Pacific Herring preliminary data summary for Strait of Georgia 2024

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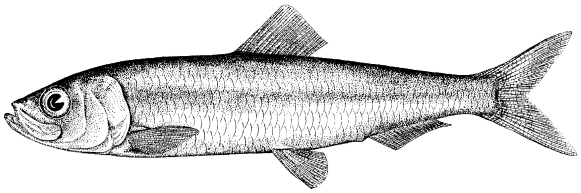

Pacific Herring (*Clupea pallasii*). Image credit: Fisheries and Oceans Canada.

Disclaimer This report contains preliminary data collected for Pacific Herring in 2024 in the Strait of Georgia 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). Note that formal stock assessments are only done for major SARs. The Pacific Herring data collection program includes fishery-dependent and -independent data from 1951 to 2024. 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

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stakeholders to locate fish and identify areas of high and 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 2024 in the Strait of Georgia 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 Strait of Georgia 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 2024 refers to the 2023/2024 Pacific Herring season.

2 Data collection programs

Biological samples were collected by the seine charter vessel *Denman Isle* for 27 days from February 20th to March 17th. Three additional industry test vessels collected biological samples from March 1st to March 14th. The primary purpose of the test charter vessel was to collect biological samples from main aggregations of herring in the SoG, as identified from soundings within the SAR boundary.

Herring spawn locations were primarily identified with fixed-wing overflights conducted by DFO Resource Management and Science staff. Fourteen flights were conducted this season, all in March.

Three dive vessels operated in the SoG:

- The *Pacific Discovery* surveyed 21 days from March 20th to April 9th,
- The *Ocean Cloud* surveyed 12 days from March 20th to March 31st, and
- Divers with A-Tlegay Fisheries Society surveyed 1 day on March 13th.

The two dive vessels and the seine charter vessel *Denman Isle* were funded by DFO, through a contract to the Herring Conservation Research Society. Additional sampling and sounding efforts conducted through the Industry Test Program were contributed in-kind by the Herring Industry.

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 2024 in the Strait of Georgia major SAR is shown in Table 4; we also calculate the estimated spawning biomass associated with SOK harvest. See the spawn index technical report for calculations to convert SOK harvest to spawning biomass. Incidental mortality from fisheries and aquaculture activities is shown in Figure 4.

In 2024, 101 Pacific Herring biological samples were collected and processed for the Strait of Georgia major SAR (Table 5, Table 6). The locations in which the biological samples were collected are presented in Figure 5. Figure 6 shows the distribution of fish weight by year and sample type. Included herein are biological summaries of observed proportion-, number-, weight-, and length-at-age (Figure 7, Table 7, and Figure 8, respectively). We also show the percent change in weight and length for age-3 and age-6 fish (Figure 9 & Figure 10, 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 52 individual locations in 2024 in the Strait of Georgia major SAR (Table 8, and Figure 11). A summary of spawn from the last decade (2014 to 2023) is shown in Figure 12. Figure 13 shows spawn start date by decade and Group. 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 9, and Figure 18). See the 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 2024).

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 2024, Section 143 contributed the most to the spawn index (45%). As with Sections, some Groups 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 2024 (Figure 21).

5 First Nations observations

The following observations were contributed by representatives of First Nations communities. These observations provide context and perspectives to this data report. In some cases we make minor edits for clarity and brevity, but we do not change the intent or substance of responses.

5.1 Homalko

Weather delayed the trip to Bute Inlet. Cruised the East shoreline from Alpha Bluff to Bear River on Tuesday March 12th but no definitively white milt in water and no herring predators observed. Found the small spawn (about 170m) reported by Bute Inlet Resort on March 8th on either side of their dock, but the spawn had stopped some time before we arrived on March 12th. No milt and no herring observed, just a very few birds and one otter. The spawn was spotty and about 2-3m wide in rock weed, as well as on a small patch of grass and on rocks. No spawning activity observed on the western shore from Purcell Point back to Orford Bay.

5.2 Qualicum

Spawns observed this year were longer and narrow and for the most part for shorter periods of time. Early and late spawns may be insurance against environmental disasters. These long skinny spawns seemed like fish were looking for optimum places to spawn. Could also be lack of substrate (e.g., seaweed) to spawn on. Fish started and continued to spawn in the shallows on ebb tides. There appeared to be deep water spawning with milt floating to surface along the edge of the spawn. Observed spawn was about half of what was observed last year, taking into consideration the narrow spawns and short duration spawns.

- March 6th active spawn off southern Cortez Island (100m by 15m); several schools in 20 to 40 fathoms (50 to 100 tons); washed out spawn along shallows on Southeast shore of Cortez Island (1.5 miles); collected a genetics sample in three fathom; sounded 1,000 to 1,500 tons in deep water on bottom; sounded 200 to 300 tons on the bottom in the horseshoe off Cape Lazo; and sounded 500 tons while crossing the bar heading to Henry Bay.
- March 7th: no fish in Baynes Sound; and sounded 300 to 400 tons in upper middle Lambert Channel.
- March 8th: sounded a few fish in deep hole at top end of Baynes Sound.
- March 10th: a few fish on sounder in lower Baynes Sound.

- March 11th: a few fish on sounder off Bowser Shore and Nile Creek; and large school of herring one mile North of French Creek in 20 to 40 fathoms (estimate 20,000 to 25,000 tons).
- March 13th: a few schools in fathoms south French Creek Harbour; light spawn starting one mile north Little Qualicum River and more fish on the bottom in 20 fathoms; collected a genetics samplein two fathoms; spawn continuing and growing although the tide was ebbing; and more fish off Nile Creek and Bowser shore.
- March 14th: cloud of milt one mile South of the horseshoe in 20 fathoms; sounded 10 to 15 tons in three small schools; collected genetics sample South of Denman Island ferry in two fathoms; sounded 500 tons in small schools in the middle of Lambert Channel; spawn starting at Hornby Island from the ferry landing to Ford's Cove; small spot spawns on Bowser shore and 2.5 miles North of Little Qualicum River; spawn out to six fathoms with lots of backing fish to 20 fathoms; and collected genetics sample in in three fathoms.
- March 15th: spawn from French Creek to mouth of Englishman River, thickest between harbour and north side Parksville Bay; collected genetics sample in 3.5 fathoms; and collected a live sample and delivered it to French Creek.
- March 16th: sounded three schools of fish outside of Mistaken Island (250 tons); a few fish sounded in Nuttle Bay and off Icarus Point in 20 fathoms; narrow strip of spawn on beach outside of Keel Cove; and collected genetics sample; in 2.5 fathoms.
- March 17th: fish on bottom in 5 to 20 fathoms off Icarus Point and washed out spawn all along beach; a few fish and washed out spawn in Nuttle Bay; a few fish at Blunden Point; spawn on beach off Lantzville and South of Icarus Point; collected a genetics sample;
- March 18th: spots of washed out spawn off Lantzville; a few fish sounded on the bottom in Pylades Channel and outside Silva Bay;
- March 19th: a few fish moving around Outside islands of Silva Bay; spawn starting eastern side of Tugboat Island and Sears Island; collected genetics sample; and narrow spawn in Logan Bay.

5.3 Tla'amin

The Nation's fishing crew for herring encountered a few light spawn sites on the southwest side of Hernando Island and the northeast side of Cortis Island. There was lots of milky water but no evidence of any eggs. A few crew members got off the boat to check the beach for eggs but none were observed. Seems that there was a higher ratio of males in the mix. The Nation was unable to get any herring or roe from Area 15 this year despite multiple efforts.

6 General observations

The following observations were reported by DFO Resource Management staff and DFO Science staff. These observations provide additional context to this data report.

- Homalko Guardians observed spawn in Bute Inlet on March 8th.

7 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 Strait of Georgia major stock assessment region (SAR). Legend: '14&17' is Statistical Areas 14 and 17 (excluding Section 173); 'ESoG' is eastern Strait of Georgia; 'Lazo' is above Cape Lazo; and 'SDodd' is South of Dodd Narrows

Region	Statistical Area	Section	Group
Strait of Georgia	13	132	Lazo
Strait of Georgia	13	135	Lazo
Strait of Georgia	14	140	14&17
Strait of Georgia	14	141	Lazo
Strait of Georgia	14	142	14&17
Strait of Georgia	14	143	14&17
Strait of Georgia	15	150	ESoG
Strait of Georgia	15	151	ESoG
Strait of Georgia	15	152	ESoG
Strait of Georgia	16	160	ESoG
Strait of Georgia	16	161	ESoG
Strait of Georgia	16	162	ESoG
Strait of Georgia	16	163	ESoG
Strait of Georgia	16	164	ESoG
Strait of Georgia	16	165	ESoG
Strait of Georgia	17	170	14&17
Strait of Georgia	17	171	14&17
Strait of Georgia	17	172	14&17
Strait of Georgia	17	173	SDodd
Strait of Georgia	18	180	SDodd
Strait of Georgia	18	181	SDodd
Strait of Georgia	18	182	SDodd

Table 2 continued

Region	Statistical Area	Section	Group
Strait of Georgia	19	190	SDodd
Strait of Georgia	19	191	SDodd
Strait of Georgia	19	192	SDodd
Strait of Georgia	19	193	SDodd
Strait of Georgia	28	280	ESoG
Strait of Georgia	29	291	ESoG
Strait of Georgia	29	292	ESoG

Table 3. Total landed commercial catch of Pacific Herring in metric tonnes (t) by gear type in 2024 in the Strait of Georgia 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	1,288
RoeSN	2,852
RoeGN	2,858

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 2014 to 2024 in the Strait of Georgia major stock assessment region (SAR). See the 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)
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
2024	0	0

Table 5. Number of Pacific Herring biological samples processed from 2014 to 2024 in the Strait of Georgia major stock assessment region (SAR). Each sample is approximately 100 fish. Note: Nearshore samples are not used in stock assessments.

	Number of samples			
Year	Commercial	Test	Nearshore	Total
2014	82	11	0	93
2015	120	38	0	158
2016	123	33	5	161
2017	121	27	0	148
2018	116	28	0	144
2019	125	35	0	160
2020	106	27	0	133
2021	89	25	0	114
2022	50	18	2	70
2023	73	21	11	105
2024	68	24	9	101

Table 6. Number and type of Pacific Herring biological samples processed in 2024 in the Strait of Georgia major stock assessment region (SAR). Each sample is approximately 100 fish.

Type	Gear	Use	Number of samples
Commercial	Gillnet	Roe fishery	27
Commercial	Seine	Bait fishery	6
Commercial	Seine	Food fishery	7
Commercial	Seine	Roe fishery	28
Test	Other	Nearshore	9
Test	Seine	Test fishery	24

Table 7. Observed proportion-at-age for Pacific Herring from 2014 to 2024 in the Strait of Georgia major stock assessment region (SAR). The age-10 class is a 'plus group' which includes fish ages 10 and older.

