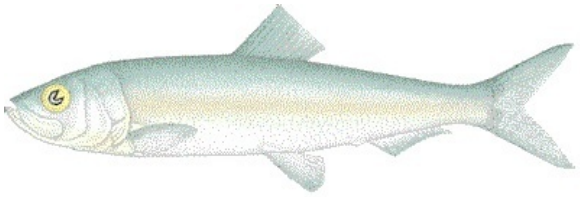
Pacific herring preliminary data summary for Area 27 2016

DFO Science*

June 16, 2017



Pacific herring (*Clupea pallasii*). Image credit: Fisheries and Oceans Canada (`www.pac.dfo-mpo.gc.ca`).

Disclaimer This report contains preliminary data. Therefore, the data may differ from data used and presented in the final Pacific herring stock assessment for Area 27 2016.

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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 2016. 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 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 the Area 27 minor SAR in 2016 (Figure 2). Data collected outside the SAR boundary are not included in this summary, and are not used for the purposes of stock assessment. Note that we refer to 'year' instead of 'herring season' in this report; therefore 2016 refers to the 2015/2016 herring season.

2 Data collection programs

There were no biological samples collected in the Area 27 minor stock area in 2016. Herring spawn was surveyed by the dive survey charter "Seaveyor".

3 Catch and biological samples

Commerical Spawn on Kelp (SOK) fishing opportunities were available in 2016 in the Area 27 minor stock area, however licences were not fished. There were no commercial seine or gillnet opportunities in 2016 in the Area 27 minor stock area. The total landed commercial catch of Pacific herring from all fisheries in 2016 in the Area 27 minor SAR was 0 t, which is the same as last year (Table 2 and Figure 3). The total harvested spawn on kelp (SOK) in 2016 in the Area 27 minor SAR was 0 lb, which is associated with an estimated spawning biomass of 0 t (Table 3). We use the following equation to convert SOK harvest to spawning biomass [ref?]

$$SB = SOK \cdot 0.00832 \tag{1}$$

where SOK is SOK harvest in pounds, and SB is spawning biomass in tonnes.

In 2016, 0 Pacific herring biological samples were collected and processed for the Area 27 minor SAR (Table 4, Table 5), and a total of 0 Pacific herring were aged in 2016. Included herein are biological summaries of observed proportion-, number-, and weight-at-age (Figure 4, Table 6, and Figure 5, respectively). Biological summaries only include samples collected using seine nets (commercial and test) due to size-selectivity of other gear types such as gillnet.

4 Spawn survey data

Herring spawn surveys were conducted at 10 locations in 2016 in the Area 27 minor SAR (Table 7, Figure 6). Spawn surveys are conducted to estimate the spawn length, width, number of layers, and substrate type, and these data are used to estimate the index of spawning biomass (i.e., the spawn index; Figure 7, Figure 8, Figure 9, Figure 10, and Table 8). 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 (1951–1987), and dive surveys (1988–2016).

Some herring Sections contribute more than others to the total spawn index, and the percentage contributed by Section varies yearly (Figure 10b, Figure 11). For example, in 2016, Section 273 contributed the most to the spawn index (100%). As with Sections, some Statistical Areas contribute more than others to the total spawn index (Figure 10c, Figure 12).

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:

- "Seaveyor" surveyed the area March 30th to April 1st.
- Survey effort is concentrated in Section 273 and identification of spawning events relies largely on communication from local residents to the DFO Resource Manager.
- Spawn dive survey in Area 27 occurred a considerable time after spawn was reported, however there were no reports of egg hatching at the time of survey.
- Fungal eggs were reported.
- Report of an early spawn around February 22nd on the south-side of Winter Harbour (couple hundred meters); this spawn was not surveyed.
- Dive survey observed lower historical length and layers. Width was average.

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. Total landed commercial catch of Pacific herring in metric tonnes (t) by fishery in 2016 in the Area 27 minor stock assessment region (SAR).

Fishery	Use	Catch (t)
NA	NA	0

Table 3. Total harvested Pacific herring spawn on kelp (SOK) in pounds (lb), and the associated estimate of spawning biomass in metric tonnes (t) from 2006 to 2016 in the Area 27 minor stock assessment region (SAR).

Year	Harvest (lb)	Spawning biomass (t)
2006	43,082	358
2007	52,691	438
2008	41,291	344
2009	42,325	352
2010	18,141	151
2011	32,517	271
2012	30,949	257
2013	15,009	125
2014	9,648	80
2015	0	0
2016	0	0

