Length and age information for Gulf of Mexico Red Snapper, *Lutjanus campechanus*, collected in association with fishery-dependent projects

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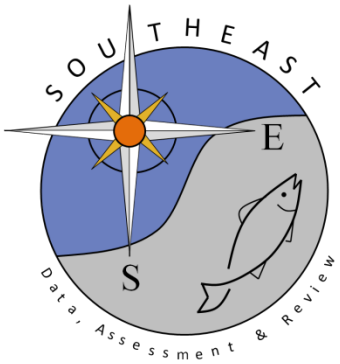
SEDAR98-DW-11

18 November 2024



Please cite this document as:

McGirl, Maria, Jessica Carroll, and Bridget Cermak. 2024. Length and age information for Gulf of Mexico Red Snapper, *Lutjanus campechanus*, collected in association with fishery-dependent projects. SEDAR98-DW-11. SEDAR, North Charleston, SC. 26 pp.

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Introduction

The Fishery-Dependent Monitoring subsection (FDM) of the Florida Fish and Wildlife Conservation Commission's Fish and Wildlife Research Institute (FWRI) monitors commercial and recreational fishing in marine environments along the Florida coast in association with several fishery-dependent research and monitoring projects. FDM administers three federal surveys: the Marine Recreational Information Program (MRIP) and The Southeast Region Headboat Survey (SRHS) for the recreational sector, and the Trip Interview Program (TIP) for the commercial sector. Additionally, FDM conducts several unique surveys of recreational anglers that allow for the collection of supplemental biological data. Each fishery-dependent research or monitoring project that contributed age and length data to the Life History Group is detailed below. During these surveys, priority was given to collecting the left otolith when removing both otoliths was not feasible, to ensure the prompt return of fish to anglers.

Commercial Fishery Data

Trip Interview Program (TIP)

The commercial fishery is sampled through the NOAA Trip Interview Program (TIP), in which Florida actively participates. The TIP program primarily focuses on collecting random size-frequency data and biological samples from commercially harvested marine species. Samplers gather information from fish offloaded from commercial fishing vessels, including fork length and natural total length (measured in millimeters). Weight measurements are recorded as whole weight or gutted weight (measured in kilograms), depending on the fish's condition upon landing. To

preserve fillet integrity, a single otolith is typically extracted from beneath the operculum. Length and weight data are submitted as part of a unified federal dataset.

Recreational Fishery Data

At-Sea Observer Sampling of For-Hire Fisheries

In 2005, at-sea observer survey coverage started on headboats operating from the Gulf coast of Florida from the panhandle through the Florida Keys. The at-sea headboat survey was funded by the Gulf Fisheries Information Network (GulfFIN) continuously through 2008 and was discontinued in 2009. In June of 2009, the state of Florida secured alternative funds to resume at-sea observer coverage in the northwest panhandle and central peninsula, expanding to include charter boats in these regions. Sampling coverage in the Florida Keys was reinstated in 2010 for both headboats and charter vessels and has continued to the present, with the exception of a hiatus in 2014. During this time, representative at-sea observer data was only collected from charter vessels in the Florida Keys.

Data collected from headboats and charter vessels in northwest and southwest Florida represented only a small subset of the for-hire fleet and may not be indicative of the entire fleet for that year. For the survey, both headboats and charter boats were randomly selected on a weekly basis throughout the year. Biological data was collected from harvested Red Snapper dockside after observed trips, including midline length (mm), whole weight (kg), and whenever possible, a left otolith was extracted from sampled fish. Measurements and otoliths collected from observer coverage represent supplemental sampling separate of the dockside sampling conducted for the Southeast Regional Headboat Survey (SRHS).

State Reef Fish Survey of Recreational Fishers

The State Reef Fish Survey (SRFS) has run continuously on the Florida Gulf coast since May 2015 when it was previously named Gulf Reef Fish Survey. Expanding state-wide in 2020, it was renamed to SRFS. This survey is a directed effort to collect data from offshore private recreational anglers who target reef fish species. Anglers wishing to harvest certain reef fish species, including Red Snapper, on Florida's coast are required to have a State Reef Fish Angler designation on their fishing license. The State Reef Fish Survey is composed of two survey components: a mail-in survey and a dockside intercept survey. The mail-in survey is sent to randomly selected anglers with the State Reef Fish Angler designation to collect data on

angler effort. The dockside intercept survey stations biologists at sampling sites to interview anglers on angler catches and fishing practices. Interview assignments are drawn from a subset of sampling sites known to have offshore fishing activity to intercept fishers that target reef fish. Data collected during dockside assignments include information regarding fishing depths, distances from shore while fishing for offshore species, number of harvested fish, and self-reported estimates of fish released during the fishing day. A subset of harvested fish are measured (fork length in mm) and weighed (in kilograms) during the survey.

Opportunistic Biological Sampling

Between 2000 and 2018 opportunistic biological sampling was conducted at angler intercept sites along the Gulf coast of Florida, supported by a limited amount of funding from GulfFIN. Sampling assignments were conducted opportunistically to maximize the number of biological samples collected, primarily from busy charter landing sites. While the sampling sites were not selected using a randomized methodology, the fish sampled were not sampled in a biased manner. Biological sampling of intercepted fish included collection of length measurements (midline length in mm), whole weight (in kg) and collection of aging structures (otoliths or spines).

Representative Biological Sampling Program

The Representative Biological (RepBio) sampling program conducts supplemental biological sampling along the Gulf coast of the Florida peninsula (Escambia to Collier County) and the Florida Keys (Monroe). The survey began a pilot phase in 2018 and was fully implemented by 2019 along the entire Gulf coast of Florida. A randomized draw process is used to ensure representative collection of biological samples, along with a species list that prioritizes collection of biological samples from data-poor, state-managed, and federally managed species when encountered. Interviews of recreational anglers are conducted at fishing access points identified via the MRIP Site Register and assigned via a weekly draw by sub-region. Biological sampling of harvested species includes collection of length measurements (midline length in mm), whole weight (in kg) and collection of aging structures (otoliths or spines). From January 1st, 2024, to August 1st, 2024, RepBio experienced a funding gap. No biological samples were collected during this period.

Ageing Protocols

Sagittal otoliths were removed from the head, cleaned, dried, and stored in vials. The left otolith was processed for age determination unless it was broken through the core, in which case the right otolith was processed. The core of the otolith was marked with pencil and the whole otolith was mounted on card stock using hot glue. Otoliths were processed on a Buehler Isomet low speed saw that was equipped with four equally spaced diamond wafering blades. With this multi-blade technique, one transverse cut yields three ~400µm thick sections that encompass both the core and the entire region surrounding the core (VanderKooy et al., 2020). After processing, sections were mounted on glass slides with Flo-texx, a chemical mounting medium.

Sectioned otoliths were examined on a stereo microscope using either reflected or transmitted light, which was at the reader's discretion. Each otolith was examined with at least two blind reads. These reads were conducted either by two readers working independently, or by a single reader examining the otolith two separate times. When age estimates did not agree between reads, a third read was conducted to resolve the discrepancy. Ageing was conducted on the dorsal lobe of the otolith along an axis near the sulcal groove from the core to the edge.

Annual ages were calculated using annulus count (number of opaque zones), degree of marginal completion, average date of otolith increment deposition, and date of capture. This traditional method is based on a calendar year instead of time since spawning (Jerald, 1983; VanderKooy et al., 2020). Previous studies have found that Red Snapper in the Gulf of Mexico complete annulus formation by late spring to early summer (Wilson and Nieland, 2001; Fischer et al., 2004; Allman et al., 2005). Using these criteria, age was advanced by one year if a large translucent zone was visible on the margin and the capture date was between January 1 and June 30. For all fish collected after June 30, age was assigned to be annulus count, since opaque zone formation is typically complete (Allman et al., 2005). Calendar ages were converted to fractional, or monthly biological, ages by adding or subtracting the fraction of a year calculated between the assumed July 1 birth date and month of capture.

The total number of new otoliths aged from FWRI sampling along the Gulf Coast of Florida for SEDAR98 was 18,325. Prior to ageing these samples, each ager read through an in-house reference set of Red Snapper otoliths representing a range of age classes, seasons, sexes and collection locations (Campana, 2001) to calibrate ageing technique, particularly identification and interpretation of the first annulus and margin type. Quality control subsets were read each sampling year by all active readers to estimate precision. Readers were assigned different portions

of the collections for individual reading. The average percent error on all first and second reads was 1.23%, which is considered highly precise (Campana, 2001); moreover, there was an 90% age agreement between all first and second reads, and a 99% agreement +/- 1 year All age data provided for SEDAR98 included increment count, calendar age and fractional age; however, the summaries including ages in this report were based on adjusted calendar age.

Results:

Fishery-Dependent Results: Age and length composition

All fishery-dependent age data have been provided to the life history workgroup; what follows is a summary of the calendar ages and lengths of aged Red Snapper. The following summaries were performed using all fish that were caught in either the central (Zone 7-12) or eastern (Zone 1-6) sub-area of the Gulf of Mexico and landed in Florida. Depending on data source, fish were geographically grouped based on capture zone or landing county. Fish for which capture zone was 7-12 (Central sub-area) were coded as northwest Florida (NWFL). Fish for which capture zone was 1-6 (Eastern sub-area) were coded as southwest FL (SWFL). Fish collected by recreational surveys (SRFS, At-Sea, Representative Biological Sampling, or Targeted Biological Sampling) were grouped by landing county if no capture zone was given. All fish landed in Escambia to Levy counties (Central sub-area) were coded as NWFL. All fish landed in Citrus to Monroe counties (Eastern sub-area) were included in SWFL if no fishing area code was given.

Age data are summarized for a total of 79,499 individuals. The majority of age samples were obtained from the commercial sector, accounting for 42,417 samples (53.36% of samples). Recreational surveys included 4,312 samples from private boat trips, 25,356 from charter trips, and 7,117 from headboats. In addition, 297 aged fish were from an unknown source (primarily fishing tournaments; Table 1). Over 92% of fish aged from the private boat fishery were collected between 2014 and 2023 with total otolith collections being above 100 per year every year since 2014 (Table 2). Over 73% of otoliths collected from charter vessels were collected before 2014 with fish collected in NWFL representing the bulk of collections each year (Table 2). Commercial samplers collected over 1,000 otoliths each year from 2011 until 2022, primarily in NWFL (Table 2). Headboat samples were heavily concentrated in 2014 and 2015, with these two years accounting for almost half (49.83%) of the total aged fish within the headboat sector (Table 2).

