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Preliminary catch and size composition time series of the U.S. pelagic longline fleets for the 2026 north Pacific albacore tuna assessment[1]

Peter T. Kuriyama and Steven L.H. Teo

NOAA Fisheries
Southwest Fisheries Science Center
8901 La Jolla Shores Drive
La Jolla, CA 92037, U.S.A.

Email: peter.kuriyama@noaa.gov

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ABSTRACT

The objective of this paper is to describe the data sources and methods used to develop seasonal catch (in metric tons) and size composition (raised to the catch) time series for two U.S. pelagic longline fleets based in the north Pacific Ocean, for use in the 2026 assessment. Noting that the ALBWG has not yet finalized the fleet structure for the assessment, the fleet structure and methods for this study were the same as that used for the 2020 and 2023 assessments. Two U.S. pelagic longline fleets (26 and 27; numbering matches that used in the assessment input files) were defined, based on the consistency of size compositions within areas. Fleet 26 consists of vessels fishing in a northern area with mostly juvenile and sub-adult albacore, using primarily shallow-set fishing gear. Fleet 27 consists of vessels fishing in a southern area with mostly large, adult albacore, using primarily deep-set fishing gear. Size composition data in 1 cm bins from an observer sampling program were subdivided into 10x10° area/month/year strata. Size compositions of stratas in each fleet were combined into seasonal size compositions by performing a weighted average of the size compositions of all stratas in each fleet by year and season. The initial input sample sizes for the size compositions were calculated as the number of fish sampled divided by 100 in each fleet by year and season. The total annual landings by U.S. pelagic longline fishery were subdivided into the seasonal landings for Fleets 26 and 27, based on the relative proportion of albacore catch in each area and season using logbook data, and the size composition of albacore in each area and season. Seasonal albacore catch in metric tons for Fleets 26 and 27 of the U.S. pelagic longline fishery in the north Pacific Ocean are shown. Most of the albacore catch occurred in the area defined for Fleet 27. Seasonal size compositions (raised to the catch) for Fleets 26 and 27 of the U.S. pelagic longline fishery are shown. Input sample sizes ranged from 0.1 to 104 for Fleet 26, and 0.1 to 387 for Fleet 27. It is recommended that the ALBWG use the seasonal catch and size composition time series described in this working paper for the 2026 stock assessment of north Pacific albacore tuna. As in the 2023 assessment, it is also recommended that the ALBWG rescale the initial input sample size of the size composition data of this and other fleets in the assessment (i.e., reweighting the size composition data) and set a minimum input sample size and/or number of fish sampled, before fitting the size compositions in the assessment model.

INTRODUCTION

The objective of this paper is to describe the data sources and methods used to develop preliminary catch and size composition time series from U.S. pelagic longline fleets based in the north Pacific Ocean in preparation for the 2026 stock assessment of north Pacific albacore tuna conducted by the albacore working group (ALBWG) of the International Scientific Committee on Tuna and Tuna-like Species in the North Pacific (ISC). The ALBWG is expected to review the data sources and methods described in this paper during the data preparation workshop. Recommendations by the ALBWG will be incorporated into the catch and size composition time series submitted for the 2026 assessment.

For the 2017, 2020, and 2023 assessments, the ALBWG used spatial definitions proposed by Teo (2016) for the U.S. longline fleets based on the consistency of size compositions within areas. A northern area had primarily juvenile and sub-adult albacore tuna while a southern area had predominantly large, adult albacore (Figure 1). Noting that the ALBWG has not yet finalized the fleet structure for the 2026 assessment, this paper has continued with those spatial definitions and has used the same data sources and methods described in Teo (2019).

In this paper, the data sources and methods used to develop time series of: 1) catch in metric tons, and 2) size compositions for two U.S. longline fleets in the north Pacific are described. Fleet 26 consists of vessels fishing in the northern area with mostly juvenile and sub-adult albacore, using primarily shallow-set fishing gear. Fleet 27 consists of vessels fishing in the southern area with mostly large, adult albacore, using primarily deep-set fishing gear.

MATERIALS AND METHODS

Data sources

Three main sources of data were used in this paper: 1) annual landings of albacore tuna in metric tons by the U.S. longline and handline fisheries in the north Pacific Ocean reported to the ISC (1966 – 2024); 2) catch-effort information from fishermen logbooks (1991-2024); and 3) biological (fork length) information from an observer sampling program (1994-2024).

Annual albacore tuna landings by the U.S. longline fishery are reported to the ISC by the National Oceanic and Atmospheric Administration (NOAA) and represent the landings from the entire U.S. longline fishery in the north Pacific Ocean. The U.S. longline fishery consists of longline vessels operating out of: 1) the U.S. West Coast (primarily California) and, 2) Hawaii. The vast majority of U.S. longline vessels operate out of and land fish in Hawaii, and Hawaii-based landings represent >95% of the total north Pacific albacore catch from U.S. longline vessels (McDaniel et al. 2006).

Catch-effort and fork length information were obtained from logbooks and observer data, respectively, from longline vessels operating out of Hawaii and California. A logbook monitoring program for the Hawaii-based longline fishery has been managed by the NOAA since 1990. However, the logbook data from 1990 were not used in this study because data collection only started near the end of the year. Importantly, the logbooks generally recorded set-by-set information on the location (latitude and longitude) of the vessel, the number of albacore caught and discarded, target species, and the number of hooks deployed. Since 1995, logbooks have also recorded the number of hooks per float that were deployed. An observer sampling program has also been in operation for the Hawaii-based pelagic longline fishery since 1994. Albacore tuna were measured to the nearest cm (fork length) by observers onboard the vessel. As with previous studies, the size compositions were developed from the observer program rather than a port-side sampling program at 'fish auction' sites to eliminate the potential of the size composition data being biased due to at-sea discards of smaller fish (McDaniel et al. 2006).

