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Catch and size composition time series of the US and Mexico surface fishery for the 2017 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 seasonal catch and size composition time series of the US and Mexico albacore surface fleet in the north Pacific Ocean for the 2017 stock assessment. Similar to the 2014 assessment, in order to simplify model structure, albacore landings from all US gears, except handline and longline, and all Mexico gears were combined into the Eastern Pacific Ocean (EPO) surface fleet. However, unlike the 2014 assessment when it was assumed that size data were randomly sampled, this analysis followed the recommendations of the ALBWG and developed a size composition time series that was raised to the catch. 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 US and Mexico; 2) catch-effort information from US fishermen logbooks; and 3) biological (fork length) information from a US port sampling program. Size composition data in 1 cm bins were first matched to logbooks to obtain average fishing location and 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 proportion of catch in weight for that season with the total annual catch of the US and Mexico surface fishery for the year. Raising of the size composition data to the catch resulted in important changes in the size compositions for some seasons. However, the difficulty in matching the port sampling data with the logbook data resulted in the size composition time series starting only in 1977 instead of 1966 in the 2014 assessment, and a sparser size composition time series. The input sample sizes ranged from 3 to 145.2, with an average of 29.7. It is recommended that the ALBWG use the catch and size composition time series described in this working paper for the 2017 stock assessment of north Pacific albacore tuna. In addition, it is recommended that the seasonal Canadian albacore catches be combined with the US and Mexico surface fishery for the 2017 assessment.

INTRODUCTION

The objective of this paper is to describe the data sources and methods used to develop catch and size composition time series for the US and Mexico albacore surface fleet in the north Pacific Ocean for the 2017 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 US surface fishery for albacore tuna is an important component of north Pacific albacore removals, with annual catches of 1960 – 27987 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 US troll and pole-and-line fisheries are the dominant US gears for albacore in the Eastern Pacific Ocean (EPO) but the US 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 US 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. In order to simplify model structure in the 2014 assessment model, landings from the handline and longline gears were combined into US longline fleets while the rest of the US and Mexico albacore landings were combined into the EPO surface fleet (ALBWG, 2014). The same approach will be taken here to combine catch from the same gears into the US and Mexico surface fleet.

In the 2014 assessment, size data for the EPO surface fleet were assumed to be randomly sampled and were not raised to the catch. However, the ALBWG recommended that the size composition data of the EPO surface fleet be raised to the catch for the 2017 assessment. Therefore, the methods used to develop the size composition time series (raised to the catch) for the US and Mexico surface fishery is described here.

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 US and Mexico; 2) catch-effort information from US fishermen logbooks; and 3) biological (fork length) information from a US port sampling program.

Annual albacore tuna landings by US and Mexico fisheries are reported to the ISC by the National Oceanic and Atmospheric Administration (NOAA) and Instituto Nacional de Pesca (INAPESCA) respectively. US 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 US 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 US commercial surface fleet, monitors all landings of albacore and maintains an independent database. The NOAA's Southwest Fisheries Science Center (SWFSC) incorporates data from these databases to estimate the annual US albacore landings by fishery, which are then submitted to the ISC. Landing statistics for US-caught albacore dates back to 1936 but only data from 1966-2015 data were used for this analysis to match the assessment period. During the assessment period, the troll and pole-and-line fisheries have been the largest US 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 US portion of the EPO surface fishery in the 2017 assessment. 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 US 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 US troll and pole-and-line fisheries. An annual logbook monitoring program for the US albacore troll and pole-and-line fisheries has been managed by the SWFSC since 1961 (Childers & Betcher, 2008). Although logbook data has been collected since 1961, only 1966-2015 data were used for this analysis to match the assessment period. The logbook format has changed over the years but time and location-specific catch-effort information have been consistently recorded throughout the program's existence. Prior to 2005, logbooks were voluntarily submitted to the SWFSC and the logbook sampling coverage varied from 7-33% (McDaniel, Crone, & Dorval, 2006). However, in 2005, logbook submission became mandatory for this fishery and sampling coverage has increased to approximately 75% of the total number of boat trips.

Size information (fork length to the nearest cm) from the US troll and pole-and-line fisheries were collected through a port-sampling program. A port sampling program for the US albacore surface fisheries has been in operation for approximately six decades (Childers & 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 was collected prior to 1961, only 1966 - 2015 data were used for this analysis to match the assessment period. 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. 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 US troll and pole-and-line fisheries are 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.

Finally, it is important to note that some data sources for the US surface fishery extend back to the early 1950s. However, the time series in this analysis begin in 1966 because the ALBWG agreed to start the 2017 assessment models start in 1966 due to concerns regarding the representativeness of some of the sample data collected prior to 1966 for both eastern and western Pacific Ocean fisheries.

Size compositions

Although the abovementioned US port sampling program records a location for each sampled trip, a preliminary examination of the location information from the port sampling program suggested that the location information from the port sampling program were not representative of actual fishing location. 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. Currently, size information from a specific vessel-trip could not be consistently matched with the corresponding vessel-trip in the logbook database for the whole time series. Therefore, size information from a specific vessel-trip were instead matched to the average fishing location for the corresponding vessel during the same month. This process likely resulted in location errors but these errors were likely small compared to the size of the area bounds of each strata. 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 de-spiked 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 the 2014 assessment, the number of sampled trips was used as the input sample size of the size compositions in the assessment model. Here, I instead used the weighted average of the number of trips of all strata by year and season in order to be consistent with the size composition data. The strata weights were calculated in the same way as the size composition data.

