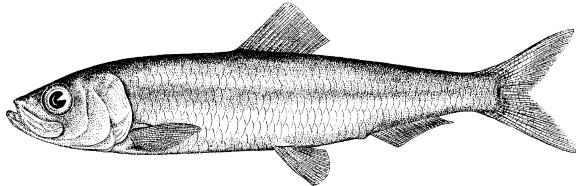


# Pacific Herring preliminary data summary for West Coast of Vancouver Island 2023

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

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

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## 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 West Coast of Vancouver Island 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). 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

Biological samples were collected by the seine charter vessel *Proud Canadian* for 20 days from February 20<sup>th</sup> to March 11<sup>th</sup>. The primary purpose of the test charter vessel was to collect biological samples from main bodies of herring from Statistical Areas 23, 24, and 25. Nearshore herring samples were collected by the Nuu-chah-nulth staff as part of a sampling program and on-going collaboration between WCVI First Nations and DFO. These nearshore biological samples were collected from spawning aggregations using cast nets. WCVI First Nations spawn reconnaissance charters reported spawn activity in all three areas. Herring spawn locations were primarily identified with fixed-wing overflights conducted by DFO Resource Management area staff. Eight flights were conducted this season in February and March.

One dive charter vessel and a shorebased crew operated in WCVI:

- The *Pachena No. 1* surveyed 16 days from March 8<sup>th</sup> to March 23<sup>rd</sup>, and
- The shorebased dive surveyed from March 13<sup>th</sup> to March 23<sup>rd</sup>.

## 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 West Coast of

Vancouver Island 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, 30 Pacific Herring biological samples were collected and processed for the West Coast of Vancouver Island 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 West Coast of Vancouver Island 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). 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 West Coast of Vancouver Island major SAR (Table 16, and Figure 11). A summary of spawn from the last decade (2013 to 2022) is shown in Figure 12. Figure 13 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 14, Figure 15, Figure 16, Figure 17, Table 17, and Figure 18). See the [draft spawn index technical report](#) for calculations to convert SOK harvest to spawning biomass. 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 17b, Figure 19). For example, in 2023, Section 242 contributed the most to the spawn index (62%). As with Sections, some Statistical Areas contribute more than others to the total spawn index (Figure 17c, Figure 20). An animation shows the spawn index by spawn survey location from 1951 to 2023 (Figure 21).

## 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:

- Good coverage of the spawns in terms of cast net sampling by First Nations charters in Areas 23 and 24.
- Difficulty getting biological samples for the test vessel and First Nations charters in Area 25 due to fish being offshore, in close to beach to spawn, and erratic fish movement.
- There were spawns close to communities that allowed FSC access. For example, there were spawns in Hotsprings Cove, near Ahousat, and northern Barkley Sound.
- Good communication and observations by First Nations charters helped with a successful spawn survey this year.
- Good spawn was observed over large geographic areas in Areas 23, 24 and 25.
- Like last year, there was a large spawn in Hesquiat Harbour that persisted for several days. Additionally, there was a large spawn that occurred within Hotsprings Cove that persisted for several days.
- There was a later spawn outside of Nootka Sound south of Escalante Point that covered a large area. Limited resources, inclement weather, and later spawn timing prevented dive surveys for spawns at Nuchatlitz, Escalante Point, and outer Flores Island.

## 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 and Sections for Pacific Herring in the West Coast of Vancouver Island major stock assessment region (SAR).

Region	Statistical Area	Section
West Coast of Vancouver Island	23	230
West Coast of Vancouver Island	23	231
West Coast of Vancouver Island	23	232
West Coast of Vancouver Island	23	233
West Coast of Vancouver Island	23	239
West Coast of Vancouver Island	24	240
West Coast of Vancouver Island	24	241
West Coast of Vancouver Island	24	242
West Coast of Vancouver Island	24	243
West Coast of Vancouver Island	24	244
West Coast of Vancouver Island	24	245
West Coast of Vancouver Island	24	249
West Coast of Vancouver Island	25	250
West Coast of Vancouver Island	25	251
West Coast of Vancouver Island	25	252
West Coast of Vancouver Island	25	253
West Coast of Vancouver Island	25	259

Table 3. Total landed commercial catch of Pacific Herring in metric tonnes (t) by gear type in 2023 in the West Coast of Vancouver Island 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 West Coast of Vancouver Island major stock assessment region (SAR). See the [draft spawn index technical report](#) for calculations to convert SOK harvest to spawning biomass. Note: data may be withheld due to privacy concerns (WP).

Year	Harvest (lb)	Spawning biomass (t)
2013	0	0
2014	0	0
2015	0	0
2016	0	0
2017	0	0
2018	0	0
2019	0	0
2020	0	0
2021	0	0
2022	0	0
2023	0	0

Table 5. Number of Pacific Herring biological samples processed from 2013 to 2023 in the West Coast of Vancouver Island 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	5	0	5
2014	0	4	0	4
2015	0	17	3	20
2016	0	15	10	25
2017	0	12	7	19
2018	0	20	22	42
2019	0	14	11	25
2020	0	12	7	19
2021	0	13	9	22
2022	0	10	19	29
2023	0	9	21	30

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

Type	Gear	Use	Number of samples
Test	Other	Nearshore	21
Test	Seine	Test fishery	9

Table 7. Observed number-at-age of Pacific Herring by sample type in 2023 in the West Coast of Vancouver Island 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	23	798	484	384	105	52	8	1	3	
Seine test	52	399	177	116	31	15	3	3	0	
Total	75	1197	661	500	136	67	11	4	3	

Table 8. Observed proportion-at-age of Pacific Herring by sample type in 2023 in the West Coast of Vancouver Island 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	0.012	0.429	0.260	0.207	0.057	0.028	0.004	0.001	0.002	
Seine test	0.065	0.501	0.222	0.146	0.039	0.019	0.004	0.004	0.000	
Total	0.028	0.451	0.249	0.188	0.051	0.025	0.004	0.002	0.001	

Table 9. Observed mean weight-at-age in grams (g) of Pacific Herring by sample type in 2023 in the West Coast of Vancouver Island 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	44	72	84	97	108	119	123	142	122	
Seine test	46	74	89	102	110	134	151	144	NA	
Total	45	73	85	98	108	122	130	144	122	

Table 10. Observed mean length-at-age in millimetres (mm) of Pacific Herring by sample type in 2023 in the West Coast of Vancouver Island 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	146	169	179	187	194	198	200	212	208	
Seine test	146	168	178	186	191	201	209	207	NA	
Total	146	169	179	187	193	199	202	208	208	

Table 11. Observed number-at-age of Pacific Herring for nearshore samples from 2015 to 2023 in the West Coast of Vancouver Island 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	
2015	67	64	130	10	3	3	0	0	0	
2016	32	537	161	122	13	3	2	0	0	
2017	43	56	355	89	64	4	0	0	0	
2018	171	203	142	1157	196	105	18	0	1	
2019	101	616	82	37	106	15	6	0	0	
2020	168	161	179	28	8	34	6	2	2	
2021	47	479	146	90	11	5	8	1	1	
2022	138	465	656	160	136	16	7	11	4	
2023	23	798	484	384	105	52	8	1	3	

Table 12. Observed proportion-at-age of Pacific Herring for nearshore samples from 2015 to 2023 in the West Coast of Vancouver Island 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	
2015	0.242	0.231	0.469	0.036	0.011	0.011	0.000	0.000	0.000	
2016	0.037	0.617	0.185	0.140	0.015	0.003	0.002	0.000	0.000	
2017	0.070	0.092	0.581	0.146	0.105	0.007	0.000	0.000	0.000	
2018	0.086	0.102	0.071	0.581	0.098	0.053	0.009	0.000	0.001	
2019	0.105	0.640	0.085	0.038	0.110	0.016	0.006	0.000	0.000	
2020	0.286	0.274	0.304	0.048	0.014	0.058	0.010	0.003	0.003	
2021	0.060	0.608	0.185	0.114	0.014	0.006	0.010	0.001	0.001	
2022	0.087	0.292	0.412	0.100	0.085	0.010	0.004	0.007	0.003	
2023	0.012	0.429	0.260	0.207	0.057	0.028	0.004	0.001	0.002	

Table 13. Observed mean weight-at-age in grams (g) of Pacific Herring for nearshore samples from 2015 to 2023 in the West Coast of Vancouver Island 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	
2015	51	67	76	81	109	104	NA	NA	NA	
2016	49	66	72	81	88	83	88	NA	NA	
2017	58	70	85	91	94	98	NA	NA	NA	
2018	53	77	85	95	103	107	112	NA	114	
2019	54	70	81	100	111	116	118	NA	NA	
2020	56	69	85	94	114	125	110	131	120	
2021	57	71	82	101	111	90	124	121	121	
2022	57	71	89	100	118	126	123	128	148	
2023	44	72	84	97	108	119	123	142	122	

Table 14. Observed mean length-at-age in millimetres (mm) of Pacific Herring for nearshore samples from 2015 to 2023 in the West Coast of Vancouver Island 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	
2015	154	170	178	182	199	200	NA	NA	NA	
2016	154	171	178	186	188	197	192	NA	NA	
2017	166	178	190	193	197	201	NA	NA	NA	
2018	159	179	188	196	200	202	211	NA	220	
2019	155	170	179	191	198	203	201	NA	NA	
2020	156	169	180	186	200	205	197	214	204	
2021	156	172	180	193	202	188	208	209	197	
2022	165	176	189	196	205	209	208	217	222	
2023	146	169	179	187	194	198	200	212	208	

Table 15. Observed proportion-at-age for Pacific Herring from 2013 to 2023 in the West Coast of Vancouver Island 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	0.034	0.241	0.150	0.475	0.050	0.045	0.005	0.000	0.000	
2014	0.029	0.752	0.147	0.029	0.032	0.007	0.000	0.004	0.000	
2015	0.140	0.238	0.505	0.068	0.017	0.028	0.004	0.000	0.001	
2016	0.040	0.648	0.168	0.124	0.014	0.003	0.004	0.001	0.000	
2017	0.025	0.076	0.664	0.132	0.082	0.016	0.002	0.002	0.000	
2018	0.053	0.133	0.109	0.566	0.096	0.035	0.005	0.002	0.000	
2019	0.055	0.504	0.097	0.049	0.232	0.040	0.018	0.003	0.000	
2020	0.180	0.275	0.347	0.047	0.024	0.100	0.022	0.004	0.000	
2021	0.173	0.533	0.136	0.118	0.014	0.009	0.013	0.003	0.002	
2022	0.073	0.292	0.436	0.089	0.097	0.005	0.001	0.005	0.001	
2023	0.065	0.501	0.222	0.146	0.039	0.019	0.004	0.004	0.000	

Table 16. Pacific Herring spawn survey locations, start date, and spawn index in metric tonnes (t) in 2023 in the West Coast of Vancouver Island 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)
23	232	Forbes Is	March 09	408
23	232	Kvarno Is	March 08	0
23	232	Larkin Is	March 09	1,003
23	232	Macoah Pass	March 06	954
23	232	Maggie Rvr	March 06	374
23	232	Mayne Bay	March 17	1,520
23	232	Ottaway Islet	March 09	217
23	232	Port Albion	March 08	95
23	232	Spilling Islet	March 09	578
23	232	Spring Cv	March 08	417
23	232	St Ines Is	March 09	726
23	232	Stopper Is	March 09	3,069
23	232	Stuart Bay	March 08	460
23	232	Toquart Bay	March 09	208
23	232	Two Rivers +	March 06	2,297
23	232	Ucluelet	March 08	141
23	232	Ucluelet Head	March 08	65
24	242	Antons Spit	January 18	6,706
24	242	Hesquiat Hrbr	March 06	1,101
24	242	Hesquiat Hrbr Hd	March 06	708
24	242	Hesquiat Pen	March 08	8,394
24	242	Hesquiat Pt	March 08	25,022
24	242	Leclaire Pt	March 06	1,296
24	242	Matlahaw Pt	March 08	4,808
24	242	Rondeault Pt	January 18	15
24	243	Baseball Cv +	March 10	875
24	243	Hootla Kootla +	March 10	964
24	243	Hot Springs Cv	March 08	5,417
24	243	Starling Pt	March 10	127
24	244	McNeil Pen	March 03	NA
24	245	Chetarpe Reserve	March 18	432
24	245	Clifford Pt	March 18	21
24	245	Father Charles Chnl	February 21	NA
24	245	Flores Is S	March 15	NA
24	245	Vargas Is	March 17	NA
24	245	Whitesand Cv	March 18	2,171
25	252	Escalante Rocks	March 21	NA
25	253	Inner Nuchatlitz	February 28	1,448

