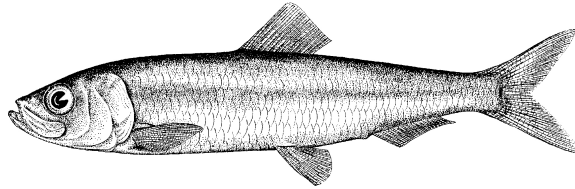


# Pacific Herring preliminary data summary for Haida Gwaii 2018

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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 2018 in the Haida Gwaii major stock assessment area (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 2018. 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 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.

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The following is a description of data collected for Pacific Herring in 2018 in the Haida Gwaii 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 2018 refers to the 2017/2018 Pacific Herring season.

## 2 Data collection programs

In 2018, biological samples were collected by the “Queens Reach”, a seine test charter vessel funded by the DFO. The primary purpose of the test charter vessel was to collect biological samples from main bodies of herring from Haida Gwaii major (priority) and minor stock areas, identified from soundings. The “Queens Reach” operated a 25 day charter from March 9<sup>th</sup> to April 2<sup>nd</sup>, collecting samples from HG and Area 2W. The spawn reconnaissance vessel “Victoria Rose”, operated a 19 day charter from March 31<sup>st</sup> to April 18<sup>th</sup>. The dive charter vessel “Haida Spirit” operated a 15 day charter from April 7<sup>th</sup> to April 21<sup>st</sup>. These vessels were funded by DFO, through a contract to the HCRS. The dive survey contract was awarded to and operated by the Haida Nation.

## 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 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; in some cases this may affect our ability to allocate catch to a specific SAR. 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 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 2018 in the Haida Gwaii 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 2018, 11 Pacific Herring biological samples were collected and processed for the Haida Gwaii major SAR (Table 5, Table 6), and a total of 1,016 Pacific Herring were aged in 2018. 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 7, and Figure 6, 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 14 individual locations in 2018 in the Haida Gwaii major SAR (Table 8, and Figure 7). A summary of spawn from the last decade (2008 to 2017) is shown in Figure 8. Figure 9 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 10, Figure 11, and Table 9). We describe the calculations used to estimate the spawn index in the [draft spawn index technical report](#). The ‘spawn index’ represents the raw survey data only, and 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 survey method: surface surveys (1951 to 1987), and dive surveys (1988 to 2018).

Some Pacific Herring Sections contribute more than others to the total spawn index, and the percentage contributed by Section varies yearly (Figure 11b, Figure 12). For example, in 2018, Section 025 contributed the most to the spawn index (40%). As with Sections, some Statistical Areas contribute more than others to the total spawn index (Figure 11c, Figure 13). An animation shows the spawn index by spawn survey location from 1951 to 2018 (Figure 14).

## 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:

- The fish seemed to arrive later than usual.
- The test boat sounded 17,460 t, which is more than previous years.
- Most significant spawns were surveyed, however, spawns in Louscoone Inlet and a spot spawn in Swan Bay were not surveyed.
- Coverage of the spawning areas was good despite the unfavourable weather.

## 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 Haida Gwaii major stock assessment region (SAR).

Region	Statistical Area	Section
Haida Gwaii	00	006
Haida Gwaii	02	021
Haida Gwaii	02	023
Haida Gwaii	02	024
Haida Gwaii	02	025

Table 3. Total landed commercial catch of Pacific Herring in metric tonnes (t) by gear type in 2018 in the Haida Gwaii major stock assessment region (SAR). Legend: ‘Other’ represents the reduction, 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 is not included. Note: ‘WP’ indicates that data are withheld due to privacy concerns.

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 2008 to 2018 in the Haida Gwaii major stock assessment region (SAR). See the [draft spawn index techincal report](#) for calculations to convert SOK harvest to spawning biomass. Note: ‘WP’ indicates that data are withheld due to privacy concerns.

Year	Harvest (lb)	Spawning biomass (t)
2008	0	0
2009	0	0
2010	0	0
2011	0	0
2012	0	0
2013	0	0
2014	0	0
2015	0	0
2016	0	0
2017	0	0
2018	0	0

Table 5. Number of Pacific Herring biological samples processed from 2008 to 2018 in the Haida Gwaii major stock assessment region (SAR). Each sample is approximately 100 fish.

Year	Number of samples		
	Commercial	Test	Total
2008	1	9	10
2009	0	12	12
2010	0	12	12
2011	0	13	13
2012	0	9	9
2013	0	12	12
2014	0	12	12
2015	0	11	11
2016	0	5	5
2017	0	8	8
2018	0	11	11

Table 6. Number and type of Pacific Herring biological samples processed in 2018 in the Haida Gwaii major stock assessment region (SAR). Each sample is approximately 100 fish.

Type	Gear	Use	Number of samples
Test	Seine	Test fishery	11

Table 7. Observed proportion-at-age for Pacific Herring from 2008 to 2018 in the Haida Gwaii 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
2008	0.093	0.074	0.634	0.076	0.086	0.018	0.016	0.000	0.002
2009	0.001	0.643	0.076	0.221	0.020	0.029	0.004	0.005	0.001
2010	0.082	0.085	0.589	0.056	0.153	0.017	0.013	0.003	0.002
2011	0.018	0.442	0.076	0.314	0.055	0.085	0.008	0.003	0.000
2012	0.174	0.148	0.380	0.040	0.203	0.018	0.030	0.002	0.004
2013	0.000	0.677	0.125	0.128	0.019	0.041	0.005	0.004	0.000
2014	0.014	0.037	0.684	0.115	0.094	0.014	0.034	0.005	0.003
2015	0.034	0.218	0.055	0.519	0.059	0.079	0.018	0.014	0.004
2016	0.166	0.162	0.170	0.058	0.376	0.044	0.020	0.002	0.002
2017	0.138	0.322	0.100	0.112	0.050	0.200	0.049	0.015	0.014
2018	0.045	0.404	0.242	0.098	0.063	0.072	0.070	0.004	0.002

Table 8. Pacific Herring spawn survey locations, start date, and spawn index in metric tonnes (t) in 2018 in the Haida Gwaii major stock assessment region (SAR). The ‘spawn index’ represents the raw survey data only, and is not scaled by the spawn survey scaling parameter,  $q$ . Missing spawn index values (NAs) indicate incomplete spawn surveys.

Statistical Area	Section	Location name	Start date	Spawn index (t)
00	006	Louscoone Inlt	February 28	NA
02	021	Alder Is	April 02	88
02	021	Alder Is Cr	April 02	269
02	021	Marco Is	April 02	0
02	021	Newberry Cv	April 02	23
02	021	Newberry Pt	April 02	21
02	021	Saw Rf	April 02	21
02	021	Scudder Pt	April 02	1,259
02	024	Alfred Pt	April 11	191
02	024	Kilmington Pt	April 11	882
02	025	Francis Bay	April 02	41
02	025	Poole Inlt	April 02	407
02	025	Rebecca Pt	April 02	607
02	025	Scudder Cr	April 02	780

Table 9. Summary of Pacific Herring spawn survey data from 2008 to 2018 in the Haida Gwaii major stock assessment region (SAR). The spawn index has two distinct periods defined by the dominant survey method: surface surveys (1951 to 1987), and dive surveys (1988 to 2018). The ‘spawn index’ represents the raw survey data only, and 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)
2008	23,770	43	1.0	4,213
2009	52,239	34	0.9	9,794
2010	33,670	49	1.2	6,845
2011	33,560	40	1.6	7,554
2012	54,610	28	1.1	9,720
2013	70,300	33	1.7	16,025
2014	52,900	57	0.9	10,566
2015	57,150	55	1.4	13,102
2016	30,345	54	1.1	6,888
2017	31,350	62	0.9	3,016
2018	35,575	44	1.1	4,588