Catch

Total annual catch of the US and Mexico surface fishery was considered to be well represented by the reported landings from NOAA and INAPESCA to ISC. The total annual catch were 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 US 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 US albacore troll and pole-and-line fisheries were representative of the entire US and Mexico surface fishery. This is a reasonable assumption because these are the dominant component fisheries and very limited information is available for the other components.

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, Lee, & Kohin, 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 US 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 US and Mexico surface fishery in year *j*.

RESULTS AND DISCUSSION

Estimates of seasonal albacore catch in metric tons of the US 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 comparison to the raw size compositions in Figure 1. Raising of the size composition data to the catch resulted in important changes in the size compositions for some seasons. However, the difficulty in matching the port sampling data with the logbook data resulted in the size composition time series starting only in 1977 instead of 1966 in the 2014 assessment, and a sparser size composition time series. Substantially more work will be required in the future to improve the matching of US logbook and port sampling databases. The input sample sizes ranged from 3 to 145.2, with an average of 29.7.

It is recommended that the ALBWG use the catch and size composition time series described in this working paper for the 2017 stock assessment of north Pacific albacore tuna. In addition, it is recommended that the seasonal Canadian albacore catches be combined with the US and Mexico surface fishery for the 2017 assessment.

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

Year	Total	Season 1	Season 2	Season 3	Season 4
1966	17521	0.0	0.0	16259.5	1261.5
1967	22634	0.0	0.4	22207.3	426.3
1968	26291	0.0	0.0	24967.2	1323.8
1969	22181	0.0	1.1	20150.1	2029.8
1970	26270	0.0	0.0	23222.9	3047.1
1971	23772	0.0	0.0	22665.2	1106.8
1972	28087	0.0	0.0	26763.3	1323.7
1973	17973	0.0	489.3	13698.2	3785.5
1974	25050	0.0	414.6	23379.1	1256.4
1975	22826	0.0	267.1	22073.6	485.3
1976	19363	0.0	263.9	17654.6	1444.4
1977	12006	0.0	53.9	10884.2	1067.9
1978	18389	84.5	107.4	17548.8	648.3
1979	7159	0.0	752.1	5854.0	552.9
1980	8137	0.0	1114.7	6943.8	78.6
1981	13588	0.0	496.2	12954.8	137.0
1982	7312	0.0	1482.3	5809.5	20.2
1983	10053	0.0	2566.0	7242.4	244.6
1984	15602	0.0	1605.3	12966.0	1030.7
1985	7793	0.0	1352.5	5470.6	969.9
1986	5028	0.0	492.6	4220.9	314.4
1987	2998	0.0	375.9	2548.3	73.8
1988	4408	0.0	0.2	3592.0	815.8
1989	2073	0.0	0.0	2029.2	43.8
1990	2879	0.0	0.5	2878.3	0.1
1991	1962	0.0	23.6	1913.9	24.5
1992	4678	0.0	62.6	3851.8	763.5
1993	6555	0.0	900.1	5263.4	391.5

Year	Total	Season 1	Season 2	Season 3	Season 4
1994	11284	0.0	1993.3	7797.1	1493.5
1995	8465	0.0	1706.2	6554.6	204.2
1996	17363	0.0	2320.9	13502.8	1539.3
1997	15603	0.0	3405.4	11919.9	277.7
1998	15921	0.0	4932.2	10700.5	288.3
1999	14387	0.0	4414.2	9450.0	522.8
2000	11818	0.0	1873.5	8233.8	1710.7
2001	13380	0.0	3236.8	8958.6	1184.5
2002	13435	0.0	1448.5	9013.8	2972.8
2003	16557	0.0	2430.0	12472.1	1654.9
2004	15256	0.0	3526.0	10907.9	822.0
2005	10394	0.0	1693.0	7893.9	807.0
2006	13139	153.0	552.7	11174.7	1258.6
2007	12493	0.0	1082.9	10275.0	1135.1
2008	12191	0.0	547.2	10417.2	1226.6
2009	13339	0.0	710.9	11974.5	653.6
2010	12583	0.0	353.0	11518.8	711.2
2011	10573	0.0	25.1	7964.8	2583.1
2012	15379	0.0	94.1	13735.0	1549.9
2013	13156	0.0	41.6	12303.6	810.8
2014	14417	0.0	31.3	14165.9	219.8
2015	12505	0.0	355.8	12067.8	81.5

