A Review of the Gulf of Mexico Red Grouper (*Epinephelus morio*) Age-Length Data, 1978-2022

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Introduction

This report describes the age and length data submitted by the National Marine Fisheries Service NMFS Panama City Lab (PC Lab), Florida Fish and Wildlife Research Institute (FRWI), Gulf Fisheries Information Network (GulfFIN), and the University of South Florida (USF) for the Southeast Data Assessment and Review (SEDAR) assessment of red grouper, *Epinephelus morio*, (SEDAR 88) in the Gulf of Mexico for the years 1978-2022. Metadata submitted for SEDAR 88 follow the SEDAR Best Practices Template, adopted for use in December 2022 (See Appendix 1).

The objective of this report is to summarize the age, length, and weight data for red grouper samples collected annually by fishery, mode, state, and gear. We also describe 1) the years and sources of otolith samples, 2) the subsampling protocol used by the PC Lab for selecting otoliths, 3) how final age, length, and weight were estimated, and 4) reader precision and ageing error.

Methods

Sample collection

Red grouper data collection began in 1978, but otoliths were not collected until 1979, and no otoliths were collected from 1982 to 1984 or in 1990. Otoliths were collected from the commercial sector through several sampling programs including Alliance, Alabama Marine Resources (ALMR), Cooperative Research Project (CO-OP), CO-OP Ward, Expanded Annual Stock Assessment Survey (EASA), Fishery Information Network (FIN-BIOSTAT), Florida Fish and Wildlife Conservation Commission (FWRI), NMFS Galveston Observer Program (GOP), PC Lab, Recreational Fisheries Information Network (RECFIN), NMFS Shark Bottom Longline Observer Program (SBLOP), the Trip Interview Program (TIP), and unknown sources (UN). Gear types sampled from the commercial sector included handline, bottom longline, spear, trap, and vertical longline. Otoliths collected from the recreational (REC) sector

were provided by CO-OP, FIN-BIOSTAT, FIN-OBS, FWRI, FWRI-OBS, Gulf Reef Fish Survey (GRFS), Beaufort Headboat Survey (HB), Marine Recreational Fishing Statistics Survey (MRFSS), NMFS PC Lab (PCLAB), RECFIN, Representative Biological Sampling (REPBIO), State Reef Fish Survey (SRFS), TIP, or UN. Gear types sampled from the recreational sector included HL, LL, SP or were specified as other (Other). Fishery Independent (FI) samples were collected via scientific surveys (SS) through the following sampling programs: CO-OP, EASA, FWRI, FWRI-FIM, PCLAB, TIP, NMFS Pascagoula Mississippi Lab (MS LAB), the University of South Florida (USF), and the U.S. Geological Survey (USGS). Gear types used in fishery independent collections included HL, LL, dip net (DN), seine net (SN), SP, TR, trawl (TW), VL, or UN.

Otolith Subsampling Protocols

Due to the PC Lab receiving large numbers of red grouper samples annually, otoliths collected from commercial handline (Table 1a), bottom longline (Table 1b) and vertical longline (2010 only; n = 556 sub-sampled ages) fleets were subsampled with a target sample size of n = 500 per strata (i.e. fleet) per year. The target sample size for each strata was multiplied by the proportion of landings per NMFS statistical grid (Figure 1) estimated from the strata-specific landings from the most recent 5 years of available data (2016 to 2020). For example, landings from NMFS grid 5 (Latitude 27^{o} N, Longitude 82-84^{o} W) accounted for 43% of red grouper commercial longline landings from 2016 to 2020. Therefore, 43% (n = 214) of the otoliths randomly sub-sampled from each year were taken from grid 5 (see full example in Supplementary Table 1). Landings per grid have not changed significantly during the last 20 years, but using the most recent years of data accounts for potential spatial shifts in landings.

Otolith Processing and Ageing

The sagittal otolith was used as the primary ageing structure (Moe 1969). Red grouper age was interpreted using reflected light from whole otoliths submerged in water. If the readers were not confident in assigning age, the otolith was selected to be sectioned. Transverse sections were taken using a Hillquist high-speed saw following the protocols outlined in the NMFS Panama City Lab Procedure Manual for Age, Growth, and Reproduction (NOAA, 2008), and readings were then interpreted from slides. Annual ages, based on a calendar year, were calculated using the reader's annulus count, edge type and capture date (Jearld 1983). Annulus counts were advanced by one year if the fish was captured between January 1st and June 30th and the edge type was determined to be fully translucent (edge type 6). Typically, marine fish in the southeastern U.S. are observed to complete annulus formation, an opaque zone, by late spring to early summer. Thus, an otolith with two completed annuli and a large translucent zone would be classified as age 3 if the fish was caught during spring in expectation a third (opaque zone) annulus would soon form. A fish caught before June 30th with an opaque edge (type 2), would be assigned an annual age equal to the annulus count. After June 30th, when opaque zone formation is underway or complete for red grouper in the Gulf of Mexico, fish were assigned annual age equal to annulus count (Moe 1969). In cases where an opaque edge was observed in an otolith collected late in the year (November and December), one year was subtracted from the annulus count to determine the annual age (Lombardi-Carlson, 2014). These fish were assumed to be prematurely depositing the next annual growth band. Fractional ages also were calculated for use in growth models. The fraction of the terminal year's age was determined as the difference between the peak spawning date (May 15; Moe 1969, Collins et al. 2002) and capture date. If capture date was after the peak spawning date, the fractional age was added to the annual age; if capture date was before the peak spawning date, the fractional age was subtracted from the annual age.

Reader precision and ageing error

Multiple readers from different ageing facilities read the red grouper otolith reference set comprised of both whole (n = 204) and sectioned otoliths (n = 36). Two primary readers, Chris Palmer and Laura Thornton, were assigned to read all samples aged at the PC Lab in approximately equal proportions (i.e. ~50% of all processed age samples). Indices of precision (average percent error, APE and average coefficient of variation, ACV), and ageing error matrices were calculated for primary vs reference set ages (see Palmer et al. 2014 for further discussion), since both readers provided approximately equal numbers of age estimates to the final age dataset. Ageing error was estimated by mirroring the primary readers and comparing age estimates versus the reference set to produce a single ageing error matrix to inform ageing error in the stock assessment model.

Final length and weight data

Conversion equations applied to observed length and weight data provided for SEDAR 88 were not updated with data from 2018-2022 and used the same meristic equation parameters provided in SEDAR 42 (2015) and SEDAR 61 (2019). Linear regression parameters for converting available non-fork length measurements (maximum total, natural total, or standard length) to fork length (mm), the final length metric submitted for SEDAR 88, are shown in Supplementary Table 2 (Table 2.14 in SEDAR 42, 2015). Weights for samples with no observed whole weight (g), the final weight metric submitted for SEDAR 88, were only converted from (final) fork length estimates (including converted FLs) because no conversion from gutted weight to whole weight was provided in SEDAR 42 (2015) or SEDAR 61 (2019).

Results and Discussion

Sample Collection

A total of n = 56,197 red grouper age records were provided for SEDAR 88, with n = 7,827 records comprising ages from the new data period (2018-2022; Table 2). A total of 48 age samples collected during the previous data period (1978 – 2017) were updated in the PC Lab data. The number of updated records ranged from 1 – 4 samples per year for all years except 1996 (n = 7); not all years from 1978 to 2017 were affected. New (n = 36) age records in the previous data period can result from processing of otoliths not received in time for previous data submissions, locating missing samples, or updating barcoding or labeling errors in the database. Removed (n =12) age records also result from updating database errors while others can result from being designated as outliers. Similarly, GulfFIN updated 23 samples since data were submitted for the previous assessment, which resulted in 16 new samples in 2015, 3 in 2016, and 4 sample removals in 2017. FWRI provided 1 new sample each for 2009, 2011, and 2017 and 51 new samples for 2012. The University of South Florida provided no new samples, as all data submitted were from a special study conducted in 2011.

The PC Lab (AGR and BSD databases) provided 84.4% of the age records, followed by 10.5% from FWRI, and 4.4% from GulfFIN (Table 2). Nearly all age samples (89.1%) were collected from fish landed in FL with only 0.3% and 0.1% of age samples collected from AL and LA, respectively. The remaining 10.5% were collected during scientific surveys (NL) conducted in FL (Table 3). The Trip Interview Program (TIP) accounted for 57.0% of all the samples collected among sampling programs, with the next largest contribution (10.5%) from fisheries independent monitoring (FWRI-FIM) conducted by FWRI (Table 4). Among fishing modes, 65.8% of age samples were taken from the commercial sector, 20.0% from scientific surveys, and 8.5% from charterboats (Table 5). Among gear types, the majority of samples were from either handline (45.6%) or bottom longline (40.0%) catches while 7.3% were taken

from trap catches (Table 6). Age sample totals for specific mode and gear combinations are provided in Table 7.

Final age, length, and weight

Minimum age in the data was 0 yrs and maximum age remained 29 yrs as in previously submitted datasets. However, a red grouper collected in 2019 from a charterboat in Bay county also was aged 29 yrs. The original 29 yr age estimate was from a fish collected during a scientific survey in 1992, but other individuals with estimated ages of 28 yrs were collected in 1999 and 2002 and several other fish were estimated at 27 yrs of age. Mean age ranged from a minimum of 3.0 yrs (1985, n = 1) to a maximum of 11.8 yrs (1980, n = 8) during the entire data period, but ranged from ~ 6 to 8 yrs for nearly all years between 1991 and 2022 (Table 8, Figure 2). Minimum FL in the data was 89.9 mm and maximum FL was 1149 mm collected during a scientific survey in 2021 and from a recreational charterboat in 2020, respectively. The 1149 mm FL individual was estimated to be only 5 yrs old. The 89.9 mm individual was not landed and age was not estimated. Mean FL (mm) was typically between 500 and 600 mm during this same period (Table 8, Figure 3). Age-at-length ranged 400 to 500 mm (FL) for ages 3 to 16 yrs with less variance in younger and older ages; age-at-length appears weakly asymptotic at ages >20 (Figure 4). Minimum whole weight in the dataset was 8.9 g and maximum whole weight was 29,444 g (predicted from final FL from the same individual having the maximum converted FL). Mean weight was more variable across the time series but has stabilized between ~2500 and 3000 g (whole weight) since 2012 (Table 8, Figure 5). Weight-at-age is also highly variable for ages 4+ and does not show dramatic increases at older age classes (Figure 6). Age-frequency histograms indicate strong year classes were observed in 1989 (peak in age-5 in 1994), 1996 (peak in age-5 in 2001), 1999 (peak in age-5 in 2004), 2006 (peak in age-5 in 2011), and 2014 (peak in age-5 in 2019) and were observed moving through the age classes of fishery catches in subsequent years (Figure 7). Fish appear to enter the fishery around age-4

and are fully selected by age-5. Fleet-specific age-frequency data are shown in Figures 8 - 10. Percent length-frequency histograms indicate sample lengths tend to increase dramatically from ~400-450 mm FL, then peak at 450 to 500 mm, which coincides with minimum length limits, before declining through to the 750-800 mm length bin (Figure 11). Fleet-specific length-frequency data are shown in Figures 12 - 14.

Reader Precision and Ageing Error

Precision and accuracy were high for both primary readers' age estimates for the reference set. Joint APE for both primary readers was 3.8 and ACV was 5.1. Reader-specific APEs for the reference set were 2.3 (ACV = 3.3) and 3.6 (ACV = 5.0). Bland-Altman plots indicated significant bias for only one age class for reader 1 and 4 age-classes for reader 2, but nearly all were biased by <1.2 yr. Among all candidate models, ageing error was best estimated, based on ΔAICc values, by a model that allowed for bias in both primary readers' age estimates and age-specific error fit with a curvilinear CV parameter. However, this model produced age-specific error estimates that were effectively linear through age 20 with a rapid increase in error after age-25. Otolith sections >25 yr of age are only represented by a few samples in the reference set. Alternatively, a different candidate model that also allowed for bias in primary reader age estimates with a curvilinear error structure estimated effectively linear age-specific error throughout the entire reference set age range. Age bias was estimated to increase by -0.031 yrs per age class (i.e., increasing under-ageing bias), with the largest value at -0.92 yrs for fish aged 29 yrs. This model produced slightly higher estimates of age-specific error than the best-fit model up to age-20, but estimated much lower age-specific error for ages 20+. Thus, this latter model was recommended as the best model to describe age-specific ageing error for use in SEDAR 88 (Figure 15), but age-specific error parameters for both scenarios were submitted for SEDAR 88.

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Figure 12. Frequency histograms (bin width = 50 mm) of final length (FL mm) by year for red grouper age samples collected from the recreational fishery in the Gulf of Mexico from 1978 to 2022. The number of observations is shown at the top right of each panel. Some values (bars) in early years (e.g., 1985, n = 1 = 100%) may be excluded from a plot if values exceeded the y-axis limit.

Figure 13. Frequency histograms (bin width = 50 mm) of final length (FL mm) by year for red grouper age samples collected from the commercial fishery in the Gulf of Mexico from 1978 to 2022. The number of observations is shown at the top right of each panel.

Figure 14. Frequency histograms (bin width = 50 mm) of final length (FL mm) by year for red grouper age samples collected during scientific surveys (FI) in the Gulf of Mexico from 1978 to 2022. The number of observations is shown at the top right of each panel. Some values (bars) in early years (e.g., 1981) may be excluded from a plot if values exceeded the y-axis limit.

Figure 15. Mode-predicted ages versus primary reader age (Read age) for each primary reader versus the reference set. The red solid line indicates the expected age (1:1 line), dashed lines indicate the 95% CI around expected age, and the solid blue line indicates the SD-at-age. Error parameters for primary reader 2 were mirrored to the parameter estimates for primary reader 1 to produce a single ageing error matrix of SD-at-age. The SD-at-age estimates were fitted with a curvilinear CV parameter. Reference set ages are assumed to be unbiased and have no error in this model scenario.

Table 1a. Number of commercial handline samples available vs. samples selected using the PC Lab subsampling strategy for age samples collected from the new data period (2018 – 2022).