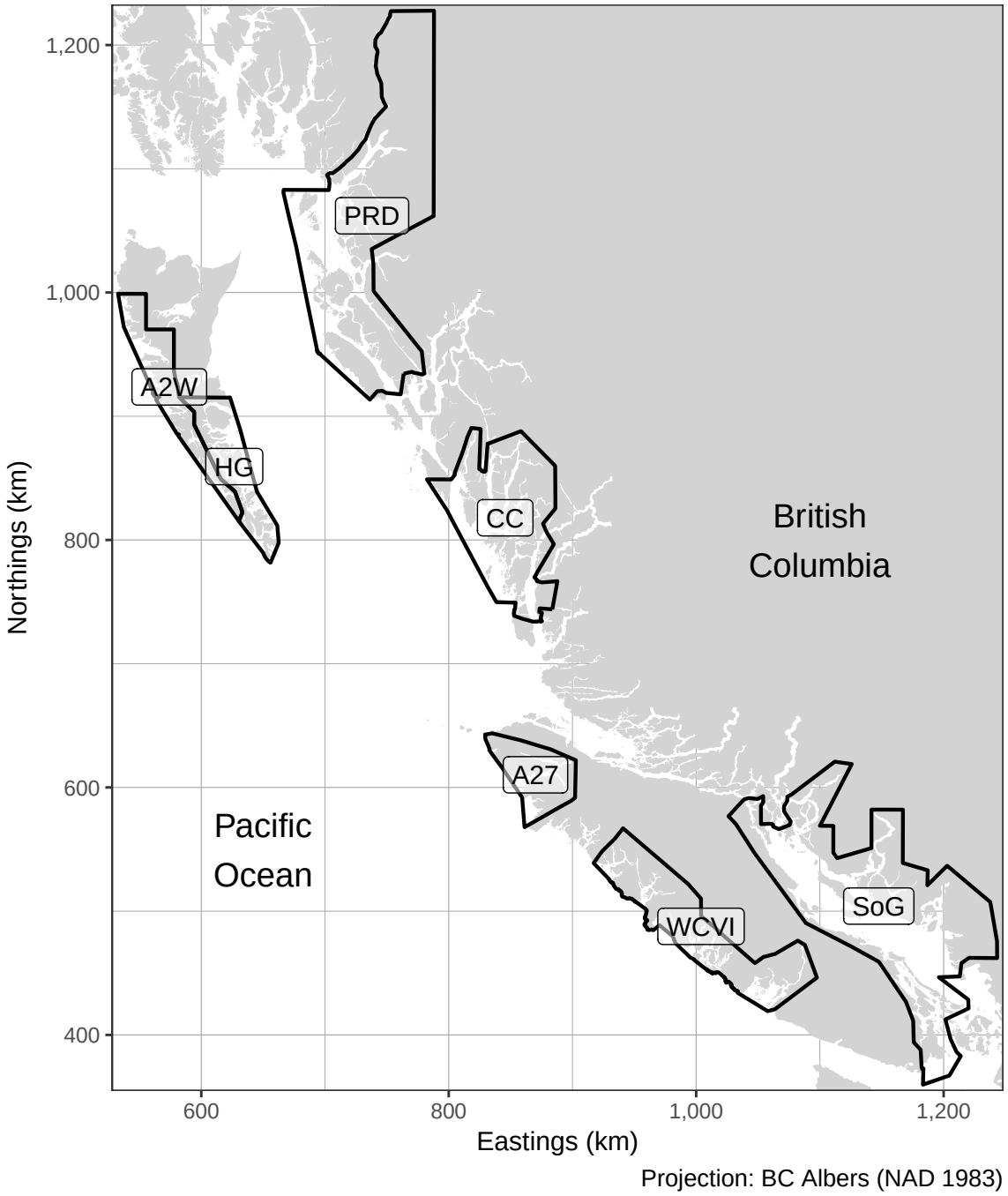

Figure 1. Boundaries for the Pacific herring stock assessment regions (SARs) in British Columbia: there are 5 major SARs (HG, PRD, CC, SoG, and WCVI), and 2 minor SARs (A27 and A2W). Units: kilometres (km). Also see Table 1.

