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Preliminary catch and size composition time series of the U.S. and Mexico surface fishery for the 2023 north Pacific albacore tuna assessment[1]

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ABSTRACT

The objective of this paper is to describe the data sources and methods used to develop preliminary, seasonal catch and size composition time series of the U.S. and Mexico albacore surface fleet in the north Pacific Ocean, in preparation for the 2023 stock assessment. The approach for this paper is the same as for the 2020 assessment. In order to simplify model structure, it is proposed that albacore landings from all U.S. gears, except handline and longline, and all Mexico gears be combined as part of the Eastern Pacific Ocean (EPO) surface fleet. Three main sources of data were used: 1) annual landings of albacore tuna in metric tons by gear in the north Pacific Ocean reported to the ISC by the U.S. and Mexico; 2) catch-effort information from U.S. fishermen logbooks; and 3) size composition (fork length) information from a U.S. port sampling program. Size composition data in 1 cm bins were first matched to logbooks to obtain average fishing location for specific vessel-trips, and subsequently aggregated into area/month/year strata. Strata with <3 sampled trips were discarded because large spikes were evident in preliminary size compositions. Size compositions from these strata were combined into seasonal size compositions by performing a weighted average of the size compositions of all strata by year and season. Strata weights were calculated as the relative proportion of albacore catch in each stratum within each season and year, using the albacore catch in number recorded in the abovementioned logbook program. Similarly, the input sample size for the size composition data was considered to be the weighted average of the number of trips of all strata by year and season. The catch in a season was calculated by multiplying the estimated proportion of catch in weight for that season with the total annual catch of the U.S. and Mexico surface fishery for the year. For the 2020 assessment, an algorithm was developed to match size information from a specific vessel-trip to the corresponding vessel-trip in the logbook database. The same algorithm was used in this study. The difficulty in matching the port sampling data with the logbook data resulted in the size composition time series starting only in 1977, and predominantly in Season 3. The initial input sample sizes ranged from 3 to217.3, with an average of 40.3. It is recommended that the ALBWG use the catch and size composition time series described in this working paper for the 2023 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, before fitting the size compositions in the assessment model. Finally, it is also recommended that the seasonal Canadian albacore catches be combined with the U.S. and Mexico surface fishery for the 2023 assessment.

INTRODUCTION

The objective of this paper is to describe the data sources and methods used to develop preliminary catch and size composition time series for the U.S. and Mexico albacore surface fleet in the north Pacific Ocean in preparation for the 2023 stock assessment of north Pacific albacore tuna to be 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 2023 assessment.

The U.S. surface fishery for albacore tuna is an important component of north Pacific albacore removals, with annual catches of 1960 – 27987 metric tons (t) since 1966. It consists primarily of troll and pole-and-line vessels that mostly capture juvenile albacore tuna. In comparison, the Mexico albacore fisheries are relatively minor, with annual catches of 0 – 113 t.

The Canada surface fishery is also an important component of north Pacific albacore removals and operates similarly to the U.S. surface fishery. However, the data for the Canada surface fishery is prepared independently by scientists from Canada, and not included in this document.

The U.S. troll and pole-and-line fisheries are the dominant U.S. gears for albacore in the Eastern Pacific Ocean (EPO) but the U.S. also reports annual albacore landings for gillnet, handline, longline, purse-seine, sports, and other gears. Mexico reports annual albacore landings for purse-seine and other gears but no other information is available. Although the U.S. troll and pole-and-line fisheries are nominally separated into two fisheries, it is difficult to consistently separate these two fisheries based on available logbook data. Both gears are often used on the same trip but fish caught are not separated by gears in the logbook or landings data. In order to simplify model structure in previous assessments, landings from the handline and longline gears were combined into U.S. longline fleets while the rest of the U.S. and Mexico albacore landings were combined as part of the EPO surface fleet (ALBWG 2014, 2017, 2020). The same approach will be taken here.

Similar to the 2020 assessment, the size composition data of the EPO surface fleet will be raised to the catch for the 2023 assessment. In this study, we use a matching algorithm to match size samples from a specific vessel-trip to the average location of the corresponding vessel-trip in the logbook database that was developed for the 2020 assessment (Teo et al. 2019).

MATERIALS AND METHODS

Data sources

Three main sources of data were used to develop the catch and size composition time series: 1) annual landings of albacore tuna in metric tons by gear in the north Pacific Ocean reported to the ISC by the U.S. and Mexico; 2) catch-effort information from U.S. fishermen logbooks; and 3) size composition (fork length) information from a U.S. port sampling program.

Annual albacore tuna landings by U.S. and Mexico fisheries in the north Pacific Ocean are reported to the ISC by the National Oceanic and Atmospheric Administration (NOAA) and Instituto Nacional de Pesca (INAPESCA) respectively. U.S. commercial landings are estimated from several databases. Landings data for California, Oregon, and Washington states are maintained in the Pacific Fisheries Information Network (PacFIN) database, while landings in Hawaii and U.S. territories in the Pacific are maintained in the Western Pacific Fishery Information Network (WPacFIN) database. Additionally, the Western Fishboat Owners' Association (WFOA), which represents part of the U.S. commercial surface fleet, monitors all landings of albacore and maintains an independent database. The Southwest Fisheries Science Center (SWFSC) of NOAA incorporates data from these databases to estimate the annual U.S. albacore landings by fishery, which are then submitted to the ISC. Landing statistics for U.S.-caught albacore dates back to 1936 but only data from 1966-2021 data were used for this analysis to match the start year of data submissions for previous assessments. The troll and pole-and-line fisheries have historically been the largest U.S. fisheries for albacore. In order to simplify model structure, the landings for the troll, pole-and-line, gillnet, purse-seine, sports, and other gears were combined to represent the landings of the U.S. portion of the EPO surface fishery in previous assessments. Similarly, the catches from the Mexico purse-seine and others gears were also combined into the EPO surface fishery. Discard rates of albacore from the U.S. fisheries are not known definitively, but limited observer data from the 1990s indicated that these rates are likely low and if accounted for, would not substantially change the estimated catch.