Commercial Handlines										
	2018		2019		2020		2021		2022	
Grid	Available	Sub-Sampled	Available	Sub-Sampled	Available	Sub-Sampled	Available	Sub-Sampled	Available	Sub-Sampled
0					8					
1					4	3				
2	6	6	12	7	6	6	6	6		
3	46	46	222	49	331	49	122	49	34	34
4	498	168	1066	168	614	168	192	168	215	168
5	57	57	103	103	159	112	279	112	327	112
6	443	61	368	61	459	61	540	61	941	61
7	701	78	700	78	621	78	780	78	512	78
8	62	21	84	21	90	21	30	21	122	21
9	2	1								
10	19	19	37	1	16	1	9	1	19	1
11	6	6	1	1			2	2	1	1
12					2	1				
13										
14										
15			2	2			2	2		
Total	1,840	463	2,595	491	2,310	500	1,962	500	2,171	476

Table 1b. Number of commercial longline samples available vs. samples selected using the PC Lab subsampling strategy for age samples collected from the new data period (2018 – 2022).

Commercial Longlines										
	2018		2019		2020		2021		2022	
Grid	Available	Sub-Sampled	Available	Sub-Sampled	Available	Sub-Sampled	Available	Sub-Sampled	Available	Sub-Sampled
0			9							
1	6	6	20	1			31	1	5	1
2	118	14	30	14					20	14
3	216	35	186	35	86	35	19	19	101	35
4	664	187	478	187	277	187	175	175	764	187
5	833	214	608	214	484	214	501	214	1,183	214
6	92	28	281	28	71	28	302	28	946	28
7	111	11	52	11	26	11	159	11	173	11
8	34	9	31	9	4	4				
9			2	1						
10	1	1								
11										
12										
13										
14	1	1								
15							10	10		
Total	2,076	506	1,697	500	948	479	1,197	458	3,192	490

Table 2. Number of red grouper (calendar) age samples by year collected from the Gulf of Mexico from 1978 to 2022. No otolith samples were collected in 1978, from 1982-1984, or in 1990.

Year	FWRI	GulfFIN	AGR	BSD	USF	Total
1979			75			75
1980			8			8
1981			304			304
1985			1			1
1986			8			8
1987			11			11
1988			10			10
1989			11			11
1991			119			119
1992			272			272
1993			494			494
1994			519			519
1995			528			528
1996			438			438
1997			158			158
1998			299			299
1999			885			885
2000			794			794
2001			2046			2046
2002		5	2135			2140
2003		6	2016			2022
2004		14	2876			2890
2005		3	2403			2406
2006	82	5	1522			1609
2007	193	2	1360			1555
2008	80		1413			1493
2009	322	1	4538			4861
2010	946	7	2449			3402
2011	503	8	2278	1145	364	4298
2012	592	2	1166	1331		3091
2013	807		997	1159		2963
2014	529	2	576	1366		2473
2015	440	318	391	1119		2268
2016	343	364	156	1155		2018
2017	512	230	81	1078		1901
2018	244	247	73	1001		1565
2019	54	521	193	1091		1859
2020	3	250	78	1102		1433
2021	69	323	163	999		1554
2022	179	175	109	953		1416
Percent	10.5	4.4	60.4	24.0	0.6	100.0
Total	5898	2483	33953	13499	364	56197

Table 3. Number of red grouper age samples by state landed (Alabama, AL; Florida, FL; Louisiana, LA; Mississippi, MS; Texas, TX; or not landed, NL) collected from the Gulf of Mexico from 1978 to 2022. No age samples were collected in 1978, from 1982-1984, or in 1990.

Year	AL	FL	LA	MS	TX	NL	Total
1979		75					75
1980		8					8
1981		304					304
1985		1					1
1986		8					8
1987		11					11
1988		10					10
1989		11					11
1991		119					119
1992		267		5			272
1993		494					494
1994		519					519
1995		523		5			528
1996		438					438
1997		158					158
1998		299					299
1999		885					885
2000		794					794
2001		2046					2046
2002	7	2128		5			2140
2003	13	1999	8	2			2022
2004	27	2863					2890
2005	8	2396	2				2406
2006	7	1514	6			82	1609
2007	6	1355	1			193	1555
2008	4	1405	4			80	1493
2009	5	4532	2			322	4861
2010	12	2436	8			946	3402
2011	15	3776	3		1	503	4298
2012	11	2476	11		1	592	3091
2013	9	2142	4		1	807	2963
2014	8	1936				529	2473
2015	3	1823		1	1	440	2268
2016	6	1665	4			343	2018
2017	2	1387				512	1901
2018	1	1318	2			244	1565
2019	1	1802	2			54	1859
2020		1429	1			3	1433
2021	3	1480	2			69	1554
2022		1237				179	1416
Percent	0.3	89.1	0.1	0.0	0.0	10.5	100.0
Total	148	50069	60	18	4	5898	56197

Table 4. Number of red grouper age samples by sampling program collected from the Gulf of Mexico from 1978 to 2022. No age samples were collected in 1978, from 1982-1984, or in 1990.

Year	ALLIANCE	CO-OP	CO-OP_WARD	EASA	FIN-BIOSTAT	FIN-OBS	FWRI	FWRI-FIM	FWRI-OBS	GOP
1979										
1980										
1981										
1985										
1986										
1987										
1988										
1989										
1991										
1992										
1993										
1994										
1995										
1996										
1997										
1998							13			
1999										
2000										
2001		2								
2002		310			5		18			
2003		52			6		28			
2004		474			14		63			
2005		453			3	18	20			
2006					5		33	82		
2007					2	1	105	193		
2008							98	80		
2009			2216		1		670	322	105	10
2010	16				7		45	946	109	
2011				1013	8		403	503	63	
2012		158			2		78	592	40	210
2013								807	81	625
2014					2			529	9	338
2015								440	205	275
2016					4			343	246	50
2017								512	133	
2018								244	146	15
2019					1			54	244	33
2020								3	64	12
2021					1			69	160	9
2022								179	102	58
Percent	0.0	2.6	3.9	1.8	0.1	0.0	2.8	10.5	3.0	2.9
Total	16	1449	2216	1013	61	19	1574	5898	1707	1635

Table 4 cont. Number of red grouper age samples by sampling program collected from the Gulf of Mexico from 1978 to 2022. No age samples were collected in 1978, from 1982-1984, or in 1990.

Year	GRFS	HB	MRFSS	MSLAB	PCLAB	RECFIN	REPBIO	SBLOP	SRFS	SRH	TIP	USF	USGS	UN	Total
1979					75										75
1980		6												2	8
1981		14		78										212	304
1985		1													1
1986		8													8
1987		11													11
1988		10													10
1989		11													11
1991		32									87				119
1992		31		5							234			2	272
1993		18									476				494
1994		23		6	6						484				519
1995		30		23							475				528
1996		33									405				438
1997		10									148				158
1998				7	3						276				299
1999		2	33	11	9						830				885
2000		11	12	1	87						683				794
2001			31	82	98						1832		1		2046
2002		1	3	30	215	110					1447			1	2140
2003		29	14	59	47	107					1680				2022
2004		41	68	166	185	87					1792				2890
2005		29		50	127	67					1639				2406
2006		21		56	32	33					1347				1609
2007		21	6	50	24	32		100			1021				1555
2008		9	18	41	92	112		9			1034				1493
2009		9	8	96	132	87					1205				4861
2010		18	35	191	100	241		145			1549				3402
2011		35	68	147	138	411					1145	364			4298
2012		33	18	140	95	157		237			1331				3091
2013		16		56	23	196					1159				2963
2014		27		34	58	110					1366				2473
2015	45	41		44	35	63		1			1119				2268
2016	62	28		37	41	52					1155				2018
2017	82			39	42	15				7	1071				1901
2018	83			31	27	14	4			18	983				1565
2019	98			39	68	9	169	53		50	1041				1859
2020	50			30	36		88		48	9	1093				1433
2021				39	115		117		45	4	995				1554
2022				15	36		56		17	5	948				1416
Percent	0.7	1.1	0.6	2.9	3.5	3.4	0.8	1.0	0.2	0.2	57.0	0.6	0.0	0.4	100
Total	420	609	314	1603	1946	1903	434	545	110	93	32050	364	1	217	56197

Table 5. Number of red grouper age samples by fishing mode (charterboat, CB; commercial, CM; headboat, HB; observer, OB; private, PR; recreational, REC; scientific survey, SS; tournament, TRN; exempted fishing permit, EFP; or unknown, UN) collected from the Gulf of Mexico from 1978 to 2022. No age samples were collected in 1978, from 1982-1984, or in 1990.

Year	CB	CM	HB	OB	PR	REC	SS	TRN	CB_EFP	HB_EFP	PR_EFP	UN	Total
1979						75							75
1980			6			2							8
1981		212	14				78						304
1985			1										1
1986			8										8
1987			11										11
1988			10										10
1989			11										11
1991	1	82	36										119
1992	26	197	33		1		5	8				2	272
1993	61	377	21		1		5	29					494
1994	72	356	29				12	50					519
1995	91	359	53				23	1				1	528
1996	139	196	42	56			5						438
1997	61	60	28		9								158
1998	72	194	21		4		8						299
1999	104	751	8		2		20						885
2000	59	655	12				68						794
2001	46	1846	1		2		151						2046
2002	294	1729	50		5		43	19					2140
2003	101	1710	30		68		106	6				1	2022
2004	144	2205	43	50	29		407					12	2890
2005	64	2087	52		1		197					5	2406
2006	38	1340	33		4		191	1				2	1609
2007	52	1093	28		8		372					2	1555
2008	73	1012	44		32		311	7				14	1493
2009	90	3415	109		26		1206		1	13		1	4861
2010	263	1712	86		41		1279			2		19	3402
2011	413	1145	114		26		2237				327	36	4298
2012	224	1920	39		14		871					23	3091
2013	216	1784	45		25		878					15	2963
2014	114	1681	30		19		606	23					2473
2015	226	1395	71		64		495					17	2268
2016	227	1205	99		75		403					9	2018
2017	139	1071	28		87		564					12	1901
2018	185	988	49		42		286	10				5	1565
2019	427	1111	105		98		101	8				9	1859
2020	193	1105	15		87		33						1433
2021	367	1004	25		50		108						1554
2022	179	1006	18		19		194						1416
Percent	8.5	65.8	2.6	0.2	1.5	0.1	20.0	0.3	0.0	0.0	0.6	0.3	100.0
Total	4761	37003	1458	106	839	77	11263	162	1	15	327	185	56197

Table 6. Number of red grouper age samples by gear group code (dipnet, DN; handline, HL; bottom longline, LL; spearfishing, SP; trap, TR; trawl, TW; vertical longline, VLL; or unknown; UN) collected from the Gulf of Mexico from 1978 to 2022. No age samples were collected in 1978, from 1982-1984, or in 1990.

Year	DN	HL	LL	SN	SP	TR	TW	VL	Other	UN	Total
1979		75									75
1980		8									8
1981		237	4			62				1	304
1985		1									1
1986		8									8
1987		11									11
1988		10									10
1989		11									11
1991		80	37			2					119
1992		111	145			14				2	272
1993		205	200			89					494
1994		396	88			35					519
1995		344	140			43				1	528
1996		328	96		6	8					438
1997		133	7		1	17					158
1998		144	122			33					299
1999		211	643			31					885
2000		344	405		6	39					794
2001		699	1301		3	43					2046
2002		927	1083		23	107					2140
2003		781	1139		14	79	9				2022
2004		1426	1318		4	90	52				2890
2005		821	1488		4	88	4			1	2406
2006		712	628			228	28	13			1609
2007		654	674		11	58	106	52			1555
2008		666	539		26	151	97			14	1493
2009		1811	2097		25	484	264	180			4861
2010		1590	738		61	331	97	585			3402
2011		1598	1951		38	511	76	124			4298
2012		1313	972		55	465	115	171			3091
2013		1092	1257	1	101	349	63	100			2963
2014	13	839	924		144	292	132	129			2473
2015		1174	630		76	246	129	13			2268
2016		1182	620		29	23	61	103			2018
2017		1118	557		25	97	82	22			1901
2018		880	538		25	43	61	8		10	1565
2019		1151	581		49	8		14	2	54	1859
2020		798	504		74			53	1	3	1433
2021		944	493		34	12	69		2		1554
2022		766	533		6		99		1	11	1416
Percent	0.0	45.6	40.0	0.0	1.5	7.3	2.7	2.8	0.0	0.2	100.0
Total	13	25599	22452	1	840	4078	1544	1567	6	97	56197

Table 7. Number of red grouper age samples by fishing mode (charterboat, CB; commercial, CM; headboat, HB; observer, OB; private, PR; recreational, REC; scientific survey, SS; tournament, TRN; exempted fishing permit, EFP; or unknown, UN) and gear group (handline, HL; bottom longline, LL; spearfishing, SP; trap, TR; trawl, TW; vertical longline, VL; dipnet, DN; seine net, SN; Other Gears, Other; or unknown gear; UN) collected from the Gulf of Mexico from 1978 to 2022. No age samples were collected in 1978, from 1982-1984, or in 1990.

	CB			**CM**					**HB**	**OB**		
Year	HL	LL	SP	HL	LL	SP	TR	VL	HL	HL	LL	TR
1979												
1980									6			
1981				212					14			
1985									1			
1986									8			
1987									11			
1988									10			
1989									11			
1991	1			43	37		2		36			
1992	24	2		42	141		14		33			
1993	61			93	200		84		21			
1994	72			239	88		29		29			
1995	91			180	140		39		53			
1996	139			86	96	6	8		42	56		
1997	61			35	7	1	17		28			
1998	72			39	122		33		21			
1999	104			77	643		31		8			
2000	59			206	405	6	38		12			
2001	46			581	1222	3	40		1			
2002	288		6	572	1067	1	89		50			
2003	101			561	1080	4	65		30			
2004	144			1054	1114	1	36		43	8	40	2
2005	64			627	1456	4			52			
2006	38			629	538		173		33			
2007	46		6	497	596				28			
2008	63		10	503	509				44			
2009	87		3	1191	2033	11		180	109			
2010	262		1	521	650	32		509	86			
2011	413			515	499	17		114	114			
2012	224			852	861	40		167	39			
2013	216			528	1148	78		30	45			
2014	114			554	902	121		104	30			
2015	226			749	587	59			71			
2016	227			538	586	17		64	99			
2017	139			529	523	13		6	28			
2018	185			458	512	18			49			
2019	427			503	556	38		14	105			
2020	193			505	474	73		53	15			
2021	367			505	454	33	12		25			
2022	179			482	518	6			18			
Percent	8.4	0.0	0.0	26.2	35.2	1.0	1.3	2.2	2.6	0.1	0.1	0.0
Total	4733	2	26	14706	19764	582	710	1241	1458	64	40	2

Table 7 cont. Number of red grouper age samples by fishing mode (charterboat, CB; commercial, CM; headboat, HB; observer, OB; private, PR; recreational, REC; scientific survey, SS; tournament, TRN; exempted fishing permit, EFP; or unknown, UN) and gear group (handline, HL; bottom longline, LL; spearfishing, SP; trap, TR; trawl, TW; vertical longline, VL; dipnet, DN; seine net, SN; Other Gears, Other; or unknown gear; UN) collected from the Gulf of Mexico from 1978 to 2022. No age samples were collected in 1978, from 1982-1984, or in 1990.

