Gulf of Mexico Scamp (*Mycteroperca phenax*) and Yellowmouth Grouper (*Mycteroperca interstitialis*) Commercial and Recreational Length and Age Compositions

Molly H. Stevens

SEDAR68OA-WP-05

29 June 2022

Please cite this document as:

Stevens, Molly H. 2022. Gulf of Mexico Scamp (*Mycteroperca phenax*) and Yellowmouth Grouper (*Mycteroperca interstitialis*) Commercial and Recreational Length and Age Compositions. SEDAR68OA-WP-05. SEDAR, North Charleston, SC. 20 pp.

Gulf of Mexico Scamp (*Mycteroperca phenax*) and Yellowmouth Grouper (*Mycteroperca interstitialis*) Commercial and Recreational Length and Age Compositions

Molly H. Stevens
NOAA Southeast Fisheries Science Center, 75 Virginia Beach Drive, Miami FL 33149

June 2022

1 Introduction

This document outlines the data and methodologies used to estimate commercial and recreational length and age compositions for the SEDAR68 Gulf of Mexico Scamp and Yellowmouth Grouper Operational Assessment. Because fishery-dependent sampling is typically opportunistic, sampled lengths may not be representative of the true size composition of landings. To account for this potential bias, length samples were weighted by their associated landings at the finest spatial and temporal scale available within fleets without losing data due to sample size criteria. Nominal age compositions were used in the Research Track Assessment Model and were provided for all commercial and recreational fleets. Conditional age-at-length (CAAL) contains more detailed information on the relationship between size and age while avoiding double use of fish (Thorson et al. 2017, Methot et al. 2020). CAAL was attempted in the SEDAR68 Research Track but did not fit well, where it was suspected this could have been due to the proxy ages used as placeholders 2003-2012 (SEDAR 2020). These issues were discussed in a Topical Working Group (TWG) where it was recommended to attempt CAAL and fall back on nominal age compositions, which were used in SEDAR68 Research Track. Both inputs are described and provided here.

2 Data Description

SEDAR68 assesses all Gulf of Mexico Scamp and Yellowmouth Grouper in federal waters extending northward from the Texas/Mexico border and eastward to the Florida Keys US1 boundary. Length data from the commercial and recreational fisheries of the Gulf of Mexico are collected by multiple state and federal agencies. Commercial data sources utilized to generate length compositions include the Trip Interview Program (TIP, 1983-2020) and Accumulated Landings Systems (ALS, 1962-2020). Recreational sources utilized were the Marine Recreational Information Program (MRIP, 1981-2020), Texas Parks and Wildlife Department's Marine Sport-Harvest Monitoring Program (TPWD, 1981-2020), and the Southeast Region Headboat Survey (SRHS, 1979-2020). The Gulf States Marine Fisheries Commission's Fisheries Information Network (GulfFIN) provided both commercial and recreational length and age data from multiple state sources (2004-2020). The majority of the age data were processed by and received from the SEFSC's Panama City Laboratory (1977-2020). Commercial fleets were

defined by vertical line (VL) and longline (LL) gears, and recreational fleets were defined by headboat (HB) and aggregated charter/private (CP) modes. These data were aggregated using length bins of 3 centimeters (cm).

Natural total length (TL_{nat}), maximum total length (TL_{max}), and standard length (SL) were converted to fork length (FL) using the following conversion equations estimated in the SEDAR68 Research Track Data Workshop:

$$FL = 1.774 + 0.89 * TL_{nat}$$
$$FL = 2.301 + 0.87 * TL_{max}$$
$$FL = 1.953 + 1.12 * SL$$

Since 1999, the recreational and commercial fisheries have had a minimum size limit of 16" (41cm) TL in Gulf federal waters. In 1990, Florida had implemented a state size limit of 20" (51cm) TL, but it was validated both anecdotally and analytically to have unidentifiable impacts on the length composition of landings, which were believed to have been primarily caught in federal waters (Stevens 2021, SEDAR68-AW-01). Length samples were processed identically to the SEDAR68 Research Track, with the exception of incorporating an 84cm FL length 'plus group' per the recommendation of the TWG. A plus group was added because there were very sparse data above this threshold, and 84cm FL was the largest fish observed in fishery independent surveys.

3 Commercial Length Compositions

3.1 Samples of Commercial Landings

Length samples of commercial landings were obtained from the TIP database maintained by the NMFS Southeast Fisheries Science Center (SEFSC) and were filtered to remove biases that include samples from pooled trips. These were supplemented with commercial lengths submitted by state agencies through GulfFIN. Due to improved extraction procedures at SEFSC, additional TIP samples were provided that did not have fishing area from either landings or effort records. The years primarily affected were 1984-1987 and 1991-1996 (Table 1; Stevens 2021, SEDAR68-AW-01 Table 1).

3.2 Compositions of Commercial Landings

Because fishery-dependent sampling is typically opportunistic, sampled lengths may not be representative of the true landings composition. Possible sampling bias in the collection of commercial length samples was removed by weighting the length compositions with the associated landings on the finest spatial and temporal scale available without losing data. VL and LL data were aggregated into three major subregions in the Gulf of Mexico based on the NMFS areas fished shown in Figure 1: SouthEastern (SE: areas 1-5), NorthEastern (NE: areas 6-12), and Western (W: areas 13-21). Within each commercial fleet, subregional-specific nominal length compositions were estimating using length bins of 3 cm, where for each year i, length bin j, and subregion r

$$LC_{i,j,r} = \frac{n_{i,j,r}}{n_{i,r}}$$

$n_{i,j,r}$ is the number of samples in year i, subregion r, and lower inclusive length bin j; $n_{i,r}$ is the number of samples in year i and subregion r; and $LC_{i,j,r}$ is the proportion of the total number of sampled fish in each year i and subregion r within each lower inclusive length bin j. A minimum sample size threshold was applied annually within each strata, $LC_{i,r}$, where these were dropped and excluded from further analyses if $n_{i,r} < 30$ (Table 1). Next, the remaining subregional-specific length compositions were weighted based on the relative annual distribution of the ALS landings estimates among subregions (Table 2). These proportions of annual landings from each subregion, $p_{i,r}$, were used to scale the subregional length compositions, $LC_{i,j,r}$, which were then summed across subregions r

$$LC_{i,j} = \sum_{r} \left(LC_{i,j,r} * p_{i,r} \right)$$

resulting in the final weighted estimates of commercial landings length compositions, $LC_{i,j}$. This procedure would downweight, for example, any instances where 60% of the length samples come from a subregion that only accounts for 20% of the landings. Nominal compositions were supplied for 1984-1985 since Scamp and Yellowmouth Grouper landings were included in aggregate Grouper landings during these years and were insufficient for the weighting procedure (Figure 2 and Figure 3).

4 Recreational Length Compositions

4.1 Samples of Recreational Landings

The recreational sampling program, MRIP, has been redesigned over the last decade to remove sources of potential bias from the sampling process. Included in this new design are imputed lengths and an assigned weighting factor, which accounts for bias associated with nonrepresentative sampling of landings. More detailed information on the MRIP survey can be found in Papacostas & Foster (2018) and more detailed information on MRIP Gulf of Mexico Scamp and Yellowmouth Grouper data can be found in Matter & Nuttall (2020).

