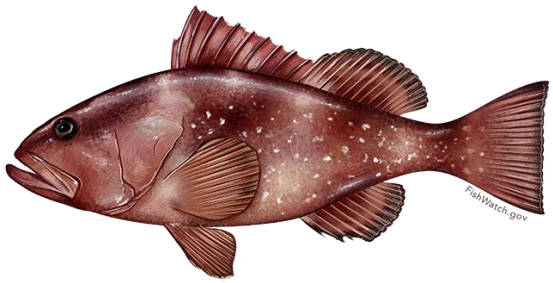

Interim Analysis for Gulf of Mexico Red Grouper

Gulf and Caribbean Branch
Sustainable Fisheries Division
NOAA Fisheries - Southeast Fisheries Science Center

December 07, 2020 DRAFT

Keywords

Interim Analysis, Index of Abundance, Red Grouper, Gulf of Mexico

Abstract

An Interim Analysis was conducted for Red Grouper following the Standard SEDAR61 stock assessment (*http://sedarweb.org/sedar-61*). Data from the NMFS MSLABS Bottom Longline Survey were used to produce an index of relative abundance updated through 2020 following the same methodology and approach described in Pollack et al. (2018). Trends in the indices were similar, and all updated index values fell within the confidence interval for the SEDAR61 index. Relative abundance peaked in 2011, and declined to record low levels in more recent years, following the trend in the index forecasted by the SEDAR61 stock assessment model. While the index value in 2020 indicates an increase in relative abundance, care must be taken with this data point because of reduced spatial coverage due to COVID, mechanical issues, and weather delays.

Introduction

Interim analyses are designed to occur between regular stock assessments conducted through the Southeast Data Assessment and Review process (SEDAR) to provide the opportunity to adjust harvest recommendations based on current stock conditions. For example, unpredictable events can occur such as a change in recruitment (e.g., pulse or failure), environmental disasters (e.g., red tides or hurricanes) or man-made disasters (e.g., Deepwater Horizon). Recent concerns have been raised over the status of Red Grouper in the Gulf of Mexico due to an inability to harvest the current quotas (**Figure 1**).

Materials and Methods

Index Data Source

The NMFS Mississippi Laboratories have conducted standardized bottom longline surveys in the Gulf of Mexico, Caribbean, and Western North Atlantic since 1995. The objective of these surveys is to provide fisheries independent data for stock assessment purposes. These surveys are conducted annually and provide an important source of fisheries independent information on large coastal sharks, snappers and groupers from the GOM and Atlantic. In 2011, a Congressional Supplement Sampling Program was conducted where high levels of survey effort were maintained from April through October (Campbell et al. 2012). For this analysis of Red Grouper, only Congressional Supplement Sampling Program data collected during the same time period as the annual survey (August/September) were used to supplement missing data from the NMFS Bottom Longline Survey in 2011.

Index of Abundance

A standardized index was developed using NMFS MSLABS Bottom Longline Survey data using delta-lognormal generalized linear model methods described in Pollack (2020) (at the end of this document). Data were limited to those stations completed in the eastern GOM (east of 87° W) and at depths less than 118 m. The index computed by this method is a mathematical combination of yearly abundance estimates from two distinct generalized linear models: a binomial (logistic) model which describes proportion of positive abundance values (i.e. presence/absence) and a lognormal model which describes variability in only the nonzero abundance data (cf. Lo et al. 1992). Additional details on survey design, data filtering and exclusions and modeling approach are provided in Pollack et al. (2018). An important caveat of the current update is that incomplete sampling in 2020 may have caused the 2020 index value to be slightly higher than it would have been if the entire area had been covered because of the lack of zero catches that are usually encountered in the panhandle of Florida. Additional details are provided in Pollack (2020) (at the end of this document).

Interim Approach

Here we adjusted the harvest recommendation for 2021 by applying the harvest control rule (HCR) presented and recommended by the Gulf of Mexico Fishery Management Council's Scientific and Statistical Committee (SSC) at their October 2018 meeting based on the following formulation:

$$ABCy = ABCassessment * (Oy + \beta)/(Fy + \beta)$$

where:

ABCassessment = 4.9 million pounds gutted weight, as recommended by the SSC at their September 2019 meeting following review of the Standard SEDAR61 stock assessment (**Table 1**). This ABC is based on an allocation of 76% commercial and 24% recreational (GMFMC 2008), and are subject to change pending a redistribution of allocation.

Oy = observed index value in year *y*, as presented in Pollack (2020) (**Table 1**; and at the end of this document)

Fy = forecasted index value in year *y* by the SEDAR61 assessment model (assuming 2018 red tide mortality was similar to 2005) (**Table 1**)

β = scalar (ranges from 1 to 9) to adjust the responsiveness of the HCR times the root mean squared error of the index obtained from the SEDAR61 stock assessment output (NMFS MSLABS Bottom Longline Survey RMSE = 0.3622).

The chosen HCR adjusts the ABC recommendation (adjusted ABC referred to as TAC herein) based on deviations between projected and observed index values and can be adjusted, using a parameter β, to be more or less sensitive to these deviations. During their September 2019 meeting, the SSC recommended a β = 1, which results in the interim catch advice being strongly driven by the index deviations. This specification was chosen by the SSC as a realistic and conservative (with respect to risk of overfishing) scenario for the provision of interim management advice as requested by the Council.

Results

Index of Abundance

Figure 2 provides a comparison of the updated index through 2020 to the SEDAR61 index with 95% confidence intervals. All updated index values fell within the confidence interval for the SEDAR61 index and the trends between indices were very similar (**Figure 2**). Relative abundance peaked in 2011 and was lowest in 2016. The index forecasted by the SEDAR61 assessment model, which assumed that red tide mortality in 2018 was similar to 2005, showed similar declines in relative abundance during 2018 and 2019 (**Table 1**, **Figure 3**). The predicted index value for 2020 remains low compared to the observed index value, but this may be an artifact of the incomplete survey coverage.

Interim Analysis

Table 2 summarizes the updated harvest recommendations. For β = 1, where the catch advice is strongly driven by the index deviations (**Figure 4**), the TAC for 2021 would be 6.522 million pounds gutted weight.

Discussion

Future work is underway to develop an MSE framework where specifications of the interim analysis can be fully tested, such as the design of the harvest control, the selection of the index where more than one index is available, and the β value.

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Tables

Table 1. Observed and forecasted indices of abundance for Red Grouper from the NMFS MSLABS Bottom Longline Survey and ABC recommendations (million pounds, gutted weight). ABC_Assessment refers to ABCs set following assessments and is the value adjusted in the harvest control rule.