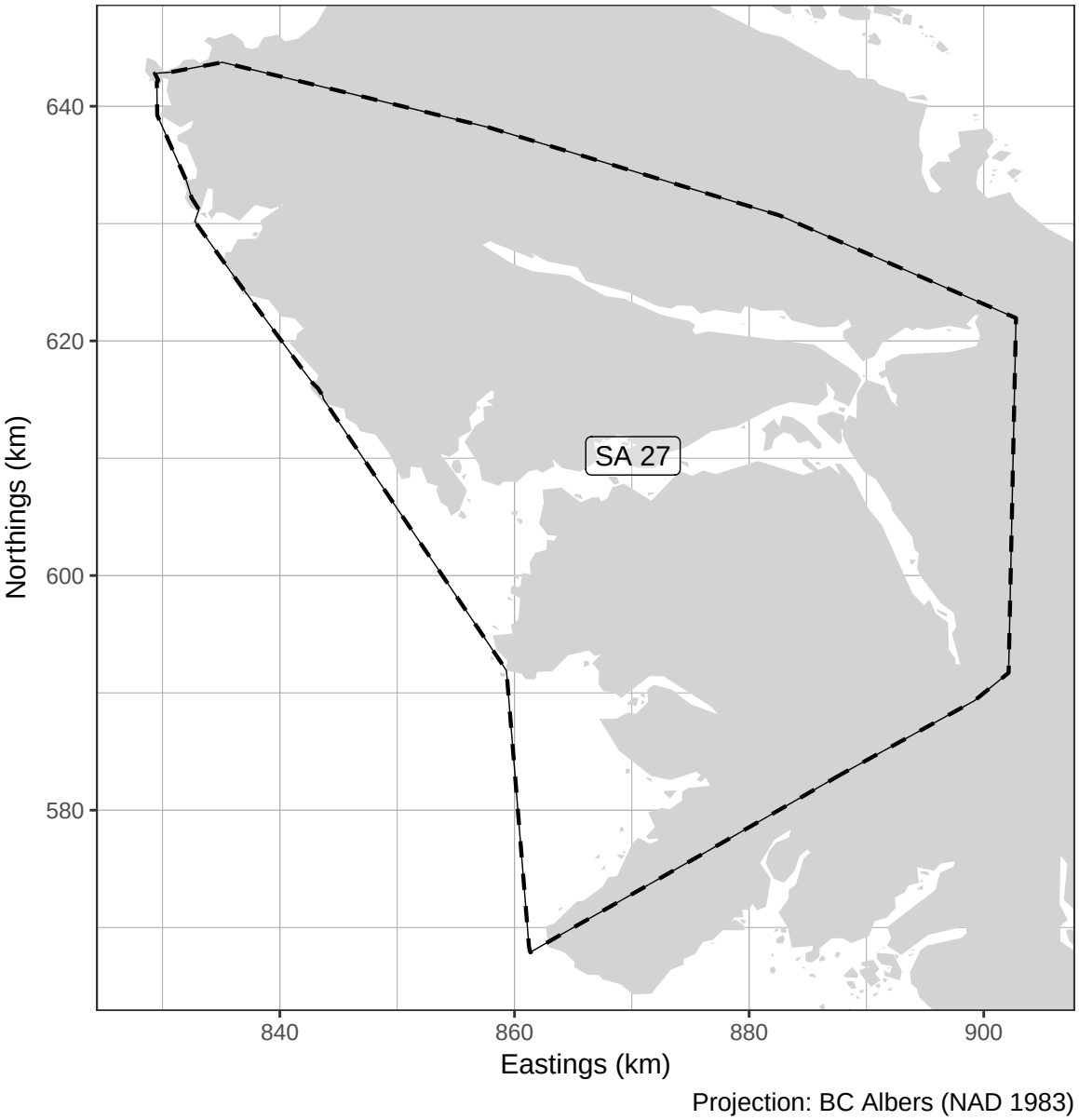

Figure 2. Boundaries for the Area 27 minor stock assessment region (SAR; thick dashed lines), and associated Statistical Areas (SA; thin solid lines). Units: kilometres (km).

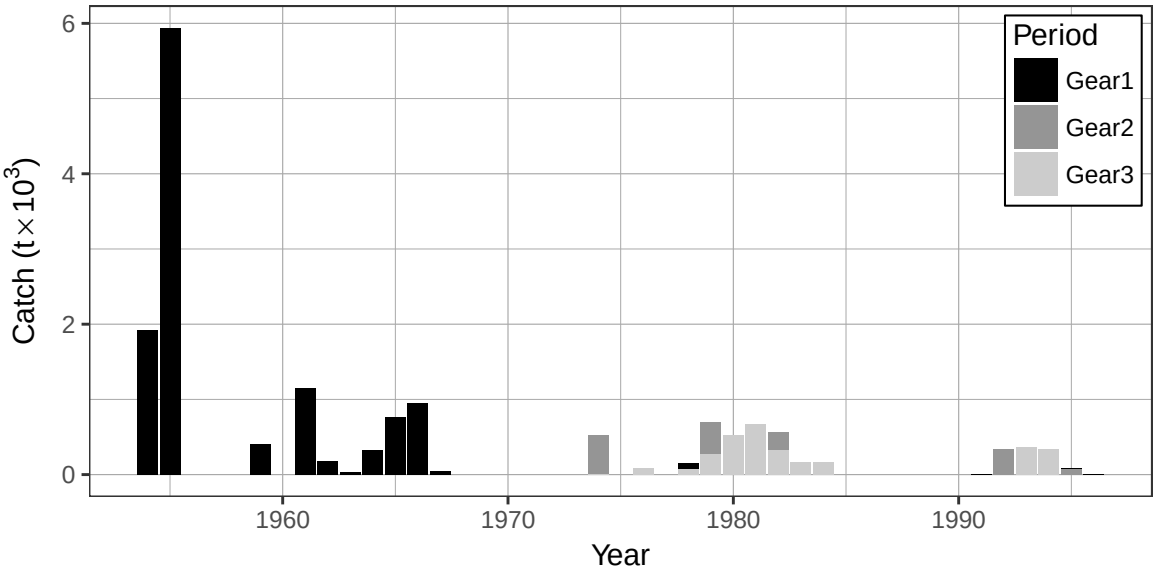

Figure 3. Time series of total landed catch in thousands of metric tonnes ($t \times 10^3$) of Pacific herring by gear type from 1951 to 2016 in the Area 27 minor stock assessment region (SAR). Legend: 'Gear1' represents the reduction, the food and bait, as well as the special use fishery; 'Gear2' represents the roe seine fishery; and 'Gear3' represents the roe gillnet fishery.

Table 4. Number of Pacific herring biological samples processed from 2006 to 2016 in the Area 27 minor stock assessment region (SAR). Each sample is approximately 100 fish.

	Number of samples		
Year	Commercial	Test	Total
2006	0	0	0
2007	5	0	5
2008	4	0	4
2009	8	0	8
2010	3	0	3
2011	3	0	3
2012	7	0	7
2013	6	0	6
2014	0	0	0
2015	0	0	0
2016	0	0	0

Table 5. Number and type of Pacific herring biological samples processed in 2016 in the Area 27 minor stock assessment region (SAR). Each sample is approximately 100 fish.

