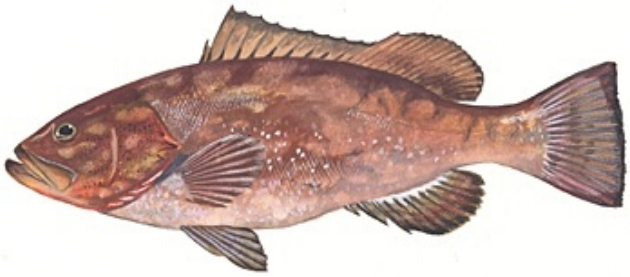
Spatial Data Summary/Analysis of Red Grouper in the South Atlantic



Southeast Fisheries Science Center

National Marine Fisheries Service

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1 Introduction

South Atlantic assessment staff and data providers have been considering new data informing spatial patterns in the distribution, abundance, and landings of South Atlantic red grouper. These patterns may indicate that the fishery and population dynamics of two aggregations (Northern and Southern regions) within the South Atlantic are sufficiently different that a single coastwide stock assessment model is indefensible. To evaluate this supposition, datasets for the Northern (North and South Carolina) and Southern (Georgia and Florida) regions of the South Atlantic Management unit are summarized in this document.

Suggestions to conduct such investigations have been previously recommended. Part of the SEDAR 19 CIE review included a suggestion that because of the disjunction between separate aggregations off the North Carolina and Florida coasts, additional analysis of data should be conducted to evauate whether the aggregations are functionally independent units. Additionally, the SEDAR 19 Data Workshop concluded the possibility that red grouper has a complex subpopulation structure that may not be genetically distinct, but could consist of functionally independent units.

2 Headboat, Commercial, and General Recreational Fisheries Landings

The initial data set suggesting large differences in spatial aggregations of red grouper was the headboat landings and in particular the large divergence in patterns of landings in the Northern and Southern regions since approximately 2012. Note that landings in the North have been in decline since 2007 and landings have numbered less than 100 fish since 2015. Conversely, landings in the South have been increasing since approximately 2010, though there was a substantial decline in 2021.

Compared to the headboat landings, the commercial fishery landings from the Atlantic Coastal Cooperative Statistics Program are less indicative of a divergence between Northern and Southern regions in recent years. However, while the landings in the Northern region of the South Atlantic demonstrate a large and monotonic decline since approximately 2008, landings in the South are stable during that time.

General recreational landings also indicate divergent patterns between the Northern and Southern regions. While landings in the South have been highly variable but without much trend, Northern region landings increased from 2000 to 2009 and then dropped to extremely low numbers from approximately 2010 to present. The overall patterns of Northern region landings since approximately 2010 are similar among the headboat, commercial, and general recreational fisheries.

Figure 1 Headboat Landings

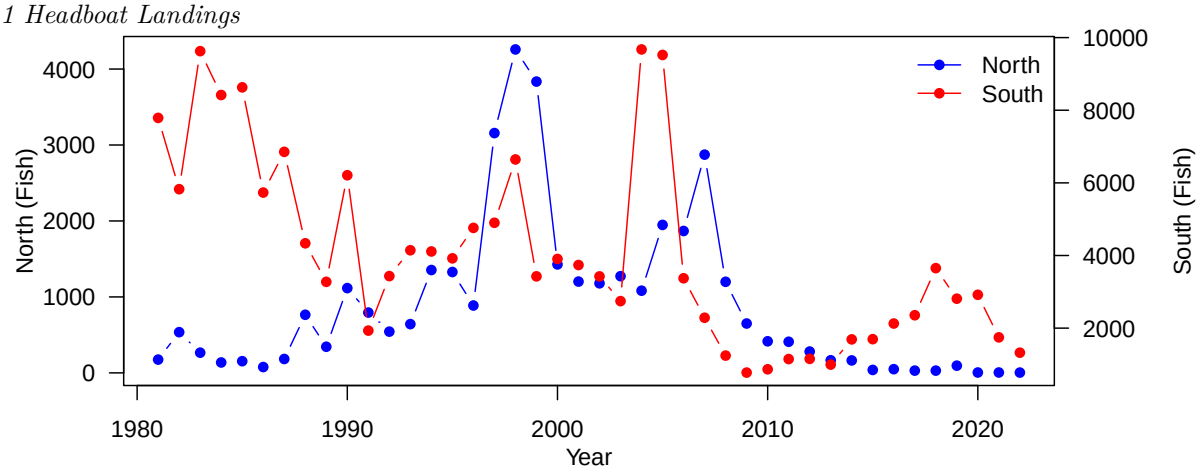


Figure 2 Commercial Landings

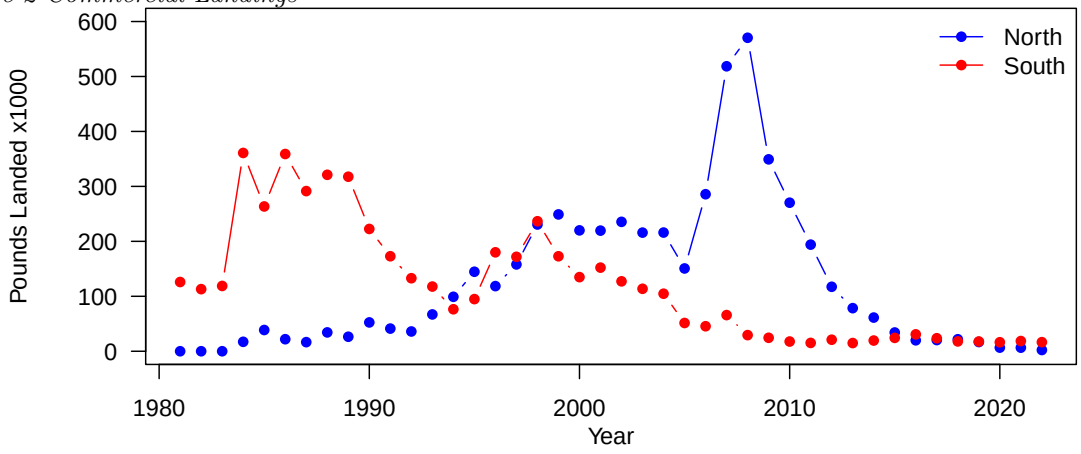
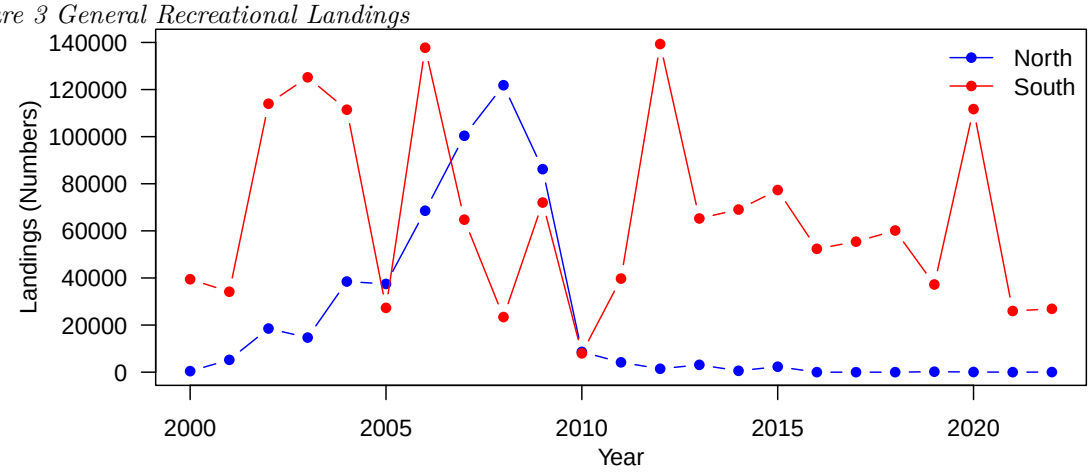


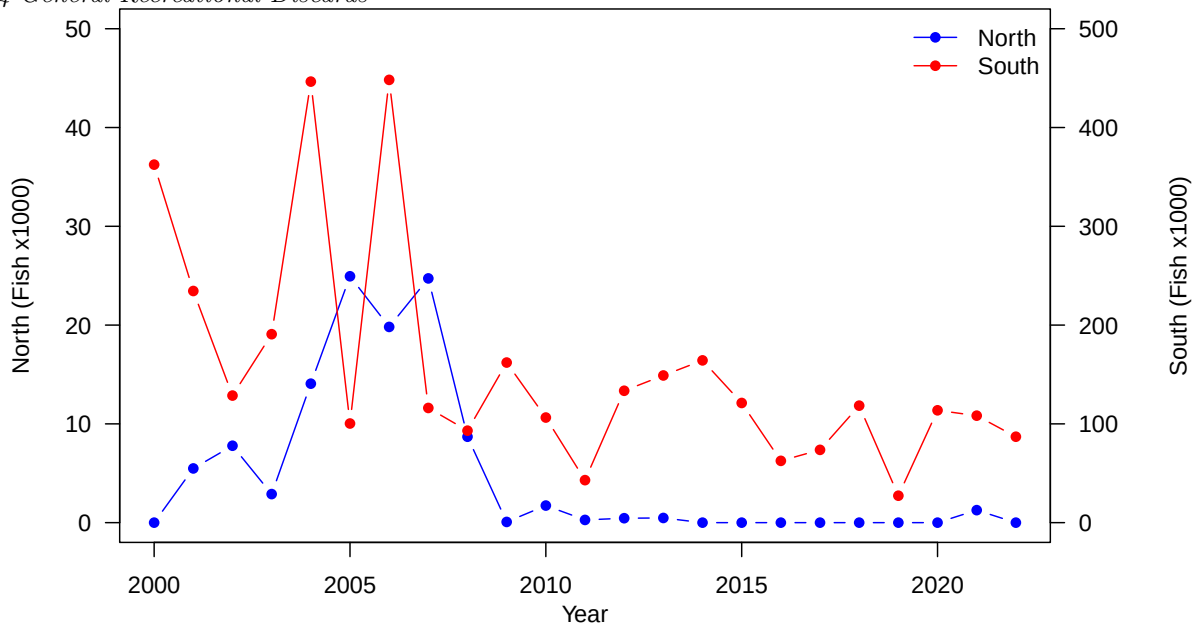
Figure 3 General Recreational Landings



3 General Recreational Discards

The general recreational discards show a similar divergence between the North and South, but both regions suggest a decline in discards beginning in approximately 2007-2009.

