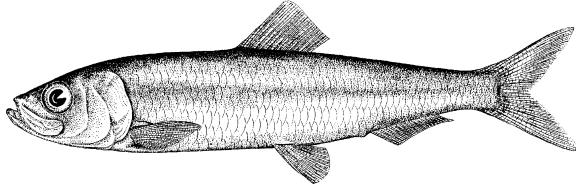


Pacific Herring preliminary data summary for Central Coast 2023

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August 15, 2023



Pacific Herring (*Clupea pallasii*). Image credit: [Fisheries and Oceans Canada](#).

Disclaimer This report contains preliminary data collected for Pacific Herring in 2023 in the Central Coast major stock assessment region (SAR). These data may differ from data used and presented in the final stock assessment.

1 Context

Pacific Herring (*Clupea pallasii*) in British Columbia are assessed as 5 major and 2 minor stock assessment regions (SARs), and data are collected and summarized on this scale (Table 1, Figure 1). The Pacific Herring data collection program includes fishery-dependent and -independent data from 1951 to 2023. This includes annual time series of commercial catch data, biological samples (providing information on proportion-at-age and weight-at-age), and spawn index data conducted using a combination of surface and SCUBA surveys. In some areas, industry- and/or First Nations-operated in-season soundings programs are also conducted, and this information is used by resource managers, First Nations, and stakeholders to locate fish and identify areas of high and

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low Pacific Herring biomass to plan harvesting activities. In-season acoustic soundings are not used by stock assessment to inform the estimation of spawning biomass.

The following is a description of data collected for Pacific Herring in 2023 in the Central Coast major SAR (Figure 2). Data collected outside the SAR boundary are not included in this summary, and are not used for the purposes of stock assessment. Although we summarise data at the scale of the SAR for stock assessments, we summarise data at finer spatial scales in this report: Locations are nested within Sections, Sections are nested within Statistical Areas, and Statistical Areas are nested within SARs (Table 2). For the Central Coast major SAR, we use another level of spatial aggregation which we refer to as a ‘Group’. Note that we refer to ‘year’ instead of ‘herring season’ in this report; therefore 2023 refers to the 2022/2023 Pacific Herring season.

2 Data collection programs

The data collection program in the Central Coast reflected a number of collaborations between DFO, the Heiltsuk Nation, and the Herring Industry. Biological samples were collected by the seine test charter vessel *Ocean Venture* for 20 days from March 10th to March 30th. The primary purpose of the test charter vessel was to collect biological samples from main bodies of herring in Statistical Areas 06, 07, and 08, identified from soundings. Heiltsuk and Kitasoo Nations collected nearshore cast net herring samples again this season. Herring spawn locations were primarily identified with fixed-wing overflights. Five spawn flights were conducted this season from the end of March to mid-April. Additional spawn reconnaissance for Area 08 was conducted by the Wuikinuxv Fisheries Program.

Two dive charter vessels operated in the CC:

- *The Pachena No. 1* surveyed 21 days from April 4th to April 24th, and
- *The Ocean Cloud* surveyed 12 days from April 7th to April 18th.

2.1 Biological samples in Statistical Area 08

In the Central Coast major SAR, Pacific Herring in Statistical Area (SA) 08 tend to be smaller than fish in other areas. In addition, fewer biological samples are typically collected from SA 08 compared to the other areas. For example, between 1994 and 2013, on average ~ 7% of biological samples came from SA 08. In 2014 and 2015, additional resources were available to collect biological samples in SA 08, which consequently received more sampling effort than previous years, compared to the other areas. In order to avoid using non-representative biological data in the Central Coast stock assessment model, biological samples from SA 08 in 2014 and 2015 are weighted by the average historic proportion of samples in that area (i.e., ~ 7%). Biological data presented in this report (e.g., proportion-at-age, weight-at-age) reflect these weights, and are considered to be representative of the Central Coast major SAR.

3 Catch and biological samples

In the 1950s and 1960s, the reduction fishery dominated Pacific Herring catch; starting in the 1970s, catch has been predominantly from roe seine and gillnet fisheries. The reduction fishery is different from current fisheries in several ways. First, the reduction fishery caught Pacific Herring of all ages, whereas current fisheries target spawning (i.e., mature) fish. Thus, reduction fisheries included an unknown number of age-1 fish which are not typically caught in current fisheries. Second, the reduction fishery has some uncertainty regarding the quantity and location of catch; however catches have been resolved to SAR and Statistical Area using fish slips as best as possible. For the roe gillnet fishery, all Pacific Herring catch has been validated by a dockside monitoring program since 1998; the catch validation program started in 1999 for the roe seine fishery. Finally, the reduction fishery operated during the summer and winter months, whereas roe fisheries typically target spawning fish between February and April.

Landed commercial catch of Pacific Herring by year and fishery is shown in Table 3 and Figure 3. Total harvested spawn-on-kelp (SOK) in 2023 in the Central Coast major SAR is shown in Table 4; we also calculate the estimated spawning biomass associated with SOK harvest. See the [draft spawn index technical report](#) for calculations to convert SOK harvest to spawning biomass.

In 2023, 18 Pacific Herring biological samples were collected and processed for the Central Coast major SAR (Table 5, Table 6). Differences between biological data collected from two sampling protocols regarding the number-, proportion-, weight-, and length-at-age for Pacific Herring in 2023 in the Central Coast major SAR are shown in Table 7, Table 8, Table 9, and Table 10, respectively. The nearshore sampling program is a multi-year pilot study (using cast nets), therefore only biological data from the seine samples were used for the purposes of stock assessment. Summaries of data collected by the nearshore sampling program are shown in Table 11, Table 12, Table 13, and Table 14. In addition, Figure 9 and Figure 10 show differences in length-at-age between the two sampling protocols, and differences by Statistical Area, respectively. The locations in which the biological samples were collected are presented in Figure 4. Included herein are biological summaries of observed proportion-, number-, weight-, and length-at-age (Figure 5, Table 15, and Figure 6, respectively). We also show the percent change in weight and length for age-3 and age-6 fish (Figure 7 & Figure 8, respectively). Some Statistical Areas tend to have larger fish at a given age (Figure 11, Table 16). Biological summaries only include samples collected using seine nets (commercial and test) due to size-selectivity of other gear types such as gillnet. Only representative biological samples are included, where ‘representative’ indicates whether the Pacific Herring sample in the set accurately reflects the larger Pacific Herring school.

4 Spawn survey data

Pacific Herring spawn surveys were conducted at 43 individual locations in 2023 in the Central Coast major SAR (Table 17, and Figure 12). A summary of spawn from the last decade (2013 to 2022) is shown in Figure 13. Figure 14 shows spawn start date

by decade and Statistical Area. Spawn surveys are conducted to estimate the spawn length, width, number of egg layers, and substrate type, and these data are used to estimate the index of spawning biomass (i.e., the spawn index; Figure 15, Figure 16, Figure 17, Figure 18, Table 18, and Figure 19). See the [draft spawn index technical report](#) for calculations to convert SOK harvest to spawning biomass. In addition, spawn surveys estimate spawn depth by Statistical Area, and Section (Figure 20). The ‘spawn index’ is not scaled by the spawn survey scaling parameter, q . Therefore, these data do not represent model estimates of spawning biomass, and are considered the minimum observed spawning biomass derived from egg counts. The spawn index has two distinct periods defined by the dominant coastwide survey method: surface surveys (1951 to 1987), and dive surveys (1988 to 2023).

Some Pacific Herring Sections contribute more than others to the total spawn index, and the percentage contributed by Section varies yearly (Figure 18b, Figure 21). For example, in 2023, Section 072 contributed the most to the spawn index (53%). As with Sections, some Statistical Areas contribute more than others to the total spawn index (Figure 18c, Figure 22). An animation shows the spawn index by spawn survey location from 1951 to 2023 (Figure 23).

5 General observations

General observations provide context to the data summary report. The following observations were reported by area DFO Resource Management staff and DFO Science staff:

- Consistently cold sea surface temperature was noted throughout CC in 2023.
- Weather conditions were generally favorable for spawn reconnaissance flights.
- First spawn was reported on March 28th in Area 7.
- In general, the spawn in the CC was sporadic.
- A lack of marine wildlife was reported throughout the season, and fish were holding deep longer into the season.

6 Tables

Table 1. Pacific Herring stock assessment regions (SARs) in British Columbia.

Name	Code	Type
Haida Gwaii	HG	Major
Prince Rupert District	PRD	Major
Central Coast	CC	Major
Strait of Georgia	SoG	Major
West Coast of Vancouver Island	WCVI	Major
Area 27	A27	Minor
Area 2 West	A2W	Minor

Table 2. Statistical Areas, Sections, and Groups for Pacific Herring in the Central Coast major stock assessment region (SAR). Legend: ‘06&07’ is Statistical Areas 06 and 07; and ‘08’ is Statistical Area 08.

Region	Statistical Area	Section	Group
Central Coast	06	067	06&07
Central Coast	07	070	06&07
Central Coast	07	071	06&07
Central Coast	07	072	06&07
Central Coast	07	073	06&07
Central Coast	07	074	06&07
Central Coast	07	075	06&07
Central Coast	07	076	06&07
Central Coast	07	077	06&07
Central Coast	07	078	06&07
Central Coast	07	079	06&07
Central Coast	08	085	8
Central Coast	08	086	8

Table 3. Total landed commercial catch of Pacific Herring in metric tonnes (t) by gear type in 2023 in the Central Coast major stock assessment region (SAR). Legend: ‘Other’ represents the reduction (1951 to 1970 only), the food and bait, as well as the special use fishery; ‘RoeSN’ represents the roe seine fishery; and ‘RoeGN’ represents the roe gillnet fishery. Data from the spawn-on-kelp (SOK) fishery are not included. Note: data may be withheld due to privacy concerns (WP).

Gear	Catch (t)
Other	0
RoeSN	0
RoeGN	0

Table 4. Total harvested Pacific Herring spawn-on-kelp (SOK) in pounds (lb), and the associated estimate of spawning biomass in metric tonnes (t) from 2013 to 2023 in the Central Coast major stock assessment region (SAR). See the [draft spawn index technical report](#) for calculations to convert SOK harvest to spawning biomass. Harvest does not include the 2,411 lbs of spawn on egregia in 2018. Note: data may be withheld due to privacy concerns (WP).

Year	Harvest (lb)	Spawning biomass (t)
2013	0	0
2014	239,861	355
2015	169,470	251
2016	351,953	521
2017	392,747	582
2018	289,358	429
2019	356,042	528
2020	44,857	66
2021	294,269	436
2022	0	0
2023	42,022	62

Table 5. Number of Pacific Herring biological samples processed from 2013 to 2023 in the Central Coast major stock assessment region (SAR). Each sample is approximately 100 fish. Note: Nearshore samples are not used in stock assessments.

Year	Number of samples			
	Commercial	Test	Nearshore	Total
2013	0	15	0	15
2014	14	12	0	26
2015	6	14	0	20
2016	5	15	0	20
2017	4	13	27	44
2018	4	12	18	34
2019	2	10	28	40
2020	0	12	5	17
2021	2	13	14	29
2022	0	14	15	29
2023	2	11	5	18

Table 6. Number and type of Pacific Herring biological samples processed in 2023 in the Central Coast major stock assessment region (SAR). Each sample is approximately 100 fish.

Type	Gear	Use	Number of samples
Commercial	Seine	SOK	2
Test	Other	Nearshore	5
Test	Seine	Test fishery	11

Table 7. Observed number-at-age of Pacific Herring by sample type in 2023 in the Central Coast major stock assessment region (SAR). The age-10 class is a ‘plus group’ which includes fish ages 10 and older. Legend: ‘Nearshore’ refers to samples collected using cast nets as part of a pilot study with First Nations.

Sample type	Number-at-age									
	2	3	4	5	6	7	8	9	10	
Nearshore	12	238	63	48	15	81	15	1	1	
Seine test	33	641	119	107	21	59	13	3	0	
Total	45	879	182	155	36	140	28	4	1	

Table 8. Observed proportion-at-age of Pacific Herring by sample type in 2023 in the Central Coast major stock assessment region (SAR). The age-10 class is a ‘plus group’ which includes fish ages 10 and older. Legend: ‘Nearshore’ refers to samples collected using cast nets as part of a pilot study with First Nations.

Sample type	Proportion-at-age									
	2	3	4	5	6	7	8	9	10	
Nearshore	0.025	0.502	0.133	0.101	0.032	0.171	0.032	0.002	0.002	
Seine test	0.033	0.644	0.119	0.107	0.021	0.059	0.013	0.003	0.000	
Total	0.031	0.598	0.124	0.105	0.024	0.095	0.019	0.003	0.001	

Table 9. Observed mean weight-at-age in grams (g) of Pacific Herring by sample type in 2023 in the Central Coast major stock assessment region (SAR). The age-10 class is a ‘plus group’ which includes fish ages 10 and older. Legend: ‘Nearshore’ refers to samples collected using cast nets as part of a pilot study with First Nations.

Sample type	Mean weight-at-age (g)									
	2	3	4	5	6	7	8	9	10	
Nearshore	43	64	74	85	99	104	109	111	107	
Seine test	44	70	77	90	102	118	122	111	NA	
Total	44	68	76	88	101	110	115	111	107	

Table 10. Observed mean length-at-age in millimetres (mm) of Pacific Herring by sample type in 2023 in the Central Coast major stock assessment region (SAR). The age-10 class is a ‘plus group’ which includes fish ages 10 and older. Legend: ‘Nearshore’ refers to samples collected using cast nets as part of a pilot study with First Nations.

Sample type	Mean length-at-age (mm)									
	2	3	4	5	6	7	8	9	10	
Nearshore	145	162	170	178	186	190	191	201	194	
Seine test	142	162	166	174	181	191	192	187	NA	
Total	143	162	167	175	183	190	191	190	194	

Table 11. Observed number-at-age of Pacific Herring for nearshore samples from 2017 to 2023 in the Central Coast major stock assessment region (SAR). The age-10 class is a ‘plus group’ which includes fish ages 10 and older. Legend: ‘Nearshore’ refers to samples collected using cast nets as part of a pilot study with First Nations.