Approximately 22.7% (18,074 fish) were female, 22.7% (18,016 fish) were male, and 54.6% (43,409 fish) were unsexed. Over the full time series, the mean ages varied little by fleet. The lowest

mean age was 4.08 ± 1.82 y in the NWFL charter fishery. The highest mean age was 5.18 ± 2.17 y in the SWFL commercial fishery. The oldest fish aged was from the charter fishery which was aged to 40 years. The next oldest fish was a 38-year-old which was sampled from the commercial fishery. A total of 22 fish were aged over 20 years old within the delivered data (Figure 1). The three sub-sectors of the recreational fishery showed similar distributions with ~30% of fish aged to 3 years and another ~25% age to 4 years. The commercial fishery had a broader age range with ages 2-6 heavily represented (Figure 2). Age distributions by region and year are presented in Figures 3-6. In years with larger sample sizes, age distributes become representative. In years with relatively low sample sizes, age distributions are skewed. The commercial fishery included the largest range of both ages and sizes of any sector (Figure 7).

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Table 1. Numbers of fish aged, mean (± SD) age, and length landed by fishing fleet (2002-2023). Regions are NWFL (central Gulf of Mexico) and SWFL (eastern Gulf of Mexico) as defined by the analysis team.

	NWFL			SWFL		
Fishing Fleet	**# Fish**	**Mean Age (y)**	**Mean FL (mm)**	**# Fish**	**Mean Age (y)**	**Mean FL (mm)**
Charter	23692	4.08 ± 1.82	462 ± 88.08	1664	4.81 ± 1.58	530.54 ± 89.90
Commercial	29784	4.6 ± 1.98	472.28 ± 107.66	12633	5.18 ± 2.17	538.15 ± 108.99
Headboat	4679	4.86 ± 1.97	475.03 ± 87.47	2438	4.56 ± 1.60	506.73 ± 90.47
Private	3941	4.58 ± 2.16	493.61 ± 92.85	371	3.98 ± 1.44	489.71 ± 93.62
Unknown	205	4.67 ± 1.65	524.47 ± 93.30	92	5.32 ± 2.18	579.41 ± 101.17

Table 2. Numbers of fish aged, mean (± SD) age, and length landed by fishing fleet by year (2002-2023). Regions are NWFL (central Gulf of Mexico) and SWFL (eastern Gulf of Mexico) as defined by the analysis team.

	NWFL					SWFL				
	# Fish	**Mean Age (y)**	**SD AGE**	**Mean FL (mm)**	**SD FL**	**# Fish**	**Mean Age (y)**	**SD AGE**	**Mean FL (mm)**	**SD FL**
Charter										
2003	3779	3.23	1.15	431.70	66.90	11	3.09	0.30	469.27	20.13
2004	2880	3.54	1.42	439.26	72.88	3	4.33	0.58	507.00	31.05
2005	4199	3.18	1.07	422.23	62.59	5	2.80	0.84	423.60	49.76
2006	2421	3.27	1.25	419.49	58.30	5	4.00	0.00	451.40	11.84
2007	98	3.21	0.76	425.49	47.66	14	4.00	0.39	459.43	25.93
2008	140	3.52	0.63	451.31	58.66	5	3.80	1.10	499.20	86.00
2009	204	4.34	1.06	491.88	82.29	49	4.08	0.93	511.86	57.58
2010	1114	4.35	1.09	495.52	76.64	105	4.48	1.04	527.24	83.29
2011	643	5.12	1.10	501.18	84.37	73	4.88	1.22	528.25	88.17
2012	1158	5.56	1.27	536.88	95.51	14	5.57	1.79	557.36	123.16
2013	1608	5.65	1.77	526.94	97.67	19	5.79	1.03	555.84	69.05
2014	678	5.46	2.07	514.01	98.43	81	5.24	1.65	546.01	109.30
2015	1432	5.75	2.22	501.15	94.88	141	4.80	0.94	568.18	60.73
2016	691	5.55	2.60	508.34	99.82	24	2.92	1.21	438.96	87.37
2017	260	4.95	2.78	493.82	91.56	66	3.50	0.85	475.32	62.51
2018	588	4.68	2.44	491.41	87.25	207	4.04	0.61	485.53	59.73
2019	515	4.72	2.21	511.87	86.35	206	4.65	1.08	522.75	77.84
2020	184	4.42	1.53	482.21	80.29	55	4.49	1.70	491.49	94.33
2021	458	4.08	1.72	476.83	88.76	276	5.21	1.71	538.73	90.04
2022	353	4.43	1.93	490.92	114.09	172	5.71	2.02	582.53	99.97
2023	289	3.83	1.49	461.81	80.29	133	5.84	2.14	564.71	100.82

	NWFL					SWFL				
	# Fish	Mean Age (y)	SD AGE	Mean FL (mm)	SD FL	# Fish	Mean Age (y)	SD AGE	Mean FL (mm)	SD FL
Commercial										
2002	2	6.00	1.41	647.00	43.84	1	4.00	.	488.00	.
2003	325	3.63	0.99	401.25	70.80	1	3.00	.	451.00	.
2006	0	.	.	.	0.00	25	4.16	1.41	515.60	80.27
2007	180	2.69	0.96	364.71	56.71	30	3.20	1.00	428.53	58.73
2008	187	3.83	0.90	441.27	65.15	66	4.41	2.34	510.65	71.77
2009	120	3.11	1.11	405.48	75.15	73	3.34	1.18	442.27	74.69
2010	299	3.55	1.15	431.36	80.06	673	4.58	1.03	521.90	82.86
2011	1785	4.58	1.39	477.90	85.28	414	4.89	1.16	519.19	81.21
2012	1593	4.87	1.37	479.92	82.10	211	5.28	1.40	529.73	85.05
2013	1476	5.22	1.80	516.29	109.23	130	5.75	1.29	542.98	87.58
2014	1276	5.63	2.01	521.64	109.59	161	5.86	2.05	551.57	108.80
2015	1655	5.27	2.30	514.55	111.60	192	5.23	2.42	533.26	114.69
2016	1981	4.24	2.54	468.75	120.90	1272	4.96	2.48	527.12	121.37
2017	2321	3.68	1.81	447.44	96.88	1481	4.46	2.48	493.91	116.19
2018	3436	3.91	1.47	454.48	90.05	1084	4.74	2.28	514.44	102.68
2019	3770	4.28	1.56	452.63	96.11	1525	5.26	2.27	538.90	101.27
2020	3112	4.99	1.98	476.16	109.81	979	5.32	1.66	535.91	97.70
2021	2842	4.77	2.01	460.95	114.11	884	5.40	1.85	555.84	103.75
2022	2783	5.13	2.25	480.18	123.31	2670	5.83	2.10	574.06	107.00
2023	641	5.95	2.62	544.32	126.57	761	5.38	2.45	572.69	114.00
Headboat										
2003	7	3.43	0.54	451.43	44.09	2	3.50	0.71	441.00	36.77
2004	28	4.11	1.26	412.11	30.88	1	3.00	.	421.00	.
2005	0	.	.	.	.	52	3.50	0.80	443.75	52.01
2006	20	3.50	0.83	410.40	30.04	78	4.36	1.12	498.44	59.29
2007	0	.	.	.	.	7	3.29	0.49	436.43	30.29
2008	144	3.35	0.72	417.33	44.57	46	3.07	1.08	474.74	66.85
2009	165	3.52	0.86	420.51	50.10	316	4.01	0.99	503.89	77.51
2010	108	4.03	1.06	485.56	79.88	238	4.53	1.10	516.12	82.96
2011	84	4.99	0.89	497.46	79.13	260	4.28	0.87	484.50	66.89
2012	78	4.68	1.30	494.97	92.82	126	5.29	1.57	527.48	82.15
2013	191	5.55	1.81	456.77	65.70	110	5.17	1.40	523.03	88.35
2014	2081	5.24	1.98	485.20	92.80	67	4.96	1.66	511.66	101.66
2015	1289	5.02	2.10	484.48	87.77	203	5.72	2.10	560.23	107.13
2016	39	4.23	1.78	469.62	84.46	39	4.82	2.21	508.41	108.55
2017	92	3.82	2.29	435.53	73.40	157	3.20	0.79	433.71	60.23
2018	123	3.50	0.81	436.81	43.17	236	4.48	1.58	487.03	78.02
2019	30	3.70	1.34	439.87	73.17	189	4.85	1.25	525.16	80.60
2020	3	6.67	5.51	558.33	296.76	0	.	.	.	.
2021	56	4.05	2.25	452.41	74.80	39	3.97	1.22	478.28	80.05
2022	35	3.86	1.42	443.20	87.67	115	5.54	2.25	553.25	121.47
2023	106	3.73	1.12	454.35	68.12	157	5.03	2.17	527.61	110.20

Table 2 (cont.).