*Table 16 continued*

Statistical Area	Section	Location name	Start date	Spawn index (t)
25	253	Nuchatlitz Inlt	March 17	NA
25	253	Outer Nuchatlitz	February 28	185
25	253	Port Langford	February 28	4,594
25	253	Rosa Hrbr	March 06	172
25	253	Rosa Is	March 06	18

Table 17. Summary of Pacific Herring spawn survey data from 2013 to 2023 in the West Coast of Vancouver Island 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	33,775	103	1.1	12,258
2014	35,825	144	1.1	13,937
2015	20,450	276	1.1	11,323
2016	60,575	122	1.4	20,528
2017	44,200	181	1.3	16,476
2018	61,825	137	1.5	28,107
2019	49,325	131	1.2	17,030
2020	44,125	163	0.9	18,761
2021	45,851	204	1.1	29,339
2022	64,925	168	1.3	23,707
2023	74,850	195	1.9	77,005

## 7 Figures

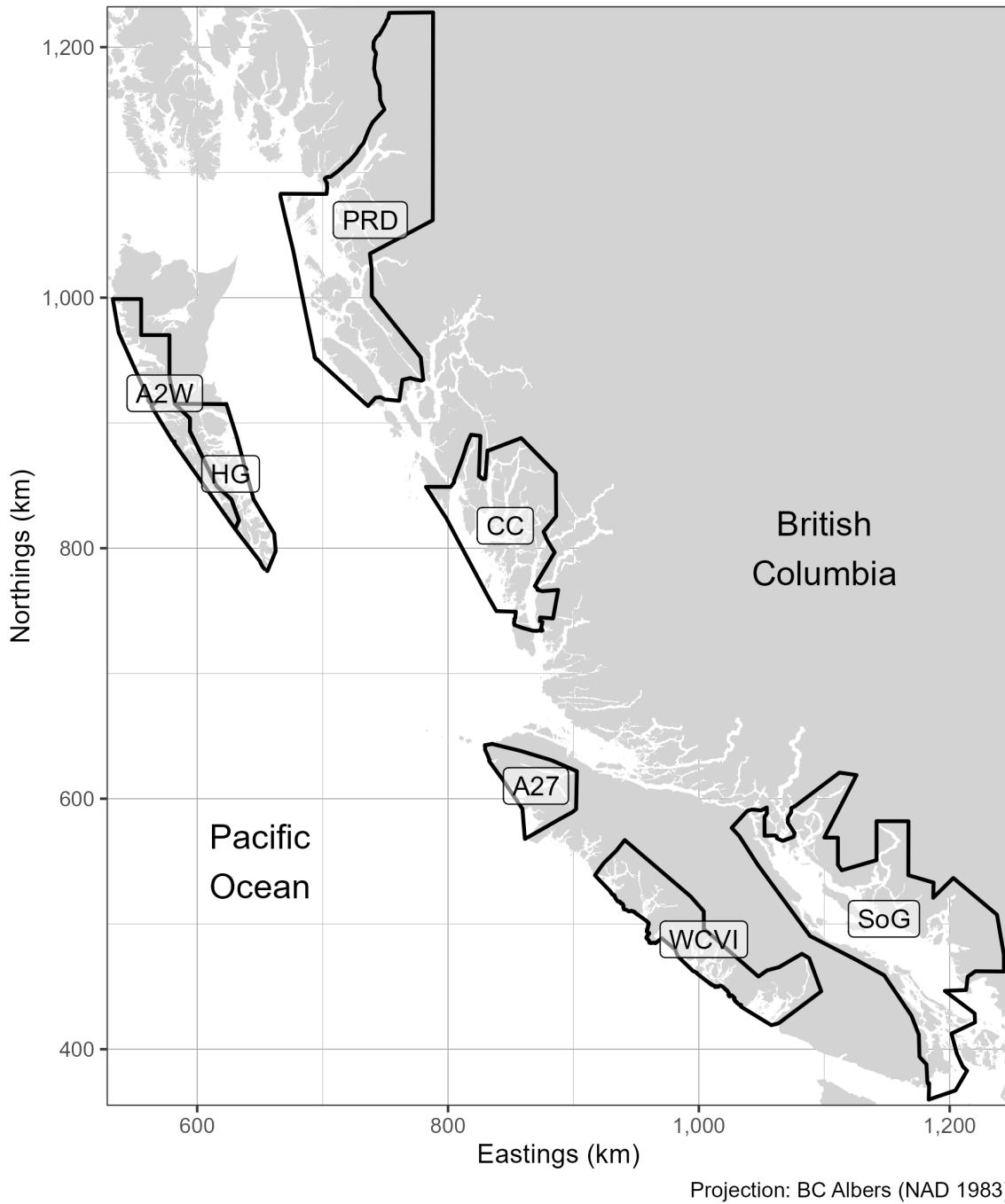


Figure 1. Boundaries for the Pacific Herring stock assessment regions (SARs) in British Columbia. There are 5 major SARs: Haida Gwaii (HG), Prince Rupert District (PRD), Central Coast (CC), Strait of Georgia (SoG), and West Coast of Vancouver Island (WCVI). There are 2 minor SARs: Area 27 (A27) and Area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

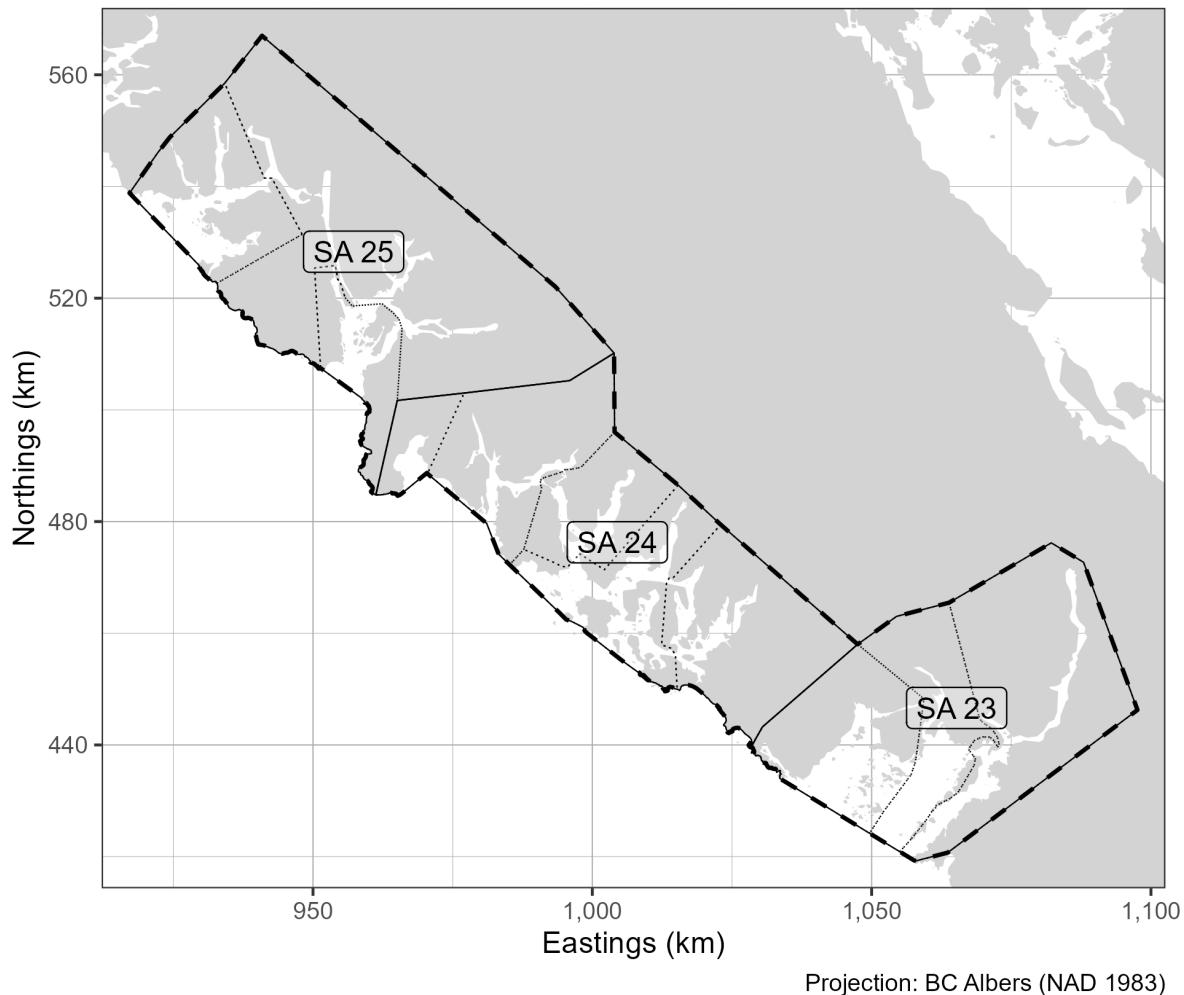


Figure 2. Boundaries for the West Coast of Vancouver Island major stock assessment region (SAR; thick dashed lines), associated Statistical Areas (SA; thin solid lines), and associated Sections (thin dotted lines). Units: kilometres (km).