Figure 4 General Recreational Discards



4 Headboat, Commercial Handline, and Southeast Reef Fish Survey Indices

Similar to the patterns in landings, the headboat and commercial handline indices display divergent patterns in relative abundance in the North and South. This divergence is particularly evident since approximately 2007. Relative abundance in North has declined during this period and has remained stable or increased in the South. Though it is of note that the commercial handline index has been more variable in the South than in the North and shows a large decline since 2019. It is noteworthy that the headboat and commercial indices are likely influenced by regulatory changes after 2017 so that they are unsuitable for use as abundance indices for stock assessment. However, index values 2018-2021 (to the right of the dashed line in Figures 5-6) are dispayed here as these patterns may still be useful to compare relative abundance in the Northern and Southern regions.

The combined SERFS chevron trap and video index for the Northern region and the for the entire South Atlantic (Coastwide) show very similar trends in relative abundance. Unfortunately, a SERFS index in the Southern region is unavailable because data sparsity does not allow construction of a credible index.

Figure 5 Headboat Index

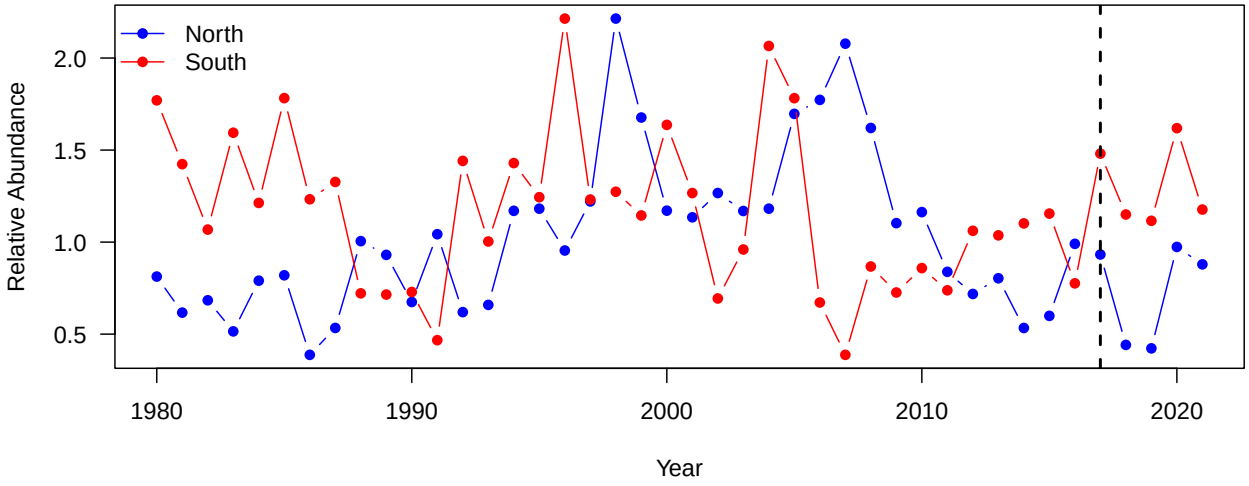


Figure 6 Commercial Handline Index

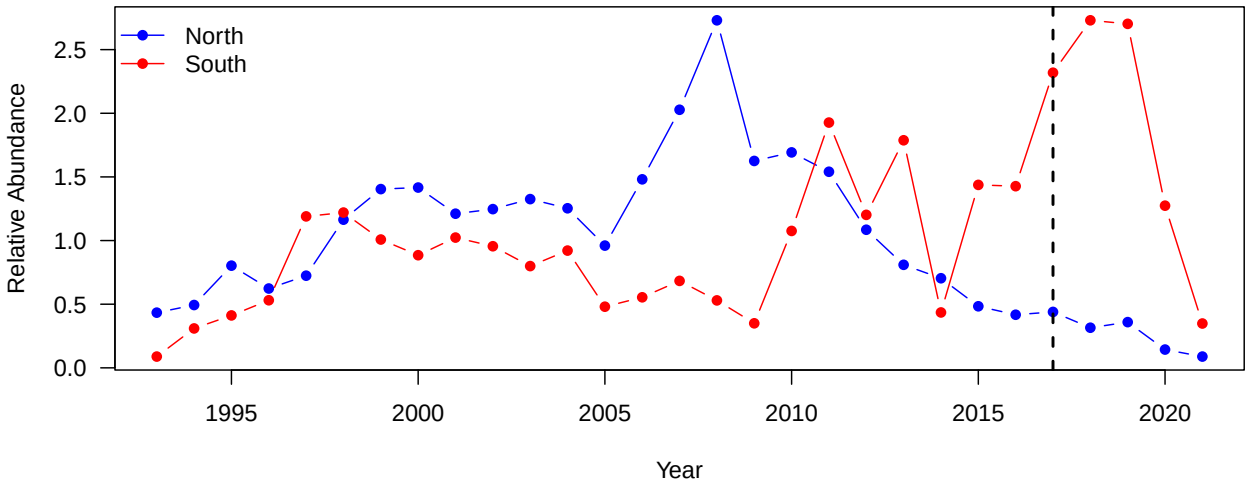
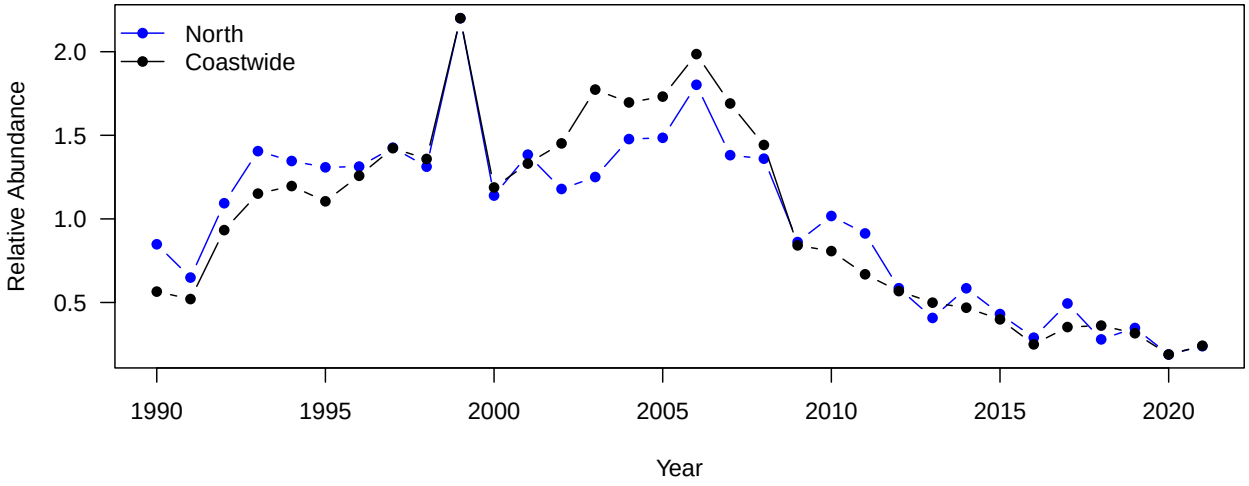