	Proportion-at-age								
Year	2	3	4	5	6	7	8	9	10
2014	0.046	0.480	0.181	0.153	0.117	0.010	0.010	0.001	0.000
2015	0.103	0.374	0.362	0.088	0.046	0.023	0.002	0.001	0.000
2016	0.153	0.267	0.334	0.178	0.040	0.016	0.009	0.001	0.001
2017	0.100	0.304	0.267	0.215	0.089	0.018	0.006	0.002	0.000
2018	0.077	0.418	0.247	0.144	0.082	0.026	0.004	0.002	0.000
2019	0.238	0.349	0.222	0.110	0.051	0.023	0.006	0.001	0.000
2020	0.124	0.529	0.208	0.081	0.035	0.016	0.004	0.002	0.000
2021	0.052	0.372	0.391	0.124	0.041	0.013	0.005	0.001	0.001
2022	0.240	0.282	0.238	0.176	0.048	0.010	0.004	0.001	0.001
2023	0.106	0.390	0.227	0.161	0.097	0.013	0.005	0.000	0.000
2024	0.079	0.375	0.327	0.114	0.071	0.027	0.005	0.002	0.000

Table 8. Pacific Herring spawn survey locations, start date, and spawn index in metric tonnes (t) in 2024 in the Strait of Georgia 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)
14	141	Kye Bay	March 13	184
14	142	Boyle Pt	March 14	736
14	142	Cape Lazo	March 13	467
14	142	Chrome Is	March 16	7
14	142	Collishaw Pt	March 17	195
14	142	Fillongley Park	March 16	4,722
14	142	Ford Cv	March 14	1,144
14	142	Goose Spit	March 13	430
14	142	Gravelly Bay	March 14	834
14	142	Komas Bluff	March 16	1,558
14	142	Mapleguard Pt	March 14	5,819
14	142	Metcalf Bay	March 16	0
14	142	Norman Pt	March 14	404
14	142	Repulse Pt	March 16	671
14	142	Shingle Spit	March 17	578
14	142	Tralee Pt	March 14	211
14	142	Whalebone Pt	March 16	4,820
14	142	Whaling Station Bay	March 13	523
14	142	Willemar Bluff	February 26	346
14	143	Big Qualicum Rvr	March 13	12,361
14	143	Bowser	March 14	5,316
14	143	Columbia Beach	March 16	1,659
14	143	Cottam Pt	March 16	81
14	143	Englishman Rvr	March 16	364
14	143	French Cr	March 15	3,329
14	143	Little Qualicum Rvr	March 13	738
14	143	Madrona Pt	March 17	910
14	143	Northwest Bay	March 17	46
14	143	Nuttal Bay	March 17	922
14	143	Parksville	March 16	342
14	143	Qualicum Bay	March 15	3,341
14	143	Qualicum Beach	March 13	7,092
14	143	Rathtrevor Beach	March 16	142
15	152	Hernando Is	March 06	873
15	152	Savary Is	March 13	6,142
15	152	Sutil Pt	March 05	2,492
17	172	Dorcas Pt	March 16	732
17	172	Hammond Bay	March 17	173

Table 8 continued

Statistical Area	Section	Location name	Start date	Spawn index (t)
17	172	Icarus Pt	March 17	477
17	172	Lagoon Hd	March 17	338
17	172	Nankivell Pt	March 16	191
17	172	Neck Pt	March 17	674
17	172	Southey Is	March 17	89
17	172	Sunrise Beach	March 17	1,731
17	172	Wallis Pt	March 17	43
17	173	Breakwater Is	March 19	3,829
17	173	Flat Top Is	March 19	1,914
17	173	Lock Bay	March 17	1,761
18	181	Ganges Hrbr	March 21	NA
18	181	Long Hrbr	March 21	NA
19	193	Esquimalt Hrbr	March 18	NA
29	292	Trail Bay (Sechelt)	March 19	NA

Table 9. Summary of Pacific Herring spawn survey data from 2014 to 2024 in the Strait of Georgia 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 2024). 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)
2014	137,090	146	1.3	120,467
2015	166,750	114	1.3	104,481
2016	118,300	157	1.2	129,501
2017	130,440	162	0.9	81,063
2018	87,745	168	1.4	91,938
2019	82,865	139	1.1	63,037
2020	154,345	133	1.4	116,150
2021	114,950	154	1.1	70,938
2022	78,995	168	1.4	86,114
2023	102,550	142	1.4	74,506
2024	123,325	129	1.4	81,774

8 Figures

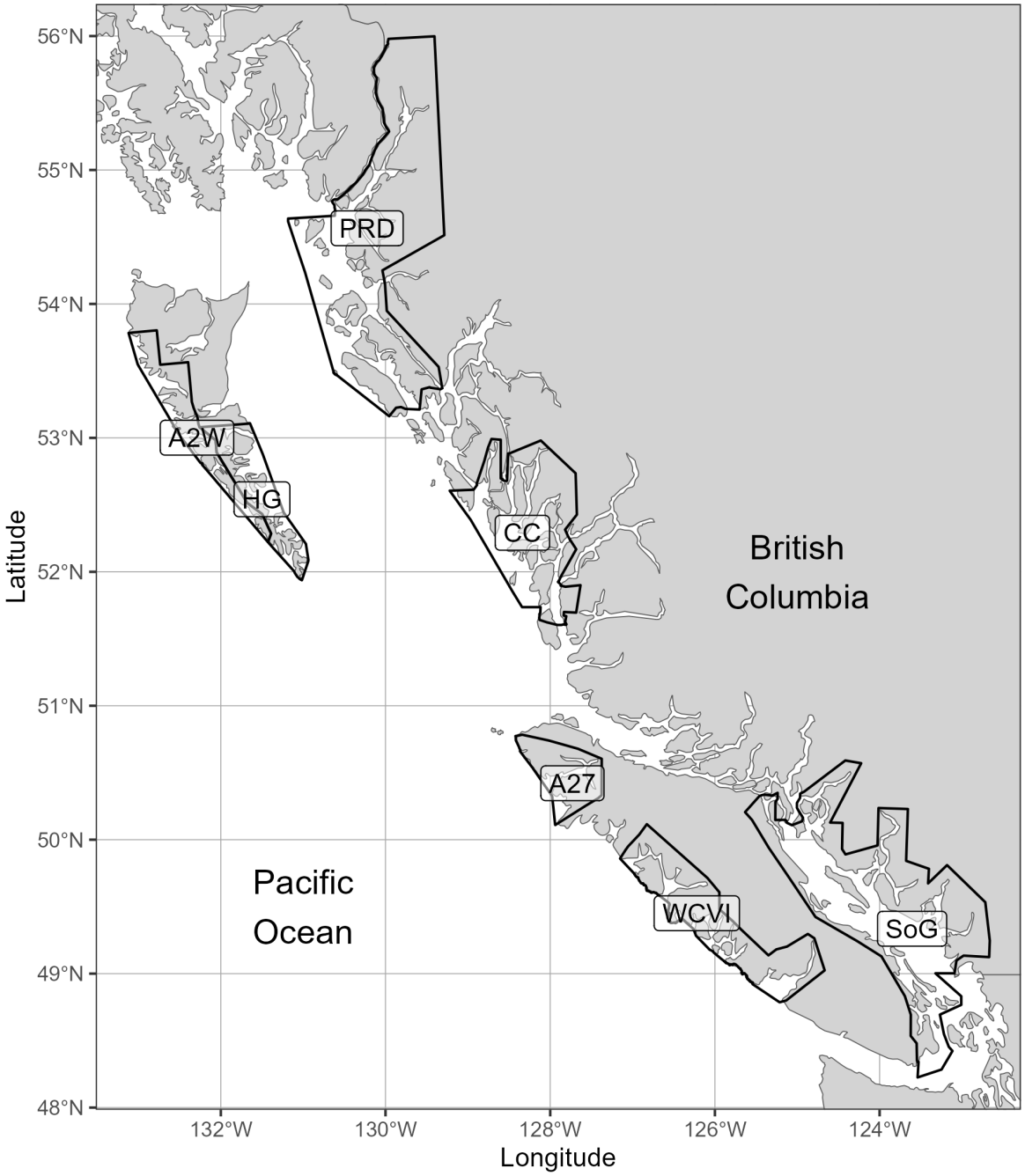

Figure 1. Boundaries for the Pacific Herring stock assessment regions (SARs) in British Columbia. There are 5 major SARs: Haida Gwaii (HG), Prince Rupert District (PRD), Central Coast (CC), Strait of Georgia (SoG), and West Coast of Vancouver Island (WCVI). There are 2 minor SARs: Area 27 (A27) and Area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

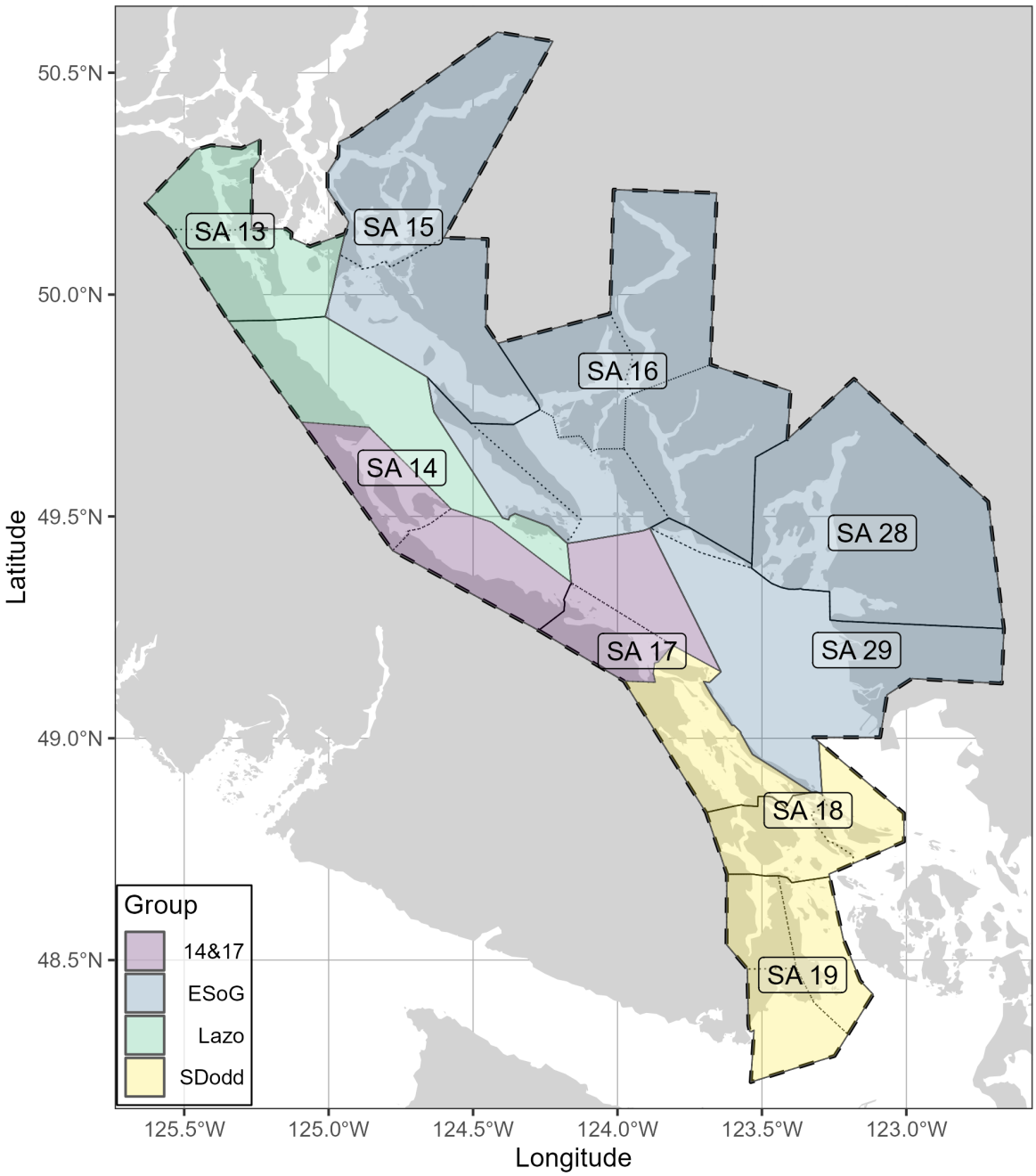

Figure 2. Boundaries for the Strait of Georgia major stock assessment region (SAR; thick dashed lines), associated Statistical Areas (SA; thin solid lines), and associated Sections (thin dotted lines). Units: kilometres (km). Legend: '14&17' is Statistical Areas 14 and 17 (excluding Section 173); 'ESoG' is eastern Strait of Georgia; 'Lazo' is above Cape Lazo; and 'SDodd' is South of Dodd Narrows