	NWFL					SWFL				
	# Fish	Mean Age (y)	SD AGE	Mean FL (mm)	SD FL	# Fish	Mean Age (y)	SD AGE	Mean FL (mm)	SD FL
Private										
2003	11	3.09	0.70	436.45	46.56	3	3.33	0.58	496.67	18.45
2004	52	3.79	0.61	455.65	47.27	0	.	.	.	.
2005	21	3.10	0.83	432.57	55.93	0	.	.	.	.
2006	35	3.20	1.26	416.91	75.95	2	3.00	0.00	394.50	12.02
2007	0	.	.	.	.	1	3.00	.	414.00	.
2008	0	.	.	.	.	10	2.90	0.32	443.80	71.36
2009	3	4.67	2.08	455.67	33.86	2	4.50	0.71	467.00	9.90
2010	14	4.00	0.78	502.50	89.52	13	5.15	0.80	589.38	56.74
2011	54	5.33	1.21	545.80	89.21	13	5.15	0.69	580.00	53.79
2012	52	5.35	1.60	545.83	85.05	0	.	.	.	.
2013	46	6.04	1.73	577.96	92.84	7	4.29	0.76	490.43	67.85
2014	258	5.62	2.09	516.94	94.30	12	3.83	1.47	459.50	104.63
2015	403	4.93	2.28	480.55	86.66	0	.	.	.	.
2016	722	5.01	2.50	502.39	101.83	10	2.00	0.00	383.40	23.90
2017	532	4.09	2.33	482.73	87.12	160	3.74	1.56	467.11	95.79
2018	467	4.25	1.92	481.21	79.35	40	4.13	0.52	499.38	58.72
2019	425	4.13	1.63	494.70	80.20	14	4.21	0.98	484.29	79.25
2020	230	4.20	1.38	498.81	81.28	10	3.20	0.42	442.70	34.48
2021	213	4.92	1.98	505.13	100.47	18	4.22	1.17	506.17	74.63
2022	161	4.13	1.98	475.02	106.00	29	4.52	1.33	555.76	90.70
2023	242	4.47	2.48	495.79	108.82	27	4.70	2.07	536.56	99.09
Unknown										
2009	0	.	.	.	.	6	3.67	0.52	513.00	42.16
2010	0	.	.	.	.	35	5.06	1.11	585.66	94.82
2011	0	.	.	.	.	17	5.41	0.87	586.94	80.12
2012	205	4.67	1.65	524.47	93.30	16	5.81	1.33	606.13	112.95
2017	0	.	.	.	.	18	5.83	4.36	558.56	127.14

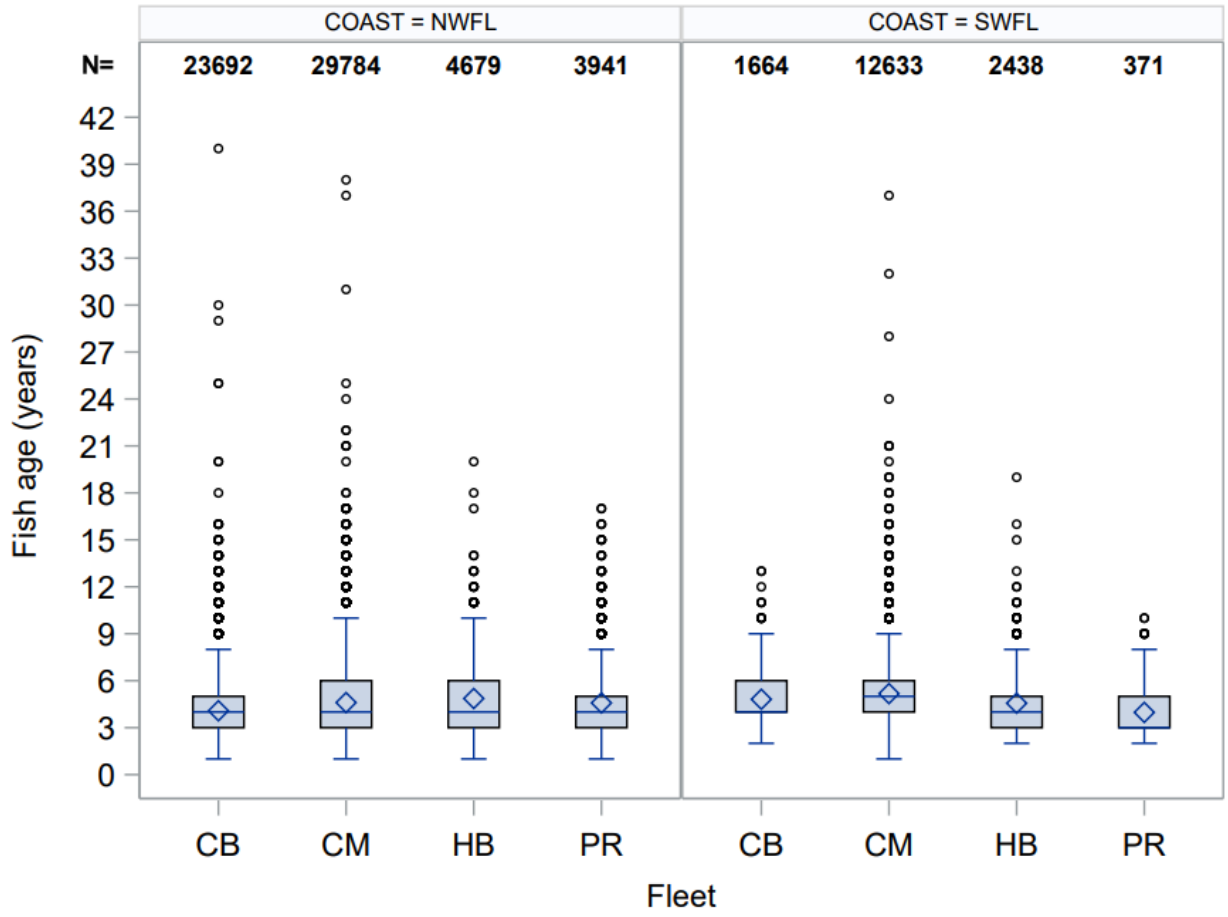

Figure 1. Age distribution by fishing fleet and area. N = total numbers of samples included in each box. Regions are NWFL (central Gulf of Mexico) and SWFL (eastern Gulf of Mexico) as defined by the analysis team.

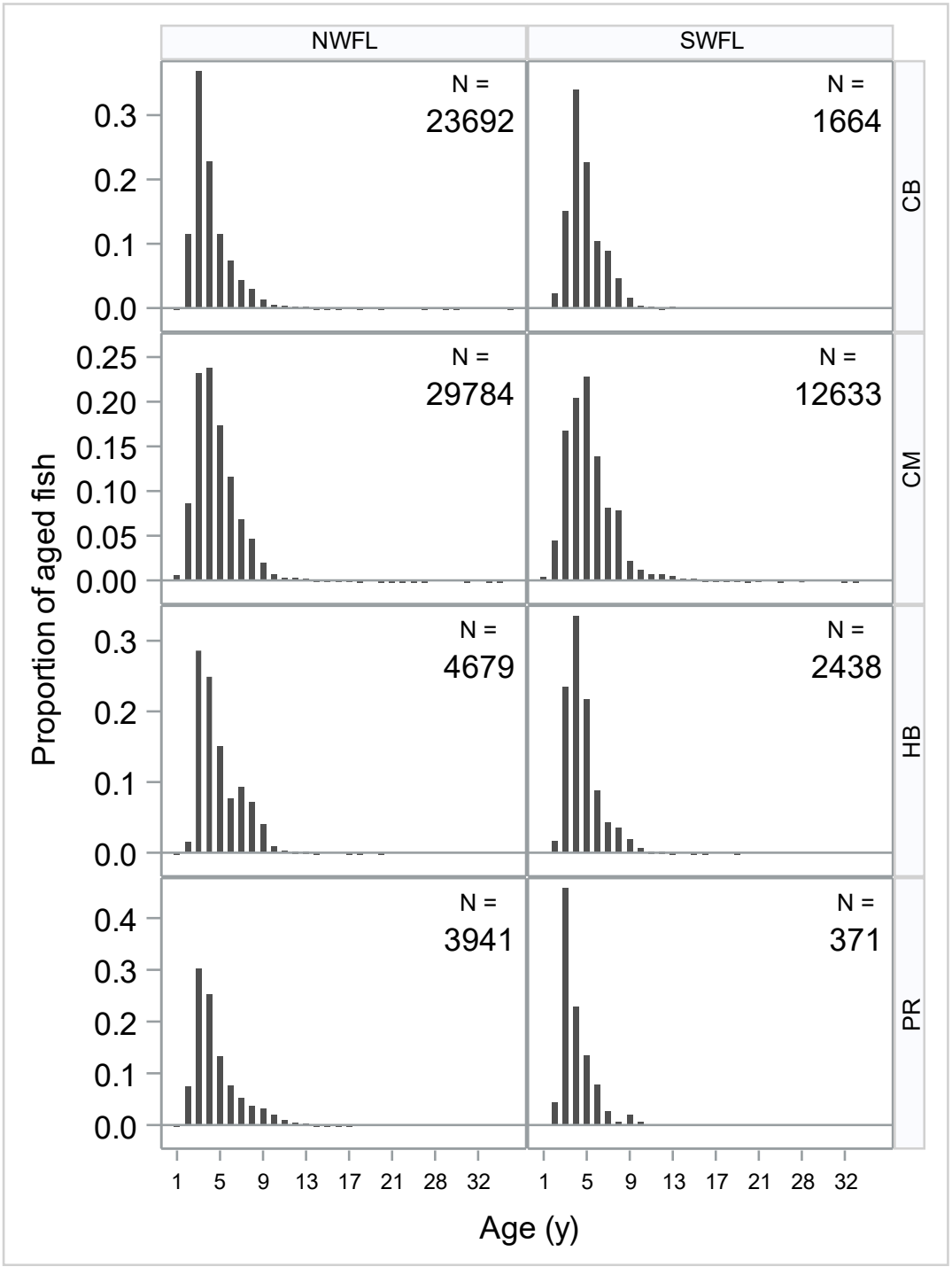

Figure 2. Age distribution of fish across entire time series in each fishery. Regions are NWFL (central Gulf of Mexico) and SWFL (eastern Gulf of Mexico) as defined by the analysis team.