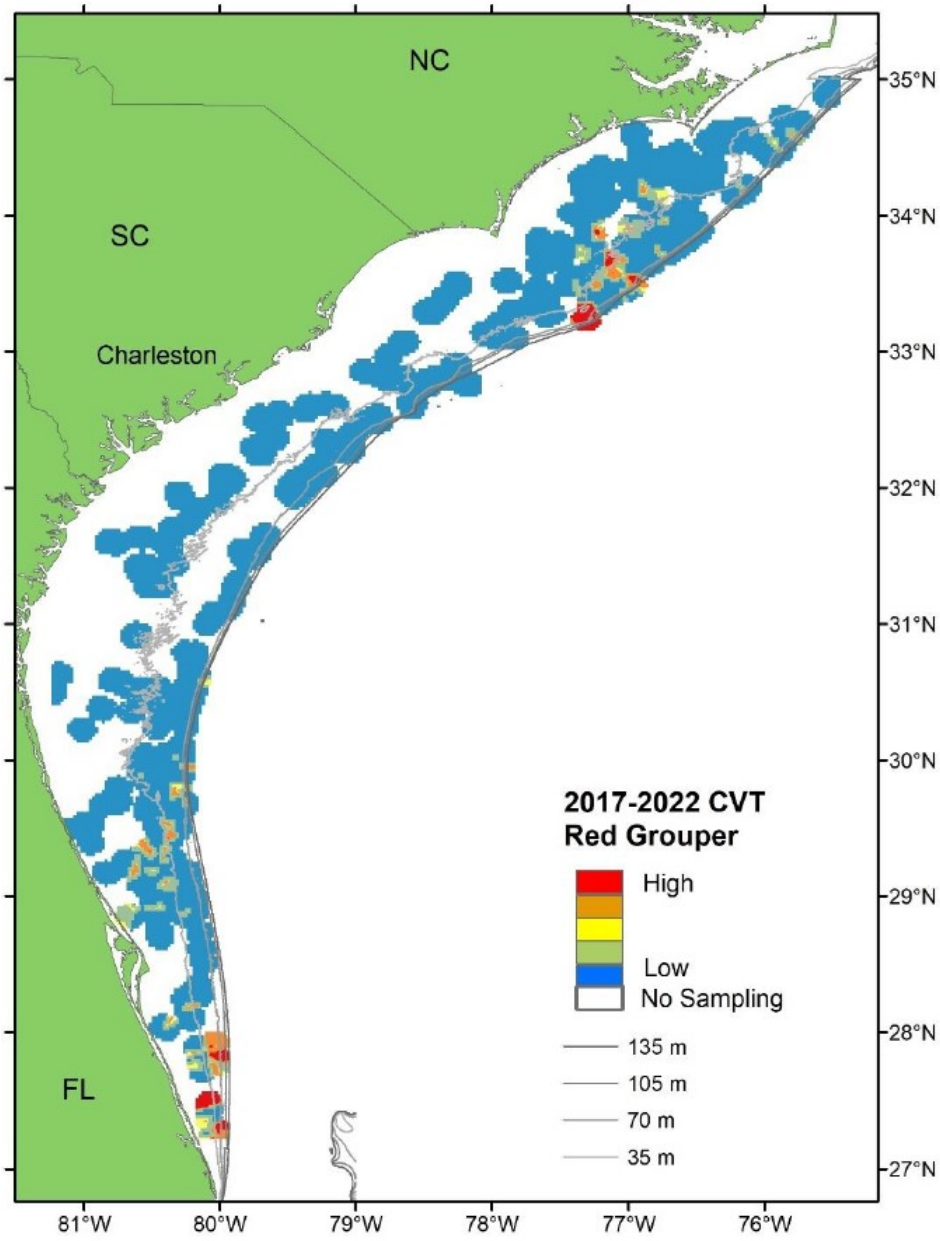
Figure 7 Southeast Reef Fish Survey Index



5 Spatial Distribution of Red Grouper Catches from the Southeast Reef Fish Survey

The most recent trends report from SCDNR (Bubley et al. 2023) indicates that the distribution of red grouper is highly concentrated in two aggregations. These aggregations occur off the Florida Coast, particularly south of Cape Canaveral, and off Cape Fear in North Carolina. Similar to landings data, few fish are observed off of the Georgia and South Carolina coasts.

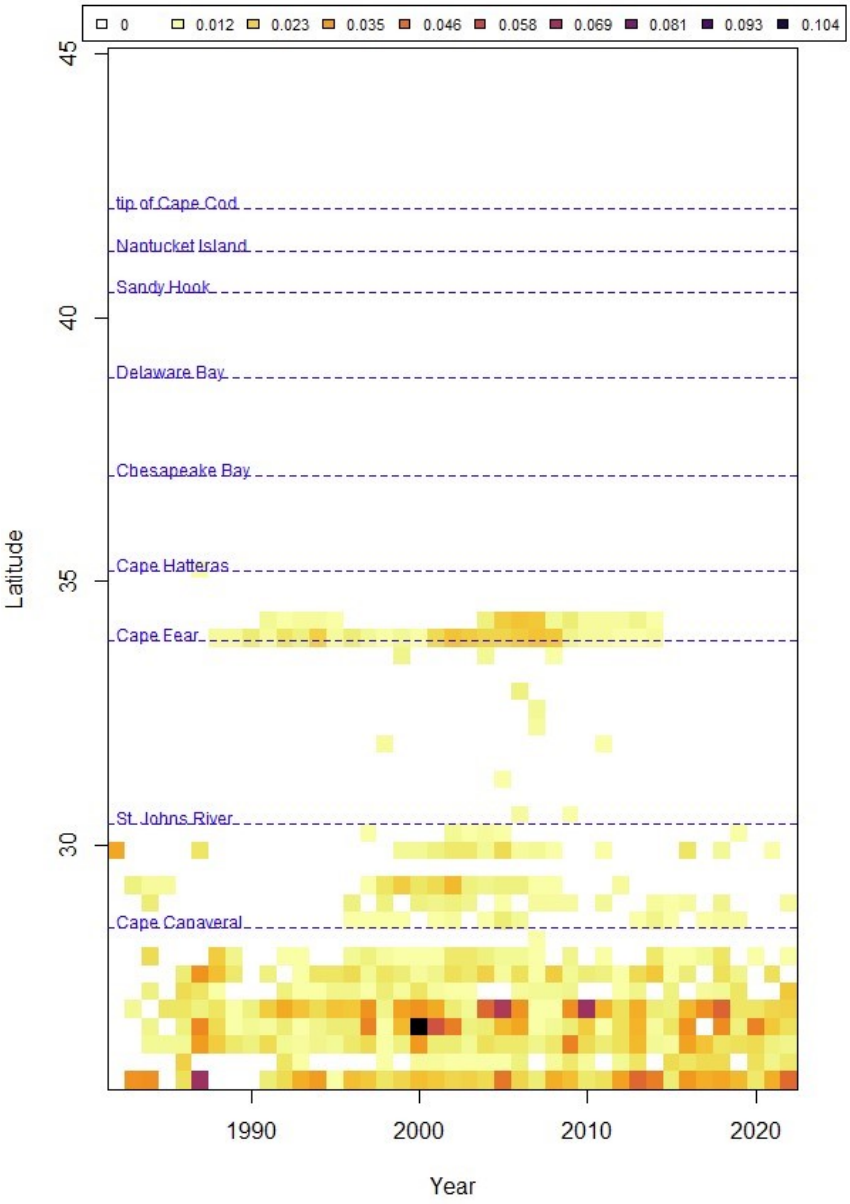
Figure 8 Red grouper distribution from the Southeast Reef Fish Survey.



6 Spatiotemporal Distribution of the Proportion of Angler Intercepts Positive for Red Grouper from the Marine Recreational Information Program

The proportion of positive angler intercepts (all modes) for red grouper again show aggregations off of North Carolina (near Cape Fear) and off of Florida, particularly south Florida. Additionally, this data summary suggests that while since approximately 2009 the proportion of positive trips off the North Carolina coast has declined, the proportion of positive trips off of South Florida has remained stable.

Figure 9 Proportion of angler intercepts (all modes) positive for red grouper by year and latitude from the Marine Recreational Information Program.



7 Evaluate Red Grouper Growth Differences Between the Northern and Southern Regions

Von Bertallanfy growth curves were fit to data from fish sampled in the Northern and Southern regions using models that considered shared or separate regional parameters. While the results imply growth rates vary between regions, differences in exploitation history (e.g., removal of large fish in the Southern region) could also cause regional growth rates to appear different.

Figure 10 Estimated red grouper regional and combined growth rates.