Year	Number-at-age									
	2	3	4	5	6	7	8	9	10	
2017	97	279	208	1111	174	454	85	74	18	
2018	24	328	252	231	521	135	87	33	10	
2019	15	1543	605	133	129	100	26	7	3	
2020	31	10	301	66	29	23	4	4	1	
2021	9	226	51	833	134	28	20	8	1	
2022	51	177	308	43	527	68	19	6	3	
2023	12	238	63	48	15	81	15	1	1	

Table 12. Observed proportion-at-age of Pacific Herring for nearshore samples from 2017 to 2023 in the Central Coast major stock assessment region (SAR). The age-10 class is a ‘plus group’ which includes fish ages 10 and older. Legend: ‘Nearshore’ refers to samples collected using cast nets as part of a pilot study with First Nations.

Year	Proportion-at-age									
	2	3	4	5	6	7	8	9	10	
2017	0.039	0.112	0.083	0.444	0.070	0.182	0.034	0.030	0.007	
2018	0.015	0.202	0.155	0.143	0.321	0.083	0.054	0.020	0.006	
2019	0.006	0.602	0.236	0.052	0.050	0.039	0.010	0.003	0.001	
2020	0.066	0.021	0.642	0.141	0.062	0.049	0.009	0.009	0.002	
2021	0.007	0.173	0.039	0.636	0.102	0.021	0.015	0.006	0.001	
2022	0.042	0.147	0.256	0.036	0.438	0.057	0.016	0.005	0.002	
2023	0.025	0.502	0.133	0.101	0.032	0.171	0.032	0.002	0.002	

Table 13. Observed mean weight-at-age in grams (g) of Pacific Herring for nearshore samples from 2017 to 2023 in the Central Coast major stock assessment region (SAR). The age-10 class is a ‘plus group’ which includes fish ages 10 and older. Legend: ‘Nearshore’ refers to samples collected using cast nets as part of a pilot study with First Nations.

Year	Mean weight-at-age (g)									
	2	3	4	5	6	7	8	9	10	
2017	49	69	83	93	98	115	116	120	128	
2018	48	68	78	94	96	104	107	107	109	
2019	52	61	67	84	97	103	102	119	114	
2020	34	59	73	78	89	88	102	89	93	
2021	38	58	74	82	91	94	103	120	104	
2022	46	60	72	92	94	103	108	121	108	
2023	43	64	74	85	99	104	109	111	107	

Table 14. Observed mean length-at-age in millimetres (mm) of Pacific Herring for nearshore samples from 2017 to 2023 in the Central Coast major stock assessment region (SAR). The age-10 class is a ‘plus group’ which includes fish ages 10 and older. Legend: ‘Nearshore’ refers to samples collected using cast nets as part of a pilot study with First Nations.

Year	Mean length-at-age (mm)									
	2	3	4	5	6	7	8	9	10	
2017	158	175	187	193	198	207	208	209	213	
2018	154	172	178	191	193	199	201	204	200	
2019	153	162	167	180	190	195	196	200	206	
2020	136	162	173	178	186	184	193	187	194	
2021	141	161	175	180	185	192	196	200	195	
2022	150	164	176	190	193	198	201	210	203	
2023	145	162	170	178	186	190	191	201	194	

Table 15. Observed proportion-at-age for Pacific Herring from 2013 to 2023 in the Central Coast major stock assessment region (SAR). The age-10 class is a ‘plus group’ which includes fish ages 10 and older.

Year	Proportion-at-age									
	2	3	4	5	6	7	8	9	10	
2013	0.026	0.480	0.129	0.243	0.056	0.057	0.004	0.003	0.001	
2014	0.095	0.146	0.467	0.089	0.141	0.028	0.029	0.004	0.000	
2015	0.008	0.454	0.156	0.249	0.055	0.064	0.009	0.004	0.001	
2016	0.040	0.091	0.549	0.094	0.146	0.028	0.039	0.011	0.003	
2017	0.029	0.170	0.132	0.446	0.089	0.092	0.024	0.012	0.007	
2018	0.090	0.168	0.174	0.147	0.295	0.066	0.041	0.014	0.005	
2019	0.012	0.616	0.178	0.053	0.053	0.059	0.024	0.002	0.002	
2020	0.028	0.028	0.739	0.101	0.045	0.029	0.021	0.007	0.002	
2021	0.012	0.295	0.031	0.521	0.085	0.033	0.015	0.007	0.001	
2022	0.105	0.163	0.376	0.045	0.243	0.047	0.013	0.006	0.002	
2023	0.030	0.614	0.118	0.104	0.027	0.089	0.014	0.003	0.000	

Table 16. Sample size for Pacific Herring weight-at-age analysis in 2023 in the Central Coast major stock assessment region (SAR) by Group from the most recent decade (2014 to 2023), and the previous decade (2004 to 2013), as displayed in Figure 11. Biological summaries only include samples collected using seine nets (commercial and test) due to size-selectivity of other gear types such as gillnet. The age-10 class is a ‘plus group’ which includes fish ages 10 and older. Legend: ‘06&07’ is Statistical Areas 06 and 07; and ‘08’ is Statistical Area 08.

Group	Age	Sample size	
		Previous decade	Recent decade
06&07	2	721	444
06&07	3	7,977	2,653
06&07	4	10,114	3,106
06&07	5	5,478	2,290
06&07	6	2,729	1,359
06&07	7	952	610
06&07	8	408	262
06&07	9	216	83
06&07	10	88	28
8	2	168	189
8	3	866	914
8	4	944	712
8	5	314	256
8	6	143	185
8	7	56	77
8	8	22	27
8	9	6	11
8	10	4	3

Table 17. Pacific Herring spawn survey locations, start date, and spawn index in metric tonnes (t) in 2023 in the Central Coast major stock assessment region (SAR). The ‘spawn index’ is not scaled by the spawn survey scaling parameter, q . Missing spawn index values indicate incomplete surveys (NAs).

Statistical Area	Section	Location name	Start date	Spawn index (t)
06	067	Kwakwa Cr	April 07	361
06	067	Marvin Is	March 28	133
06	067	Osment Inlt	March 28	638
06	067	Parsons Anch	March 30	993
06	067	Thistle Psg	March 30	5
06	067	Wilby Pt	March 30	475
06	067	Wingate Pt	April 07	64
06	067	Woodcock Is	April 04	3
07	072	Balagny Pass	April 03	672
07	072	Berry Inlt	March 30	645
07	072	Bird Pt	April 02	17
07	072	Blair Inlt	April 03	11
07	072	Branks It	April 03	326
07	072	Bullen Rk	April 01	176
07	072	Bush Pt	March 30	1,426
07	072	Cameron Pt	March 30	47
07	072	Fisher Pt	March 30	238
07	072	Foote Islets	April 01	108
07	072	Ivory Is	March 30	1,189
07	072	Mouat Cv	March 30	213
07	072	Port Blackney	April 02	115
07	072	Powell Anch	March 30	916
07	072	Reid Pass	April 02	488
07	072	Shingle Rk	April 01	592
07	072	Spiller Chnl	April 01	286
07	072	Tankeeah River	April 01	507
07	072	Watch Is	April 03	1,306
07	073	Troup Nrws	April 05	2
07	074	Cape Swaine	April 01	308
07	074	Dundivan Inlt	April 01	151
07	074	Houghton Is	April 01	17
07	074	Idol Pt	April 01	1,189
07	074	Kimlock Pt	April 01	52
07	074	McGown Pt	April 04	91
07	074	Princess Alice Is	April 01	305
07	074	Rait Nrws	April 01	98
07	076	Leckie Bay	March 30	13
07	077	Dallas Is	April 04	92

Table 17 continued

Statistical Area	Section	Location name	Start date	Spawn index (t)
07	077	E Higgins Pass	April 04	1,691
07	078	Mathieson Chnl	April 15	163
08	085	Kwakume Pt	April 05	231
08	085	Pruth Bay	April 05	441
08	086	Tomahawk Is	April 12	754

Table 18. Summary of Pacific Herring spawn survey data from 2013 to 2023 in the Central Coast major stock assessment region (SAR). The spawn index has two distinct periods defined by the dominant coastwide survey method: surface surveys (1951 to 1987), and dive surveys (1988 to 2023). The ‘spawn index’ is not scaled by the spawn survey scaling parameter, q . Units: metres (m), and metric tonnes (t).

Year	Total length (m)	Mean width (m)	Mean number of egg layers	Spawn index (t)
2013	158,205	34	0.9	20,369
2014	160,450	38	0.7	13,309
2015	167,060	39	1.3	32,146
2016	164,575	40	1.6	32,508
2017	125,525	39	1.5	23,517
2018	98,149	25	1.1	12,264
2019	181,750	38	1.8	46,255
2020	160,625	39	2.0	42,713
2021	128,625	41	1.5	28,674
2022	153,675	43	1.3	22,711
2023	117,250	46	1.4	17,551

7 Figures

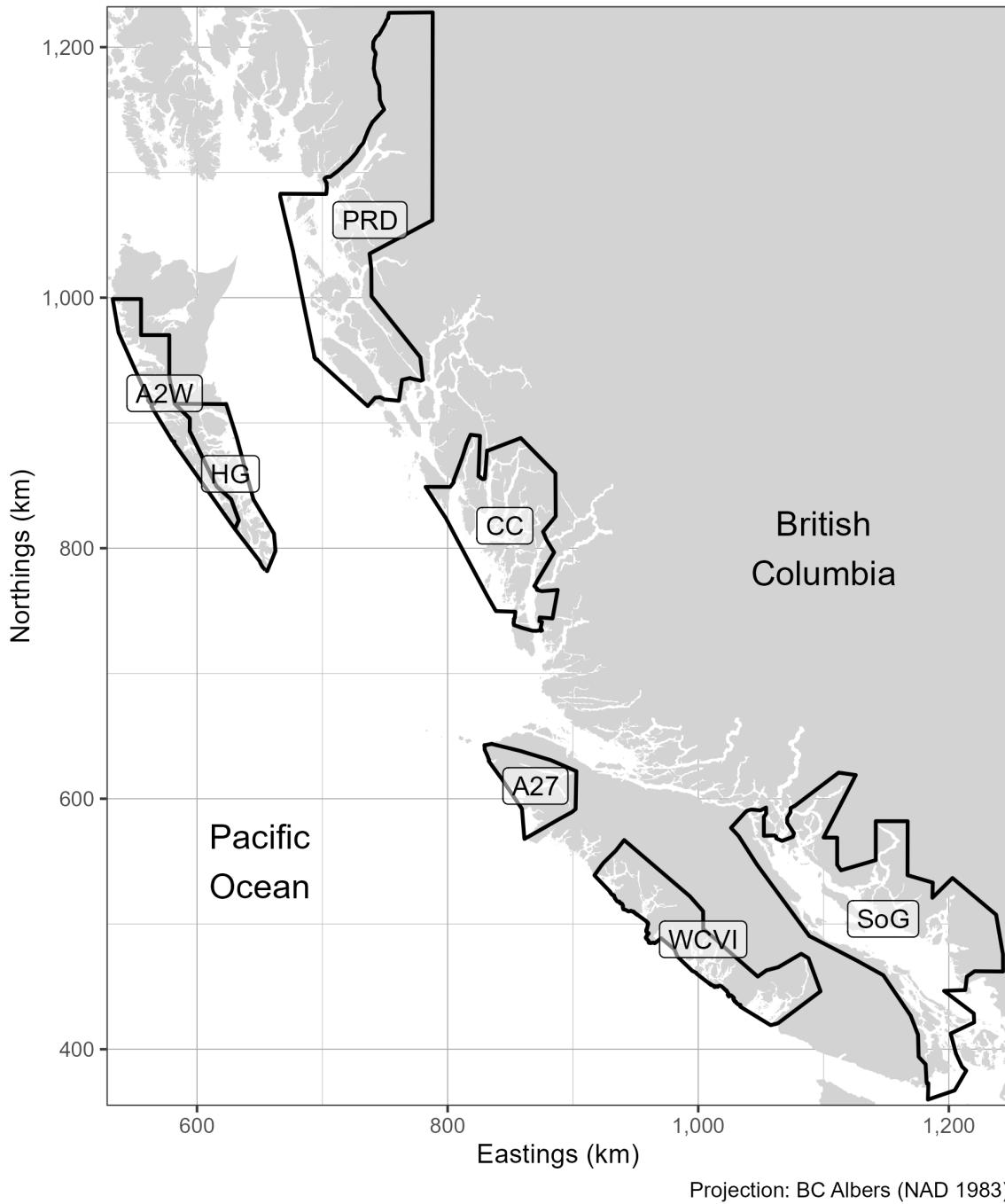


Figure 1. Boundaries for the Pacific Herring stock assessment regions (SARs) in British Columbia. There are 5 major SARs: Haida Gwaii (HG), Prince Rupert District (PRD), Central Coast (CC), Strait of Georgia (SoG), and West Coast of Vancouver Island (WCVI). There are 2 minor SARs: Area 27 (A27) and Area 2 West (A2W). Units: kilometres (km).