Size compositions

Size composition data for Fleets 26 and 27 of the U.S. pelagic longline fishery were developed from spatial definitions defined by Teo (2016) and agreed to by the ALBWG for the 2017, 2020, and 2023 assessments (Figure 1). Size composition data in 1 cm bins from the abovementioned observer sampling program were aggregated into 10x10° area/month/year strata. Visual examination of the size compositions suggested that a minimum sample size of 3 trips reduced the 'spikiness' of the data without altering the overall shape of the size compositions.

The strata specific to each fleet were combined by calculating a weighted average of the strata-specific length compositions. The season definitions were January-March for Season 1, April-June for Season 2, July-September for Season 3, and October-December for Season 4.

The weights of each strata were calculated as the relative proportion of albacore catch in each strata within each fleet, season, and year, using the albacore catch in number recorded in the abovementioned logbook program.

In the 2023 assessment and in this study, the initial input sample sizes were calculated as the number of fish sampled divided by 100 in each fleet by year and season. The weights of each strata were calculated in the same way as the size composition data. In the 2023 assessment, a minimum input sample size of 1 was used to remove potentially unrepresentative size compositions. However, this was not done here in order to show all the data.

A small bug, which misassigned one time-area strata, was found in the code used to process data for the 2023 assessment. This bug has been corrected and the differences in the length composition data are shown in the figures below.

Catch

Total annual catch of the U.S. longline fishery is considered to be well represented by the reported landings from NOAA to ISC (Table 1). However, landings data are not available on a spatial scale that is fine enough to be separated into landings for Fleets 26 and 27. Therefore, the total annual landings was subdivided into the seasonal landings for Fleets 26 and 27, based on the relative proportion of albacore catch for each fleet and season using logbook data, and the size composition of albacore for each fleet and season.

The average weights of albacore caught in each season within the areas defined for Fleets 26 and 27 were calculated from the seasonal size compositions described in the "Size compositions" section. Seasonal size compositions were first converted into weight compositions based on the length-weight relationships estimated by Watanabe et al. (2006). A previous study (Teo et al. 2010) found that using the relationship,

$$w = 7 \times 10^{-5} \times l^{2.71} ,$$

where w is the weight in kg and l is the fork length in cm, was appropriate for the albacore caught by the U.S. pelagic longline fishery, and is the length-weight relationship estimated by Watanabe et al (2006) in Area 4 and Quarter 1. The average weight for each fleet and season was calculated as the average of the weight composition in kg for the respective fleet and season. For periods with missing size compositions, the average weight was assumed to be the average weight for that fleet and season for all years with observed size compositions.

For the 1991 – 2024 period, the relative proportions of albacore catch in weight was calculated from the number of albacore and average weight of albacore in each season and fleet using,

$$p_{i,j,k} = (n_{i,j,k} \times w_{i,j,k}) / \sum_i \sum_j (n_{i,j,k} \times w_{i,j,k}),$$

where $p_{i,j,k}$, $n_{i,j,k}$, and $w_{i,j,k}$ are the relative proportions, numbers of albacore, and average weight of albacore caught in Fleet *i*, season *j*, and year *k* respectively. Prior to 1991, $p_{i,j,k}$, could not be calculated for each year because of the lack of logbook data. It was instead assumed that,

$$p_{i,j,1966-1990} = (\bar{n}_{i,j,1991-1994} \times \bar{w}_{i,j,1991-1994}) / \sum_i \sum_j \left(\bar{n}_{i,j,1991-1994} \times \bar{w}_{i,j,1991-1994}\right).$$

where $\bar{n}_{i,j,1991-1994}$, and $\bar{w}_{i,j,1991-1994}$ are the average numbers of albacore, and average weight of albacore caught in Fleet *i*, and season *j*, during 1991 – 1994.

The U.S. handline albacore fishery is based in Hawaii and predominantly catch large, adult albacore tuna, and all albacore catch from the U.S. handline fishery was therefore assigned to Fleet 2. The catch in metric tons of Fleet 1 during season *j* and year *k*, $C_{1,j,k}$, was therefore calculated as,

$$C_{1,j,k} = p_{1,j,k} \times C_{LL,k} ,$$

where $C_{LL,k}$ is the total U.S. longline albacore catch in year *k*.

The seasonal catch in metric tons for Fleet 2 was calculated as,

$$C_{2,j,k} = p_{2,j,k} \times C_{LL,k} + C_{HL,j,k} ,$$

where $C_{HL,j,k}$ is the albacore catch from U.S. handline vessels in season *j* and year *k*.

RESULTS AND DISCUSSION

Seasonal albacore catch in metric tons for Fleets 26 and 27 of the U.S. pelagic longline fishery in the north Pacific Ocean are shown in Table 1. Note that seasonal catch from the U.S. handline fishery are included in Fleet 27. Most of the albacore catch occurred in the area defined for Fleet 27.

Seasonal size compositions (raised to the catch) for Fleets 26 and 27 of the U.S. pelagic longline fishery are shown in Figure 2. The input sample sizes ranged from 0.1 to 104 for Fleet 26 with a mean of 16.5. For fleet 27, the sample sizes ranged from 0.1 to 387 with a mean of 37.8. Some of the seasonal size compositions exhibit large spikes because of the small number of fish sampled. Values with a sample size less than 1 are shown here but will likely be filtered out for the stock assessment as done in 2023.