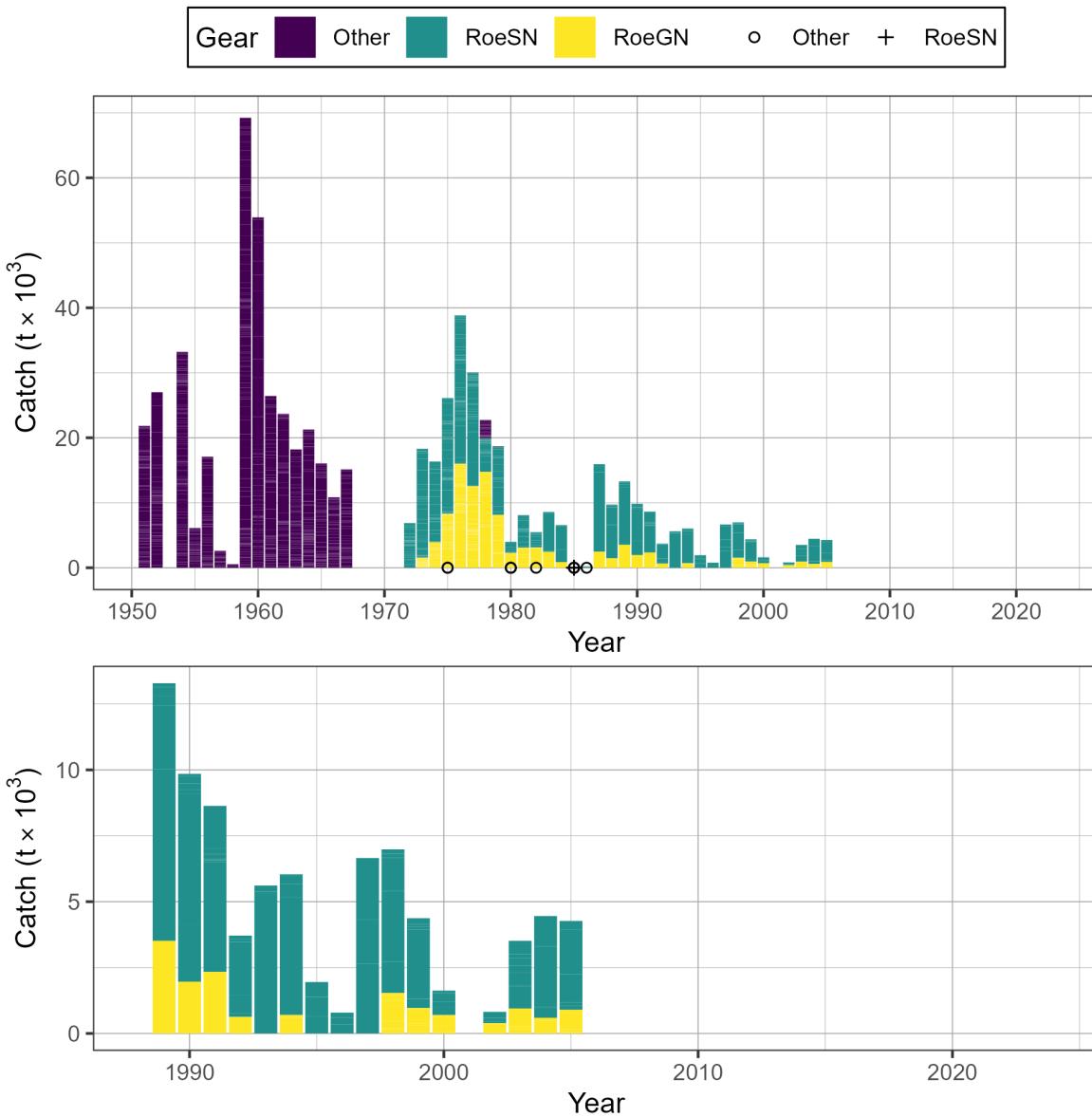


Figure 3. Time series of total landed catch in thousands of metric tonnes ( $t \times 10^3$ ) of Pacific Herring by gear type from 1951 to 2023 in the West Coast of Vancouver Island major stock assessment region (SAR). Legend: ‘Other’ represents the reduction (1951 to 1970 only), the food and bait, as 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.

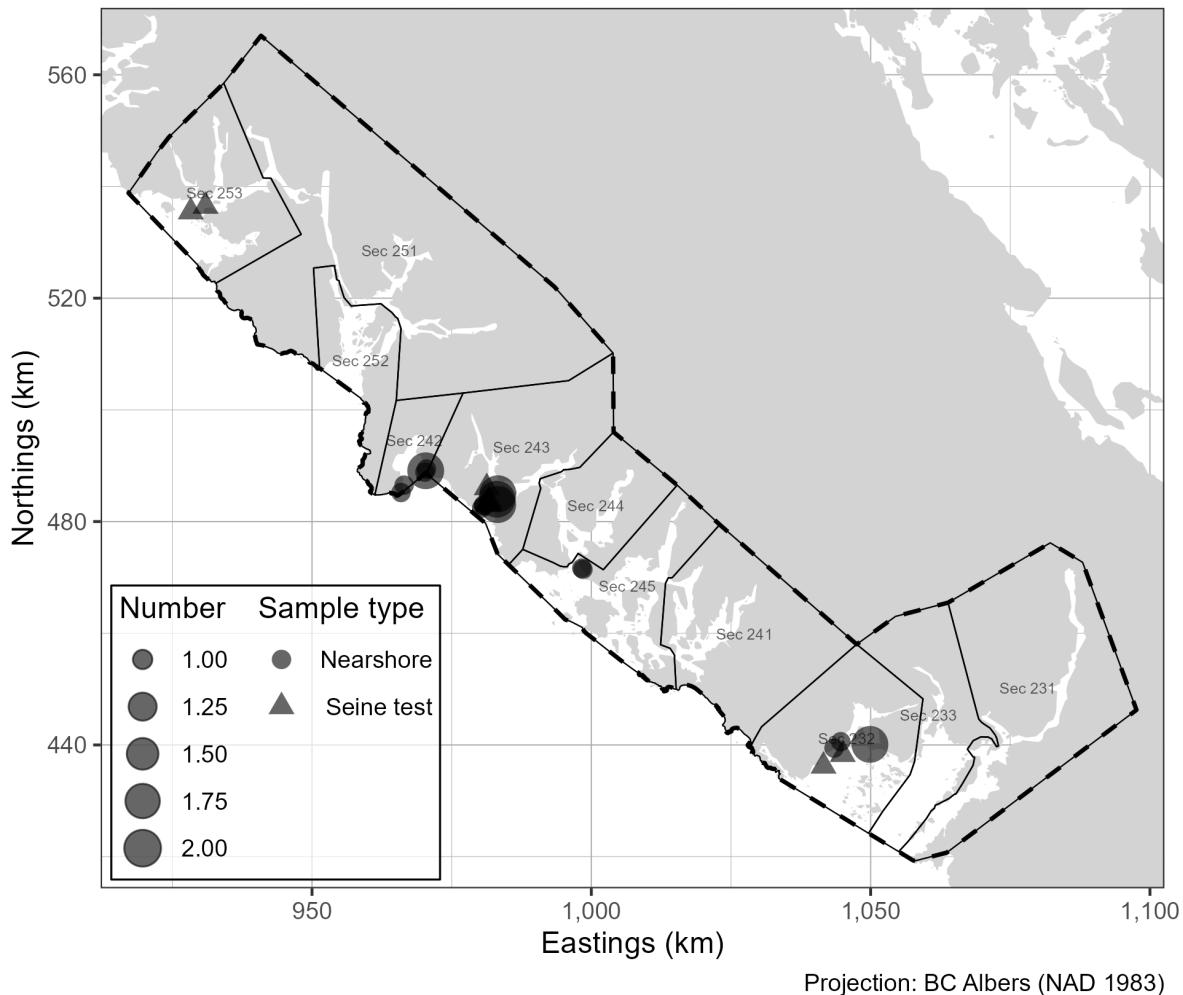


Figure 4. Location and type of Pacific Herring biological samples collected in 2023 in the West Coast of Vancouver Island major stock assessment region (SAR; thick dashed lines), and associated Sections (Sec; thin solid lines). Units: kilometres (km).

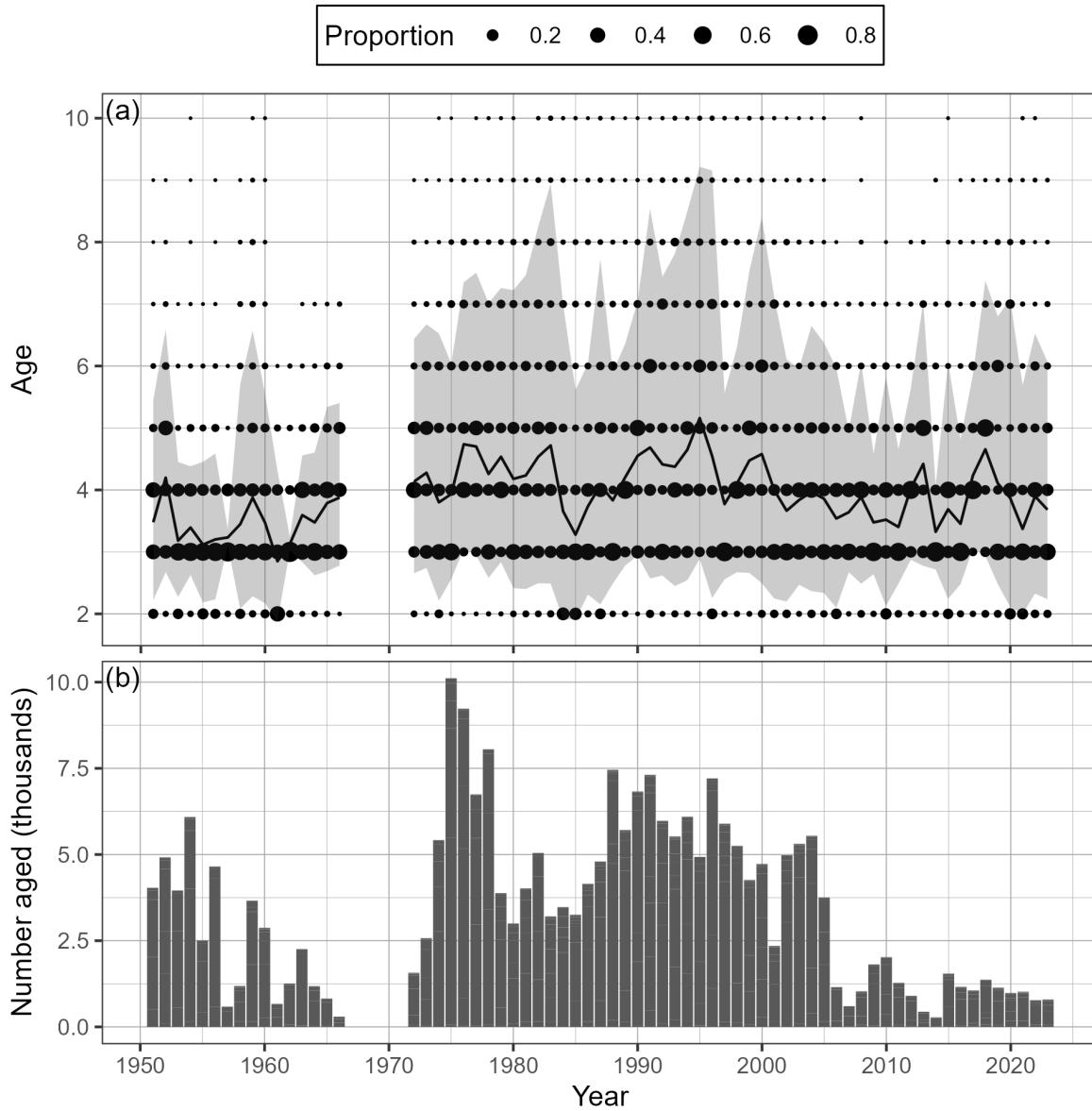


Figure 5. Time series of observed proportion-at-age (a) and number aged in thousands (b) of Pacific Herring from 1951 to 2023 in the West Coast of Vancouver Island major stock assessment region (SAR). The black line is the mean age, and the shaded area is the approximate 90% distribution. Biological 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.