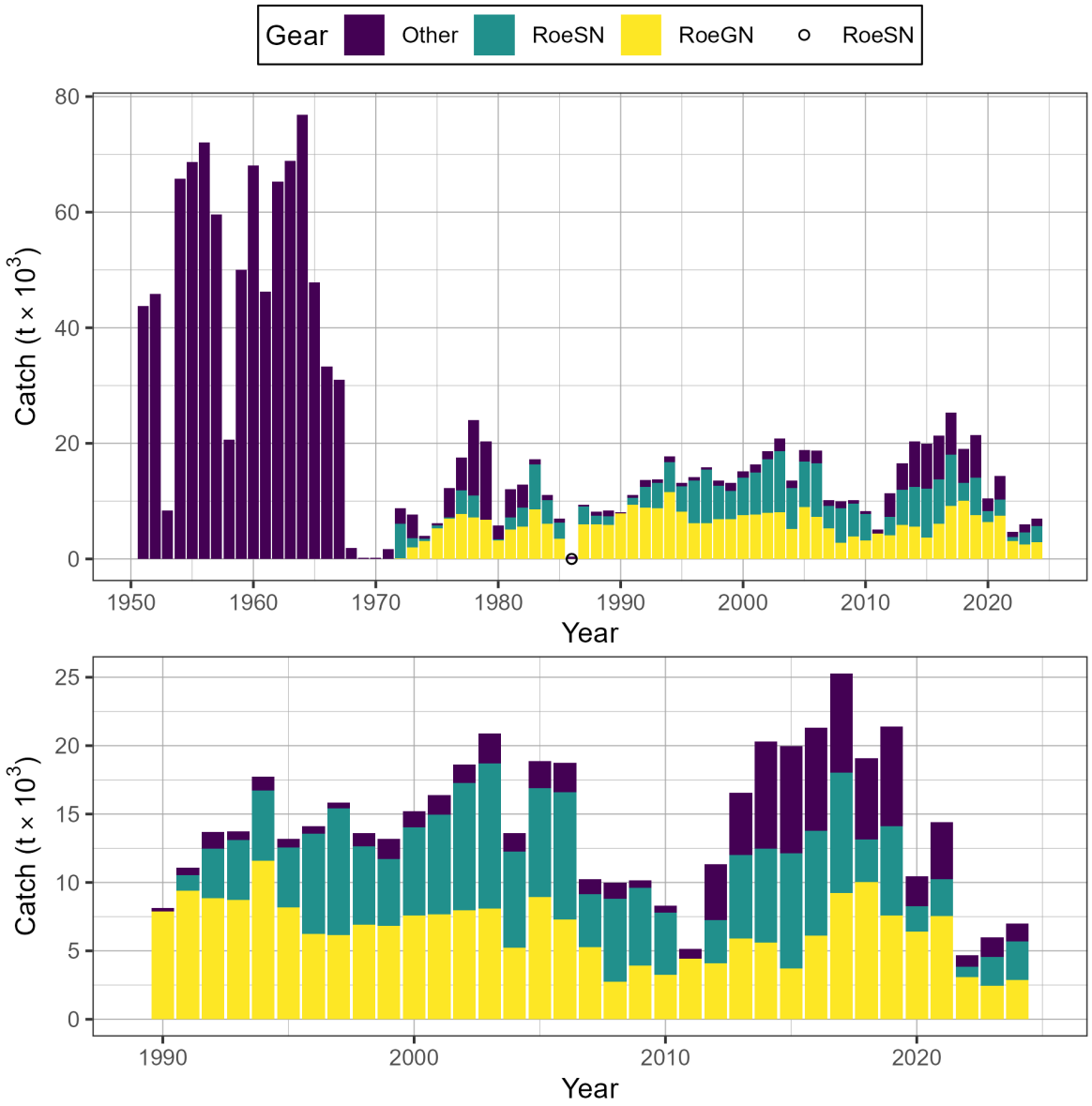

Figure 3. Time series of total landed catch in thousands of metric tonnes ($t \times 10^3$) of Pacific Herring by gear type from 1951 to 2024 in the Strait of Georgia major stock assessment region (SAR). Legend: 'Other' represents the reduction (1951 to 1970 only), the food and bait, as well as the special 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 1989 in more detail. Note: symbols indicate years in which catch by gear type (i.e., Other, RoeSN, RoeGN) is withheld due to privacy concerns.

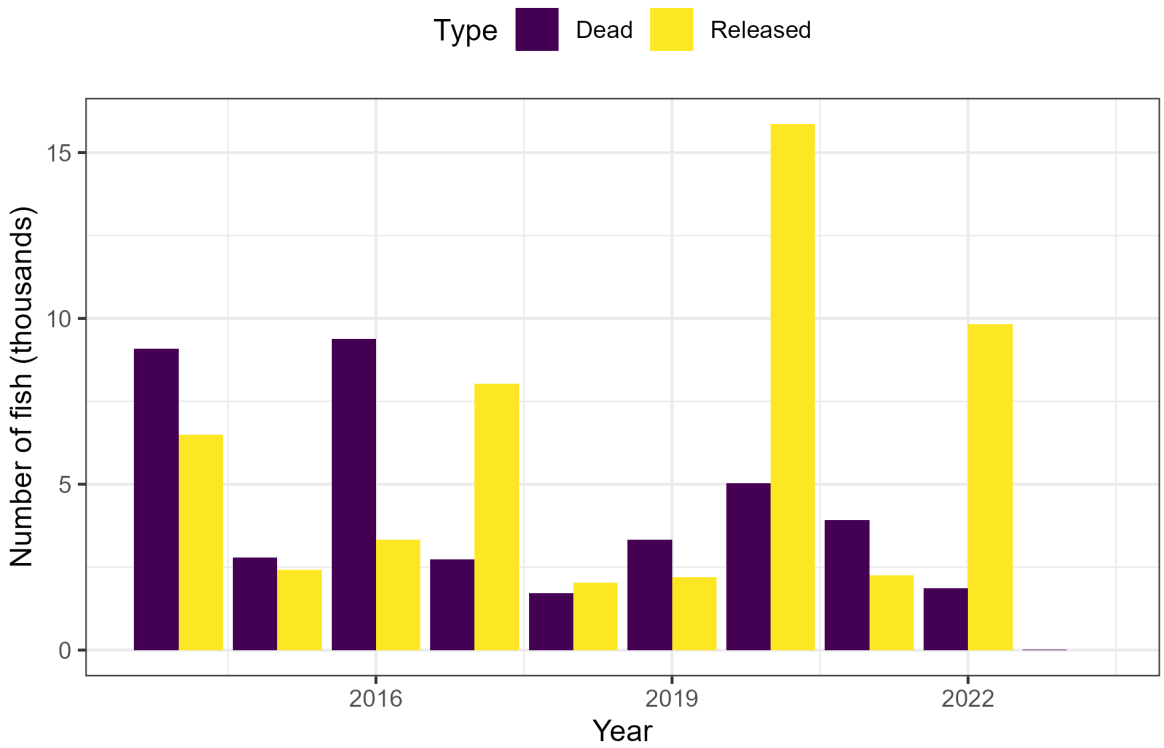

Figure 4. Incidental Pacific Herring mortality in aquaculture activities in thousands of fish from 2014 to 2024 in the Strait of Georgia major stock assessment region (SAR). Note: figure may include data outside SAR boundaries.

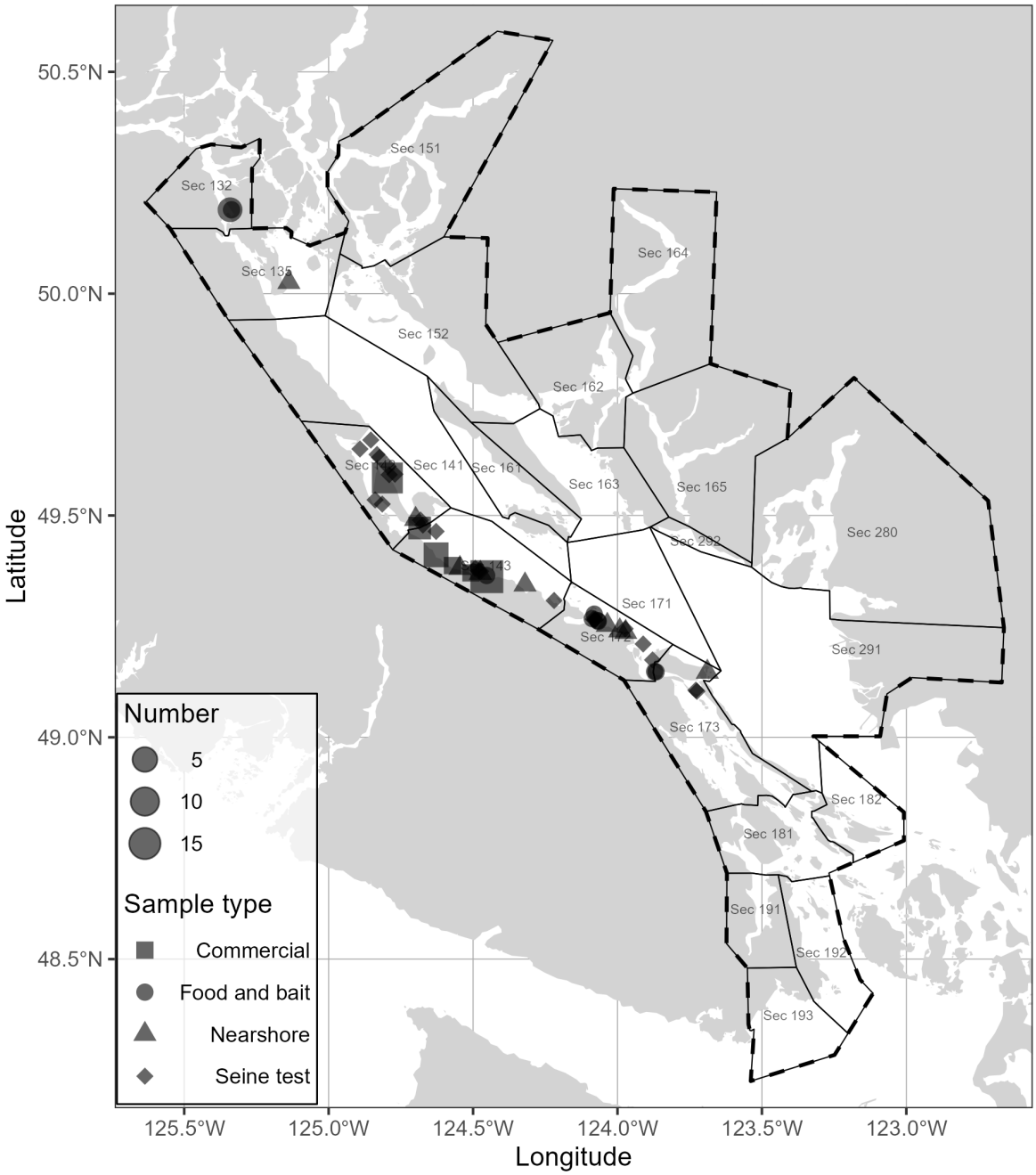

Figure 5. Location and type of Pacific Herring biological samples collected in 2024 in the Strait of Georgia major stock assessment region (SAR; thick dashed lines), and associated Sections (Sec; thin solid lines). Units: kilometres (km).

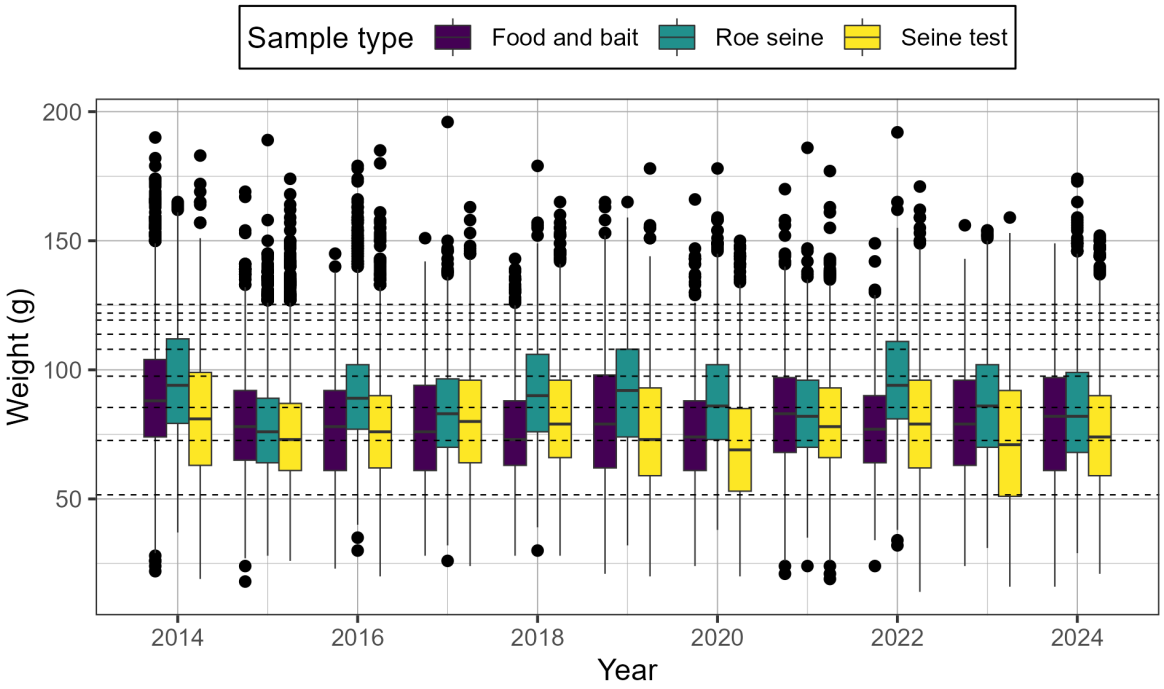

Figure 6. Time series of weight in grams (g) of Pacific Herring by sample type from 2014 to 2024 in the Strait of Georgia major stock assessment region (SAR) in Statistical Areas 14 and 17. The outer edges of the boxes indicate the 25th and 75th percentiles, and the middle lines indicate the 50th percentiles (i.e., medians). The whiskers extend to 1.5 $\times$ IQR, where IQR is the distance between the 25th and 75th percentiles, and dots indicate outliers. Horizontal dashed lines indicate the mean weight-at-age for age-2 (lowest line) to age-10 (incrementing higher from age-2) fish. 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.