It is recommended that the ALBWG use the catch and size composition time series described in this working paper for the 2026 stock assessment of north Pacific albacore tuna. In addition, it is recommended that the ALBWG rescale the initial input sample size of the size composition data of this and other fleets in the assessment (i.e., reweighting the size composition data) and set a minimum input sample size and/or number of fish sampled, before fitting the size compositions in the assessment model.

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TABLES

Table 1: Seasonal catch in metric tons for Fleets 26 and 27 of the U.S. pelagic longline fishery and the total annual U.S. longline and handline catch reported to the ISC.

		Fleet 26				Fleet 27			
Year	**Total**	**S1**	**S2**	**S3**	**S4**	**S1**	**S2**	**S3**	**S4**
1966	8	0.7	0.9	1	0.8	1.1	1.3	1.1	1.2
1967	12	1	1.4	1.5	1.2	1.6	1.9	1.7	1.7
1968	11	0.9	1.3	1.3	1.1	1.5	1.7	1.6	1.6
1969	14	1.2	1.6	1.7	1.4	1.9	2.2	2	2
1970	9	0.7	1	1.1	0.9	1.2	1.4	1.3	1.3
1971	11	0.9	1.3	1.3	1.1	1.5	1.7	1.6	1.6
1972	8	0.7	0.9	1	0.8	1.1	1.3	1.1	1.2
1973	14	1.2	1.6	1.7	1.4	1.9	2.2	2	2
1974	9	0.7	1	1.1	0.9	1.2	1.4	1.3	1.3
1975	33	2.7	3.8	4	3.3	4.5	5.2	4.7	4.8
1976	23	1.9	2.7	2.8	2.3	3.2	3.6	3.3	3.3
1977	37	3	4.3	4.5	3.6	5.1	5.8	5.2	5.4
1978	54	4.4	6.3	6.6	5.3	7.4	8.5	7.6	7.9
1979	0	0	0	0	0	0	0	0	0
1980	0	0	0	0	0	0	0	0	0
1981	25	2.1	2.9	3	2.5	3.4	3.9	3.5	3.6
1982	105	8.6	12.2	12.8	10.4	14.4	16.5	14.9	15.3
1983	6	0.5	0.7	0.7	0.6	0.8	0.9	0.8	0.9
1984	2	0.2	0.2	0.2	0.2	0.3	0.3	0.3	0.3
1985	0	0	0	0	0	0	0	0	0
1986	0	0	0	0	0	0	0	0	0
1987	150	12.3	17.4	18.3	14.8	20.5	23.6	21.2	21.8
1988	307	25.3	35.7	37.4	30.3	42.1	48.2	43.5	44.7
1989	248	20.4	28.8	30.2	24.5	34	39	35.1	36.1
1990	311	14.6	20.6	21.5	0.3	24.2	27.8	25.1	176.7
1991	312	7.3	6.6	2.3	66.3	40.5	97.3	42.4	49.6
1992	334	13.4	4.1	2	124.7	44.5	71	28.6	45.7
1993	438	11.8	6.1	1.6	190.1	49.8	102.9	39.1	36.7
1994	564	31.4	0.7	8.2	164.9	59.4	57	60.9	182
1995	885	34.1	2.9	12.5	141	97.3	250.6	147.3	199.7
1996	1187	75.9	0.3	2.2	68.6	193.5	481.5	183.8	181.7
1997	1655	45.4	2.4	0.6	21.6	483.7	773.7	270	57.4
1998	1127	12.1	0.7	7	36.7	161.4	419	335.6	154.7
1999	1552	59.8	9.9	11.9	46.5	269.6	428.7	332.6	392.8
2000	953	49.5	12.8	1.9	2	83.3	363.2	155.6	285
2001	1303	2.2	0.9	0.6	2.4	251.3	665.7	265.9	113.8

2002	525	3.4	0	2.7	0	73.7	317.8	70.6	56.8
2003	524	1.1	0.7	3.7	0	105.3	378.9	20.9	13.5
2004	361	0	0	6.2	3.8	75.8	38.3	160.9	76
2005	296	9.6	0.4	2.2	5.3	95.4	131.4	24.2	27.4
2006	270	6.2	3.9	6.2	0	82.9	98	57.5	15.2
2007	344	18.5	0.2	2.9	4.1	110.4	48.2	26.3	133.4
2008	383	22.1	5.2	33.5	18.9	165.2	86.1	10.6	41.6
2009	301	37.5	12.7	23	3	107.2	46	57	15
2010	476	20.8	8.2	7.9	36.2	212.4	106.9	59.8	23.5
2011	809	30.7	15.4	95.1	16.4	362.5	111.1	97.5	80.2
2012	933	18.1	70.8	53.1	7.5	332.5	262.3	65	123.2
2013	365	16.3	5	6.8	3.5	170.6	109.9	12.6	40.2
2014	262	10.2	9.7	6.7	0.7	79.9	70.3	25.7	58.7
2015	308	5.3	5.9	3.5	0.2	143.8	119.3	12.8	17.3
2016	272	2	4.5	5.5	1.4	81.3	147.3	24.5	5.3
2017	130	14	0.9	4.8	5.3	72.6	14.8	12.8	4.8
2018	107	2.7	6.3	31.6	5.1	8.3	12.8	13.8	26.5
2019	114	2.1	10.1	12.8	4.8	20.5	12.8	38.1	12.8
2020	150	10.4	94.4	3.3	10.4	10.2	2.9	15.6	2.9
2021	231	39.8	23.3	51.2	20	26.6	8.6	37	24.5
2022	207	55.5	45.5	3.8	14	24.1	8	26.8	29.3
2023	511	52.7	77.8	161.2	19.2	48.1	11.3	36.6	104
2024	273	15.3	25.5	9.3	2.9	83.9	52.1	47.1	36.9