Type	Gear	Use	Number of samples
NA	NA	NA	0

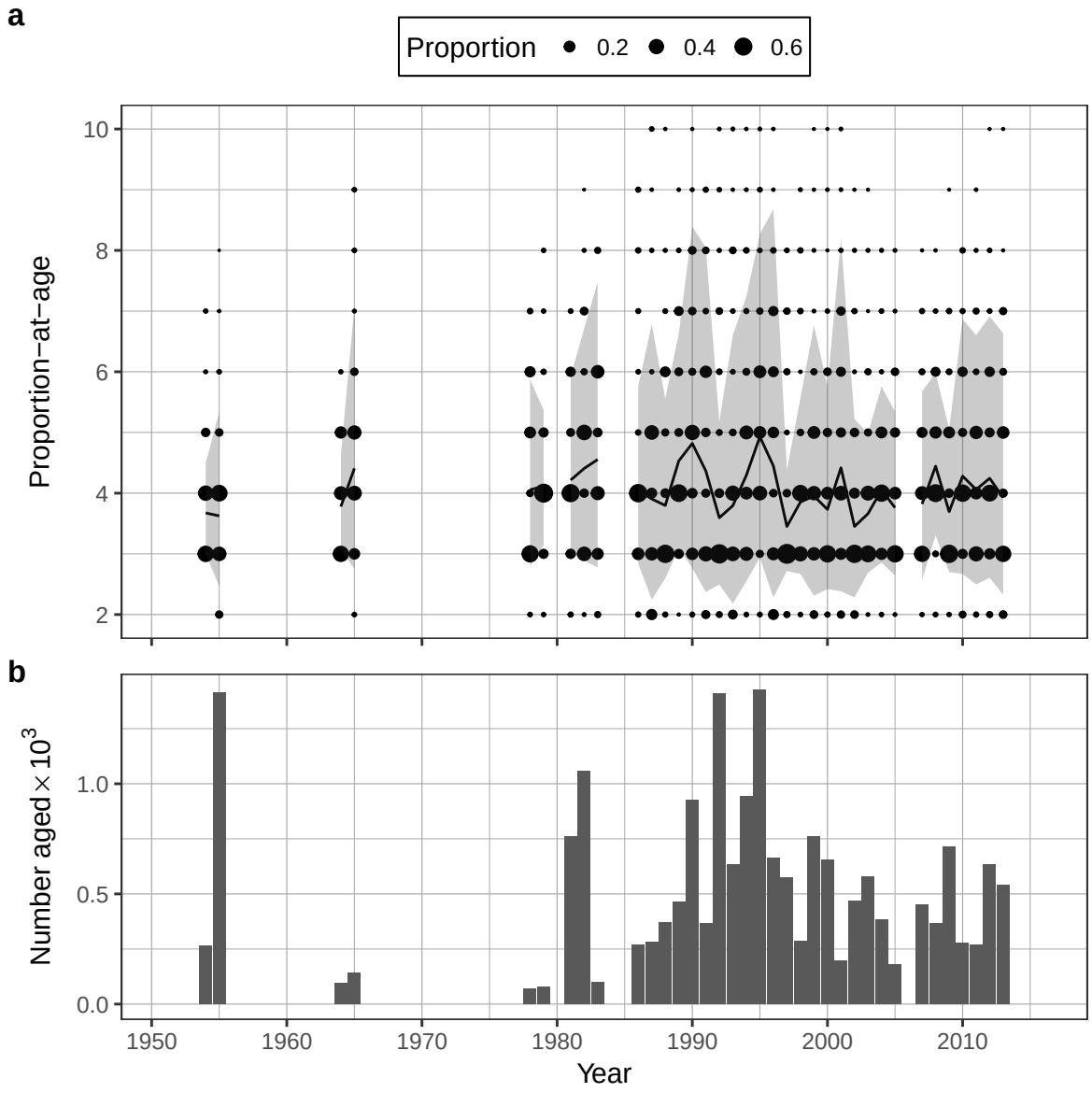

Figure 4. Time series of observed proportion-at-age (a) and number aged (b) of Pacific herring from 1951 to 2016 in the Area 27 minor stock assessment region (SAR). The black line is the mean age, and the shaded area is the approximate 90% distribution. Biological summaries only include samples collected 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.

Table 6. Observed proportion-at-age for Pacific herring from 2006 to 2016 in the Area 27 minor 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
2006	NA	NA	NA	NA	NA	NA	NA	NA	NA
2007	0.011	0.461	0.309	0.159	0.035	0.022	0.002	0.000	0.000
2008	0.016	0.033	0.596	0.219	0.120	0.014	0.003	0.000	0.000
2009	0.013	0.627	0.102	0.200	0.032	0.025	0.000	0.001	0.000
2010	0.054	0.126	0.554	0.090	0.129	0.022	0.025	0.000	0.000
2011	0.022	0.389	0.237	0.274	0.030	0.037	0.007	0.004	0.000
2012	0.040	0.172	0.503	0.120	0.134	0.016	0.013	0.000	0.002
2013	0.078	0.471	0.094	0.235	0.054	0.065	0.002	0.000	0.002
2014	NA	NA	NA	NA	NA	NA	NA	NA	NA
2015	NA	NA	NA	NA	NA	NA	NA	NA	NA
2016	NA	NA	NA	NA	NA	NA	NA	NA	NA

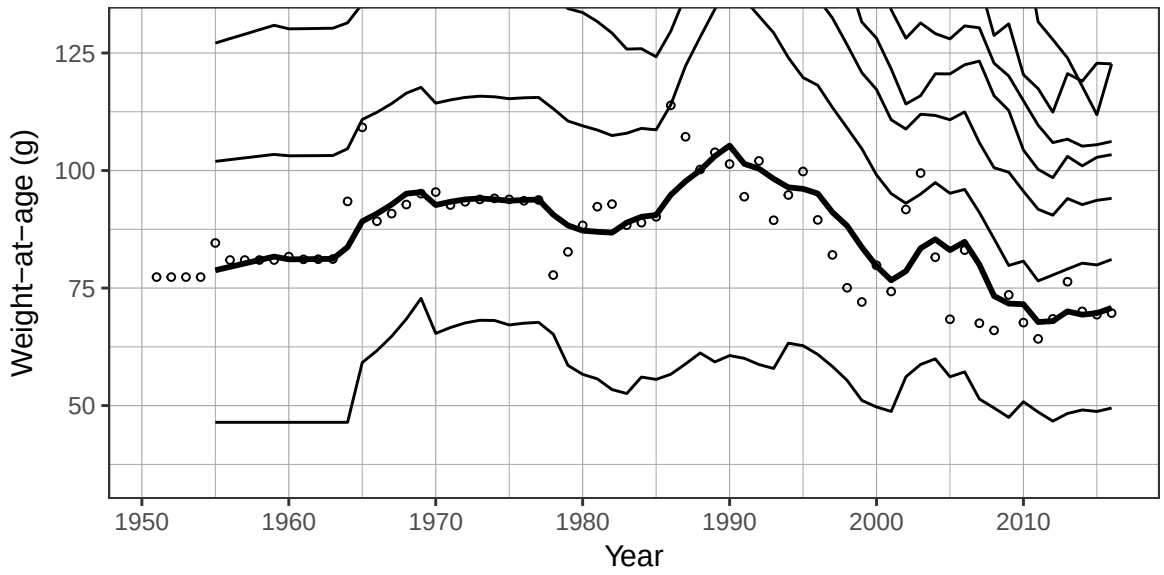

Figure 5. Time series of weight-at-age in grams (g) for age-3 (circles) and 5-year running mean weight-at-age (lines) for Pacific herring from 1951 to 2016 in the Area 27 minor stock assessment region (SAR). Lines show 5-year running means for age-2 to age-10 herring (incrementing higher from the lowest line); the thick black line highlights age-3 herring. Missing weight-at-age values (i.e., years where there are 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.