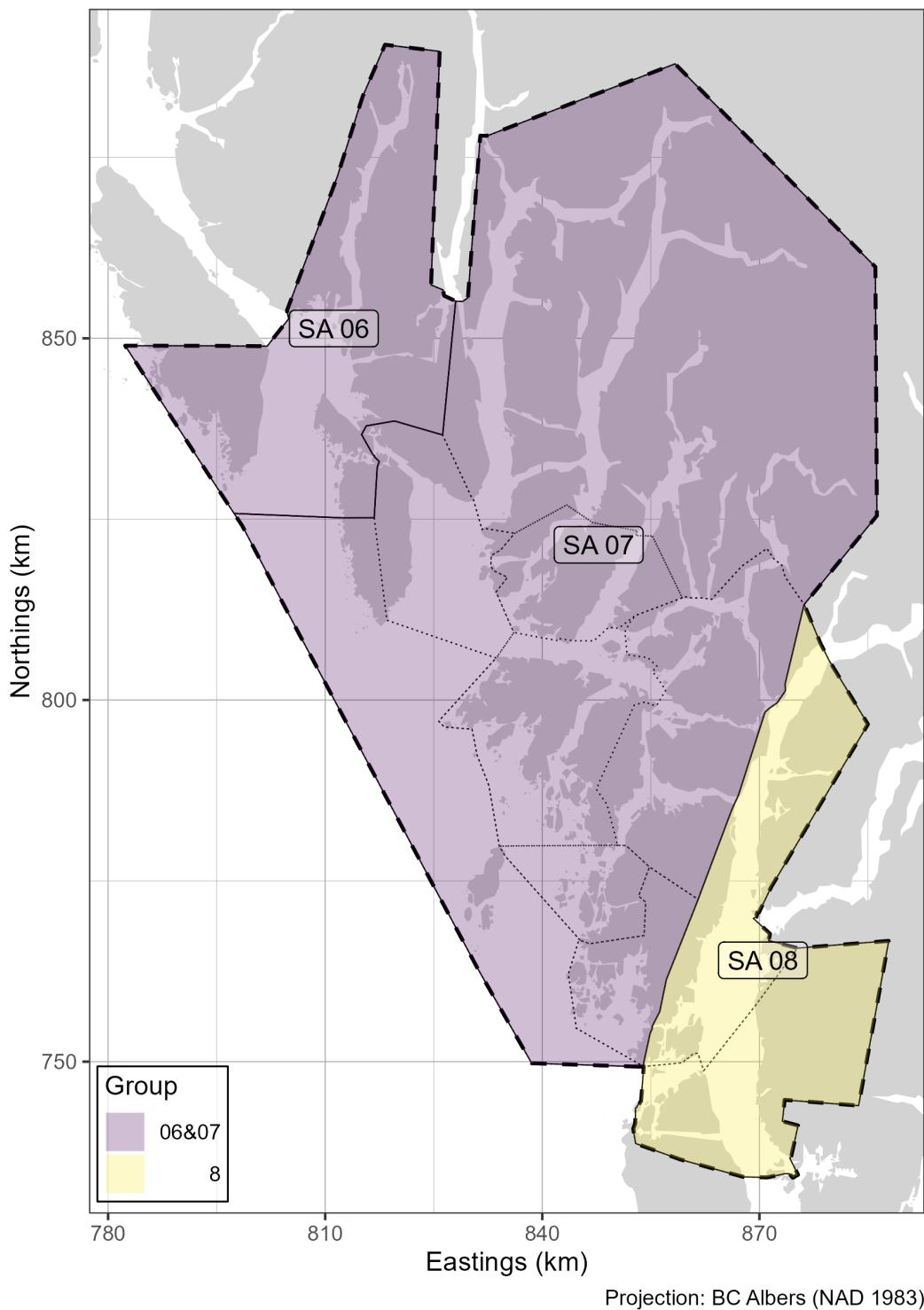


Figure 2. Boundaries for the Central Coast major stock assessment region (SAR; thick dashed lines), associated Statistical Areas (SA; thin solid lines), and associated Sections (thin dotted lines). Units: kilometres (km). Legend: '06&07' is Statistical Areas 06 and 07; and '08' is Statistical Area 08.

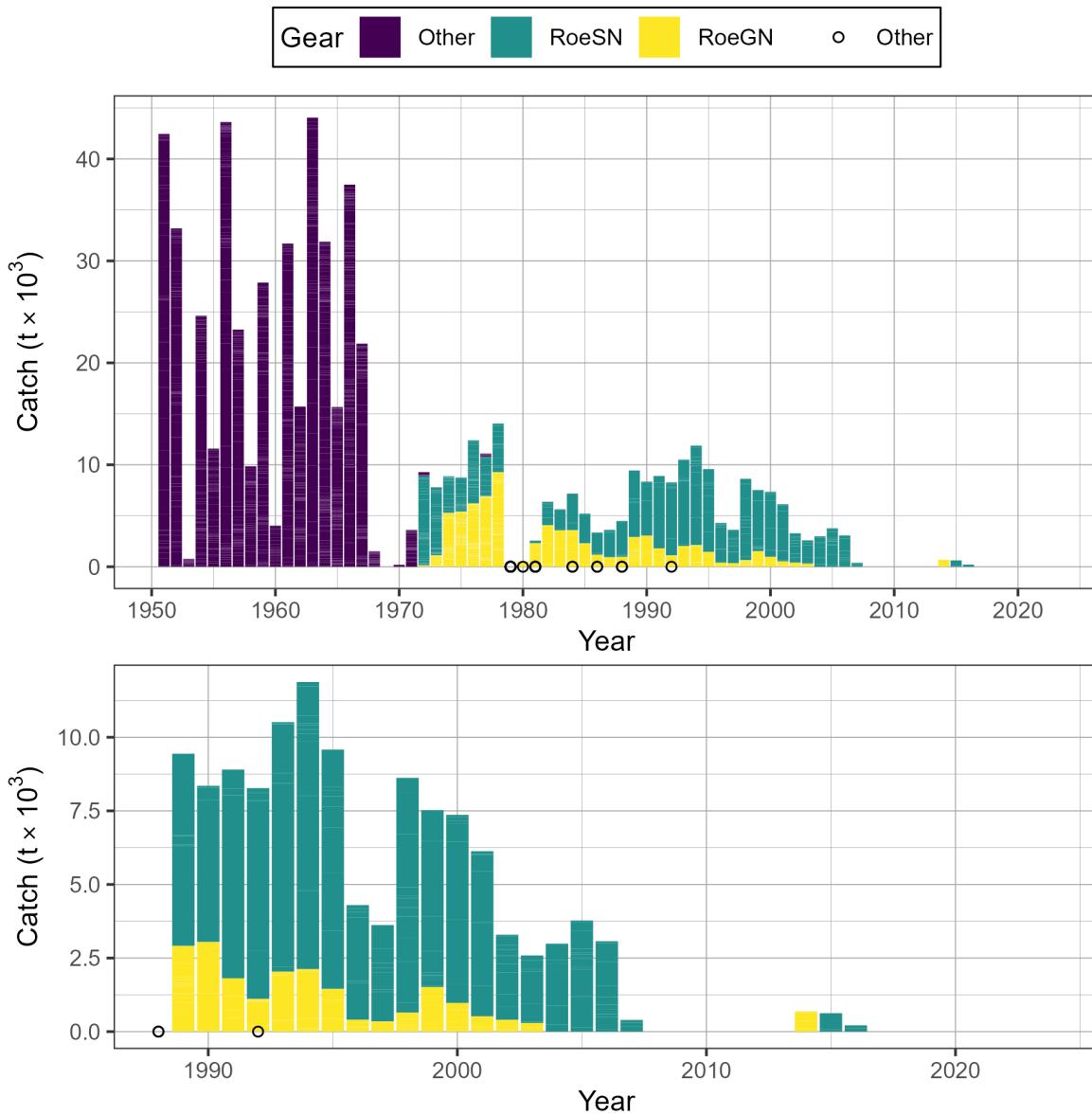


Figure 3. Time series of total landed catch in thousands of metric tonnes ($t \times 10^3$) of Pacific Herring by gear type from 1951 to 2023 in the Central Coast major stock assessment region (SAR). Legend: ‘Other’ represents the reduction (1951 to 1970 only), the food and bait, as well as the special use fishery; ‘RoeSN’ represents the roe seine fishery; and ‘RoeGN’ represents the roe gillnet fishery. Data from the spawn-on-kelp (SOK) fishery are not included. Bottom panel shows catch since 1988 in more detail. Note: symbols indicate years in which catch by gear type (i.e., Other, RoeSN, RoeGN) is withheld due to privacy concerns.

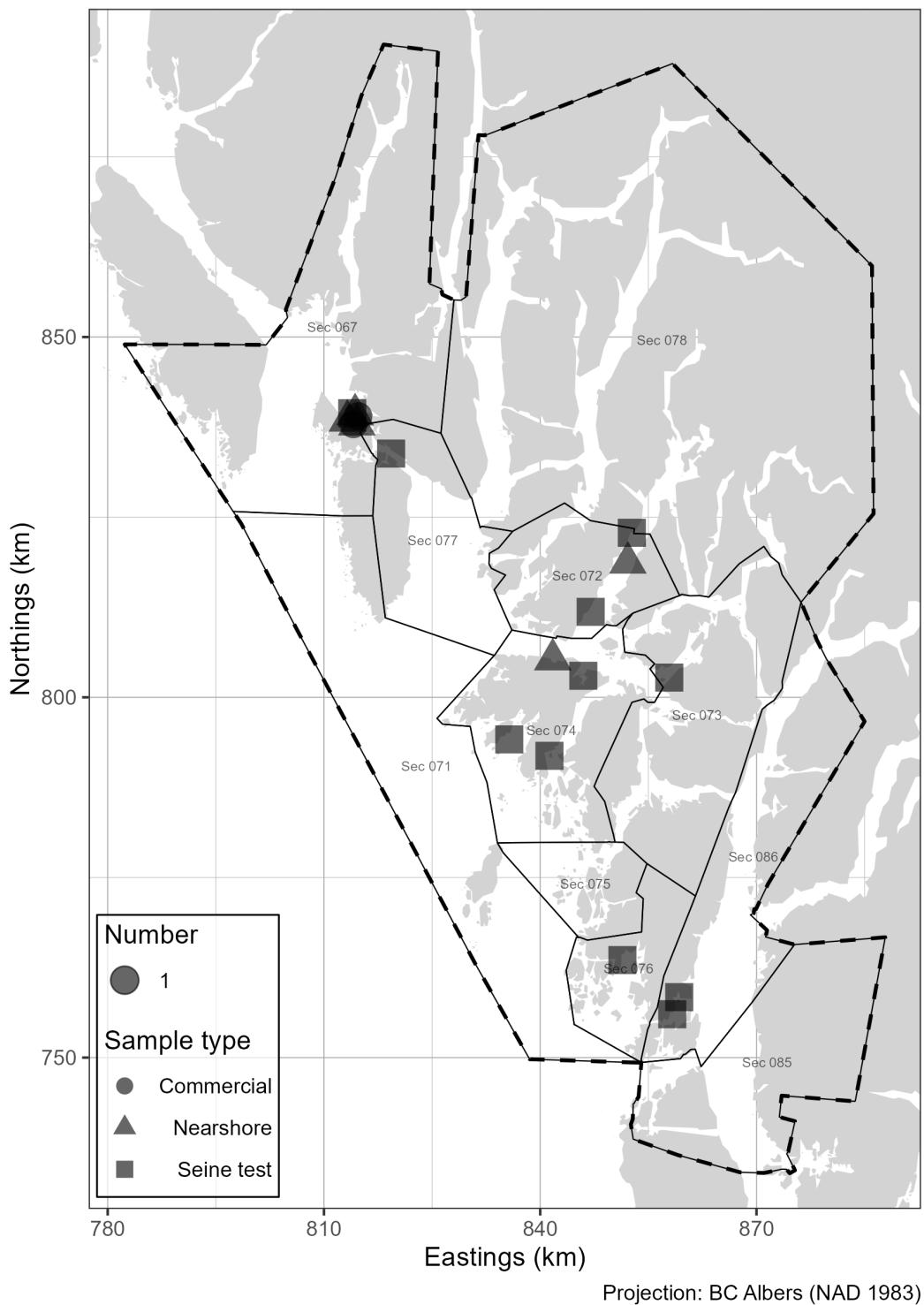


Figure 4. Location and type of Pacific Herring biological samples collected in 2023 in the Central Coast major stock assessment region (SAR; thick dashed lines), and associated Sections (Sec; thin solid lines). Units: kilometres (km).

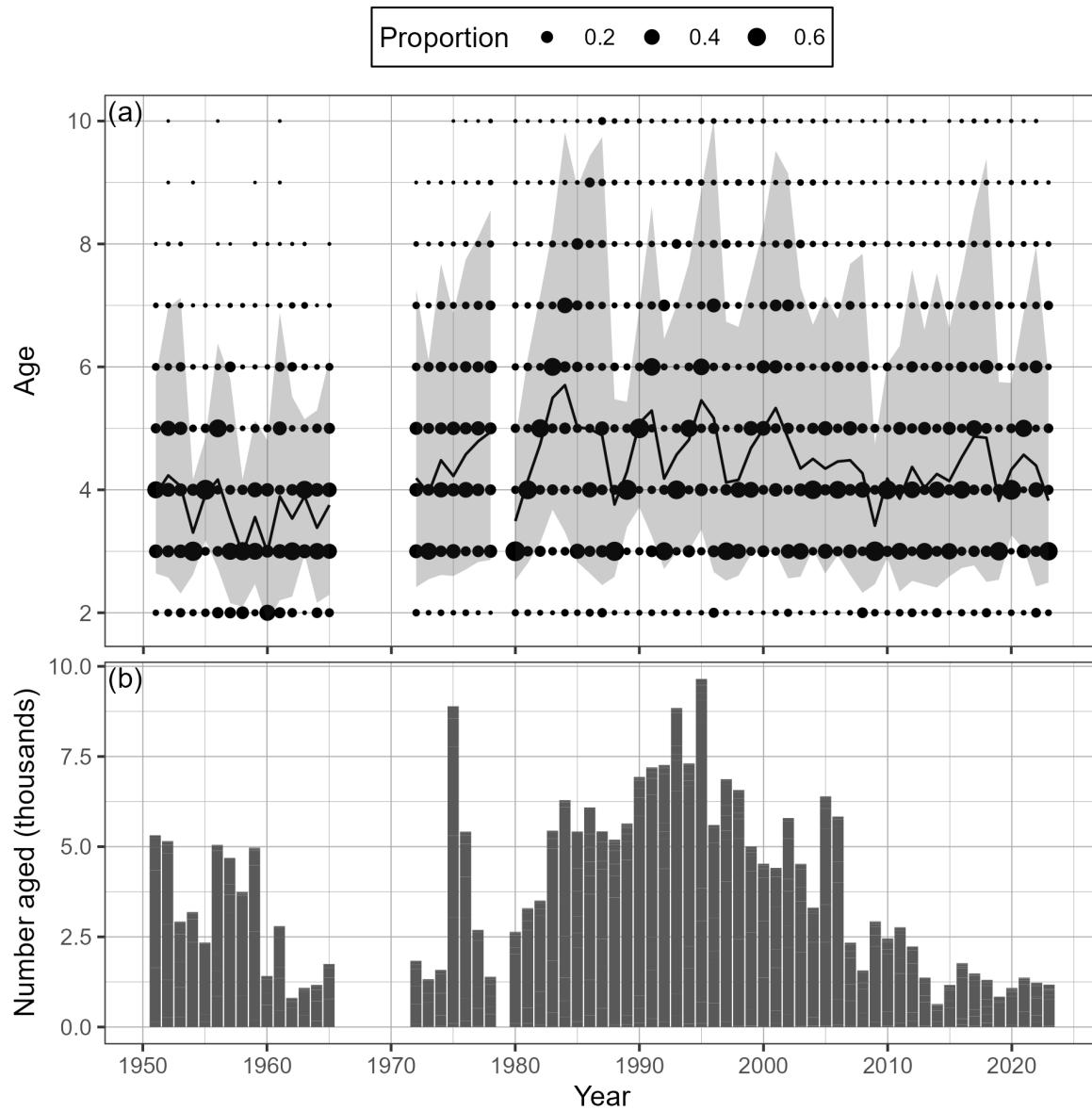


Figure 5. Time series of observed proportion-at-age (a) and number aged in thousands (b) of Pacific Herring from 1951 to 2023 in the Central Coast major stock assessment region (SAR). The black line is the mean age, and the shaded area is the approximate 90% distribution. Biological summaries only include samples collected using seine nets (commercial and test) due to size-selectivity of other gear types such as gillnet. The age-10 class is a ‘plus group’ which includes fish ages 10 and older.