FIGURES

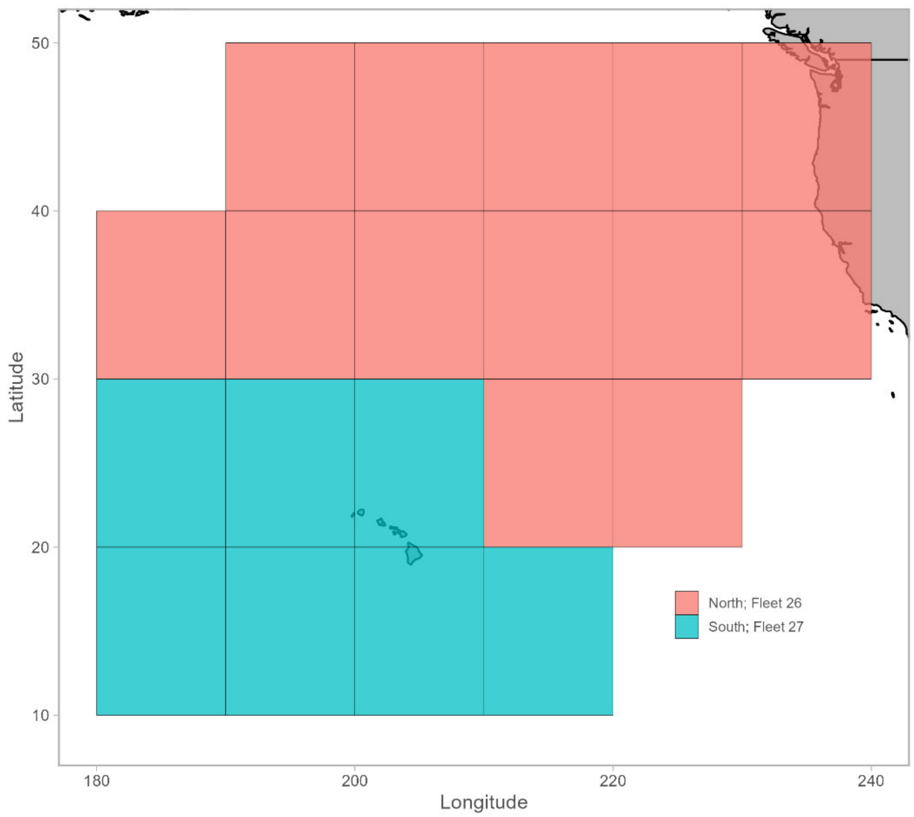

Figure 1: Spatial definition of Fleet 26 (red tiles) and 27 (blue tiles) of the U.S. pelagic longline fishery, based on Teo (2016). Grids are 10x10° and were used to assemble the size composition data.