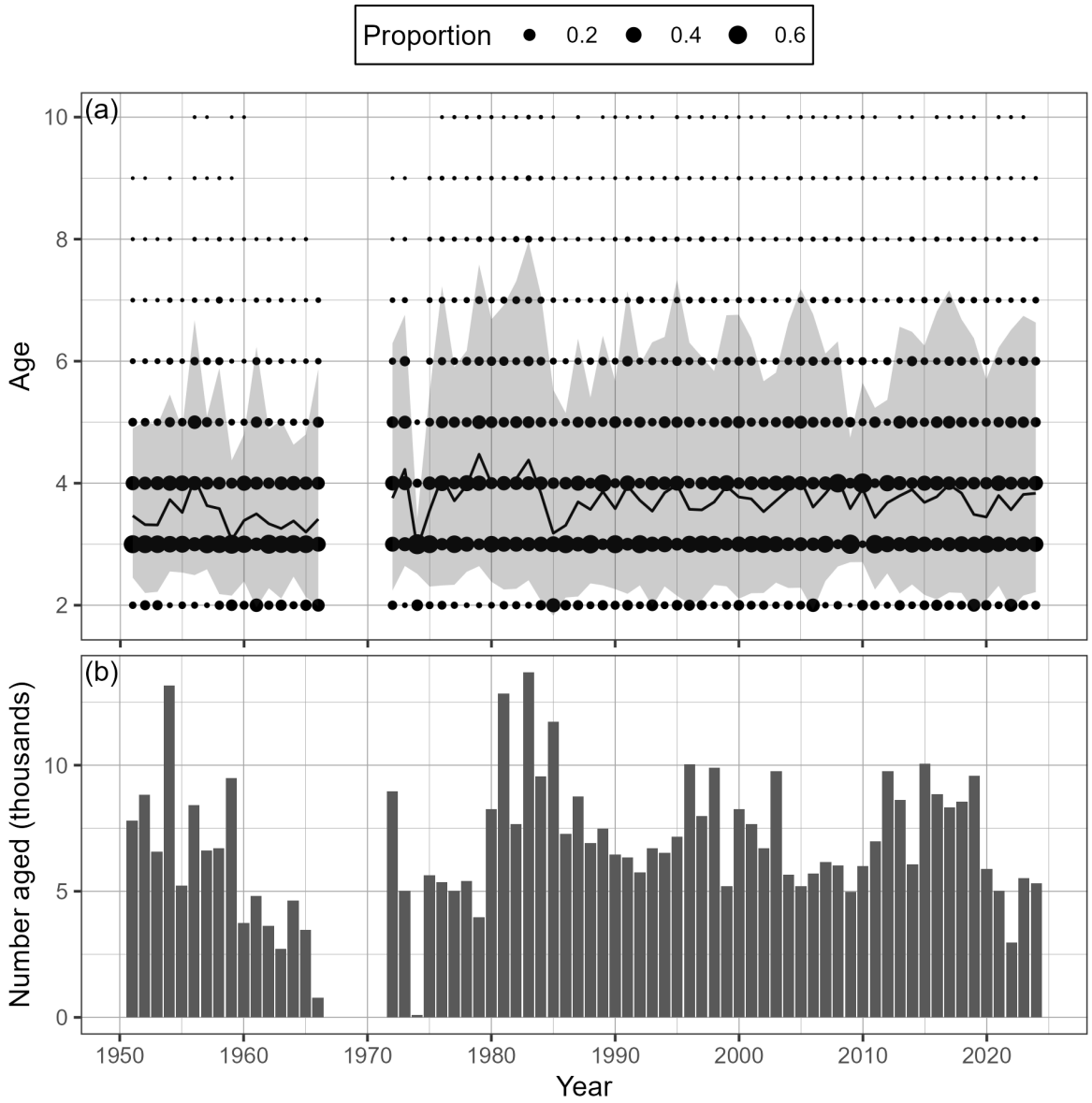

Figure 7. Time series of observed proportion-at-age (a) and number aged in thousands (b) of Pacific Herring from 1951 to 2024 in the Strait of Georgia major stock assessment region (SAR). The black line is the mean age, and the shaded area is the approximate 90% distribution. Biological summaries only 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.

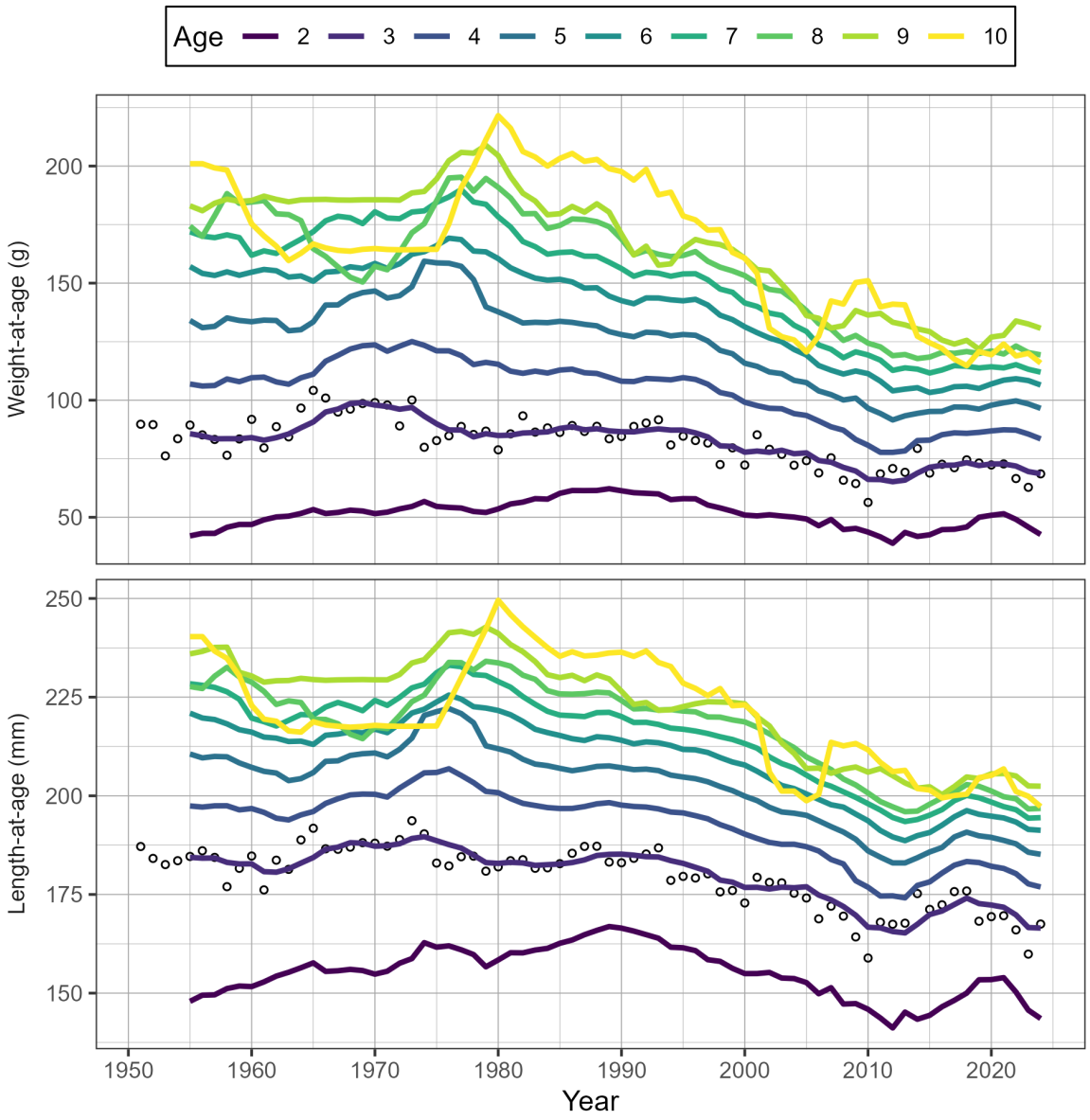

Figure 8. Time series of weight-at-age in grams (g) and length-at-age in milimetres (mm) for age-3 (circles) and 5-year running mean weight- and length-at-age (lines) for Pacific Herring from 1951 to 2024 in the Strait of Georgia major stock assessment region (SAR). Missing weight- and length-at-age 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.

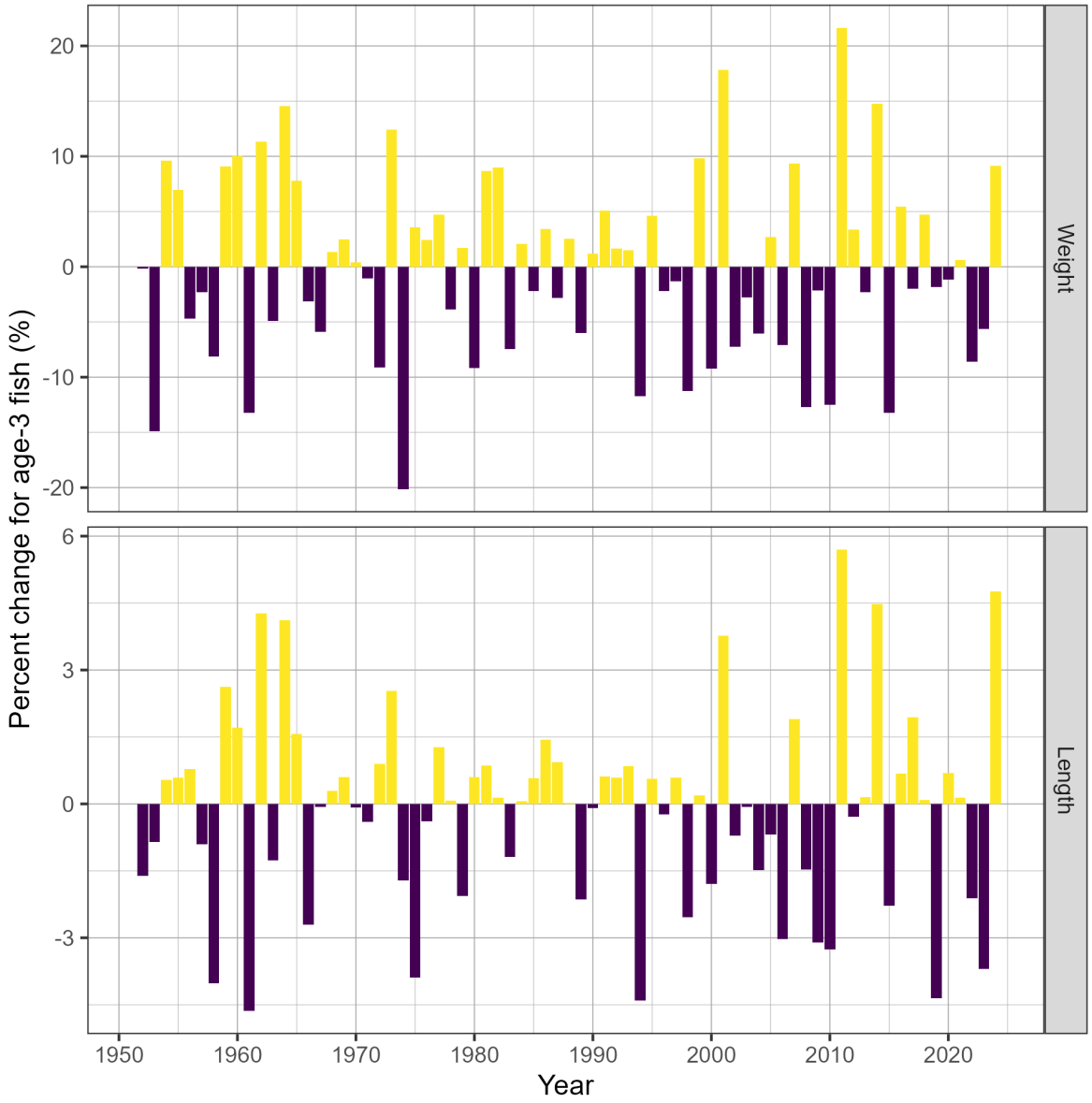

Figure 9. Time series of percent change (%) in weight and length for age-3 fish for Pacific Herring from 1951 to 2024 in the Strait of Georgia major stock assessment region (SAR). Percent change is $\delta_t = \frac{\alpha_t - \alpha_{t-1}}{\alpha_{t-1}}$ where α_t is the weight and length of age-3 fish, 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.