Table 7. Pacific herring spawn survey locations and spawn index in metric tonnes (t) in 2016 in the Area 27 minor 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 (i.e., NA) indicate incomplete spawn surveys.

Statistical Area	Section	Location code	Location name	Spawn index (t)
27	273	1318	Winter Hrbr	NA
27	273	1319	Forward Inlt	135
27	273	1321	Hazard Pt	174
27	273	1326	Quashtin Cr	40
27	273	1327	Moores Is	205
27	273	1328	Browning Inlt	144
27	273	1329	Matthews Is	15
27	273	1571	North Hrbr	3
27	273	1706	Flint Rk	34
27	273	1709	Galato Cr	63

Table 8. Summary of spawn survey data from 2006 to 2016 in the Area 27 minor stock assessment region (SAR). The spawn index has two distinct periods defined by the dominant survey method: surface surveys (1951–1987), and dive surveys (1988–2016). 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 layers	Spawn index (t)
2006	9,500	29	1.319	2,044
2007	14,860	55	0.676	2,248
2008	3,300	59	0.846	796
2009	12,730	21	0.578	1,201
2010	11,270	32	0.707	846
2011	4,900	26	1.274	547
2012	13,310	38	0.250	744
2013	12,500	38	0.368	914
2014	7,575	102	0.859	1,307
2015	9,800	38	1.128	2,169
2016	11,375	52	0.441	814

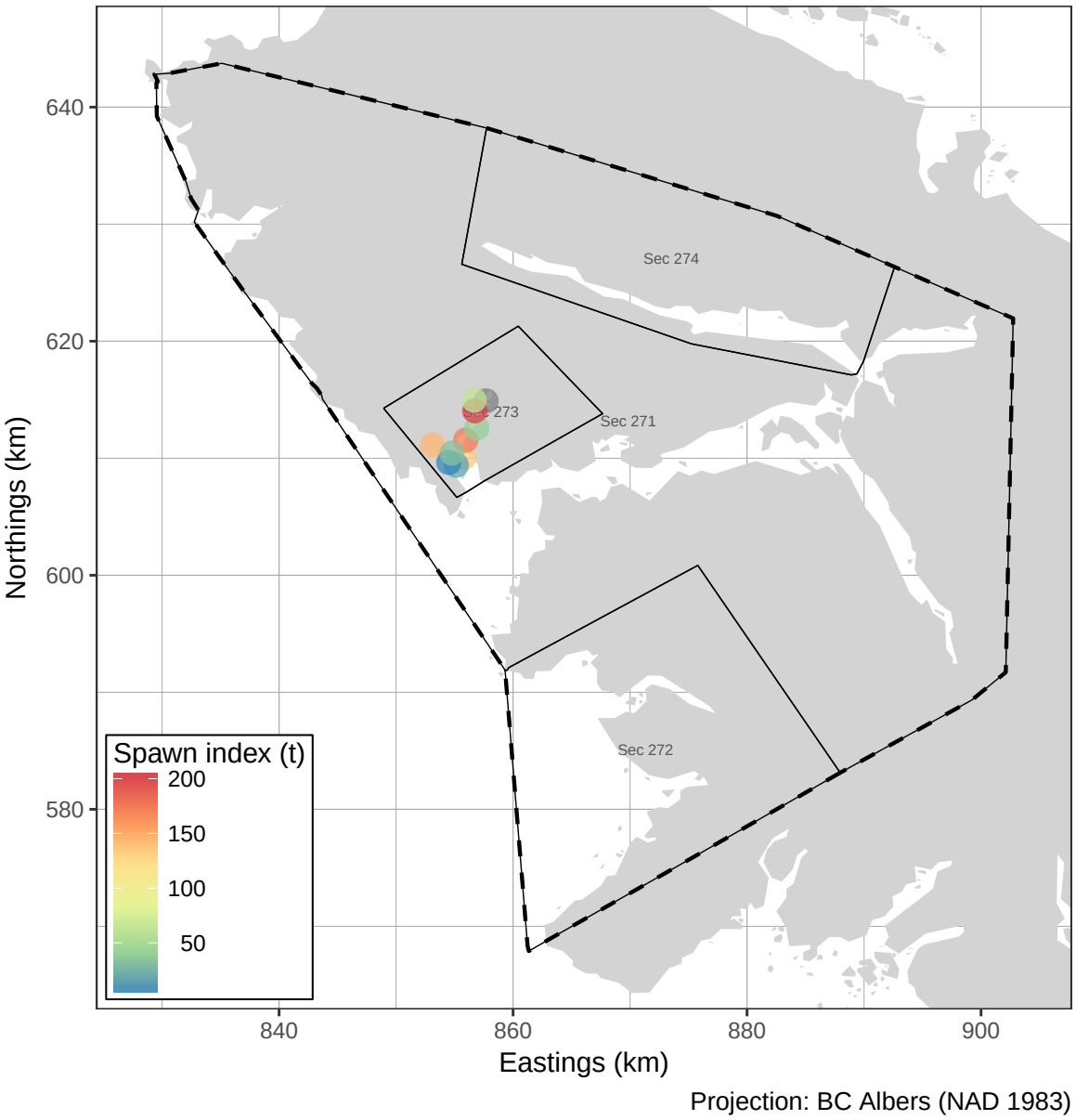

Figure 6. Location of Pacific herring spawning locations in 2016 in the Area 27 minor stock assessment region (SAR; thick dashed lines), and associated Sections (Sec; thin solid lines). The 'spawn index' represents the raw survey data only, and is not scaled by the spawn survey scaling parameter, q. Missing spawn index values (grey circles) indicate incomplete spawn surveys. Units: kilometres (km), and metric tonnes (t).