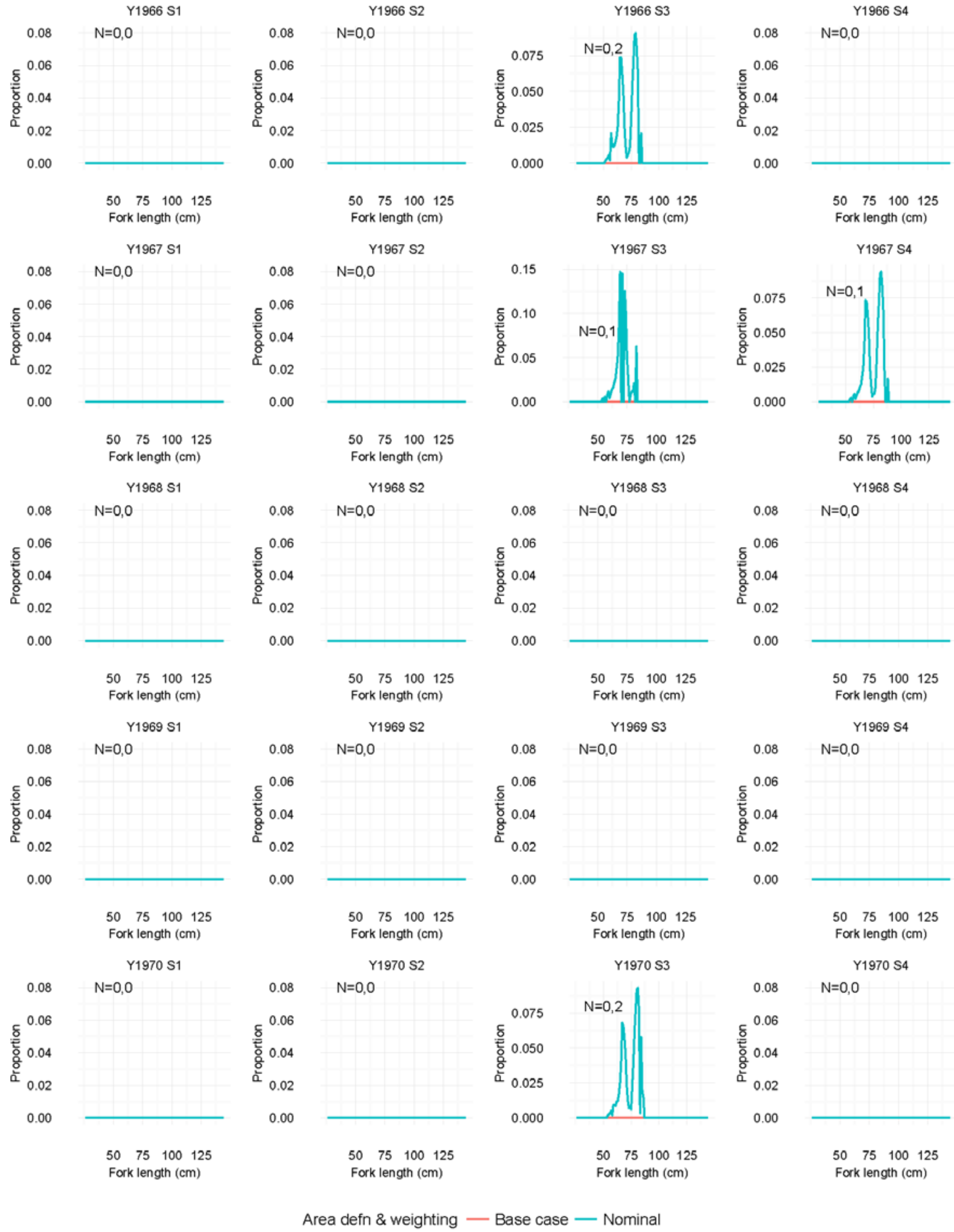
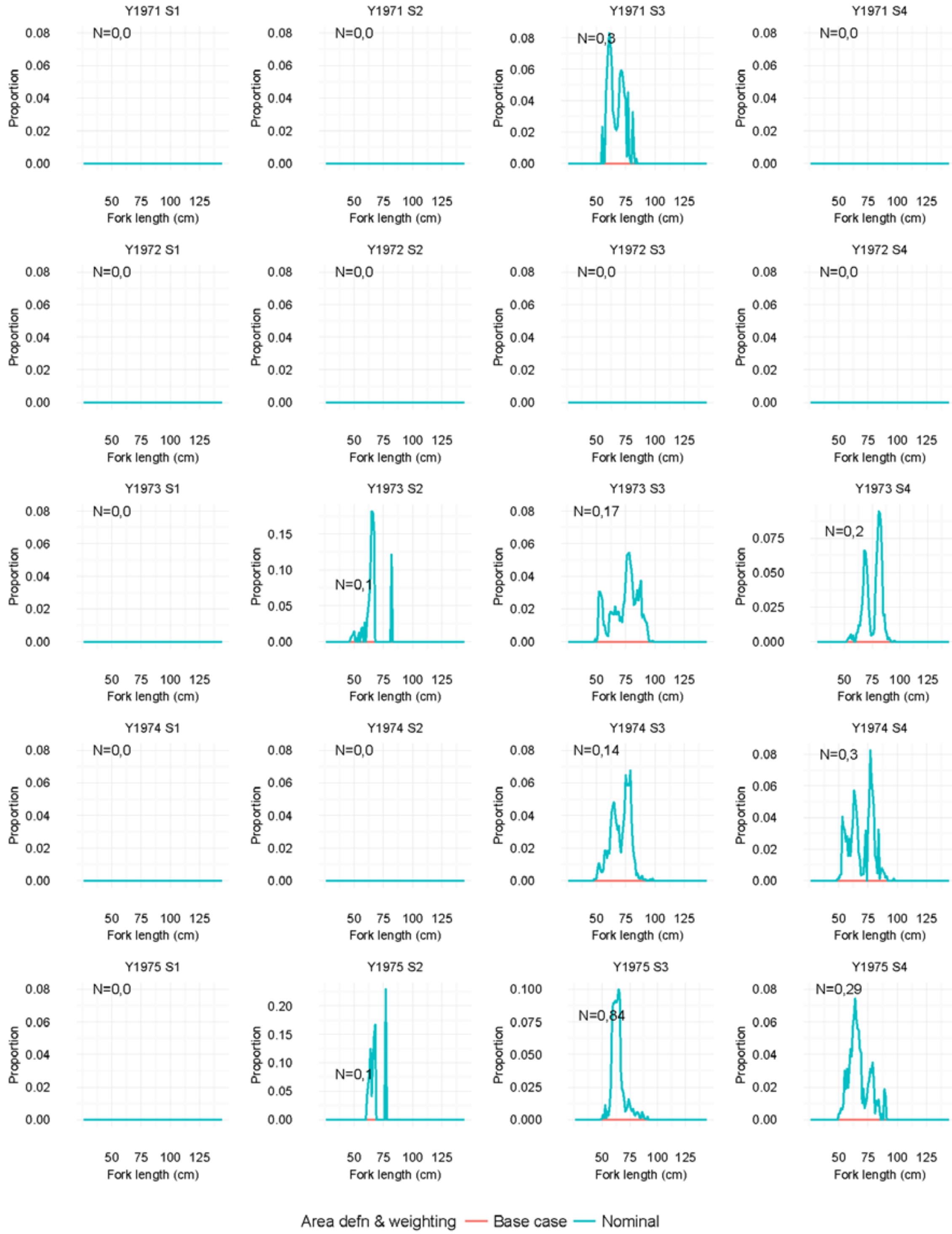