Year	Observed	Forecasted	ABC	ABC_Reference	ABC_Assessment
2008	0.634	0.752	6.560	Amendment 30B	6.560
2009	0.983	0.756	7.570	73 FR 68390	7.570
2010	1.346	0.927	7.570	75 FR 63780	7.570
2011	2.510	1.190	6.310	76 FR 58456	7.570
2012	2.428	1.302	7.930	76 FR 66672	7.570
2013	1.072	1.211	7.930		7.570
2014	0.620	0.885	7.930		7.570
2015	0.795	0.622	7.930		7.570
2016	0.370	0.514	13.920	81 FR 70365	7.930
2017	0.765	0.483	13.920		7.930
2018	0.466	0.461	13.920		7.930
2019	0.472	0.453	4.900	SSC (Sep 2019)	4.900
2020	0.731	0.459	4.900		4.900
2021			4.900		4.900

Table 2. Adjusted harvest recommendations (million pounds, gutted weight) across different β levels for Red Grouper after Interim Analysis using the updated index of abundance derived from the NMFS MSLABS Bottom Longline Survey. Catch advice for 2021 is highlighted in red.

Year	beta1	beta3	beta5	beta7	beta9
2008	6.560	6.560	6.560	6.560	6.560
2009	6.560	6.560	6.560	6.560	6.560
2010	10.031	9.146	8.729	8.486	8.328
2011	10.031	9.146	8.729	8.486	8.328
2012	12.692	11.139	10.308	9.791	9.439
2013	12.692	11.139	10.308	9.791	9.439
2014	5.960	6.551	6.825	6.983	7.085
2015	5.960	6.551	6.825	6.983	7.085
2016	6.628	7.217	7.439	7.556	7.628
2017	6.628	7.217	7.439	7.556	7.628
2018	7.983	7.958	7.949	7.944	7.942
2019	7.983	7.958	7.949	7.944	7.942
2020	6.522	5.762	5.487	5.345	5.258
2021	6.522	5.762	5.487	5.345	5.258

Figures

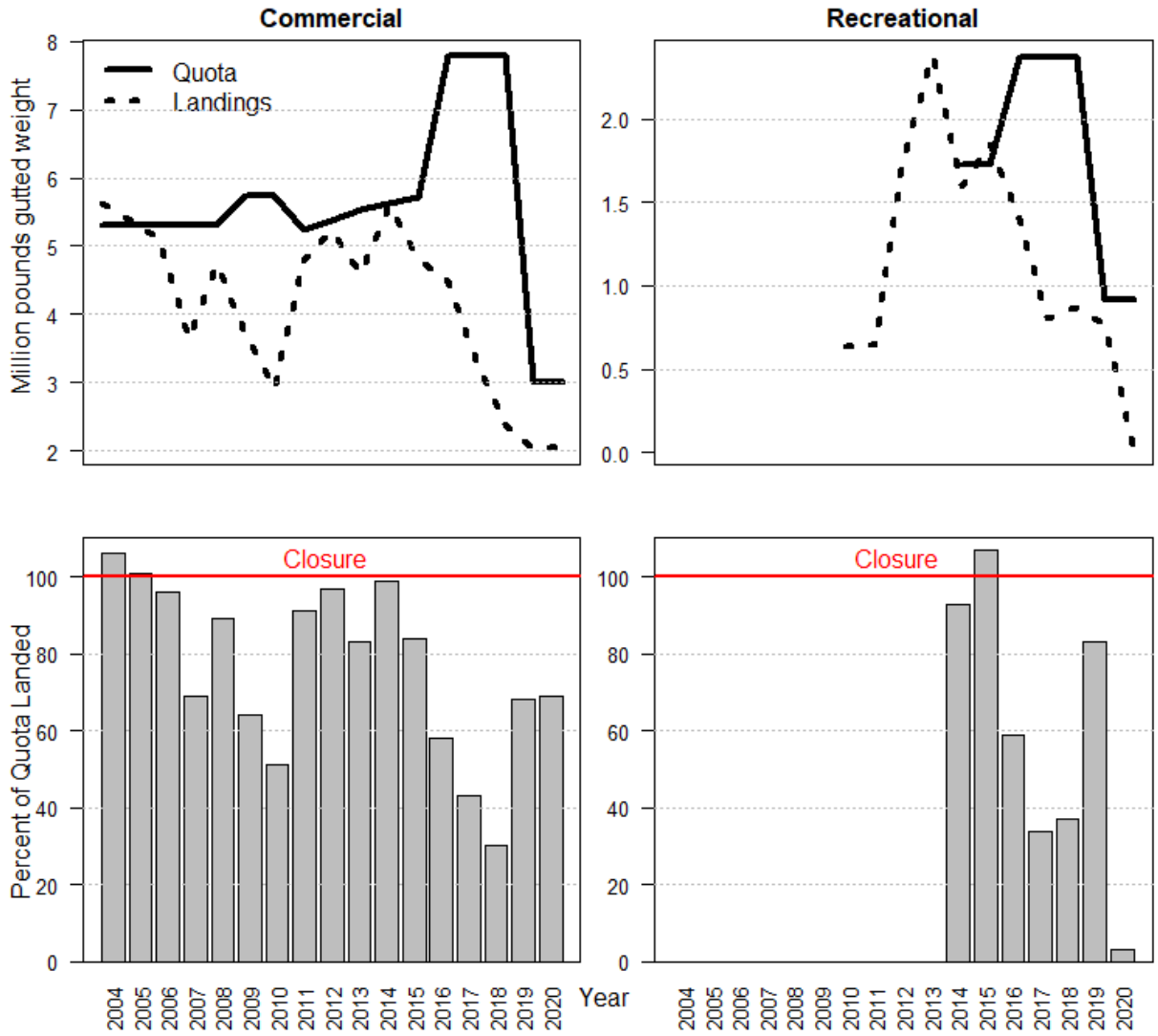


Figure 1. Commercial and recreational landings (dashed line) and quotas (thick line) for Red Grouper in the Gulf of Mexico. Bars represent the percent of quota landed, with the thick red line indicative of closures due to the quota being exceeded. Commercial data from 2010 through 2020 were obtained from the Quotas and Catch Allowances, accessed December 3, 2020 (*https://portal.southeast.fisheries.noaa.gov/reports/cs/CommercialQuotasCatchAllowanceTable.pdf*), remaining years were obtained from the Gulf of Mexico Historical Commercial Landings and Annual Catch Limits (ACLs), updated November 7, 2018 (*https://www.fisheries.noaa.gov/southeast/gulf-mexico-historical-commercial-landings-and-annual-catch-limit-monitoring/gulf_commercial_historical.pdf*). Recreational data from 2010 through 2018 were obtained from recreational historical landings, updated October 13, 2020 (*https://www.fisheries.noaa.gov/southeast/recreational-fishing-data/gulf-mexico-historical-recreational-landings-and-annual-catch*), data from 2019 and 2020 (through June) were obtained December 3, 2020 from *https://www.fisheries.noaa.gov/southeast/2019-and-2020-gulf-mexico-recreational-landings-and-annual-catch-limits-acls-and-annual*.