	PR			REC	SS								
Year	HL	Other	SP	HL	DN	HL	LL	SN	SP	TR	TW	VL	UN
1979				75									
1980				2									
1981						11	4			62			1
1985													
1986													
1987													
1988													
1989													
1991													
1992	1					5							
1993	1									5			
1994						6				6			
1995						19				4			
1996						5							
1997	9												
1998	4					8							
1999	2					20							
2000						67				1			
2001	2					69	79			3			
2002	5					9	16			18			
2003	64		4			24	59			14	9		
2004	27		2			138	164		1	52	52		
2005	1					72	32			88	4		1
2006	4					5	90			55	28	13	
2007	8					73	78		5	58	106	52	
2008	25		7			31	30		2	151	97		
2009	15		11			394	64			484	264		
2010	30		11			687	88			331	97	76	
2011	26					188	1452			511	76	10	
2012	12		2			176	111			465	115	4	
2013	17		8			286	109	1		349	63	70	
2014	19				13	122	22			292	132	25	
2015	62		2			64	43			246	129	13	
2016	72		3			246	34			23	61	39	
2017	87					335	34			97	82	16	
2018	40		2			138	26			43	61	8	10
2019	94	2	2			14	25			8			54
2020	85	1	1				30						3
2021	47	2	1				39				69		
2022	18	1				69	15				99		11
	1.4	0.0	0.1	0.1	0.0	5.8	4.7	0.0	0.0	6.0	2.7	0.6	0.1
	777	6	56	77	13	3281	2644	1	8	3366	1544	326	80

Table 7 cont. Number of red grouper age samples by fishing mode (charterboat, CB; commercial, CM; headboat, HB; observer, OB; private, PR; recreational, REC; scientific survey, SS; tournament, TRN; exempted fishing permit, EFP; or unknown, UN) and gear group (handline, HL; bottom longline, LL; spearfishing, SP; trap, TR; trawl, TW; vertical longline, VL; dipnet, DN; seine net, SN; Other Gears, Other; or unknown gear; UN) collected from the Gulf of Mexico from 1978 to 2022. No age samples were collected in 1978, from 1982-1984, or in 1990.

	TRN			CB_EFP	HB_EFP	PR_EFP		UN			
Year	HL	LL	SP	HL	HL	HL	SP	HL	SP	UN	**Total**
1979											75
1980											8
1981											304
1985											1
1986											8
1987											11
1988											10
1989											11
1991											119
1992	6	2								2	272
1993	29										494
1994	50										519
1995	1									1	528
1996											438
1997											158
1998											299
1999											885
2000											794
2001											2046
2002	3		16								2140
2003			6					1			2022
2004								12			2890
2005								5			2406
2006	1							2			1609
2007								2			1555
2008			7							14	1493
2009				1	13			1			4861
2010					2			2	17		3402
2011						326	1	16	20		4298
2012								10	13		3091
2013									15		2963
2014			23								2473
2015								2	15		2268
2016									9		2018
2017									12		1901
2018	10								5		1565
2019	8								9		1859
2020											1433
2021											1554
2022											1416
	0.2	0.0	0.1	0.0	0.0	0.6	0.0	0.1	0.2	0.0	100.0
	108	2	52	1	15	326	1	53	115	17	56197

Table 8. Mean and standard deviation (SD) of red grouper Final Age (yr), Length (FL, mm), and Weight (whole, g) age samples collected from the Gulf of Mexico from 1978 to 2022. No age samples were collected in 1978, from 1982-1984, or in 1990.

Year	n	Mean Age	SD Age	Mean FL	SD FL	Mean WWt	SD WWt
1979	75	10.12	4.10	669.76	89.55	5531.57	2198.75
1980	8	11.75	7.17	719.00	78.33	7255.00	2877.72
1981	304	5.26	2.89	451.59	121.75	1946.69	1473.08
1985	1	3.00	NA	388.56	NA	1250.00	NA
1986	8	3.25	1.49	367.30	105.39	1070.00	1082.67
1987	11	3.91	1.92	437.01	135.48	2071.82	2663.95
1988	10	6.30	1.70	574.76	98.27	3932.00	2064.00
1989	11	4.09	2.74	443.23	161.20	1983.64	2264.50
1991	119	8.43	4.10	658.04	110.03	5494.39	2641.39
1992	272	7.35	2.56	622.27	95.87	4371.03	2250.65
1993	494	6.90	2.29	611.94	92.71	4241.72	2081.33
1994	519	6.66	2.70	583.09	97.37	3731.59	2138.00
1995	528	7.13	2.48	590.86	93.70	3870.17	2111.28
1996	438	6.75	1.87	563.57	99.75	3348.31	1886.93
1997	158	6.93	2.16	582.59	92.58	3503.18	1969.55
1998	299	6.96	2.00	592.05	83.48	3728.57	1837.71
1999	885	8.11	2.22	604.99	85.05	4089.93	1881.07
2000	794	7.42	2.96	593.70	93.86	3929.14	1966.68
2001	2046	7.13	2.85	583.30	93.43	3719.17	1995.01
2002	2140	7.94	3.23	596.17	95.69	3990.73	2156.09
2003	2022	8.22	3.47	589.40	102.24	3894.12	2200.00
2004	2890	7.50	3.26	567.39	109.15	3521.07	2133.07
2005	2406	7.39	2.73	574.52	90.64	3499.20	1865.42
2006	1609	7.41	2.36	555.80	89.05	3157.96	1591.57
2007	1555	7.09	2.83	532.44	118.37	2958.48	1713.51
2008	1493	6.71	3.03	536.09	133.05	3117.37	1931.33
2009	4861	5.88	2.78	456.10	112.95	1898.07	1545.31
2010	3402	6.15	2.68	515.99	120.30	2739.35	1885.08
2011	4298	5.70	2.26	489.86	107.99	2269.73	1661.73
2012	3091	6.47	2.27	524.31	99.23	2677.36	1575.68
2013	2963	7.08	2.12	537.63	92.69	2882.15	1565.87
2014	2473	7.62	2.56	542.00	105.84	3021.65	1707.00
2015	2268	8.04	3.09	547.13	116.87	3120.00	1754.85
2016	2018	8.22	3.36	559.38	110.20	3351.28	1869.51
2017	1901	6.90	3.51	522.29	131.04	2888.75	1979.32
2018	1565	7.30	3.56	548.23	120.54	3224.71	2063.51
2019	1859	7.04	3.34	548.52	99.95	3064.07	1743.12
2020	1433	6.95	2.85	535.55	85.69	2815.02	1707.78
2021	1554	6.91	2.81	535.98	99.68	2858.75	1584.96
2022	1416	7.05	2.98	530.09	113.94	2853.07	1678.37

Figures

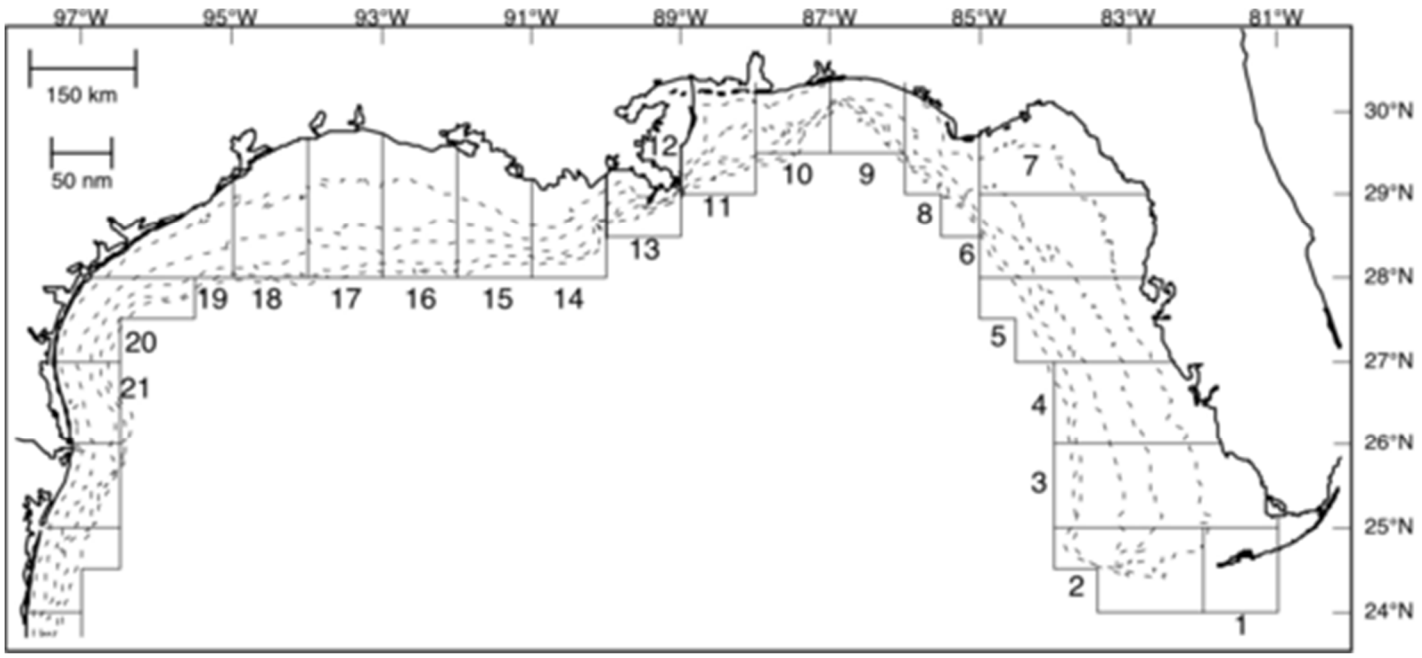

Figure 1. National Marine Fisheries statistical fishing grids for the Gulf of Mexico.

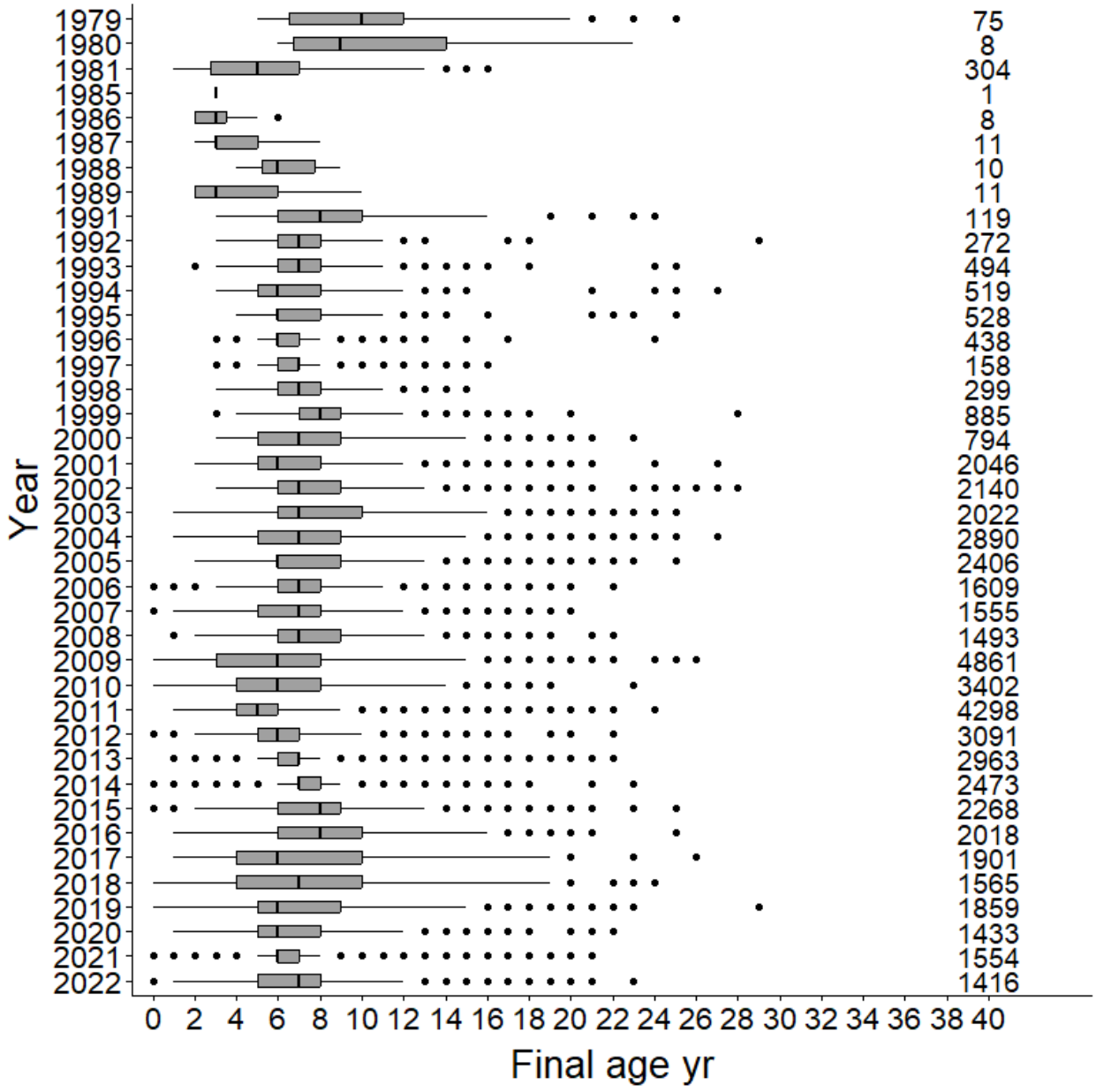

Figure 2. Boxplots of final age (yr) by year for red grouper age samples collected from the Gulf of Mexico from 1978 to 2022. Sample numbers are shown along the right side of the figure. Boxes indicate the 25th and 75th percentiles, vertical lines indicate median values, horizontal lines indicate the min and max values of the IQR*1.5, and points indicate values outside that range.