4.2 Compositions of Recreational Landings

The recreational fleets in SEDAR68 were headboat and charter/private. The private fishing mode had insufficient samples to generate length compositions alone and was aggregated with charter mode because of their similar length distributions and collection through the same survey (MRIP). CP data were aggregated into three major subregions in the Gulf of Mexico based on county landed defined east to west: SouthEastern (SE: FL Collier-FL Levy), NorthEastern (NE: FL Dixie-MS), and Western (W: LA-TX). These regions approximately match the regions defined in the commercial fleets. HB data were aggregated into two major subregions in the Gulf of Mexico based on state landed: Eastern (E: FL-MS) and Western (W: LA-TX). Spatial weighting was investigated for all recreational fleets, but there were insufficient samples in most strata to allow for this procedure (Table 3). Within each recreational fleet, nominal length compositions, $LC_{i,j}$, were estimated for each year i and length bin j

$$LC_{i,j} = \frac{m_{i,j}}{m_i}$$

where the sum of all fish within year i and lower inclusive length bin j ($m_{i,j}$) were divided by the sum of all fish within each fleet annually (m_i). A minimum sample size threshold was applied where length compositions LC_i were dropped and excluded from further analyses if $m_i < 30$. This resulted in the deletion of CP: 1981, 1983:1992, 1994:1996 and HB: 1981:1985, 2001, 2020 (Figure 4 and Figure 5).

5 Commercial and Recreational Age Compositions

5.1 Age Samples

Otolith processing for scamp was compromised for data collected 2003-2012. A proxy age was estimated using otolith weights for as much of these data as possible to generate as a placeholder for SEDAR68 Research Track, where methodology is detailed in the SEDAR (2020) Data Workshop Report. The remaining otoliths during this time period were processed, but loss of samples resulted in spatial and temporal gaps in the final age data, particularly in the recreational data and commercial VL data (Table 4).

5.2 Age Compositions

Age compositions were estimated for each commercial (VL, LL) and recreational (CP, HB) fleet. The process outlined below was applied to each fleet individually, and any year with less than 10 age samples was dropped. Nominal age compositions of landings were estimated using the following equation for each year i and age bin k.

$$NAC_{i,k} = \frac{a_{i,k}}{a_i}$$

The recreational age compositions were completed at this phase (Figure 6 and Figure 7). Commercial nominal age compositions were also estimated (Figure 8 and Figure 9).

5.3 Commercial Conditional Age-at-Length

Commercial age samples were a subset of the length samples. Within each commercial fleet (VL, LL) conditional age-at-length was estimated where for each year i, length bin j, and age class k

$$CAAL_{i,j,k} = \frac{a_{i,j,k}}{a_{i,j}}$$

$a_{i,j,k}$ is the number of age samples in year i, lower inclusive length bin j, and age class k; $a_{i,j}$ is the number of age samples in year i and lower inclusive length bin j; and $CAAL_{i,j,k}$ is the proportion of fish samples in year i and length bin j within age class k (Figure 10 and Figure 11).

Fleet-specific mean length-at-age and associated sample sizes were also provided to aide in model diagnostics for commercial and recreational fleets. Mean length-at-age, $MLAA_{i,k}$, was estimated as the sum of all lengths $L_{i,k}$ divided by the associated sample sizes $a_{i,k}$ within each year i and age class k.

$$MLAA_{i,k} = \frac{\sum L_{i,k}}{a_{i,k}}$$

6 References

Chih, C.P. 2009. Evaluation of sampling efficiency of three otolith sampling methods for king mackerel fisheries. *Transactions of the American Fisheries Society 138: 990-999.*

Matter, V.M. and M.A. Nuttall. 2020. Recreational Survey data for Scamp and Yellowmouth Grouper in the Gulf of Mexico. SEDAR68-DW-09. SEDAR, North Charleston, SC. 27 pp.

Papacostas, K.J and Foster, J. 2018. Survey Design and Statistical Methods for Estimation of Recreational Fisheries Catch and Effort. Retrieved from National Marine Fisheries Service's Marine Recreational Information Program: *https://www.fisheries.noaa.gov/resource/document/survey-design-and-statistical-methods-estimation-recreational-fisheries-catch-and*.

SEDAR. 2015. SEDAR Procedural Workshop 7: Data Best Practices. SEDAR, North Charleston SC. 151 pp. available online at: *http://sedarweb.org/pw-07*.

SEDAR. 2020. SEDAR 68 Gulf of Mexico Scamp: Data Workshop Report. Age and Growth Data. SEDAR, North Charleston SC. pp 22-28. available online at: *http://sedarweb.org/docs/page/Gulf_DW_report_final_watermark.pdf*.

Stevens, Molly H. 2021. Gulf of Mexico Scamp (*Mycteroperca phenax*) and Yellowmouth Grouper (*Mycteroperca interstitialis*) Commercial and Recreational Length and Age Compositions. SEDAR68-AW-01. SEDAR, North Charleston, SC. 24 pp.

7 Tables

Table 1: Annual number of commercial vertical line (VL) and longline (LL) length samples by subregion. The length compositions resulting from these samples were weighted with landings where there were more than 30 samples in each strata or dropped from further analyses if n<30.

Year	SE_VL	NE_VL	W_VL	SE_LL	NE_LL	W_LL
1984	545	143	135	504	28	9
1985	669	120	259	936	70	127
1986	385	32	164	1,611	31	17
1987	517	1	68	748	0	10
1988	226	27	27	260	98	18
1989	34	11	71	73	1	9
1990	126	220	338	392	188	14
1991	420	301	860	441	212	79
1992	327	173	785	700	78	58
1993	328	1,027	468	613	85	71
1994	312	862	461	365	107	0
1995	539	1,330	296	623	197	10
1996	552	1,373	139	351	222	7
1997	240	1,485	275	767	396	0
1998	1,003	853	62	2,842	456	0
1999	1,123	1,095	96	3,027	259	26
2000	355	437	20	1,643	457	36
2001	529	581	56	1,681	331	0
2002	581	562	71	1,972	350	16
2003	286	561	148	2,574	492	73
2004	129	617	34	2,222	278	8
2005	237	242	113	1,873	147	13
2006	274	356	123	1,043	180	33
2007	73	375	293	1,052	183	43
2008	75	408	285	1,184	536	91
2009	188	737	153	1,057	146	36
2010	346	316	179	924	307	26
2011	315	633	258	843	315	4
2012	535	1,159	1,115	704	144	148
2013	375	1,227	904	556	235	251
2014	323	796	728	595	113	0
2015	242	961	774	728	88	15
2016	311	1,259	1,613	948	187	6
2017	331	662	1,001	667	334	67
2018	285	820	725	691	266	63
2019	218	1,090	891	438	260	119
2020	145	462	220	96	85	24

Table 2: Annual relative distribution of commercial vertical line (VL) and longline (LL) ALS landings by subregion, where each value is the proportion of landings $p_{i,r}$ from year i and subregion r. The majority of VL samples were caught in the NE, while the majority of LL samples were caught in the SE. These proportions were used to re-scale length compositions where there were more than 30 samples in each strata.

Year	SE_VL	NE_VL	NW_VL	SE_LL	NE_LL	NW_LL
1986	0.191	0.570	0.239	0.420	0.276	0.304
1987	0.208	0.572	0.220	0.504	0.357	0.139
1988	0.188	0.431	0.381	0.432	0.393	0.174
1989	0.149	0.547	0.303	0.383	0.405	0.211
1990	0.254	0.700	0.045	0.396	0.384	0.220
1991	0.449	0.494	0.057	0.724	0.194	0.082
1992	0.524	0.381	0.095	0.809	0.127	0.064
1993	0.441	0.500	0.059	0.783	0.212	0.005
1994	0.361	0.591	0.048	0.770	0.230	0.000
1995	0.246	0.741	0.013	0.567	0.433	0.000
1996	0.247	0.725	0.028	0.620	0.380	0.000
1997	0.285	0.674	0.041	0.553	0.447	0.000
1998	0.370	0.586	0.044	0.741	0.255	0.004
1999	0.280	0.695	0.025	0.637	0.338	0.025
2000	0.128	0.430	0.442	0.621	0.281	0.098
2001	0.190	0.563	0.247	0.683	0.303	0.015
2002	0.195	0.490	0.314	0.667	0.299	0.034
2003	0.176	0.538	0.286	0.653	0.288	0.058
2004	0.168	0.499	0.333	0.736	0.241	0.023
2005	0.160	0.546	0.295	0.699	0.291	0.010
2006	0.207	0.543	0.250	0.744	0.236	0.021
2007	0.124	0.538	0.338	0.756	0.214	0.030
2008	0.088	0.597	0.316	0.560	0.380	0.060
2009	0.101	0.663	0.236	0.663	0.264	0.074
2010	0.235	0.507	0.258	0.791	0.205	0.003
2011	0.241	0.515	0.245	0.831	0.162	0.006
2012	0.238	0.636	0.126	0.844	0.151	0.006
2013	0.232	0.639	0.128	0.805	0.192	0.003
2014	0.208	0.546	0.246	0.905	0.089	0.006
2015	0.249	0.528	0.223	0.799	0.169	0.032
2016	0.224	0.556	0.220	0.796	0.178	0.027
2017	0.247	0.471	0.282	0.770	0.166	0.064
2018	0.272	0.519	0.209	0.802	0.184	0.013
2019	0.264	0.462	0.273	0.697	0.259	0.044
2020	0.288	0.438	0.273	0.786	0.162	0.052