## 7 Figures

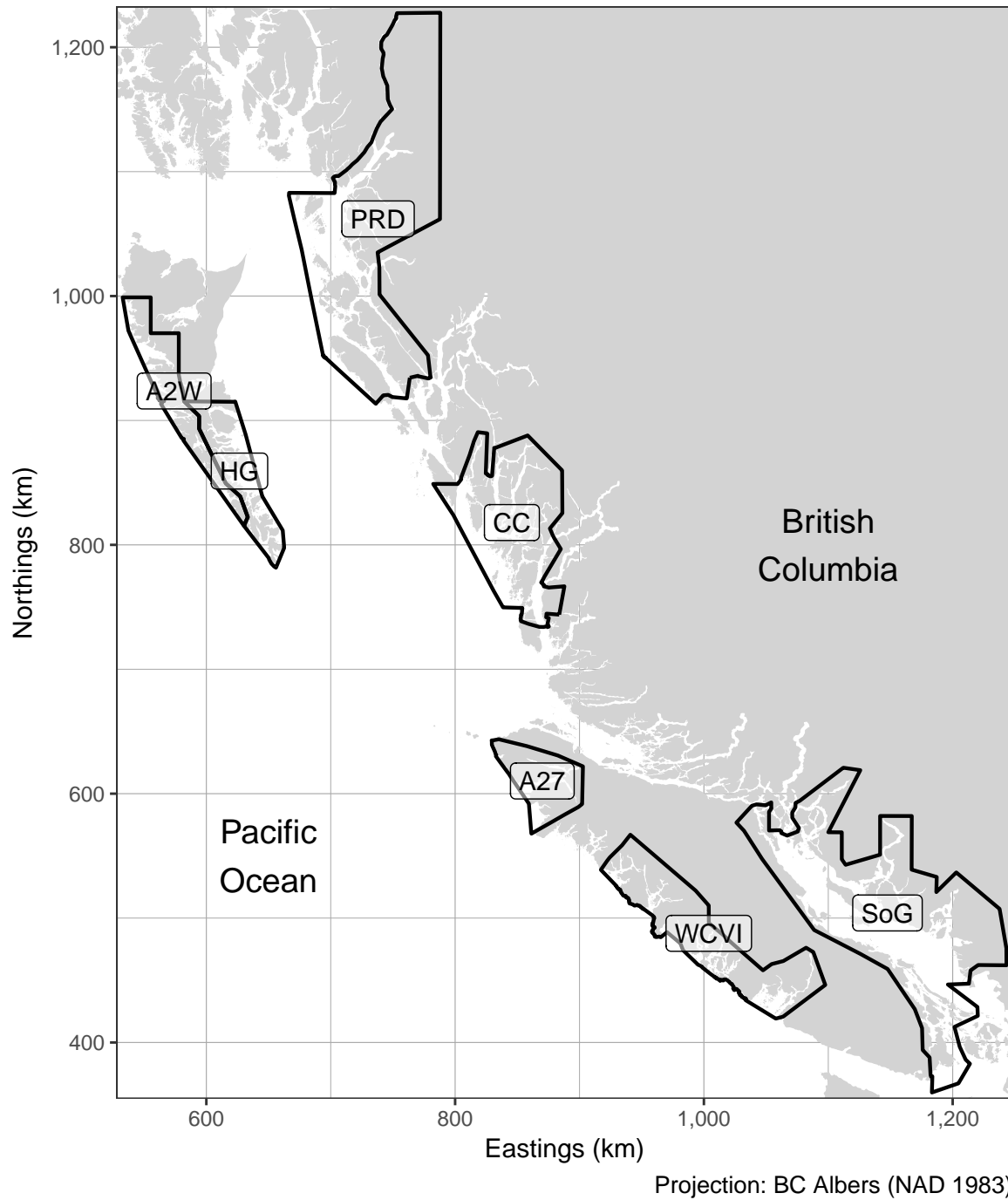


Figure 1. Boundaries for the Pacific Herring stock assessment regions (SARs) in British Columbia: there are 5 major SARs (HG, PRD, CC, SoG, and WCVI), and 2 minor SARs (A27 and A2W; Table 1). Units: kilometres (km).



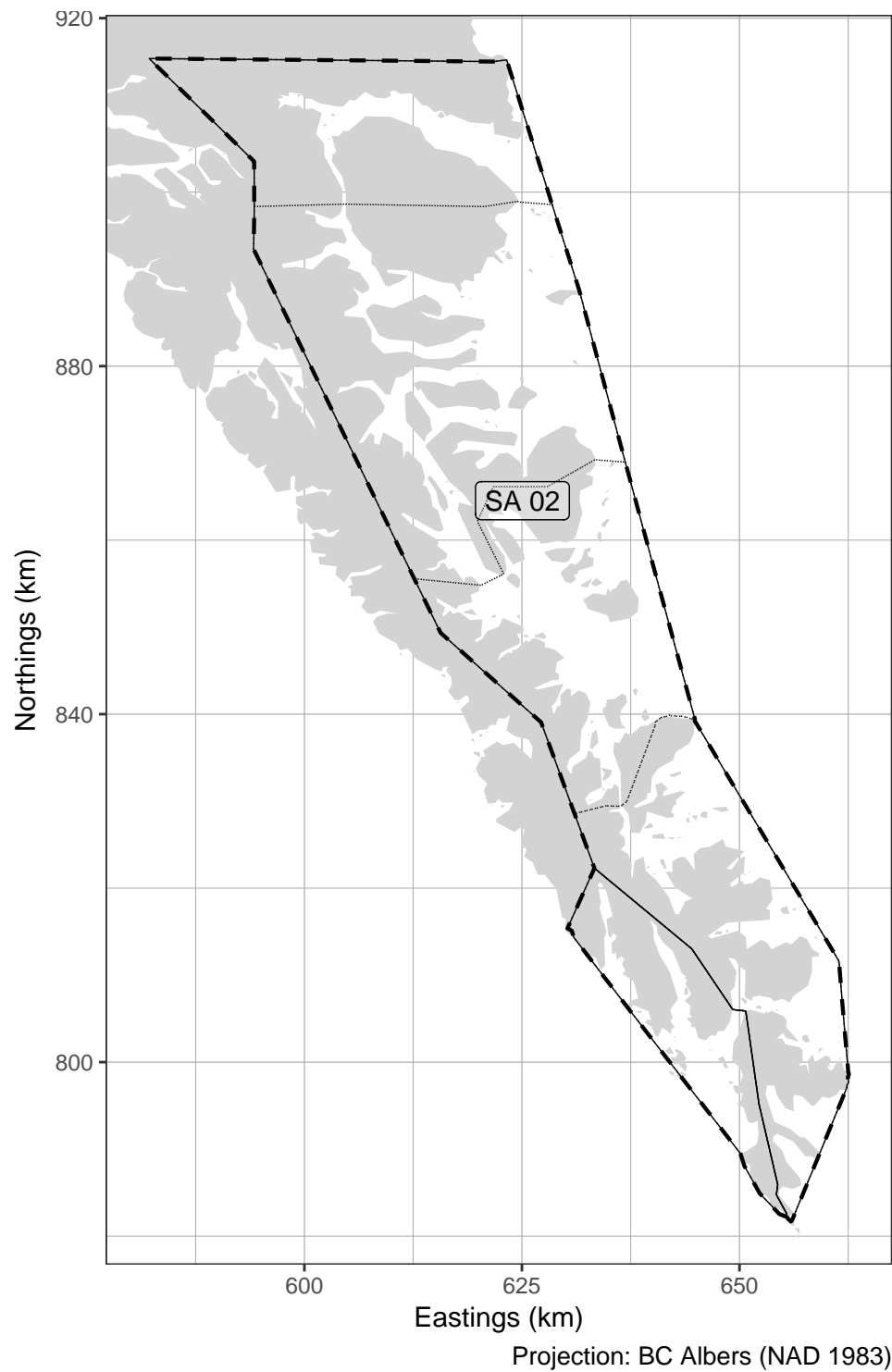


Figure 2. Boundaries for the Haida Gwaii major stock assessment region (SAR; thick dashed lines), associated Statistical Areas (SA; thin solid lines), and associated Sections (thin dotted lines). Units: kilometres (km).