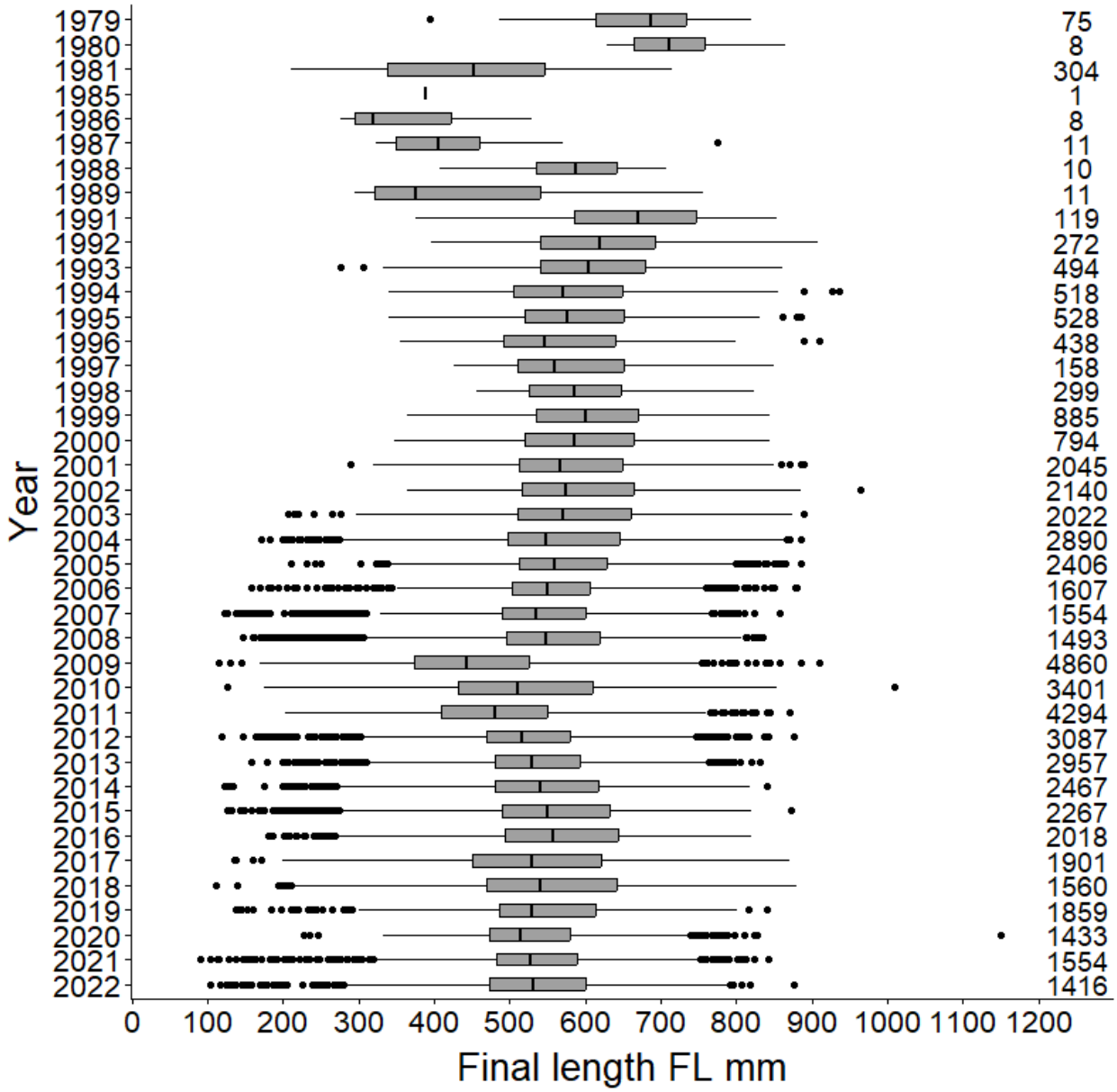

Figure 3. Boxplots of final length (FL mm) by year for red grouper age samples collected from the Gulf of Mexico from 1978 to 2022. Sample numbers are shown along the right side of the figure. Boxes indicate the 25th and 75th percentiles, vertical lines indicate median values, horizontal lines indicate the min and max values of the IQR*1.5, and points indicate values outside that range.

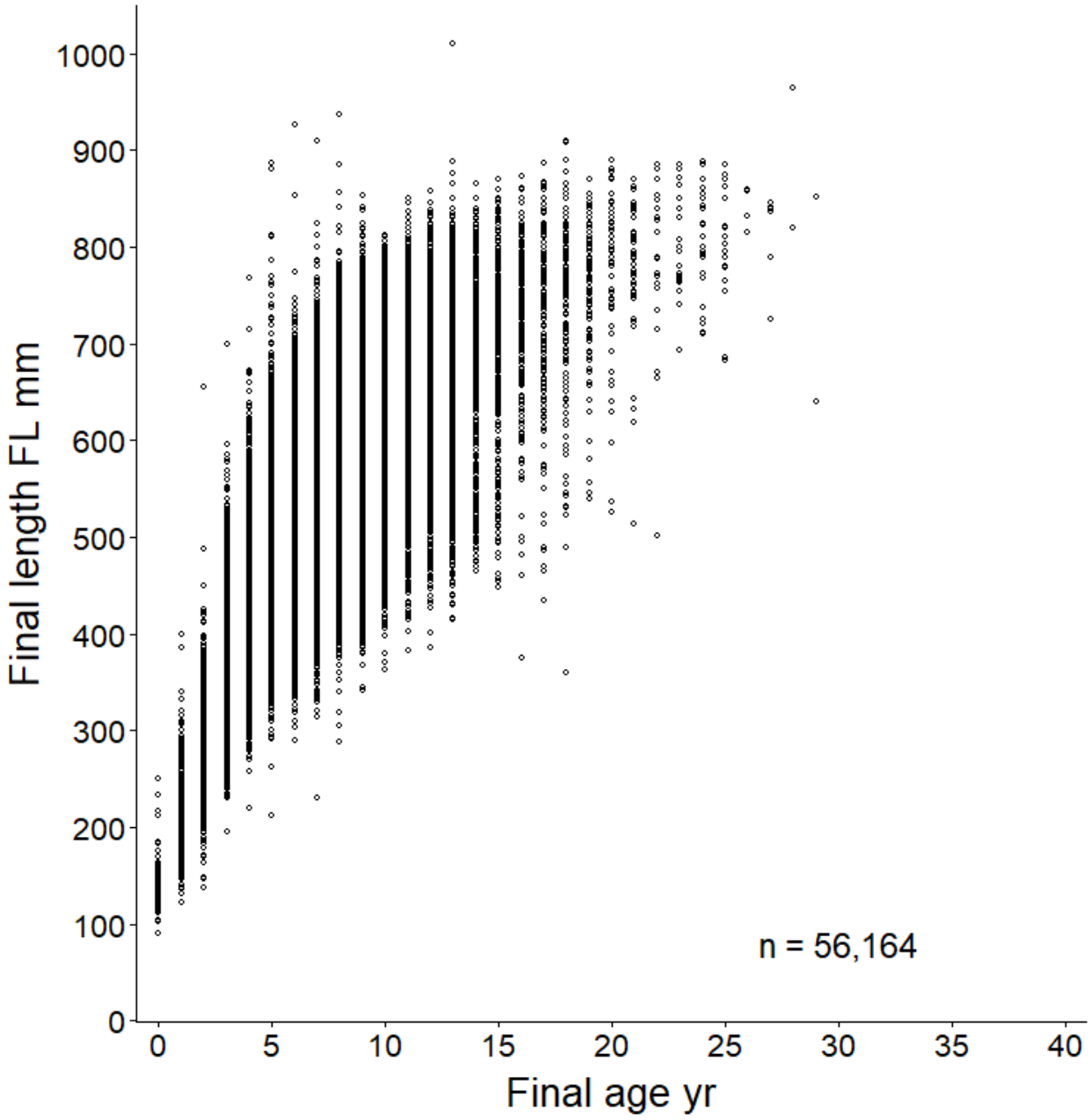

Figure 4. Scatterplot of final age (yr) vs final length (FL mm) for red grouper age samples collected from 1978 to 2022 from the Gulf of Mexico.

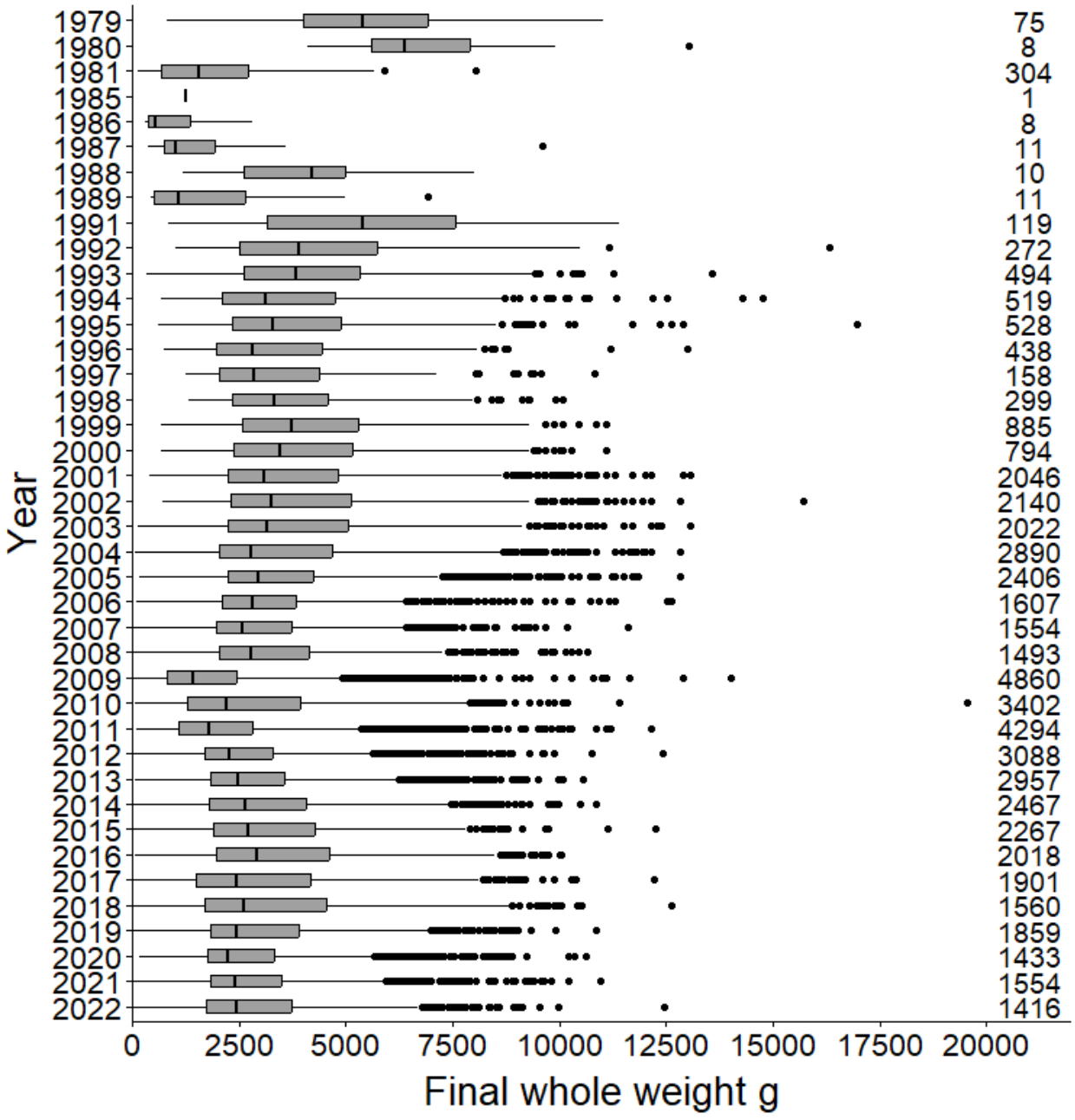

Figure 5. Boxplots of final whole weight (g) by year for red grouper age samples collected from the Gulf of Mexico from 1978 to 2022. Sample numbers are shown along the right side of the figure. Boxes indicate the 25th and 75th percentiles, vertical lines indicate median values, horizontal lines indicate the min and max values of the IQR*1.5, and points indicate values outside that range.

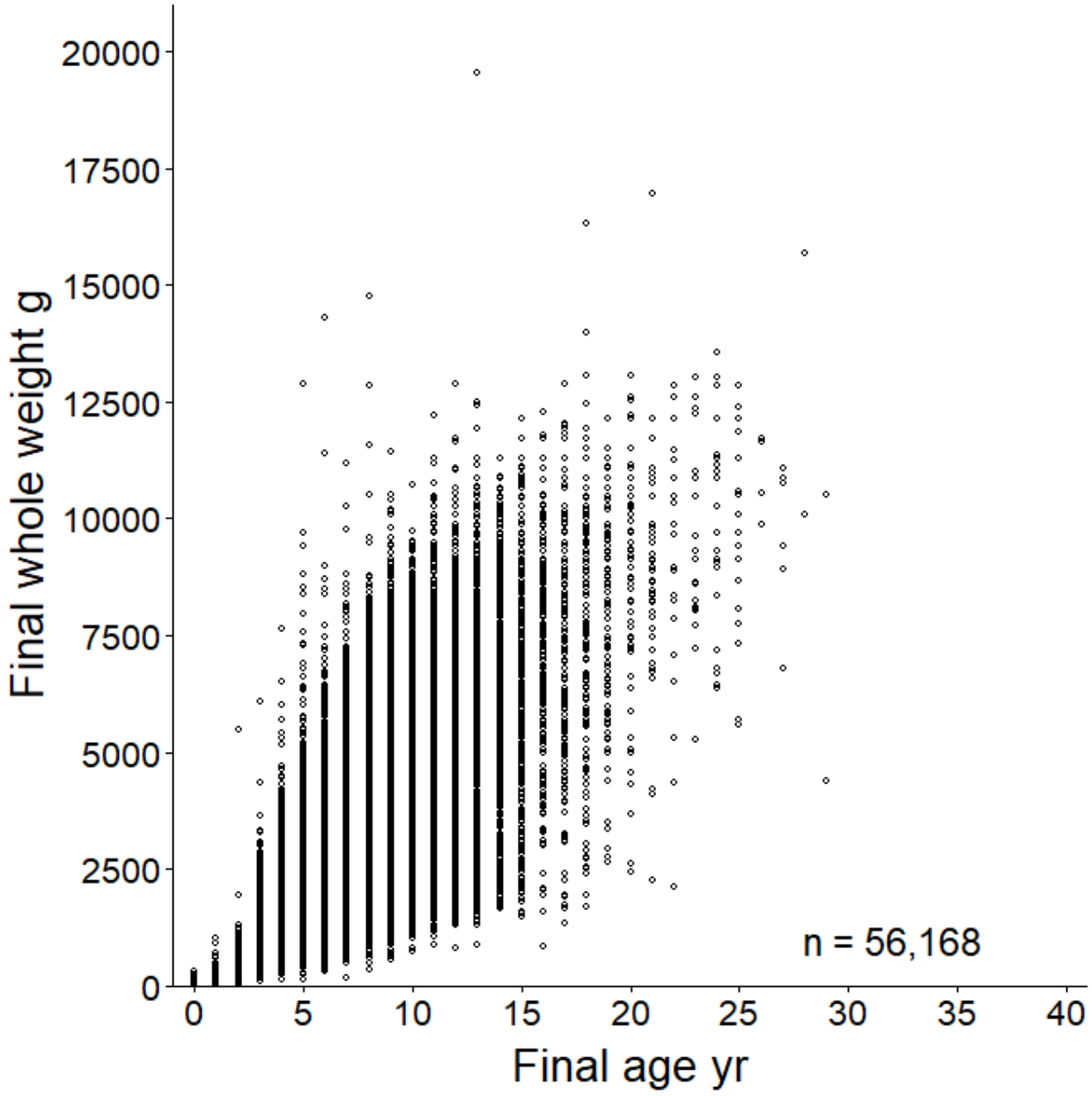

Figure 6. Scatterplot of final age (yr) versus final whole weight (g) for red grouper age samples collected from 1978 to 2022 from the Gulf of Mexico.