Table 3: Annual number of Scamp recreational charter/private (CP) and headboat (HB) length samples within defined subregions in the Gulf. Insufficient samples within subregions led to the generation of nominal compositions for all recreational fleets. Lower sample sizes in 2020 were due to reduced sampling effort during the pandemic.

Year	SE_CP	NE_CP	W_CP	E_HB	W_HB
1981	1	4		16	
1982	4	28		6	
1983		1	1	13	
1984		1		10	
1985			7	7	
1986	4	7	4	98	78
1987	5	10	5	98	48
1988	5	7	1	72	15
1989	2	2		185	19
1990		3	1	99	24
1991	1	3	4	43	6
1992		24	3	36	27
1993	4	29	1	38	10
1994		4	2	44	33
1995		2	3	40	28
1996		6	1	40	13
1997	3	33	5	19	12
1998		137	1	25	12
1999	10	214	4	26	12
2000	6	86	11	33	2
2001	1	216	2	21	6
2002	1	241	6	40	4
2003	21	268	3	154	11
2004	38	386	7	41	5
2005	8	260	14	22	6
2006	5	168	27	41	10
2007	5	133	7	58	5
2008	6	118	11	38	3
2009	4	70	4	58	5
2010	16	59	4	108	4
2011		239	8	59	1
2012	4	113	15	99	44
2013	8	65	3	37	48
2014	11	103		17	51
2015	10	110	1	35	69
2016	2	90	3	17	66
2017	5	34	1	26	48
2018	8	34	10	37	71
2019	8	28	1	122	28
2020	2	44	3	3	3

Table 4: Annual number of age samples for commercial vertical line (VL) and longline (LL) fleets, and recreational charter/private (CP) and headboat (HB) fleets used to estimate final age compositions (a_i<10 fish were excluded). Data are shown as number of fish (number of trips), where trip identifying factors were likely unreliable 1977-1981.

Year	VL	LL	CP	HB
1977	20 (1)	-- (--)	-- (--)	-- (--)
1978	14 (1)	-- (--)	-- (--)	-- (--)
1979	149 (1)	-- (--)	-- (--)	10 (1)
1980	94 (1)	-- (--)	-- (--)	17 (1)
1981	102 (1)	-- (--)	12 (1)	-- (--)
1986	-- (--)	-- (--)	-- (--)	34 (27)
1988	-- (--)	-- (--)	-- (--)	11 (9)
1989	-- (--)	-- (--)	-- (--)	19 (12)
1991	195 (29)	24 (2)	-- (--)	18 (15)
1992	57 (19)	48 (21)	-- (--)	51 (36)
1993	264 (70)	39 (9)	-- (--)	30 (23)
1994	109 (33)	-- (--)	59 (22)	52 (37)
1995	109 (33)	-- (--)	51 (16)	32 (26)
1996	64 (19)	21 (6)	117 (35)	38 (26)
1997	10 (4)	27 (5)	27 (10)	21 (13)
1998	31 (8)	34 (7)	46 (14)	-- (--)
1999	25 (7)	70 (26)	47 (9)	-- (--)
2000	52 (10)	119 (27)	-- (--)	-- (--)
2001	411 (76)	679 (106)	-- (--)	-- (--)
2002	330 (69)	1243 (137)	53 (12)	24 (4)
2003	-- (--)	462 (157)	-- (--)	-- (--)
2004	-- (--)	475 (119)	-- (--)	-- (--)
2005	10 (7)	455 (142)	-- (--)	-- (--)
2006	-- (--)	510 (144)	-- (--)	-- (--)
2007	-- (--)	468 (125)	-- (--)	-- (--)
2008	-- (--)	456 (144)	-- (--)	-- (--)
2009	112 (46)	332 (77)	-- (--)	18 (4)
2010	148 (51)	333 (56)	-- (--)	-- (--)
2011	314 (122)	443 (104)	26 (19)	-- (--)
2012	674 (255)	237 (80)	-- (--)	-- (--)
2013	495 (231)	637 (227)	109 (14)	64 (35)
2014	513 (204)	536 (114)	132 (22)	46 (28)
2015	532 (228)	497 (117)	165 (89)	69 (50)
2016	620 (196)	520 (125)	200 (67)	65 (33)
2017	642 (185)	544 (133)	76 (34)	51 (30)
2018	480 (195)	517 (123)	61 (40)	37 (23)
2019	343 (185)	446 (104)	82 (45)	82 (51)
2020	626 (181)	173 (38)	27 (12)	-- (--)

8 Figures

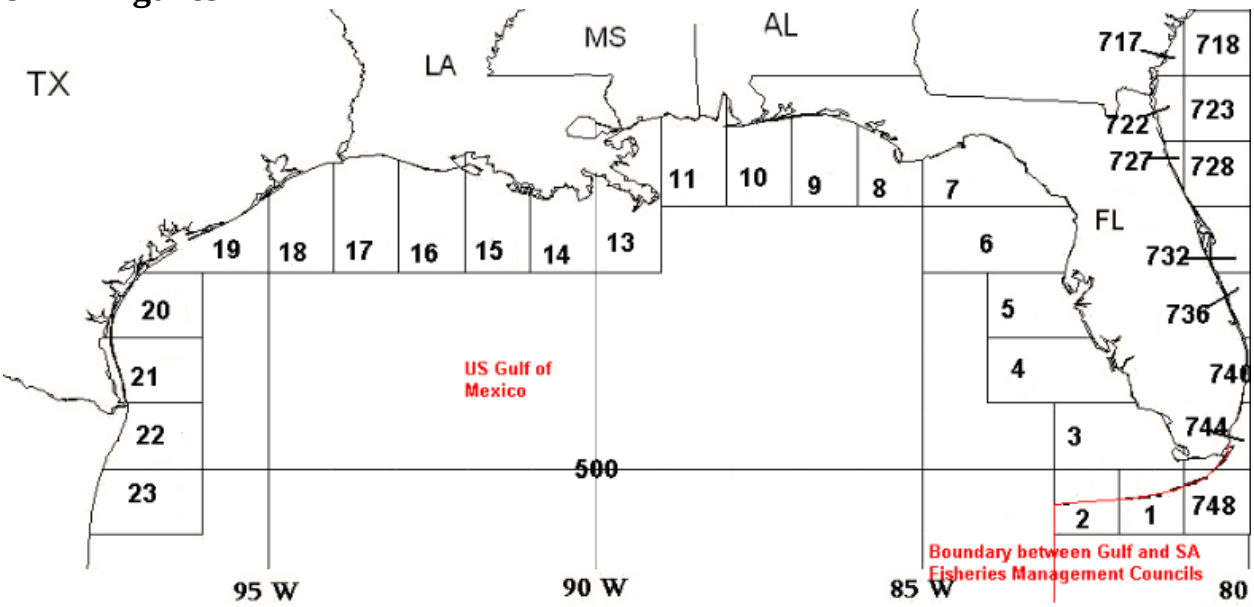

Figure 1: NMFS commercial fishing areas in the Gulf of Mexico used to define spatial strata in the weighting procedure.