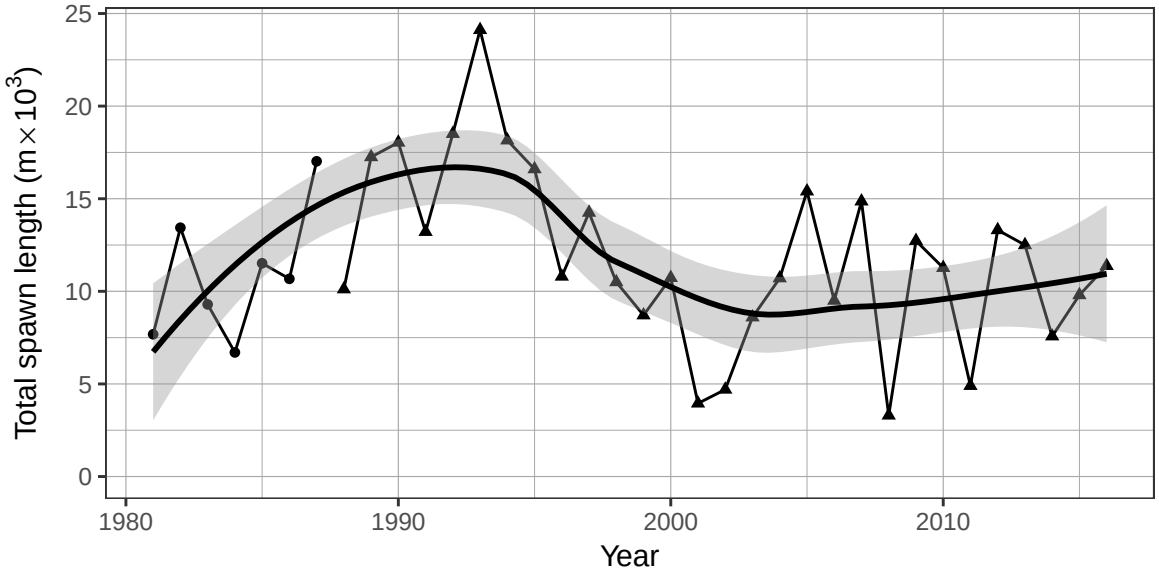

Figure 7. Time series of total spawn length in thousands of metres ($m \times 10^3$) for Pacific herring from 1981 to 2016 in the Area 27 minor stock assessment region (SAR). The thick black line is a loess curve, and the shaded area is the 90% confidence interval. The spawn index has two distinct periods defined by the dominant survey method: surface surveys (1951–1987), and dive surveys (1988–2016).

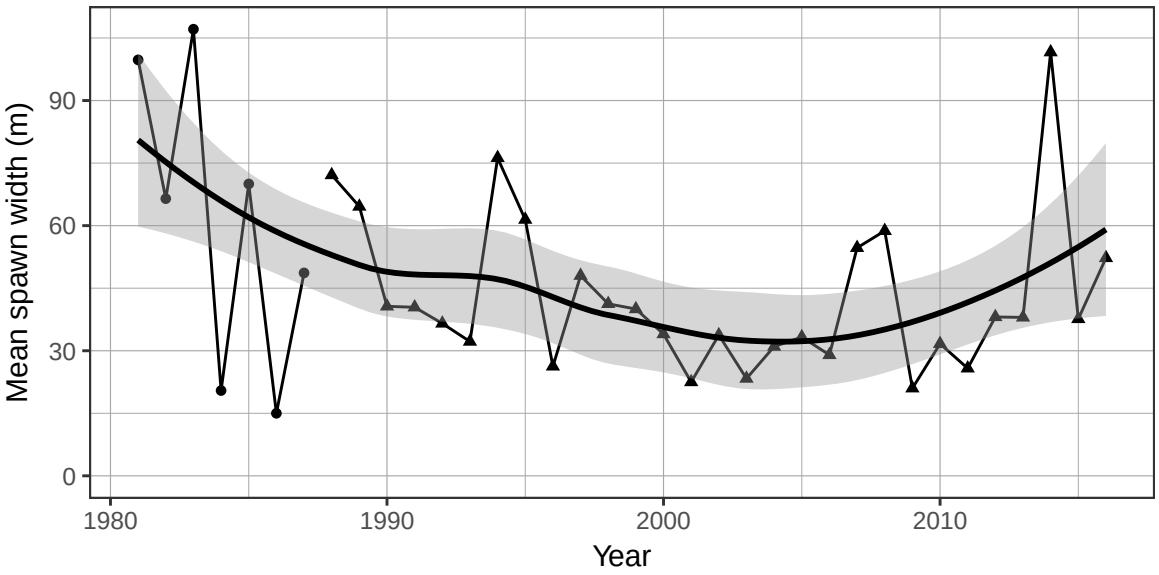

Figure 8. Time series of mean spawn width in metres (m) for Pacific herring from 1981 to 2016 in the Area 27 minor stock assessment region (SAR). The thick black line is a loess curve, and the shaded area is the 90% confidence interval. The spawn index has two distinct periods defined by the dominant survey method: surface surveys (1951–1987), and dive surveys (1988–2016).