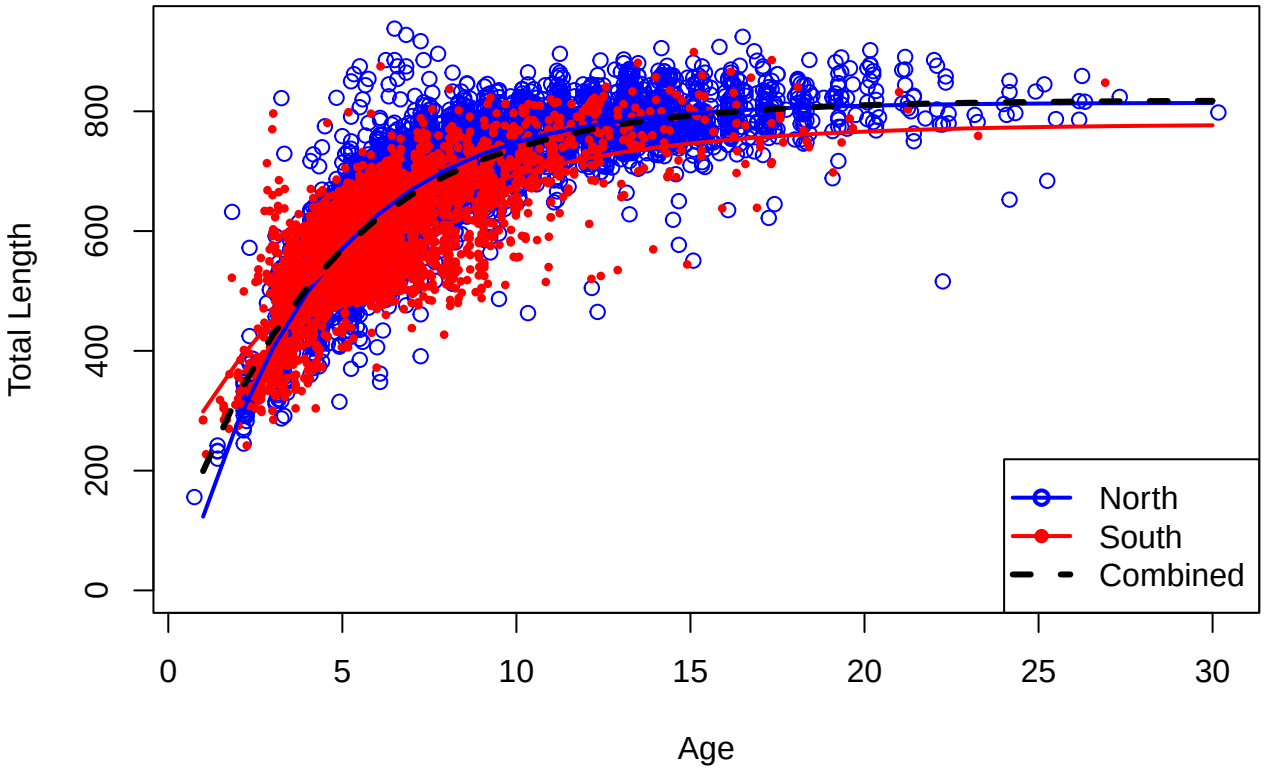


Table 1. Von Bertalanffy growth model selection table. Results imply different growth rates between the Northern and Southern regions where model selection favors different values for all the Von Bertalanffy parameters.

Model	K	AICc	DeltaAICc	AICcWt	Cum.Wt	LL
All differ	7	161813.2	0.00	0.98	0.98	-80899.6
K & t0 differ	6	161821.1	7.86	0.02	1.00	-80904.5
Linf & t0 differ	6	161855.8	42.61	0.00	1.00	-80921.9
Linf & K differ	6	161966.3	153.12	0.00	1.00	-80977.2
Linf differs	5	162189.5	376.33	0.00	1.00	-81089.8
K differs	5	162448.6	635.36	0.00	1.00	-81219.3
t0 differs	5	162749.0	935.76	0.00	1.00	-81369.5
None differ	4	162994.5	1181.33	0.00	1.00	-81493.3

Table 2. Von Bertalannfy model parameter estimates and confidence intervals for the best (full) model corresponding to Northern region (1) and Southern region (2).

Parameter	Estimate	low 95 percent CI	upp 95 percent CI
K[1]	0.26	0.25	0.27
K[2]	0.19	0.18	0.21
t0[1]	0.37	0.29	0.45
t0[2]	-1.51	-1.81	-1.23
Linf[1]	814.20	810.50	818.10
Linf[2]	778.30	764.80	793.40

8 Red Grouper Annual Age Compostion by Region

Examination of red grouper age compositions for both the fishery dependent and fishery independent samples generally suggests that samples from the Northern region contain older fish than samples from the Southern region.

8.1 Fishery Dependent Age Compostion

Figure 11 Fishery dependent age composition (1 of 3)

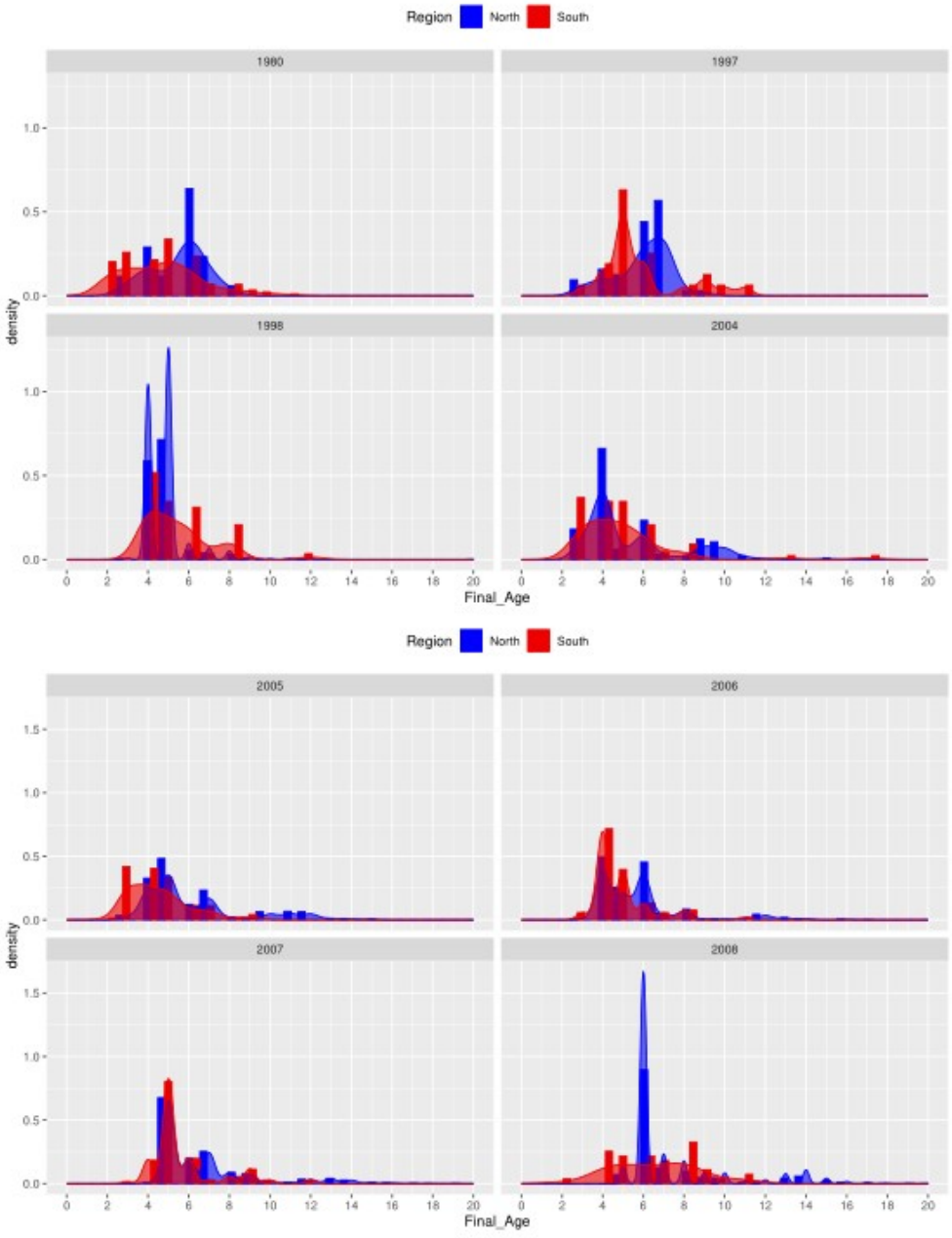


Figure 12 Fishery dependent age composition (2 of 3)