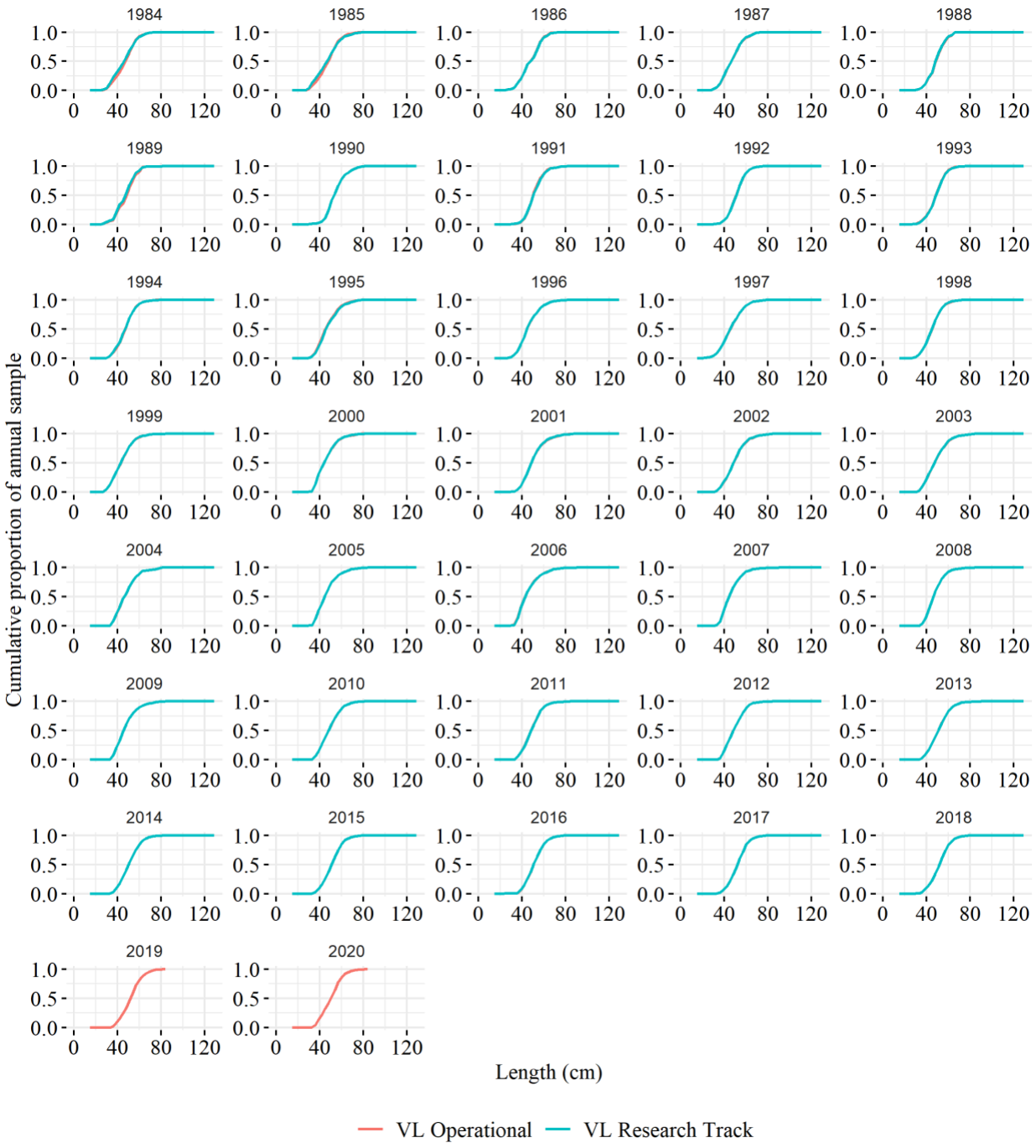

Figure 2: Annual Scamp commercial VL cumulative length distributions.

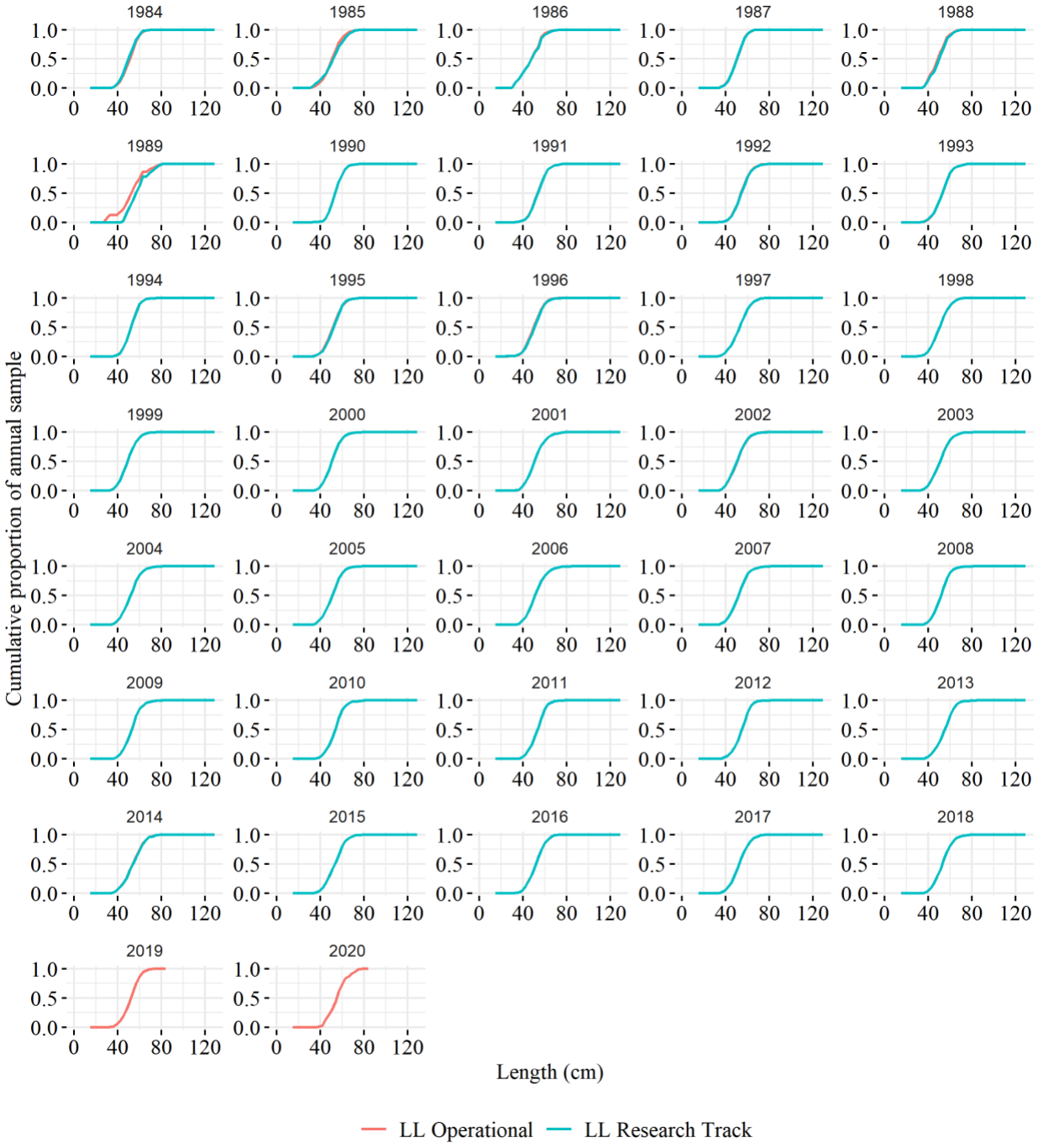

Figure 3: Annual Scamp commercial LL cumulative length distributions.