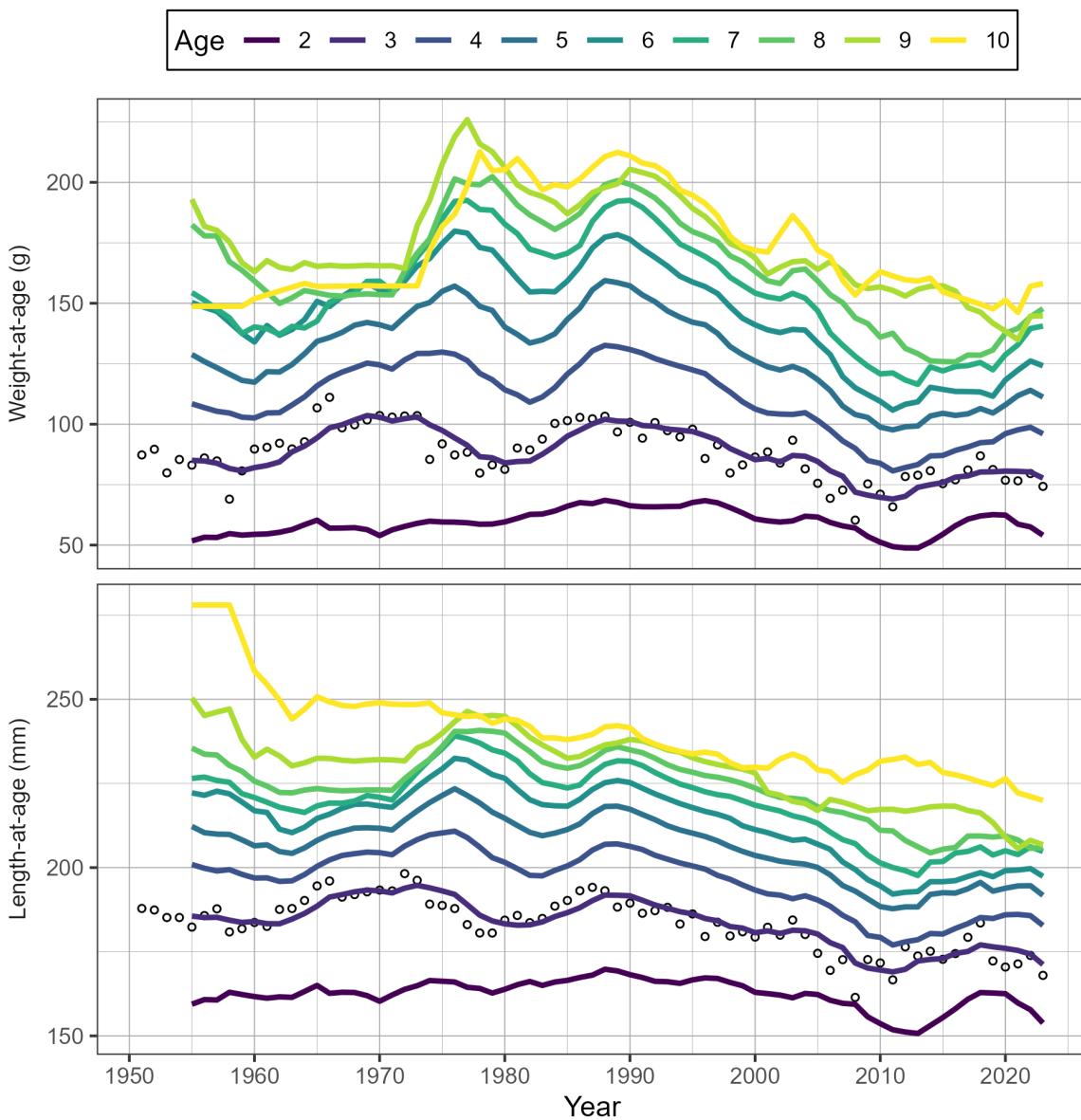


Figure 6. Time series of weight-at-age in grams (g) and length-at-age in millimetres (mm) for age-3 (circles) and 5-year running mean weight- and length-at-age (lines) for Pacific Herring from 1951 to 2023 in the West Coast of Vancouver Island major stock assessment region (SAR). Missing weight- and 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.

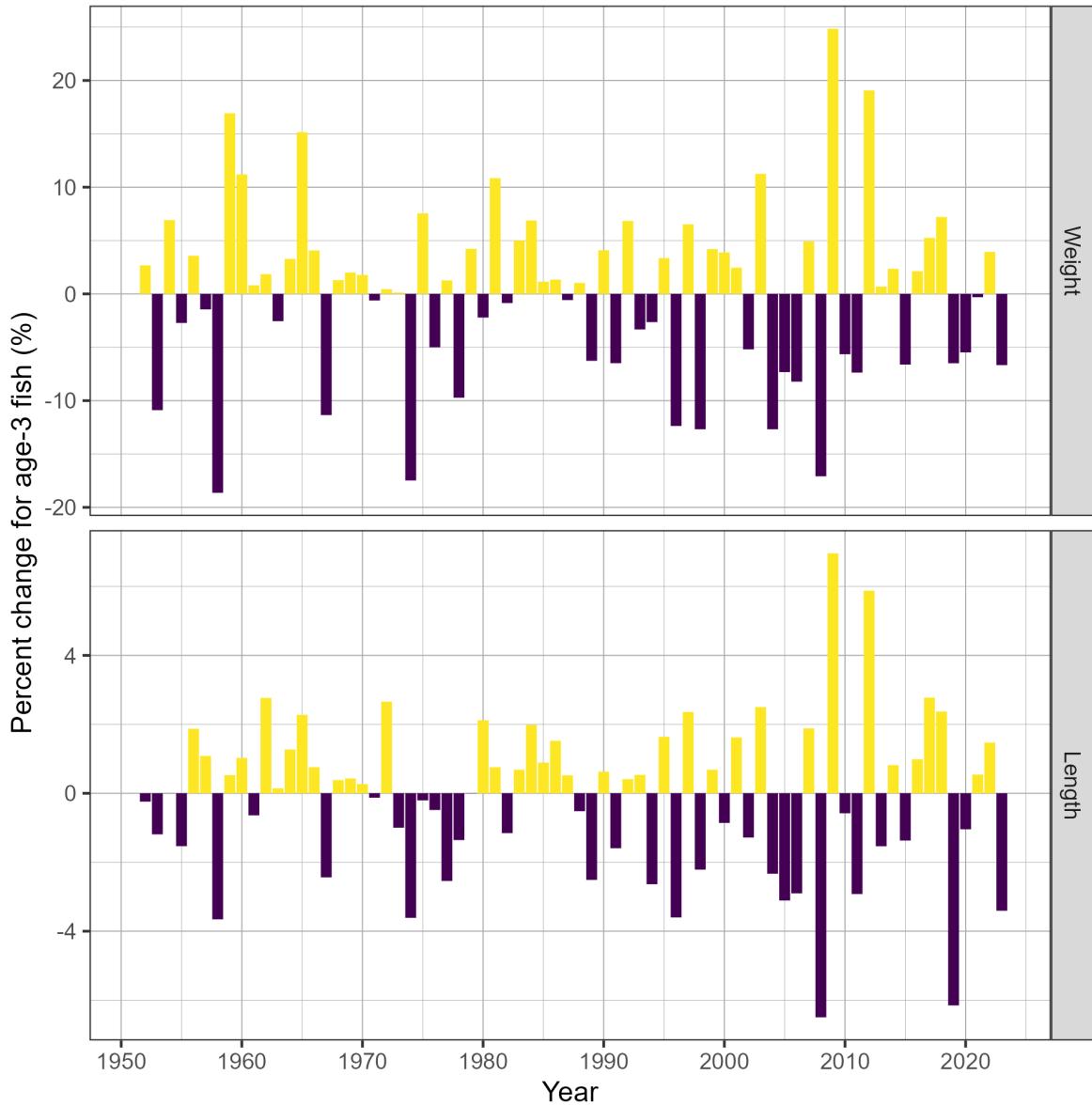


Figure 7. Time series of percent change (%) in weight and length for age-3 fish for Pacific Herring from 1951 to 2023 in the West Coast of Vancouver Island major stock assessment region (SAR). Percent change is  $\delta_t = \frac{\alpha_t - \alpha_{t-1}}{\alpha_{t-1}}$  where  $\alpha_t$  is the weight 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.

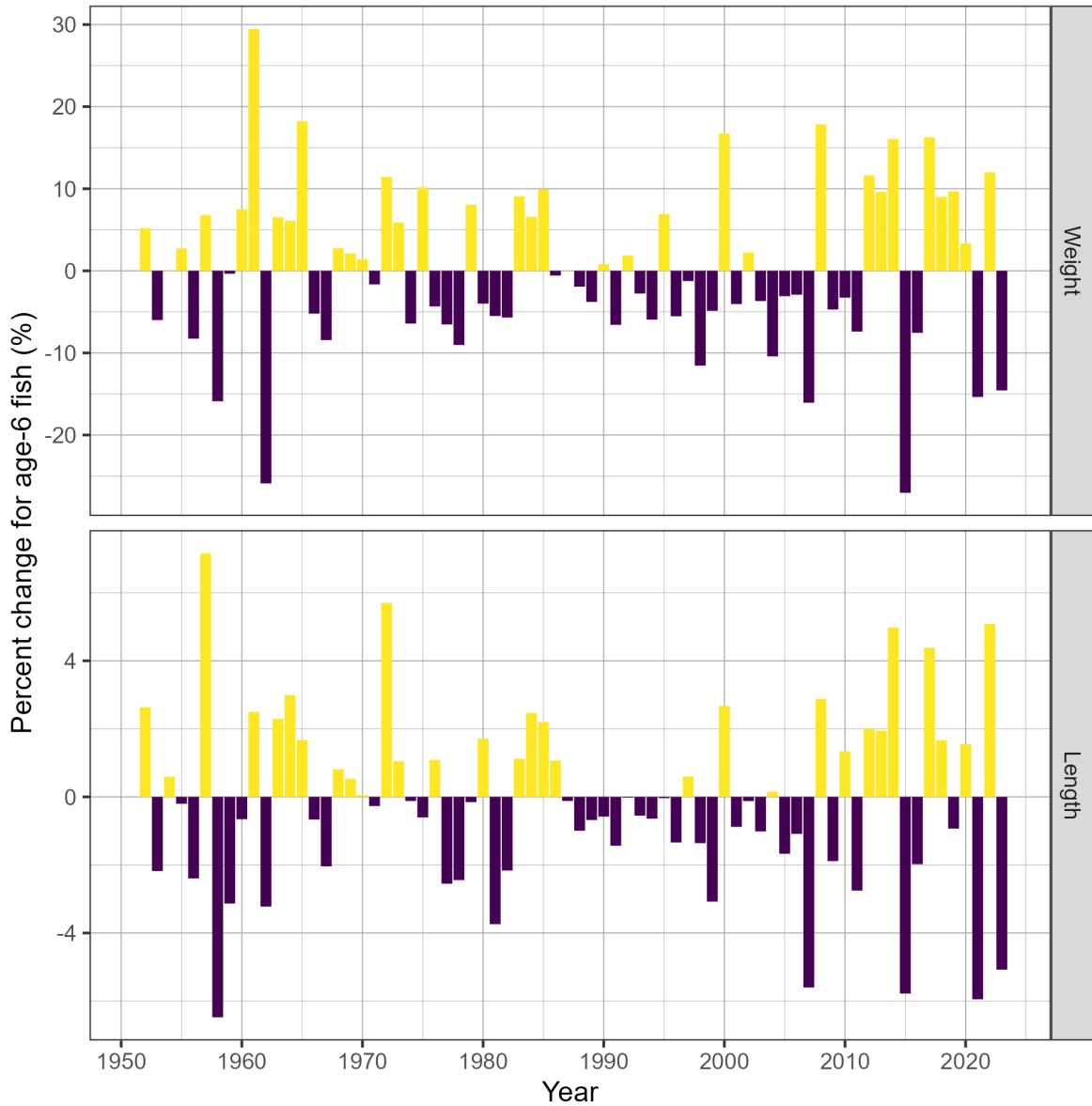


Figure 8. Time series of percent change (%) in weight and length for age-6 fish for Pacific Herring from 1951 to 2023 in the West Coast of Vancouver Island major stock assessment region (SAR). Percent change is  $\delta_t = \frac{\alpha_t - \alpha_{t-1}}{\alpha_{t-1}}$  where  $\alpha_t$  is the weight 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.