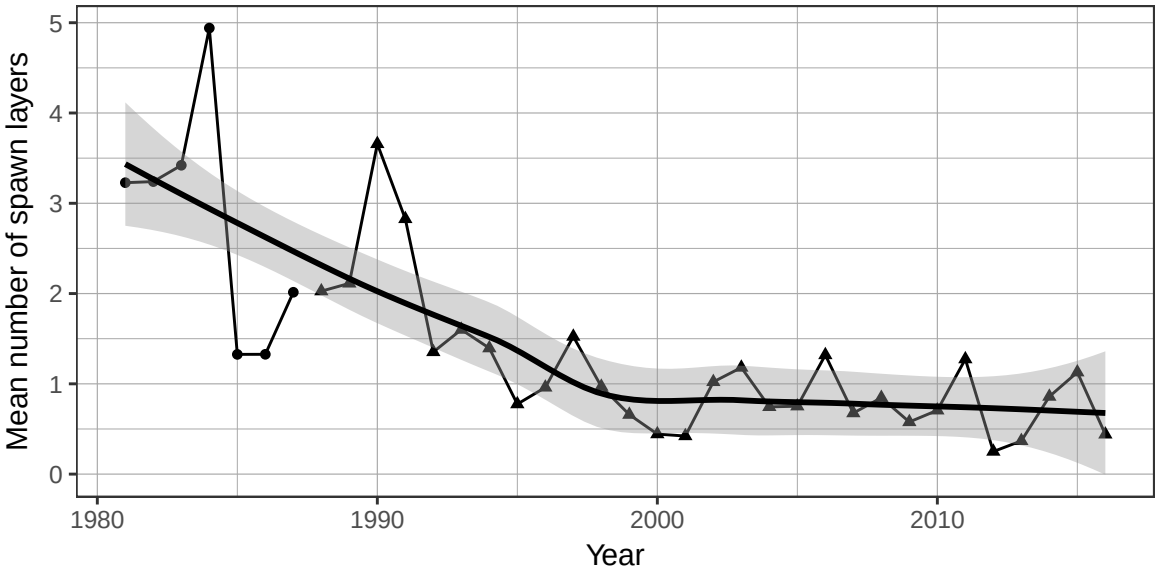

Figure 9. Time series of mean number of spawn layers for Pacific herring from 1981 to 2016 in the Area 27 minor stock assessment region (SAR). The thick black line is a loess curve, and the shaded area is the 90% confidence interval. The spawn index has two distinct periods defined by the dominant survey method: surface surveys (1951–1987), and dive surveys (1988–2016).

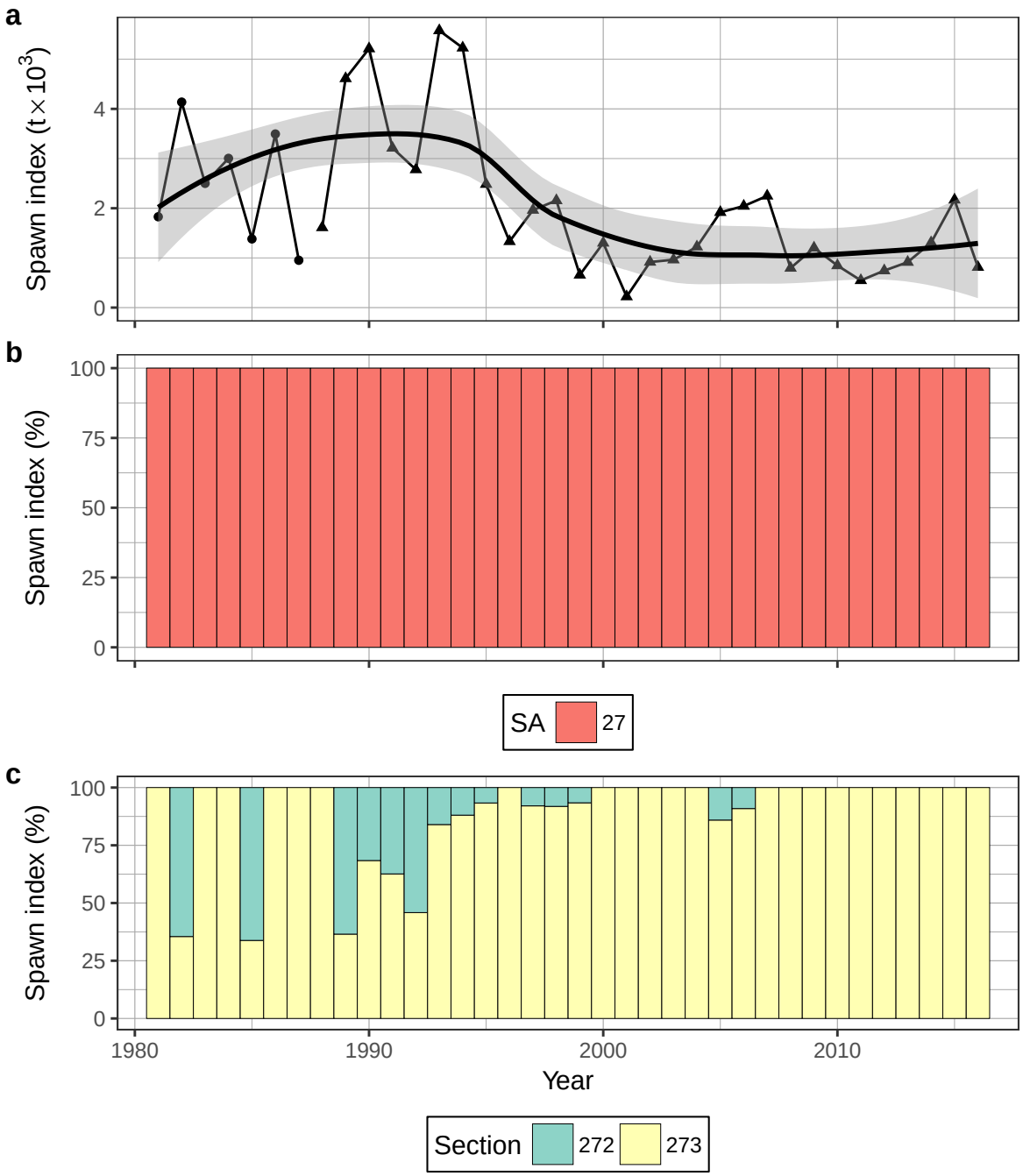

Figure 10. Time series of spawn index in thousands of metric tonnes ($t \times 10^3$) for Pacific herring from 1981 to 2016 in the Area 27 minor stock assessment region (SAR; a), as well as percent contributed by Statistical Area (SA), and Section (b, & c, respectively). The thick black line is a loess curve, and the shaded area is the 90% confidence interval. The spawn index has two distinct periods defined by the dominant survey method: surface surveys (1951–1987), and dive surveys (1988–2016). The 'spawn index' represents the raw survey data only, and is not scaled by the spawn survey scaling parameter, q.