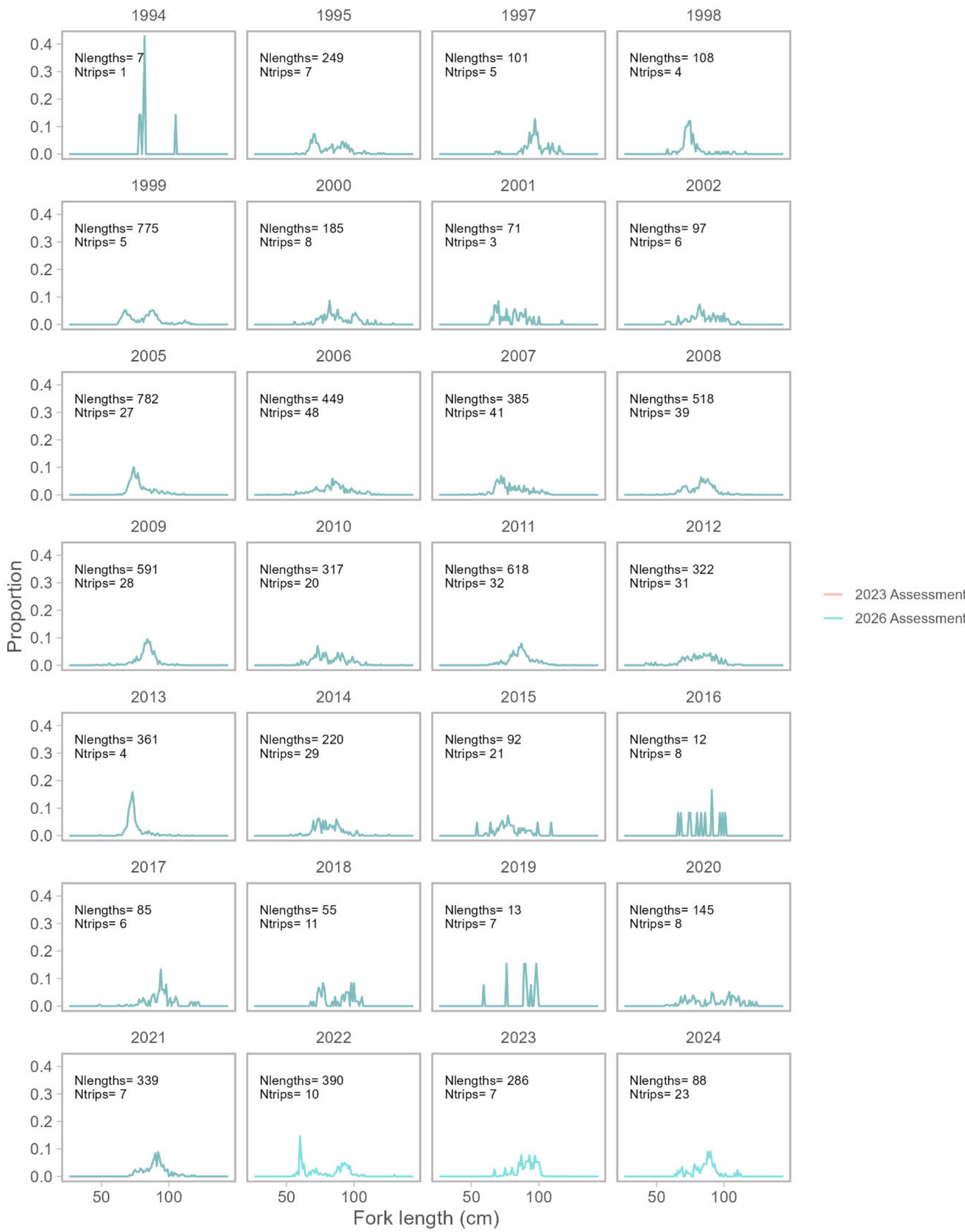

Figure 2: Length compositions for Fleet 26, Season 1 for the upcoming 2026 assessment (blue lines) and from the previous 2023 assessment (red lines) arranged by year. The number of trips and number of length measurements are shown in the top left of each panel. There were virtually no differences between the composition data.

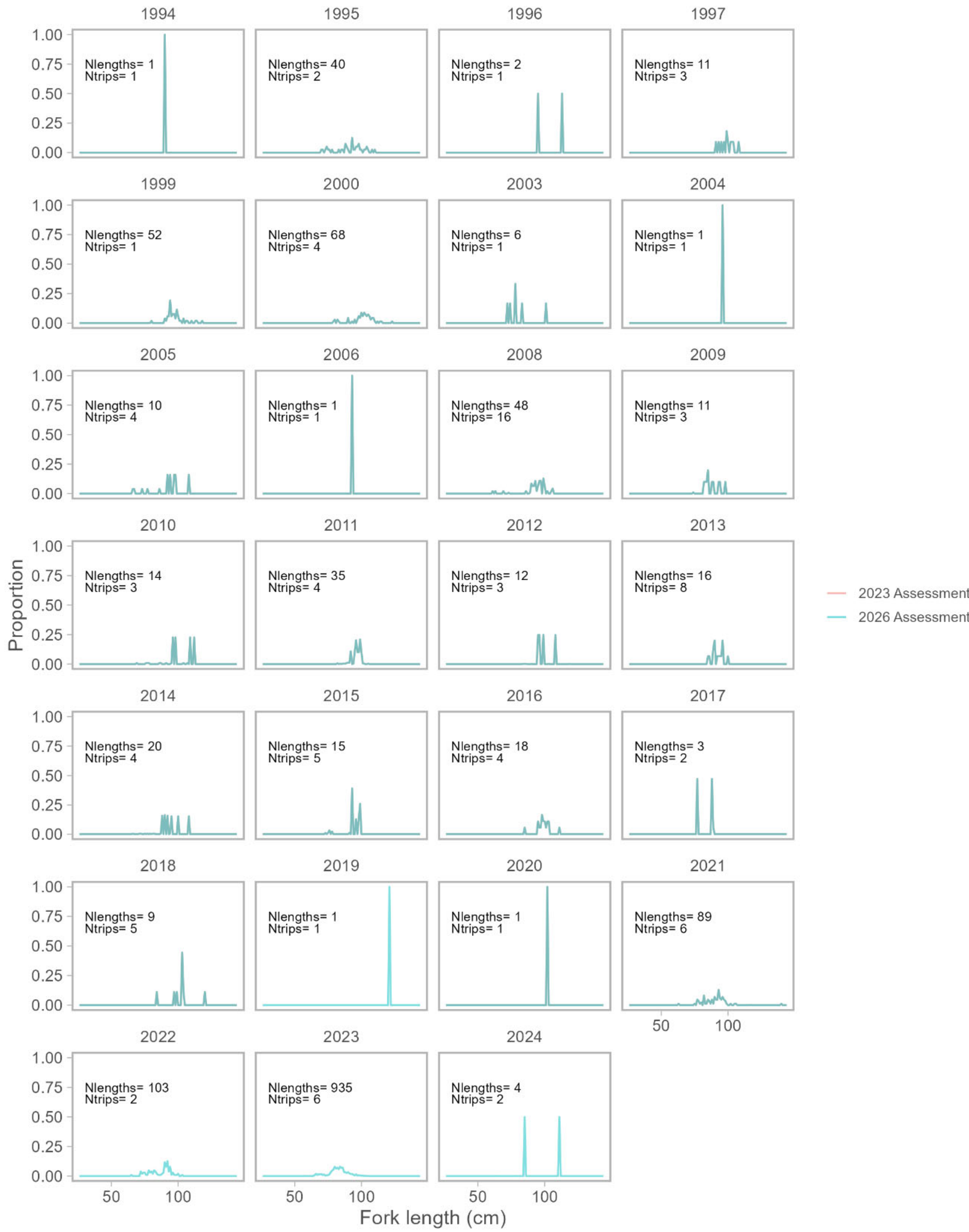

Figure 3: Length compositions for Fleet 26, Season 2 for the upcoming 2026 assessment (blue lines) and from the previous 2023 assessment (red lines) arranged by year. The number of trips and number of length measurements are shown in the top left of each panel. There were virtually no differences between the composition data.

