herring stock. Weights presented for 2000 may be biased slightly high due to misinterpretation of scale annuli. For years with blanks, data was either not collected or is not available.