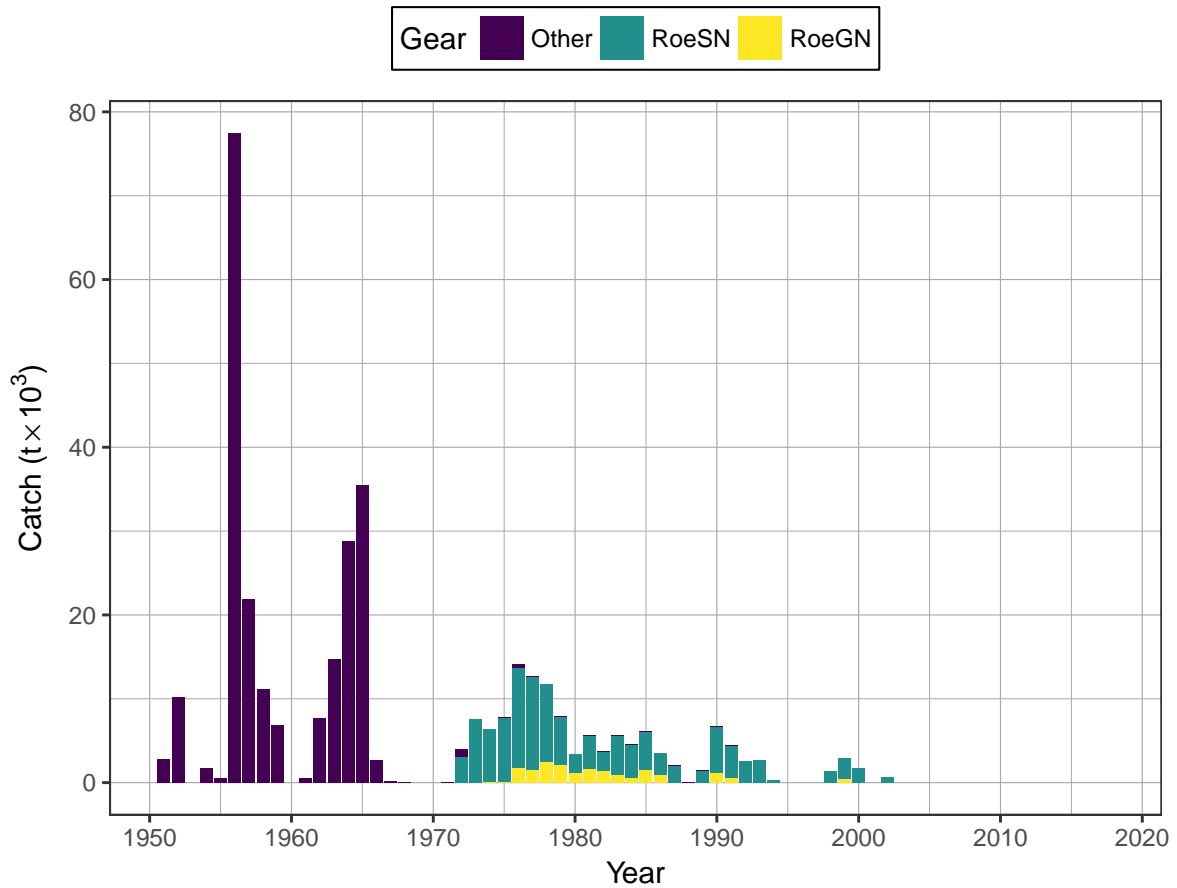


Figure 3. Time series of total landed catch in thousands of metric tonnes ( $t \times 10^3$ ) of Pacific Herring by gear type from 1951 to 2018 in the Haida Gwaii major stock assessment region (SAR). Legend: ‘Other’ represents the reduction, the food and bait, as well as the special use fishery; ‘RoeSN’ represents the roe seine fishery; and ‘RoeGN’ represents the roe gillnet fishery. Data from the spawn-on-kelp (SOK) fishery is not included.

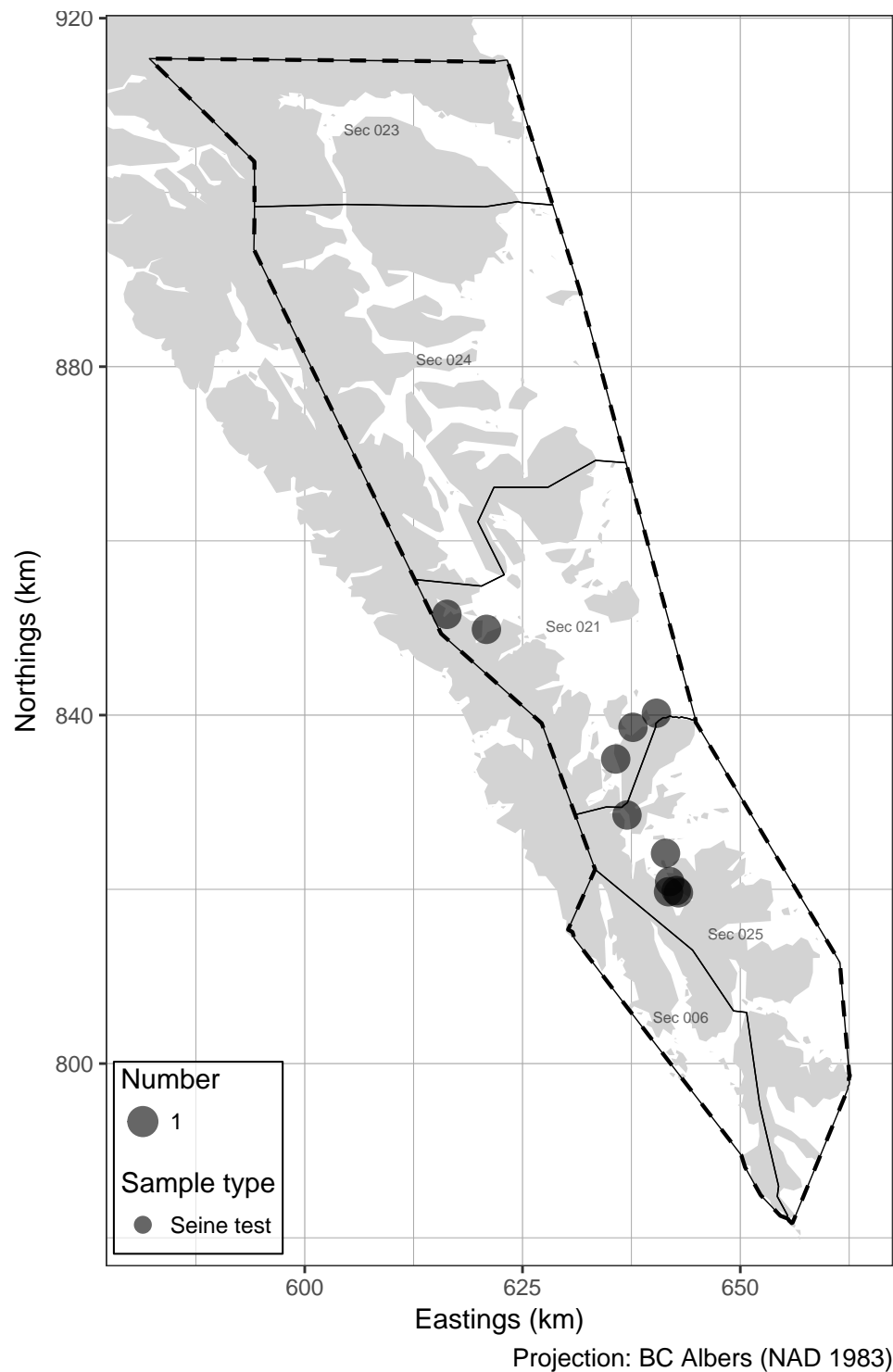


Figure 4. Location and type of Pacific Herring biological samples collected in 2018 in the Haida Gwaii major stock assessment region (SAR; thick dashed lines), and associated Sections (Sec; thin solid lines). Units: kilometres (km).