Logbook data were used to obtain time and location-specific catch and effort of the U.S. troll and pole-and-line fisheries. An annual logbook monitoring program for the U.S. albacore troll and pole-and-line fisheries has been managed by the SWFSC since 1961 (Childers and Betcher 2008). Although logbook data has been collected since 1961, only 1966-2021 data were used for this analysis. The logbook format has changed over the years but time and location-specific catch-effort information has been consistently recorded throughout the program's existence. Logbook sampling coverage varied from 7-33% prior to 2005 because logbook submission was voluntary (McDaniel et al. 2006). In 2005, logbook submission became mandatory for this fishery and sampling coverage has increased to approximately 81% of the total annual landings of north Pacific albacore (Pacific Fishery Management Council 2019).

Size information (fork length to the nearest cm) from the U.S. troll and pole-and-line fisheries were collected through a port sampling program. A port sampling program for the U.S. albacore surface fisheries has been in operation for approximately six decades (Childers and Betcher 2008). Size composition data presented here were based only on troll and pole-and-line samples although small numbers of samples from other fisheries (e.g., recreational, and gill net fisheries) are also present in the port sampling database. Although information on albacore size composition were collected from 1950, only 1973-2021 data were used for this analysis because prior to 1973, vessel identifiers in the logbook database were unique to that database and could not be used to match the size samples. For most boat trips after 1961, a sample of usually 50 to 100 fish per trip was measured to the nearest cm. If the albacore from a boat trip were sorted by size class prior to measurement, approximately 25 fish from each size class were measured but these samples were not used for this analysis. The number of measured fish used in the analysis for each year ranged from 208 in 1993 to 49425 in 1996, with >15000 fish measured for most years (Coan 2006). It is assumed that the size compositions developed from the U.S. troll and pole-and-line fisheries were representative of the entire EPO surface fishery. This is a reasonable assumption because these are the dominant component fisheries and very limited size data are available for the other components.

Size compositions

Although the abovementioned U.S. port sampling program can record a fishing location for each sampled trip, a preliminary examination of the location information from the port sampling program suggested that the location information was often not recorded or if recorded, was often not representative of the fishing locations recorded in logbooks. Therefore, the port sampling size data were matched with the location data from corresponding logbooks instead of depending on the location information from the port sampling program.

In this study and the 2020 assessment, an algorithm was used to match size information from a specific vessel-trip to the corresponding vessel-trip in the logbook database. The matching was performed in three steps. First, during 1995-2021, the majority of vessel-trips in the size sample and logbook databases included unique trip identifiers based on the fish landing ticket. For these vessel-trips, the unique trip identifiers were used to match the size samples and logbook data. The remaining sampled vessel-trips (i.e., no matching trip identifiers; no trip identifiers; or vessel-trips prior to 1995, which had no trip identifiers) were then matched to logbooks in the second step. For the second step, the vessel identifier coupled with the sampling date in the size samples were matched exactly to the vessel identifier and port arrival date in the logbook database. For the third step, the remaining unmatched size samples were also matched to the vessel identifier and port arrival date in the logbook database but the sampling date was allowed to be one day after the arrival date. After each step, the average fishing location for each matched vessel-trip from the logbook data was assigned to the size samples for the corresponding vessel-trip.

Each sampled vessel-trip was assigned to one of four areas based on the latitude and longitude bounds: 1) northeast (40-60 °N, 130-110 °W); 2) southeast (0-40 °N, 130-110 °W); 3) northwest (40-60 °N, >130 °W); and 4) southwest (0-40 °N, >130 °W). Subsequently, size composition data in 1 cm bins were aggregated into area/month/year strata. Strata with <3 sampled trips were discarded because large spikes were evident in preliminary size compositions. 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 size compositions of strata were combined into seasonal size compositions by performing a weighted average of the size compositions of all strata by year and season (season 1: Jan – Mar; season 2: Apr – Jun; season 3: Jul – Sep; season 4: Oct – Dec). The strata weights were calculated as the relative proportion of albacore catch in each stratum within each season and year, using the albacore catch in number recorded in the abovementioned logbook program.

In this study and the 2020 assessment, the weighted average of the number of trips of all strata by year and season was used as the initial input sample sizes of the size compositions in the assessment model, using the same strata weights as the size composition data.

Catch

Total annual catch of the U.S. and Mexico surface fishery was considered to be well represented by the reported landings from NOAA and INAPESCA to ISC. The total annual catch was subdivided into seasonal catch based on the relative proportion of albacore catch by weight for each season using logbook and size composition data. As described above, only logbook information from the U.S. albacore troll and pole-and-line fisheries were available for this analysis. Therefore, it was assumed that the proportion of catch for each season of the U.S. albacore troll and pole-and-line fisheries were representative of all U.S. and Mexico surface fishing gears. This is a reasonable assumption because these are the dominant component fisheries and very limited information is available for the other components.

Following the approach in the 2020 assessment, the average weights of albacore caught in each season 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,

$$w = 2.3 \times 10^{-5} \times l^{2.98} ,$$

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. surface fishery, and is the length-weight relationship estimated by Watanabe et al (2006) in Area 3 and Quarter 3. The average weight for each season was calculated as the average of the weight composition in kg for the respective season. For periods with missing size compositions, the average weight was assumed to be the average weight for that season for all years with observed size compositions.

The relative proportions of albacore catch in weight was calculated from the number and average weight of albacore in each season using,

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

where $p_{i,j}$, $n_{i,j}$, and $w_{i,j}$ were the relative proportions, numbers of albacore, and average weight of albacore caught in season i, and year j respectively. The catch in season i and year j was then calculated by multiplying $p_{i,j}$ with the total annual catch of the U.S. and Mexico surface fishery in year j.

RESULTS AND DISCU.S.SION

Estimates of seasonal albacore catch in metric tons of the U.S. and Mexico surface fishery in the north Pacific Ocean are shown in Table 1. Most of the albacore catch occurred in Season 3. Seasonal size compositions (raised to the catch) are shown in Figure 1. The difficulty in matching the port sampling data with the logbook data resulted in the size composition time series starting only in 1977, and predominantly in Season 3. Substantially more work will be required in the future to improve the matching of U.S. logbook and port sampling databases. The initial input sample sizes ranged from 3 to 217.3, with an average of 40.3. Some of the size compositions were relatively 'spiky', especially those with low input sample sizes (N < 10), which indicates that the size samples may not have been representative for those seasons.