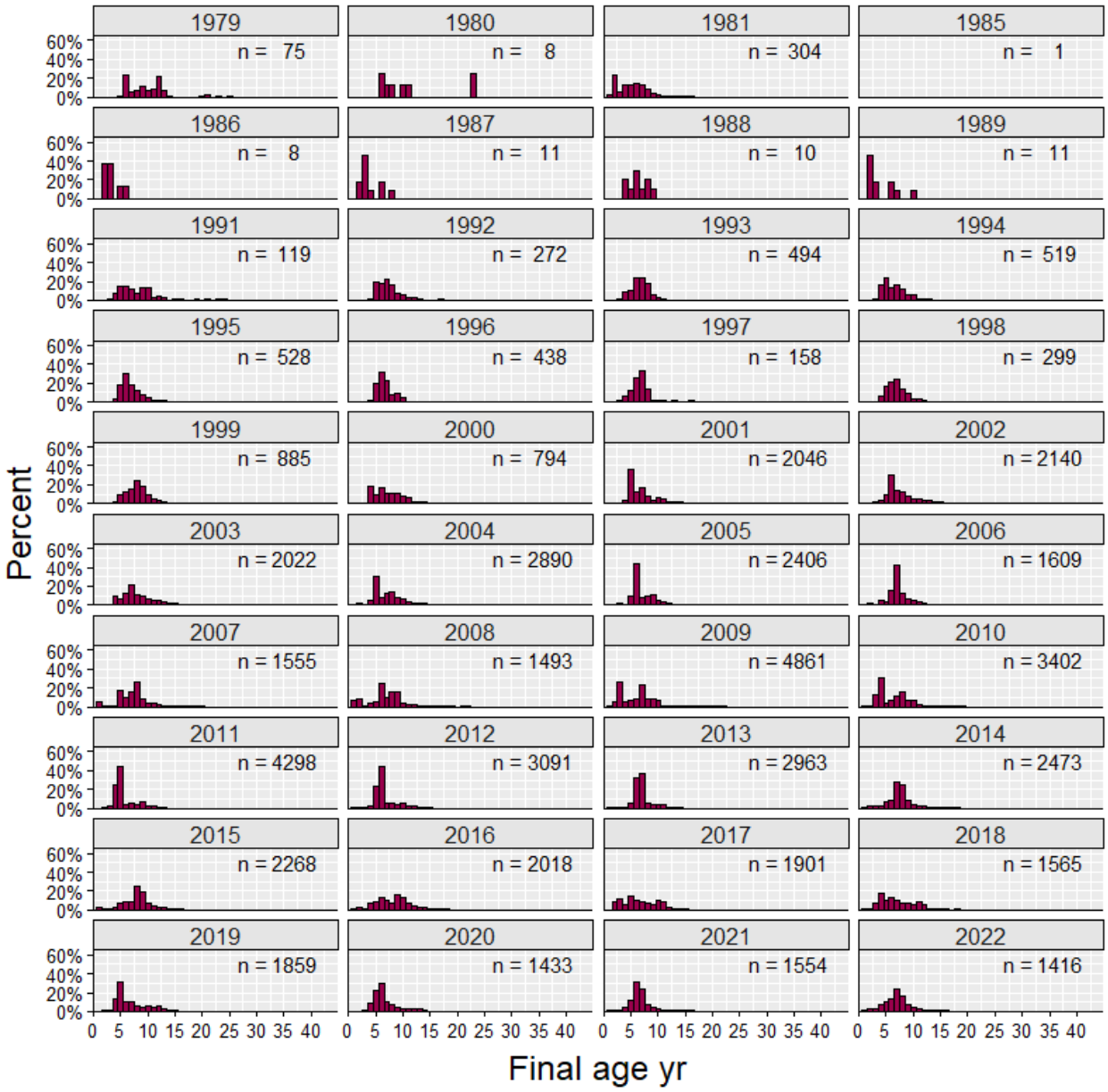

Figure 7. Frequency histograms of final age (yr) by year for all red grouper age samples collected from the Gulf of Mexico from 1978 to 2022. The number of observations is shown at the top right of each panel. Some values (bars) in early years (e.g., 1985, n = 1 = 100%) may be excluded from a plot if values exceeded the y-axis limit.

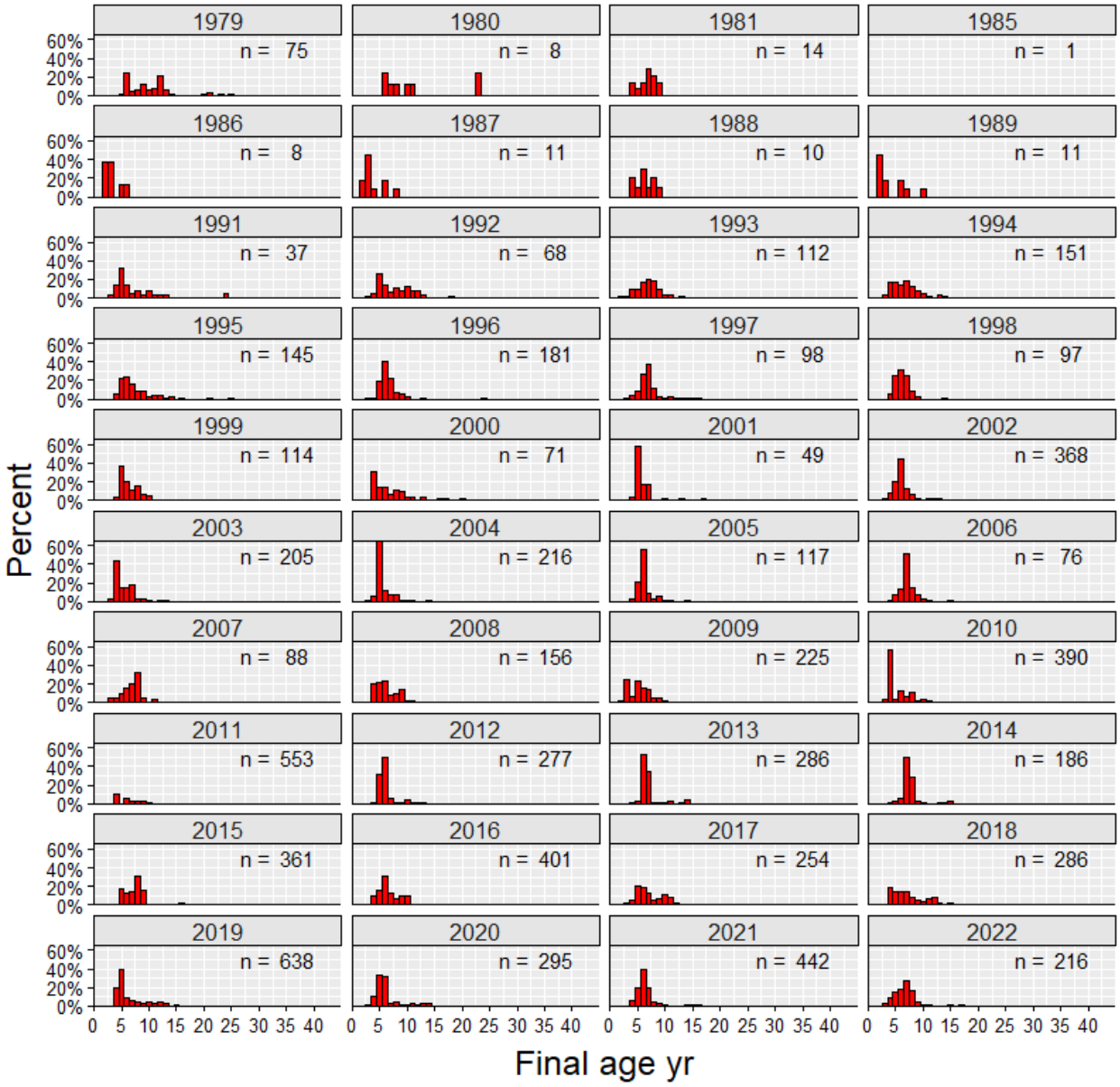

Figure 8. Frequency histograms of final age (yr) by year for red grouper age samples collected from the recreational fishery in the Gulf of Mexico from 1978 to 2022. The number of observations is shown at the top right of each panel. Some values (bars) in early years (e.g., 1985, n = 1 = 100%) may be excluded from a plot if values exceeded the y-axis limit.

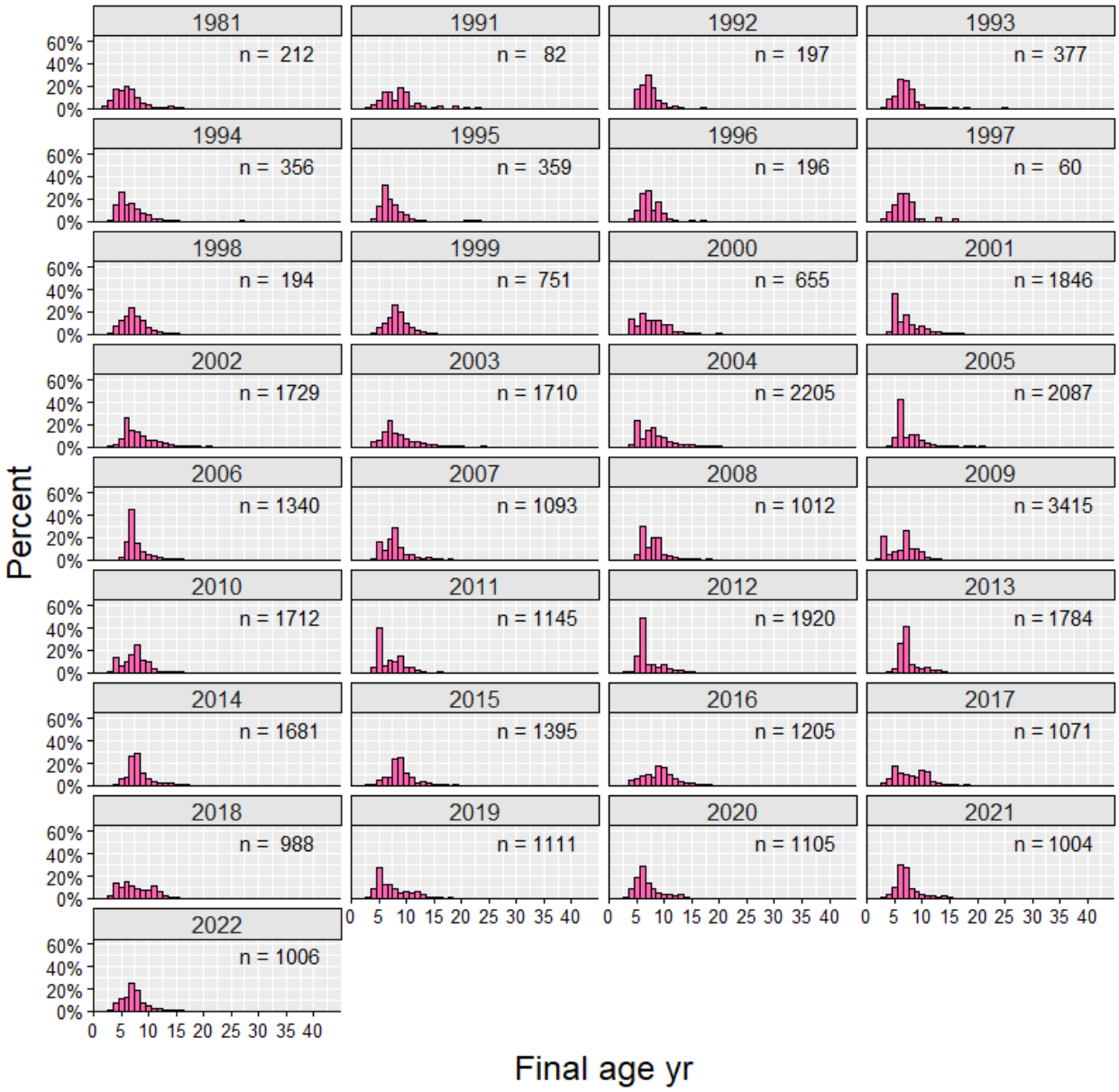

Figure 9. Frequency histograms of final age (yr) by year for red grouper age samples collected from the commercial fishery in the Gulf of Mexico from 1978 to 2022. The number of observations is shown at the top right of each panel.