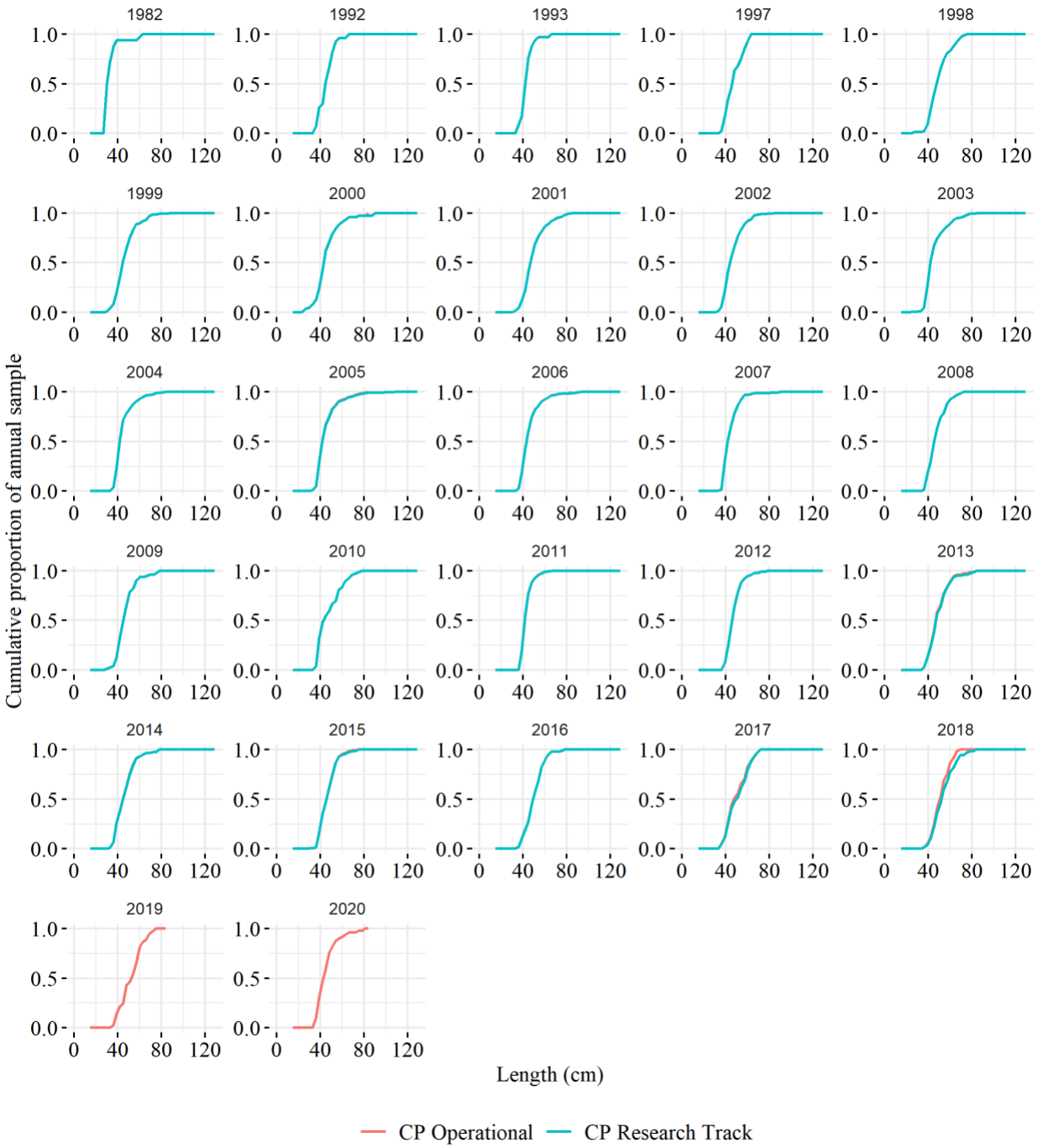

Figure 4: Annual Scamp recreational charter/private cumulative length distributions.

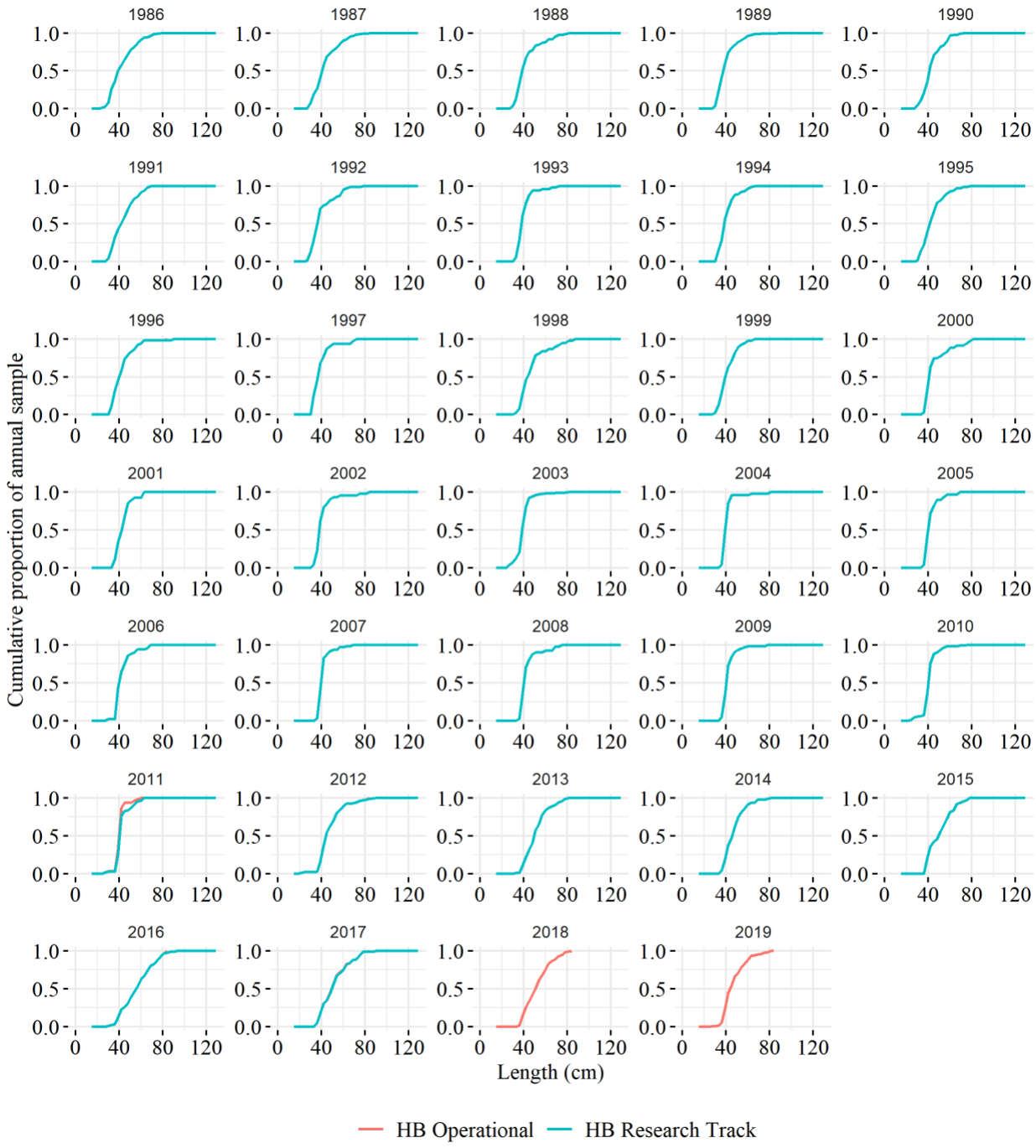

Figure 5: Annual Scamp recreational headboat cumulative length distributions.