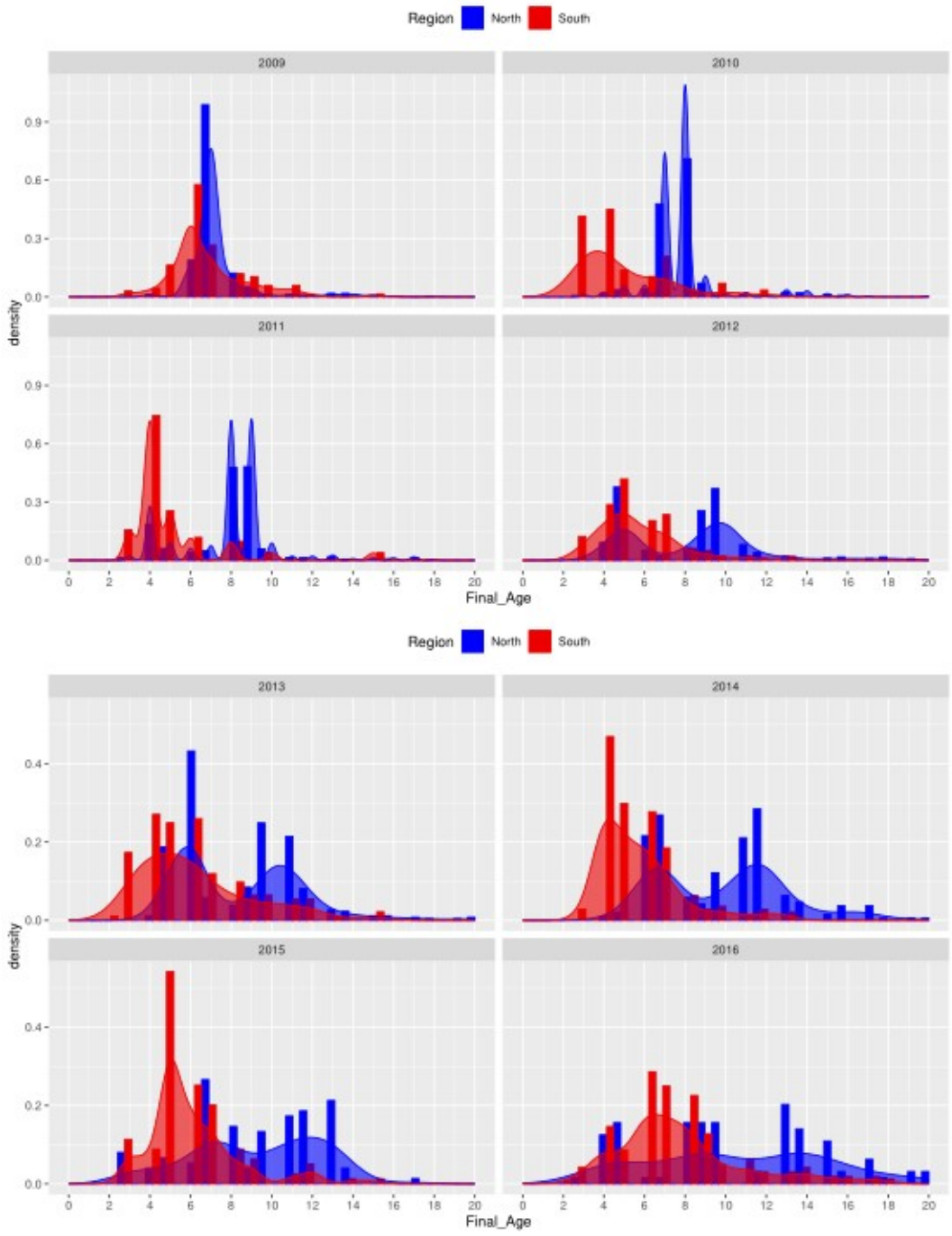


Figure 13 Fishery dependent age composition (3 of 3)

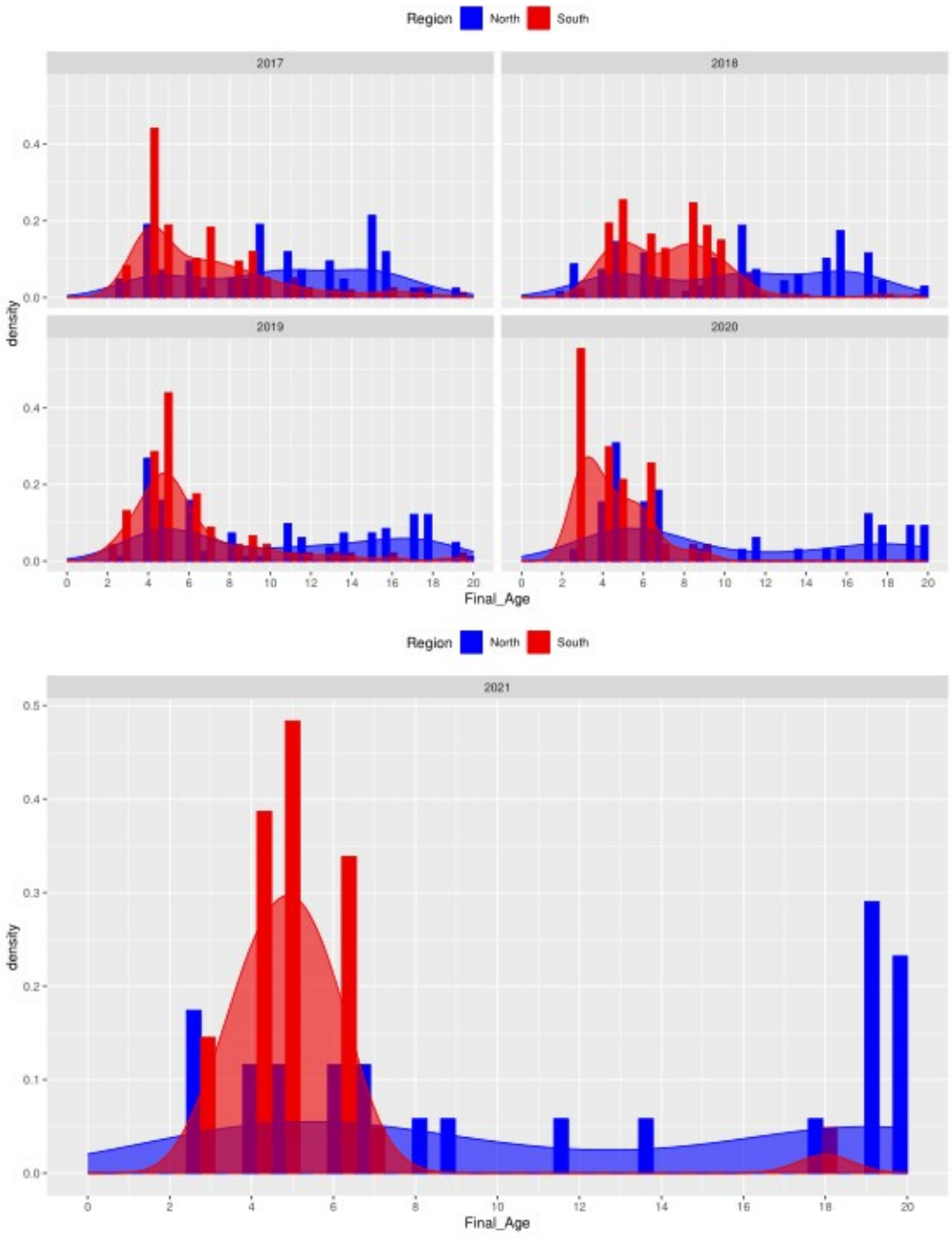


Table 3. Annual fishery dependent age compostion sample size by region.

Year	North	South
1977	0	7
1978	2	10
1979	14	24
1980	25	129
1981	25	144
1982	11	62
1983	0	38
1984	1	43
1985	1	23
1986	0	14
1987	10	3
1988	18	3
1989	5	0
1990	9	2
1991	14	2
1992	4	0
1993	4	0
1994	5	3
1995	0	0
1996	23	0
1997	46	23
1998	1621	42
1999	0	28
2000	0	64
2001	1	76
2002	1	70
2003	1	49
2004	193	63
2005	505	104
2006	863	78
2007	2356	103
2008	2142	40
2009	978	98
2010	807	42
2011	735	74
2012	684	142
2013	379	134
2014	276	204
2015	109	115
2016	98	240
2017	65	230
2018	109	194
2019	121	66
2020	50	34
2021	29	30

8.2 Fishery Independent Red Grouper Age Compostion by Region

Figure 14 Fishery independent age composition (1 of 2)

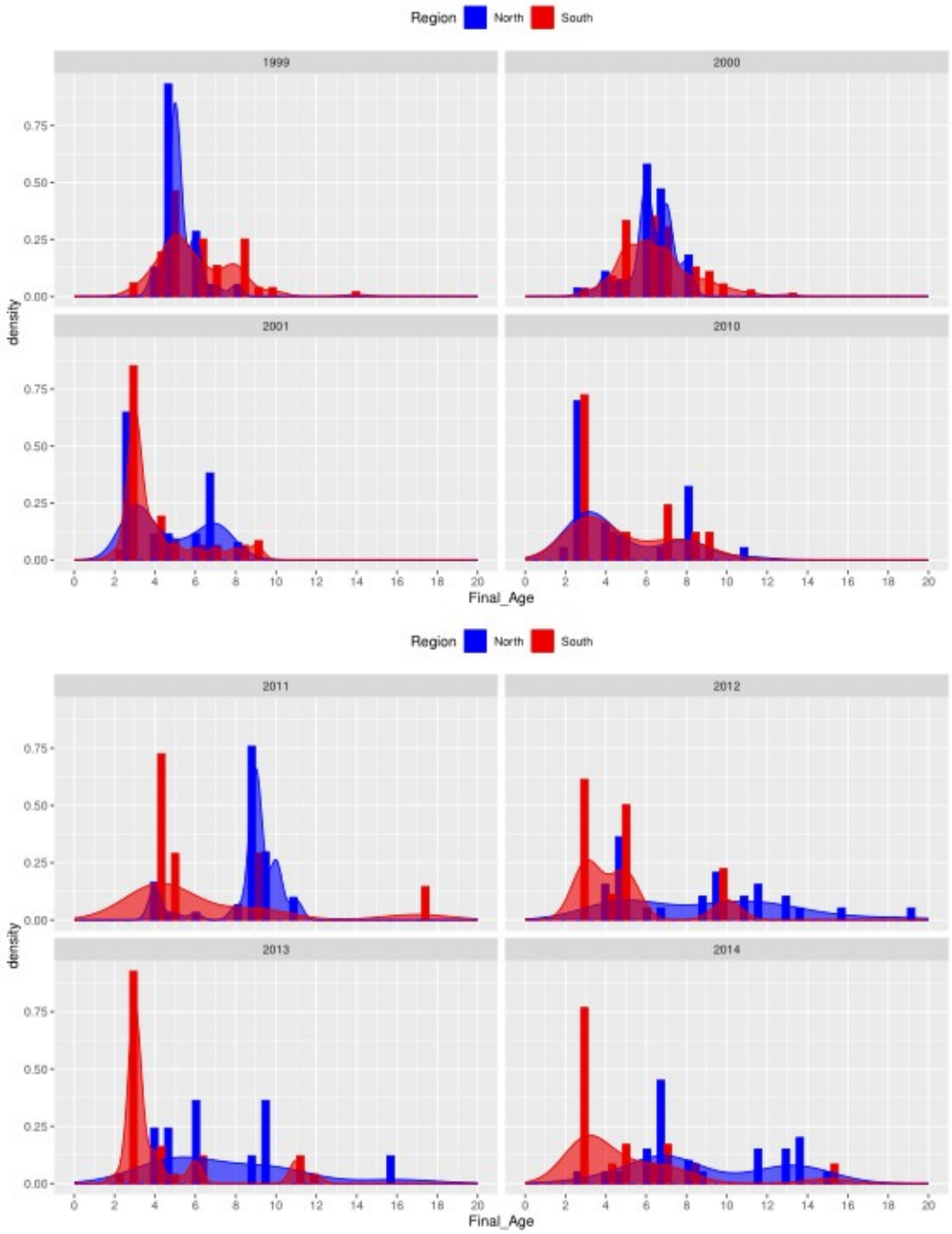


Figure 15 Fishery independent age composition (2 of 2)