Figure 2. Seasonal size compositions (red: raised to the catch; blue: nominal) for the US surface fishery for 1966 – 2015. N indicate the input sample size for size compositions raised to the catch (red: base case) and raw size compositions (blue: nominal) respectively.



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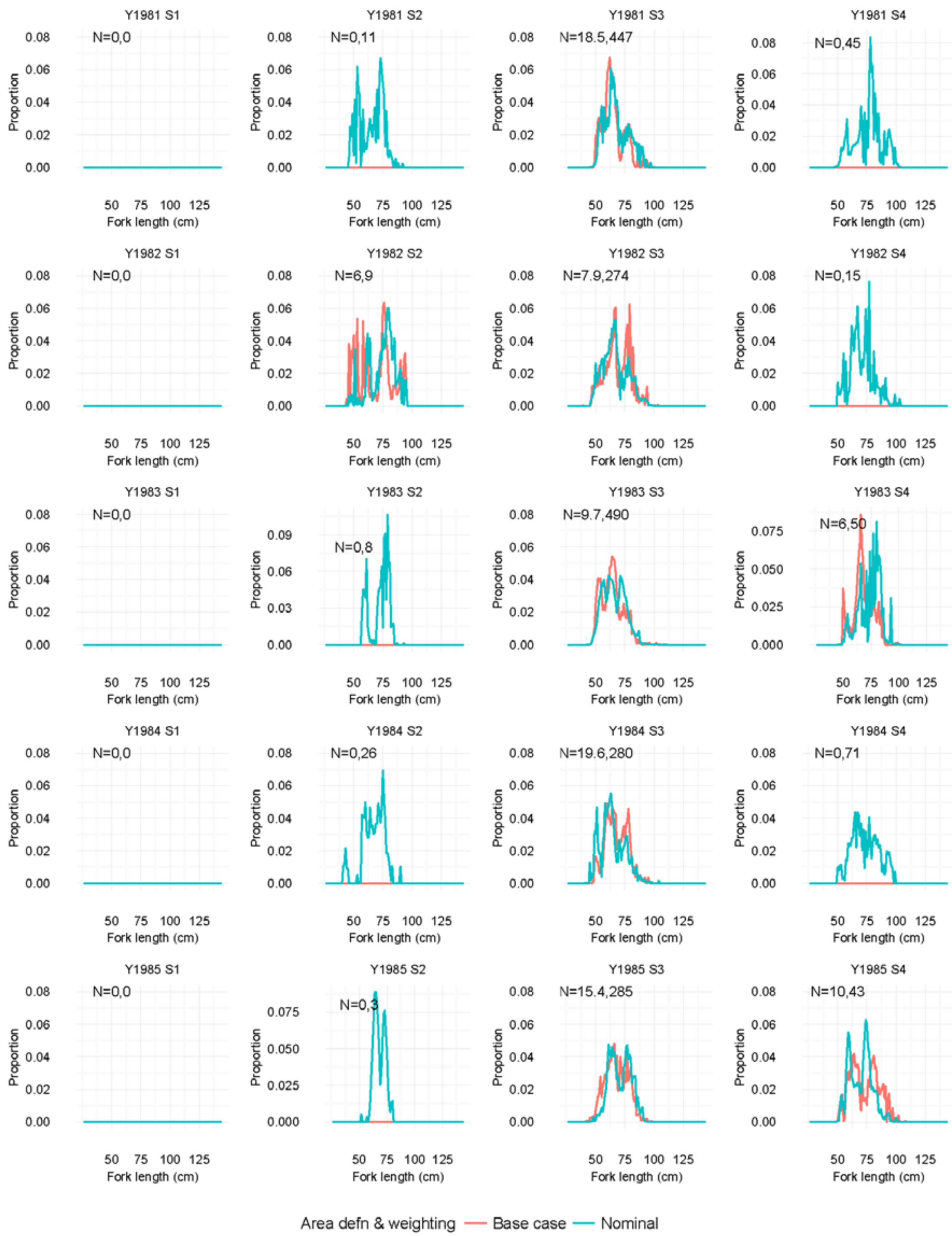