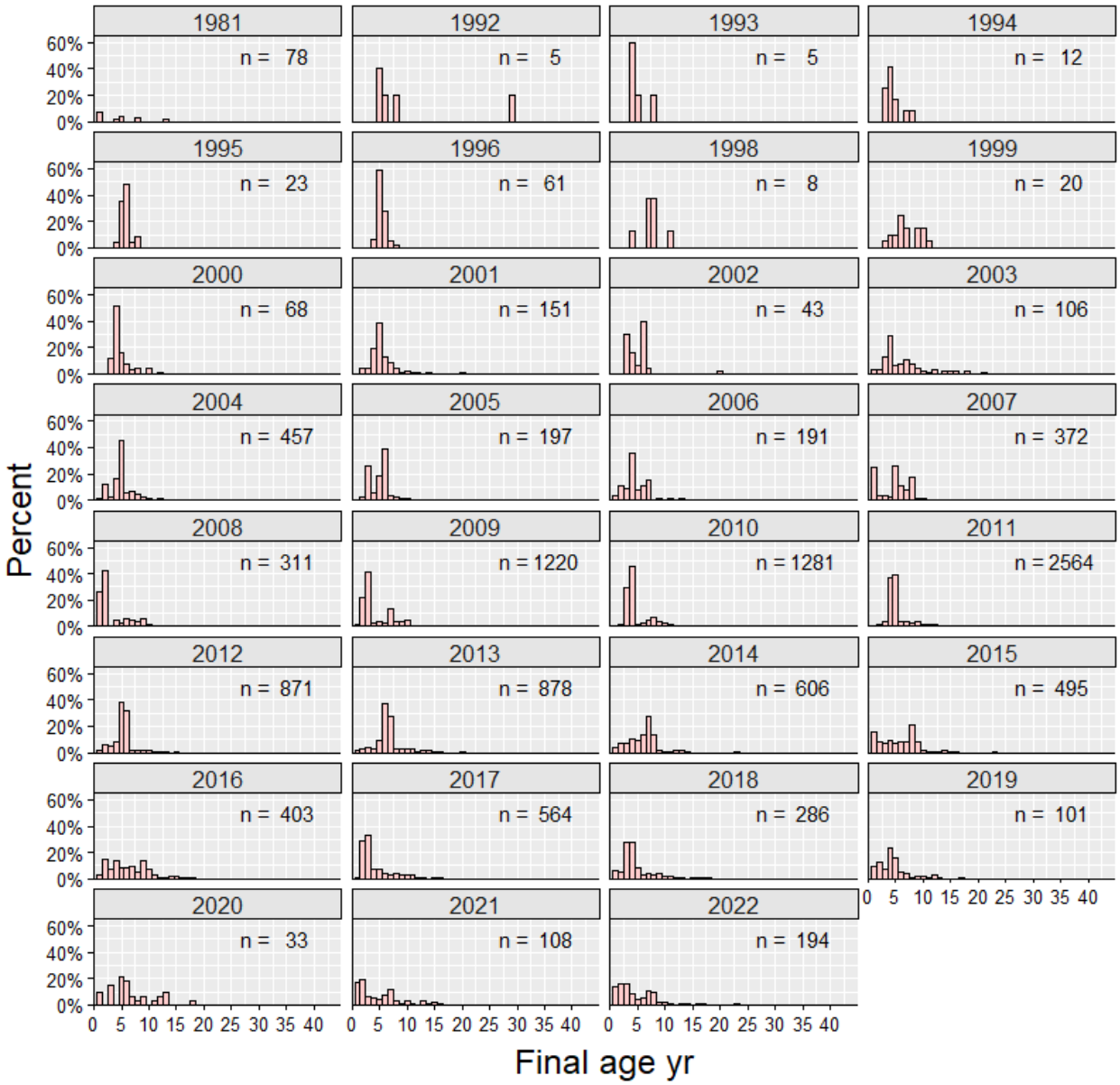

Figure 10. Frequency histograms of final age (yr) by year for red grouper age samples collected during scientific surveys (FI) in the Gulf of Mexico from 1978 to 2022. The number of observations is shown at the top right of each panel. Some values (bars) in early years (e.g., 1981) may be excluded from a plot if values exceeded the y-axis limit.

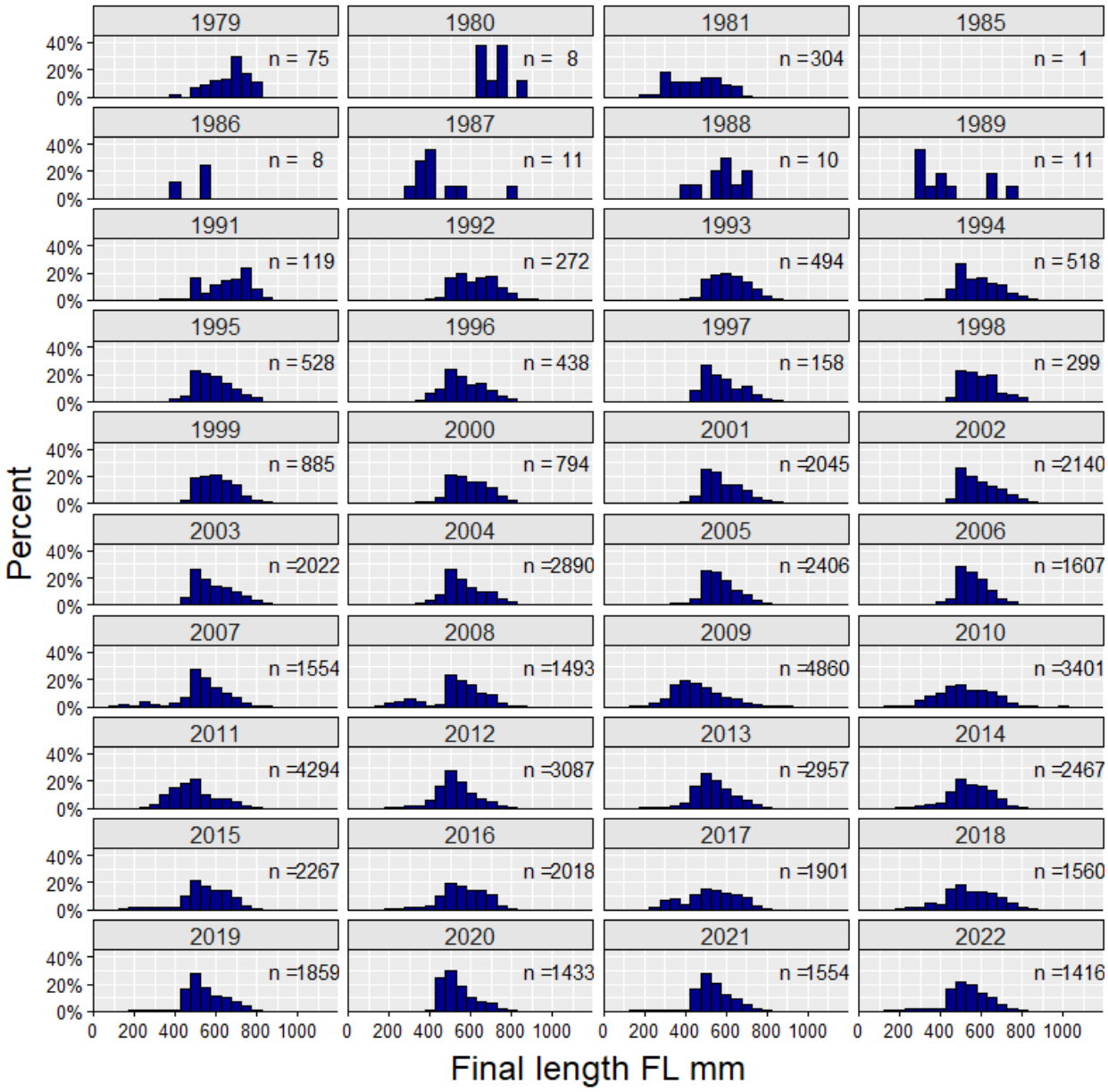

Figure 11. Frequency histograms (bin width = 50 mm) of final length (FL mm) by year for all red grouper age samples collected from the Gulf of Mexico from 1978 to 2022. The number of observations is shown at the top right of each panel. Some values (bars) in early years (e.g., 1985, n = 1 = 100%) may be excluded from a plot if values exceeded the y-axis limit.

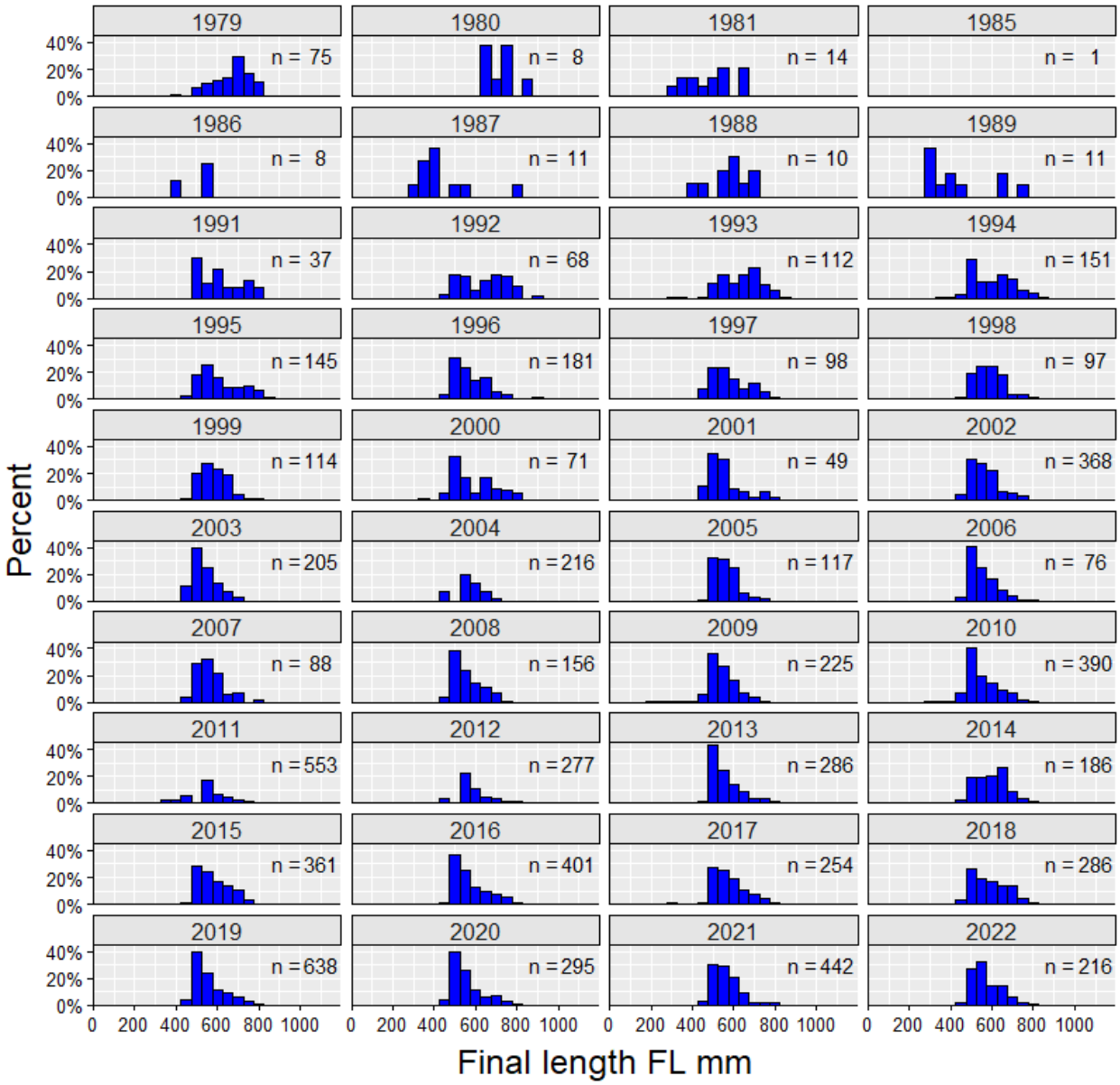

Figure 12. Frequency histograms (bin width = 50 mm) of final length (FL mm) by year for red grouper age samples collected from the recreational fishery in the Gulf of Mexico from 1978 to 2022. The number of observations is shown at the top right of each panel. Some values (bars) in early years (e.g., 1985, n = 1 = 100%) may be excluded from a plot if values exceeded the y-axis limit.

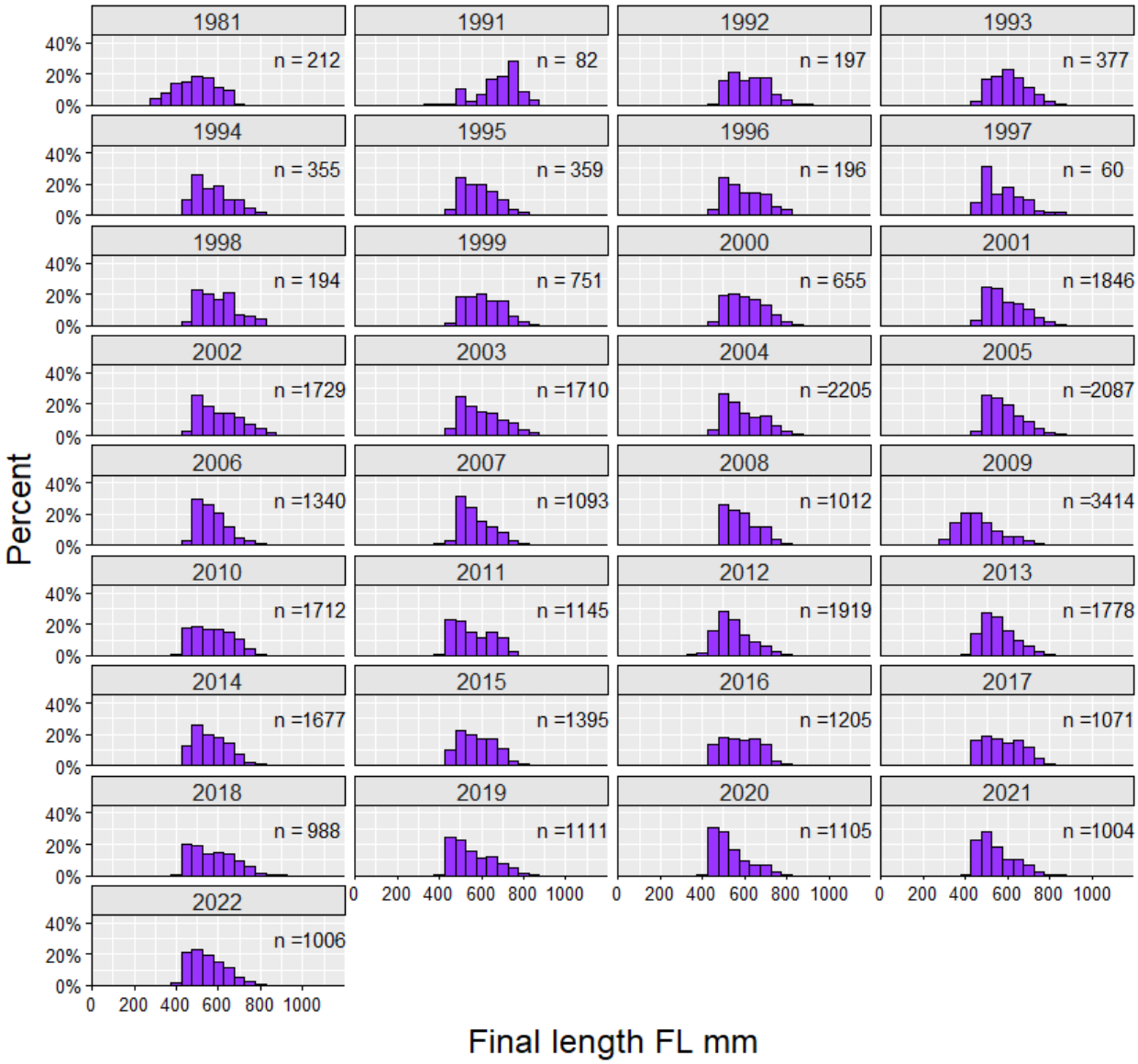

Figure 13. Frequency histograms (bin width = 50 mm) of final length (FL mm) by year for red grouper age samples collected from the commercial fishery in the Gulf of Mexico from 1978 to 2022. The number of observations is shown at the top right of each panel.