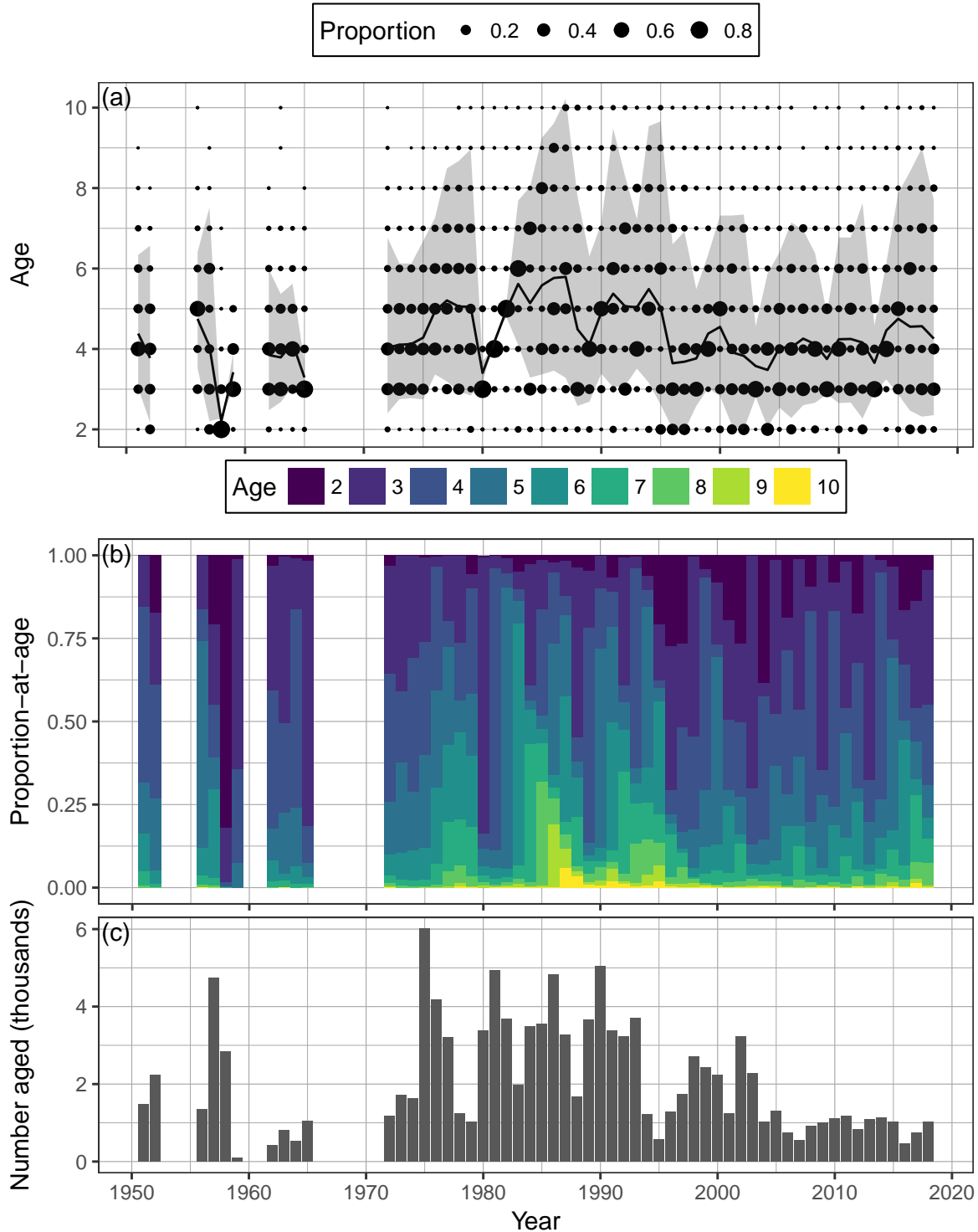


Figure 5. Time series of observed proportion-at-age (a, b) and number aged in thousands (c) of Pacific Herring from 1951 to 2018 in the Haida Gwaii major stock assessment region (SAR). The black line is the mean age, and the shaded area is the approximate 90% distribution. Biological summaries only include 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.