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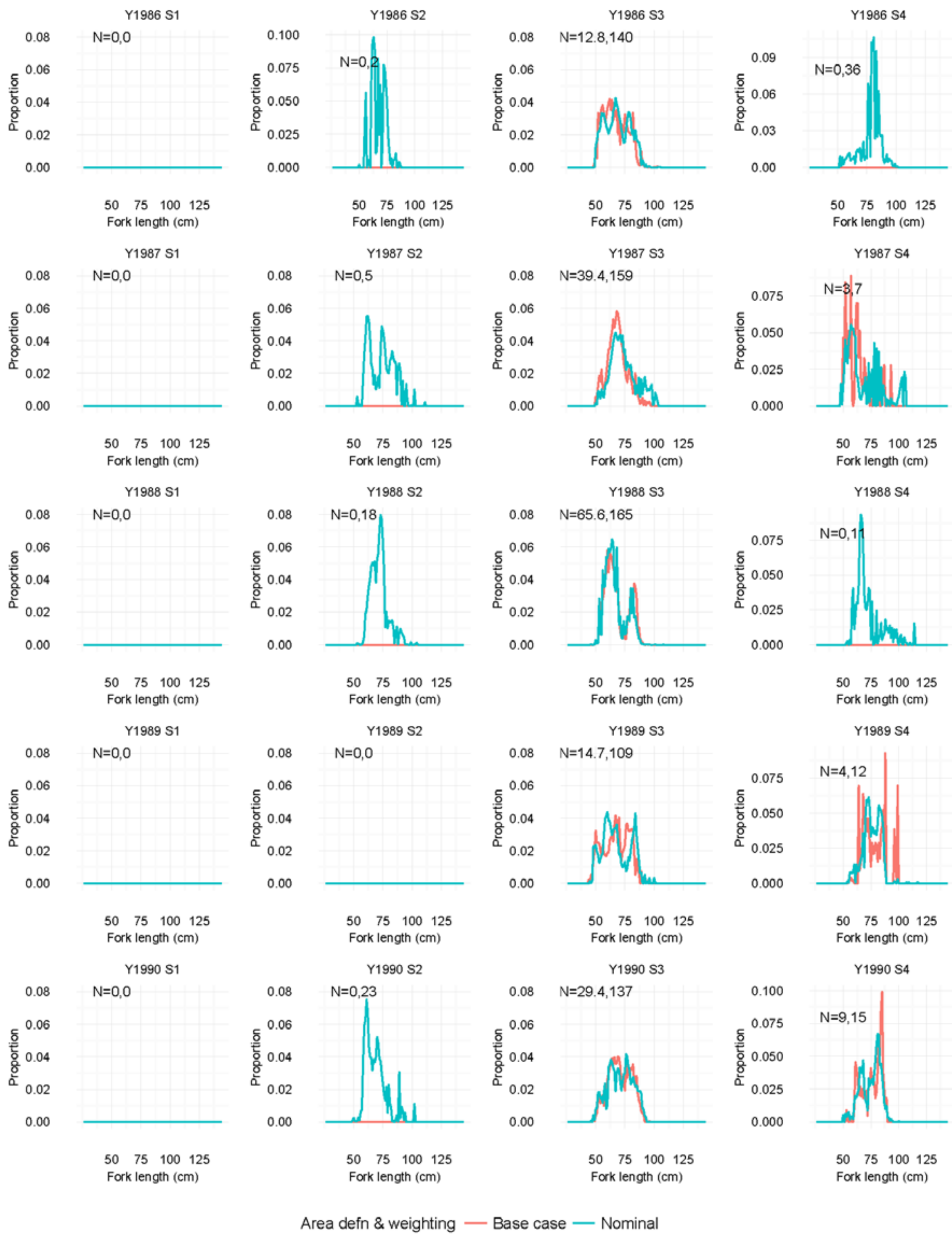

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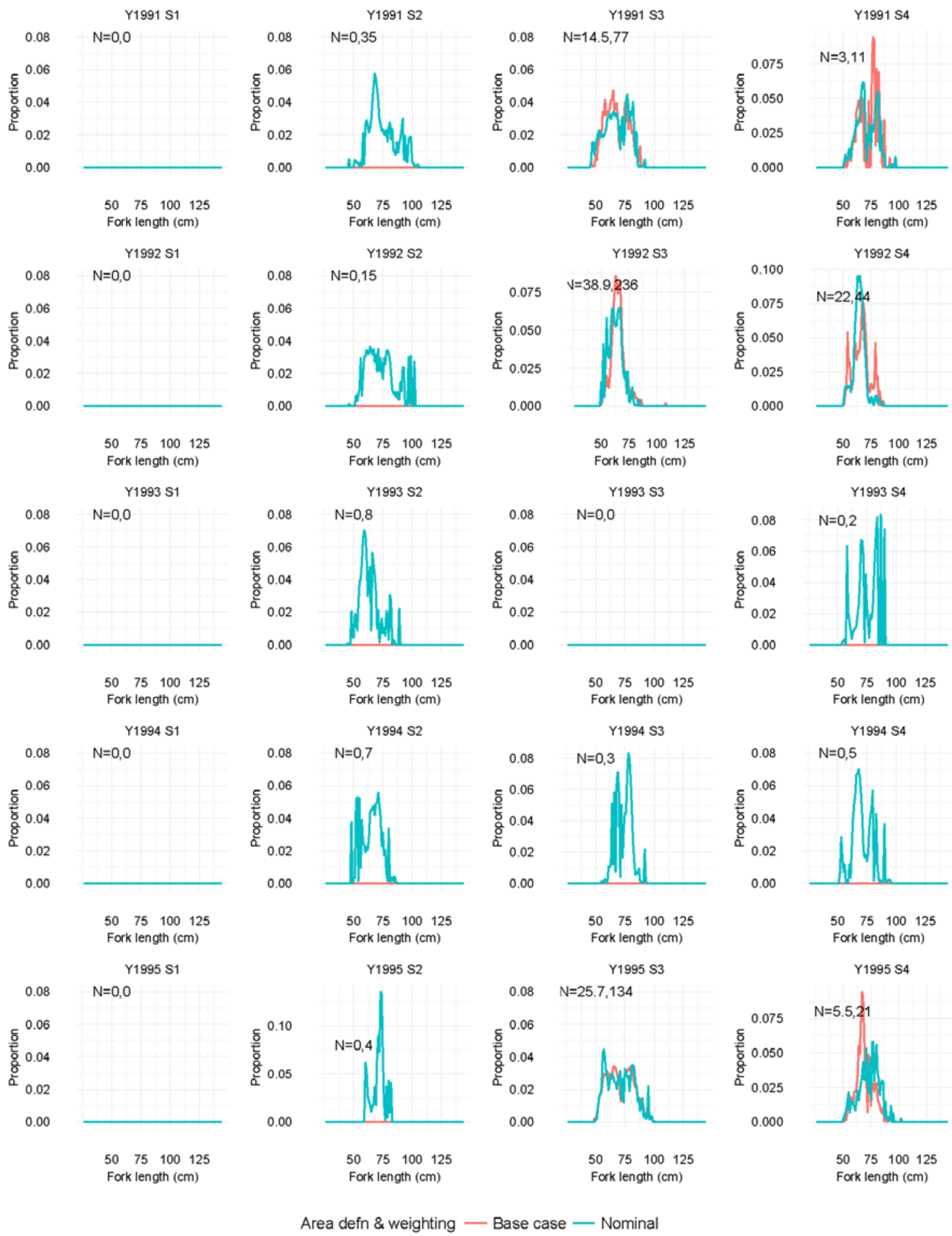