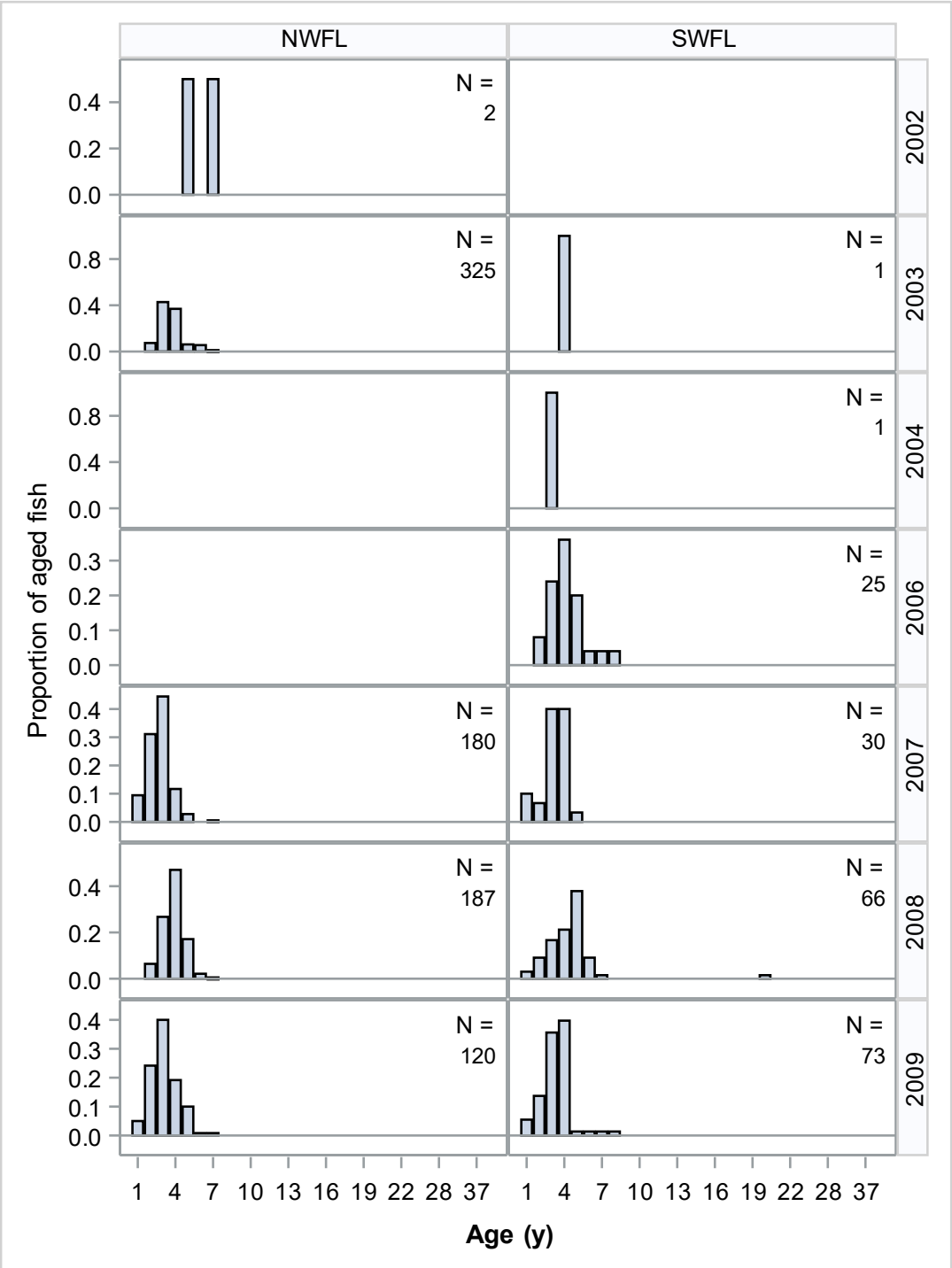

Figure 3. Proportion of total fish aged by year and region from the **COMMERCIAL** fishery. Regions are NWFL (central Gulf of Mexico) and SWFL (eastern Gulf of Mexico) as defined by the analysis team.

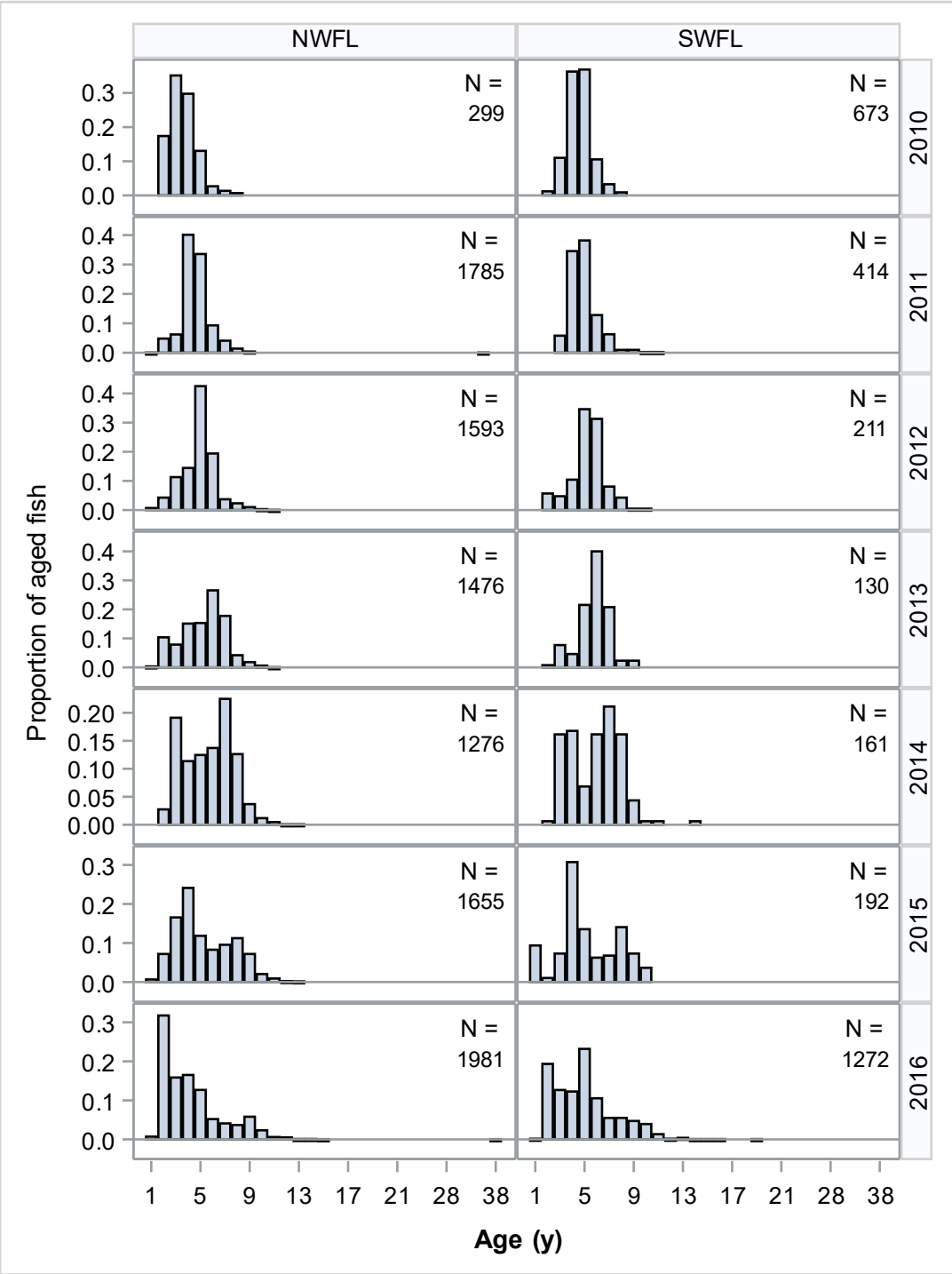

Figure 3 (cont). Proportion of total fish aged by year and region from the **COMMERCIAL** fishery. Regions are NWFL (central Gulf of Mexico) and SWFL (eastern Gulf of Mexico) as defined by the analysis team.

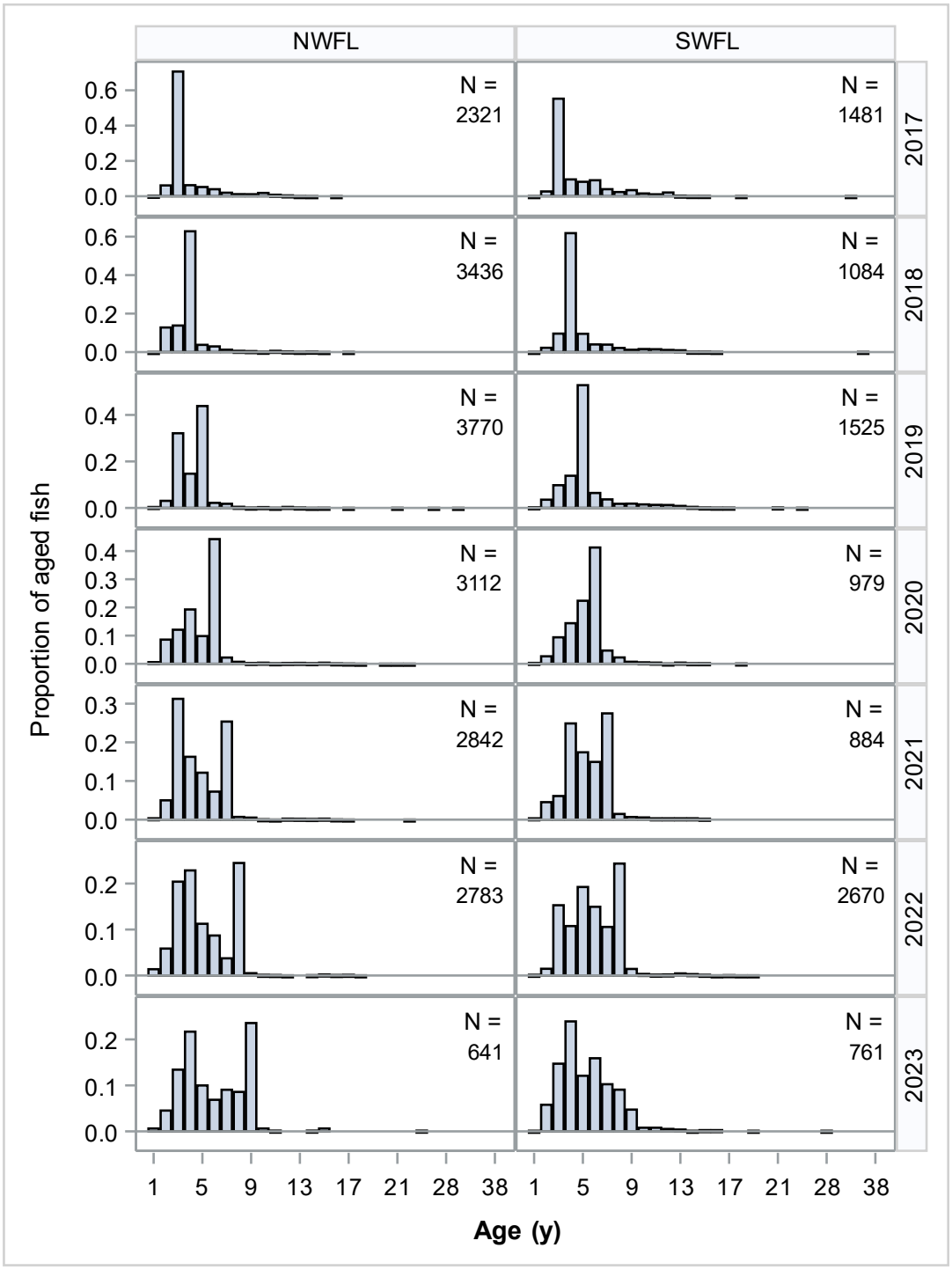

Figure 3 (cont). Proportion of total fish aged by year and region from the **COMMERCIAL** fishery. Regions are NWFL (central Gulf of Mexico) and SWFL (eastern Gulf of Mexico) as defined by the analysis team.