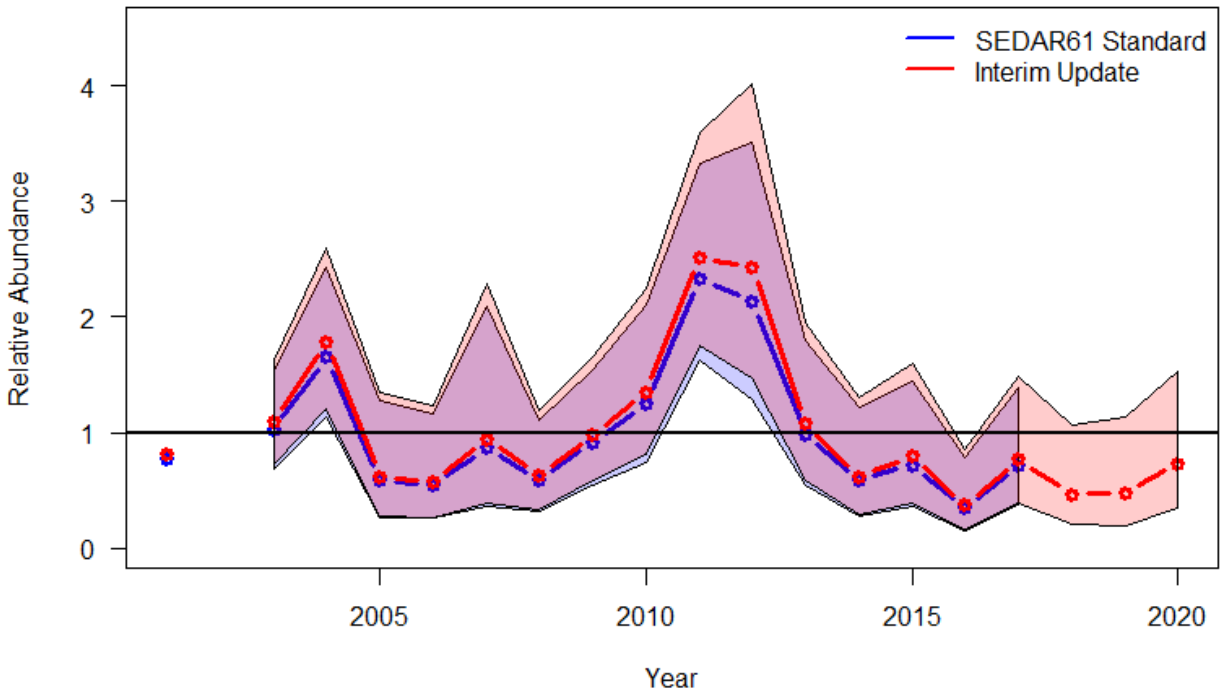


Figure 2. Comparison of NMFS MSLABS Bottom Longline Survey index of abundance derived for Red Grouper in the Gulf of Mexico for SEDAR61 compared to the index updated through 2020 for Interim Analysis with confidence intervals.

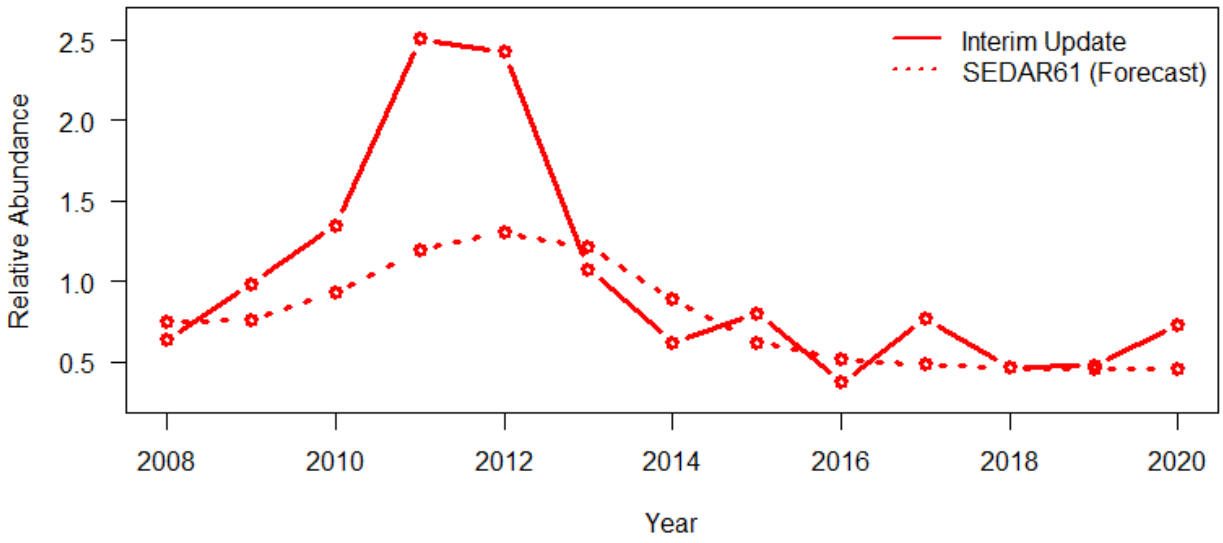


Figure 3. Comparison of the index of abundance derived for Red Grouper in the Gulf of Mexico through 2020 for Interim Analysis and the forecasted index from the SEDAR61 assessment model.