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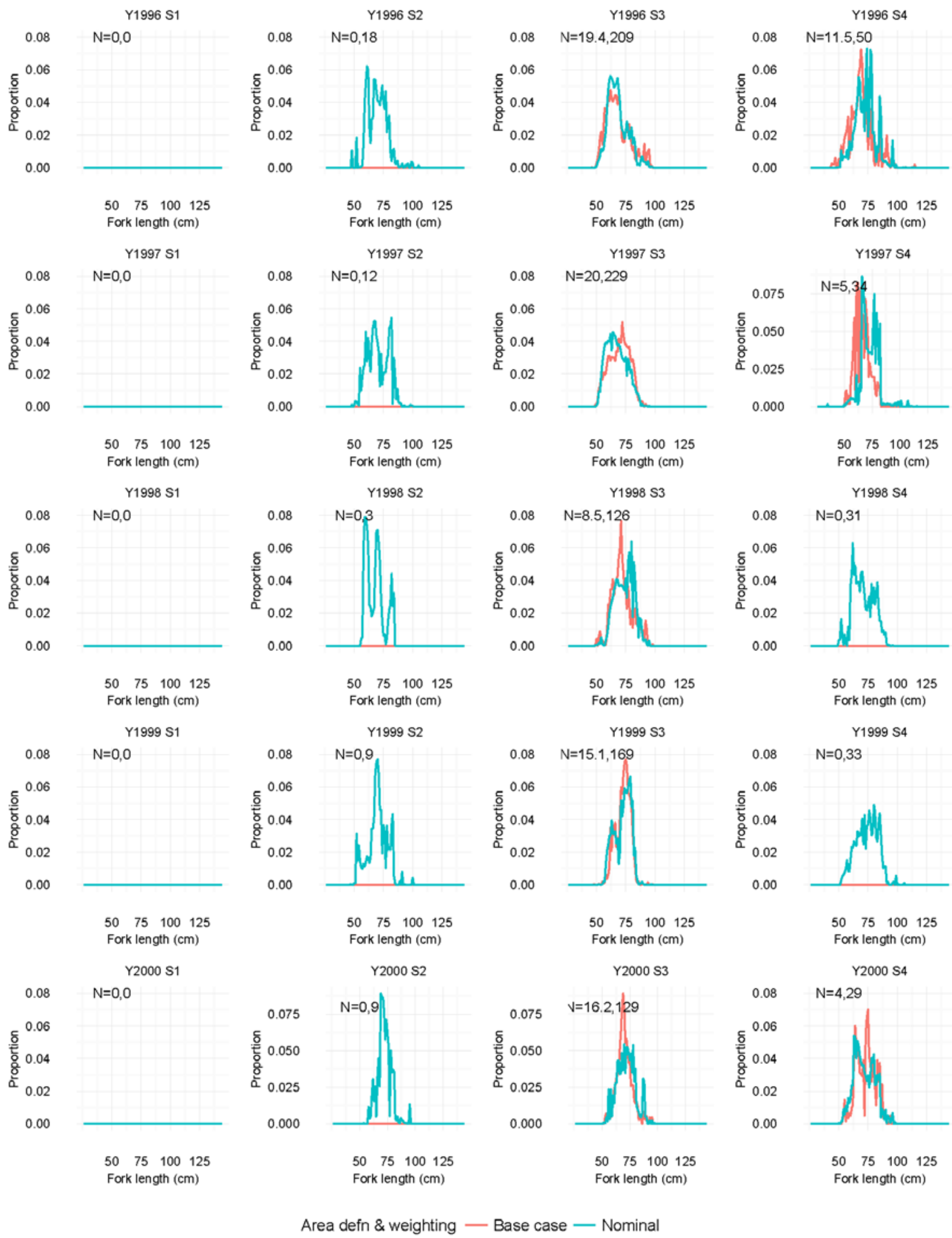