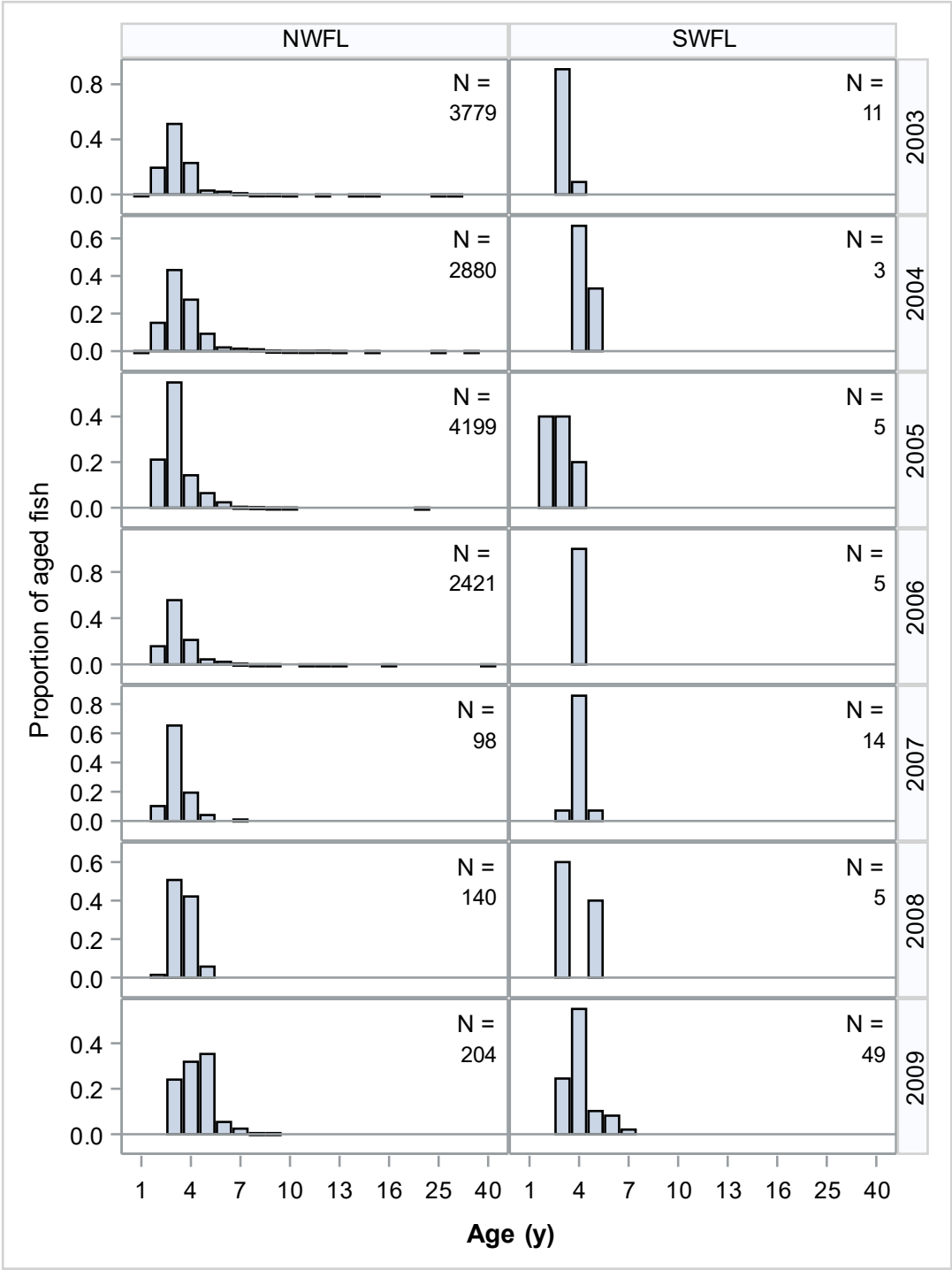

Figure 4 (cont). Proportion of total fish aged by year and region from the **CHARTER** fishery. Regions are NWFL (central Gulf of Mexico) and SWFL (eastern Gulf of Mexico) as defined by the analysis team.

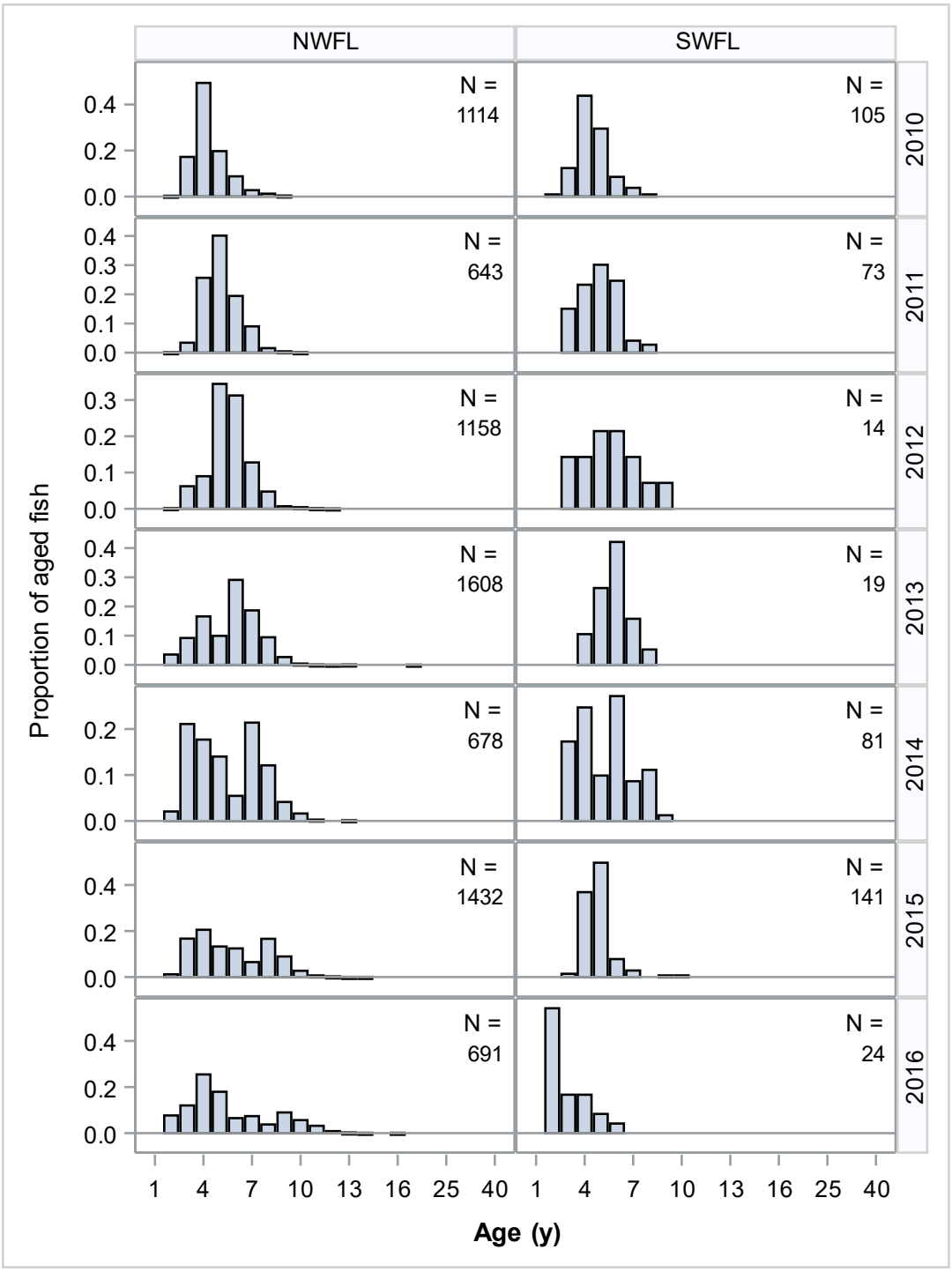

Figure 4 (cont). Proportion of total fish aged by year and region from the **CHARTER** fishery. Regions are NWFL (central Gulf of Mexico) and SWFL (eastern Gulf of Mexico) as defined by the analysis team.