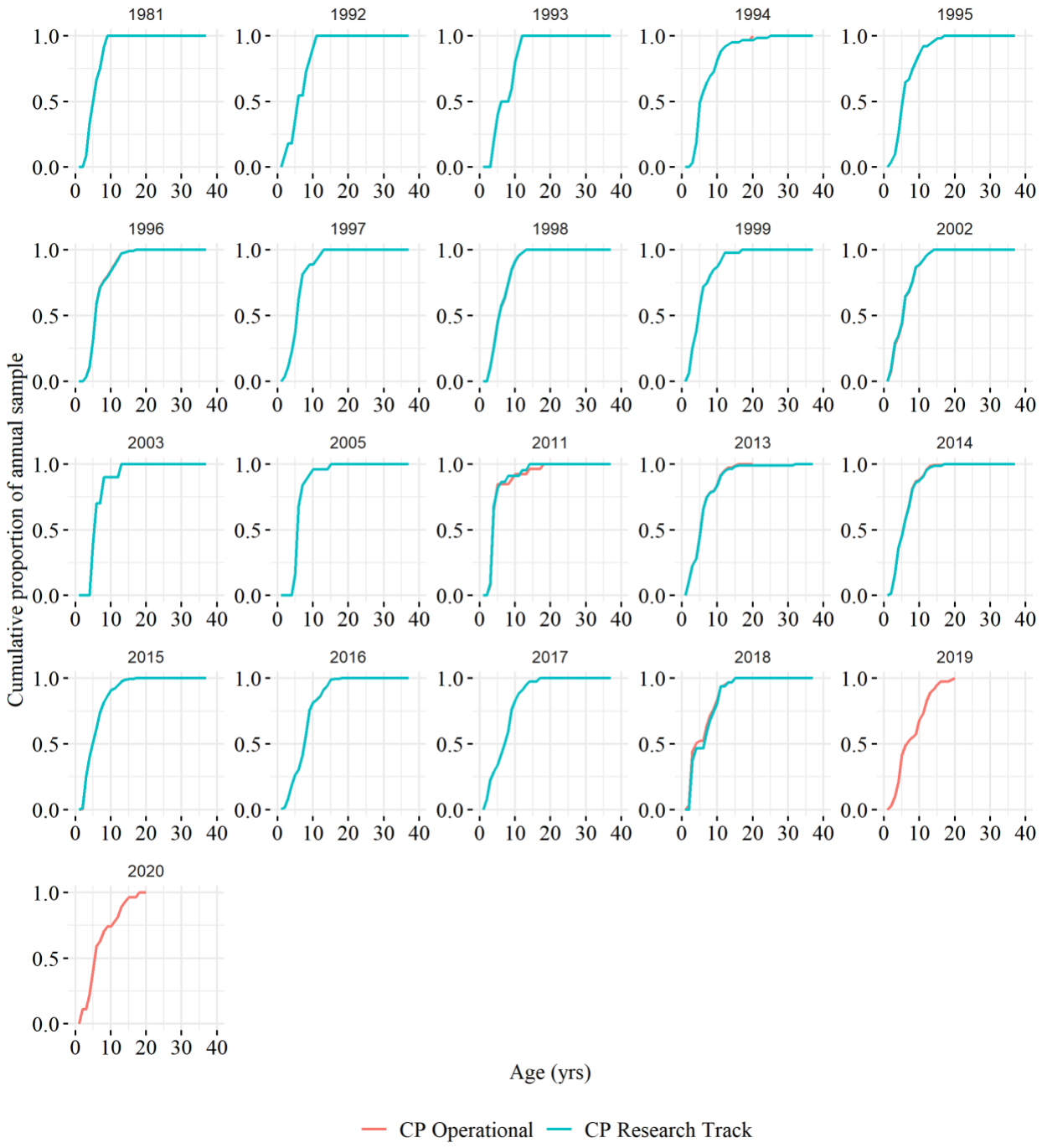

Figure 6: Annual Scamp recreational charter/private cumulative age distributions.

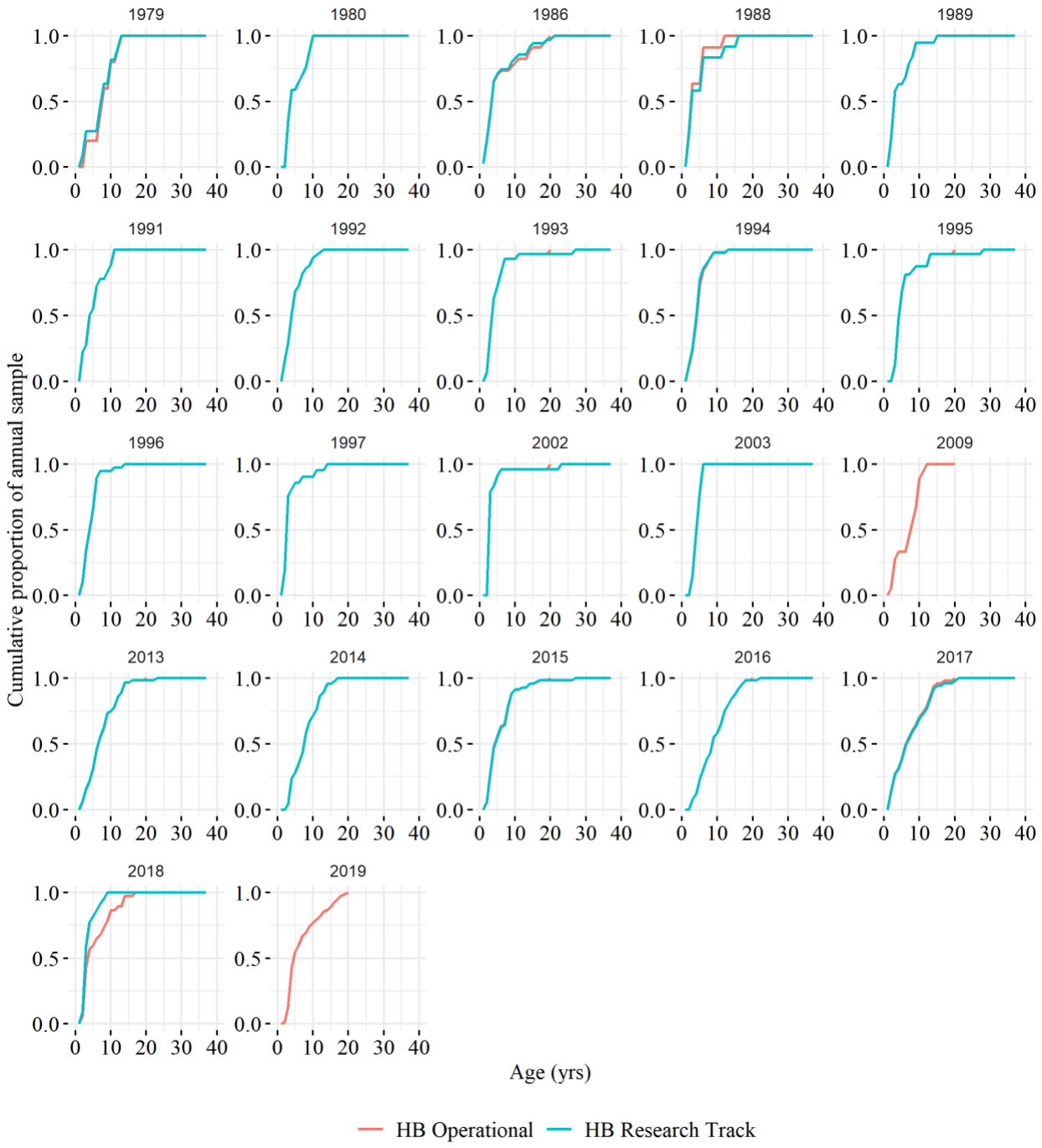

Figure 7: Annual Scamp recreational headboat cumulative age distributions.