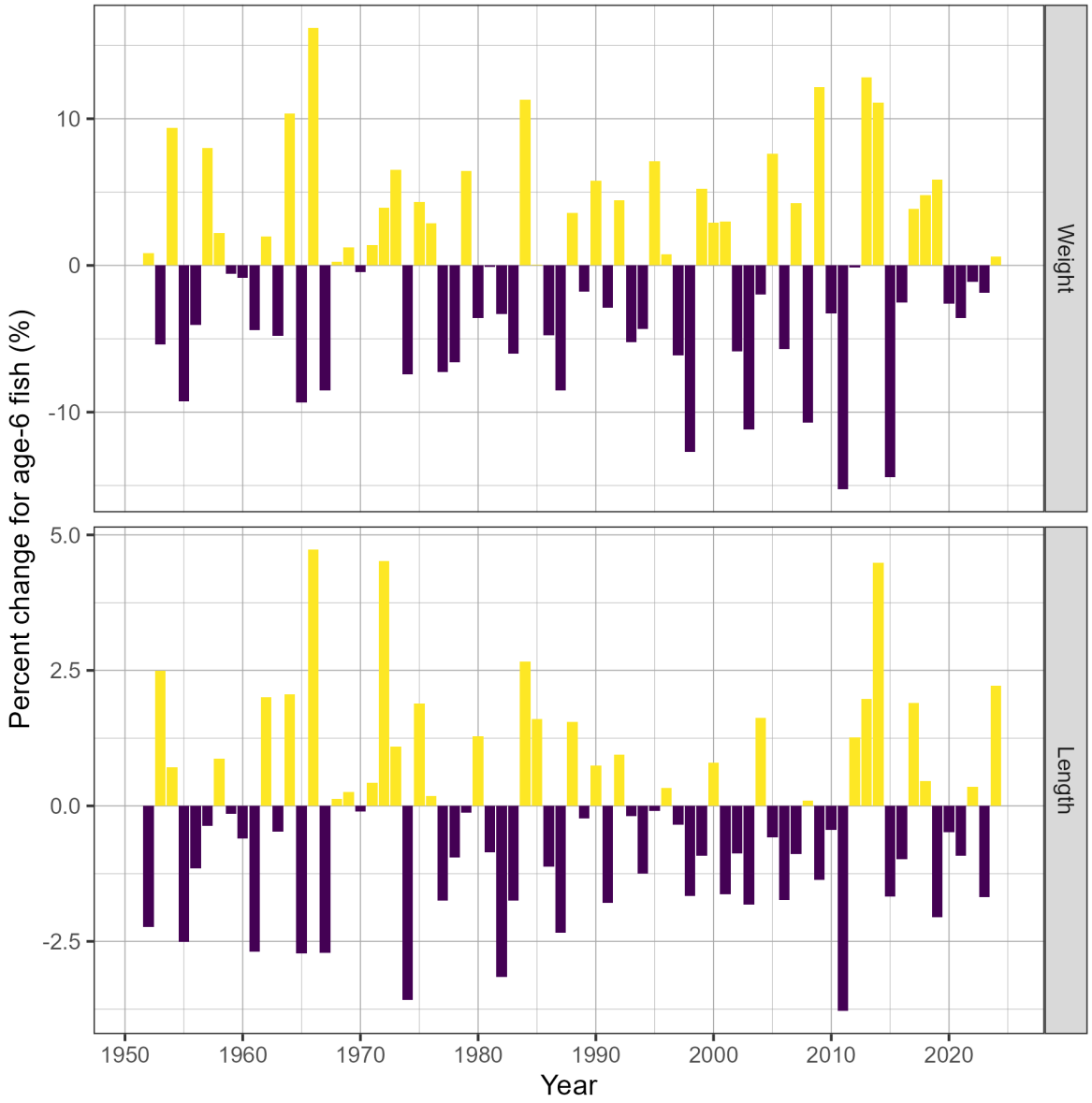

Figure 10. Time series of percent change (%) in weight and length for age-6 fish for Pacific Herring from 1951 to 2024 in the Strait of Georgia major stock assessment region (SAR). Percent change is $\delta_t = \frac{\alpha_t - \alpha_{t-1}}{\alpha_{t-1}}$ where α_t is the weight and length of age-6 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.

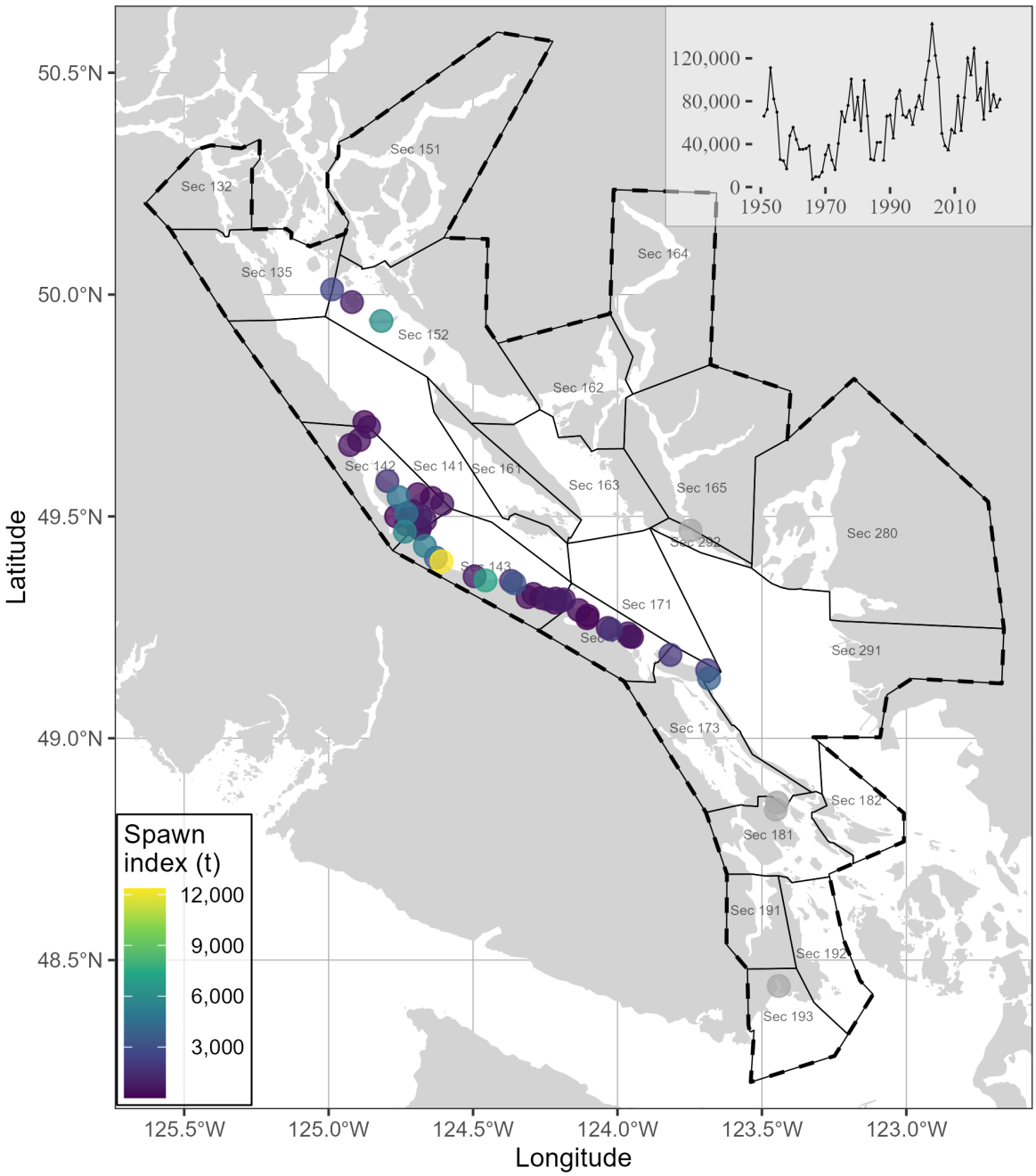

Figure 11. Pacific Herring spawn survey locations, and spawn index in metric tonnes (t) in 2024 in the Strait of Georgia major stock assessment region (SAR; thick dashed lines), and associated Sections (Sec; thin solid lines). The 'spawn index' is not scaled by the spawn survey scaling parameter, q. Missing spawn index values indicate incomplete surveys (grey circles). Inset tracks the total spawn index. Units: kilometres (km).

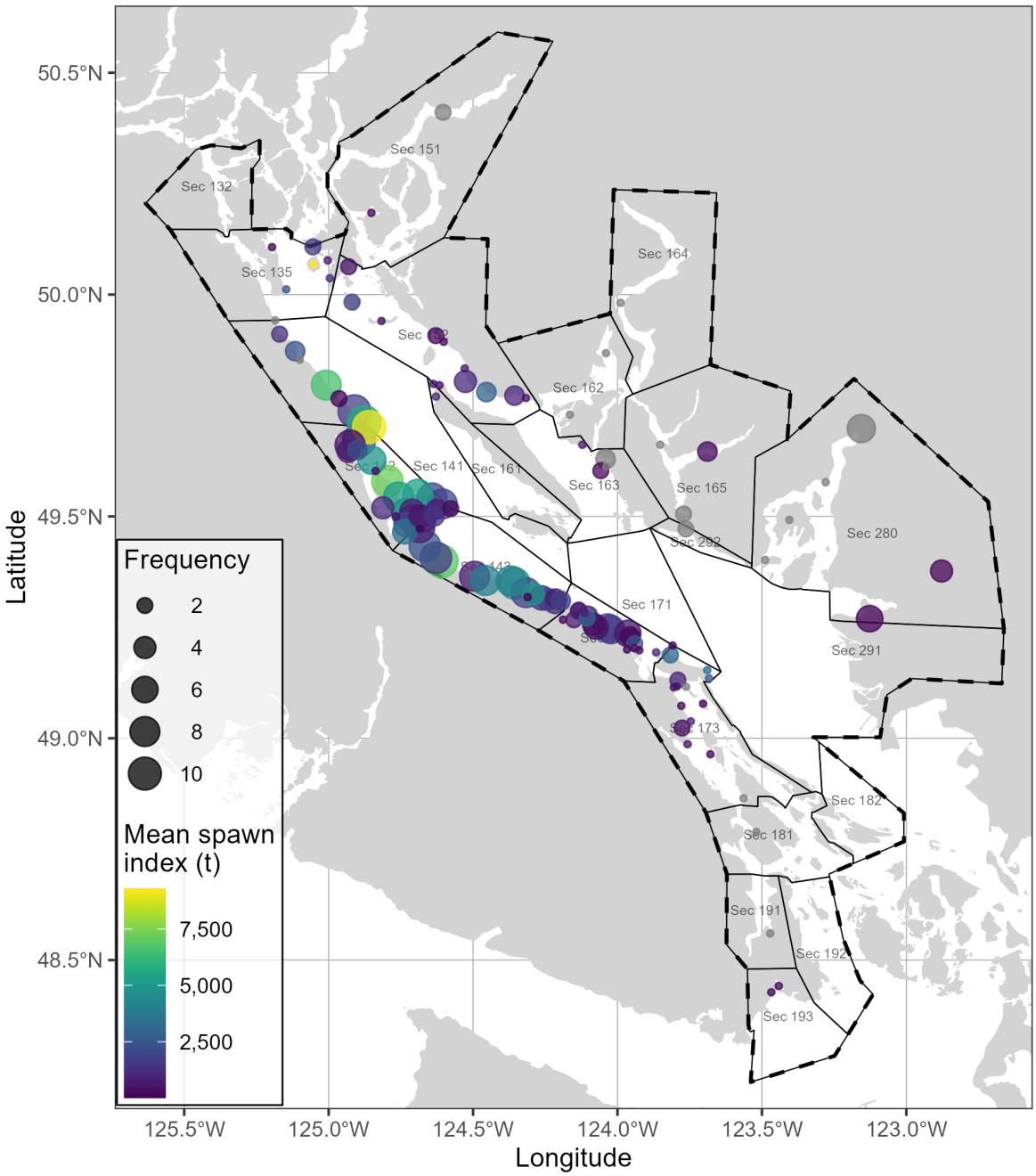

Figure 12. Pacific Herring spawn survey locations, mean spawn index in metric tonnes (t), and spawn frequency from 2014 to 2023 in the Strait of Georgia major stock assessment region (SAR; thick dashed lines), and associated Sections (Sec; thin solid lines). The 'spawn index' is not scaled by the spawn survey scaling parameter, q. Missing spawn index values indicate incomplete surveys (grey circles). Units: kilometres (km).