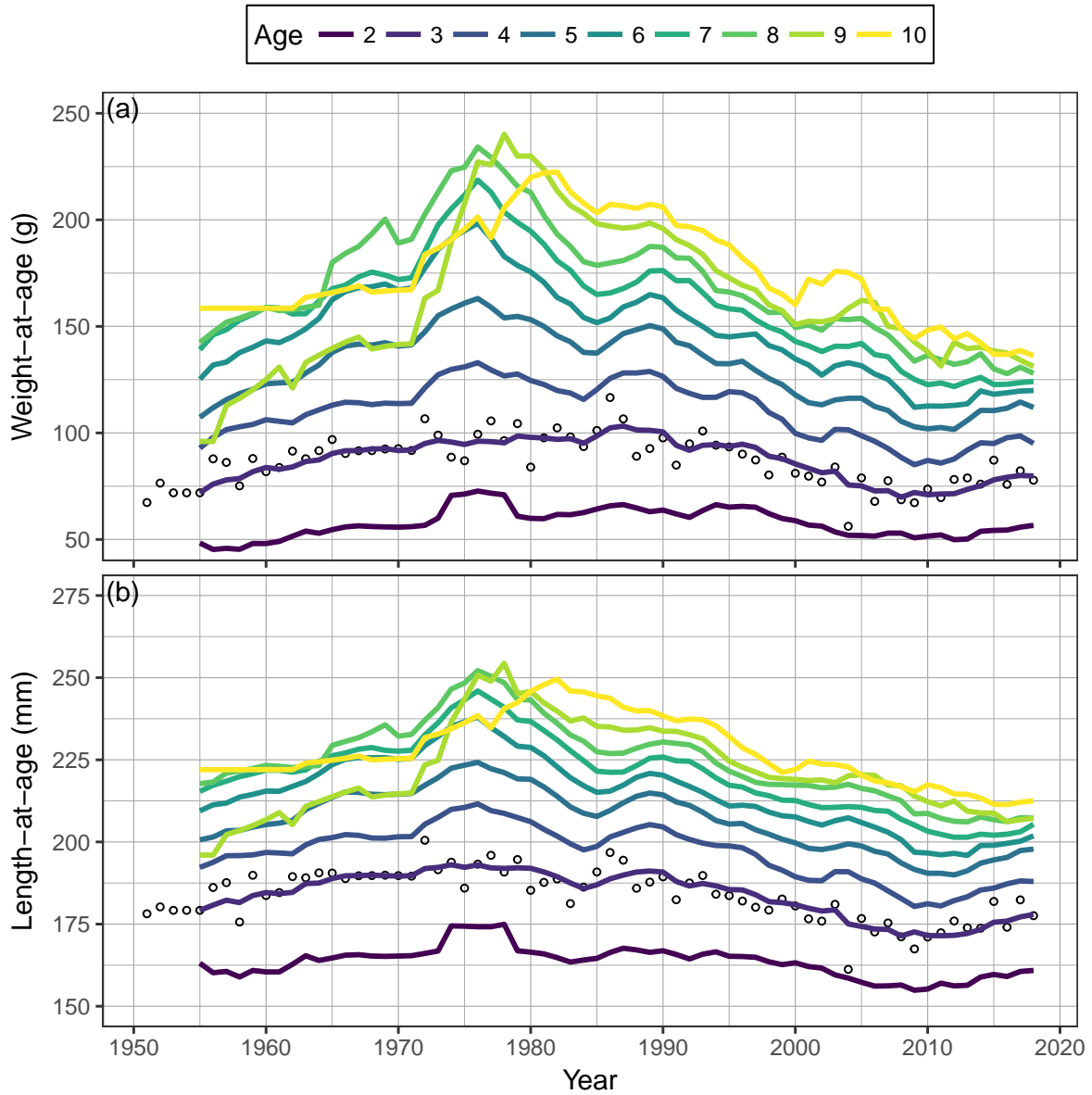


Figure 6. Time series of weight-at-age in grams (g; panel a) and length-at-age in millimetres (mm; panel b) for age-3 (circles) and 5-year running mean weight- and length-at-age (lines) for Pacific Herring from 1951 to 2018 in the Haida Gwaii major stock assessment region (SAR). Missing weight- and length-at-age 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.

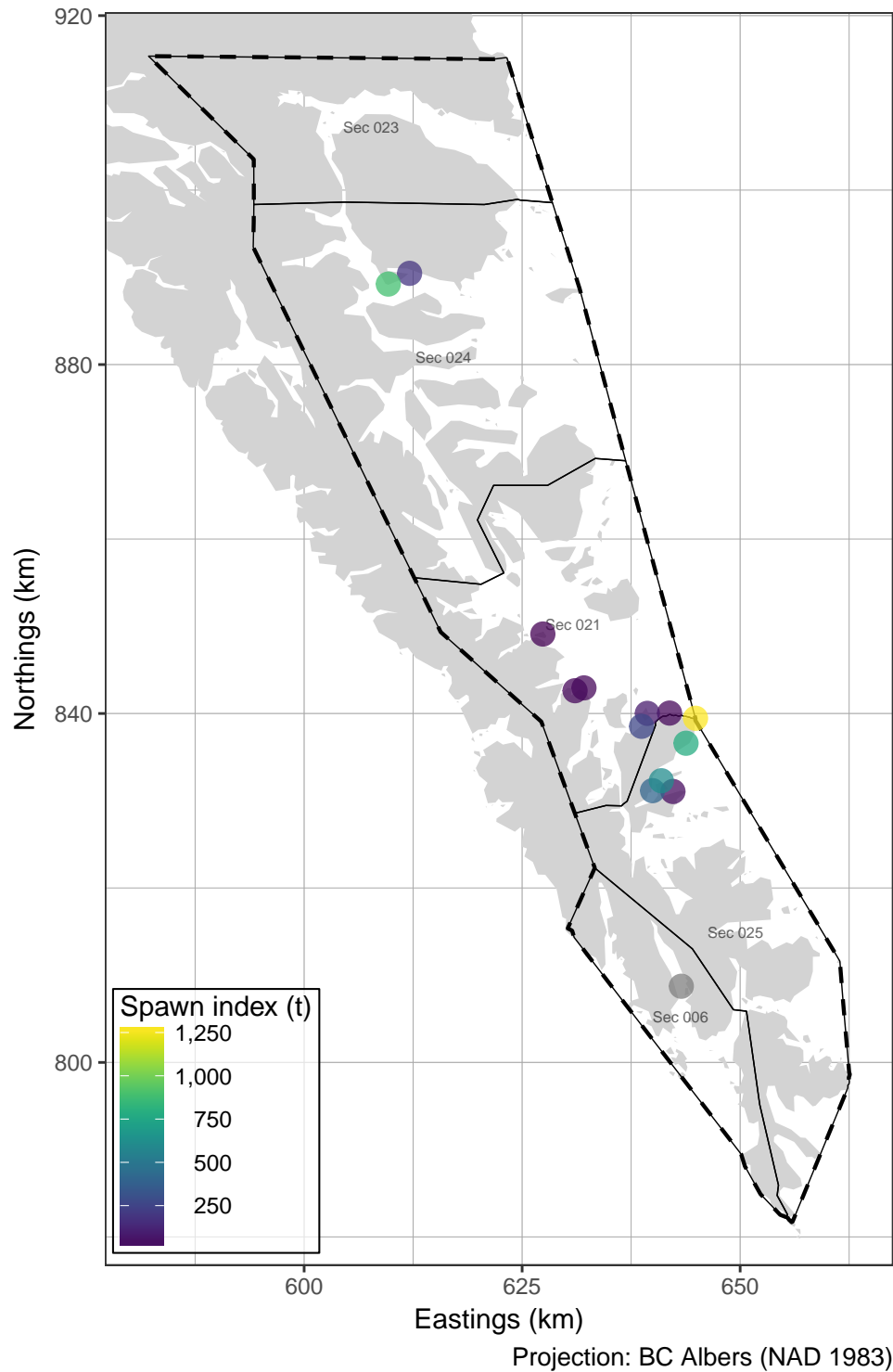


Figure 7. Pacific Herring spawn survey locations, and spawn index in metric tonnes (t) in 2018 in the Haida Gwaii major stock assessment region (SAR; thick dashed lines), and associated Sections (Sec; thin solid lines). The ‘spawn index’ represents the raw survey data only, and is not scaled by the spawn survey scaling parameter,  $q$ . Missing spawn index values (grey circles) indicate incomplete spawn surveys. Units: kilometres (km).