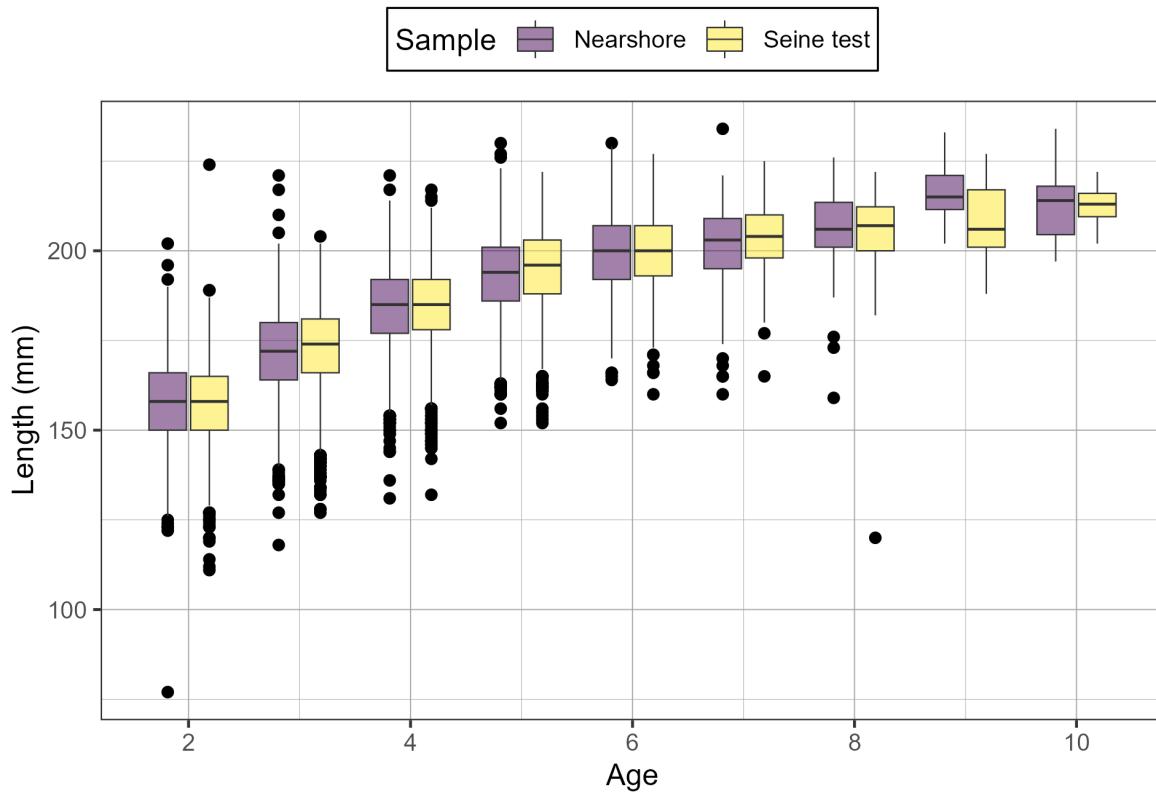


Figure 9. Length-at-age in millimetres (mm) of Pacific Herring from 2015 to 2023 in the West Coast of Vancouver Island major stock assessment region (SAR) by sample type. The outer edges of the boxes indicate the 25<sup>th</sup> and 75<sup>th</sup> percentiles, and the middle lines indicate the 50<sup>th</sup> percentiles (i.e., medians). The whiskers extend to 1.5 × IQR, where IQR is the distance between the 25<sup>th</sup> and 75<sup>th</sup> 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.

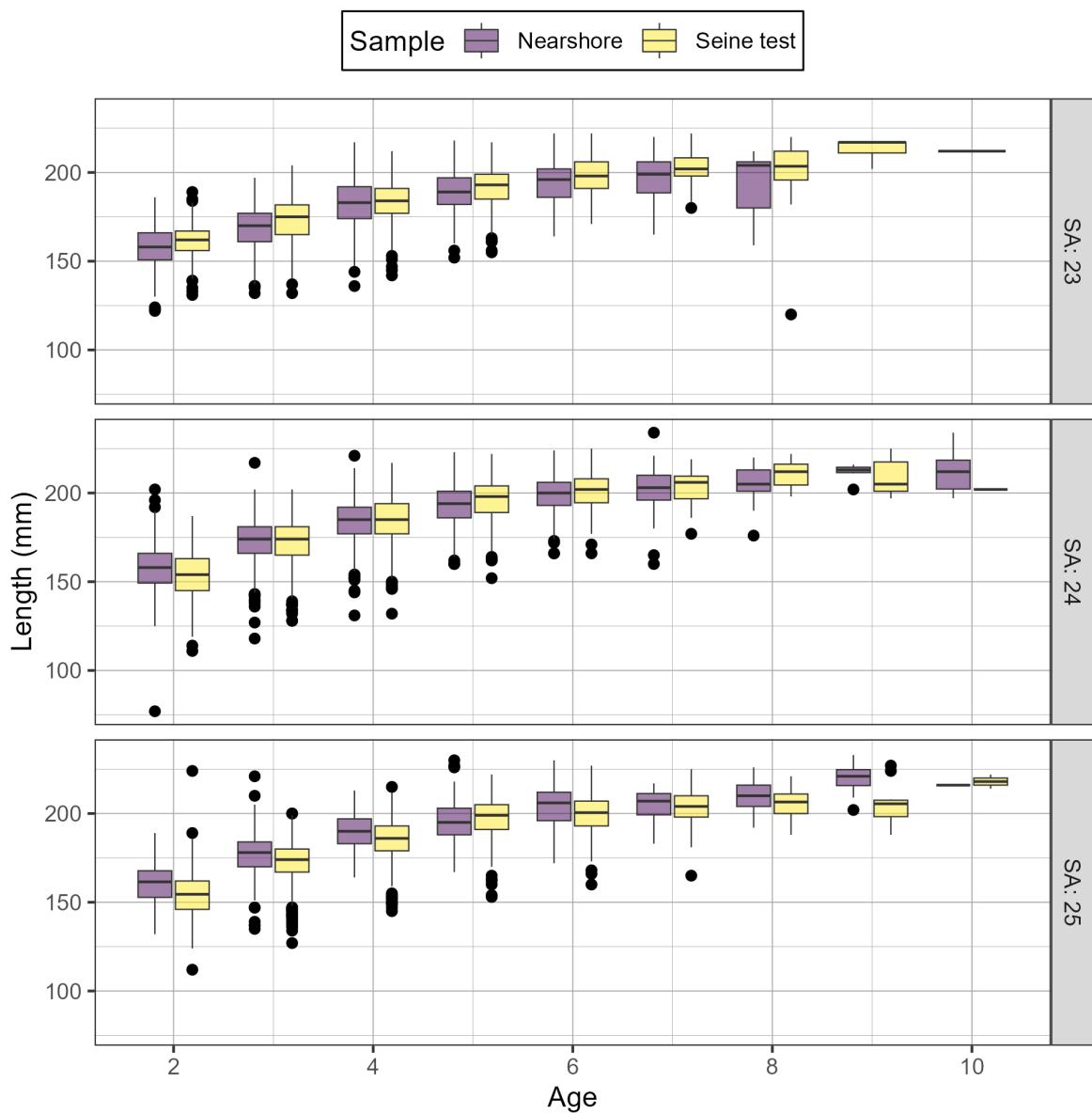


Figure 10. Length-at-age in millimetres (mm) of Pacific Herring from 2015 to 2023 in the West Coast of Vancouver Island major stock assessment region (SAR) by sample type and statistical area (SA). The outer edges of the boxes indicate the 25<sup>th</sup> and 75<sup>th</sup> percentiles, and the middle lines indicate the 50<sup>th</sup> percentiles (i.e., medians). The whiskers extend to 1.5 × IQR, where IQR is the distance between the 25<sup>th</sup> and 75<sup>th</sup> 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.

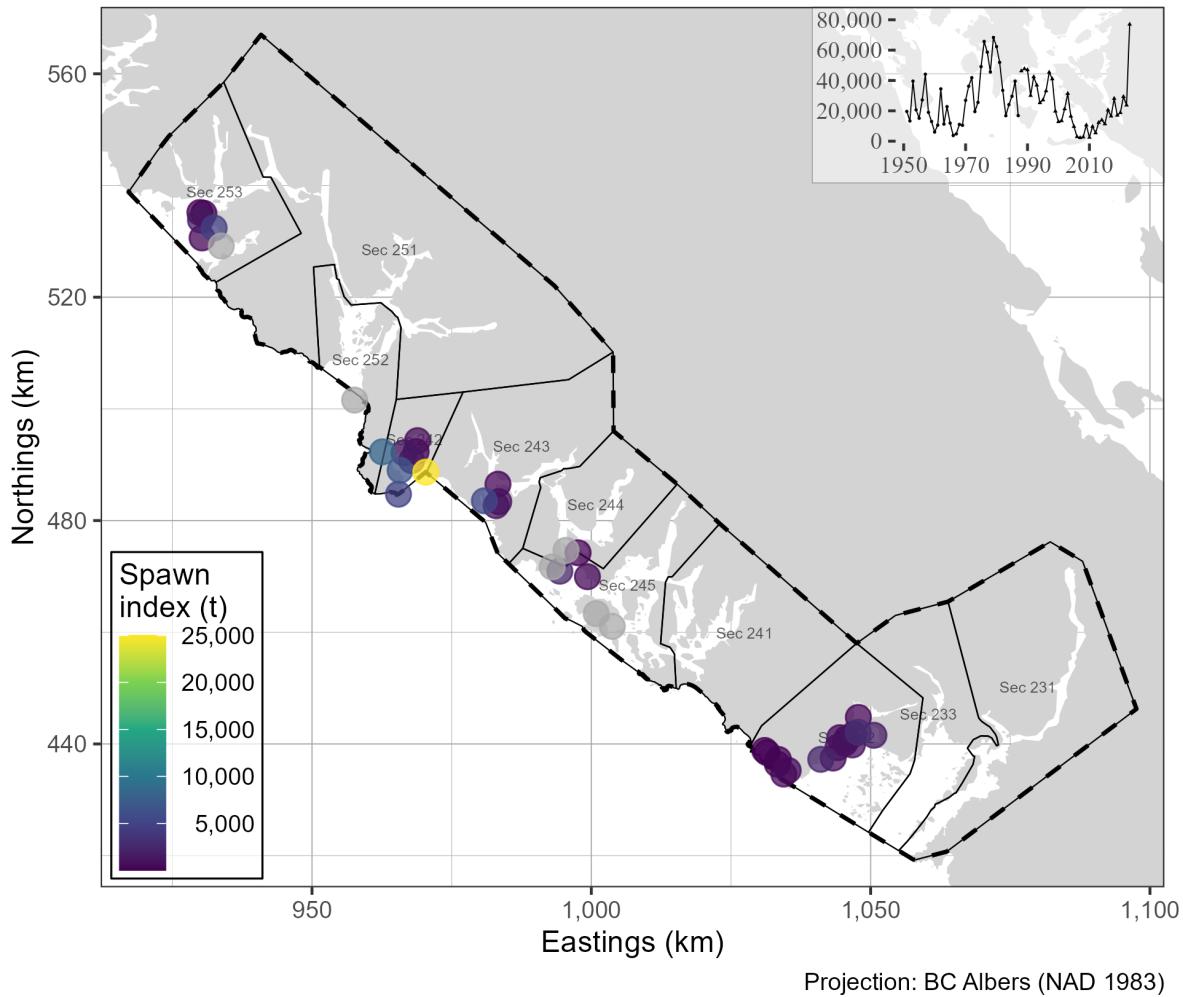


Figure 11. Pacific Herring spawn survey locations, and spawn index in metric tonnes (t) in 2023 in the West Coast of Vancouver Island major stock assessment region (SAR; thick dashed lines), and associated Sections (Sec; thin solid lines). The ‘spawn index’ is not scaled by the spawn survey scaling parameter,  $q$ . Missing spawn index values indicate incomplete surveys (grey circles). Inset tracks the total spawn index. Units: kilometres (km).