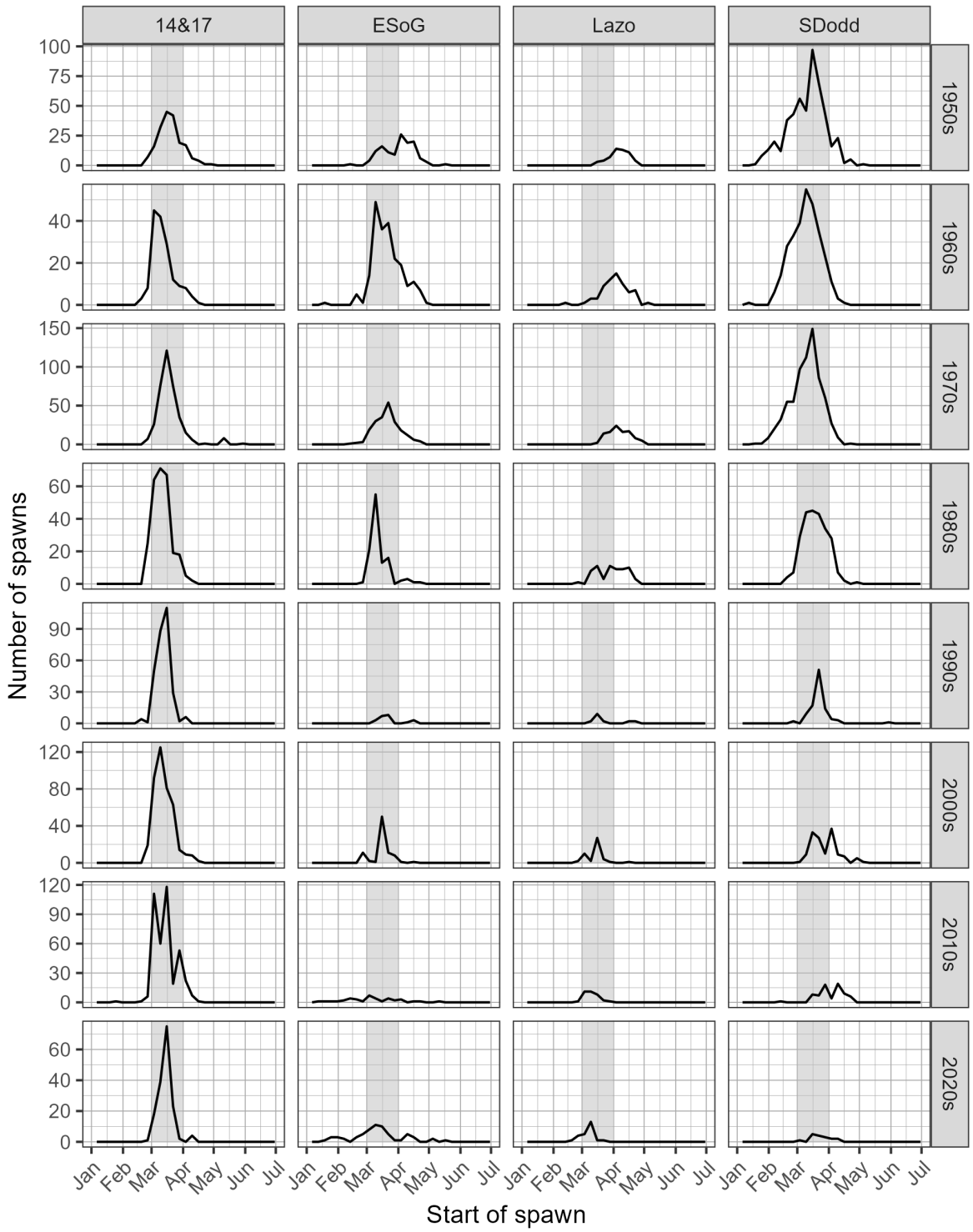

Figure 13. Pacific Herring spawn start date by decade and Group. Grey shaded regions indicate March 1st to 31st. Note that spawn size and intensity varies; therefore the number of spawns is not directly proportional to spawn extent or biomass. Legend: '14&17' is Statistical Areas 14 and 17 (excluding Section 173); 'ESoG' is eastern Strait of Georgia; 'Lazo' is above Cape Lazo; and 'SDodd' is South of Dodd Narrows

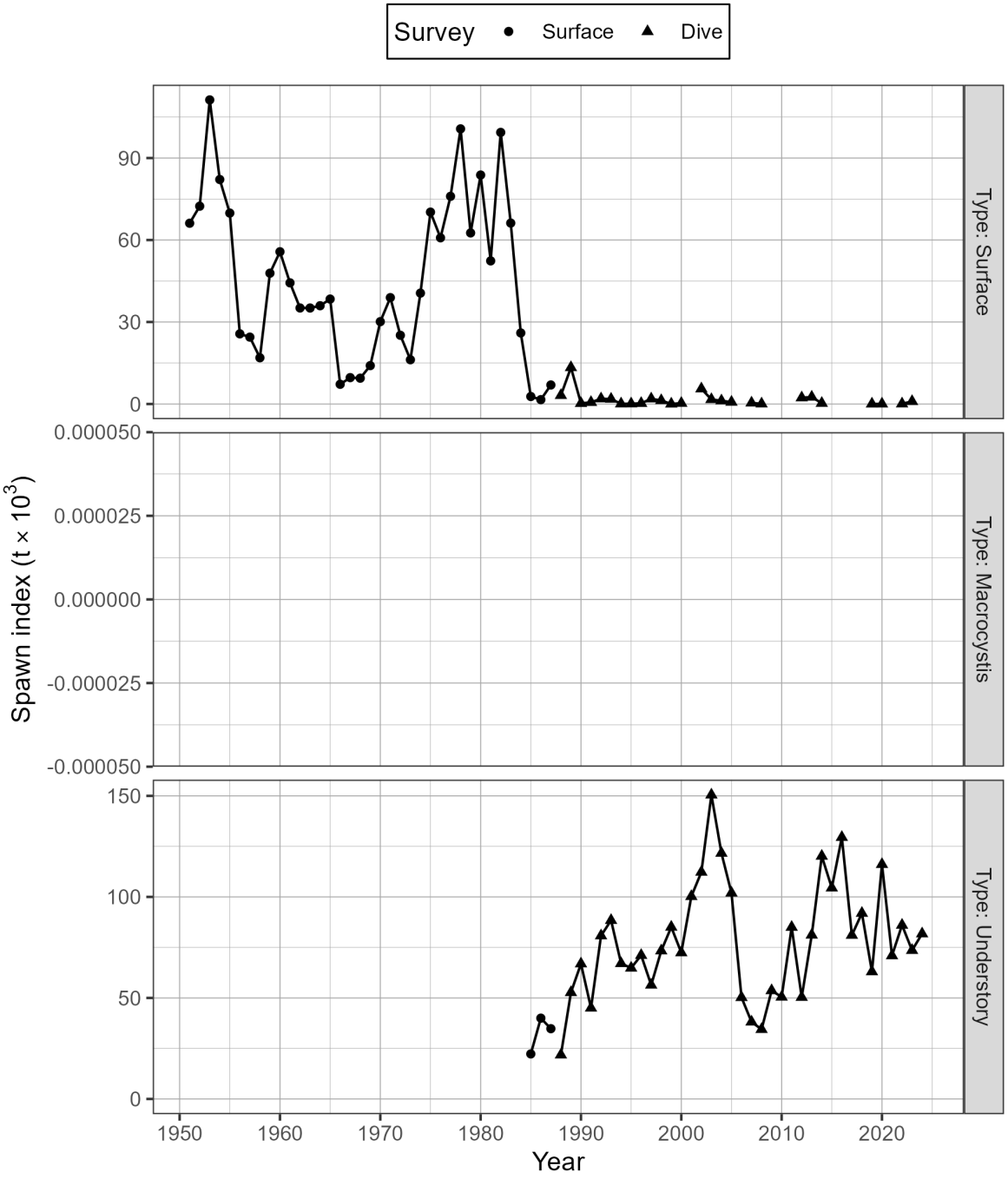

Figure 14. Time series of spawn index in thousands of metric tonnes ($t \times 10^3$) by type for Pacific Herring from 1951 to 2024 in the Strait of Georgia major stock assessment region (SAR). There are three types of spawn survey observations: observations of spawn taken from the surface usually at 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 2024).

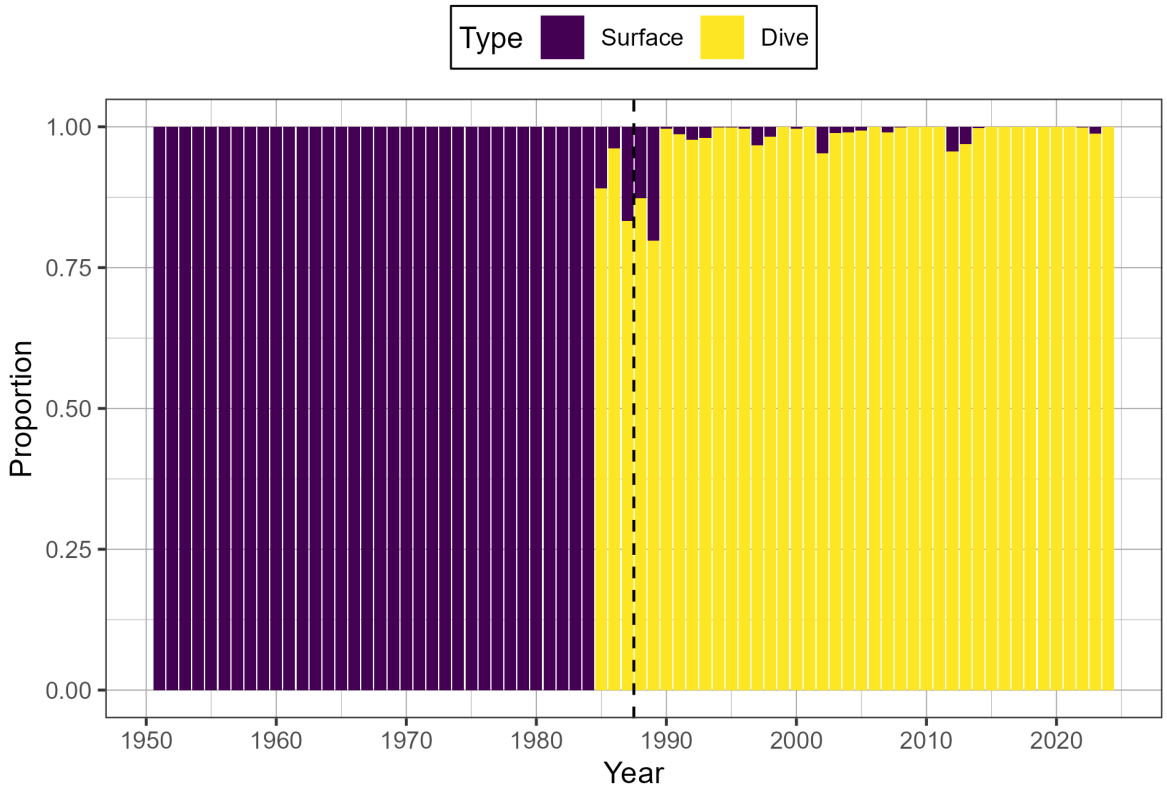

Figure 15. Time series of proportion of spawn index by surface and dive surveys for Pacific Herring from 1951 to 2024 in the Strait of Georgia major stock assessment region (SAR). The spawn index has two distinct periods defined by the dominant coastwide survey method: surface surveys (1951 to 1987), and dive surveys (1988 to 2024).