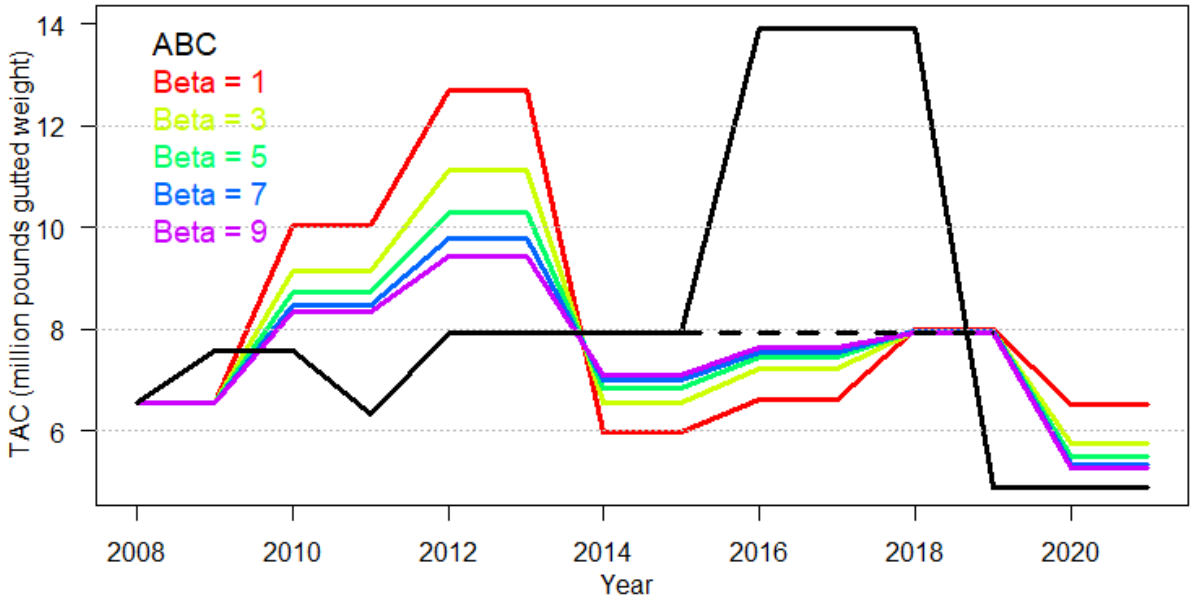


Figure 4. Application of the harvest control rule accepted for use by the SSC at their October 2018 meeting. Shown are the ABC over time (thick black line) and the HCR TAC over time across different β levels (denoted by different colors). The dashed black line starting in 2015 indicates ignoring the ABC increase that resulted from SEDAR42, which was supported by the SSC at their October 2018 meeting. Changes to the TAC are implemented every other year.

Appendix

An Updated Index of Relative Abundance for Red Grouper Captured During the NMFS Bottom Longline Survey in the Northern Gulf of Mexico

Adam G. Pollack

NOAA Fisheries, Southeast Fisheries Science Center,
Mississippi Laboratories, Pascagoula, MS

December 2020

This document serves to update the index of relative abundance for red grouper (*Epinephelus morio*) captured during the NMFS Bottom Longline Survey in the Gulf of Mexico (GOM) through 2020. Data were limited to those stations completed in the eastern GOM (east of 87° W) and at depths less than 118 m (Figure 1). To date, only four red grouper have been captured westward of this boundary and no red grouper have been captured in the western GOM (west of 89.15° W). The analysis follows the same methodology (delta-lognormal model) as outlined in Pollack et al. (2018).

The final delta-lognormal NMFS Bottom Longline Survey index of red grouper abundance retained year, area, time of day and depth in the binomial submodel, and year and area in the lognormal submodel. The updated annual abundance index is shown in Table 1 and Figure 2. Figure 3 shows the comparison between the updated index and the index presented for SEDAR 61.

One important thing to note is that in the terminal year of 2020, due to complications from COVID-19, weather (i.e. hurricanes), and mechanical issues, only half of the area used in the red grouper index was sampled (Appendix Figure 1). The majority of the sampling occurred south of Tampa Bay, FL, with only two samples to the north. This may have led to the 2020 index value being slightly higher than it would have been if the entire area had been covered because of the lack of zero catches that are usually encountered in the panhandle of Florida.

Literature Cited

Pollack, A.G., David S. Hanisko and G. Walter Ingram, Jr. 2018. An Index of Relative Abundance for Red Grouper Captured During the NMFS Bottom Longline Survey in the Northern Gulf of Mexico. SEDAR61-WP-02. SEDAR, North Charleston, SC. 19 pp.

Table 1. Index of red grouper abundance developed using the delta-lognormal (DL) model for 2001-2020 for the NMFS Bottom Longline Survey. The nominal frequency of occurrence, the number of samples (*N*), the DL Index (number per 100 hook hour), the DL indices scaled to a mean of one for the time series, the coefficient of variation on the mean (CV), and lower and upper confidence limits (LCL and UCL) for the scaled index are listed.

Survey Year	Frequency	*N*	DL Index	Scaled Index	CV	LCL	UCL
2001	0.215	93	0.74	0.818	0.291	0.462	1.448
2002							
2003	0.342	117	0.983	1.087	0.203	0.727	1.625
2004	0.418	98	1.606	1.775	0.193	1.21	2.604
2005	0.25	40	0.553	0.611	0.408	0.279	1.339
2006	0.282	39	0.52	0.575	0.393	0.269	1.228
2007	0.195	41	0.851	0.941	0.466	0.388	2.284
2008	0.267	60	0.573	0.634	0.324	0.337	1.192
2009	0.349	63	0.889	0.983	0.265	0.584	1.655
2010	0.343	67	1.217	1.346	0.259	0.809	2.24
2011	0.398	123	2.27	2.51	0.182	1.749	3.602
2012	0.469	49	2.196	2.428	0.255	1.468	4.014
2013	0.34	47	0.97	1.072	0.306	0.589	1.95
2014	0.262	42	0.561	0.62	0.384	0.295	1.302
2015	0.255	52	0.719	0.795	0.361	0.395	1.601
2016	0.18	50	0.335	0.37	0.436	0.161	0.854
2017	0.326	43	0.692	0.765	0.343	0.393	1.491
2018	0.191	47	0.422	0.466	0.428	0.205	1.059
2019	0.2	40	0.427	0.472	0.462	0.196	1.136
2020	0.314	35	0.661	0.731	0.384	0.348	1.535