It is recommended that the ALBWG use the catch and size composition time series described in this working paper for the 2023 stock assessment. The ALBWG 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. Finally, it is also recommended that the seasonal Canadian albacore catches be combined with the U.S. and Mexico surface fishery for the 2023 assessment.

REFERENCES

ALBWG. 2014. Stock assessment of albacore tuna in the North Pacific Ocean in 2014. Page 132.

ALBWG. 2017. Stock assessment of albacore tuna in the North Pacific Ocean in 2017. Page 103. International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean.

ALBWG. 2020. Stock assessment of albacore tuna in the North Pacific Ocean in 2020. Page 109. International Scientific Committee for Tuna and Tuna-like Species in the North Pacific Ocean, Stock Assessment.

Childers, J., and A. Betcher. 2008. Summary of the 2006 US North and South Pacific albacore troll fisheries. ISC/08/ALBWG/03. Working document submitted to the ISC Albacore Working Group Meeting, February 28-March 6, NOAA\NMFS, Southwest Fisheries Science Center, 8604 La Jolla Shores drive, La Jolla, CA 92037, USA.

Coan, A. L. 2006. International Scientific Committee Albacore Working Group database catalog. ISC/06/ALBWG/01. Working document submitted to the ISC Albacore Working Group Meeting, November 28 - December 5, 2006.

McDaniel, J. D., P. R. Crone, and E. Dorval. 2006. Critical evaluation of important time series associated with albacore fisheries (United States, Canada, and Mexico) of the Eastern North Pacific Ocean. Page Report of the ISC Albacore Working Group Workshop, 28 November - 5 December, 2006. ISC/06/ALBWG/09, Shimizu, Shizuoka, Japan.

Pacific Fishery Management Council. 2019. Current status of the U.S. west coast fisheries for highly migratory species. Stock assessment and fishery evaluation.

Teo, S. L. H., Y. Gu, and J. Childers. 2019. Preliminary catch and size composition time series of the U.S. and Mexico surface fishery for the 2020 north Pacific albacore tuna assessment. Working document submitted to the ISC Albacore Working Group Meeting, 12-18 November 2019, National Research Institute of Far Seas Fisheries, Shimizu, Shizuoka Japan.

Teo, S. L. H., H. Lee, and S. Kohin. 2010. Time series associated with albacore fisheries based in the Northeast Pacific Ocean. ISC/10-3/ALBWG/02. Working document submitted to the ISC Albacore Working Group Meeting, 12-19 October 2010.

Watanabe, K., K. Uosaki, T. Kokubo, P. R. Crone, A. L. Coan, and C. C. Hsu. 2006. Revised practical solutions of application issues of length-weight relationship for the North Pacific albacore with respect to stock assessment. ISC/06/ALBWG/14. Report of the ISC Albacore Working Group Workshop, 28 November - 5 December, 2006.

Table 1. Seasonal and annual catch in metric tons for the U.S. and Mexico surface fishery. Annual catch of the U.S. and Mexico surface fishery is the sum of the annual catches of the U.S. gillnet, U.S. pole-and-line, U.S. troll, U.S. others, U.S. purse-seine, U.S. sport, Mexico others, Mexico purse-seine fisheries reported to the ISC by the U.S. and Mexico.

Year	Total	Season 1	Season 2	Season 3	Season 4
1966	17521	0.0	0.0	16246.9	1274.1
1967	22634	0.0	0.4	22203.0	430.6
1968	26291	0.0	0.0	24954.4	1336.6
1969	22181	0.0	1.1	20131.3	2048.6
1970	26270	0.0	0.0	23195.4	3074.6
1971	23772	0.0	0.0	22654.4	1117.6
1972	28087	0.0	0.0	26750.4	1336.6
1973	17973	0.0	523.1	13185.6	4264.3
1974	25050	0.0	398.0	23383.1	1268.9
1975	22826	0.0	145.3	21957.8	722.9
1976	19363	0.0	253.1	17649.8	1460.2
1977	12006	0.0	52.1	10863.7	1090.1
1978	18389	91.3	112.3	17477.4	708.0
1979	7159	0.0	794.2	5745.0	619.8
1980	8137	0.0	953.1	6921.2	262.7
1981	13588	0.0	493.2	12940.4	154.3
1982	7312	0.0	1489.9	5786.6	35.5
1983	10053	0.0	1380.5	8450.6	221.9
1984	15602	0.0	1725.4	12743.4	1133.1
1985	7793	0.0	1306.4	5447.3	1039.4
1986	5028	0.0	456.1	4247.0	324.9
1987	2998	0.0	370.1	2518.5	109.4
1988	4408	0.0	0.8	4366.8	40.4
1989	2073	0.0	0.0	2038.0	35.0
1990	2879	0.0	3.0	2875.4	0.6
1991	1962	0.0	51.5	1854.8	55.7
1992	4678	0.0	0.0	4253.8	424.2
1993	6555	0.0	505.9	5529.7	519.4
1994	11284	0.0	1100.0	9053.7	1130.4
1995	8465	0.0	1264.4	7172.9	27.7
1996	17363	0.0	1192.7	15114.5	1055.8
1997	15603	0.0	2839.6	12434.0	329.4
1998	15921	0.0	3877.6	11489.5	553.9
1999	14387	0.0	2742.4	10988.0	656.6
2000	11818	0.0	521.4	9878.0	1418.5
2001	13380	0.0	2821.1	9760.7	798.2
2002	13435	0.0	1839.2	8565.0	3030.8
2003	16557	0.0	2028.4	13354.9	1173.7
2004	15256	0.0	1193.2	12630.8	1432.1

Year	Total	Season 1	Season 2	Season 3	Season 4
2005	10394	0.0	295.8	9031.5	1066.6
2006	13139	1.0	46.4	12003.7	1087.8
2007	12493	0.0	295.6	11563.1	634.3
2008	12191	0.0	228.9	11480.7	481.4
2009	13339	0.0	314.6	12572.8	451.6
2010	12583	0.0	323.4	11477.1	782.5
2011	10573	0.0	21.7	8105.5	2445.8
2012	15374	0.0	89.7	13737.6	1546.7
2013	13156	0.0	40.6	12364.6	750.8
2014	14443	0.0	30.1	14202.3	210.6
2015	12532	0.0	354.2	12057.8	120.0
2016	11435	0.0	1335.6	9919.0	180.3
2017	7818	0.0	330.1	7216.0	272.0
2018	8110	0.0	401.0	7698.1	10.9
2019	9135	0.0	39.8	8608.5	486.7
2020	7785	0.0	25.0	7609.2	150.8
2021	4526	0.0	60.8	4398.1	67.1