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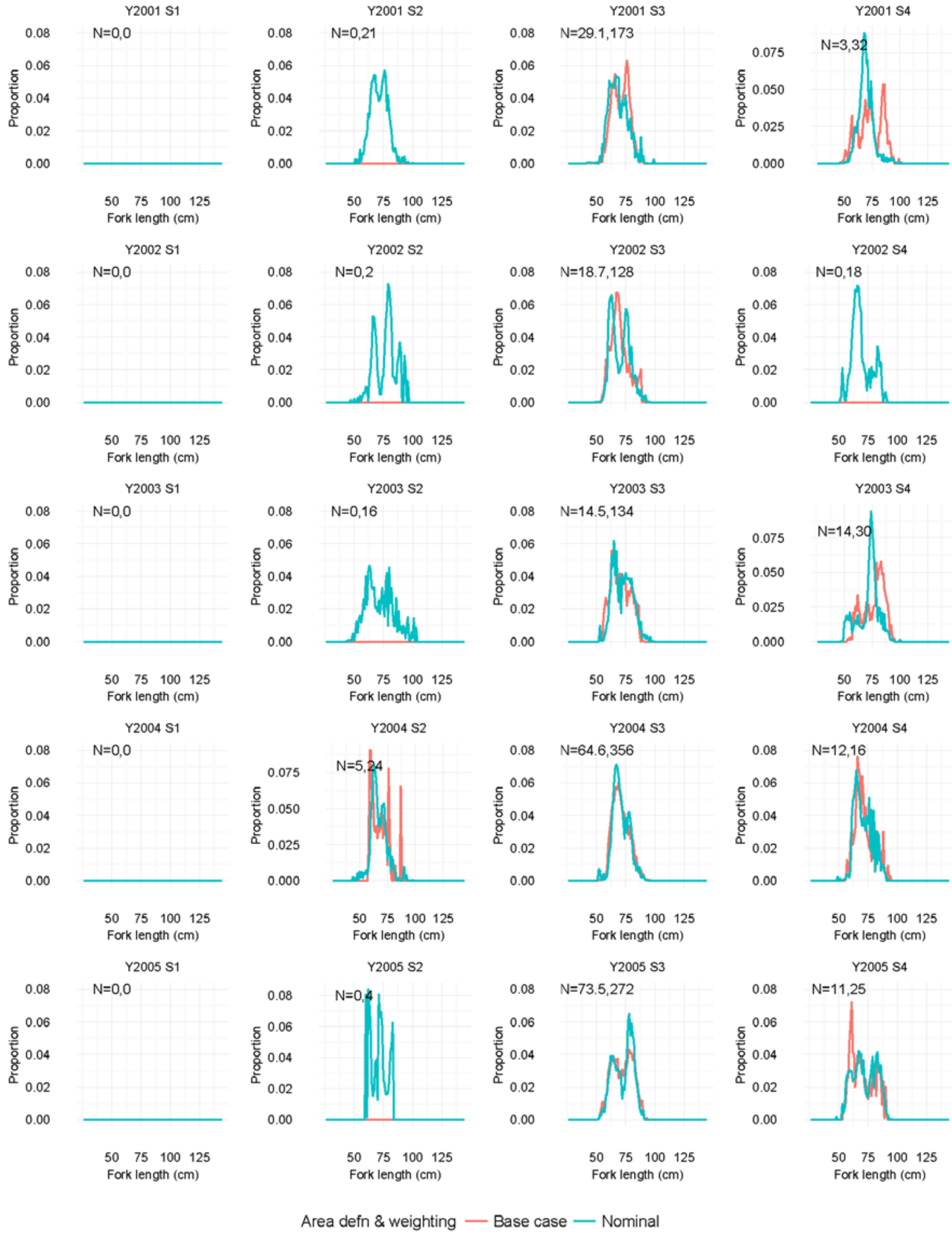

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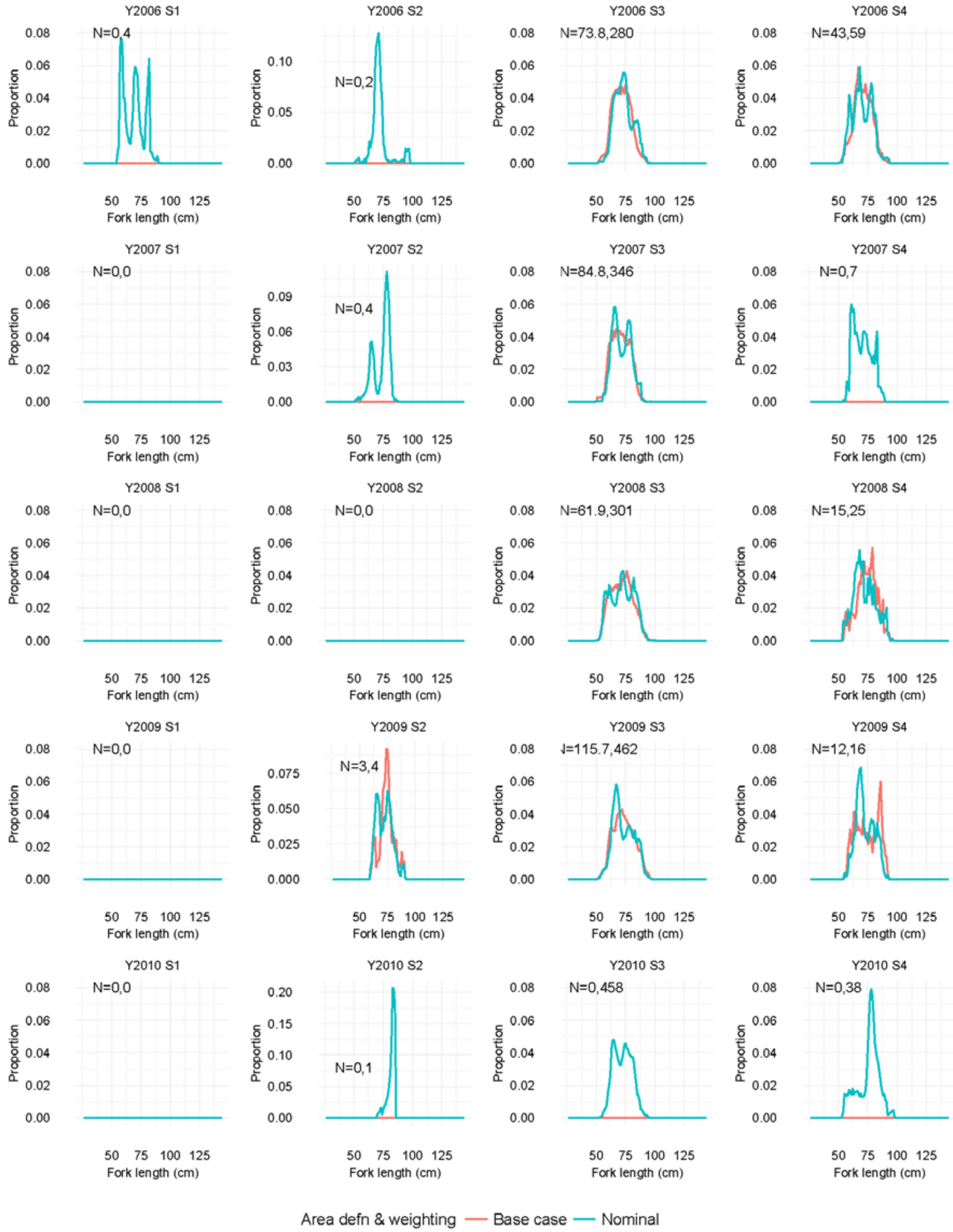