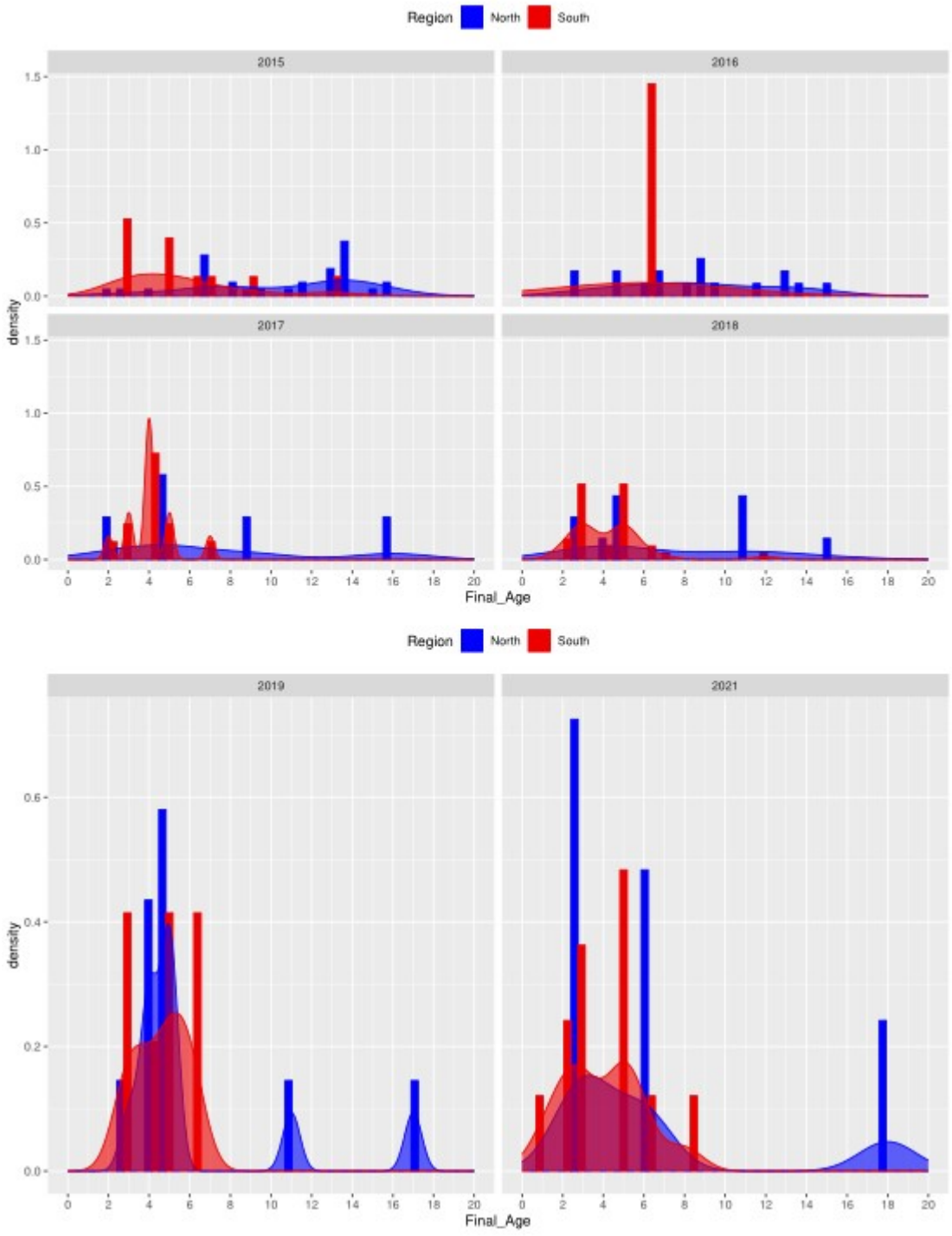


Table 4. Annual fishery independent age compostion sample size by region.

Year	North	South
1980	1	1
1981	0	0
1982	0	0
1983	0	0
1984	0	0
1985	1	0
1986	1	0
1987	0	0
1988	1	0
1989	0	0
1990	2	0
1991	4	0
1992	15	0
1993	22	0
1994	30	0
1995	10	0
1996	8	1
1997	87	13
1998	106	0
1999	56	75
2000	40	214
2001	38	68
2002	34	5
2003	34	1
2004	41	1
2005	34	5
2006	47	3
2007	64	4
2008	25	0
2009	34	2
2010	27	12
2011	44	10
2012	28	26
2013	12	36
2014	29	17
2015	31	11
2016	17	3
2017	5	12
2018	10	31
2019	10	7
2020	0	0
2021	6	12

9 Red Grouper Annual Length Compostion by Region

Examination of red grouper length compositions for both the fishery dependent and fishery independent samples generally suggests that samples from the Northern region contain larger fish than samples from the Southern region.

9.1 Fishery Dependent Red Grouper Length Compostion by Region

Figure 16 Fishery dependent length composition (1 of 3)

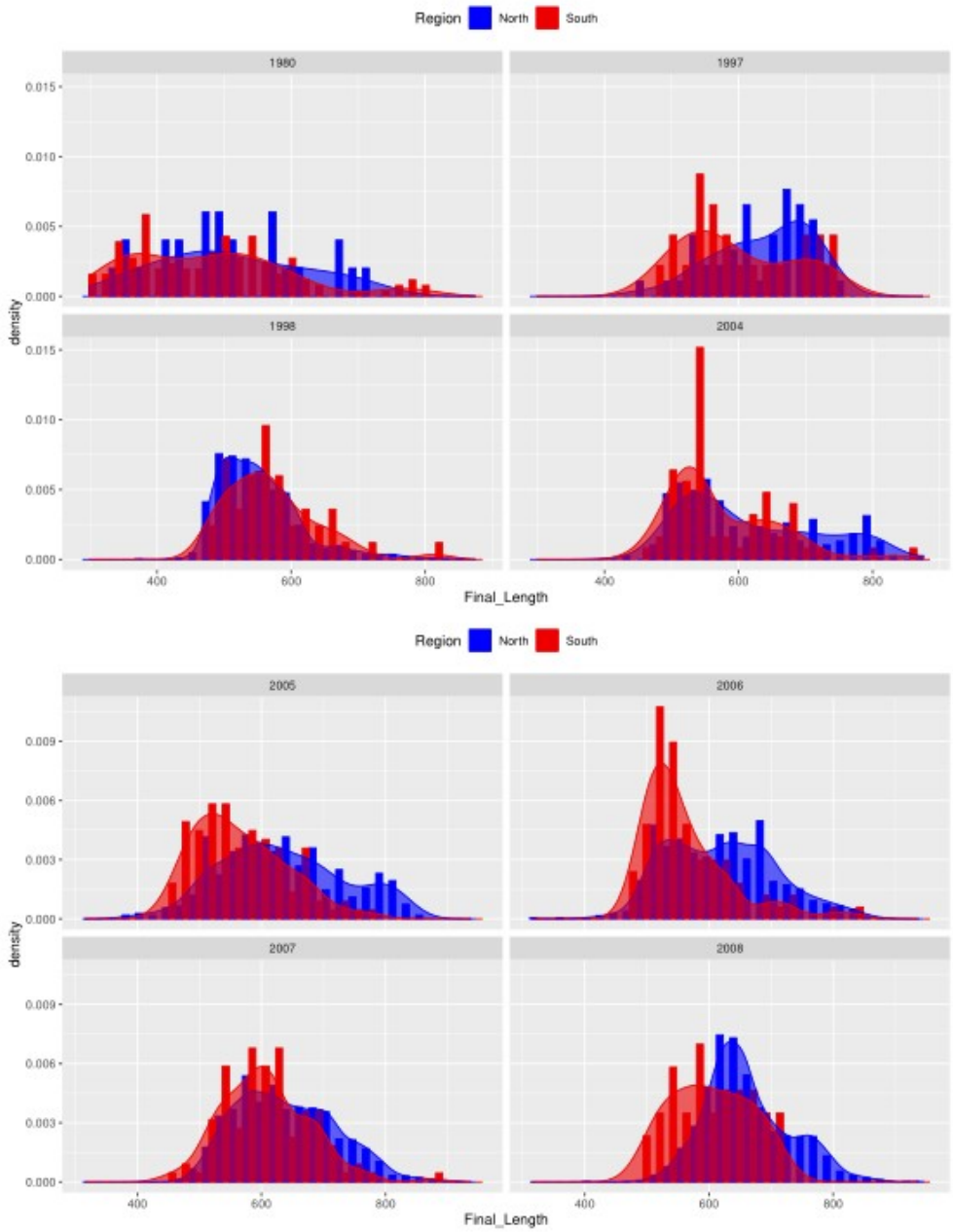


Figure 17 Fishery dependent length composition (2 of 3)