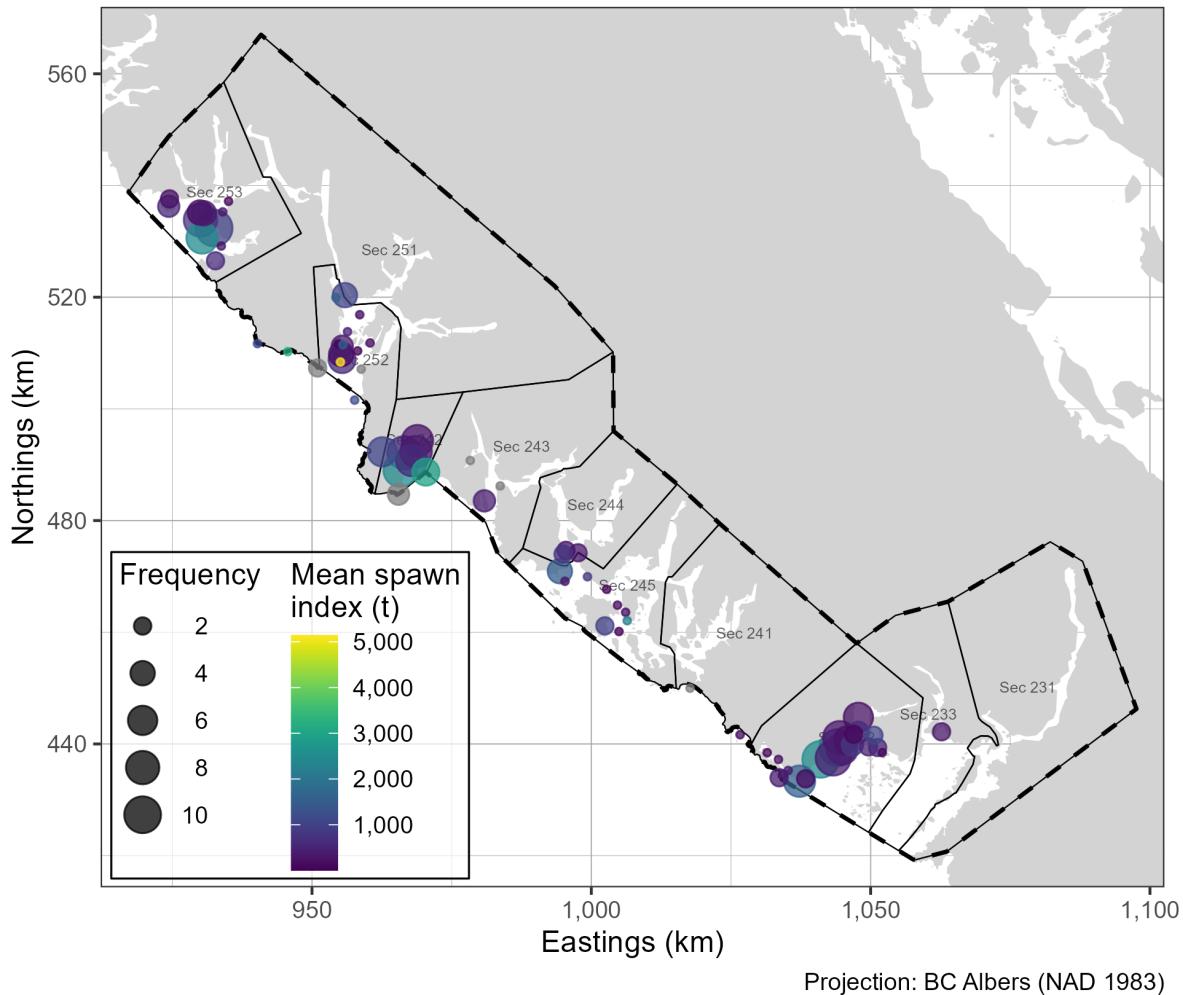


Figure 12. Pacific Herring spawn survey locations, mean spawn index in metric tonnes (t), and spawn frequency from 2013 to 2022 in the West Coast of Vancouver Island major stock assessment region (SAR; thick dashed lines), and associated Sections (Sec; thin solid lines). The ‘spawn index’ is not scaled by the spawn survey scaling parameter,  $q$ . Missing spawn index values indicate incomplete surveys (grey circles). Units: kilometres (km).

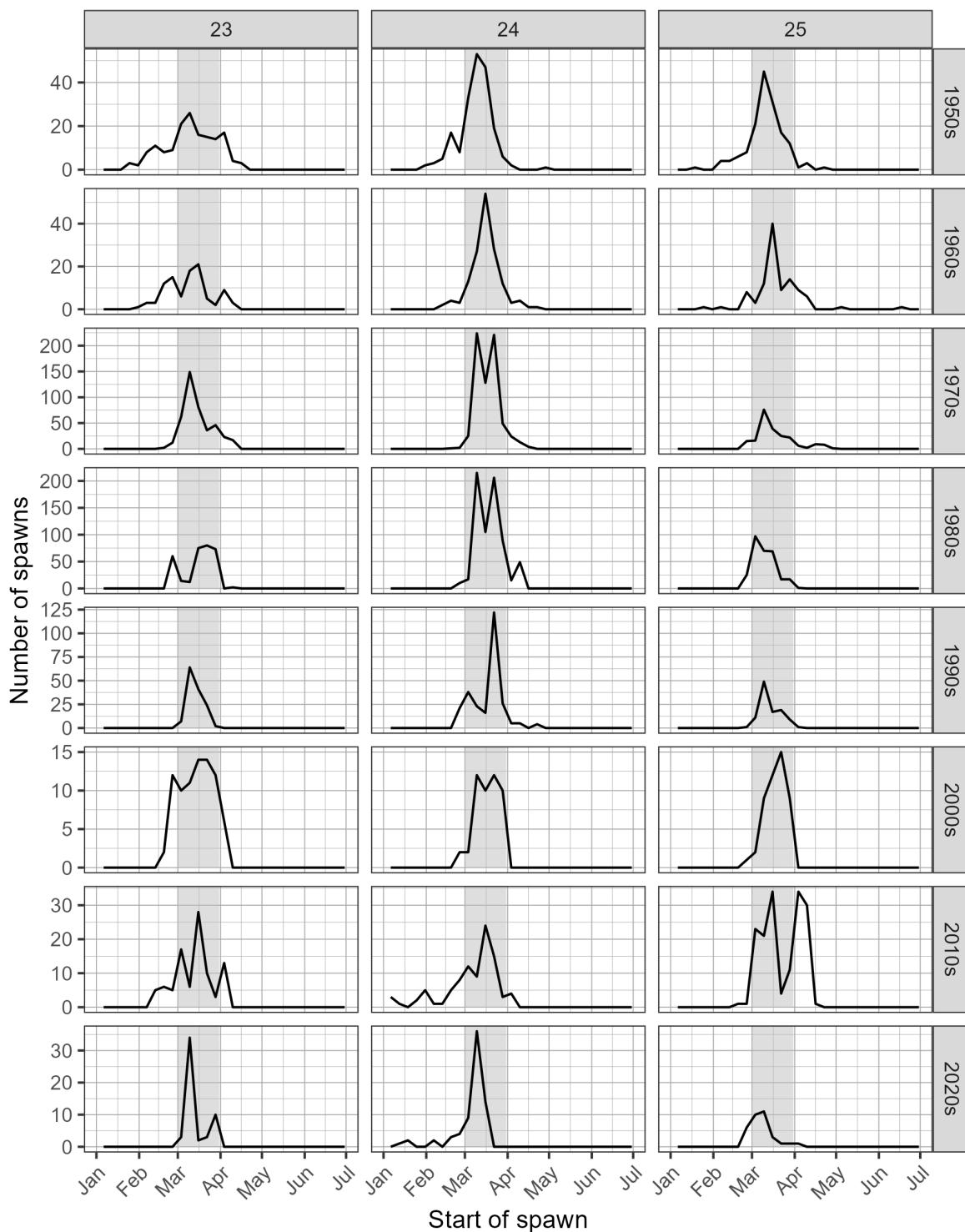


Figure 13. Pacific Herring spawn start date by decade and Statistical Area. Grey shaded regions indicate March 1<sup>st</sup> to 31<sup>st</sup>. Note that spawn size and intensity varies; therefore the number of spawns is not directly proportional to spawn extent or biomass.

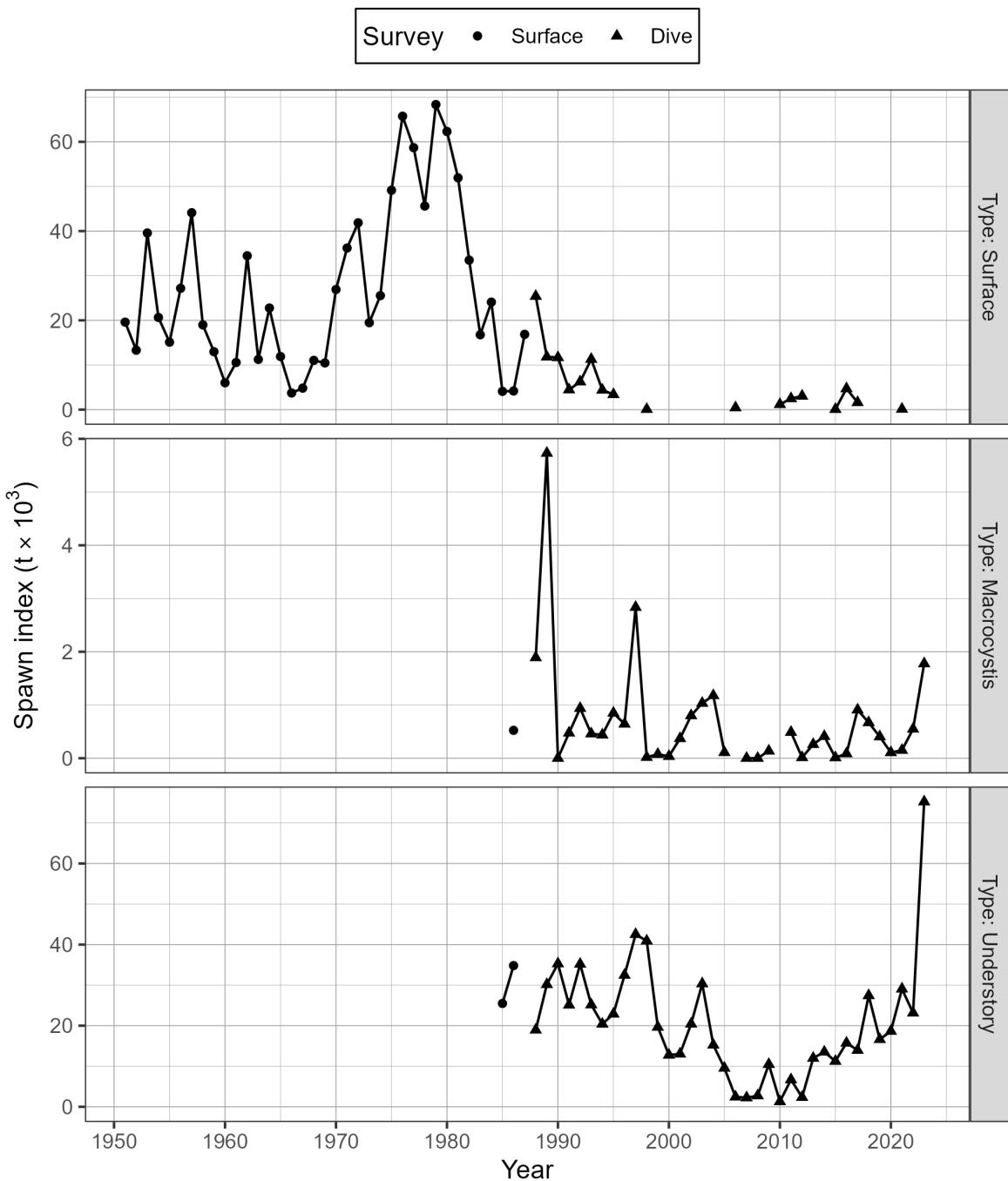


Figure 14. Time series of spawn index in thousands of metric tonnes ( $t \times 10^3$ ) by type for Pacific Herring from 1951 to 2023 in the West Coast of Vancouver Island major stock assessment region (SAR). There are three types of spawn survey observations: observations of spawn taken from the surface 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).