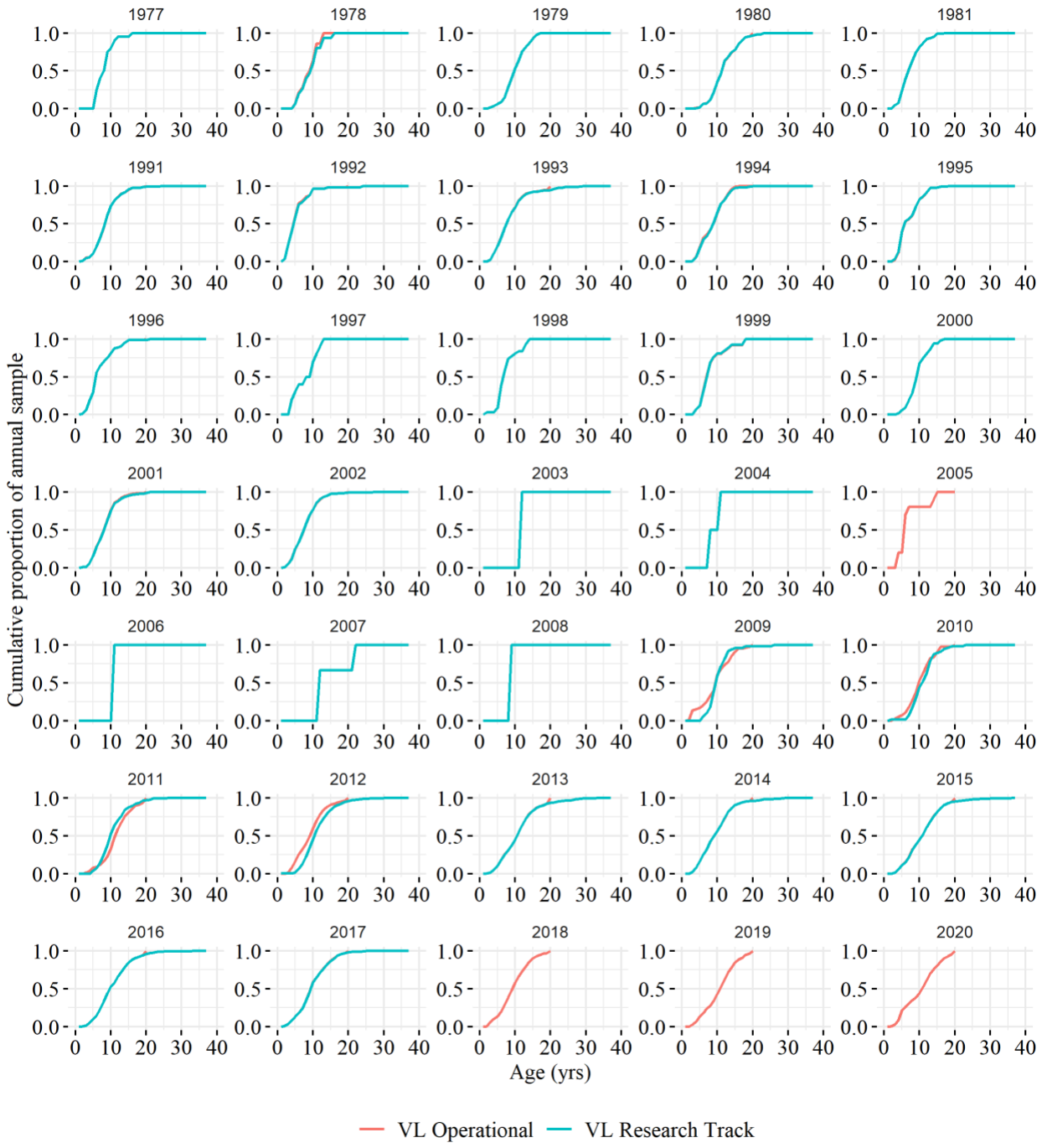

Figure 8: Annual Scamp commercial HL cumulative age distributions.

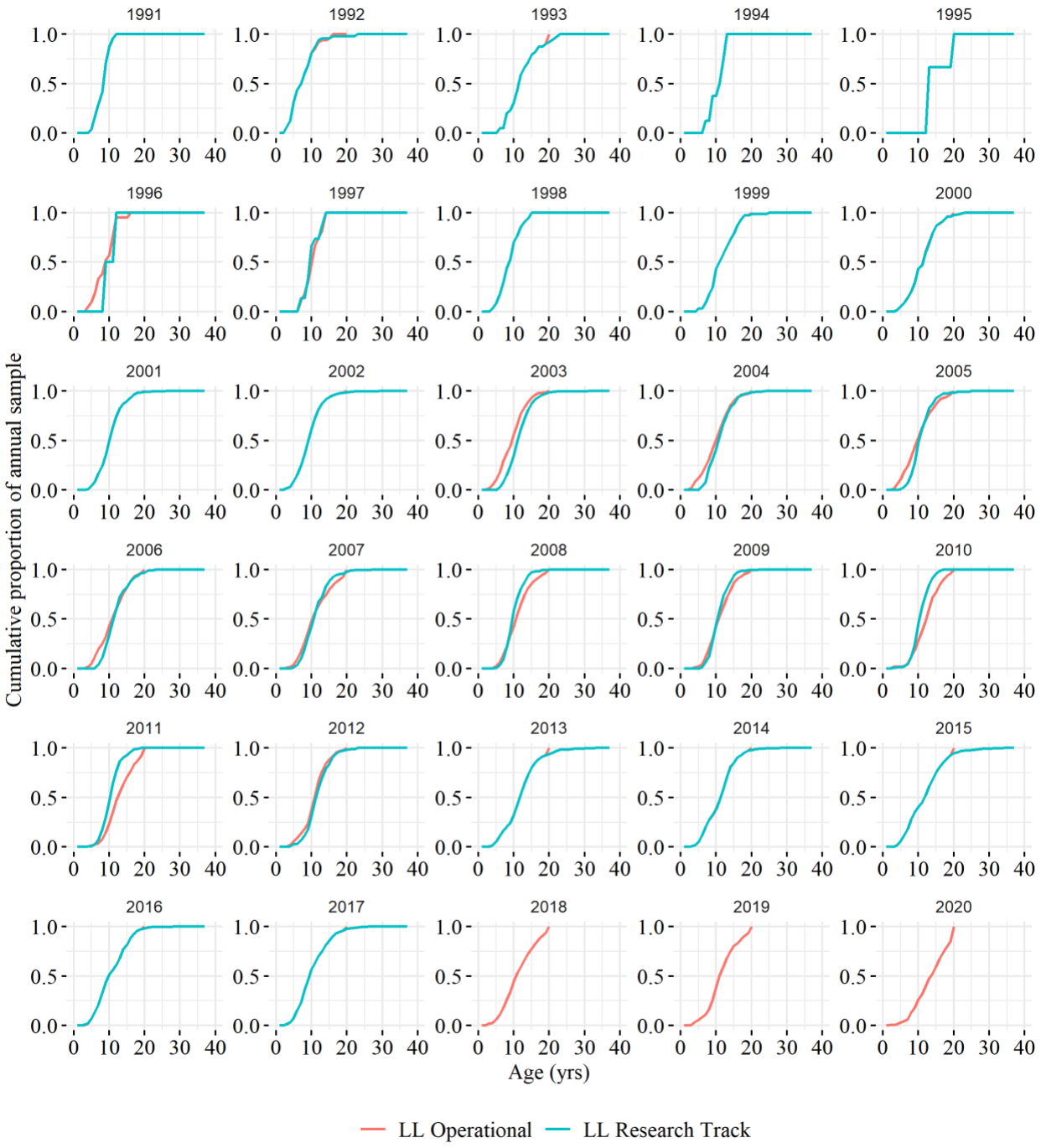

Figure 9: Annual Scamp commercial LL cumulative age distributions.