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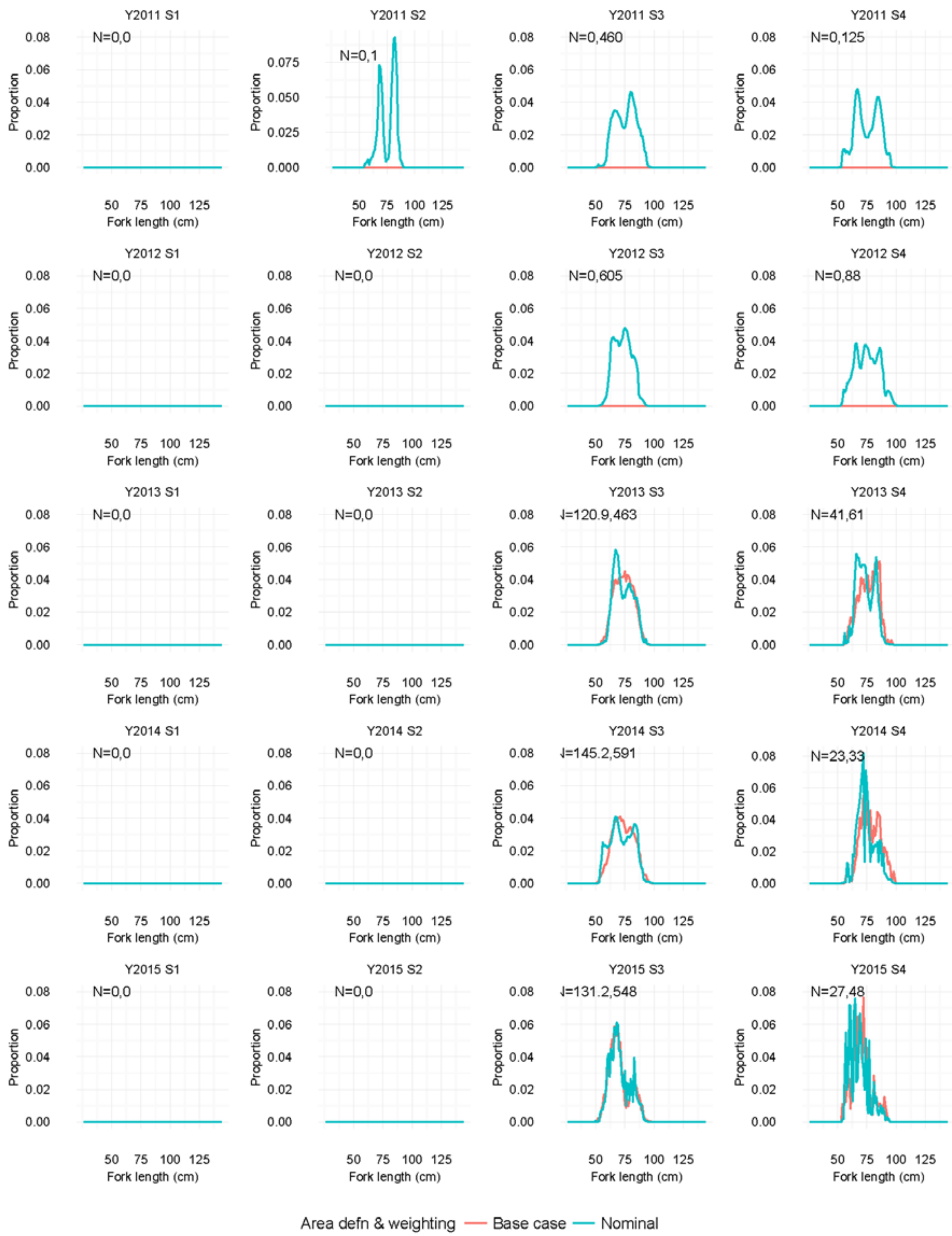

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