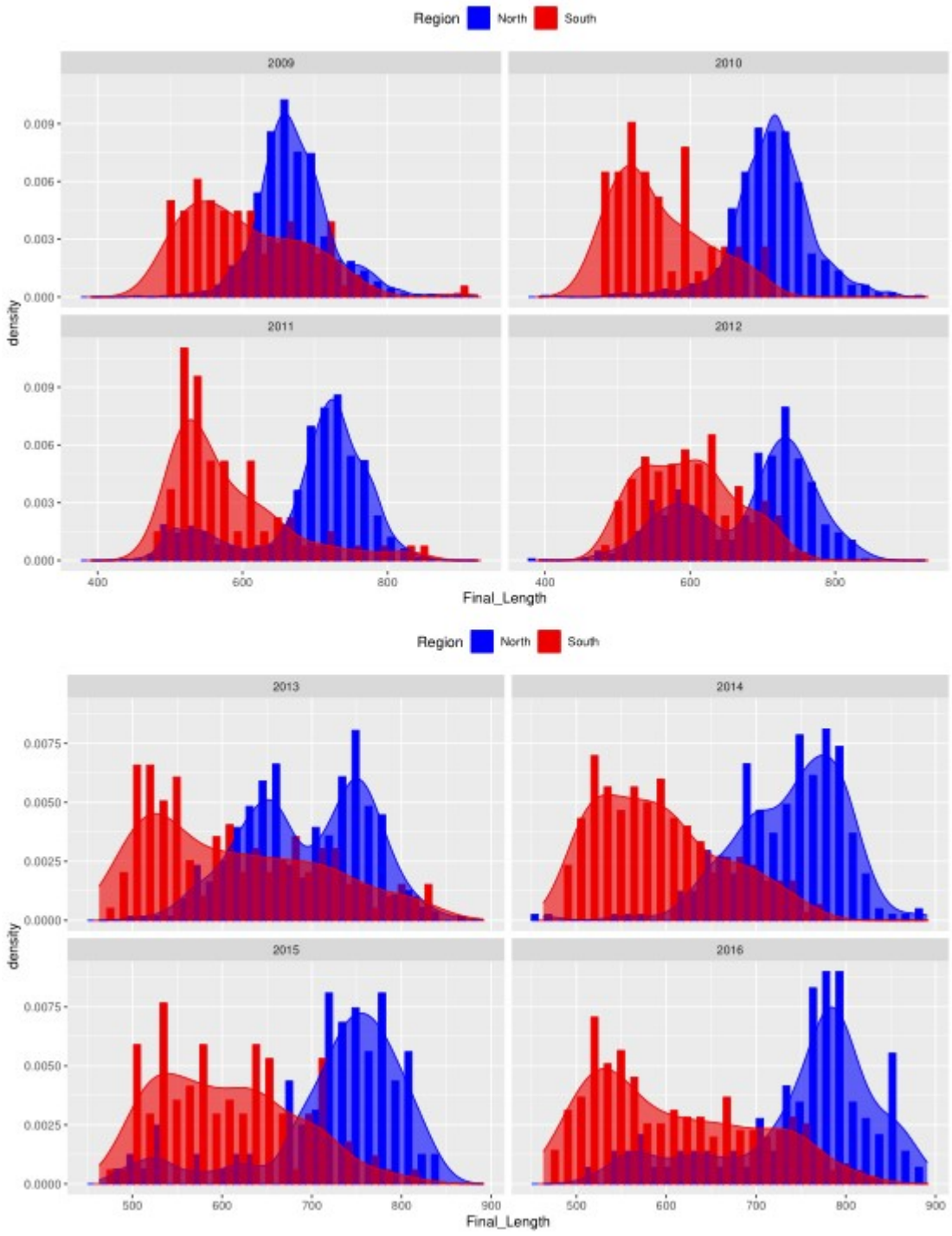


Figure 18 Fishery dependent length composition (3 of 3)

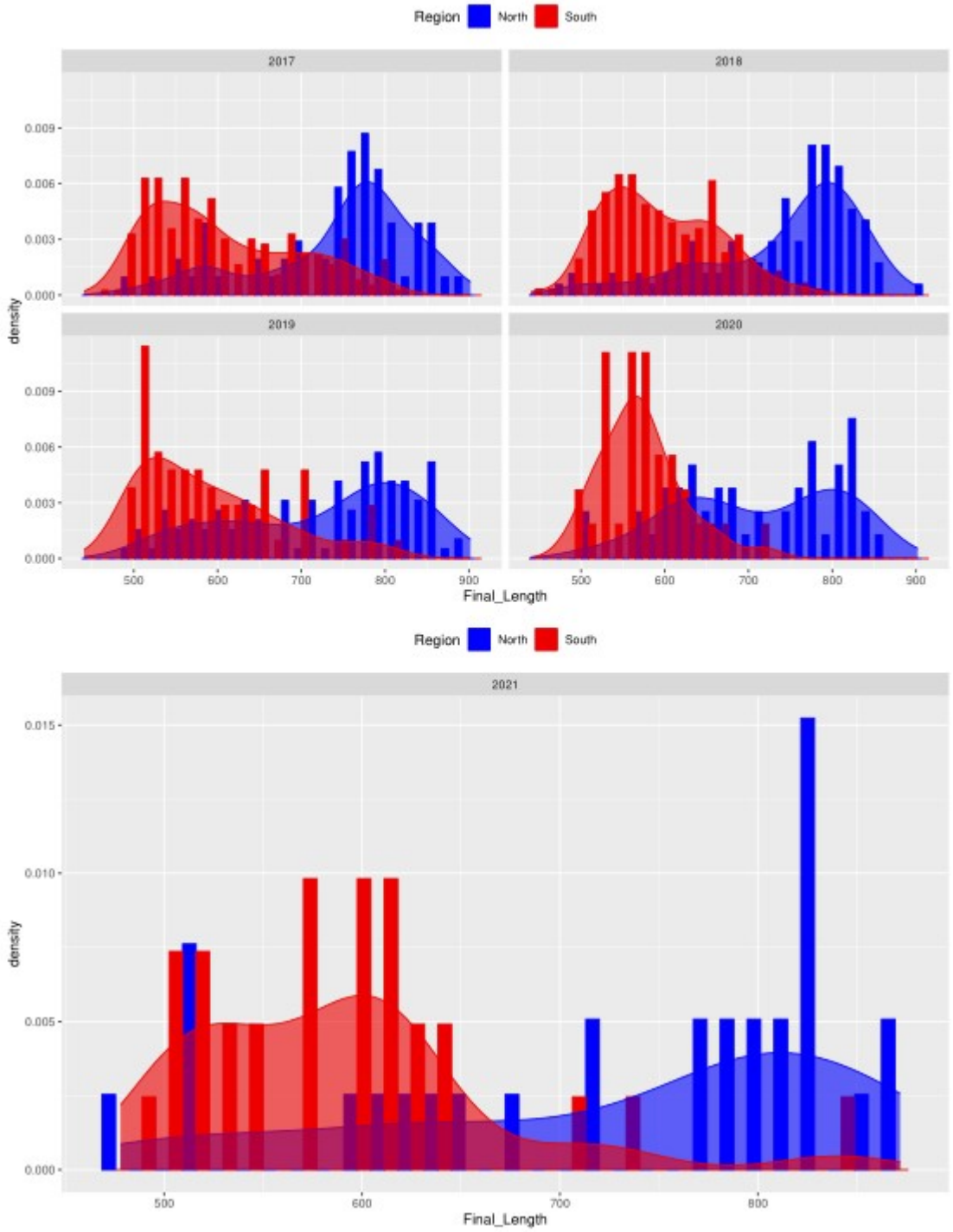


Table 5. Annual fishery dependent length compostion sample size by region.