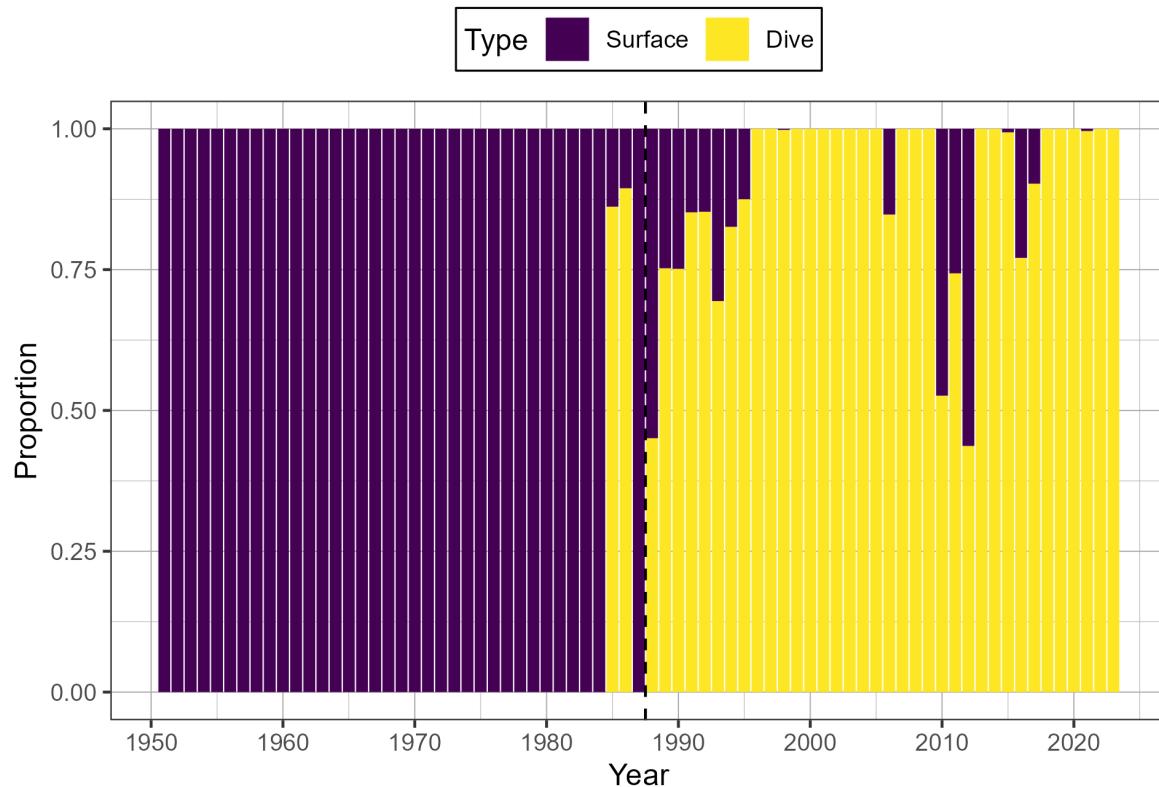


Figure 15. Time series of proportion of spawn index by surface and dive surveys for Pacific Herring from 1951 to 2023 in the West Coast of Vancouver Island major stock assessment region (SAR). The spawn index has two distinct periods defined by the dominant coastwide survey method: surface surveys (1951 to 1987), and dive surveys (1988 to 2023).

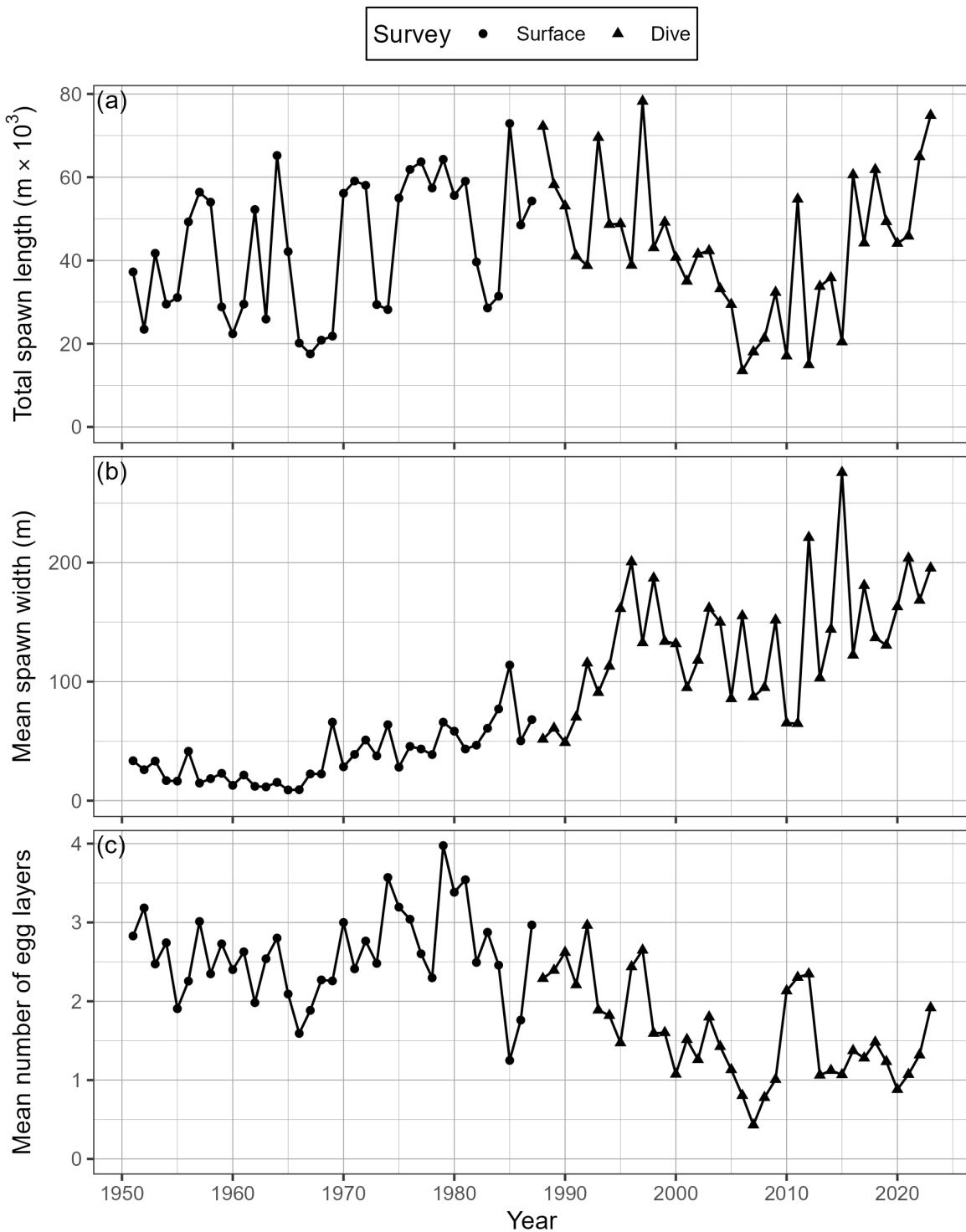


Figure 16. Time series of total spawn length in thousands of metres ( $m \times 10^3$ ; panel a), mean spawn width in metres (b), and mean number of egg layers (c) for Pacific Herring from 1951 to 2023 in the West Coast of Vancouver Island major stock assessment region (SAR). The spawn index has two distinct periods defined by the dominant coastwide survey method: surface surveys (1951 to 1987), and dive surveys (1988 to 2023).

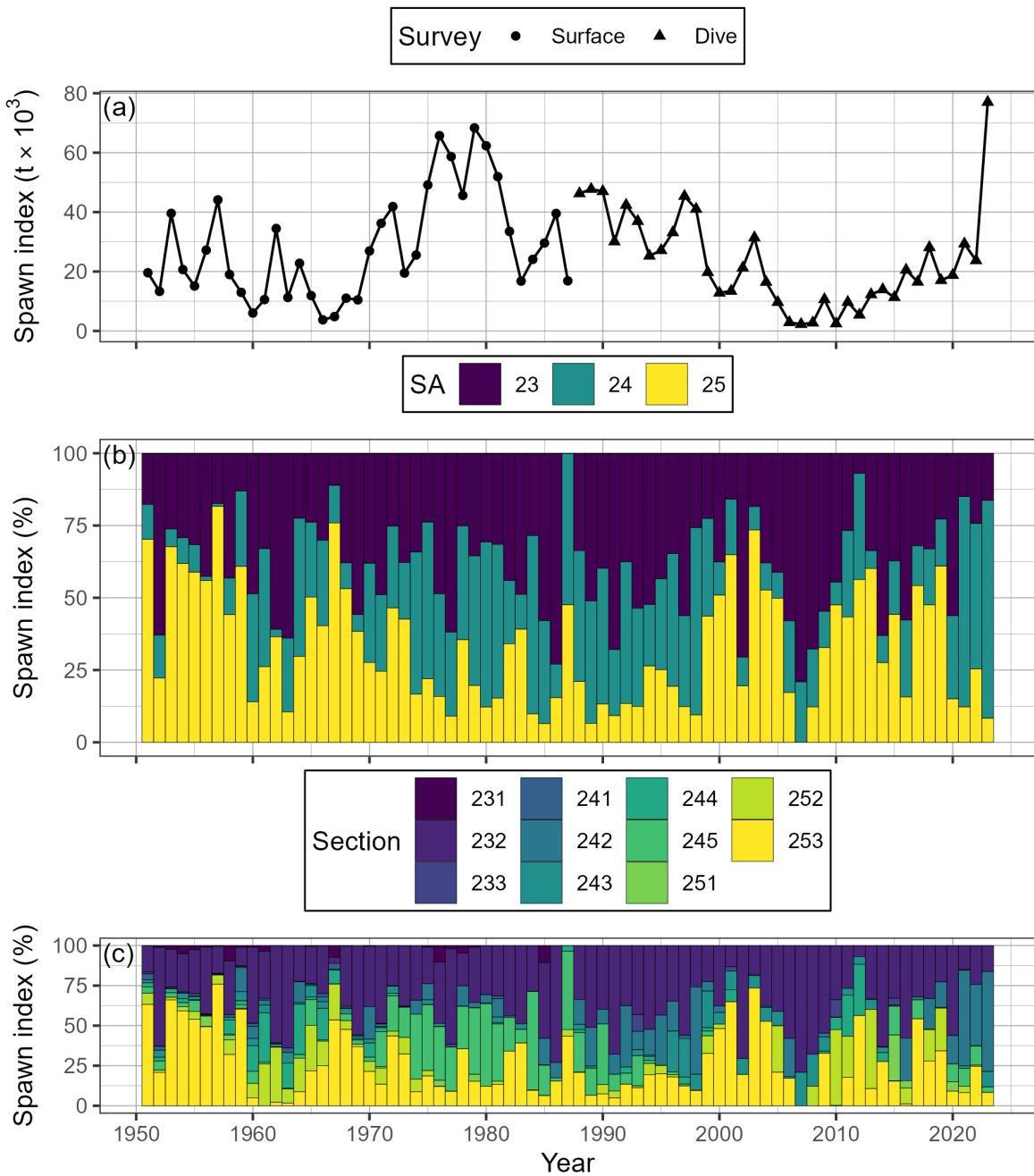


Figure 17. Time series of spawn index in thousands of metric tonnes ( $t \times 10^3$ ) for Pacific Herring from 1951 to 2023 in the West Coast of Vancouver Island major stock assessment region (SAR; panel a), as well as percent contributed by Statistical Area (SA), and Section (b, & c, respectively). 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 14 and 15). The ‘spawn index’ is not scaled by the spawn survey scaling parameter,  $q$ .