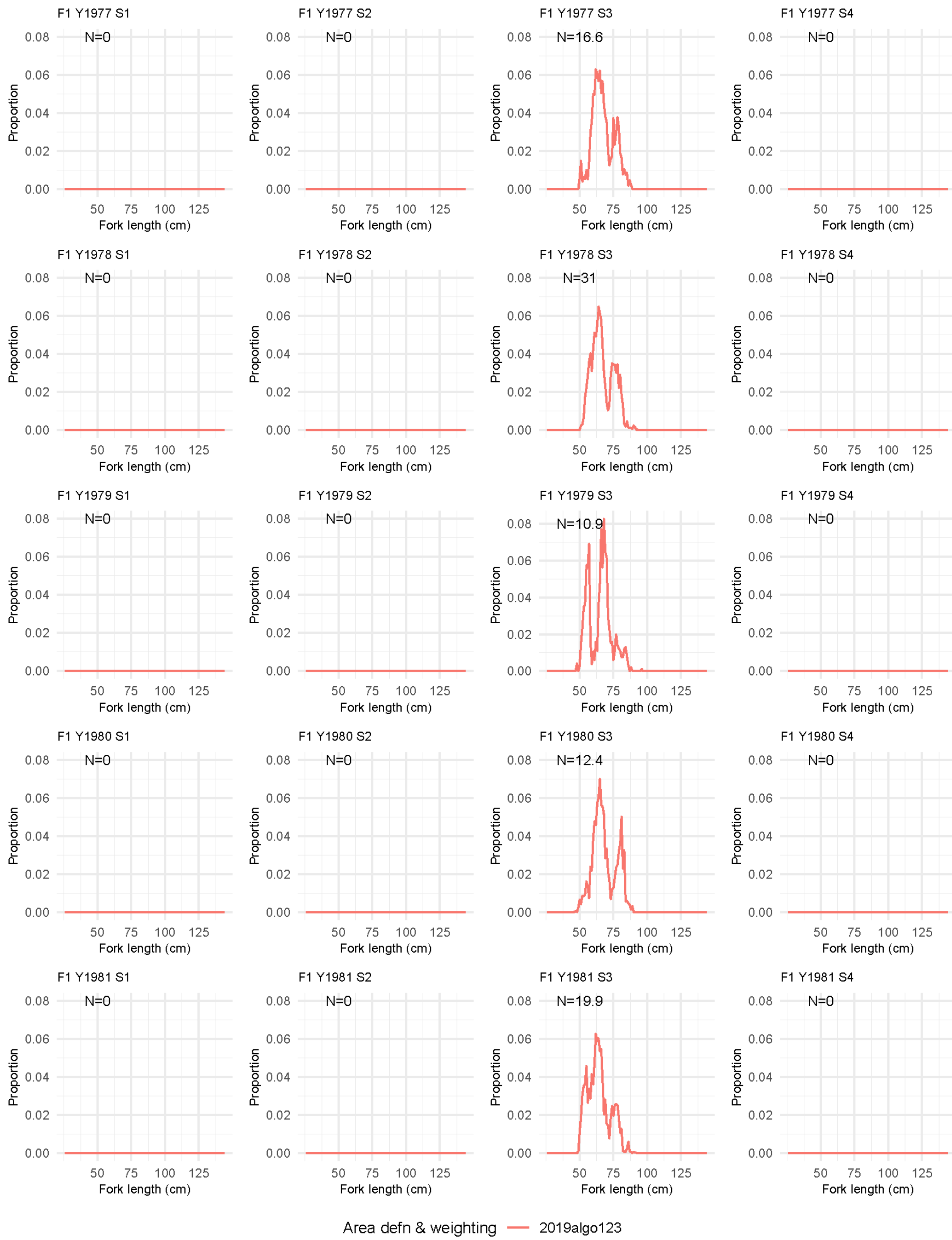
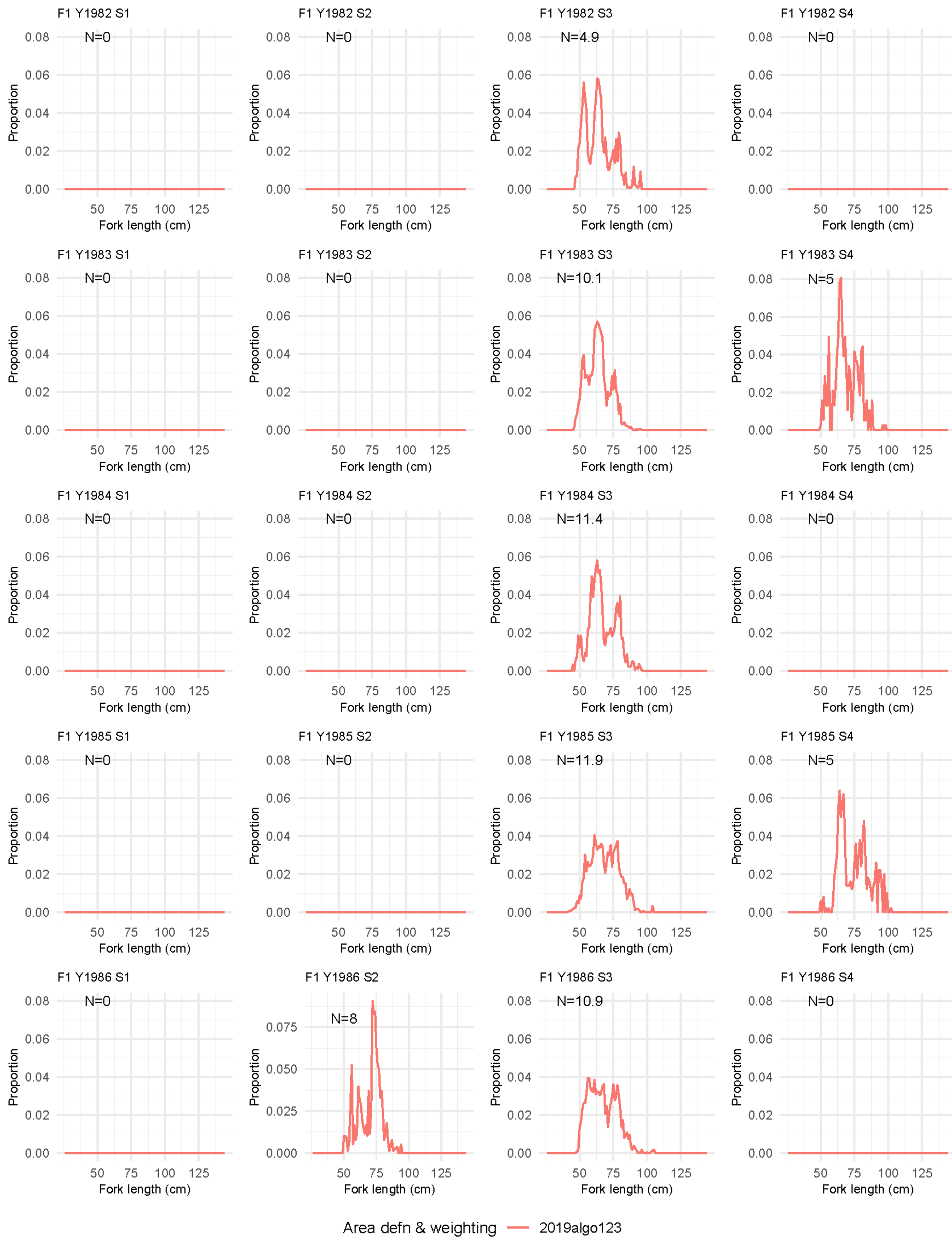