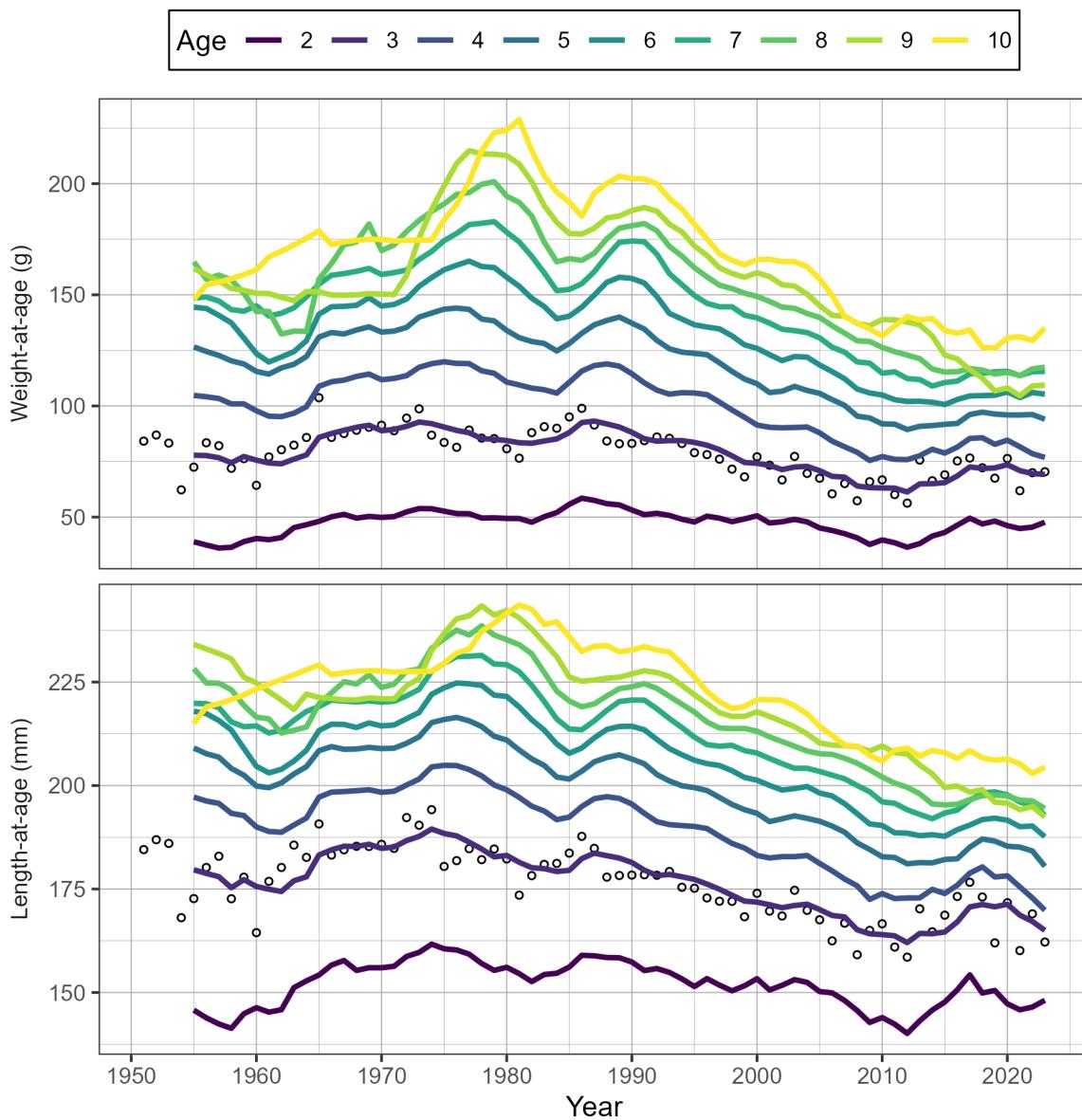


Figure 6. Time series of weight-at-age in grams (g) and length-at-age in milimetres (mm) for age-3 (circles) and 5-year running mean weight- and length-at-age (lines) for Pacific Herring from 1951 to 2023 in the Central Coast major stock assessment region (SAR). Missing weight- and length-at-age values (i.e., years with no biological samples) are imputed using one of two methods: missing values at the beginning of the time series are imputed by extending the first non-missing value backwards; other missing values are imputed as the mean of the previous 5 years. Biological summaries only include samples collected using seine nets (commercial and test) due to size-selectivity of other gear types such as gillnet. The age-10 class is a ‘plus group’ which includes fish ages 10 and older.

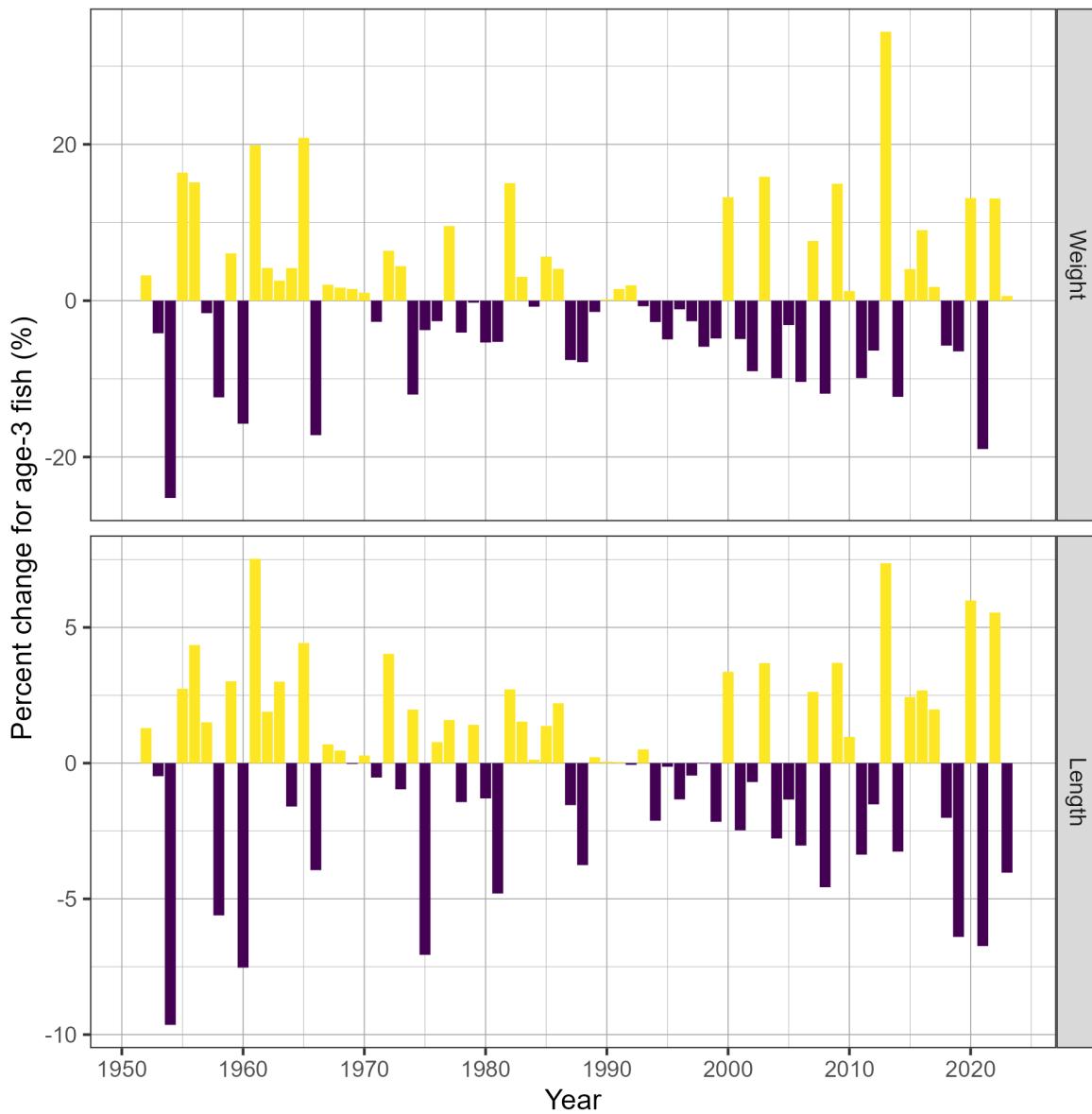


Figure 7. Time series of percent change (%) in weight and length for age-3 fish for Pacific Herring from 1951 to 2023 in the Central Coast major stock assessment region (SAR). Percent change is $\delta_t = \frac{\alpha_t - \alpha_{t-1}}{\alpha_{t-1}}$ where α_t is the weight and length of age-3 fish, respectively, in year t . Biological summaries only include samples collected using seine nets (commercial and test) due to size-selectivity of other gear types such as gillnet.

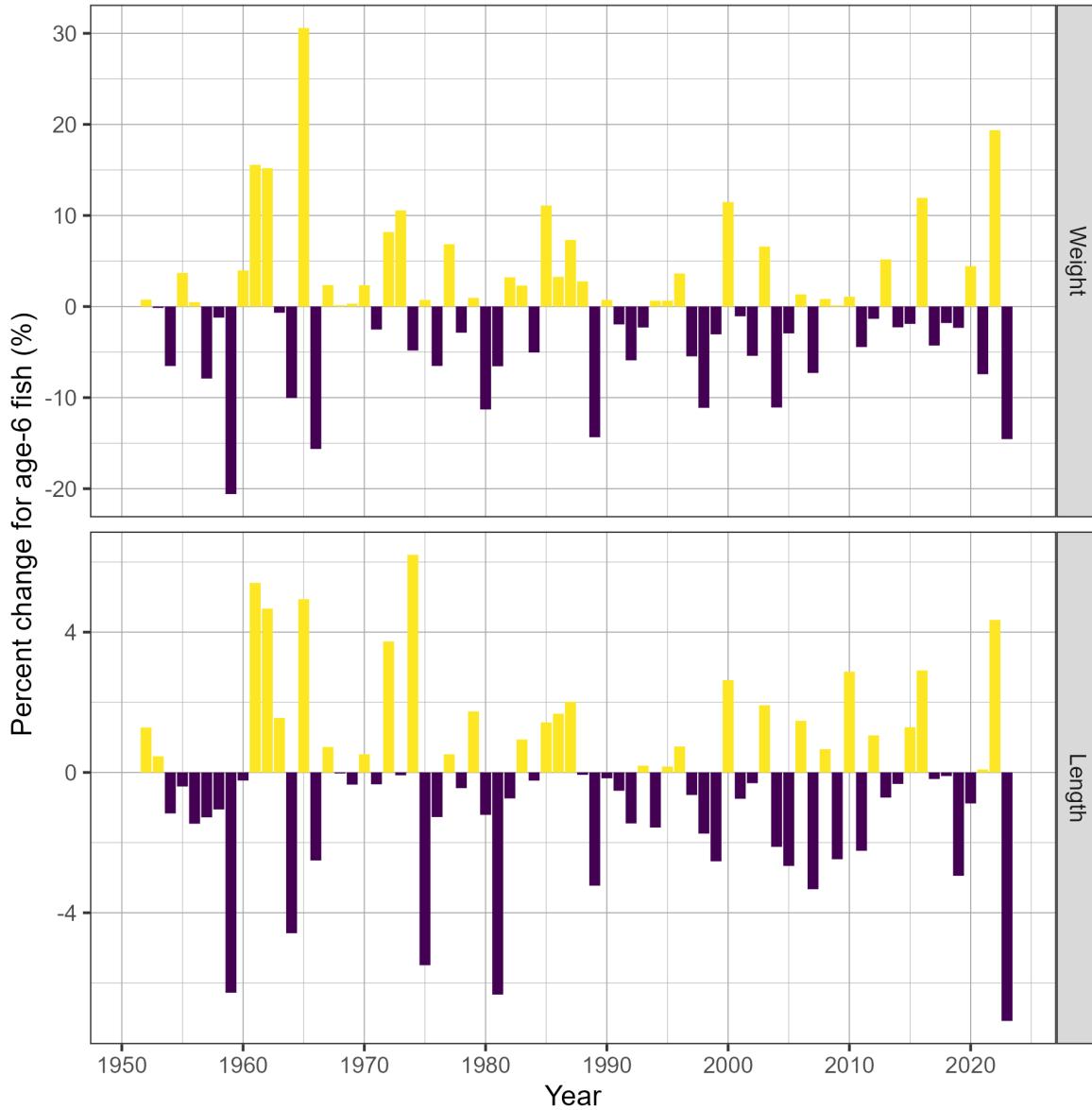


Figure 8. Time series of percent change (%) in weight and length for age-6 fish for Pacific Herring from 1951 to 2023 in the Central Coast major stock assessment region (SAR). Percent change is $\delta_t = \frac{\alpha_t - \alpha_{t-1}}{\alpha_{t-1}}$ where α_t is the weight and length of age-6 fish, respectively, in year t . Biological summaries only include samples collected using seine nets (commercial and test) due to size-selectivity of other gear types such as gillnet.