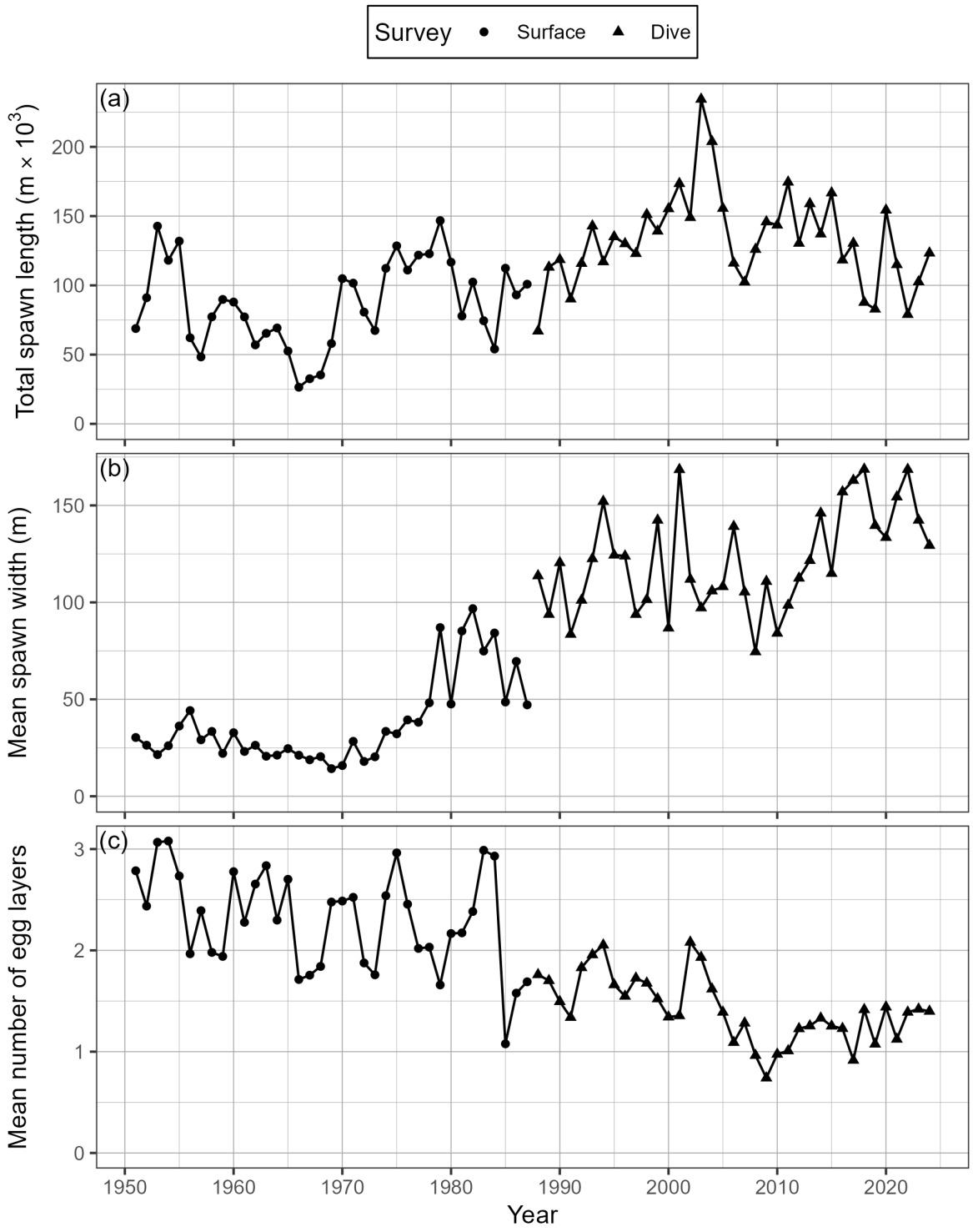

Figure 16. Time series of total spawn length in thousands of metres ($m \times 10^3$; panel a), mean spawn width in metres (b), and mean number of egg layers (c) for Pacific Herring from 1951 to 2024 in the Strait of Georgia major stock assessment region (SAR). The spawn index has two distinct periods defined by the dominant coastwide survey method: surface surveys (1951 to 1987), and dive surveys (1988 to 2024).

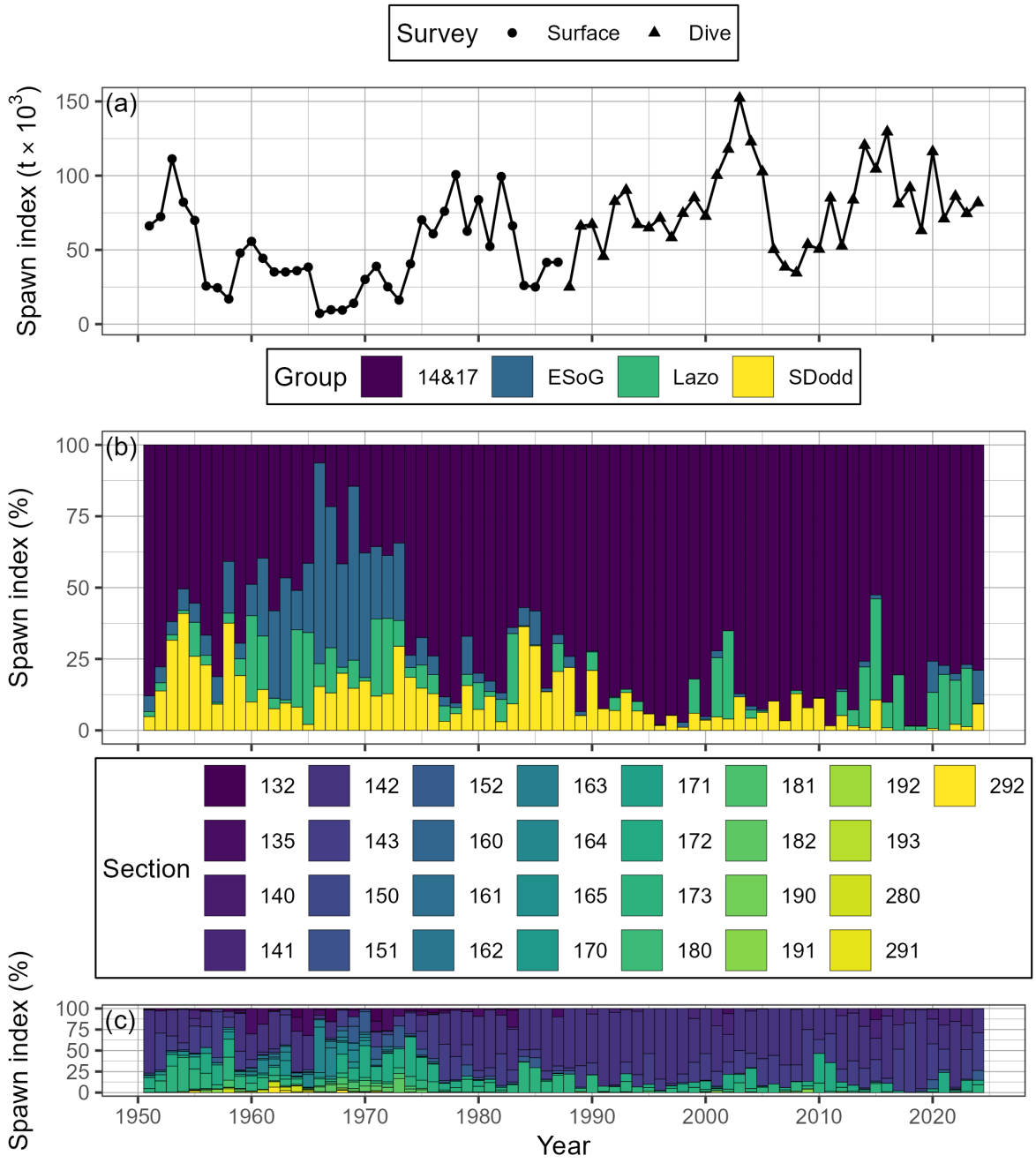

Figure 17. Time series of spawn index in thousands of metric tonnes ($t \times 10^3$) for Pacific Herring from 1951 to 2024 in the Strait of Georgia major stock assessment region (SAR; panel a), as well as percent contributed by Group, and Section (b, & c, respectively). The spawn index has two distinct periods defined by the dominant coastwide survey method: surface surveys (1951 to 1987), and dive surveys (1988 to 2024). Note that spawn surveys in the dive survey period (1988 to 2024) 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. Legend: '14&17' is Statistical Areas 14 and 17 (excluding Section 173); 'ESoG' is eastern Strait of Georgia; 'Lazo' is above Cape Lazo; and 'SDodd' is South of Dodd Narrows

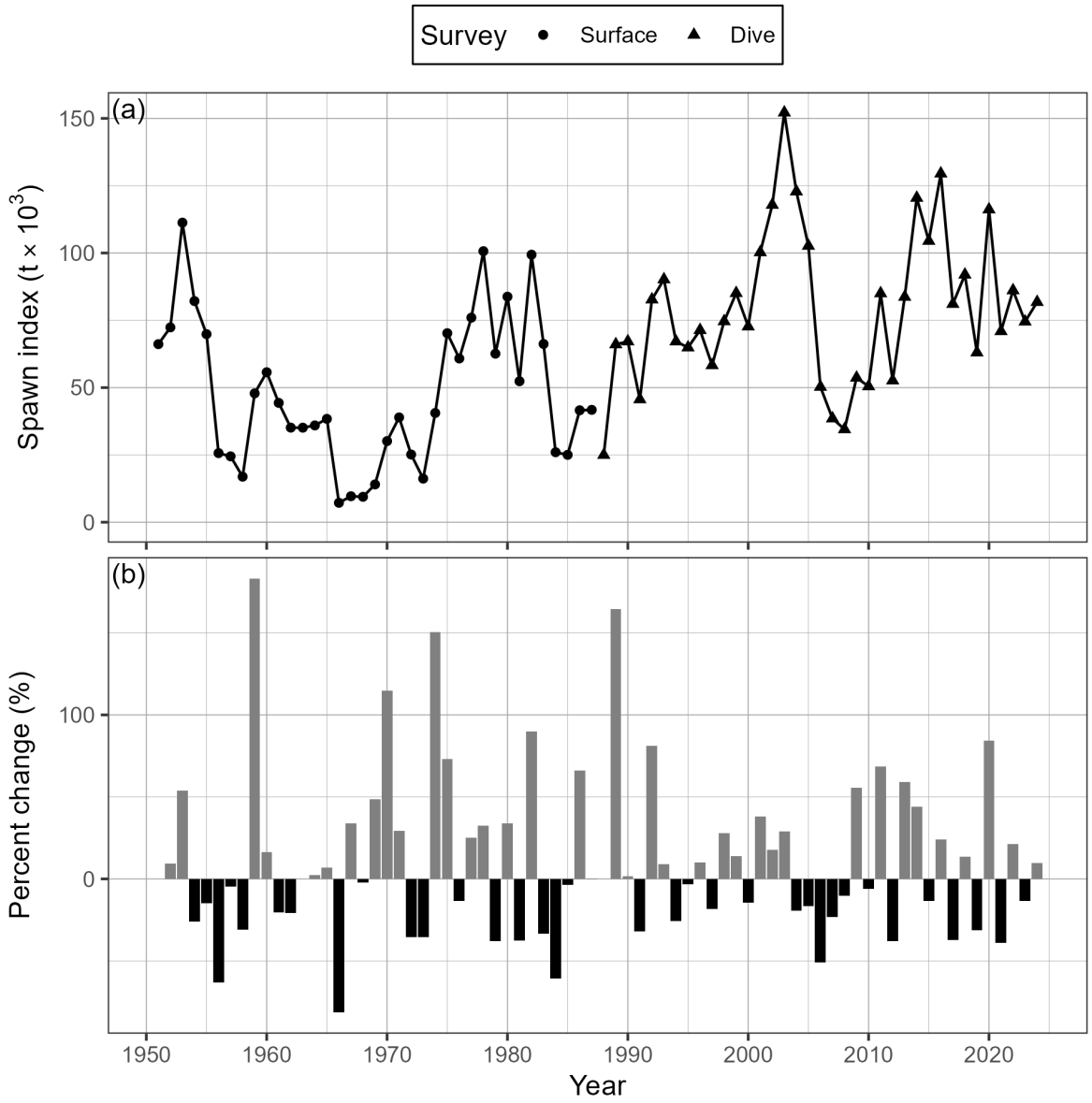

Figure 18. Time series of spawn index in thousands of metric tonnes ($t \times 10^3$) for Pacific Herring from 1951 to 2024 in the Strait of Georgia major stock assessment region (SAR; panel a), and percent change (b). Percent change is $\delta_t = \frac{\alpha_t - \alpha_{t-1}}{\alpha_{t-1}}$ where 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 2024). The 'spawn index' is not scaled by the spawn survey scaling parameter, q. Note that spawn surveys in the dive survey period (1988 to 2024) are a combination of surface and dive surveys (Figures 14 and 15).