Figure 1. Seasonal size compositions for the U.S. surface fishery for 1977 – 2021. N indicate the input sample size for size compositions.



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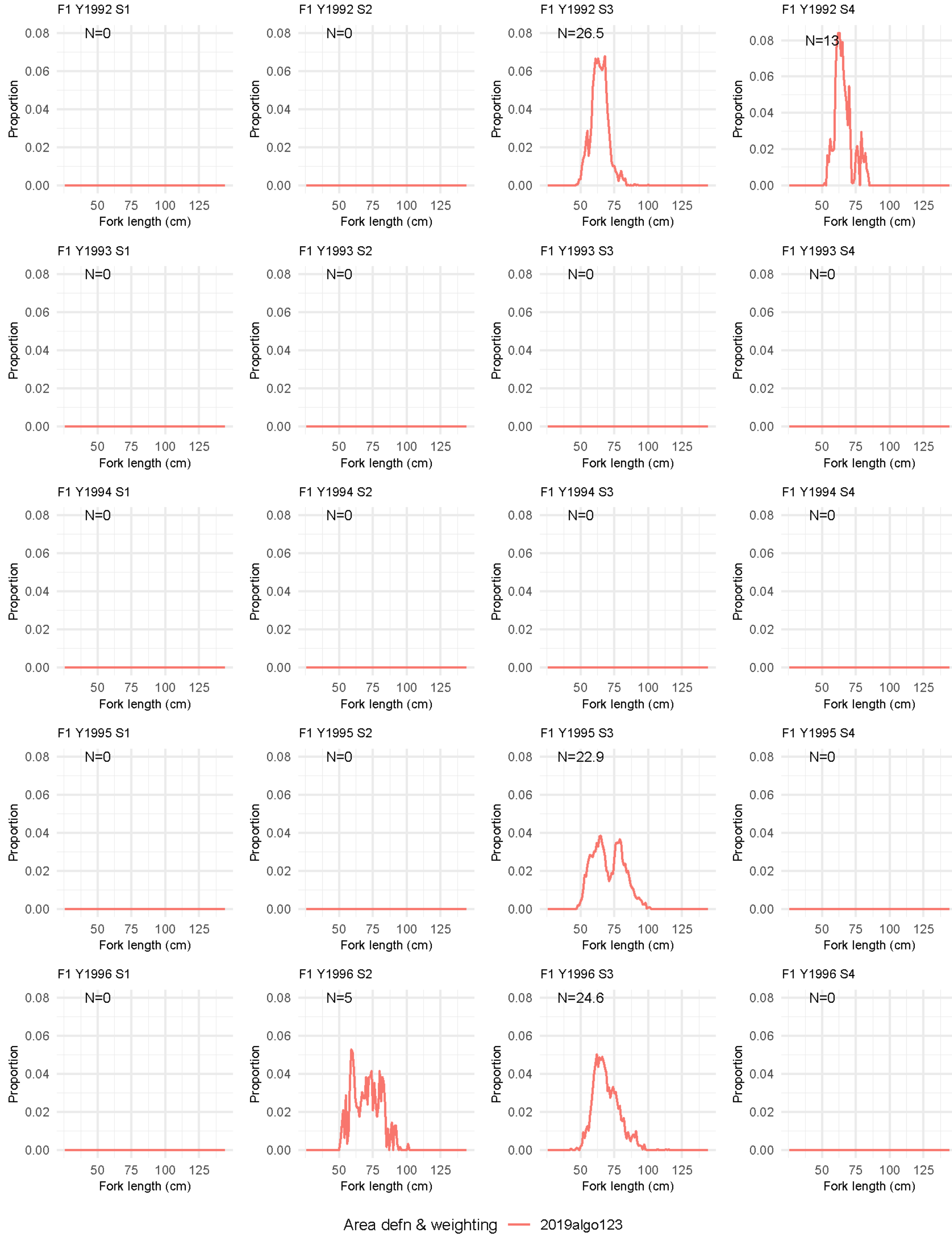