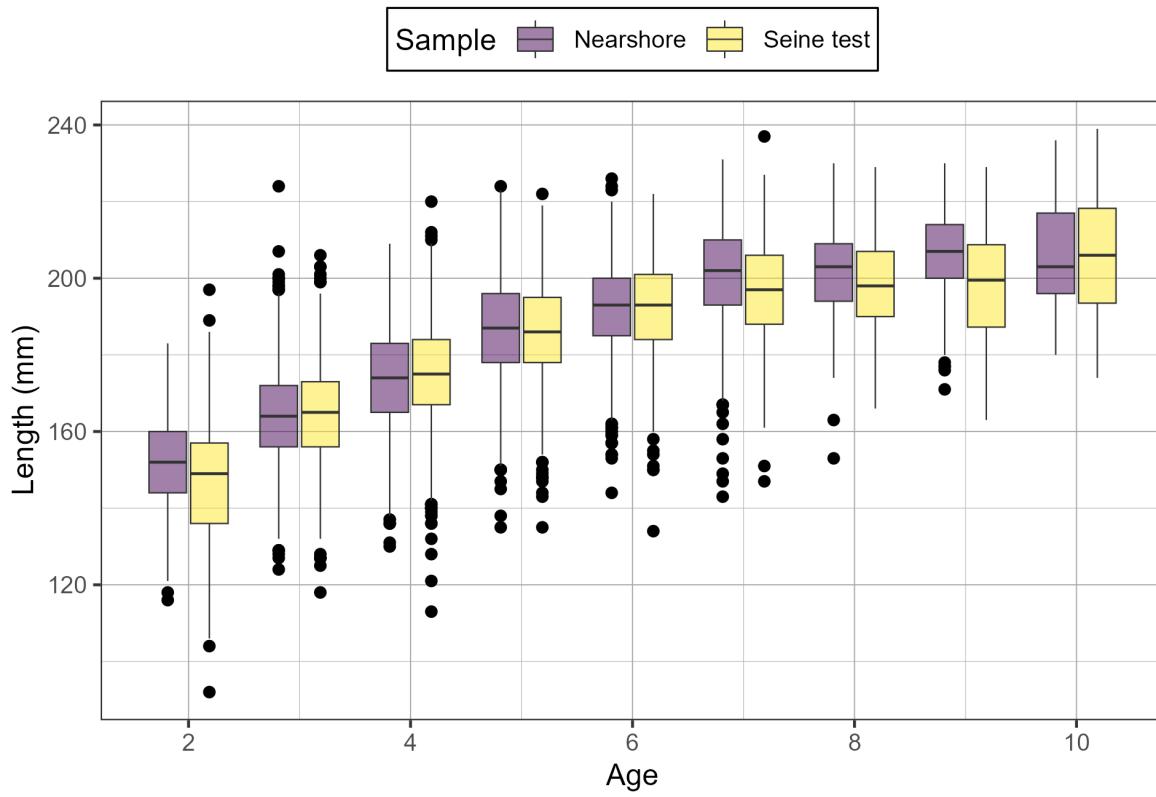


Figure 9. Length-at-age in millimetres (mm) of Pacific Herring from 2017 to 2023 in the Central Coast major stock assessment region (SAR) by sample type. The outer edges of the boxes indicate the 25th and 75th percentiles, and the middle lines indicate the 50th percentiles (i.e., medians). The whiskers extend to 1.5 × IQR, where IQR is the distance between the 25th and 75th percentiles, and dots indicate outliers. Biological summaries only include samples collected using seine nets (commercial and test) due to size-selectivity of other gear types such as gillnet. Legend: ‘Nearshore’ refers to samples collected using cast nets as part of a pilot study with First Nations. The age-10 class is a ‘plus group’ which includes fish ages 10 and older.

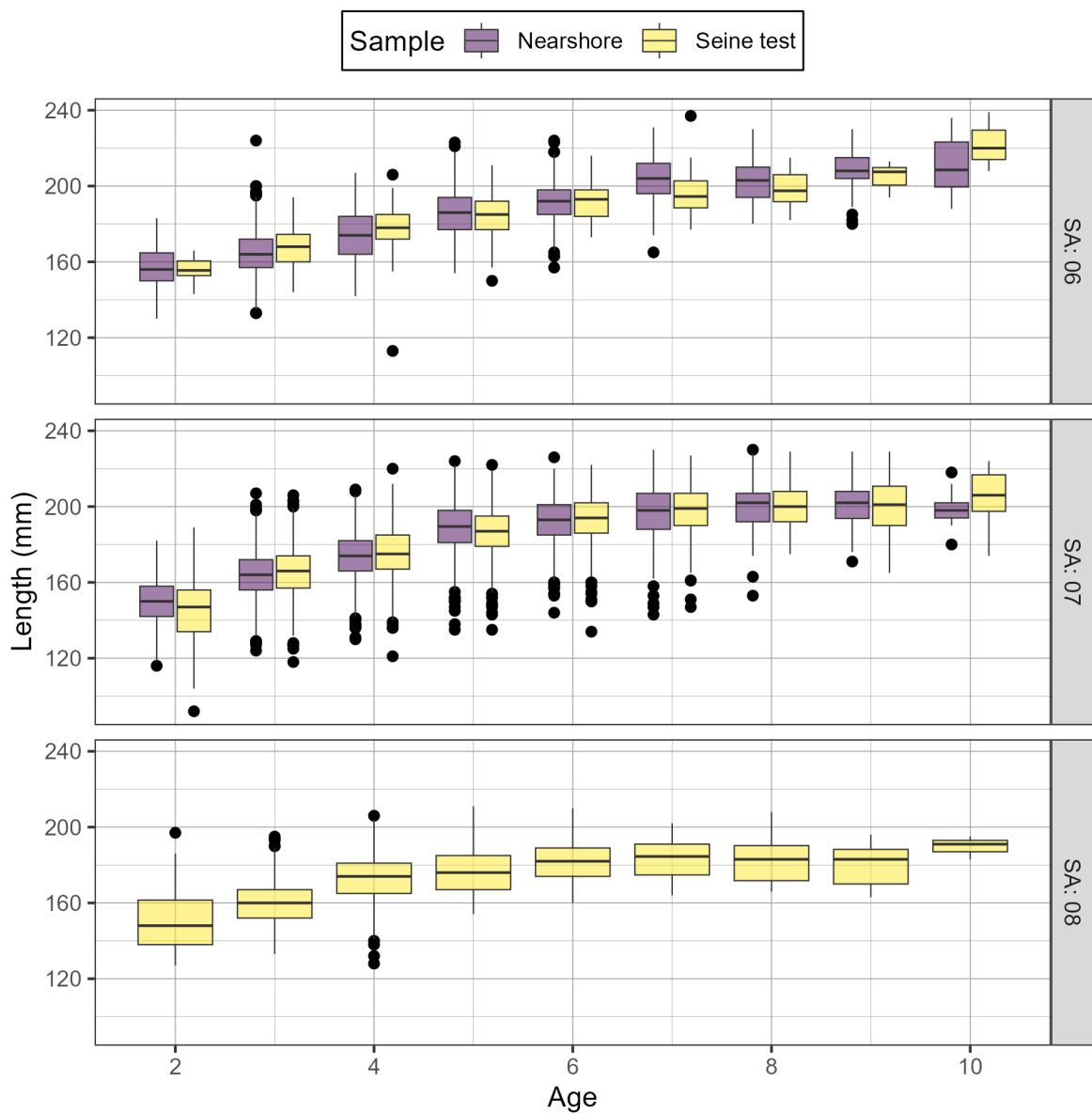


Figure 10. Length-at-age in millimetres (mm) of Pacific Herring from 2017 to 2023 in the Central Coast major stock assessment region (SAR) by sample type and statistical area (SA). The outer edges of the boxes indicate the 25th and 75th percentiles, and the middle lines indicate the 50th percentiles (i.e., medians). The whiskers extend to $1.5 \times \text{IQR}$, where IQR is the distance between the 25th and 75th percentiles, and dots indicate outliers. Biological summaries only include samples collected using seine nets (commercial and test) due to size-selectivity of other gear types such as gillnet. Legend: 'Nearshore' refers to samples collected using cast nets as part of a pilot study with First Nations. The age-10 class is a 'plus group' which includes fish ages 10 and older.

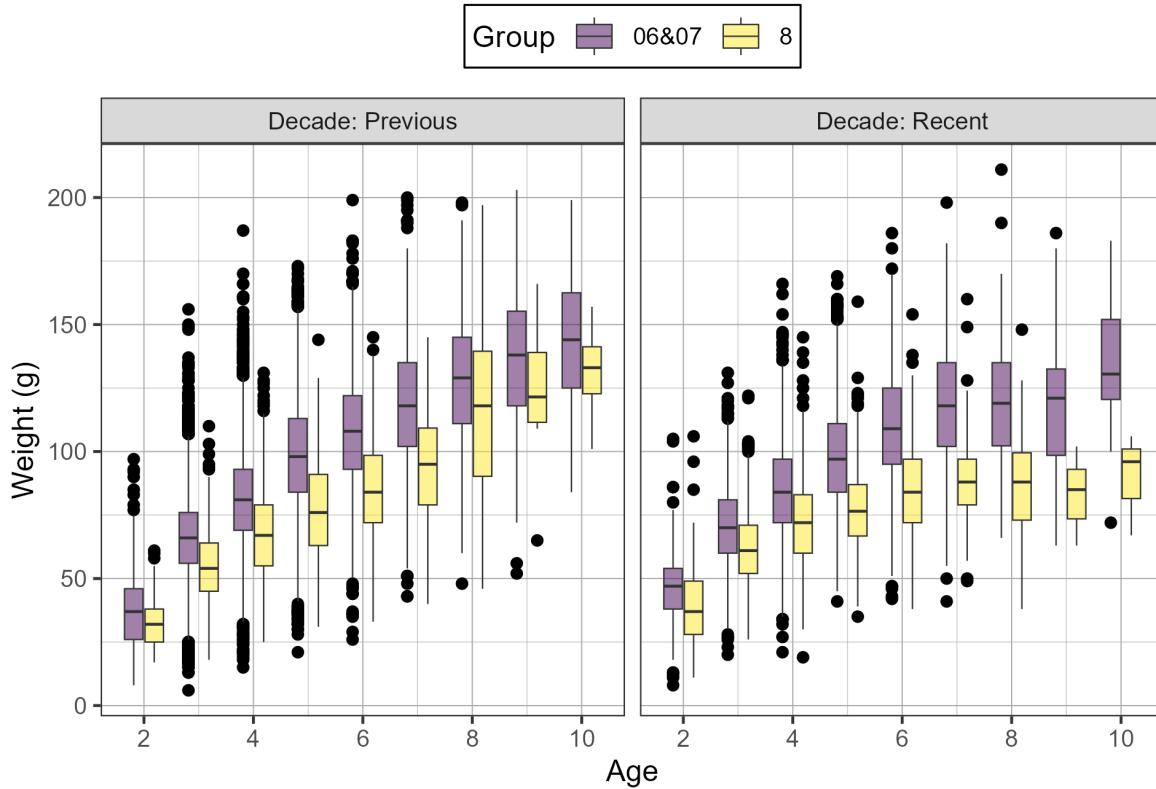


Figure 11. Weight-at-age in grams (g) of Pacific Herring in the Central Coast major stock assessment region (SAR) by Group from the most recent decade (2014 to 2023), and the previous decade (2004 to 2013). The outer edges of the boxes indicate the 25th and 75th percentiles, and the middle lines indicate the 50th percentiles (i.e., medians). The whiskers extend to $1.5 \times \text{IQR}$, where IQR is the distance between the 25th and 75th percentiles, and dots indicate outliers. Sample sizes are given in Table 16. Biological summaries only include samples collected using seine nets (commercial and test) due to size-selectivity of other gear types such as gillnet. The age-10 class is a ‘plus group’ which includes fish ages 10 and older. Legend: ‘06&07’ is Statistical Areas 06 and 07; and ‘08’ is Statistical Area 08.

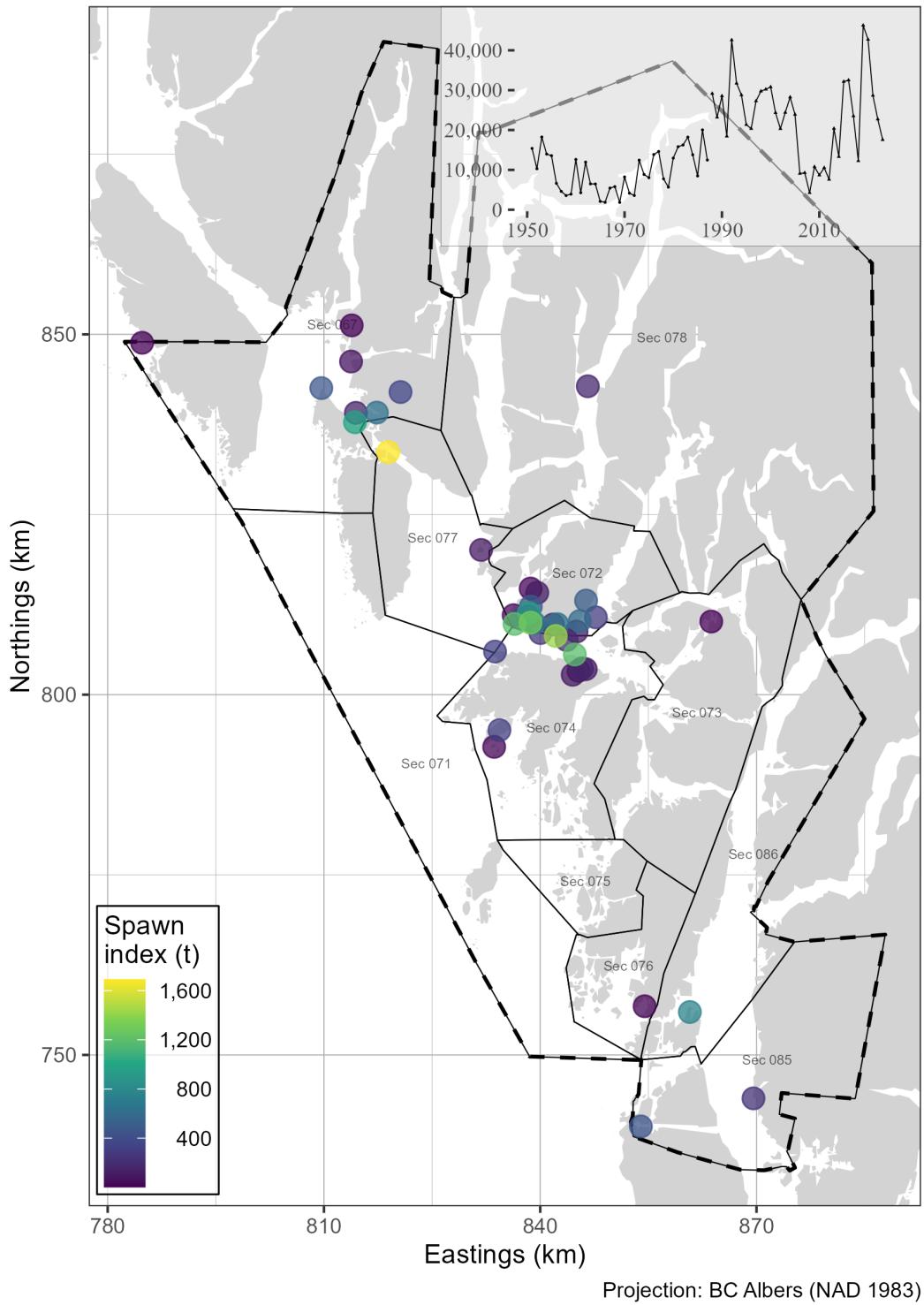


Figure 12. Pacific Herring spawn survey locations, and spawn index in metric tonnes (t) in 2023 in the Central Coast major stock assessment region (SAR; thick dashed lines), and associated Sections (Sec; thin solid lines). The ‘spawn index’ is not scaled by the spawn survey scaling parameter, q . Missing spawn index values indicate incomplete surveys (grey circles). Inset tracks the total spawn index. Units: kilometres (km).