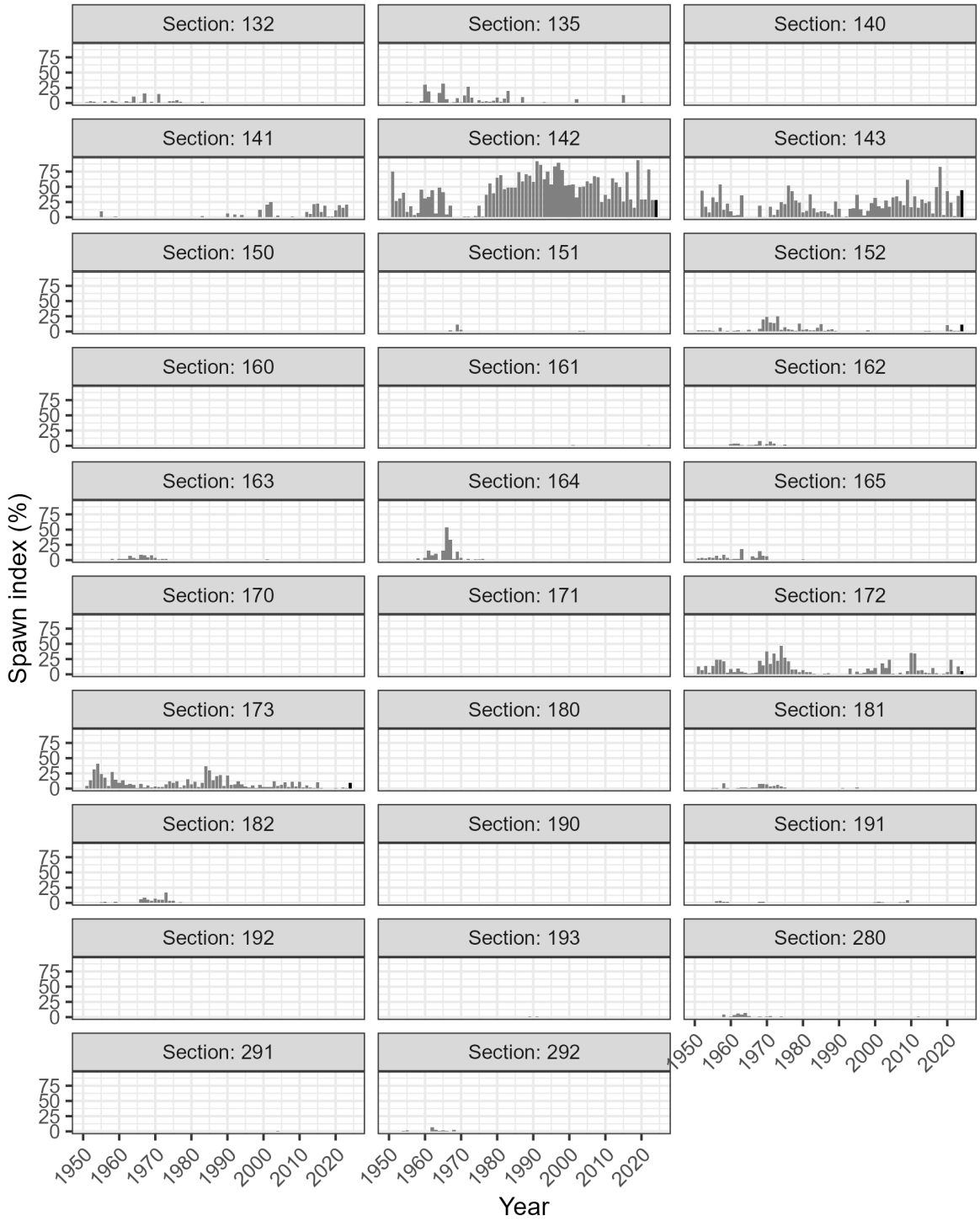

Figure 19. Time series of percent of spawn index by Section for Pacific Herring from 1951 to 2024 in the Strait of Georgia major stock assessment region (SAR). The year 2024 has a darker bar to facilitate interpretation. The spawn index has two distinct periods defined by the dominant coastwide survey method: surface surveys (1951 to 1987), and dive surveys (1988 to 2024). The 'spawn index' is not scaled by the spawn survey scaling parameter, q.

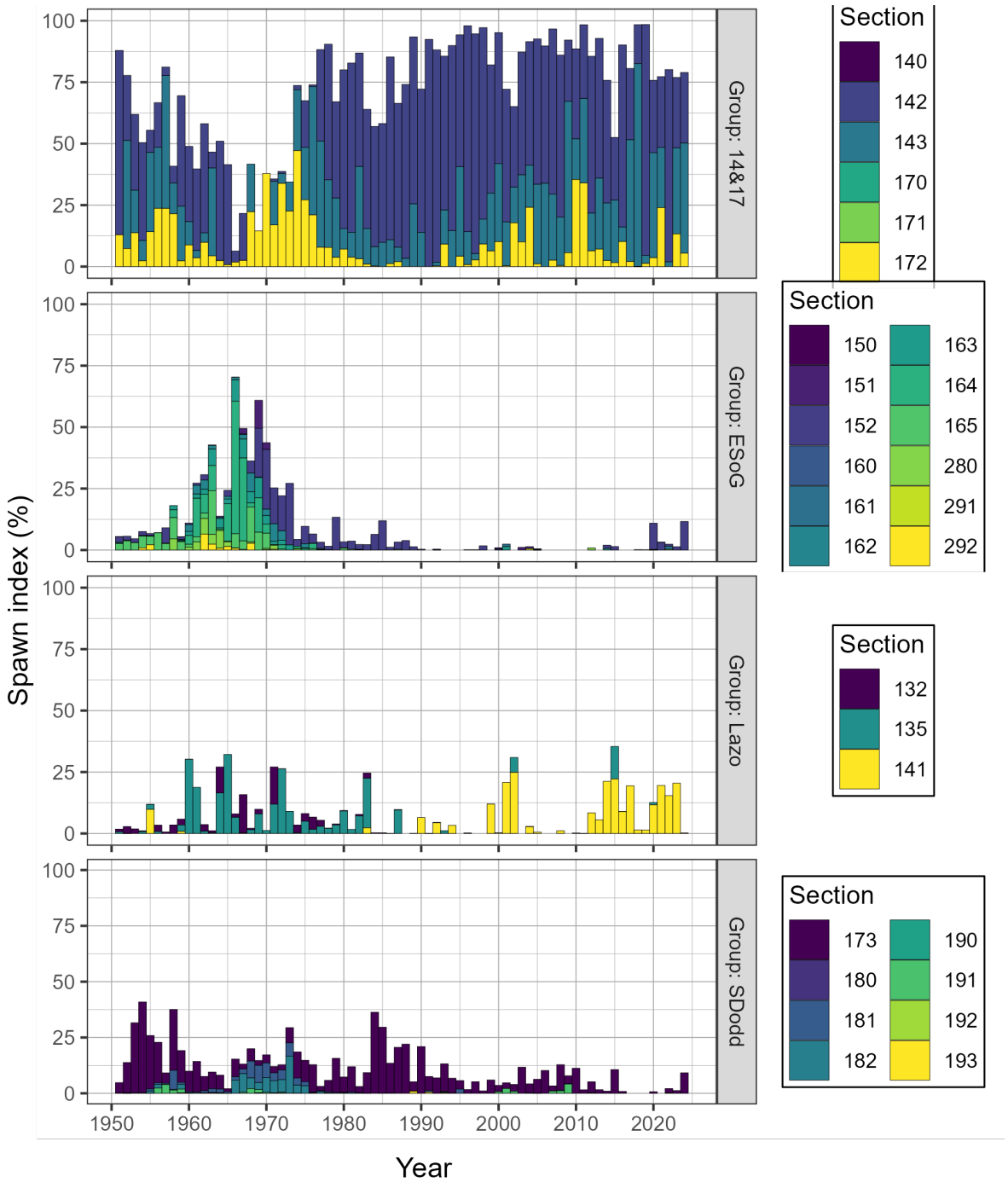

Figure 20. Time series of percent of spawn index by Group and Section for Pacific Herring from 1951 to 2024 in the Strait of Georgia major stock assessment region (SAR). The spawn index has two distinct periods defined by the dominant coastwide survey method: surface surveys (1951 to 1987), and dive surveys (1988 to 2024). The 'spawn index' is not scaled by the spawn survey scaling parameter, q. Legend: '14&17' is Statistical Areas 14 and 17 (excluding Section 173); 'ESoG' is eastern Strait of Georgia; 'Lazo' is above Cape Lazo; and 'SDodd' is South of Dodd Narrows

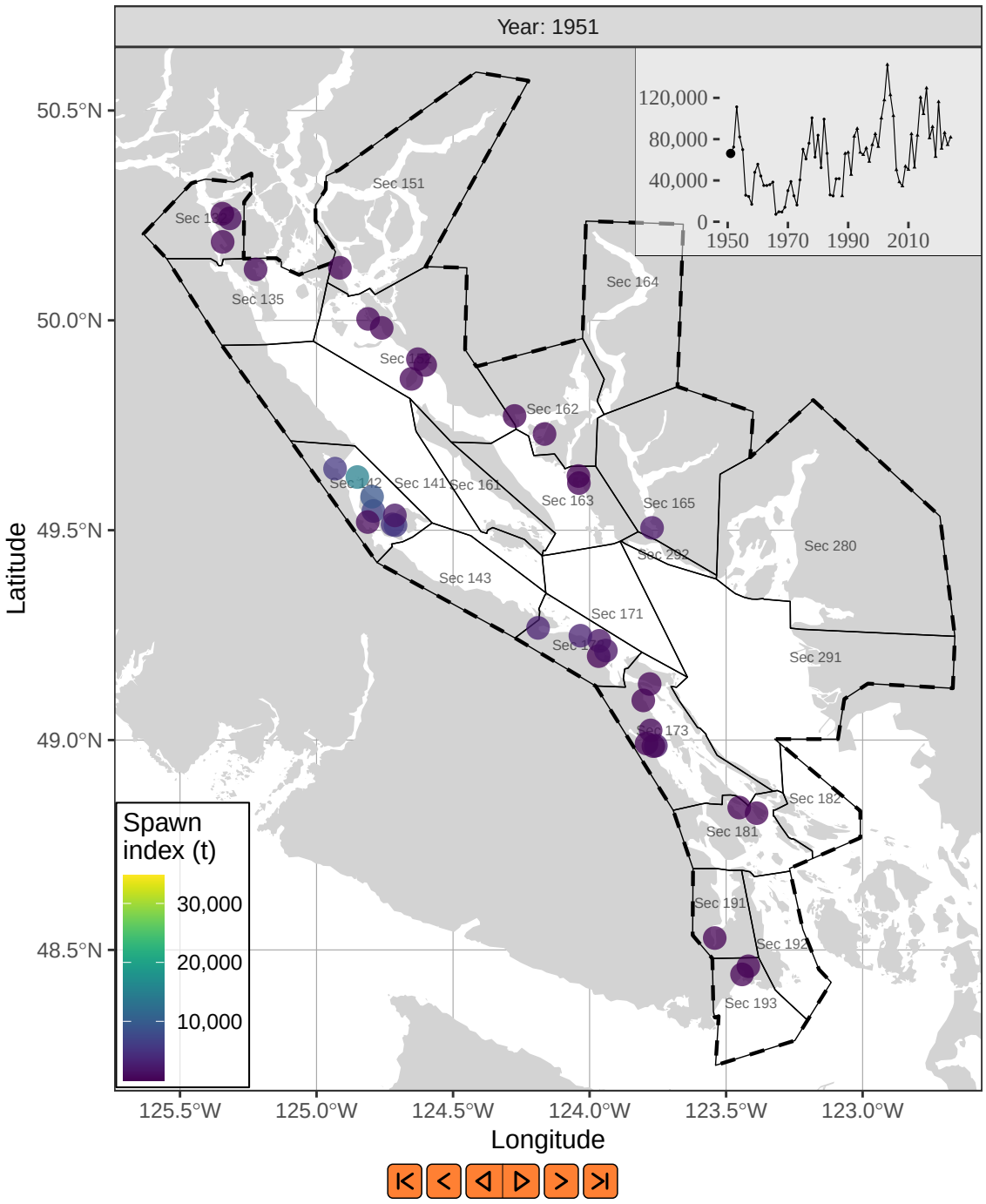

Figure 21. Animation of Pacific Herring spawn index in metric tonnes (t) by Location from 1951 to 2024 in the Strait of Georgia major stock assessment region (SAR; thick dashed lines), and associated Sections (Sec; thin solid lines). The spawn index has two distinct periods defined by the dominant coastwide survey method: surface surveys (1951 to 1987), and dive surveys (1988 to 2024). 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".