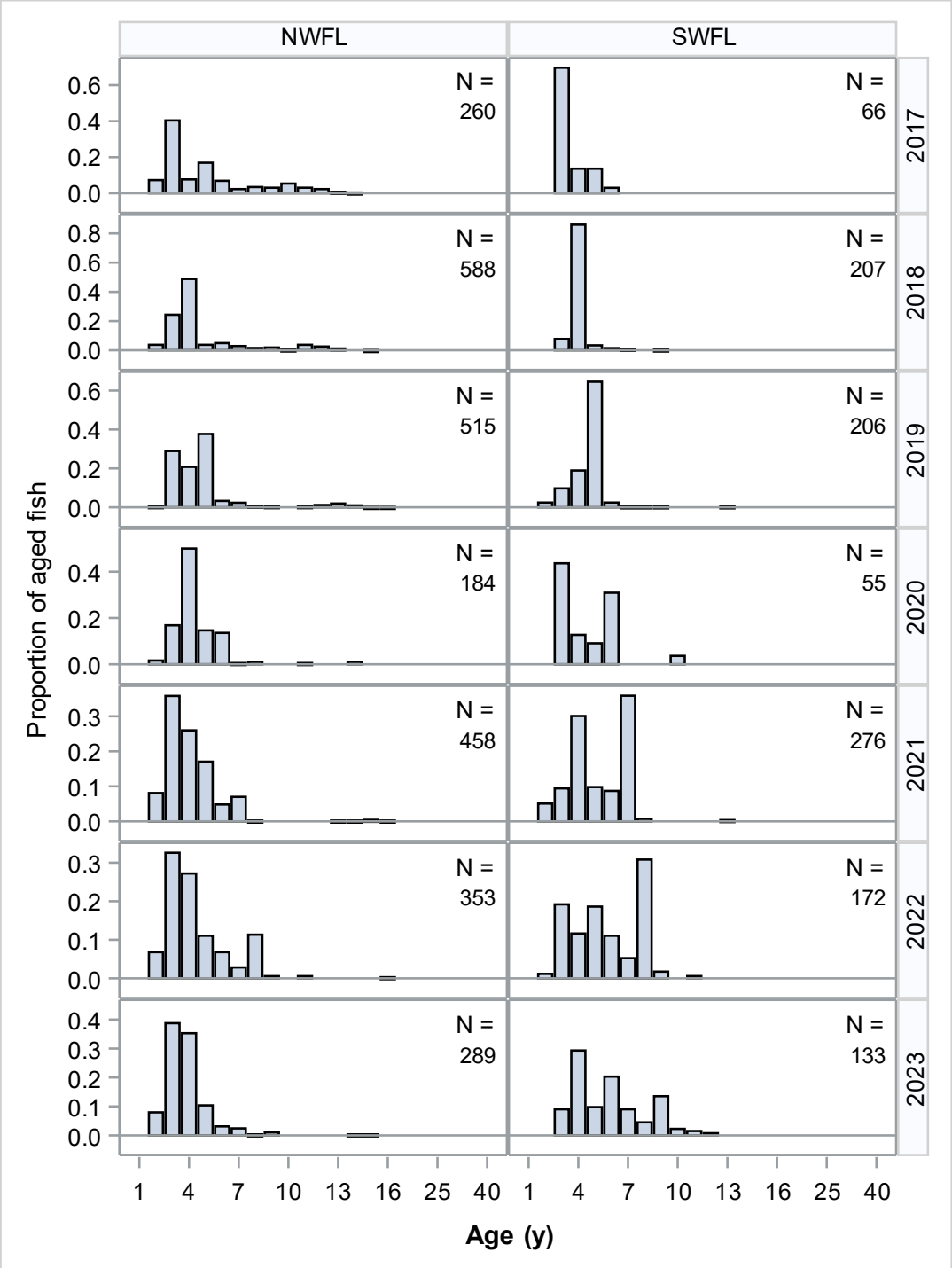

Figure 4 (cont). Proportion of total fish aged by year and region from the **CHARTER** fishery. Regions are NWFL (central Gulf of Mexico) and SWFL (eastern Gulf of Mexico) as defined by the analysis team.

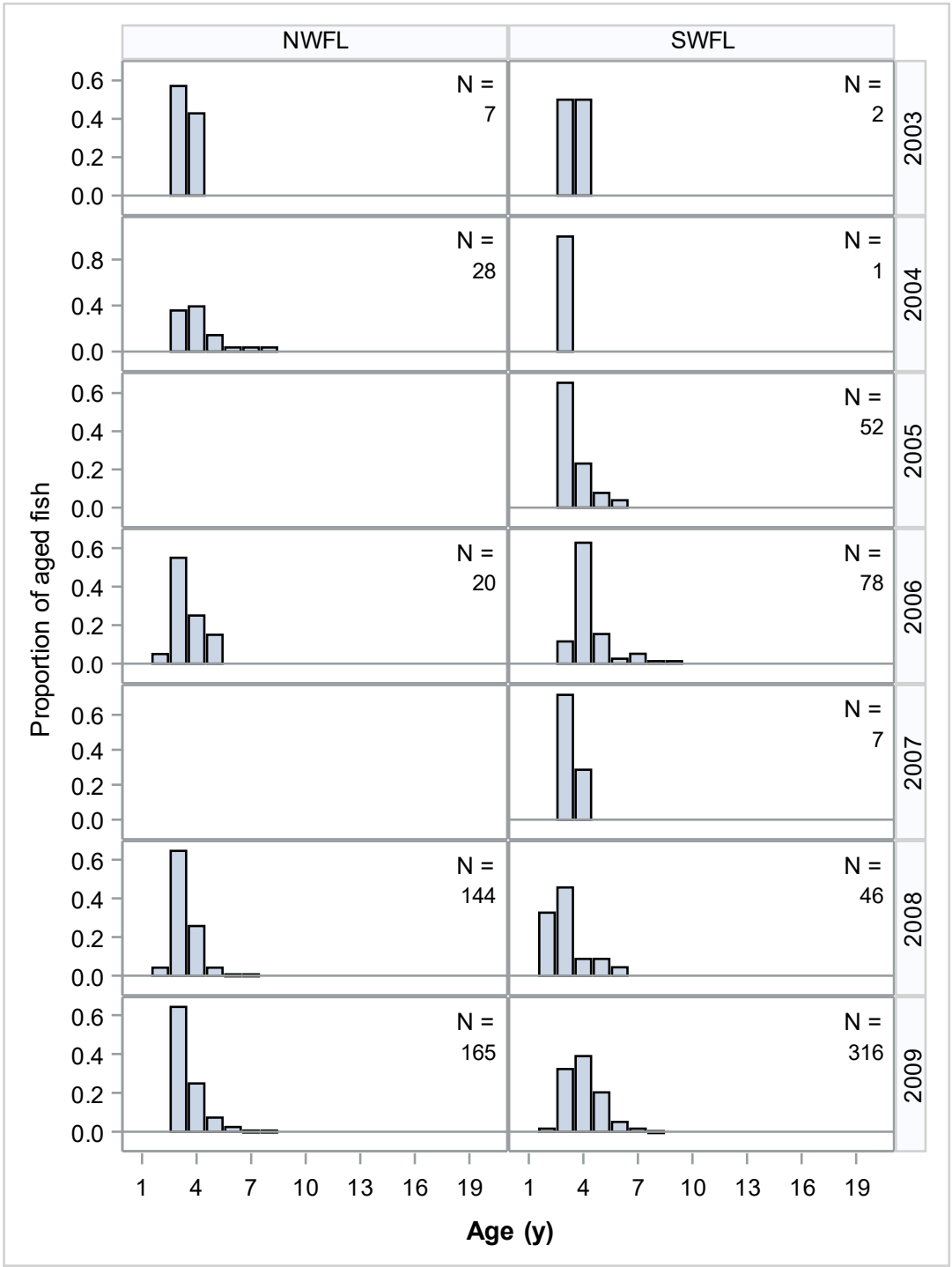

Figure 5 (cont). Proportion of total fish aged by year and region from the **HEADBOAT** fishery. Regions are NWFL (central Gulf of Mexico) and SWFL (eastern Gulf of Mexico) as defined by the analysis team.

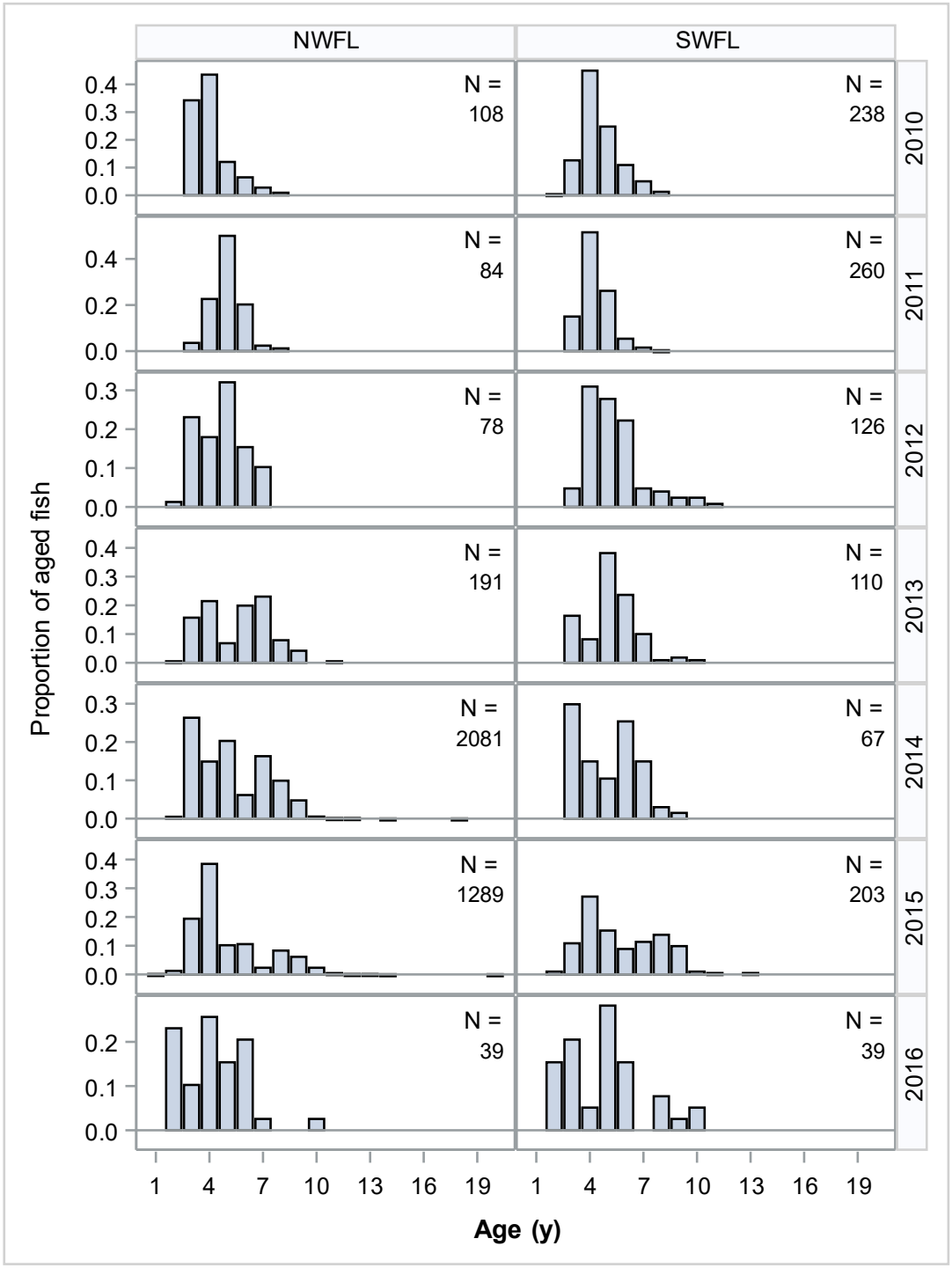

Figure 5 (cont). Proportion of total fish aged by year and region from the **HEADBOAT** fishery. Regions are NWFL (central Gulf of Mexico) and SWFL (eastern Gulf of Mexico) as defined by the analysis team