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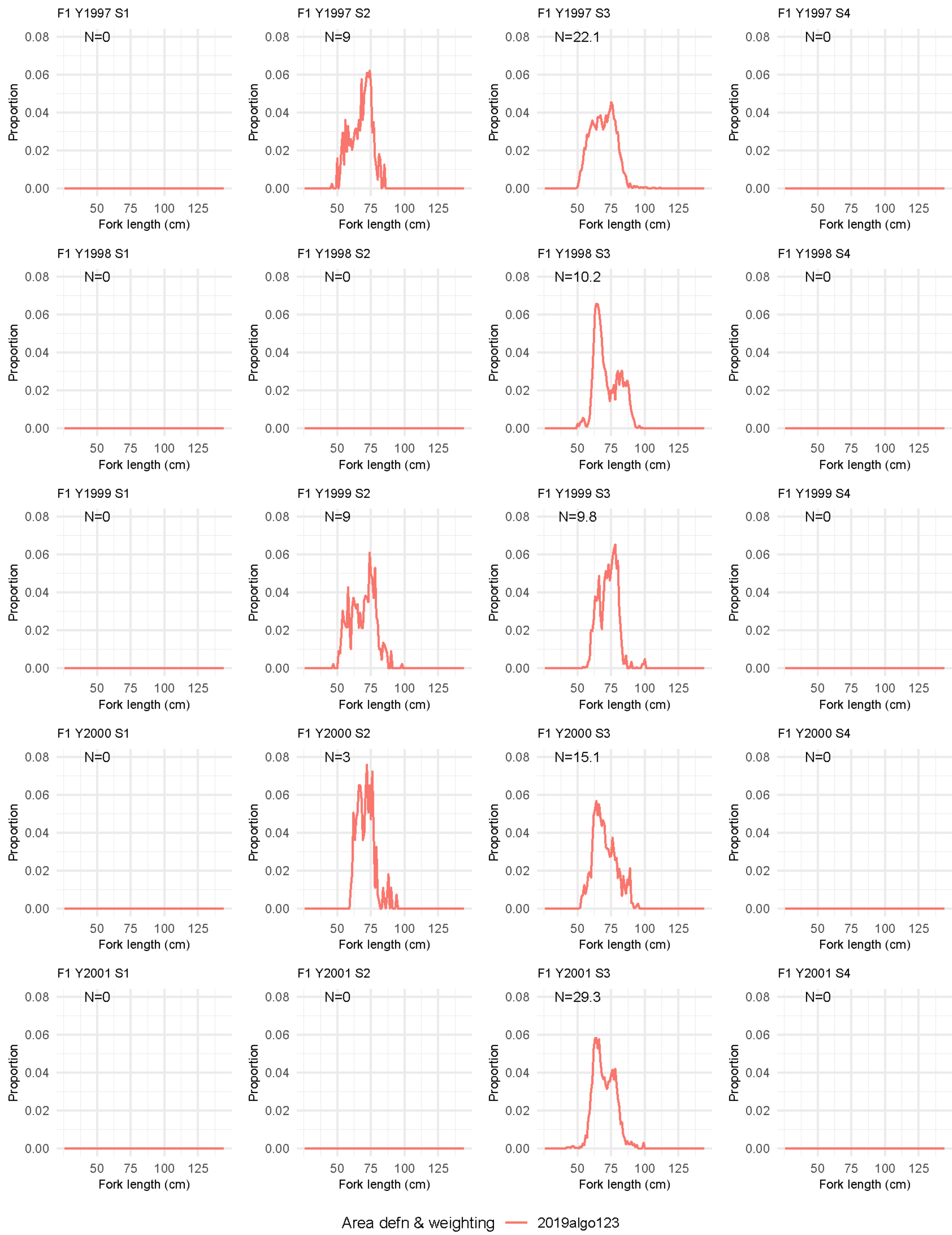

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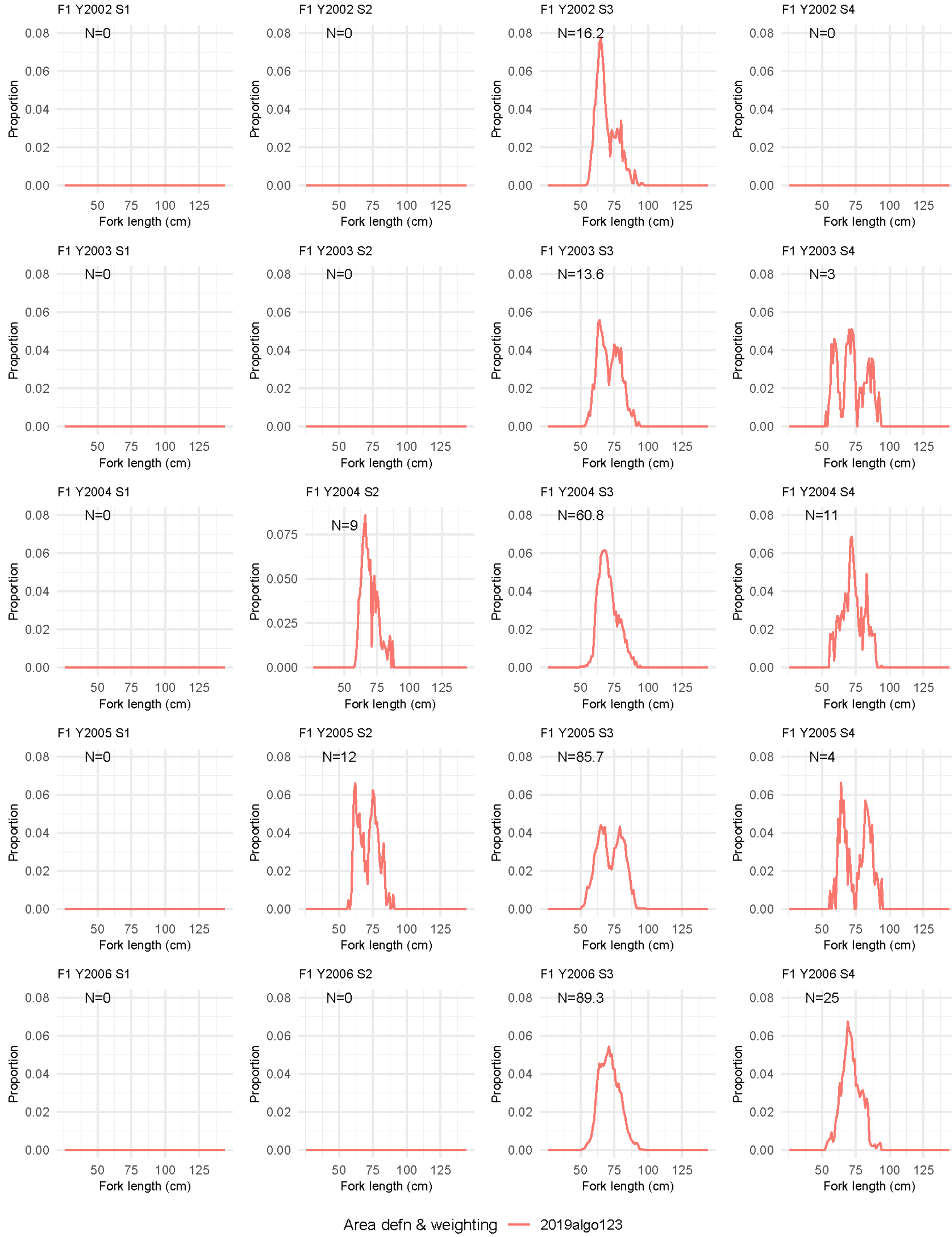