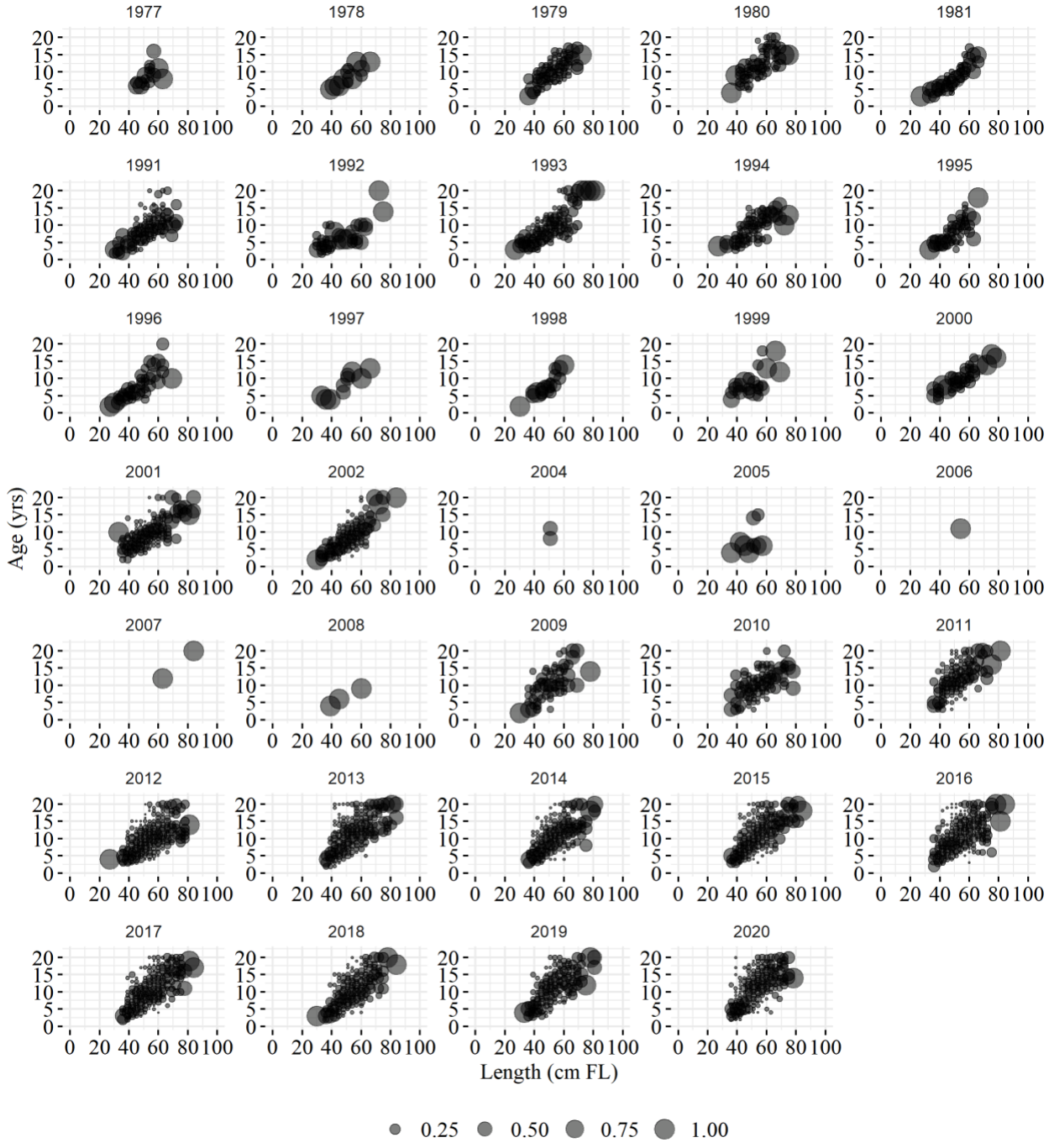

Figure 10: Annual Scamp commercial VL conditional age-at-length estimates.

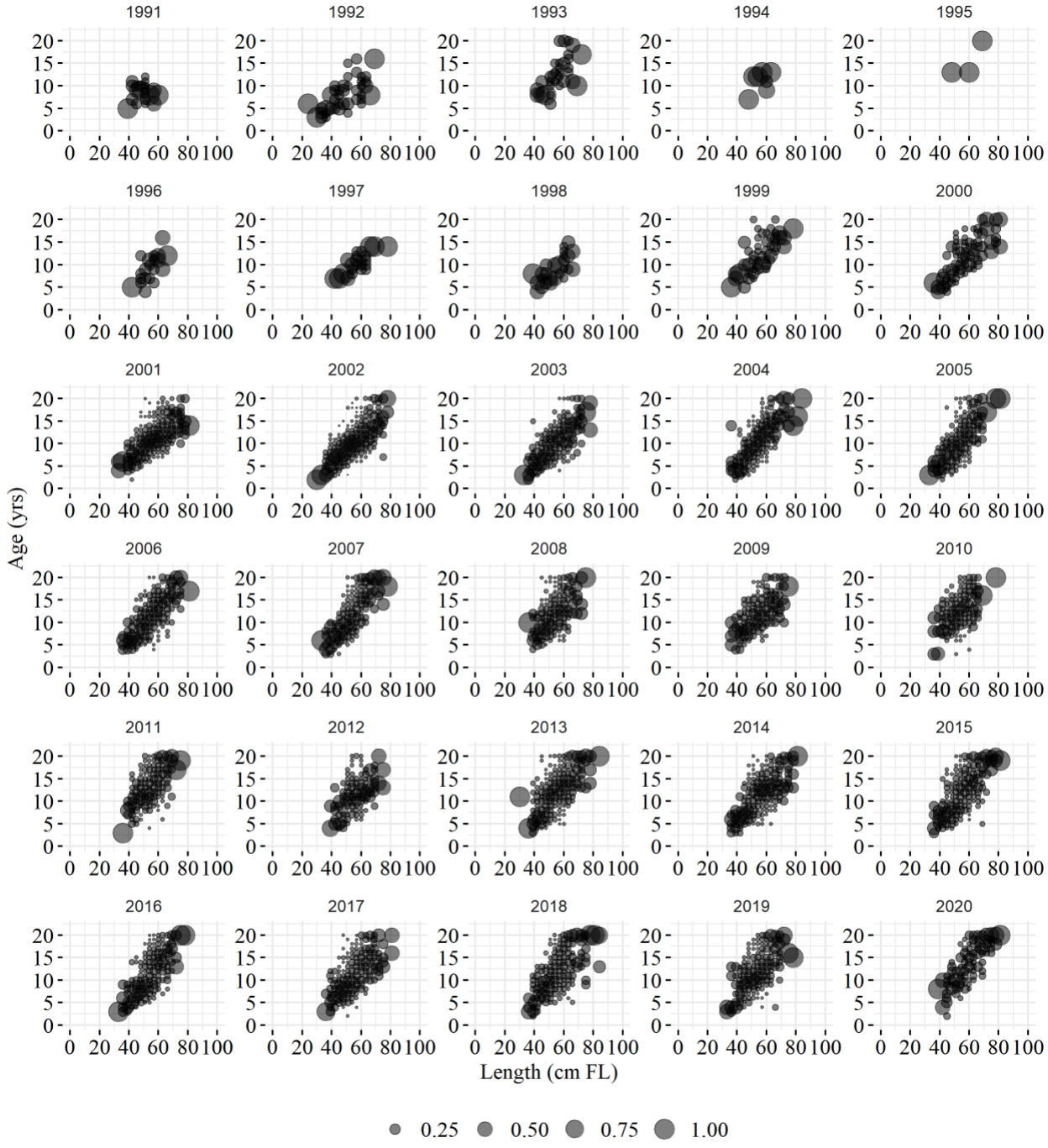

Figure 11: Annual Scamp commercial LL conditional age-at-length estimates.