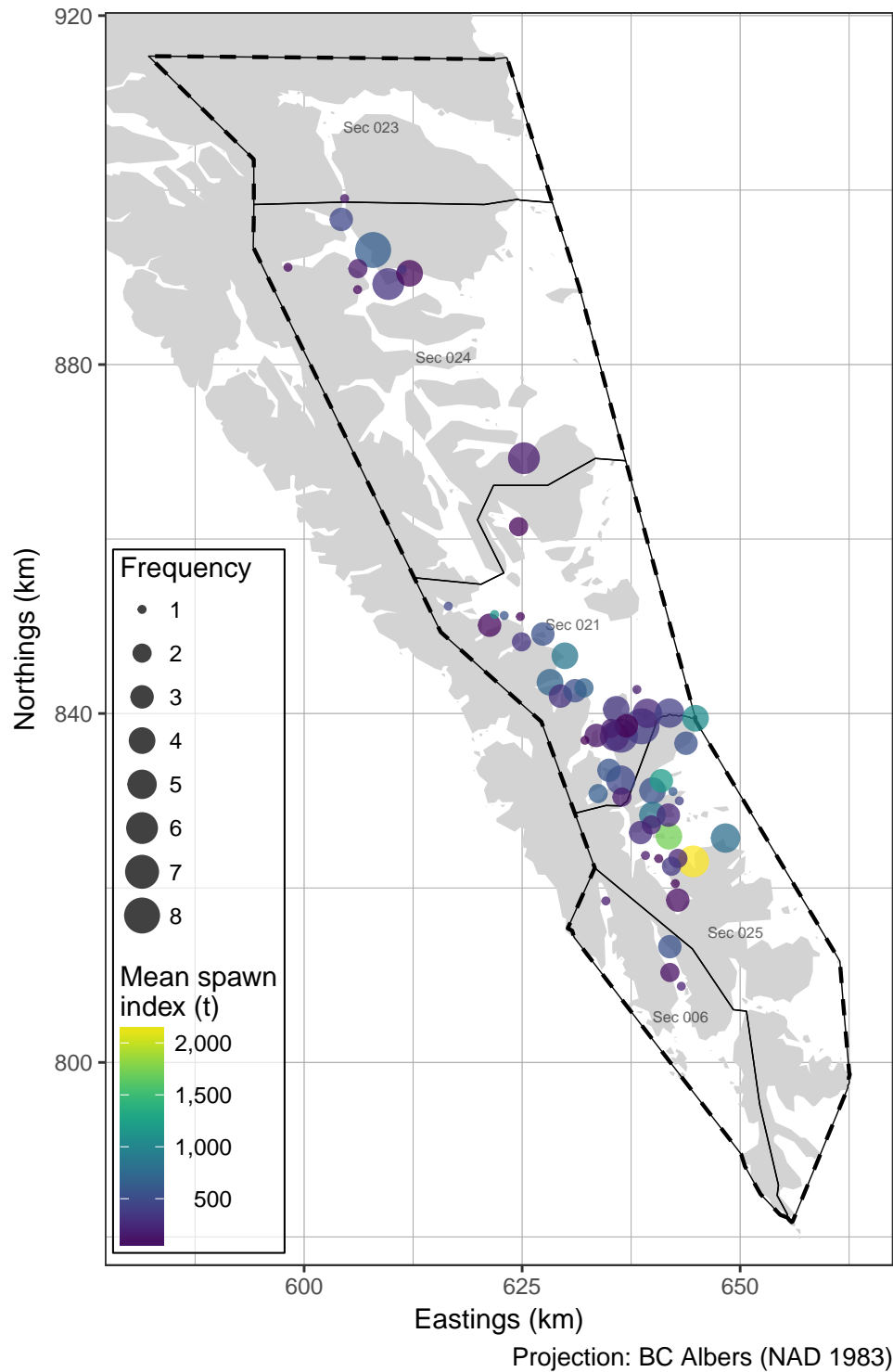


Figure 8. Pacific Herring spawn survey locations, mean spawn index in metric tonnes (t), and spawn frequency from 2008 to 2017 in the Haida Gwaii major stock assessment region (SAR; thick dashed lines), and associated Sections (Sec; thin solid lines). The ‘spawn index’ represents the raw survey data only, and is not scaled by the spawn survey scaling parameter,  $q$ . Missing spawn index values (grey circles) indicate incomplete spawn surveys. Units: kilometres (km).

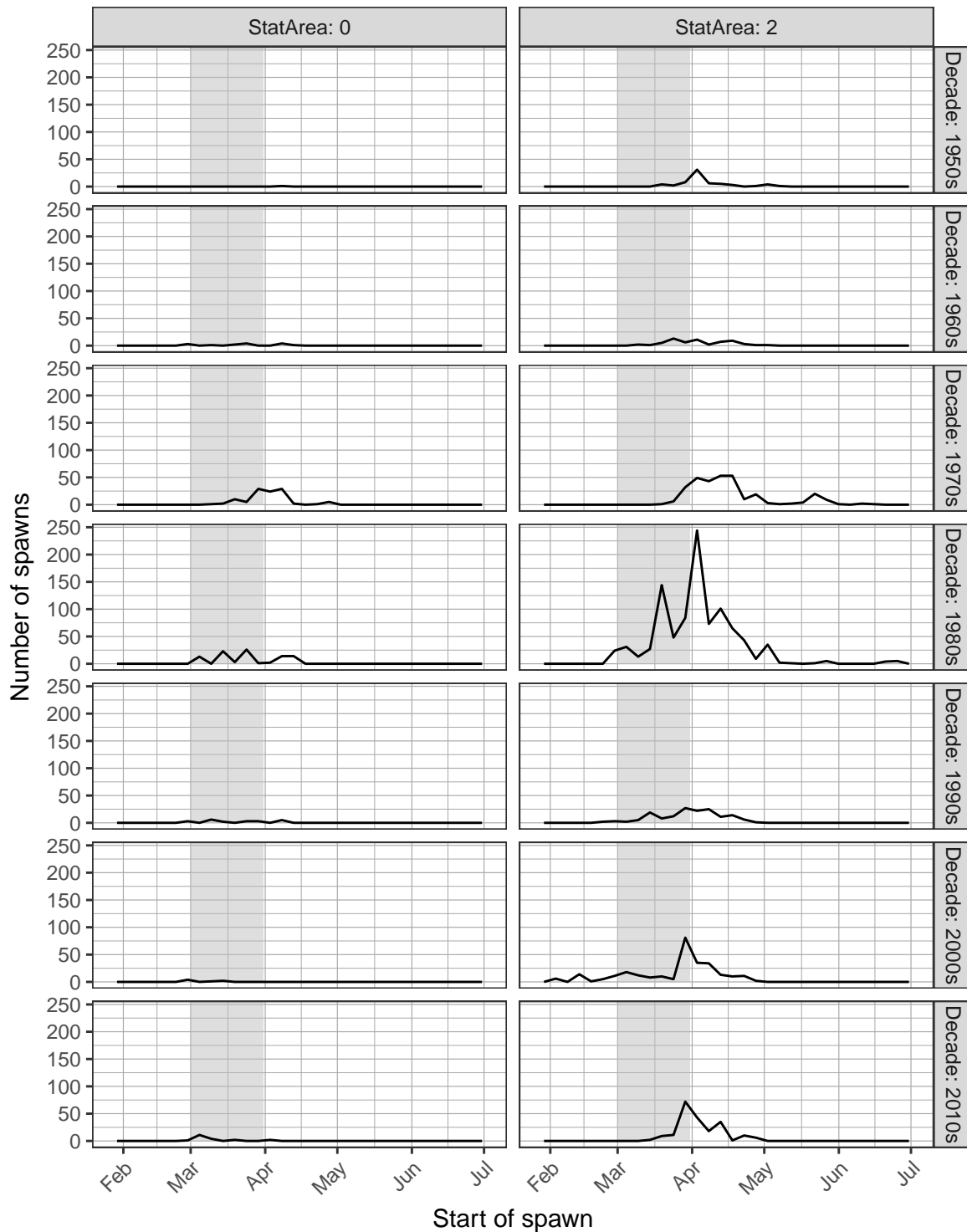


Figure 9. Pacific Herring spawn start date by decade and Statistical Area. Grey shaded regions indicate March 1<sup>st</sup> to 31<sup>st</sup>. Note that spawn size and intensity varies; therefore the number of spawns is not directly proportional to spawn extent or biomass.