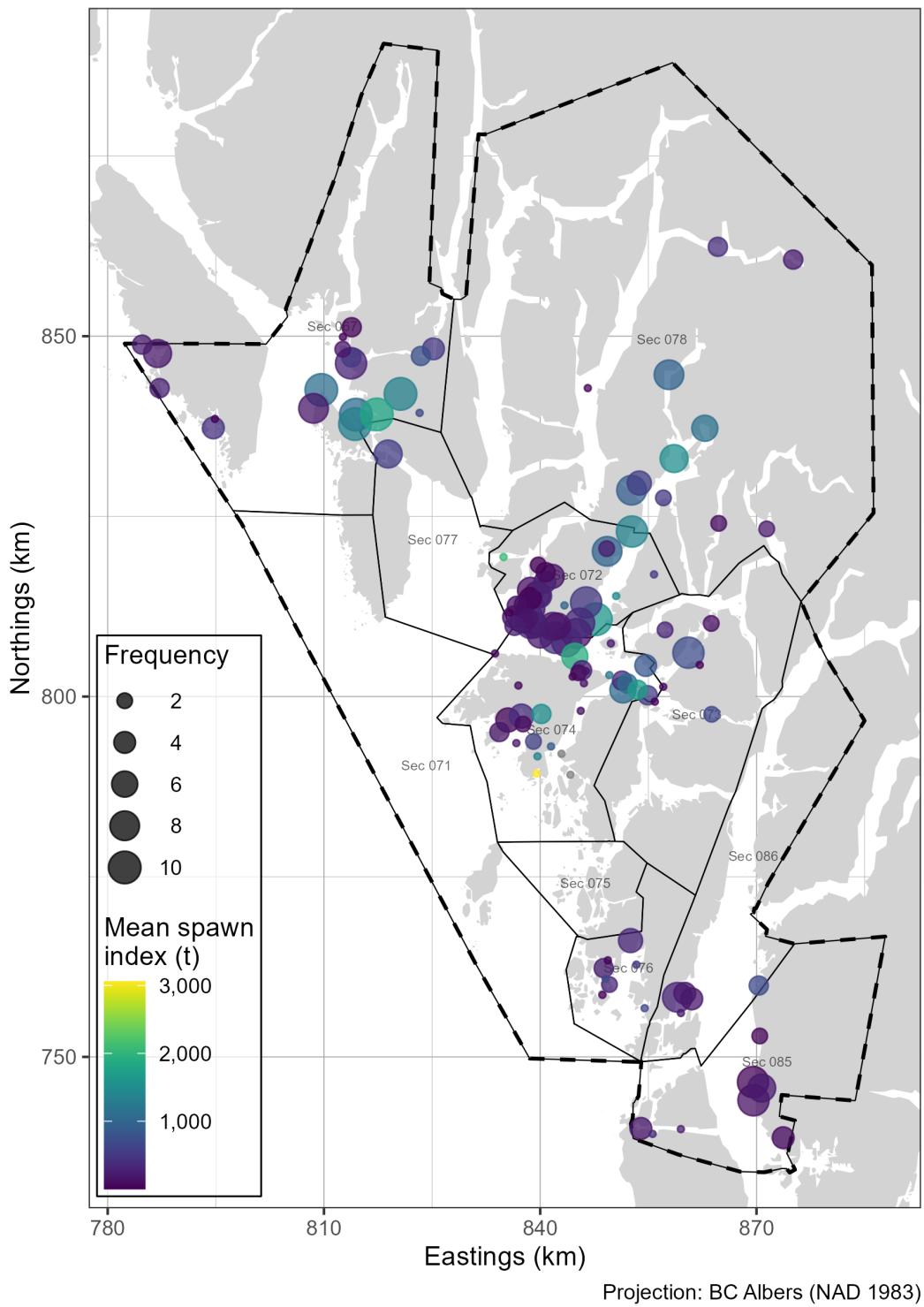


Figure 13. Pacific Herring spawn survey locations, mean spawn index in metric tonnes (t), and spawn frequency from 2013 to 2022 in the Central Coast major stock assessment region (SAR; thick dashed lines), and associated Sections (Sec; thin solid lines). The ‘spawn index’ is not scaled by the spawn survey scaling parameter, q . Missing spawn index values indicate incomplete surveys (grey circles). Units: kilometres (km).

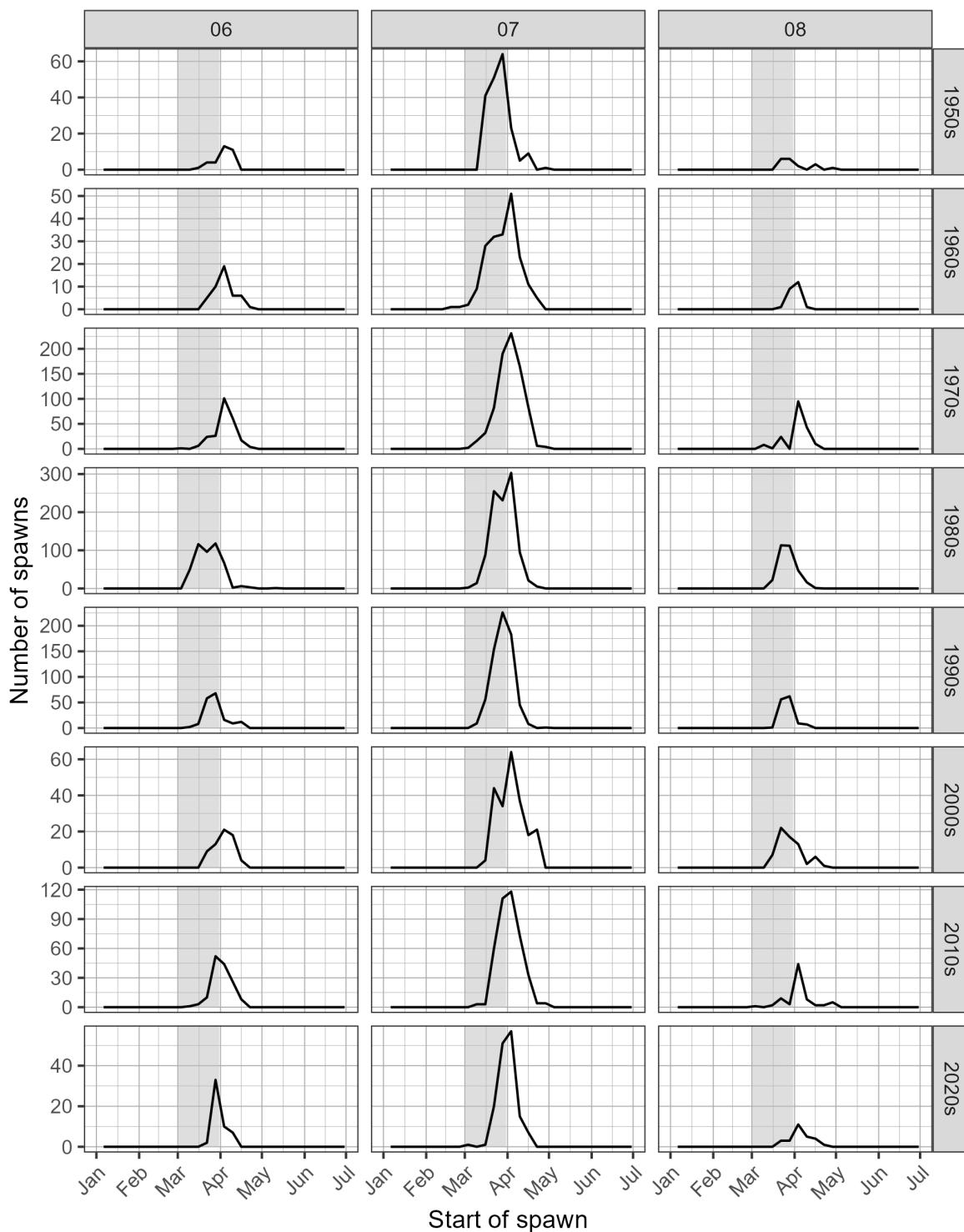


Figure 14. Pacific Herring spawn start date by decade and Statistical Area. Grey shaded regions indicate March 1st to 31st. Note that spawn size and intensity varies; therefore the number of spawns is not directly proportional to spawn extent or biomass.

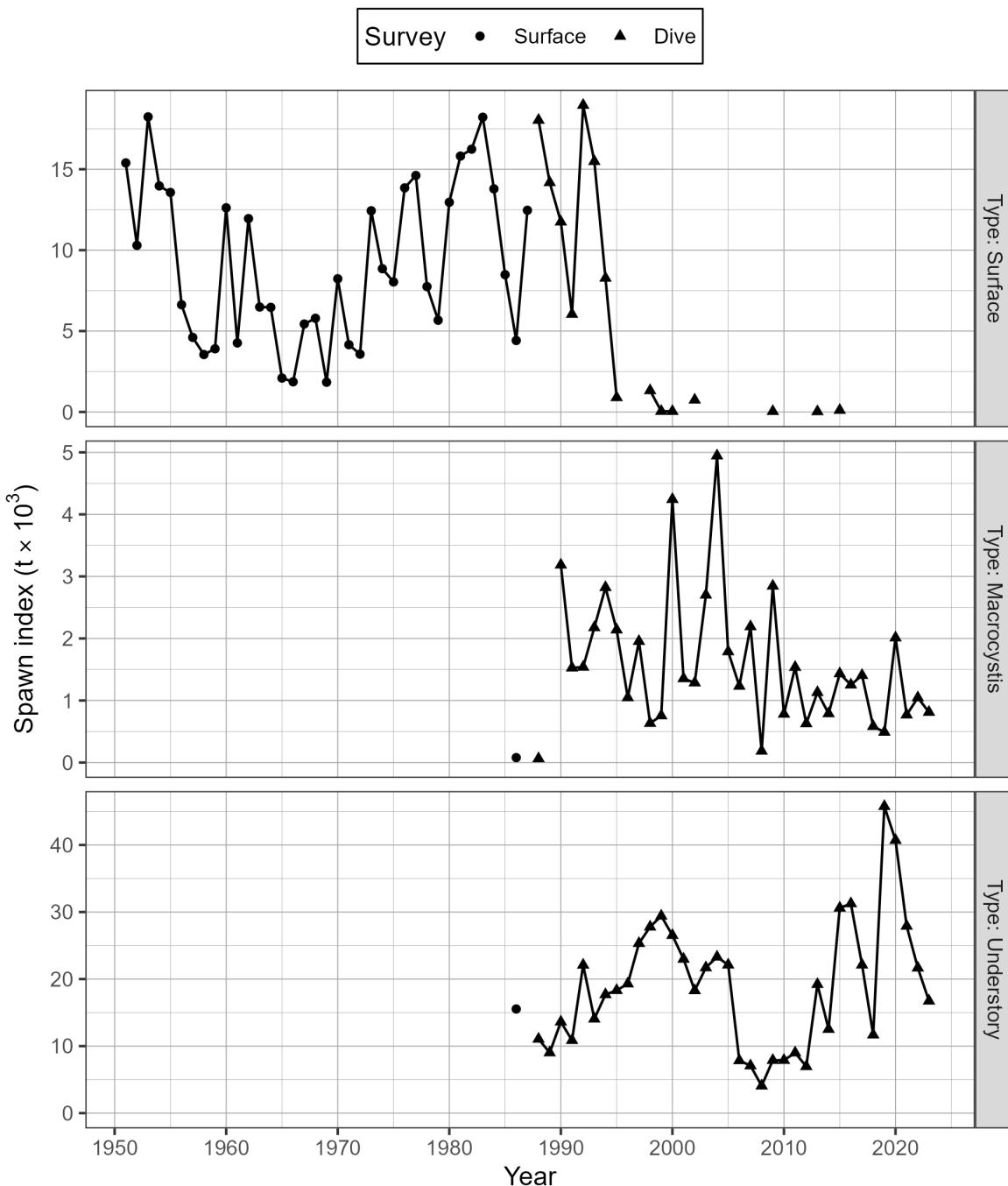


Figure 15. Time series of spawn index in thousands of metric tonnes ($t \times 10^3$) by type for Pacific Herring from 1951 to 2023 in the Central Coast major stock assessment region (SAR). There are three types of spawn survey observations: observations of spawn taken from the surface usually at low tide, underwater observations of spawn on giant kelp, *Macrocystis* (*Macrocystis* spp.), and underwater observations of spawn on other types of algae and the substrate, which we refer to as ‘understory.’ The spawn index has two distinct periods defined by the dominant coastwide survey method: surface surveys (1951 to 1987), and dive surveys (1988 to 2023).