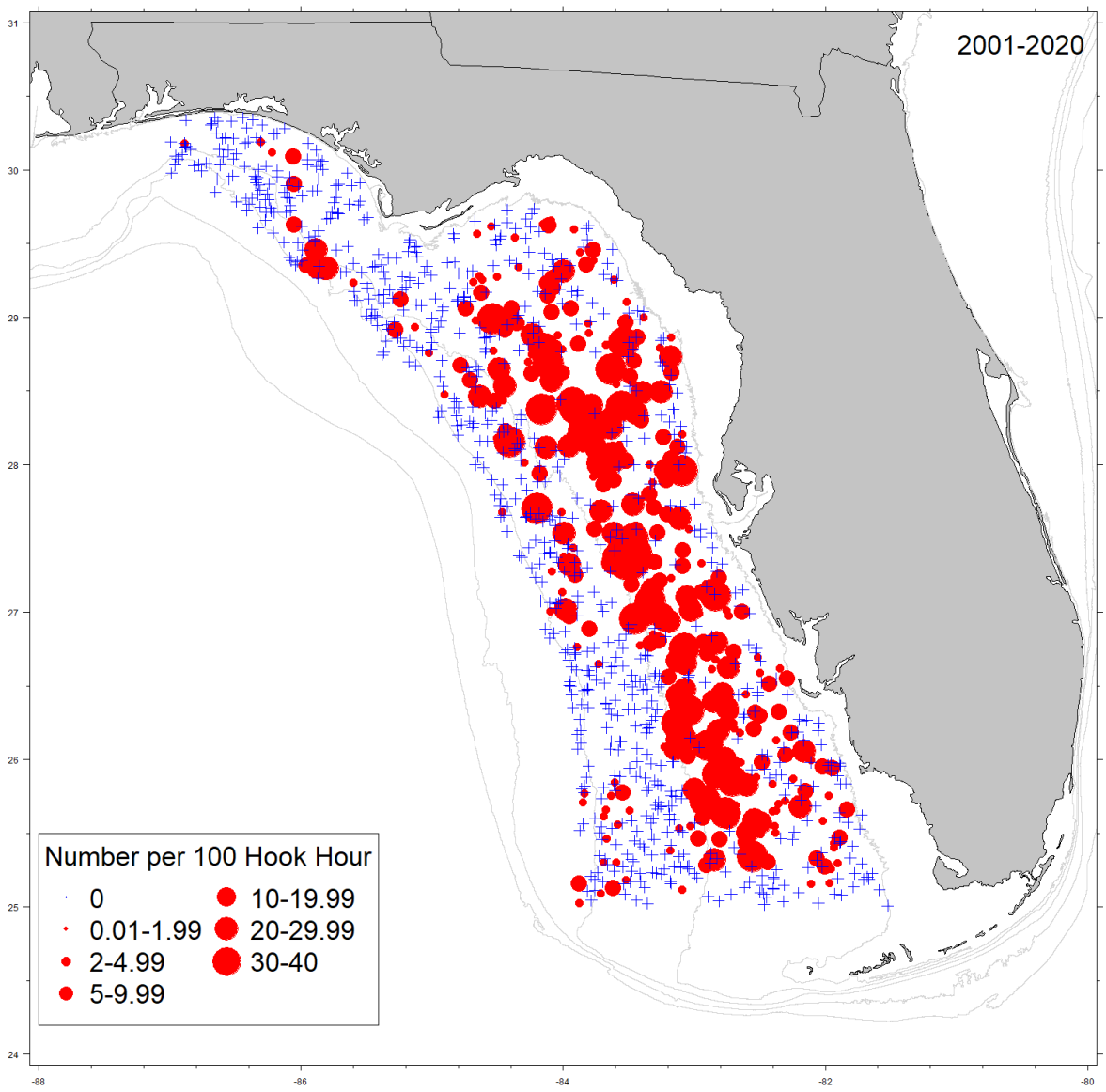


Figure 1. Stations sampled from 2001 to 2020 (limited to the area used for the index) during the NMFS Bottom Longline Survey with the CPUE for red grouper.

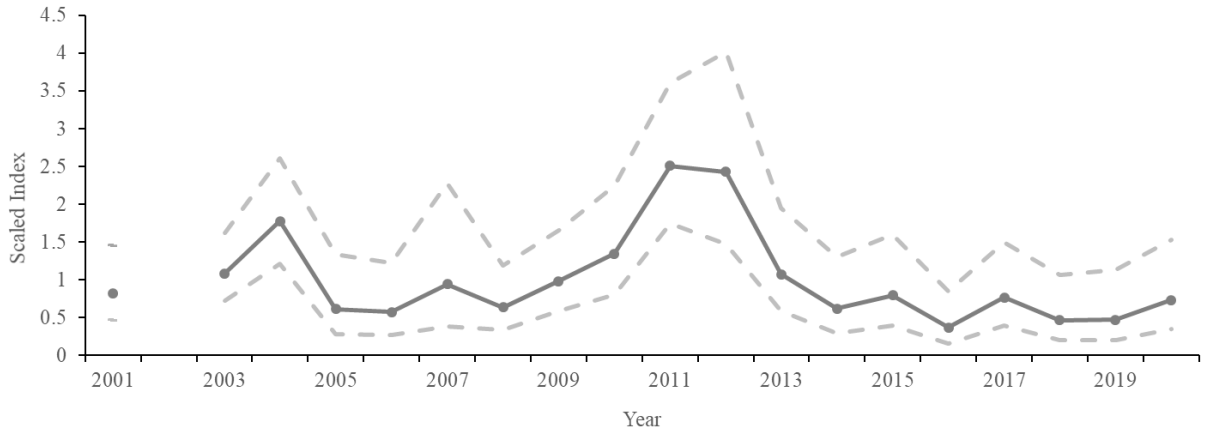


Figure 2. Annual index of abundance for red grouper from the NMFS Bottom Longline Survey from 2001 – 2020.