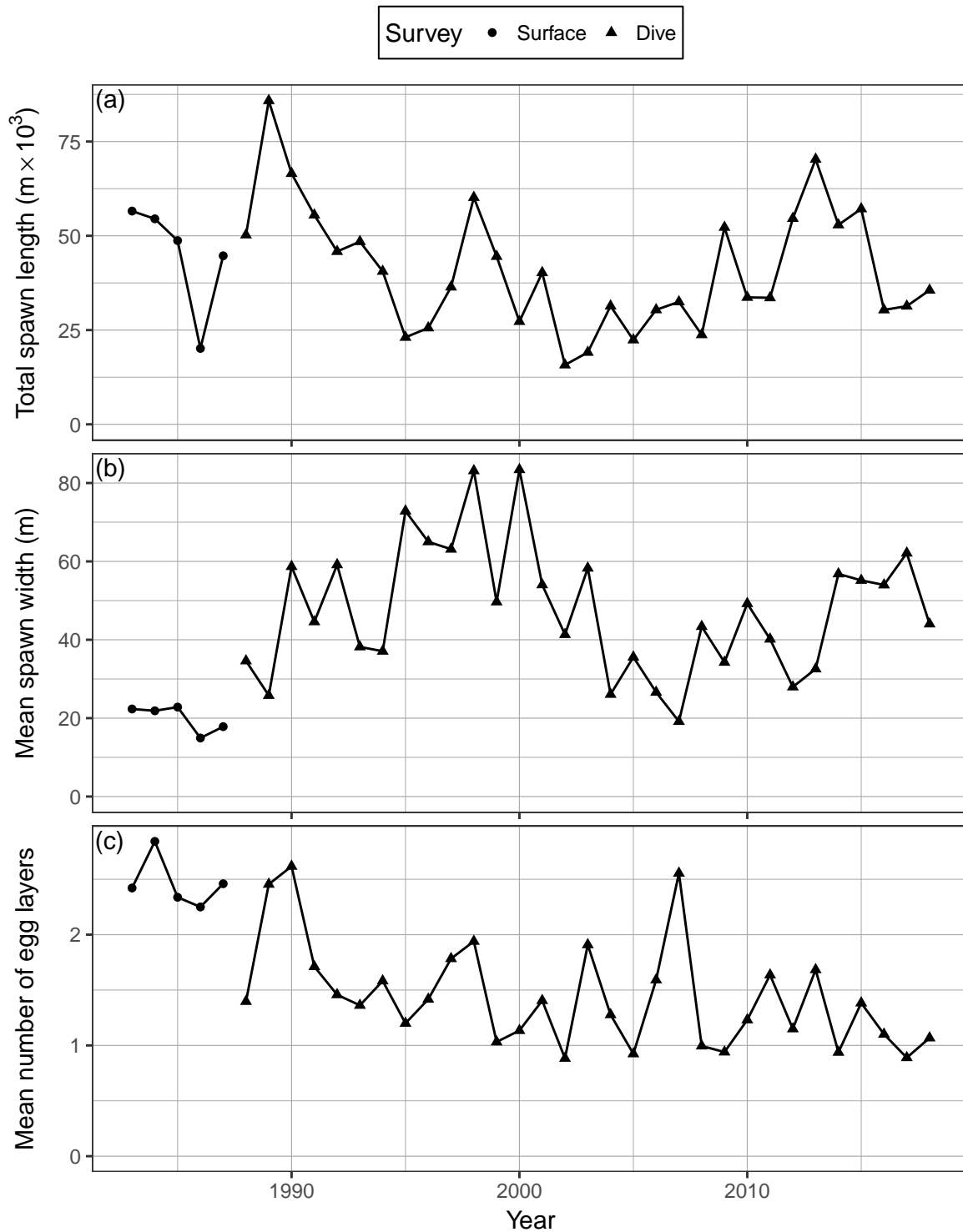


Figure 10. Time series of total spawn length in thousands of metres ( $m \times 10^3$ ; panel a), mean spawn width in metres (b), and mean number of egg layers (c) for Pacific Herring from 1983 to 2018 in the Haida Gwaii major stock assessment region (SAR). The spawn index has two distinct periods defined by the dominant survey method: surface surveys (1951 to 1987), and dive surveys (1988 to 2018).

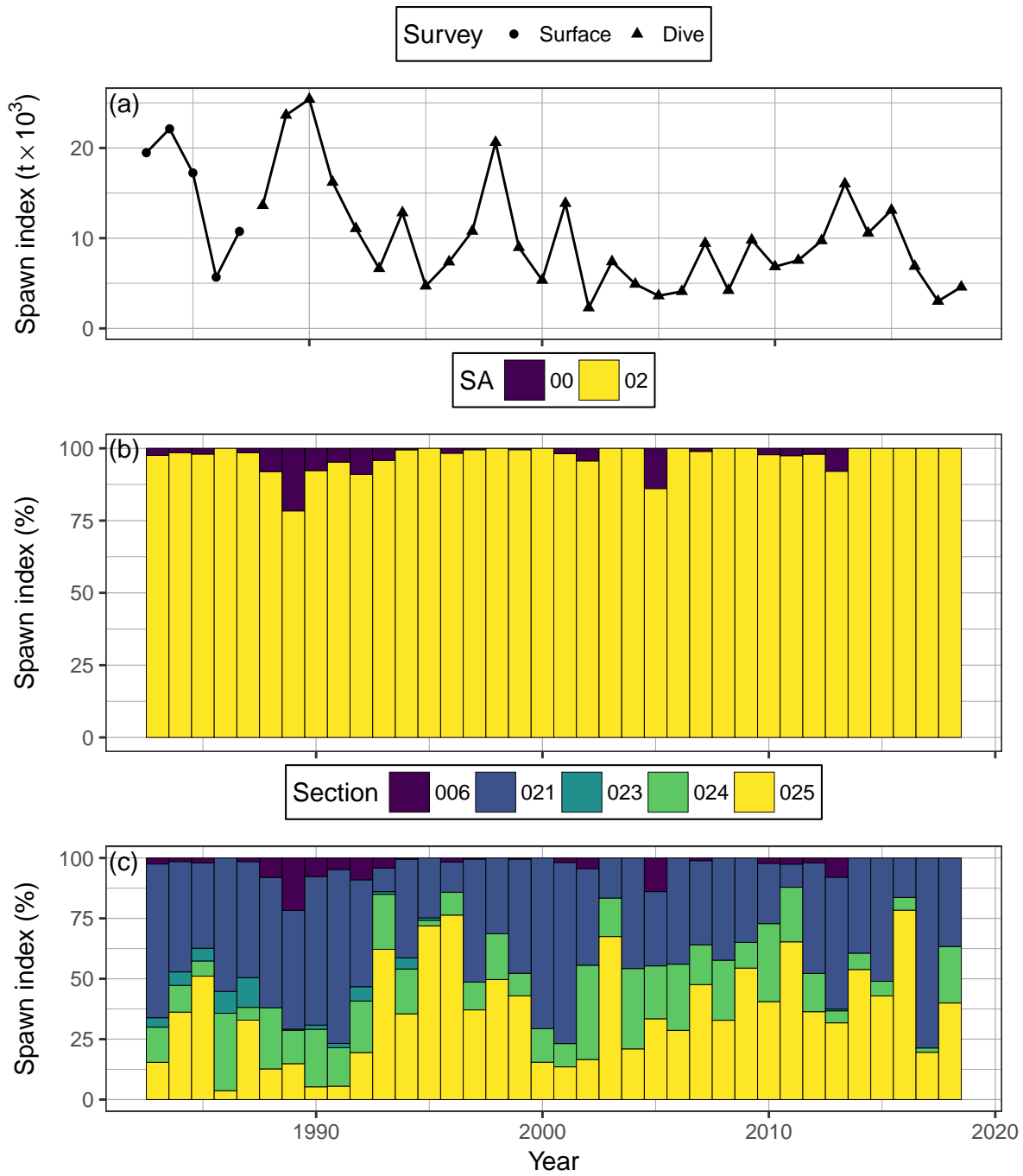


Figure 11. Time series of spawn index in thousands of metric tonnes ( $t \times 10^3$ ) for Pacific Herring from 1983 to 2018 in the Haida Gwaii major stock assessment region (SAR; panel a), as well as percent contributed by Statistical Area (SA), and Section (b, & c, respectively). The spawn index has two distinct periods defined by the dominant survey method: surface surveys (1951 to 1987), and dive surveys (1988 to 2018). The ‘spawn index’ represents the raw survey data only, and is not scaled by the spawn survey scaling parameter,  $q$ .