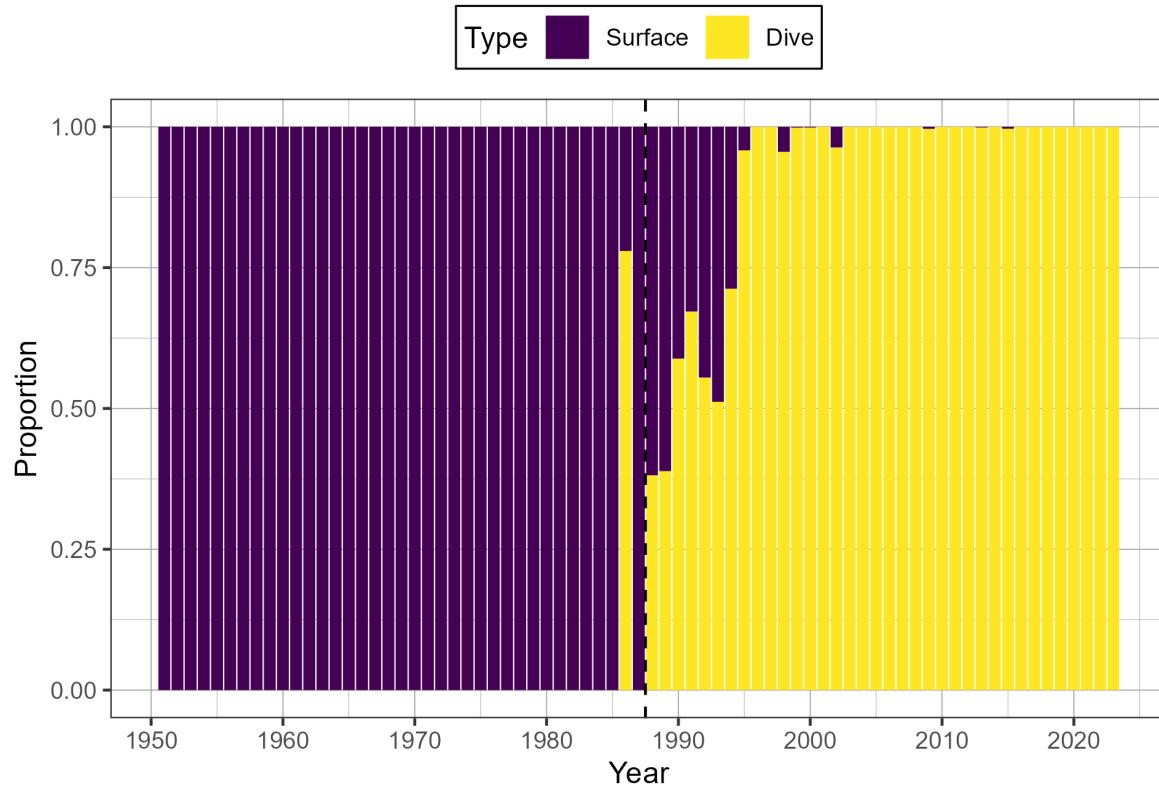


Figure 16. Time series of proportion of spawn index by surface and dive surveys for Pacific Herring from 1951 to 2023 in the Central Coast major stock assessment region (SAR). The spawn index has two distinct periods defined by the dominant coastwide survey method: surface surveys (1951 to 1987), and dive surveys (1988 to 2023).

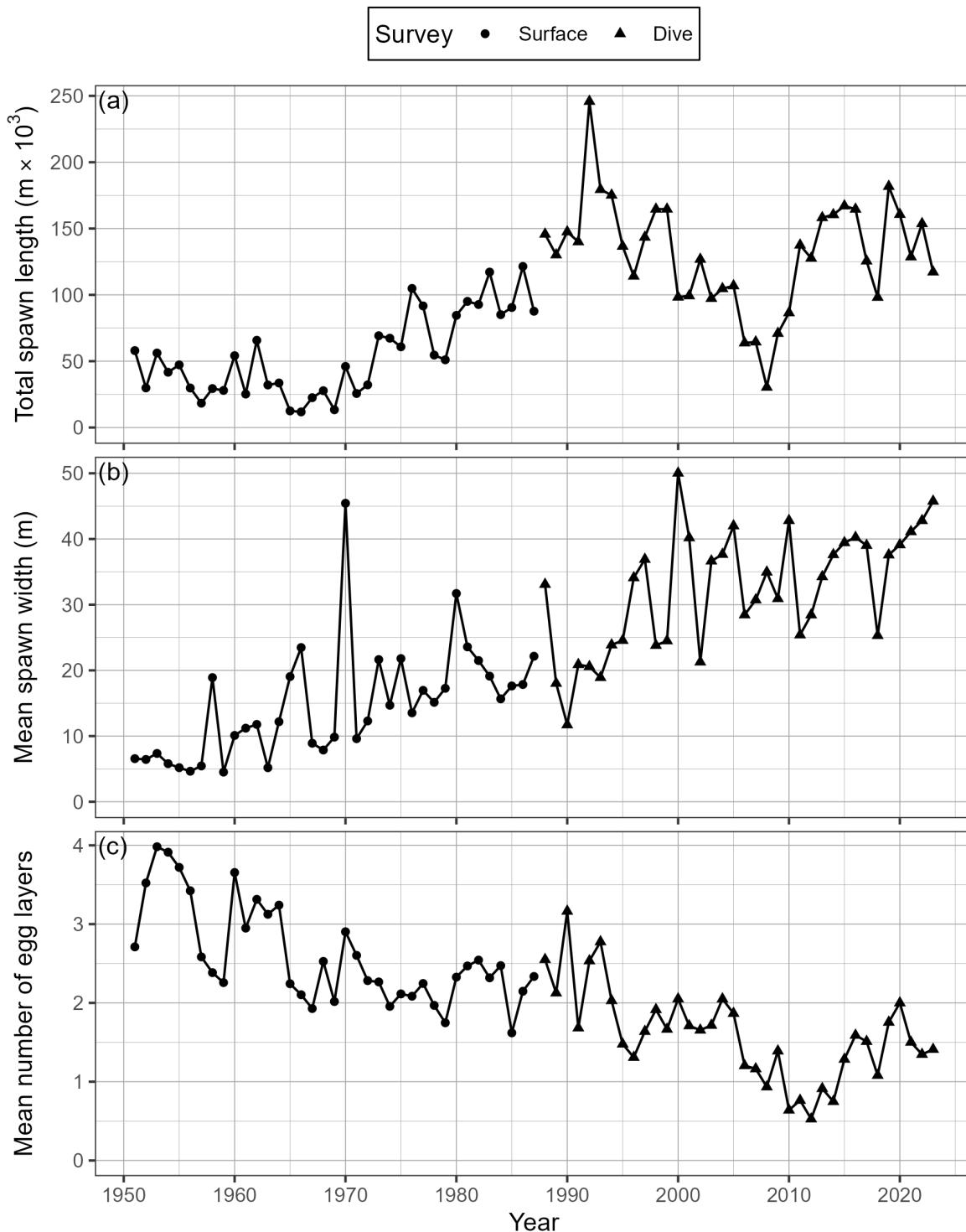


Figure 17. Time series of total spawn length in thousands of metres ($m \times 10^3$; panel a), mean spawn width in metres (b), and mean number of egg layers (c) for Pacific Herring from 1951 to 2023 in the Central Coast major stock assessment region (SAR). The spawn index has two distinct periods defined by the dominant coastwide survey method: surface surveys (1951 to 1987), and dive surveys (1988 to 2023).

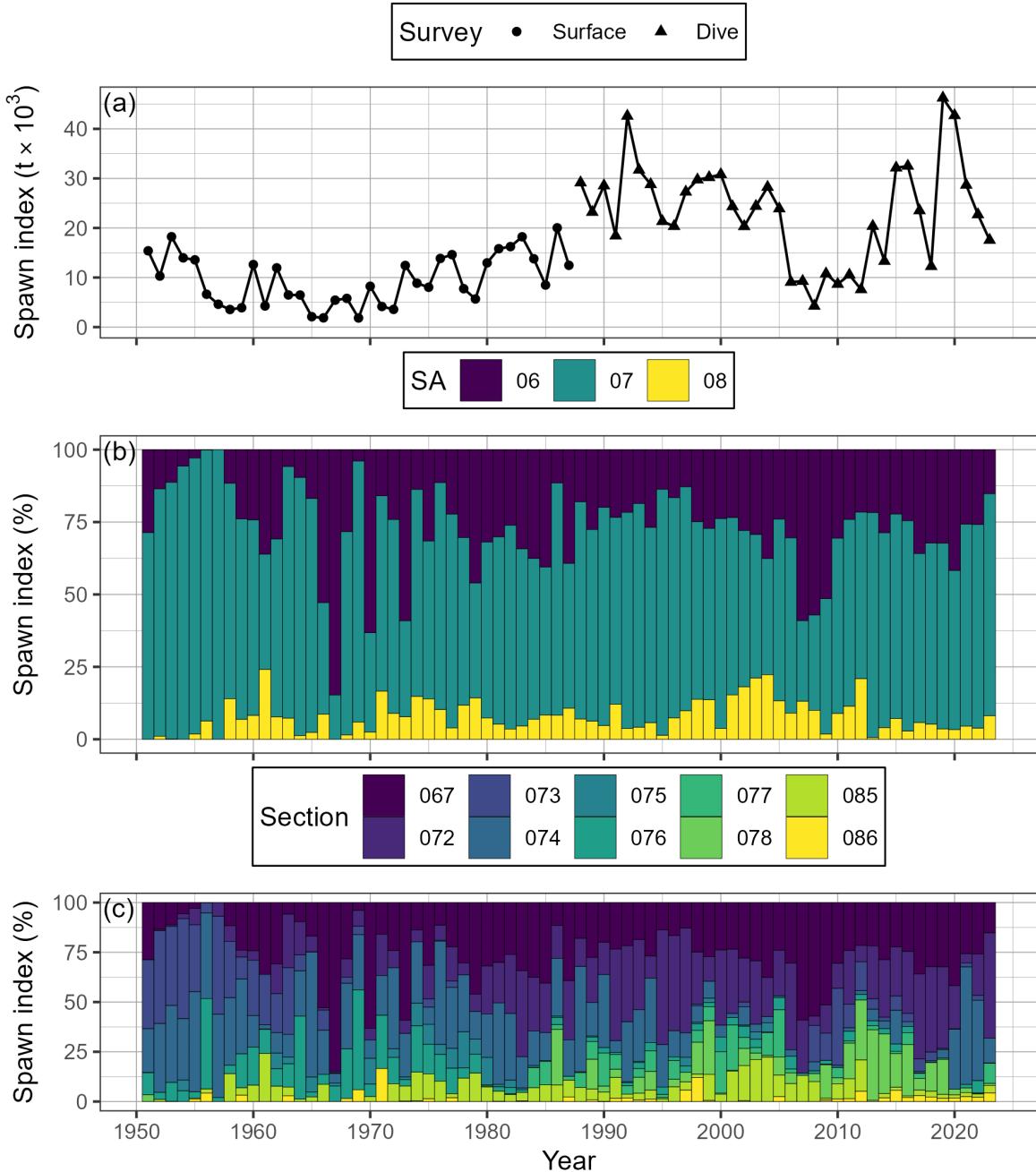


Figure 18. Time series of spawn index in thousands of metric tonnes ($t \times 10^3$) for Pacific Herring from 1951 to 2023 in the Central Coast major stock assessment region (SAR; panel a), as well as percent contributed by Statistical Area (SA), and Section (b, & c, respectively). The spawn index has two distinct periods defined by the dominant coastwide survey method: surface surveys (1951 to 1987), and dive surveys (1988 to 2023). Note that spawn surveys in the dive survey period (1988 to 2023) are a combination of surface and dive surveys (Figures 15 and 16). The ‘spawn index’ is not scaled by the spawn survey scaling parameter, q . Legend: ‘06&07’ is Statistical Areas 06 and 07; and ‘08’ is Statistical Area 08.

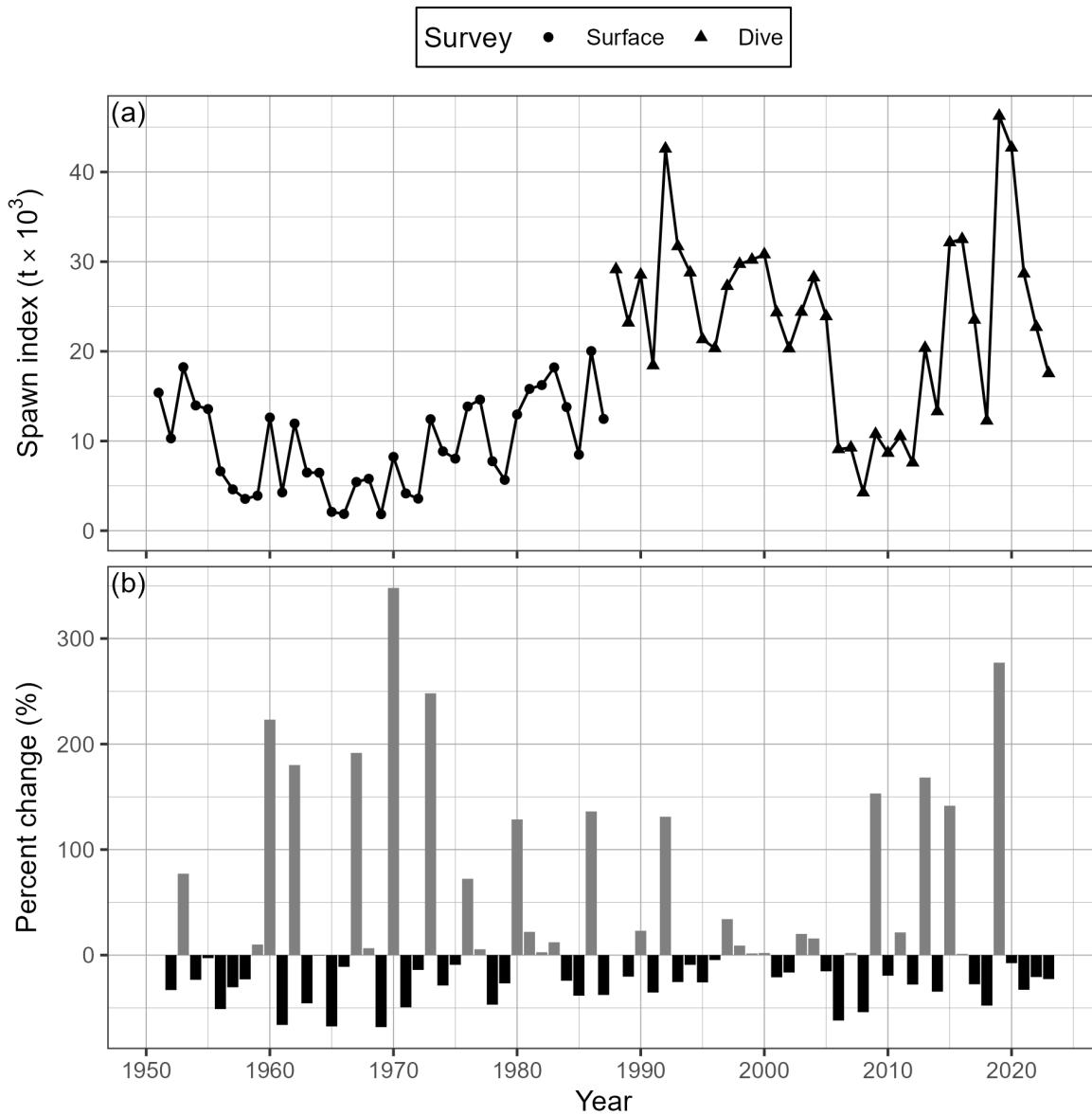


Figure 19. Time series of spawn index in thousands of metric tonnes ($t \times 10^3$) for Pacific Herring from 1951 to 2023 in the Central Coast major stock assessment region (SAR; panel a), and percent change (b). Percent change is $\delta_t = \frac{\alpha_t - \alpha_{t-1}}{\alpha_{t-1}}$ where α_t is the spawn index in year t . The spawn index has two distinct periods defined by the dominant coastwide survey method: surface surveys (1951 to 1987), and dive surveys (1988 to 2023). The ‘spawn index’ is not scaled by the spawn survey scaling parameter, q . Note that spawn surveys in the dive survey period (1988 to 2023) are a combination of surface and dive surveys (Figures 15 and 16).