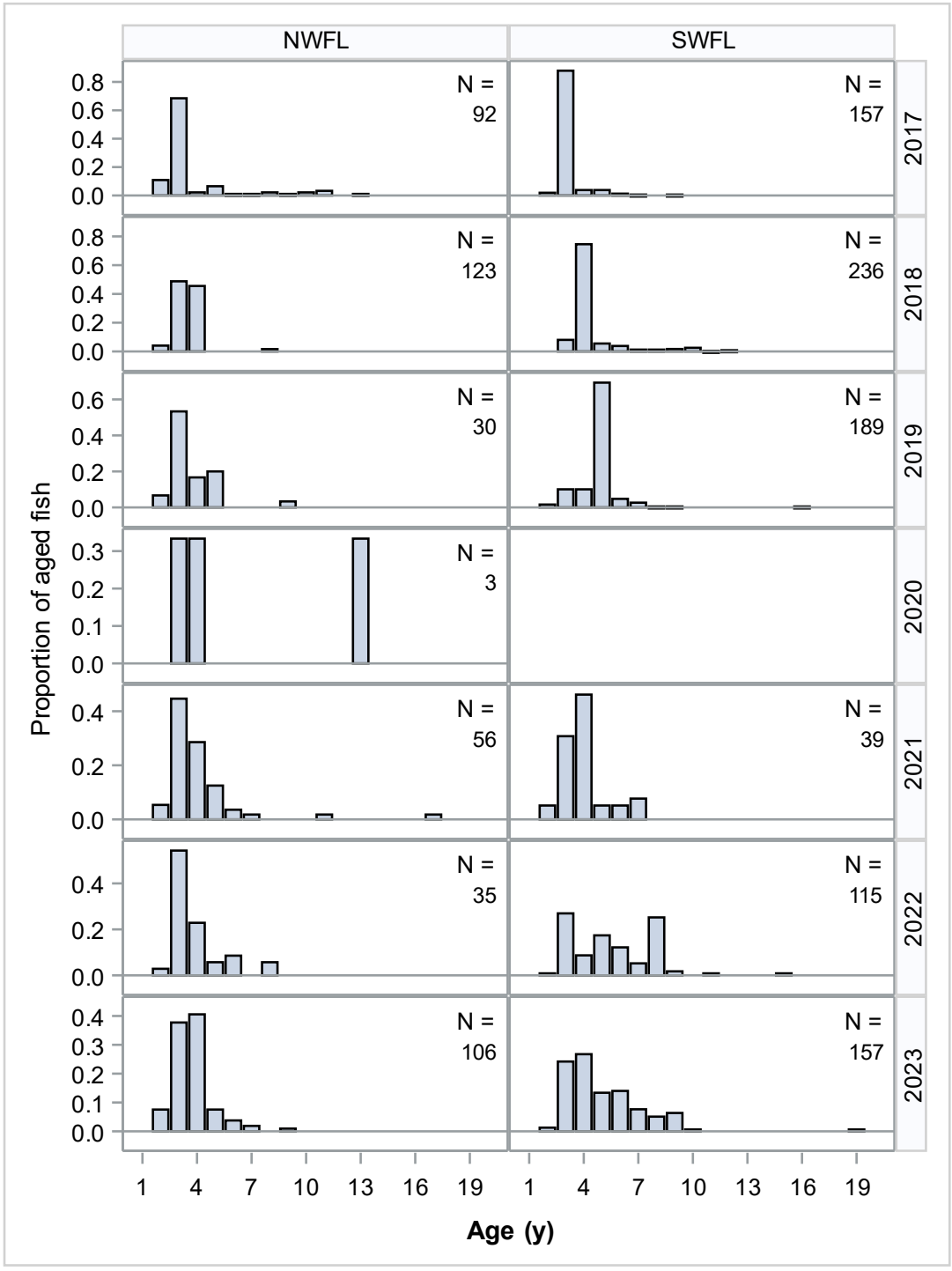

Figure 5 (cont). Proportion of total fish aged by year and region from the **HEADBOAT** fishery. Regions are NWFL (central Gulf of Mexico) and SWFL (eastern Gulf of Mexico) as defined by the analysis team

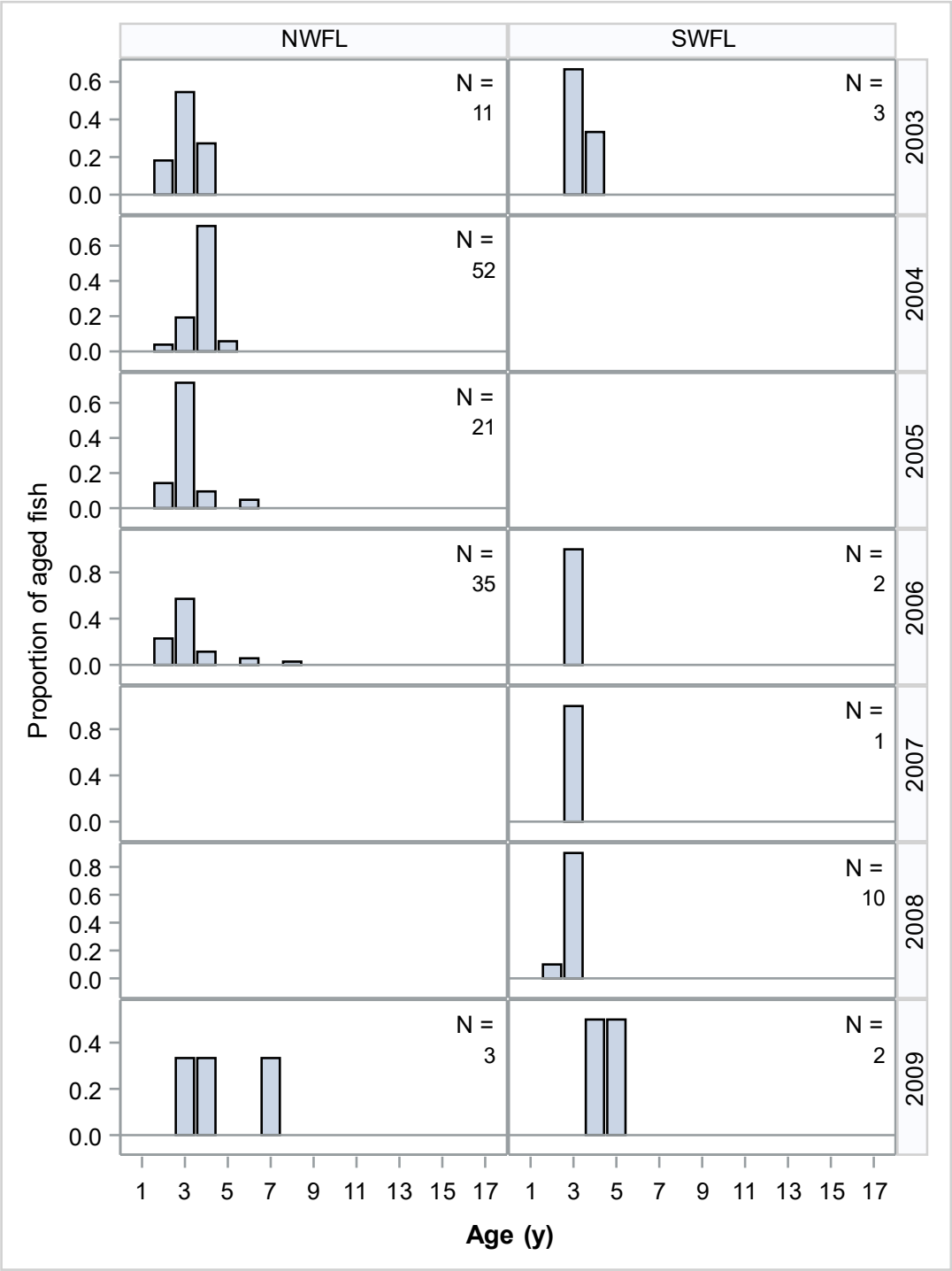

Figure 6 (cont). Proportion of total fish aged by year and region from the **PRIVATE** fishery. Regions are NWFL (central Gulf of Mexico) and SWFL (eastern Gulf of Mexico) as defined by the analysis team.