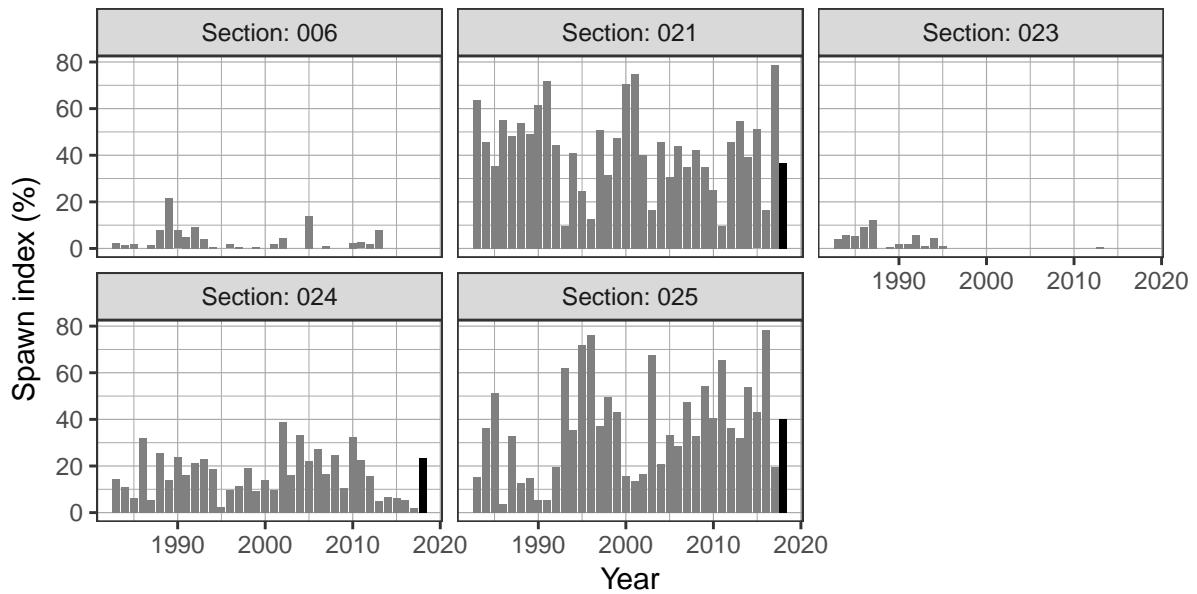


Figure 12. Time series of percent of spawn index by Section for Pacific Herring from 1983 to 2018 in the Haida Gwaii major stock assessment region (SAR). The year 2018 has a darker bar to facilitate interpretation. The spawn index has two distinct periods defined by the dominant survey method: surface surveys (1951 to 1987), and dive surveys (1988 to 2018). The ‘spawn index’ represents the raw survey data only, and is not scaled by the spawn survey scaling parameter,  $q$ .

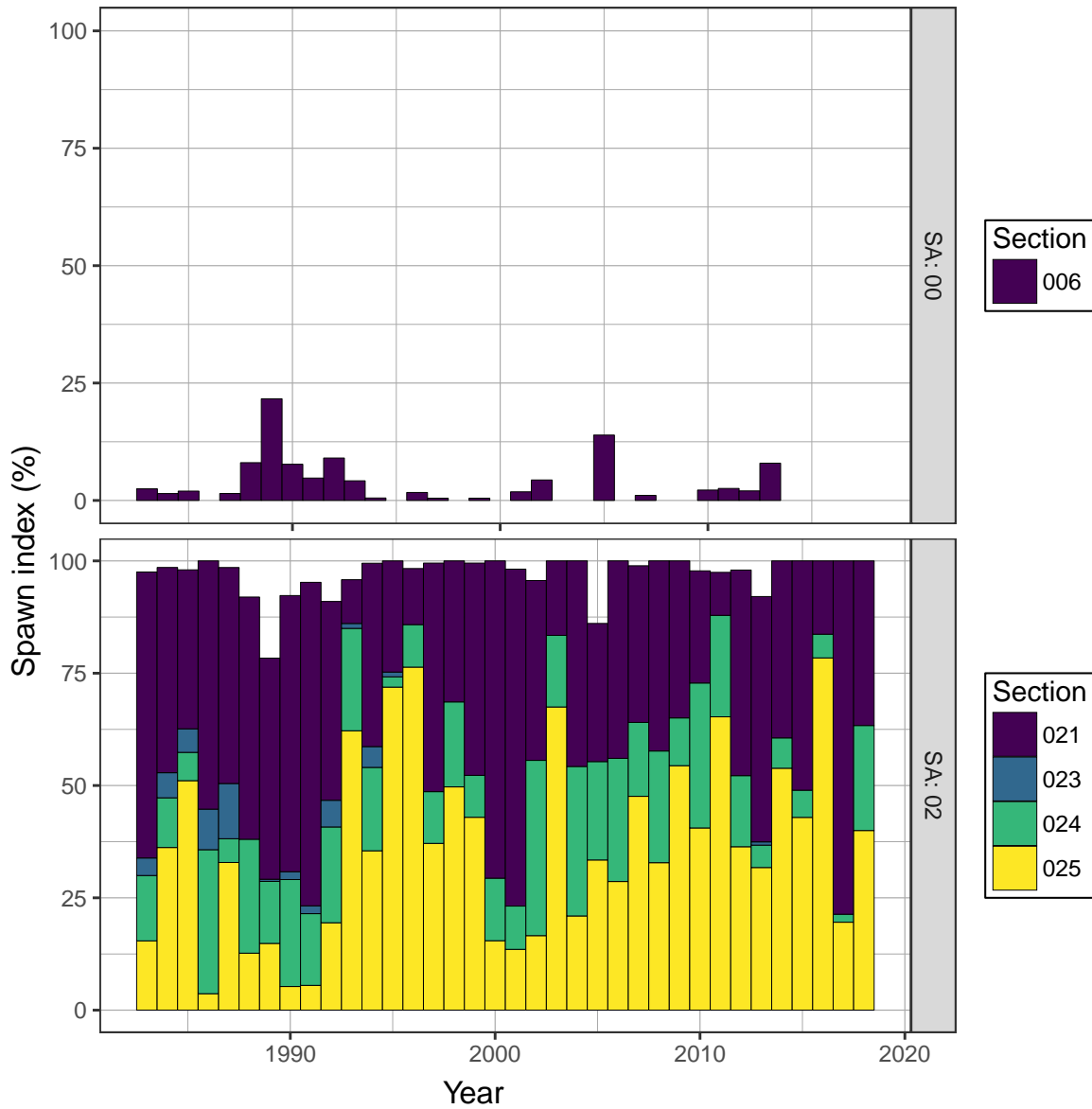


Figure 13. Time series of percent of spawn index by Statistical Area (SA) and Section for Pacific Herring from 1983 to 2018 in the Haida Gwaii major stock assessment region (SAR). The spawn index has two distinct periods defined by the dominant survey method: surface surveys (1951 to 1987), and dive surveys (1988 to 2018). The ‘spawn index’ represents the raw survey data only, and is not scaled by the spawn survey scaling parameter,  $q$ .

Figure 14. Animation of Pacific Herring spawn survey locations and spawn index in metric tonnes (t) from 1951 to 2018 in the Haida Gwaii 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 survey method: surface surveys (1951 to 1987), and dive surveys (1988 to 2018). The ‘spawn index’ represents the raw survey data only, and is not scaled by the spawn survey scaling parameter,  $q$ . Missing spawn index values (grey circles) indicate incomplete spawn surveys. The inset shows the total spawn index by year. Units: kilometres (km).