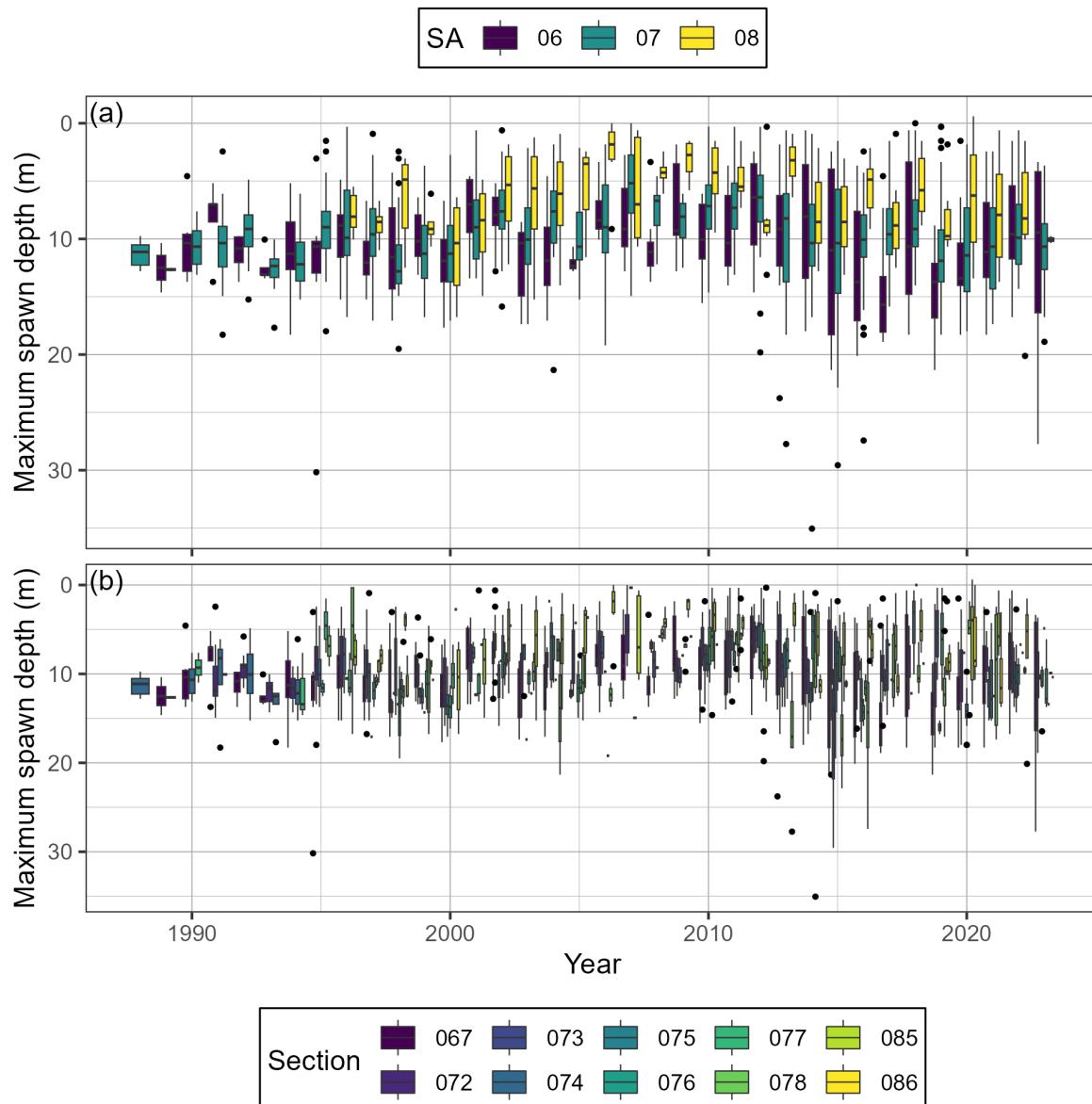


Figure 20. Time series of maximum spawn depth in metres (m) for Pacific Herring from 1988 to 2023 in the Central Coast major stock assessment region (SAR) by Statistical Area (SA; panel a), and Section (b). Note that depth is not corrected to chart datum. The spawn index has two distinct periods defined by the dominant coastwide survey method: surface surveys (1951 to 1987), and dive surveys (1988 to 2023).

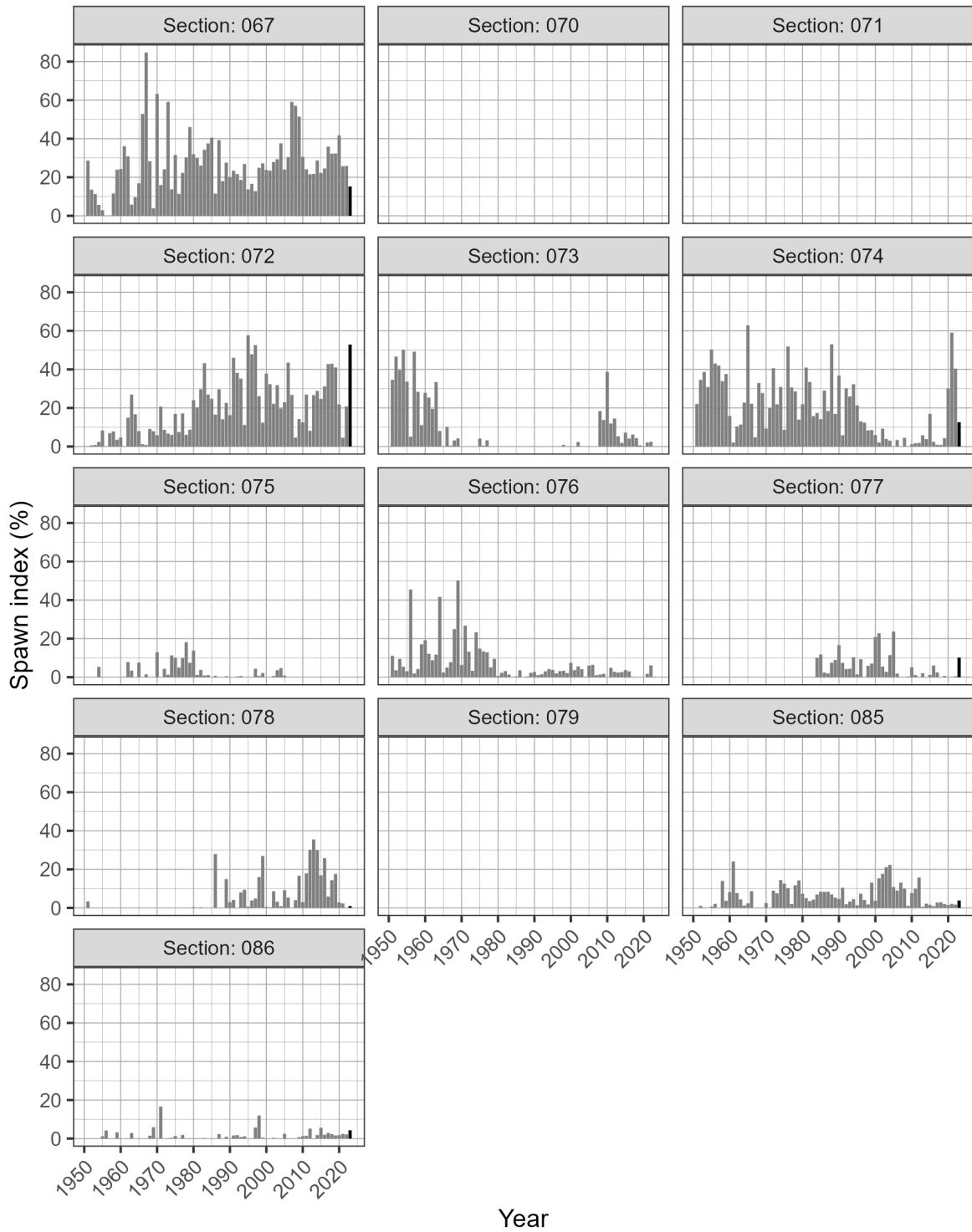


Figure 21. Time series of percent of spawn index by Section for Pacific Herring from 1951 to 2023 in the Central Coast major stock assessment region (SAR). The year 2023 has a darker bar to facilitate interpretation. The spawn index has two distinct periods defined by the dominant coastwide survey method: surface surveys (1951 to 1987), and dive surveys (1988 to 2023). The ‘spawn index’ is not scaled by the spawn survey scaling parameter, q .

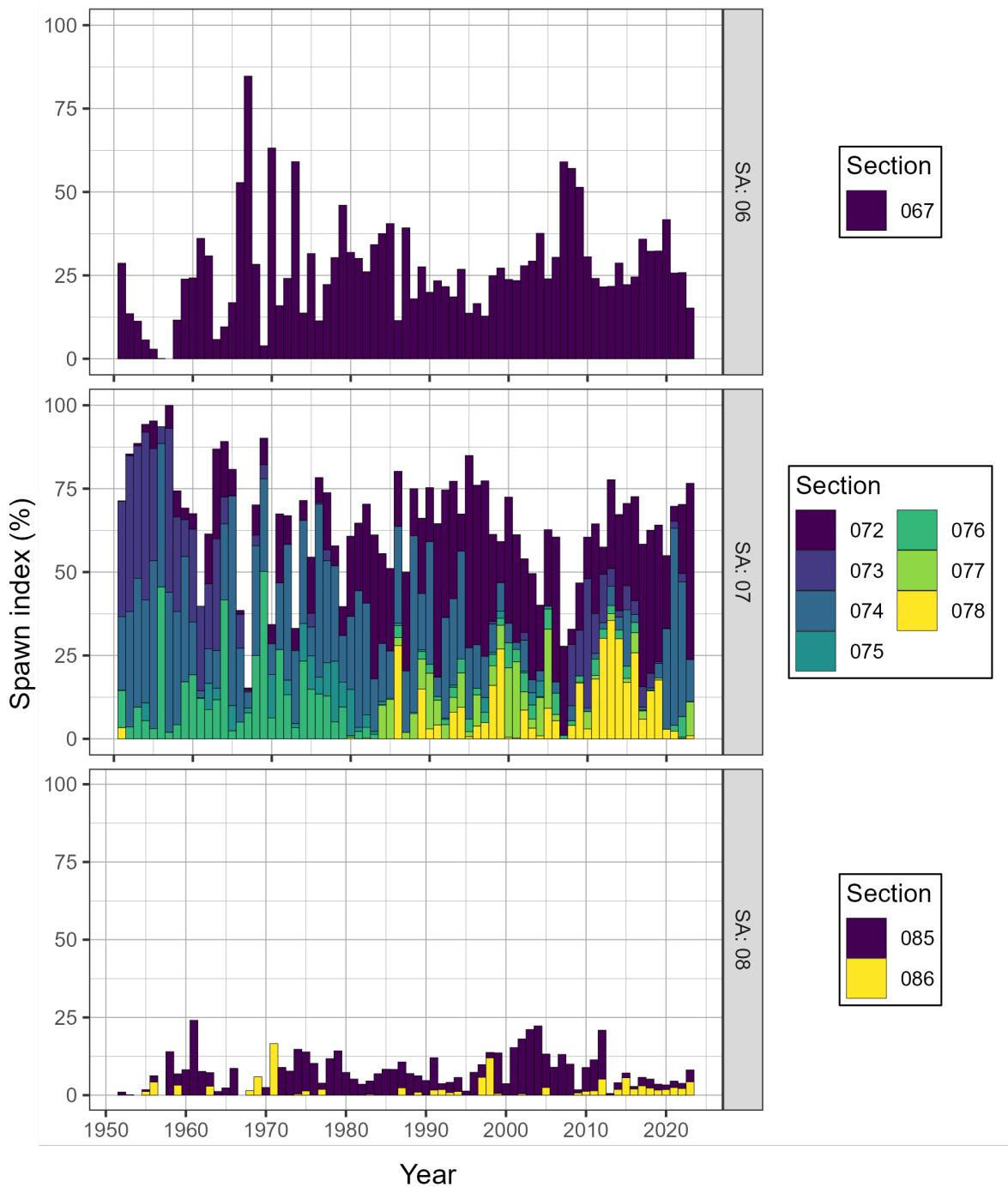


Figure 22. Time series of percent of spawn index by Statistical Area (SA) and Section for Pacific Herring from 1951 to 2023 in the Central Coast major stock assessment region (SAR). The spawn index has two distinct periods defined by the dominant coastwide survey method: surface surveys (1951 to 1987), and dive surveys (1988 to 2023). The ‘spawn index’ is not scaled by the spawn survey scaling parameter, q . Legend: ‘06&07’ is Statistical Areas 06 and 07; and ‘08’ is Statistical Area 08.

Figure 23. Animation of Pacific Herring spawn index in metric tonnes (t) by Location from 1951 to 2023 in the Central Coast major stock assessment region (SAR; thick dashed lines), and associated Sections (Sec; thin solid lines). The spawn index has two distinct periods defined by the dominant coastwide survey method: surface surveys (1951 to 1987), and dive surveys (1988 to 2023). The ‘spawn index’ is not scaled by the spawn survey scaling parameter, q . Missing spawn index values indicate incomplete surveys (grey circles). Inset tracks the total spawn index. Units: kilometres (km). View the animation: download the report, open with Adobe, enable Java, and click “play”.