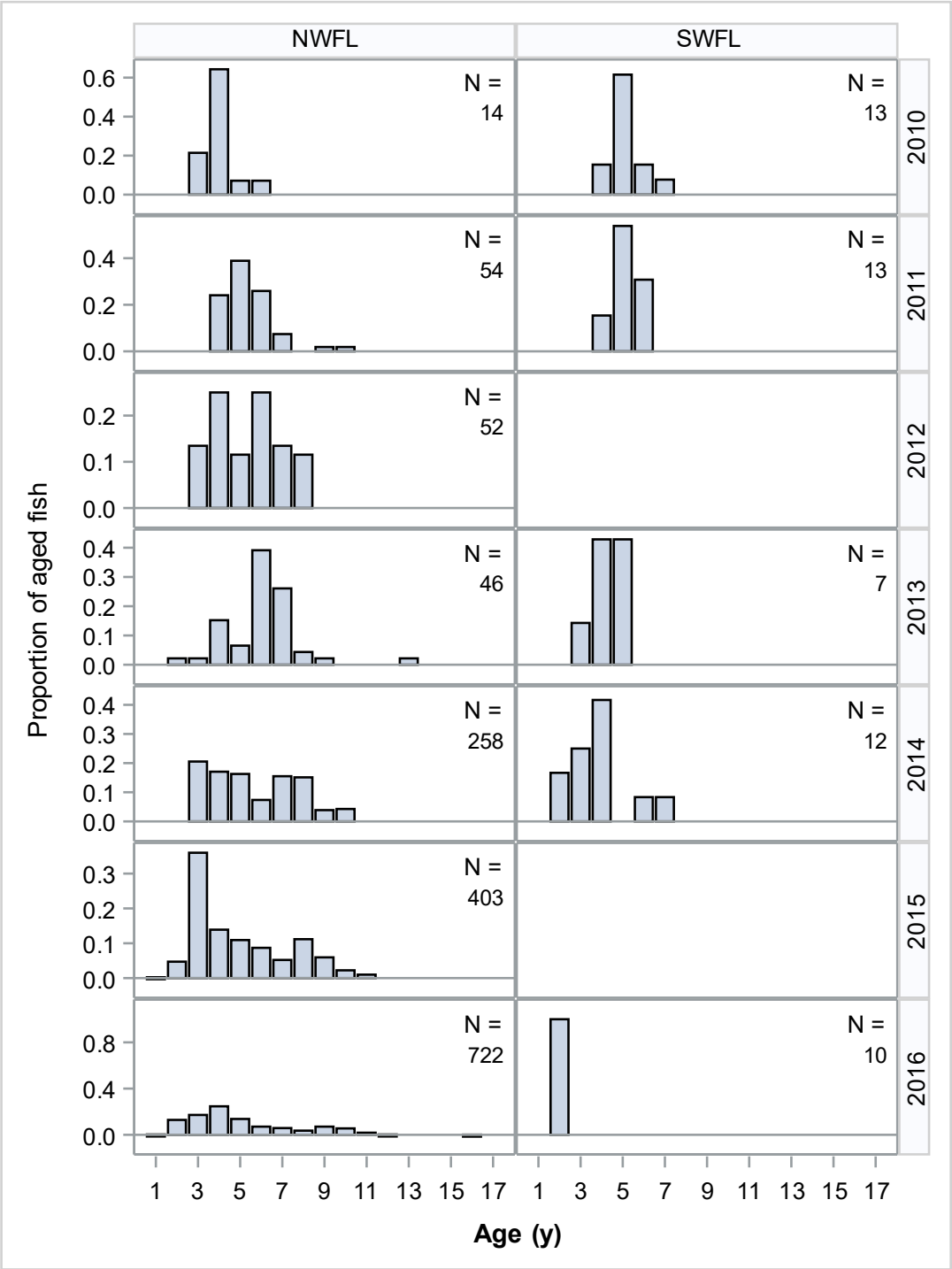

Figure 6 (cont). Proportion of total fish aged by year and region from the **PRIVATE** fishery. Regions are NWFL (central Gulf of Mexico) and SWFL (eastern Gulf of Mexico) as defined by the analysis team.

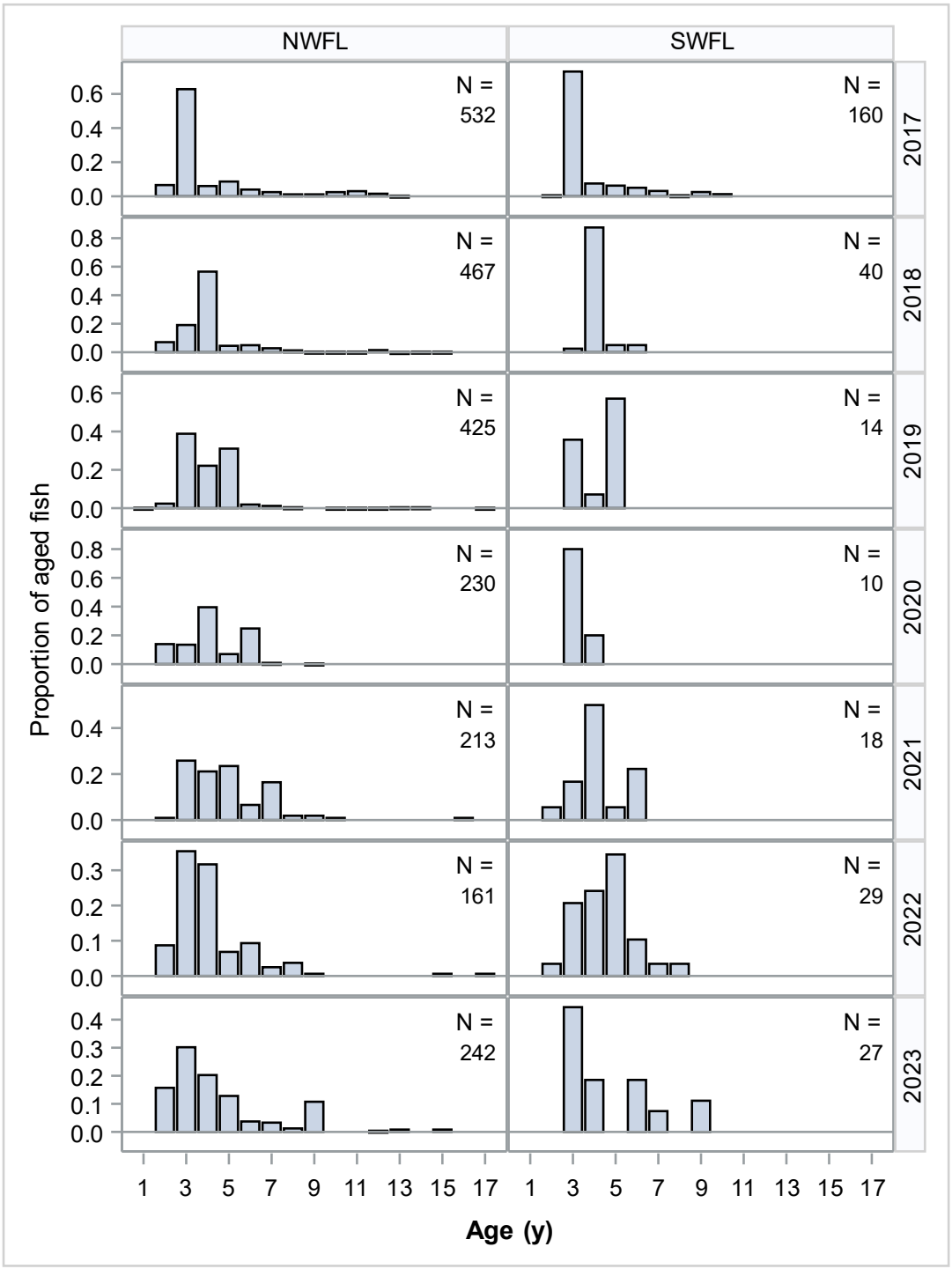

Figure 6 (cont). Proportion of total fish aged by year and region from the **PRIVATE** fishery. Regions are NWFL (central Gulf of Mexico) and SWFL (eastern Gulf of Mexico) as defined by the analysis team.

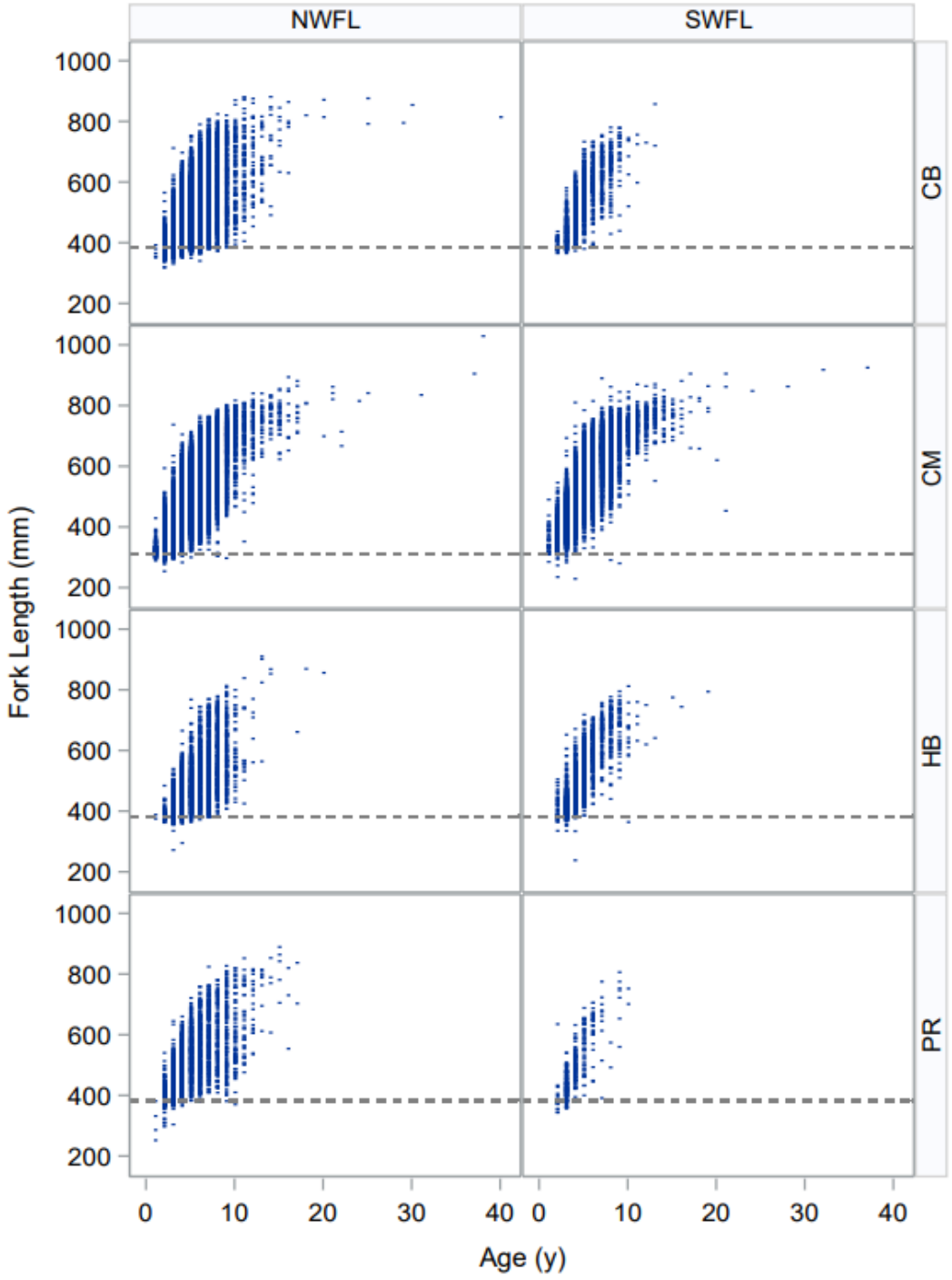

Figure 7. Fork length (FL) as a function of age in each fishery sector. The dashed line represents the 16” TL minimum size for all recreational fisheries and 13” for the commercial fleet. Total length was converted to FL using FL = -1.07382 + 0.938899*TL (SEDAR 24, 2010). Regions are NWFL (central Gulf of Mexico) and SWFL (eastern Gulf of Mexico) as defined by the analysis team.