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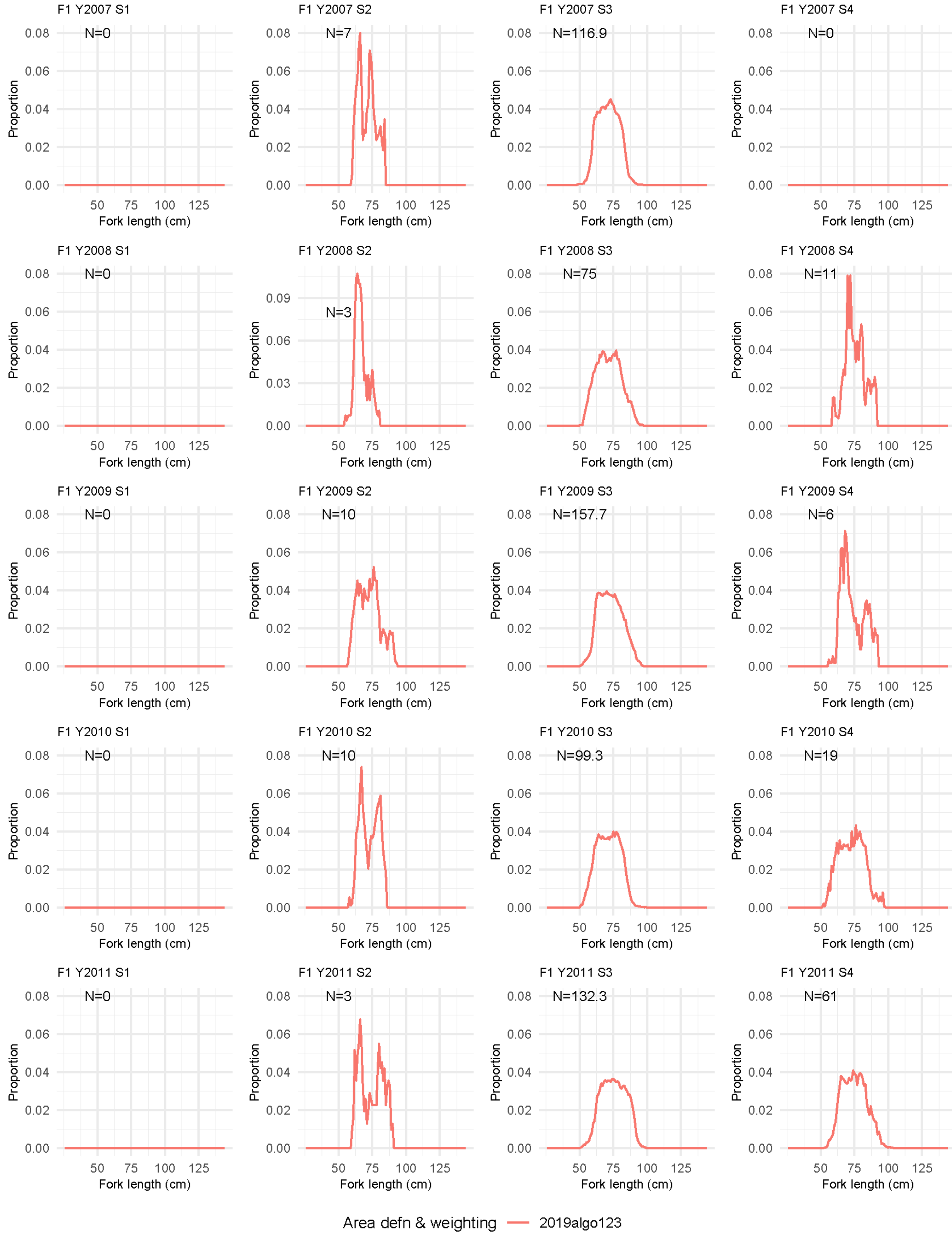