Year	North	South
1977	0	7
1978	2	10
1979	14	24
1980	25	129
1981	25	144
1982	11	62
1983	0	38
1984	1	43
1985	1	23
1986	0	14
1987	10	3
1988	18	3
1989	5	0
1990	9	2
1991	14	2
1992	4	0
1993	4	0
1994	5	3
1995	0	0
1996	23	0
1997	46	23
1998	1621	42
1999	0	28
2000	0	64
2001	1	76
2002	1	70
2003	1	49
2004	193	63
2005	505	104
2006	863	78
2007	2356	103
2008	2142	40
2009	978	98
2010	807	42
2011	735	74
2012	684	142
2013	379	134
2014	276	204
2015	109	115
2016	98	240
2017	65	230
2018	109	194
2019	121	66
2020	50	34
2021	29	30

9.2 Fishery Independent Red Grouper Length Compostion by Region

Figure 19 Fishery independent length composition (1 of 2)

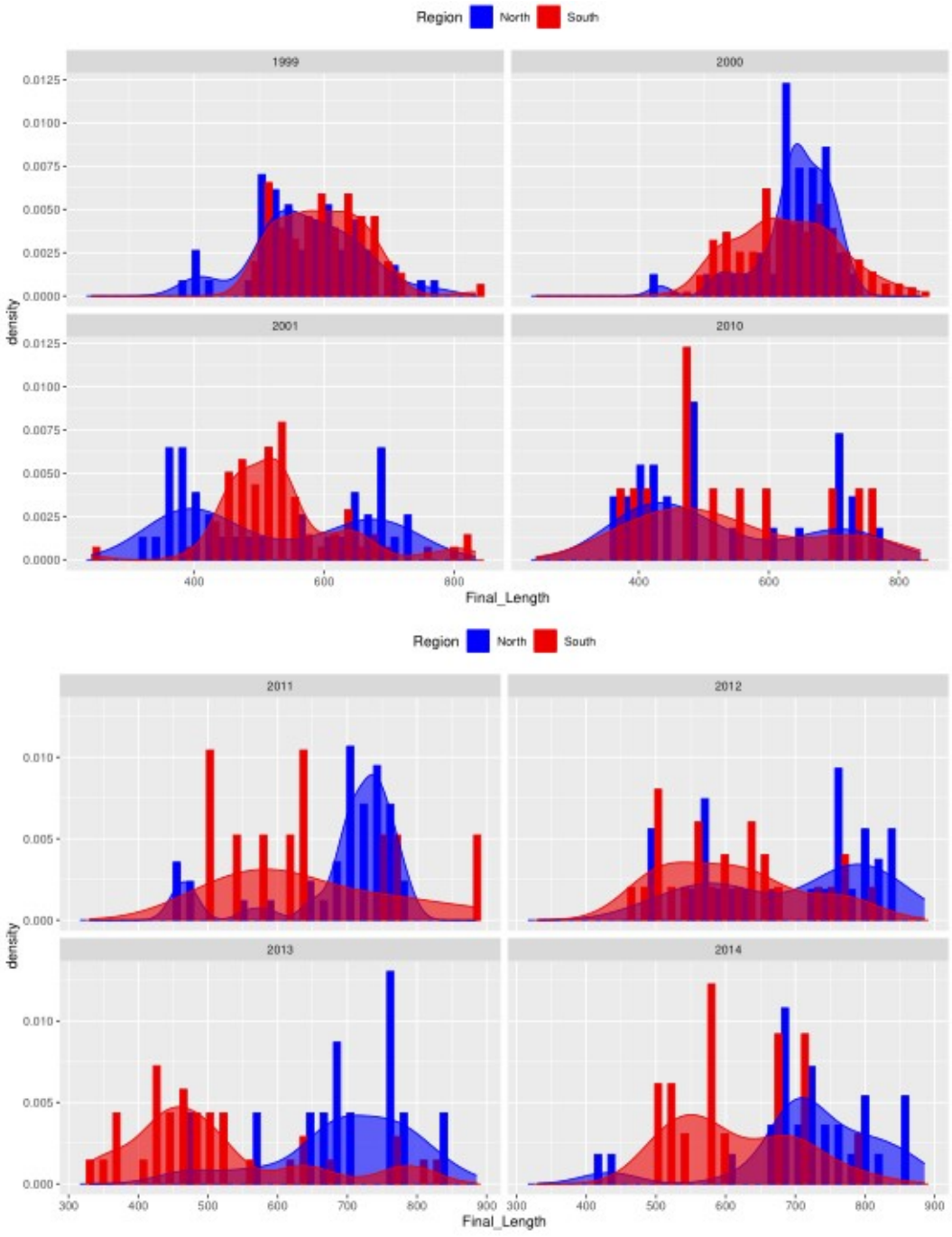


Figure 20 Fishery independent length composition (2 of 2)

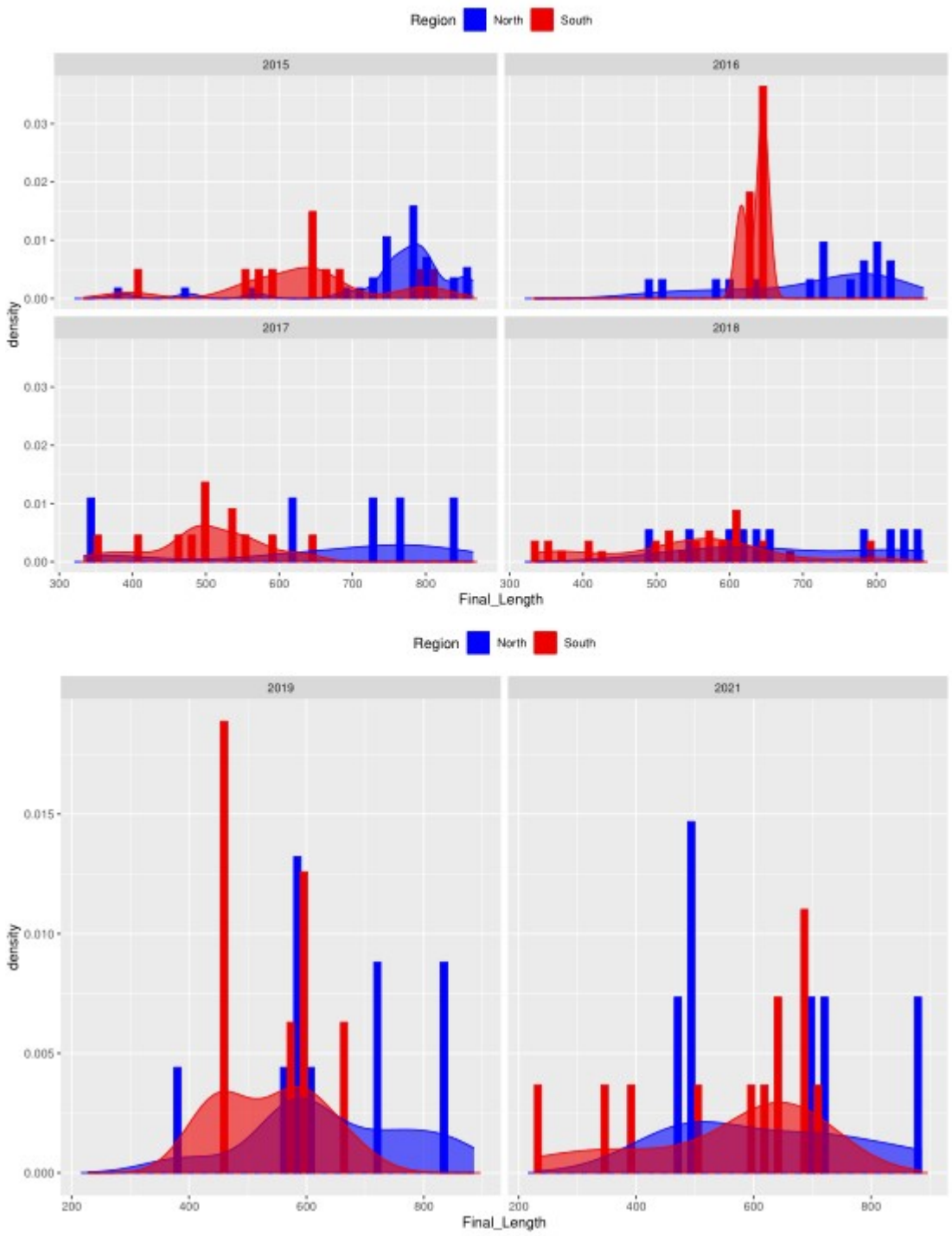


Table 6. Annual fishery independent length compostion sample size by region.

Year	North	South
1980	1	1
1981	0	0
1982	0	0
1983	0	0
1984	0	0
1985	1	0
1986	1	0
1987	0	0
1988	1	0
1989	0	0
1990	2	0
1991	4	0
1992	15	0
1993	22	0
1994	30	0
1995	10	0
1996	8	1
1997	87	13
1998	106	0
1999	56	75
2000	40	214
2001	38	68
2002	34	5
2003	34	1
2004	41	1
2005	34	5
2006	47	3
2007	64	4
2008	25	0
2009	34	2
2010	27	12
2011	44	10
2012	28	26
2013	12	36
2014	29	17
2015	31	11
2016	17	3
2017	5	12
2018	10	31
2019	10	7
2020	0	0
2021	6	12

10 Implications Regarding South Atlantic Red Grouper Regional Aggregations

South Atlantic assessment staff have reviewed the data summaries presented in this document and have concluded that it is likely a single stock model is inappropriate for South Atlantic red grouper. Therefore, we believe it is appropriate to investigate other modeling approaches to provide a defensible assessment and best management advice. This may be a challenge as data limitations are likely to arise. However, it is critical to investigate the most appropriate and defensible assessment methods.