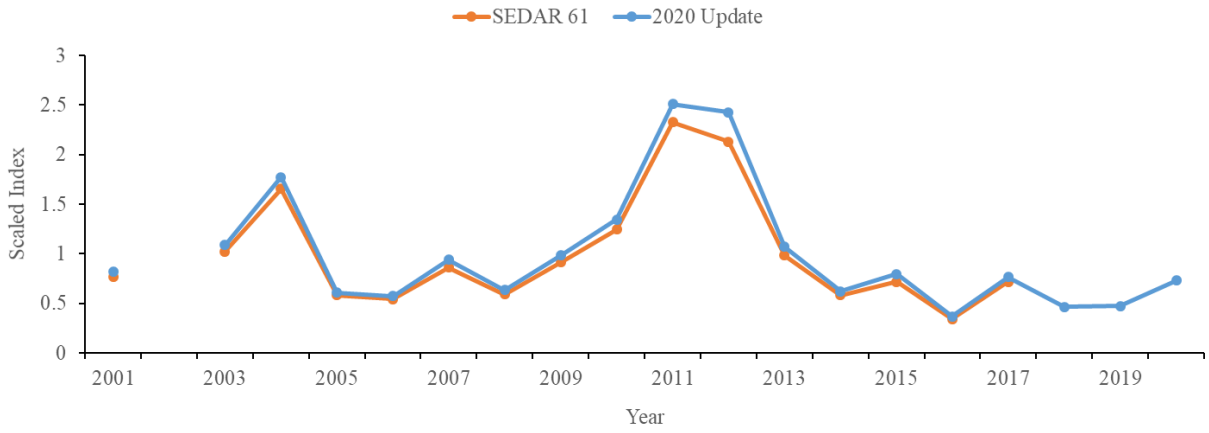
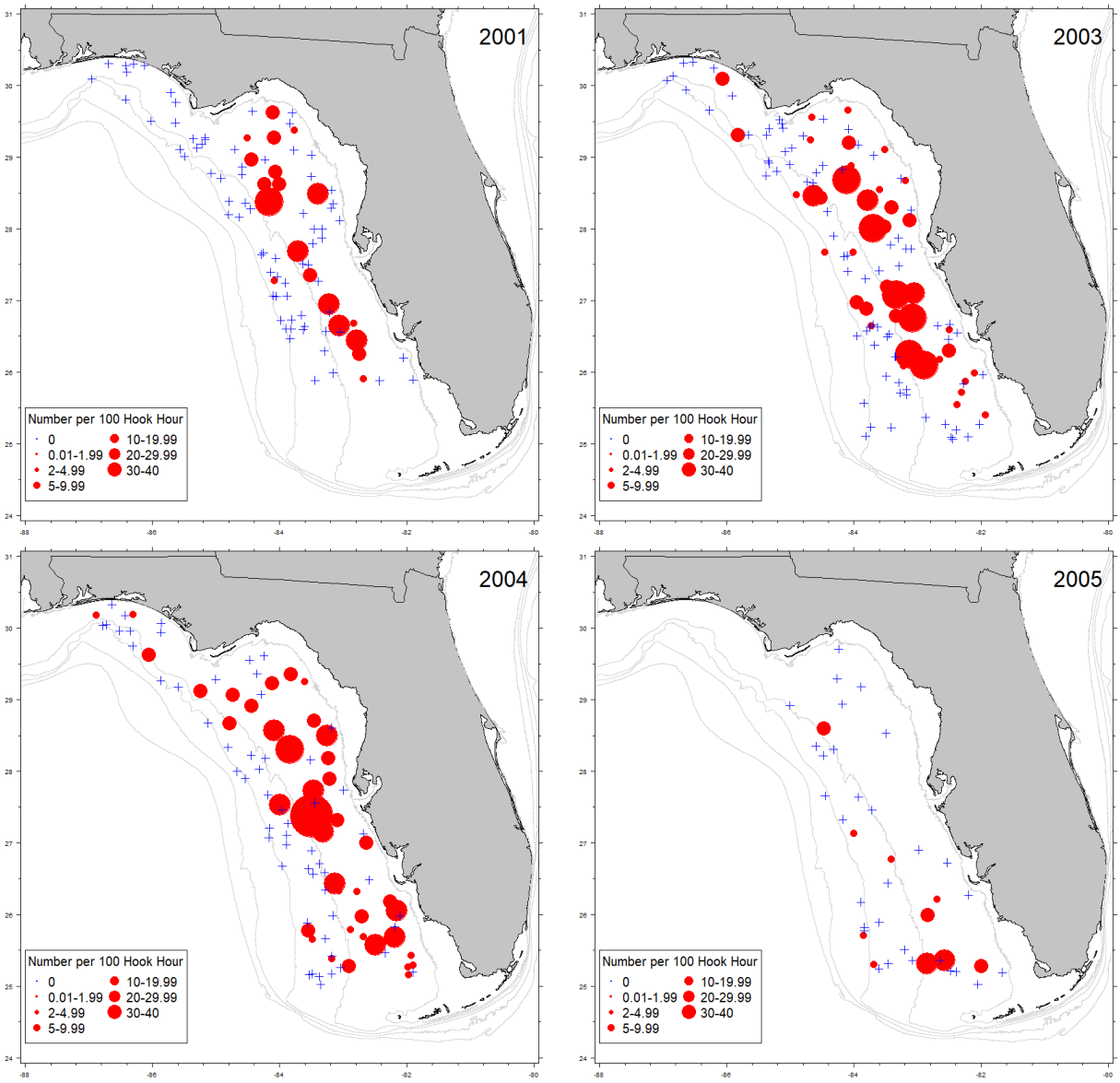
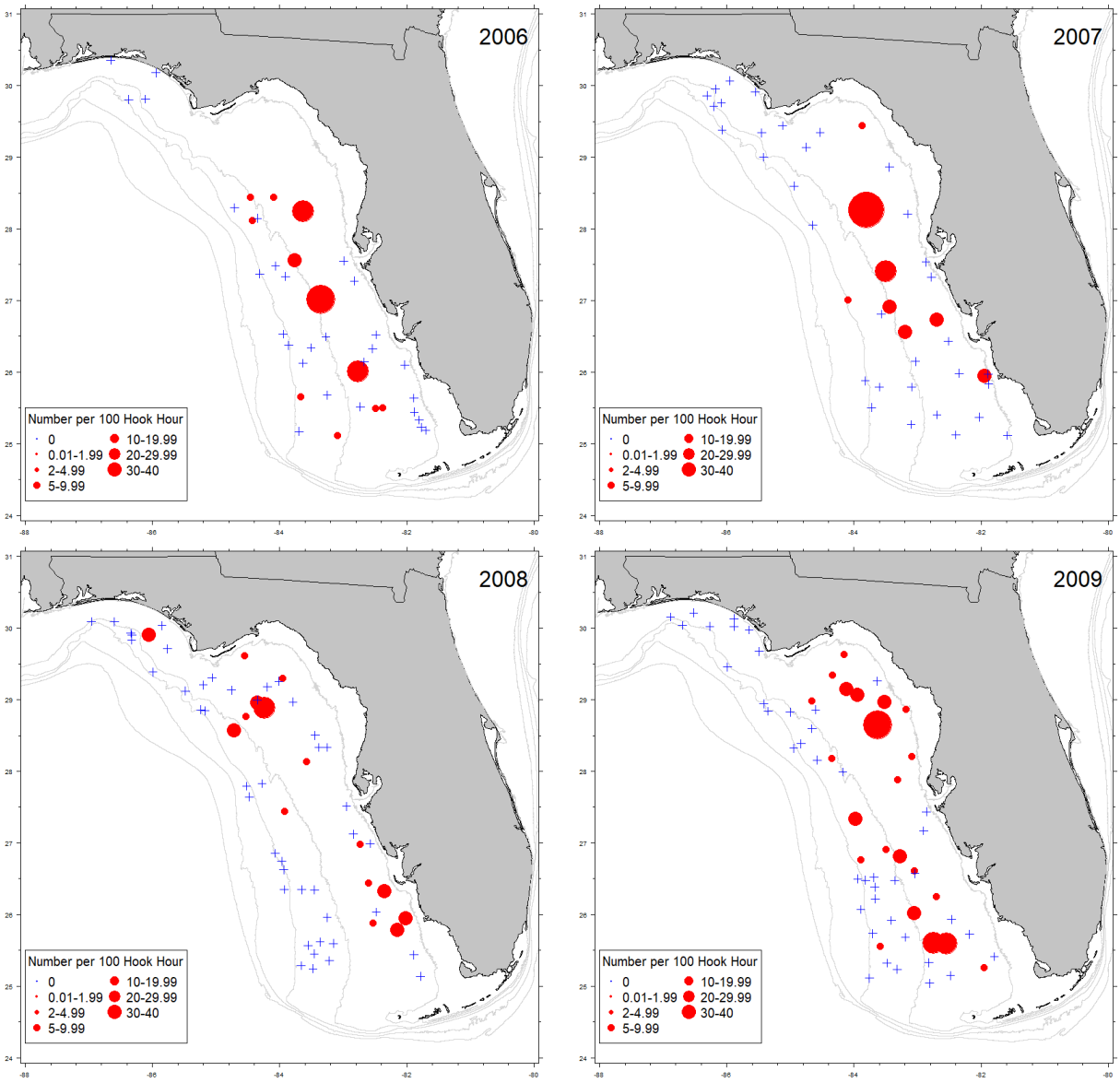