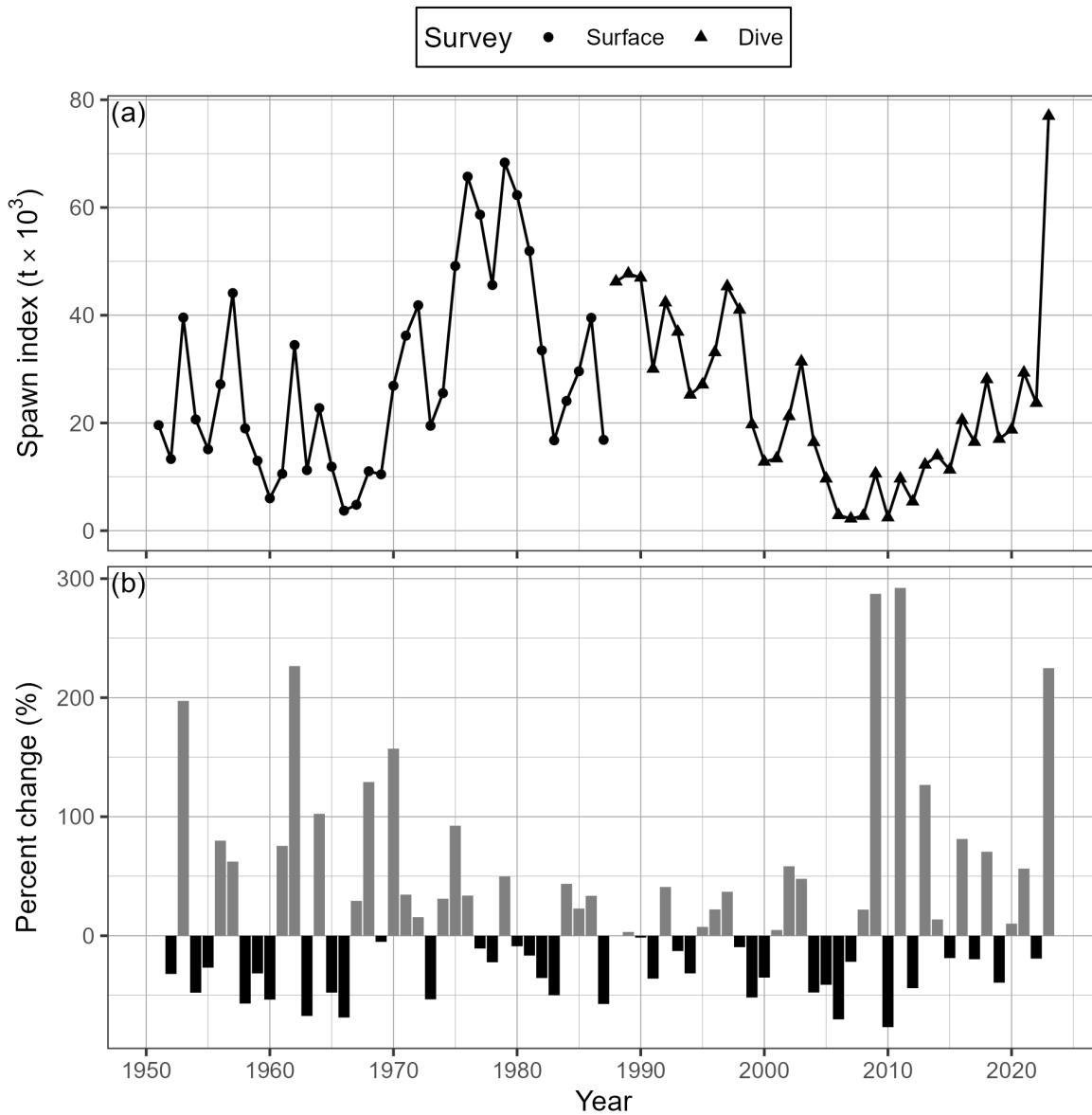


Figure 18. Time series of spawn index in thousands of metric tonnes ( $t \times 10^3$ ) for Pacific Herring from 1951 to 2023 in the West Coast of Vancouver Island major stock assessment region (SAR; panel a), and percent change (b). Percent change is  $\delta_t = \frac{\alpha_t - \alpha_{t-1}}{\alpha_{t-1}}$  where  $\alpha_t$  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 14 and 15).

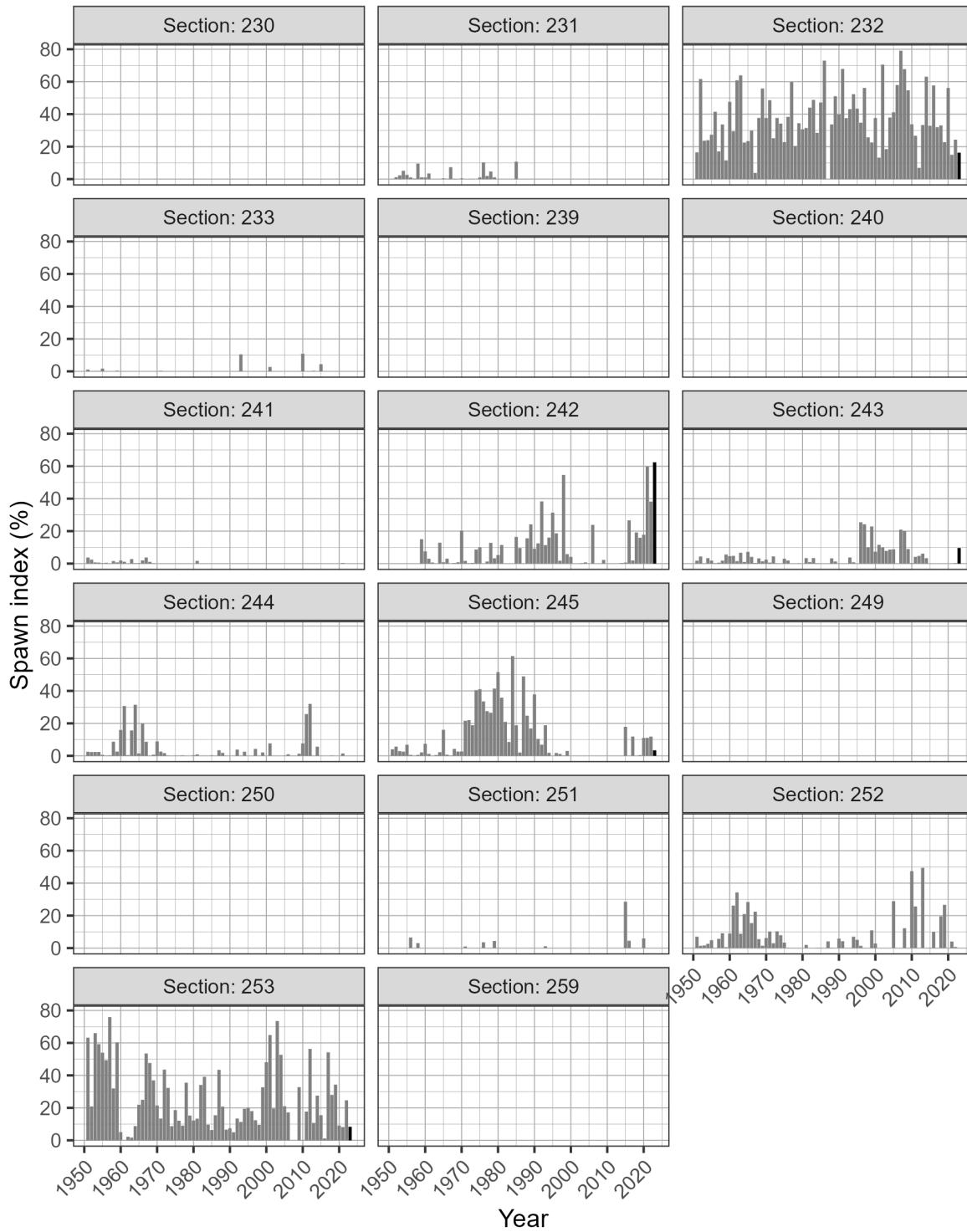


Figure 19. Time series of percent of spawn index by Section for Pacific Herring from 1951 to 2023 in the West Coast of Vancouver Island major stock assessment region (SAR). The year 2023 has a darker bar to facilitate interpretation. The spawn index has two distinct periods defined by the dominant coastwide 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,  $q$ .

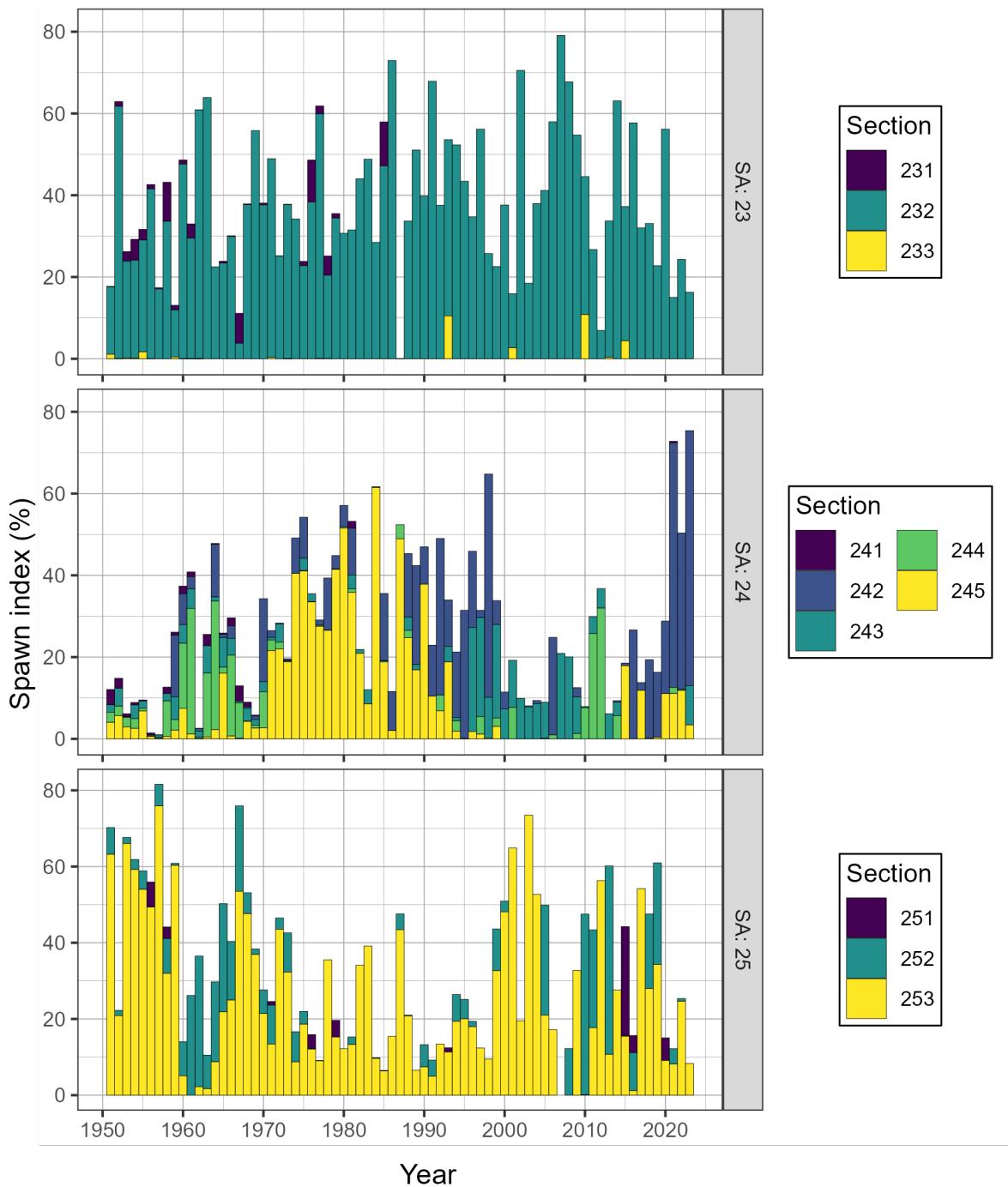


Figure 20. Time series of percent of spawn index by Statistical Area (SA) and Section for Pacific Herring from 1951 to 2023 in the West Coast of Vancouver Island major stock assessment region (SAR). The spawn index has two distinct periods defined by the dominant coastwide survey method: surface surveys (1951 to 1987), and dive surveys (1988 to 2023). The ‘spawn index’ is not scaled by the spawn survey scaling parameter,  $q$ .

Figure 21. Animation of Pacific Herring spawn index in metric tonnes (t) by Location from 1951 to 2023 in the West Coast of Vancouver Island 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”.