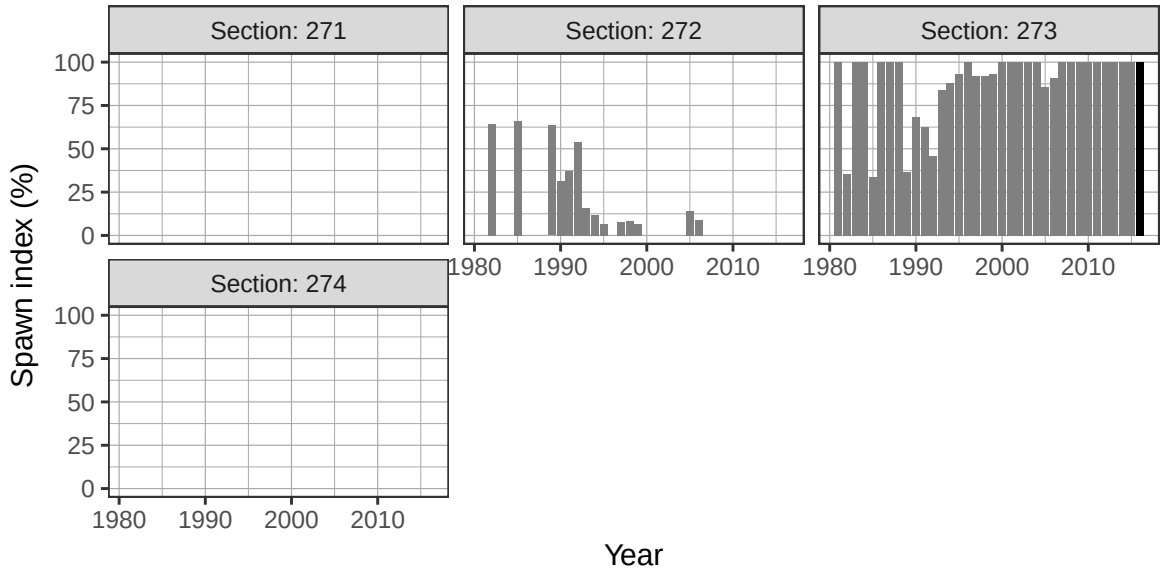

Figure 11. Time series of percent of spawn index by Section for Pacific herring from 1981 to 2016 in the Area 27 minor stock assessment region (SAR). The year 2016 has a darker bar to facilitate interpretation. The spawn index has two distinct periods defined by the dominant survey method: surface surveys (1951–1987), and dive surveys (1988–2016). The 'spawn index' represents the raw survey data only, and is not scaled by the spawn survey scaling parameter, q.

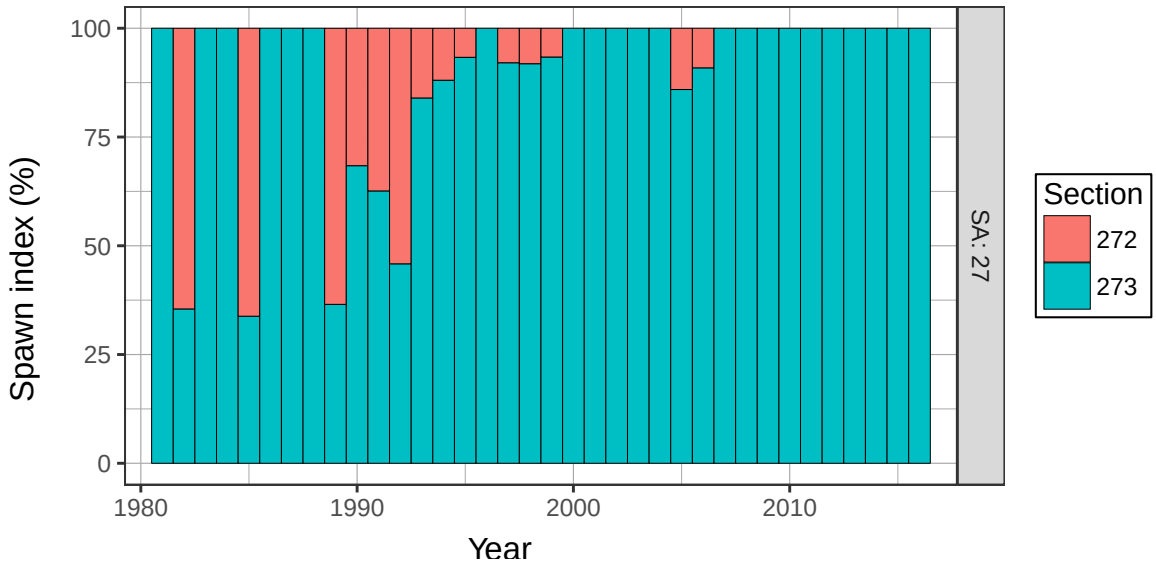

Figure 12. Time series of percent of spawn index by Statistical Area (SA) and Section for Pacific herring from 1981 to 2016 in the Area 27 minor stock assessment region (SAR). The spawn index has two distinct periods defined by the dominant survey method: surface surveys (1951–1987), and dive surveys (1988–2016). The 'spawn index' represents the raw survey data only, and is not scaled by the spawn survey scaling parameter, q.