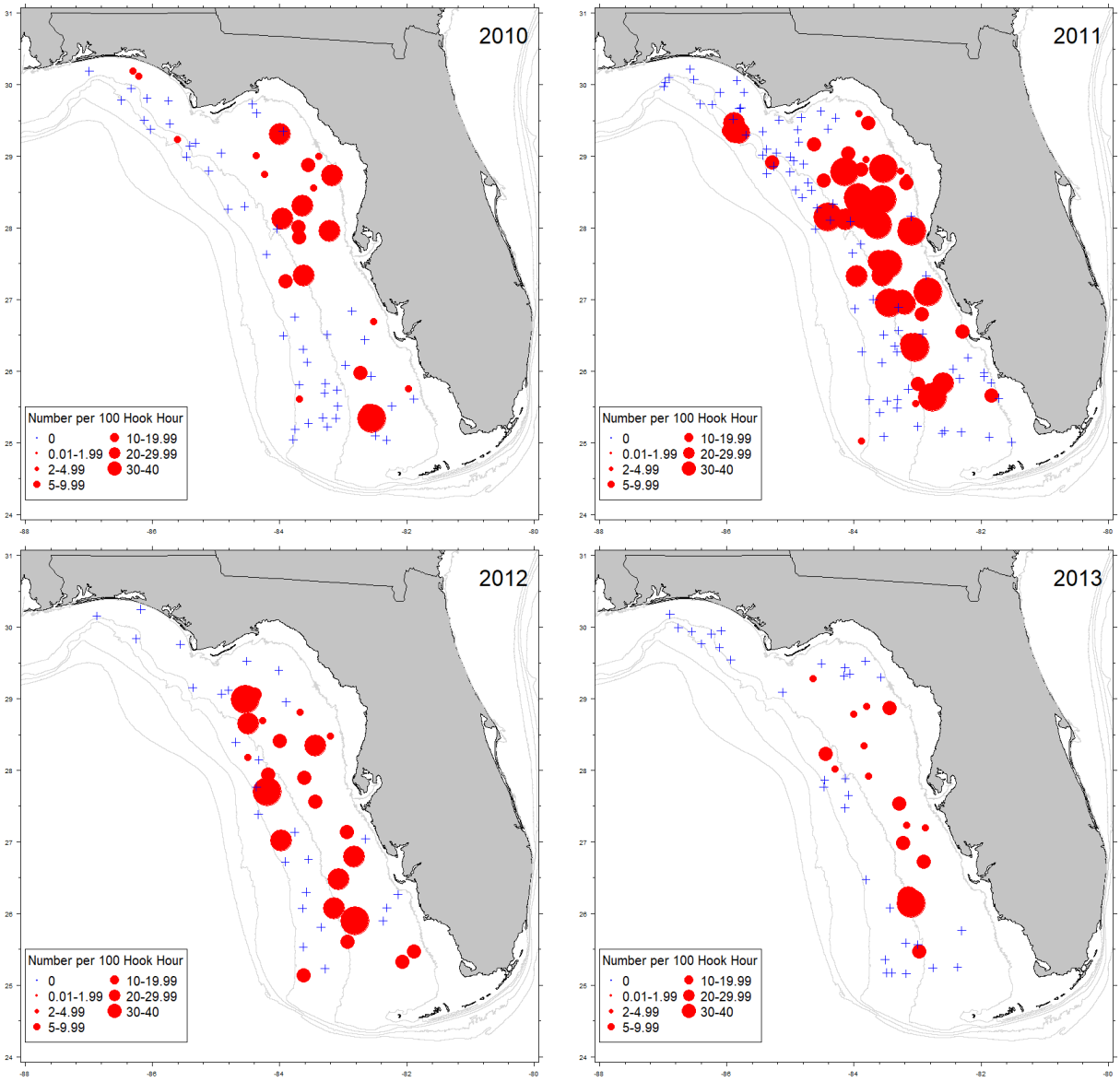
Figure 3. Annual index of abundance for red grouper from the NMFS Bottom Longline Survey from 2001 – 2020 compared to the index of abundance submitted for SEDAR 61.