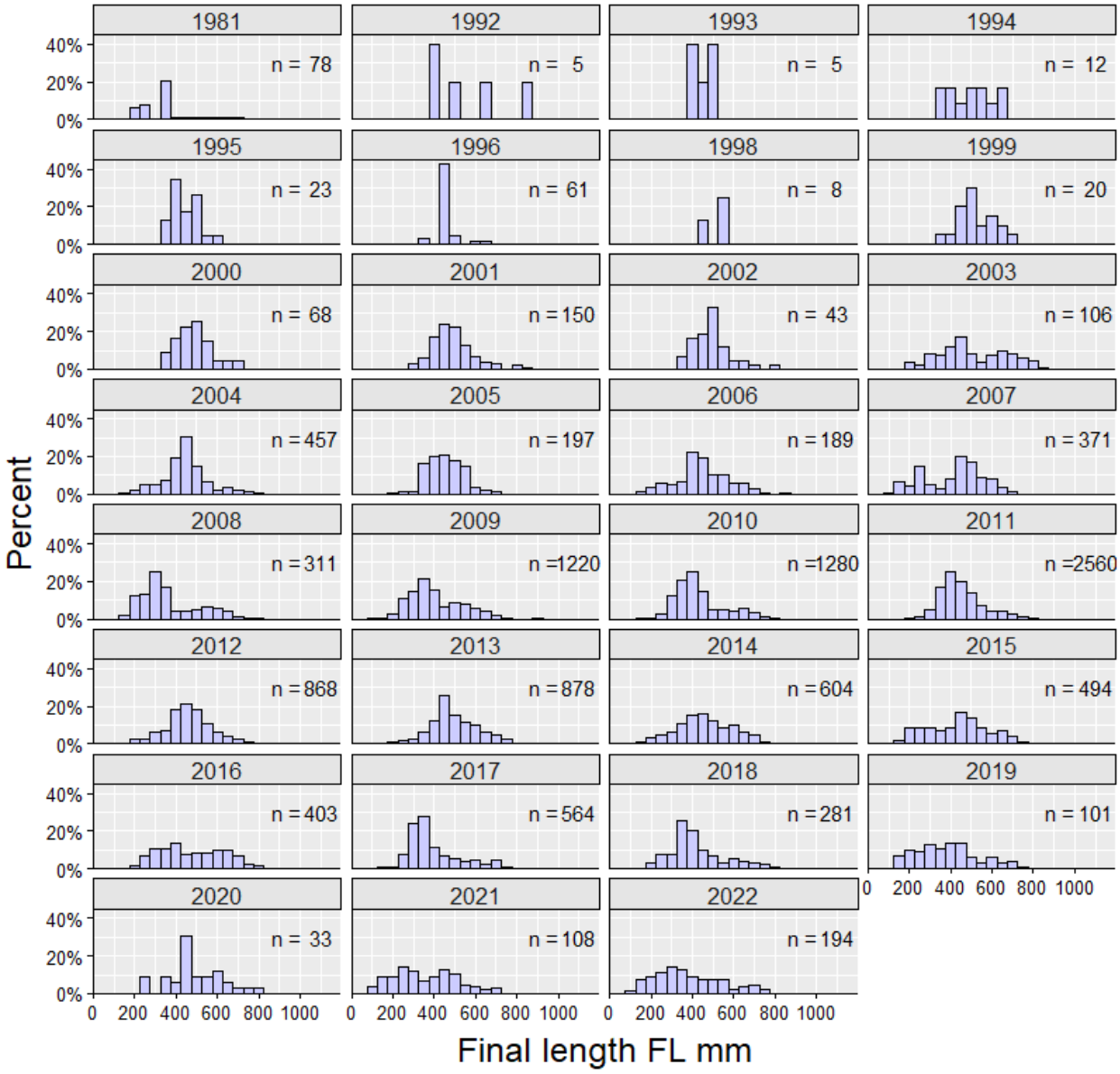

Figure 14. Frequency histograms (bin width = 50 mm) of final length (FL mm) by year for red grouper age samples collected during scientific surveys (FI) in the Gulf of Mexico from 1978 to 2022. The number of observations is shown at the top right of each panel. Some values (bars) in early years (e.g., 1981) may be excluded from a plot if values exceeded the y-axis limit.

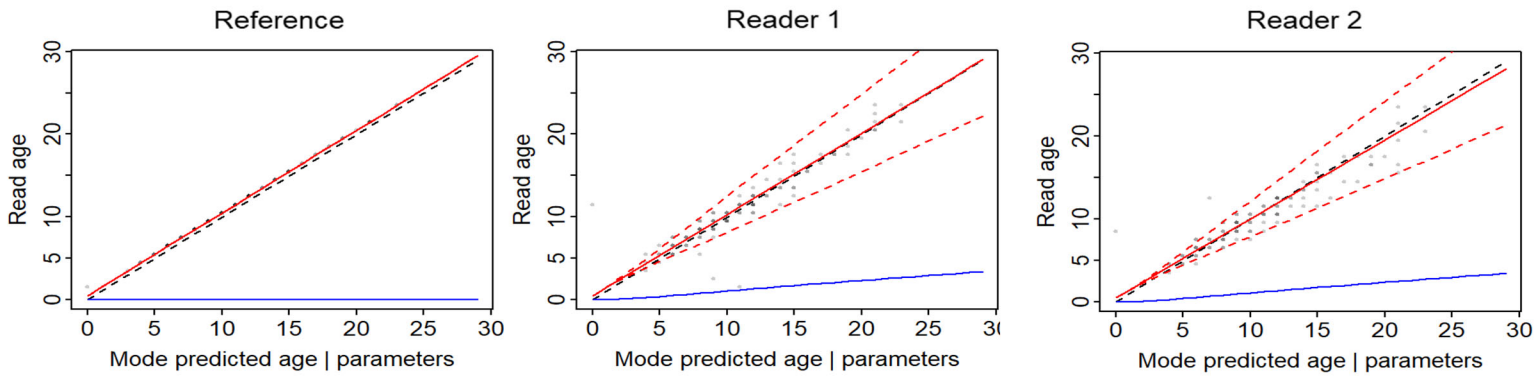

Figure 15. Mode-predicted ages versus primary reader age (Read age) for each primary reader versus the reference set. The red solid line indicates the expected age (1:1 line), dashed lines indicate the 95% CI around expected age, and the solid blue line indicates the SD-at-age. Error parameters for primary reader 2 were mirrored to the parameter estimates for primary reader 1 to produce a single ageing error matrix of SD-at-age. The SD-at-age estimates were fitted with a curvilinear CV parameter. Reference set ages are assumed to be unbiased and have no error in this model scenario.

Supplementary Tables

Supplementary Table 1. Example calculations for determining subsample size for the commercial handline fleet from all available otolith samples for a single year. Landings and proportions are estimated from the most recent 5 years of available data (2016 to 2020). Fleet specific sample totals will not meet the 500 sample target in some years depending on the number of samples available per grid.

Grid	Landings (lbs)	Proportion of total	Sample Target	Samples Available	Samples Selected
1	21142	0.002	1	6	1
2	331486	0.028	14	118	14
3	830814	0.070	35	216	35
4	4465494	0.374	187	664	187
5	5108714	0.428	214	833	214
6	679589	0.057	28	92	28
7	266308	0.022	11	111	11
8	213264	0.018	9	34	9
9	27096	0.002	1	0	0
10	58	0.000	0	1	0
11	3493	0.000	0	0	0
14	989	0.000	0	1	0
16	13	0.000	0	0	0
18	57	0.000	0	0	0
Total	11948517	1.000	500	2076	499

Supplementary Table 2. Regression parameters for red grouper (1978-2013) meristic equations from the Gulf of Mexico as prepared for SEDAR 42 (Table 2.14; 2015). See SEDAR 42 for full description of methods used to estimate regression parameters.

Regression	Equation	statistic	N	Data Range
Max TL to FL	FL = 5.35 + max_TL *0.95	r^2=0.9963	5818	Max TL: 120 – 954; FL: 116 – 910
Nat TL to FL	FL = 5.71 + nat_TL * 0.95	r^2=0.9909	3901	Nat TL: 151 – 957; FL: 149 – 910
SL to FL	FL = 15.90 + SL * 1.14	r^2=0.9938	985	SL: 130 – 686; FL: 159 – 830
SL to Max TL	Max_TL = 9.19 + SL * 1.21	r^2=0.9944	3399	SL: 130 – 720; Max TL: 161 – 876
SL to Nat TL	Nat_TL= -51.18 + SL * 1.32	r^2=0.9791	7	SL: 404 – 670; Nat TL: 484 – 860
Max TL to G Wt	G WT = 4.33×10^{-8} * (max_TL^2.83)	RSE = 0.7421	633	Max TL: 458 – 980; G WT: 0.82 – 15.05
Max TL to W Wt	WWT =5.21×10^{-09} * (max_TL^3.16)	RSE = 0.5152	3725	Max TL: 127 – 954; W WT: 0.03 – 16.96
Nat TL to G Wt	GWT = 5.70×10^{-08} * (nat_TL^2.78)	RSE = 0.6398	34	Nat TL: 490 – 802; G WT: 1.28 – 7.17
Nat TL to W Wt	WWT = 7.58×10^{-09} * (nat_TL^3.10)	RSE = 0.3482	3912	Nat TL: 120 – 957; W WT: 0.02 – 14.00
FL to G Wt	GWT= $3.37\ 10^{-09}$ * (FL^3.25)	RSE = 0.3499	37414	FL: 230 – 935; G WT: 0.26 – 16.96
FL to W Wt	WWT = 5.46×10^{-09} * (FL^3.18)	RSE = 0.4667	7361	FL: 123 – 965; W WT: 0.05 – 16.96
SL to W Wt	WWT = 2.32×10^{-08} * (SL^3.03)	RSE = 0.1825	483	SL: 147 – 670; W WT: 0.10 – 9.00

Appendix 1

SEDAR Data Best Practices Template (Updated version December 2022)

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

Fields and definitions: Red Grouper SEDAR 88 Operational Assessment
Key Updated May 2023

Field Names	Description	Type	Units	Acceptable Values
SEDAR	Year SEDAR is scheduled to begin and assigned SEDAR number (yearSEDARnumber).	Text		2024SEDAR088
SEDAR_Date_Submit[3]	Month, and Year data submitted to data assessors, this can be added by LHG data compiler (ex: June 2015).	Text		January 2024
Species	Current scientific name.	Text		*Epinephelus morio*
Stock[1]	Stock identification based on stock definition through Stock ID process (ex: Gulf of Mexico, South Atlantic, or Caribbean). See most recent SEDAR Documentation for Terms of Reference.	Text		Gulf of Mexico
Data_Provider[1]	Name (Acronym) of agency or university providing the life history dataset to SEDAR. The list is not exclusive/exhaustive. Add acronym as appropriate and define in metadata. This does not include sampling program within data provider (See sampling program descriptor below).	Text		FWRI - Florida Fish and Wildlife Conservation Commission, Florida Wildlife Research Institute GulfFIN- Gulf States Marine Fisheries Commission, Fisheries Information Network NMFS Panama City – AGR, National Marine Fisheries Service, Panama City Laboratory: Age, Growth and Reproduction database ; NMFS Panama City – BSD, National Marine Fisheries Service, Panama City Laboratory: Biological Sampling Database USF – Univeristy of South Florida via Steve Murawski
Sampling_Program[1]	Sampling Program that collected morphometric data and/or life history sample. Can use acronym	Text		ALLIANCE ALMR – Alabama Marine Resources CO-OP – Cooperative Research Project CO-OP Ward – W. Ward Project

Field Names	Description	Type	Units	Acceptable Values
	as long as more detail is provided in the metadata tab. Formerly called "Source".			EASA – Expanded Annual Stock Assessment Survey FIN-BIOSTAT – Fishery Information Network, biosampling for GulfFIN FIN-OBS – FIN-funded headboat at-sea observer surveys (2005-2007) FWRI – Florida Fish and Wildlife Conservation Commission, Florida Wildlife Research Institute FWRI-FIM – Fishery Independent Monitoring FWRI-OBS – Florida Wildlife Research Institute, Observer GOP – Galveston Observer Program GRFS – Gulf Reef Fish Survey HB – Beaufort Head Boat Survey MRFSS – Marine Recreational Fishing Statistics Survey MSLAB – NMFS Pascagoula, MS PCLAB – NMFS Panama City, FL RECFIN – Recreational Fisheries Information Network REPBIO – Representative Biological Sampling SBLOP - NOAA Fisheries, Shark Bottom Longline Observer Program SRFS – State Reef Fish Survey SRH – Southeast Region Headboat Survey TIP – Trip Interview Program UN – Unknown USF – University of South FL USGS – U.S. Geological Survey
Sample_Method_Type[2]	Record how sample was collected by sampler. This will need to be described by individual data sources.	Text		As Available Landed Sorted Landed Unsorted Quota Sampling Random Intercept Targeted Biological (Blank values are acceptable, if Random or Bias_Type are recorded)
Random[2]	Record if sample was randomly collected based on collection method. This is being pulled from TIPS as IS_Random, or contributor's data submission.	Text		Y - Yes N - No (Blank values are acceptable, if Sample_Method_Type or Bias_Type are recorded)
Bias_Type[2]	Record if the sample was collected using a bias method. This will need to be described by individual data sources.	Text		No Bias Known