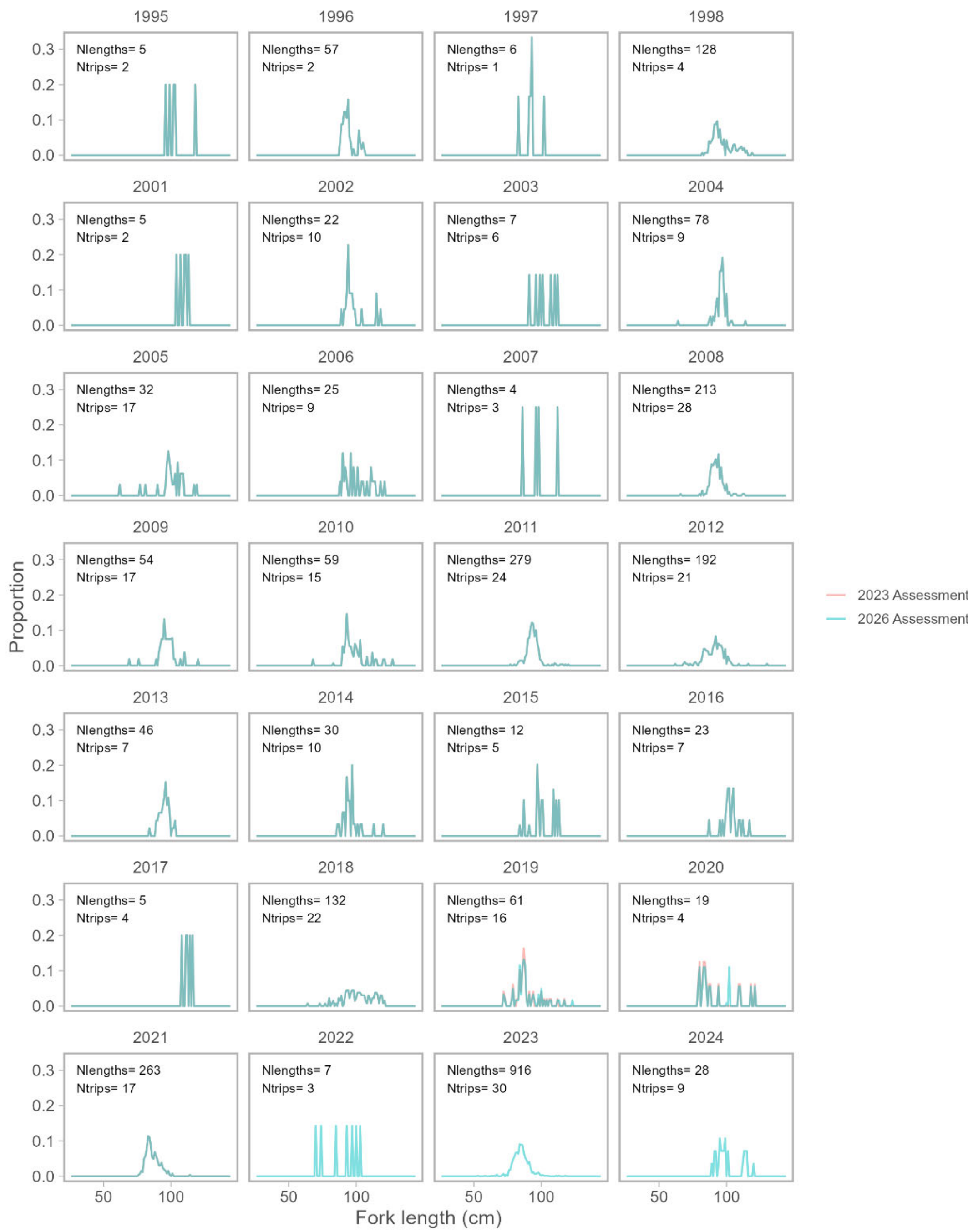

Figure 4: Length compositions for Fleet 26, Season 3 for the upcoming 2026 assessment (blue lines) and from the previous 2023 assessment (red lines) arranged by year. The number of trips and number of length measurements are shown in the top left of each panel. There were virtually no differences between the composition data.

Figure 5: Length compositions for Fleet 26, Season 4 for the upcoming 2026 assessment (blue lines) and from the previous 2023 assessment (red lines) arranged by year. The number of trips and number of length measurements are shown in the top left of each panel. There were virtually no differences between the composition data.