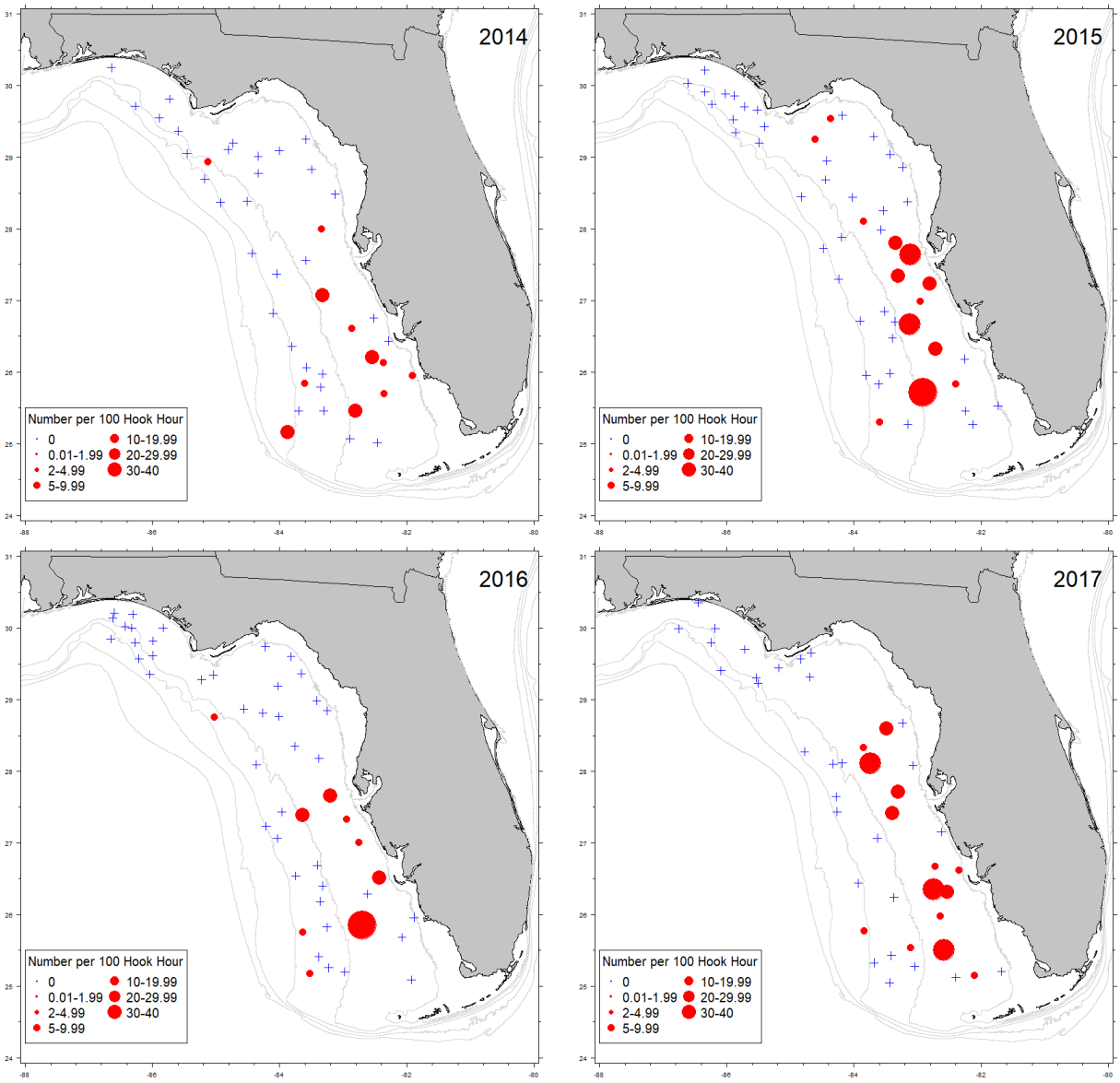
Appendix

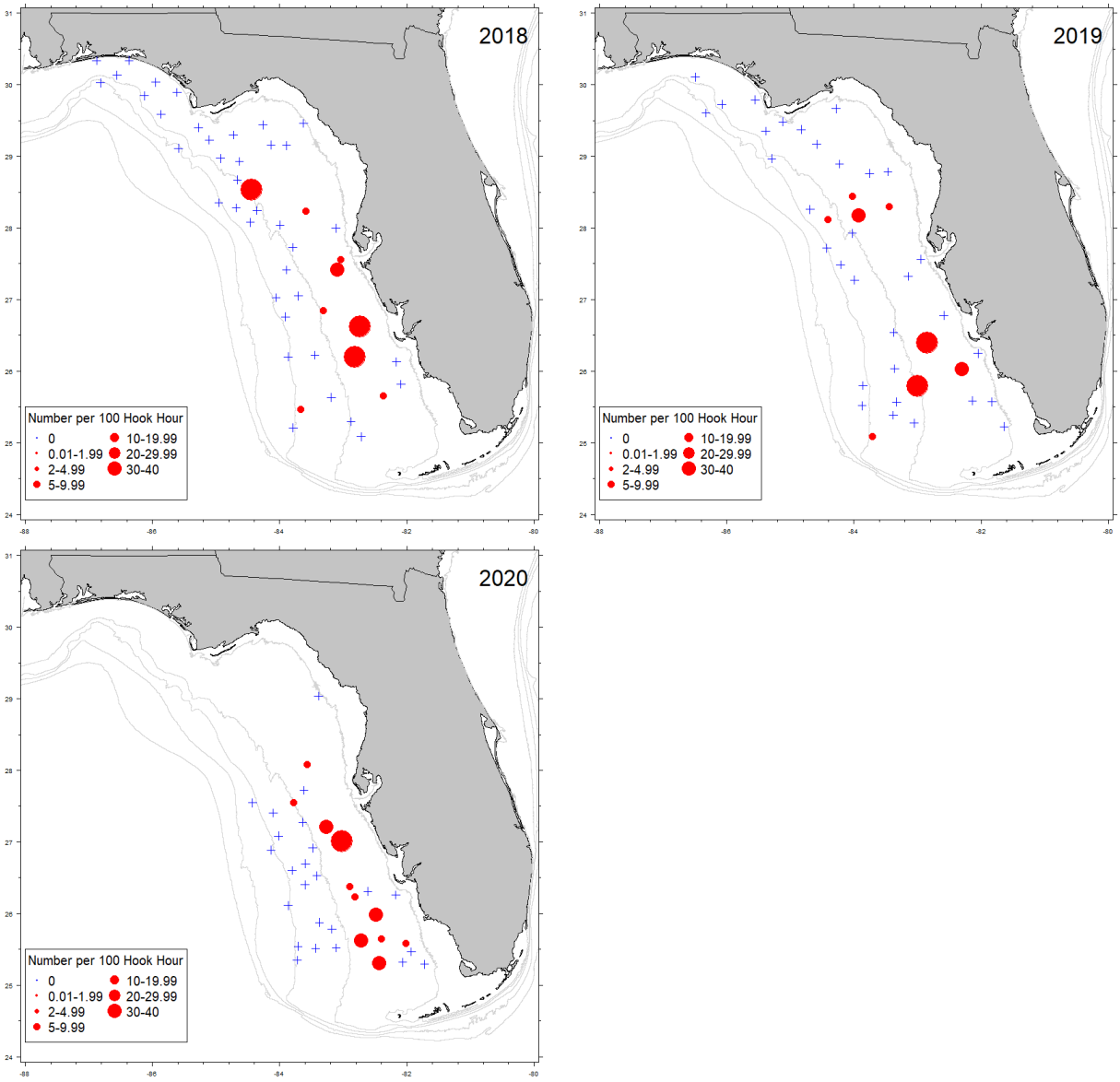
Appendix Figure 1. . Annual survey effort and catch of red grouper from the NMFS Bottom Longline Survey (2001-2020).




2006
2007
2008
2009
Number per 100 Hook Hour
0
0.01-1.99
2-4.99
5-9.99
10-19.99
20-29.99
30-40


2010
2011
2012
2013
Number per 100 Hook Hour
0
0.01-1.99
2-4.99
5-9.99
10-19.99
20-29.99
30-40


2014
2015
2016
2017
Number per 100 Hook Hour
0
0.01-1.99
2-4.99
5-9.99
10-19.99
20-29.99
30-40


2018
2019
2020
Number per 100 Hook Hour
0
0.01-1.99
2-4.99
5-9.99
10-19.99
20-29.99
30-40