Field Names	Description	Type	Units	Acceptable Values
Fishery[1]	Broad designation as recreational, commercial or fishery independent based on Fishing_Mode.	Text		COM – Commercial FI – Fishery-Independent REC – Recreational UN – Unknown
Fishing_Mode[1]	Type of fishing activity listed for fishery-dependent and fishery-independent samples identified to the trip level. For Special permitted trips, be sure to include a description or working paper to SEDAR or Life History group describing how the data were collected and why they should or should not be used to characterize the landings (randomly collected, included in other program such as TIP or SRHS).	Text		CB – Charter Boat CB-EFP – Charter Boat with Exempted Fishing Permit CM – Commercial HB – Headboat HB-EFP – Headboat with Exempted Fishing Permit OB – Observer PR – Private Vessel PR-EFP – Private Vessel with Exempted Fishing Permit REC – Recreational SS – Scientific Survey TRN – Tournament UN – Unknown
Sampling_Unit_ID[1]	Interview or collection number - identifies a unique trip/collection from within a sampling program.	Text		
Specimen_ID[1]	Unique identifier, assigned by the sampling program for an individual fish within sampling unit ID.	Text		
DP_Unique_Identifier	Unique number or identifier assigned by the Data Provider (e.g., auxiliary number or barcode).	Text (no spaces)		
Month[1]	Month sample collected.	Integer		If unknown fill with 99
Day[1]	Day sample collected.	Integer		If unknown fill with 99
Year[1]	Year sample collected.	Integer		If unknown fill with 9999
State_Landed[1]	Postal state abbreviations from USPS. If a sample was collected through a Scientific survey (Fishery-independent program, and the fish is not landed), then it'll be labeled as NL (Not landed as part of fishery-dependent landings).	Text		AL – Alabama FL – Florida LA- Louisiana MS – Mississippi NL – Not Landed (mode-SS, data provider=FWRI) TX – Texas

Field Names	Description	Type	Units	Acceptable Values
County_Landed	Fishery-dependent data (COM, REC) - county landed. Fishery-independent data, this may reflect a specific sampling site. If available, otherwise leave blank.	Text		ALACHUA BALDWIN BAY CHARLOTTE CITRUS COLLIER DIXIE ESCAMBIA FRANKLIN GALVESTON GULF HERNANDO HILLSBOROUGH JACKSON JEFFERSON LAFOURCHE LEE LEVY MANATEE MOBILE MONROE NUECES OKALOOSA PASCO PINELLAS PLAQUEMINES SANTA ROSA SARASOTA TAYLOR UN – UNKNOWN WAKULLA
Headboat_Area	Headboat Area assigned by the SRHS.	Integer		18 21 22 23 26 29
NMFS_Statistical_Grid	Standard statistical grid including sub-areas (decimals).	Numeric		Values 0 to 18.8888
Latitude	Latitude of where fish was caught.	Numeric	Decimal Degrees	Latitudes and Longitudes are currently in a variety of formats of decimal degrees, degrees and decimal minutes, and degrees minutes seconds.
Longitude	Longitude of where fish was caught.	Numeric	Decimal Degrees	Latitudes and Longitudes are currently in a variety of formats of decimal degrees, degrees and decimal minutes, and degrees minutes seconds. Some records will include the negative sign and some will not.
Gear_Code	Specific Gear Code (alpha or number) used by sampling program – provide a complete list,	Text		0 300 355

Field Names	Description	Type	Units	Acceptable Values
	specific to sampling program.			400 610 611 612 613 614 616 657 660 675 676 690 760 762 802 943 989 999 DN HL HL-EFP HLL HNL HS LL SP SP-EFP TR TRPV TRPZ TRW TRWB TRWI TRWS VLL UN

Field Names	Description	Type	Units	Acceptable Values
Gear_Name	Text description of the Gear Code – provide a complete description.	Text		-12.8-m Trawl (SEAMAP Cruises – SA and GOM) -183-m Haul Seine -20-m Balloon Trawl (Batfish Cruises) -6.1-m Otter Trawl -BUOY GEAR, VERTICAL -COMBINED GEARS -Dip Net -DIVING OUTFITS, OTHER -Hand-Line -Hand-Line – Exempted Fishing Permit -Hook and Line - actively fished -Hook and Line - actively fished, repetitive time drop (3 anglers) -Hook and Line – actively fished, timed drop, 2 hooks: 6/0 and 9/0 -Horizontal Longline -Horizontal Longline - 12 hooks: 15/0, 11/0, and 8/0 repeated 4x. -Horizontal Longline - 12 hooks: 15/0, 11/0, and 8/0 repeated 4x. GOM sampling -Kali Pole -LINES ELECTRICAL DEVICES -LINES HAND, OTHER -LINES LONG SET WITH HOOKS -LINES LONG, REEF FISH -LINES TROLL, GREEN-STICK -Long-Line -NOT CODED 000 -POTS AND TRAPS, SPINY LOBSTER -REEL, ELECTRIC OR HYDRAULIC -REEL, MANUAL -ROD & REEL -ROD AND REEL -ROD AND REEL, ELECTRIC (HAND) -Spear -Spear – Exempted Fishing Permit -SPEAR, SCUBA_762 -SPEARS -Trap -Trap, Chevron

Field Names	Description	Type	Units	Acceptable Values
				-Trap, Z -Trawl -UNSPECIFIED GEAR Use this gear to denote fish of unknown gear. -Vertical Longline -Vertical Long-line -Vertical Longline – 10 hooks, all 11/0 -Vertical Longline – 10 hooks, all 15/0 -Vertical Longline – 10 hooks, all 8/0 -Vertical Longline – 2 hooks, all 11/0 -Vertical Longline – 2 hooks, all 15/0
Gear_Group_Code[1]	Collapsed grouping of the Gear Code using acronyms. If additional values, please provide value and description in order to cross reference to NMFS codes if necessary.	Text		DN – Dip Net HL - Hook and-Line (Handline, vertical hook and line gear with limited number of hooks, but not longline) LL – Longline OTHER GEARS SN – Seine Net SP – Spear TR – Trap TW – Trawl UN – Unassigned, unknown, or combined gear VL – Vertical Longline
Min_Depth	Minimum depth of fishing. If only one depth provided, put in this column.	Numeric	meters	
Max_Depth	Maximum depth of fishing.	Numeric	meters	
Jurisdictional_Waters	Refers to water body jurisdiction where fish was caught.	Text		Federal State Unknown
Distance_from_Shore	Record the distance from shore where the fish was caught. Leave blank if unknown.	Numeric	Nautical Miles	
Original_Length_Unit	Length unit used in measurement (cm, mm, inches) recorded by the source.	Text		mm
Observed_Maximum_TL_mm	Measured maximum total length (i.e. tail pinched).	Integer	mm	

Field Names	Description	Type	Units	Acceptable Values
Observed_Natural_TL_mm	Measured natural total length (tail not pinched).	Integer	mm	
Observed_FL_mm	Measured fork length.	Integer	mm	
Observed_SL_mm	Measured standard length.	Integer	mm	
Predicted_Maximum_TL_mm[3]	Use morphometric conversions to calculate- Will be calculated by Life History data compiler.	Integer	mm	
Predicted_Natural_TL_mm[3]	Use morphometric conversions to calculate- Will be calculated by Life History data compiler.	Integer	mm	
Predicted_FL_mm[3]	Use morphometric conversions to calculate- Will be calculated by Life History data compiler.	Integer	mm	
Predicted_SL_mm[3]	Use morphometric conversions to calculate- Will be calculated by Life History data compiler.	Integer	mm	
Final Length_mm[3]	This is the designated length for specific SEDAR. It will vary by species and assessment. A combination of observed and predicted lengths. Will be calculated by Life History data compiler.	Integer	mm	
Final_Length_Type[3]	Is it FL or Natural TL or Maximum TL? Will be recorded by Life History data compiler.	Text		FL
Whole_Weight	Measured whole weight.	Numeric	g	
Gutted_Weight	Measured gutted weight.	Numeric	g	
Fresh_Gonad_Weight[6]	Measured gonad weight from fresh gonads only.	Numeric	g	
Condition_Type	Description of weight recorded (head on; head off, etc.).	Text		GUTTED – HEAD OFF GUTTED – HEAD ON ROUND (WHOLE) UNGRADED UNKNOWN WHITE ROE WHOLE
Predicted_Whole_Weight[3]	Use morphometric conversions to calculate- Will be calculated by Life History data compiler (start with WW = GW, then WW= FL then WW = maxTL etc.).	Numeric	g	
Final_Whole_Weight[3]	Compilation of measured and predicted.	Numeric	g	

Field Names	Description	Type	Units	Acceptable Values
Duplicate_Length	Refers to whether the length is recorded in another data set (Eg., TIP, SRH, SERFS, etc.).	Text		N – No Y – Yes
Annuli_Count	Reader(s) consensus of annuli count.	Integer		
Edge_Type	Reader(s) consensus of edge type, edge type may vary by ageing facility. If other edge types are used, please provide and define.	Text		Code Description (Gulf States, Atlantic States) 1 opaque zone on margin 2 translucent zone <1/3 complete 3 translucent zone 1/3 to 2/3 complete 4 translucent zone >2/3 to fully complete Codes Description (Panama City Lab) (n=3, typically not assigned for YEG) 2_PC opaque zone complete 4_PC translucent zone forming to < 1/3complete 6_PC translucent zone 1/3 to fully Complete O_PC opaque edge T_PC translucent edge
Calendar_Age	Age assigned to an individual fish to place that fish in a calendar year. Can be considered Cohort age. Allows us to account for time of capture and when it would lay down an annulus. Since it is subjective, it needs to be analyzed by individual reader or data provider if consensus age is submitted. To be filled out by data contributors unless it's a species that uses annuli count, then leave blank.	Integer		
Final_Age	Age to be used in age compositions. Species-specific, could be annuli count or calendar age. Can be filled out by contributors.	Integer		
Fractional_Age[3]	Fractional age assigned to an individual fish based on peak spawning date/month. This will be species- specific. To be filled out by data compilers.	Numeric		Two decimal places

Field Names	Description	Type	Units	Acceptable Values
Sub_Sampled	Whether or not an individual fish was subsampled from a larger set of samples. If subsampled, please provide methodology in metadata (e.g. simple random, stratified random, etc.).	Text		N – No Y – Yes
Gonad_Observed[1,4]	Observed in the field (macro assessment, gonad weight).	Text		N – No Y – Yes
Histo_Sample[1,5,6]	Tissue - histologically processed.	Text		N – No Y – Yes
Macro_Sex[4]	Sex identified by field sampler based on macroscopic appearance of gonad.	Text		D – Did not attempt F– Female I – Indeterminate M – Male N – No Gonad Tissue Present (TIP Code) T – Transitional U – Unknown
Secondary_Sex	Secondary sex characteristics expressed in fish size, shape or color.	Text		
Secondary_Sex_Attribute	A description of the secondary sex attribute (e.g. “copperbelly” in gag, “adipose fin” in tilefish).	Text		
Macro_Repro_Phase[4]	Maturity based on macroscopic evaluation of reproductive tissue.	Text		DN - Did Not attempt
Histo_Sex[5]	Sex assigned after histological reading of gonad tissue.	Text		F - Female M - Male T - Transitional
Histo_Historic_Data[5]	Any histological data not recorded following Brown-Peterson et al. (2011).	Text		
Histo_Repro_Phase[5]	Standardized terminology that includes both males and females. Reference documents (Brown-Peterson et al. (2011), Tables 2 and 3; see also Lowerre-Barbieri et al. (2009) Table 1).	Text		
Histo_Repro_Subphase[5]	Further detailed information of Histo_Repro_Phase.	Text		

Field Names	Description	Type	Units	Acceptable Values
	For description of male GE subphases, see Brown-Peterson et al. (2011). Other subphases from Table 1 in Lowerre-Barbieri et al. (2009).			
Histo_Most_Advanced_Gamete_Stage[5,6]	Males and females. Stage must occur in ≥ 5% of the tissue section to be considered "most advanced". Scan of the entire slide: 4x on female tissue and 10x on male tissue.	Text		
Histo_POF[5,6]	Relative age of post-spawning indicator. POF = postovulatory follicle.	Text		
BF_Est[6]	Batch fecundity estimate.	Number		
BF_Pres[6]	How were gonads for fecundity preserved?	Text		
Catch_time	Time of day fish was caught (include time zone in metadata)	Numeric		
Histo_Melanomacrophages	One or more melanomacrophage centers observed in the gonad.	Text		
Macro_Gonad_Parasites	Macroscopic evidence of parasitic infection anywhere in gonad.	Text		U - Unknown/did not assess
Histo_Gonad_Parasites	Histological evidence of parasitic infection anywhere in gonad.	Text		
Histo_Indicator_1	Other structures found within the histological section that support Histo_Repro_Phase classifications, especially in the case of immature vs regenerating specimens. Order of three Histological Indicator fields does not indicate priority.	Text		
Histo_Indicator_2	Other structures found within the histological section that support Histo_Repro_Phase classifications, especially	Text		

Field Names	Description	Type	Units	Acceptable Values
	in the case of immature vs regenerating specimens. Order of three Histological Indicator fields does not indicate priority.			
Histo_Indicator_3	Other structures found within the histological section that support Histo_Repro_Phase classifications, especially in the case of immature vs regenerating specimens. Order of three Histological Indicator fields does not indicate priority.	Text		
Outliers	*Not included as part of the SEDAR Best Practices Template	Text		AGE_LENGTH_OUTLIER AGE_LENGTH_WEIGHT_OUTLIER AGE_OTOLITH_WEIGHT_OUTLIER LENGTH_WEIGHT_OUTLIER Y: length/weight outlier Y: no length measurements
Comments	*Not included as part of the SEDAR Best Practices Template	Text		Extracted from Linda's SEDAR 61 File Not in SEDAR 61