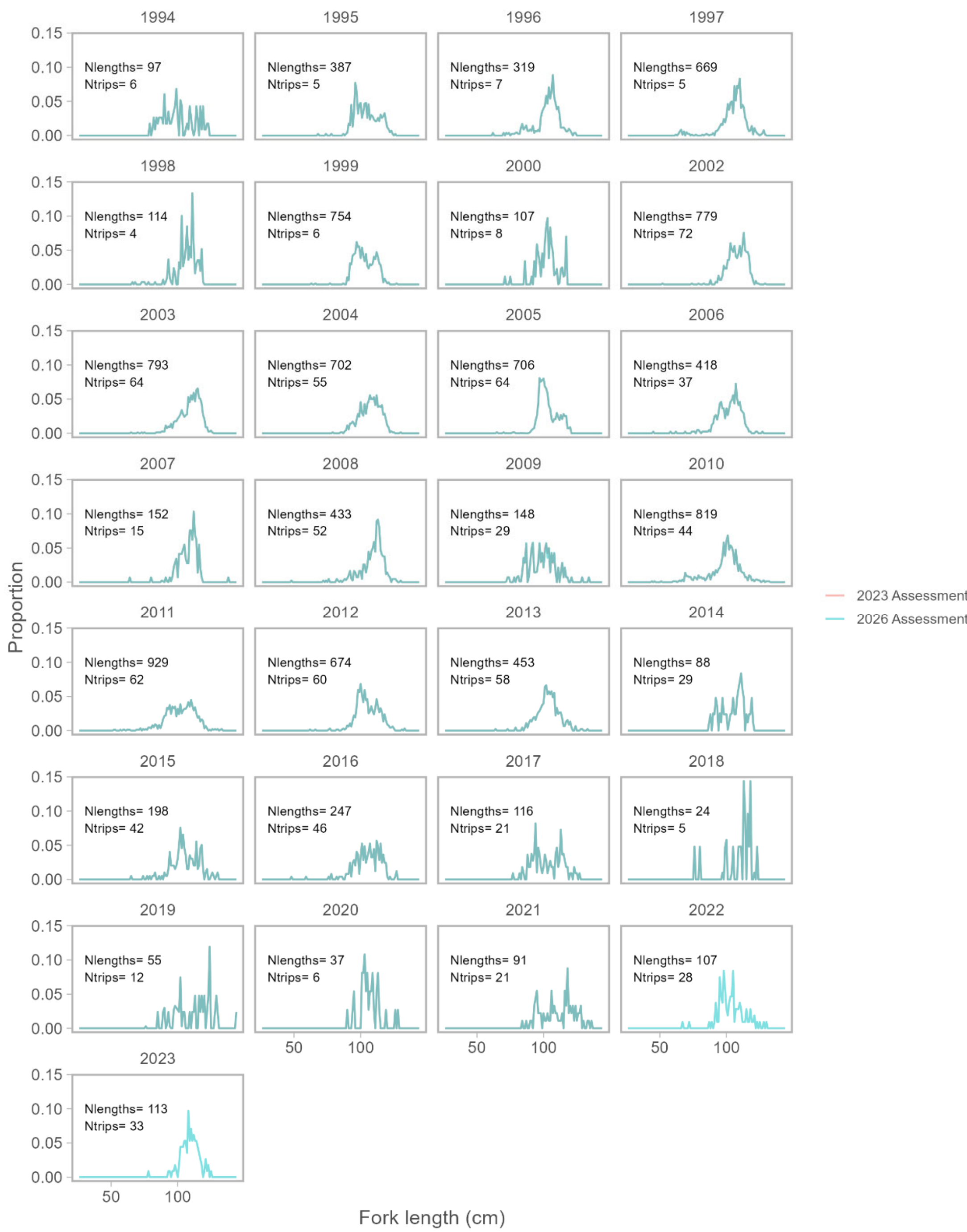

Figure 6: Length compositions for Fleet 27, Season 1 for the upcoming 2026 assessment (blue lines) and from the previous 2023 assessment (red lines) arranged by year. The number of trips and number of length measurements are shown in the top left of each panel. There were virtually no differences between the composition data.