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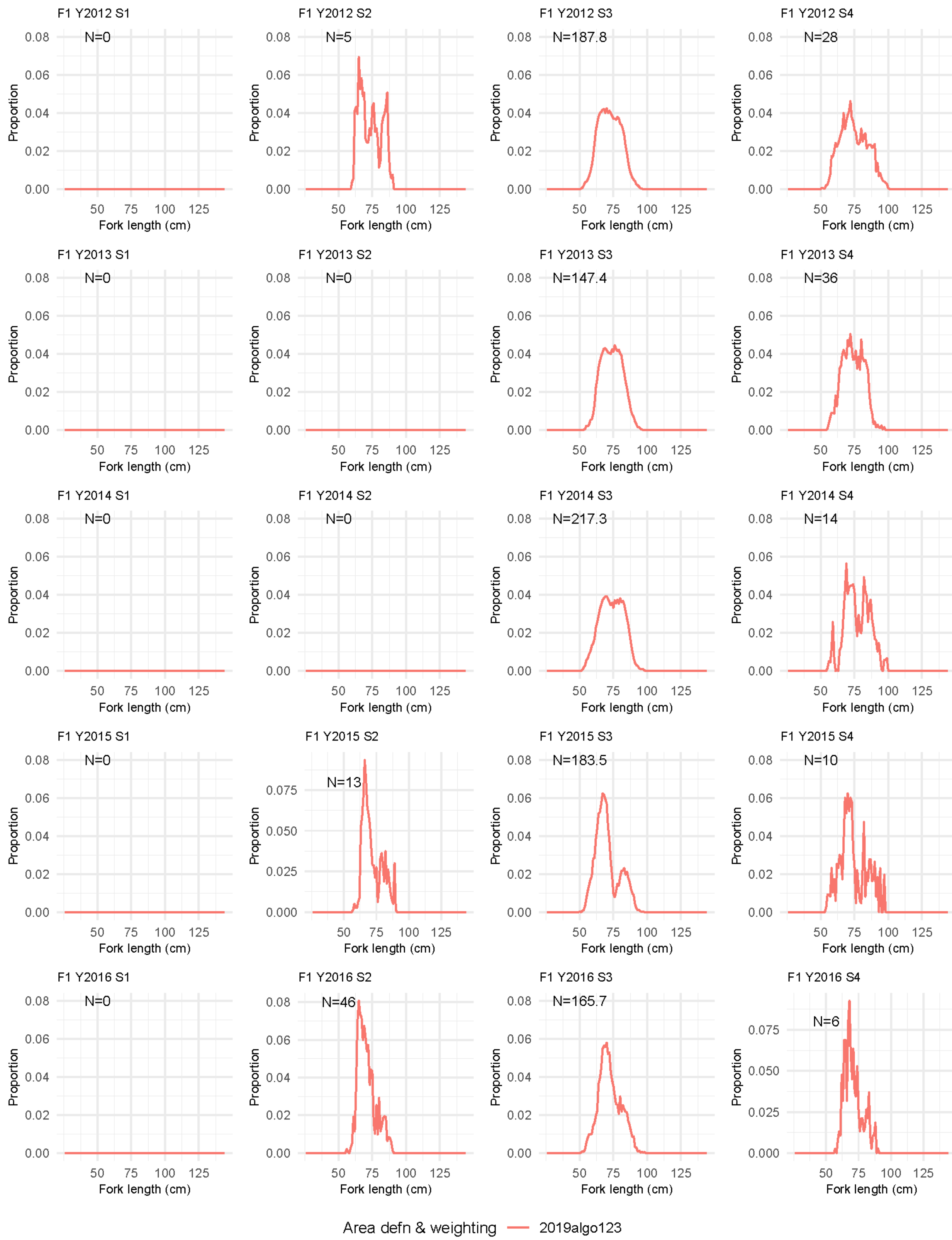

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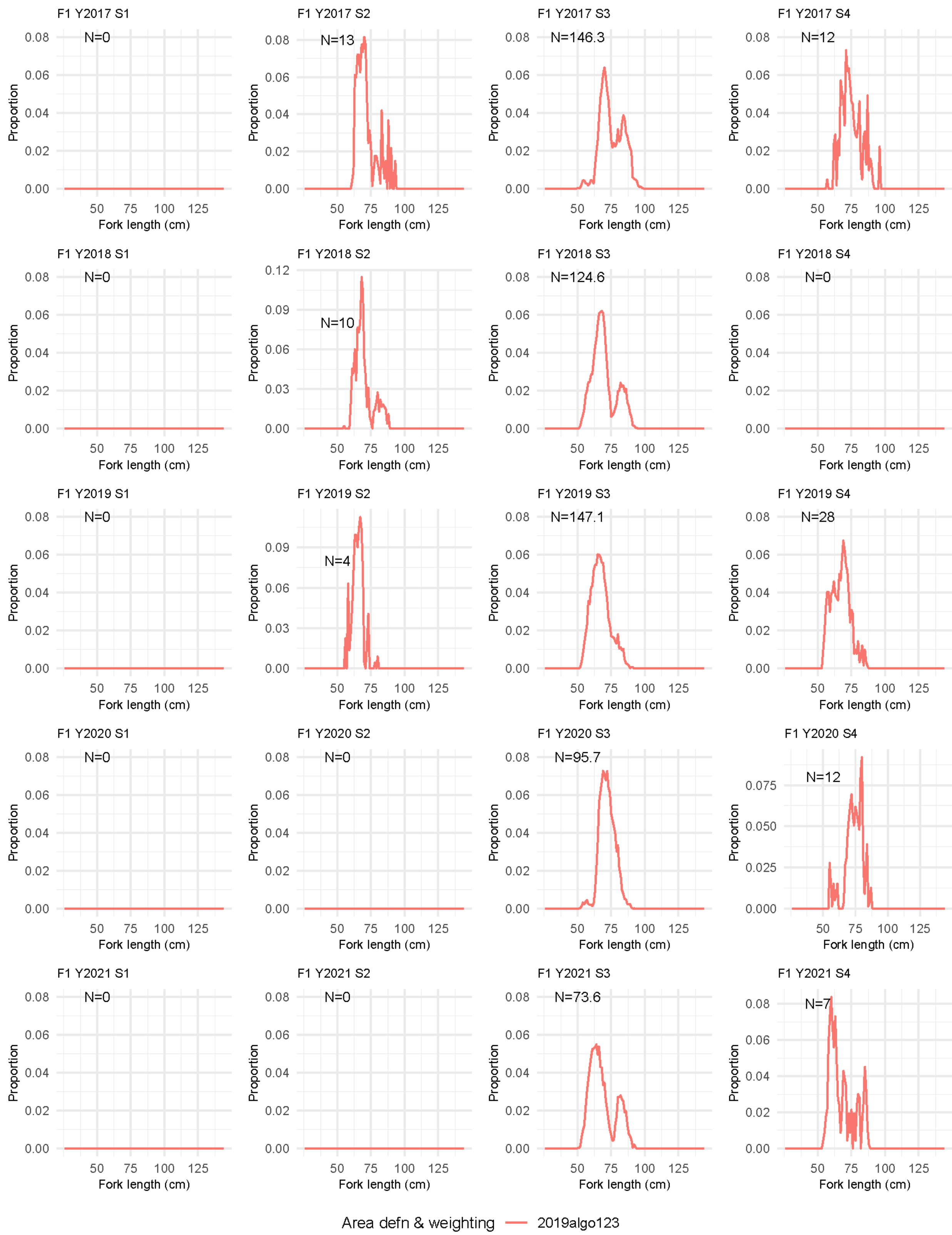

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