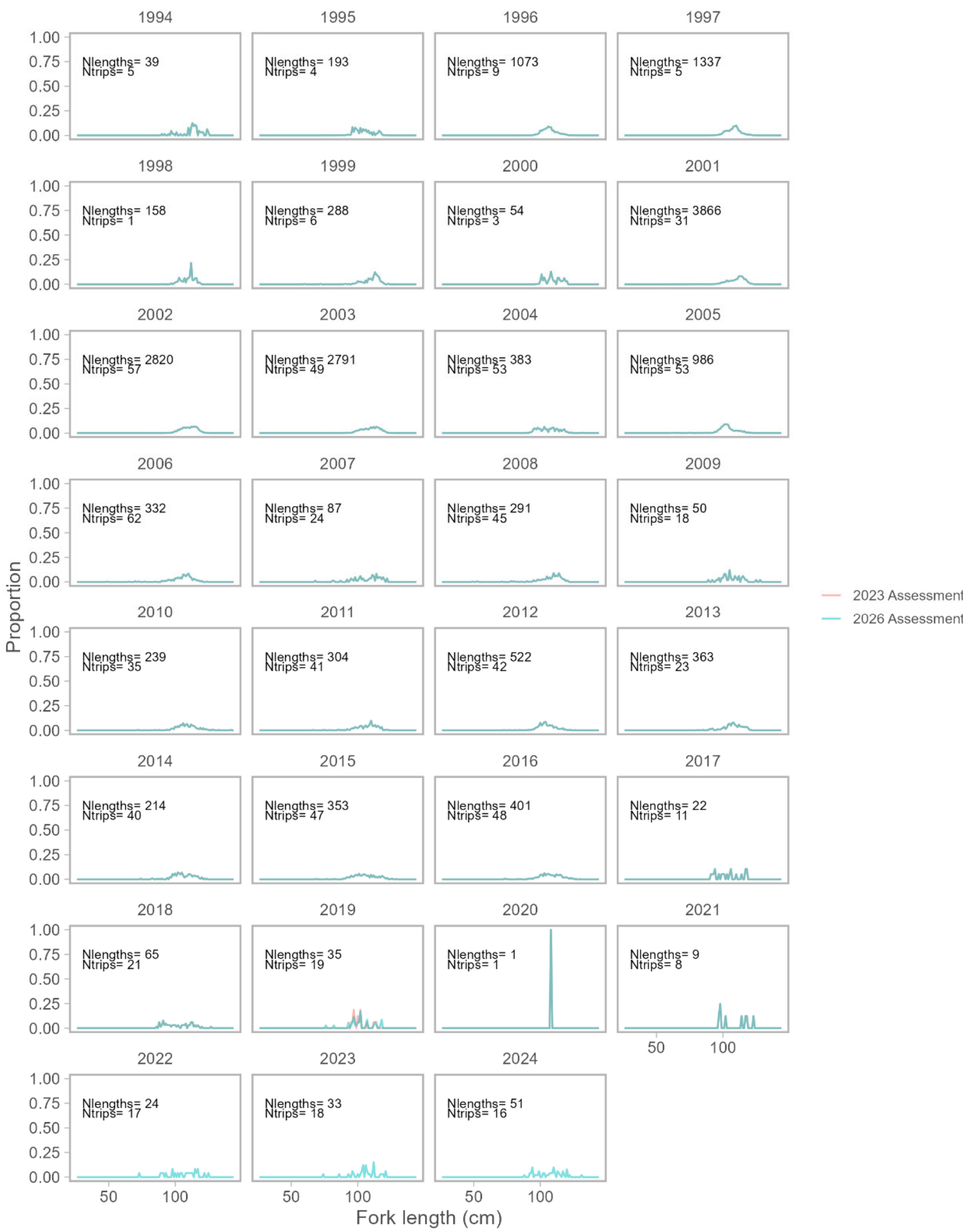

Figure 7: Length compositions for Fleet 27, Season 2 for the upcoming 2026 assessment (blue lines) and from the previous 2023 assessment (red lines) arranged by year. The number of trips and number of length measurements are shown in the top left of each panel. There were virtually no differences between the composition data.

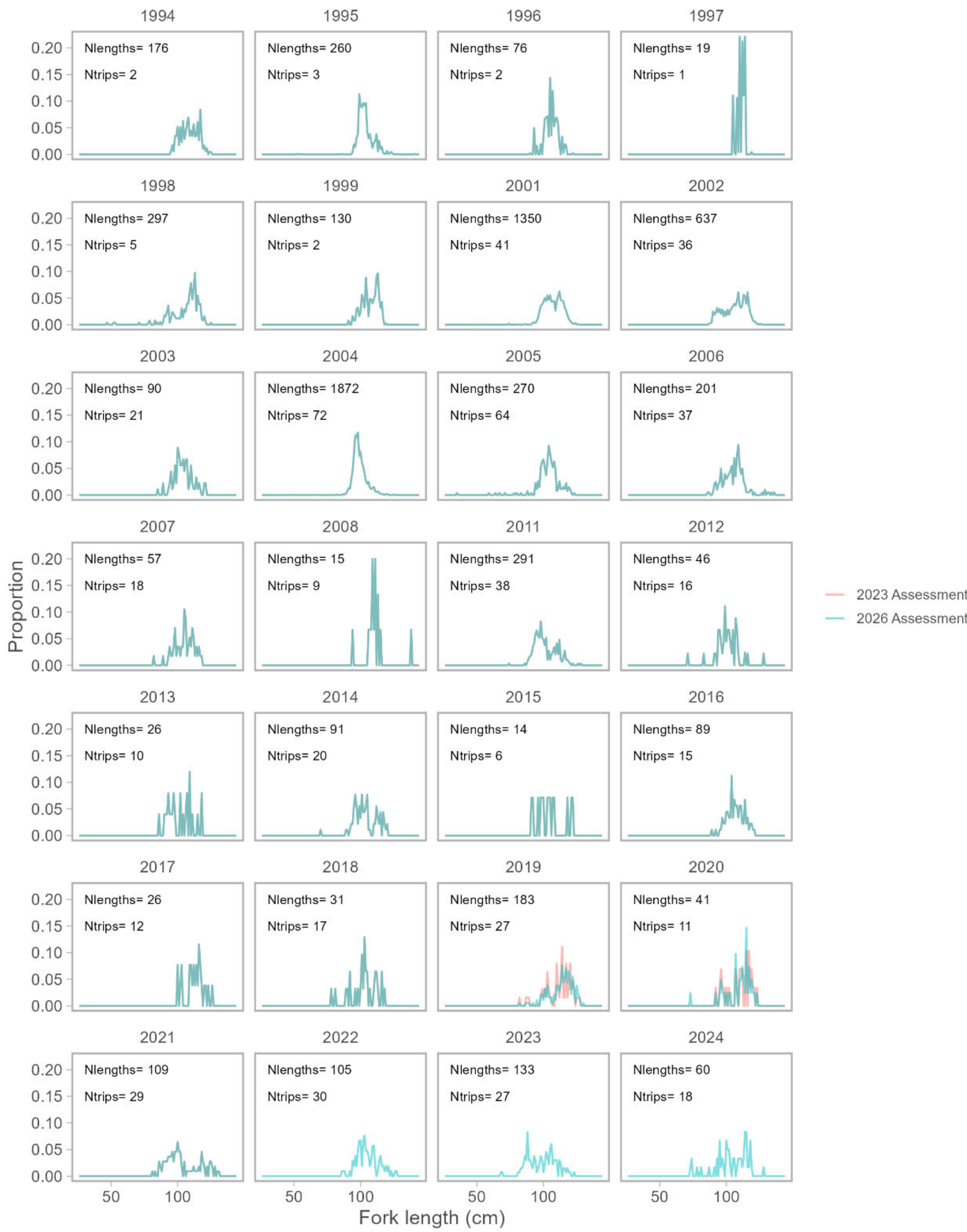

Figure 8: Length compositions for Fleet 27, Season 3 for the upcoming 2026 assessment (blue lines) and from the previous 2023 assessment (red lines) arranged by year. The number of trips and number of length measurements are shown in the top left of each panel. There were virtually no differences between the composition data.

Figure 9: Length compositions for Fleet 27, Season 4 for the upcoming 2026 assessment (blue lines) and from the previous 2023 assessment (red lines) arranged by year. The number of trips and number of length measurements are shown in the top left of each panel. There were virtually no differences between the composition data.