Additional Analyses of Relative Abundance for Red Snapper Captured During Fishery Independent Bottom Longline Surveys in the Northern Gulf of Mexico

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This document provides additional analyses and alternative indices of relative abundance for red snapper (*Lutjanus campechanus*) captured during the NMFS Bottom Longline and DISL Bottom Longline surveys in the Gulf of Mexico (GOM) through 2020. Three abundance indices will be presented, one from a reduced area in the eastern GOM and two from the entire northern GOM.

Reduced Area in the eastern Gulf of Mexico

As noted in the previous document, sampling in 2020 was limited to an area roughly south of 28.5° N in the eastern GOM due to complications from COVID-19, weather (i.e. hurricanes), and mechanical issues and an area between 87.4° W and 88.4° W by DISL. A question was raised about how the index was affected by this limited coverage, considering the data typically extends further north to the Florida panhandle. Therefore, a new index was created where the data were limited to those stations completed in the eastern GOM (between 87.4° W and 88.4° W and south of 28.5° N) and at depths less than 183 m (Figure 1) through the entire time series. The analysis follows the same methodology (delta-lognormal model) as outlined in Pollack et al. (2017).

The final delta-lognormal index of red snapper abundance retained year, area and data source in the binomial submodel, and year and data source in the lognormal submodel. The updated annual abundance index is shown in Table 1. Figure 2 shows the comparison between the updated index from the reduced spatial area and the indices from the previous 2020 Update and SEDAR 52. When examining the original 2020 Update index and the 2020 Update index from the reduced area, there does not appear to be any major difference in the trends of red snapper abundance. The difference in the index values in 2011, 2012, and 2013 could be attributed to the high catch rates from the DISL survey, which began in 2010.

Gulf-wide Index

The second index produced was a gulf-wide index for red snapper from 2001- 2020. The same general methodology that was outlined in Pollack et al. (2017) was followed for model construction. Data was once again limited to stations at depths less than 183 m (Figure 3). In addition, the 2005 survey year was removed due to lack of spatial coverage (Appendix Figure 1) and the 2008 survey year was removed due to zero red snapper being captured (this survey was also limited spatially to the eastern GOM due to weather/vessel issues).

The final delta-lognormal index of red snapper abundance retained year, area and depth zone in the binomial submodel, and year and area in the lognormal submodel. The updated annual abundance index is shown in Table 2. Using 2020 as the terminal year in the gulf-wide index may pose a problem because of the limited spatial coverage in the eastern GOM and the complete lack of sampling in the western GOM, where most of the red snapper are typically caught. This lack of coverage is the most likely reason for the sharp decline in relative abundance in 2020 (Figure 4) and the large amount of uncertainty around the estimate.

An alternative gulf-wide model was also produced that used 2019 as the terminal year. The final delta-lognormal index of red snapper abundance retained year, area and depth zone in the binomial submodel, and year and area in the lognormal submodel. The updated annual abundance index is shown in Table 3. In this case, the estimate for the terminal year appears to be much more reliable, but the tradeoff is the lack of any estimate for the 2020 survey year (Figure 5).

Literature Cited

Pollack, A.G., David S. Hanisko and G. Walter Ingram, Jr. 2017. Red Snapper Abundance Indices from Bottom Longline Surveys in the Northern Gulf of Mexico. SEDAR52-WP-16. SEDAR, North Charleston, SC. 38 pp.

Table 1. Index of red snapper abundance developed using the delta-lognormal (DL) model for 2001-2020 for the NMFS Bottom Longline and DISL Bottom Longline surveys in the eastern Gulf of Mexico (reduced area). 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	0.01449	69	0.0342	0.06185	1.28291	0.0086	0.44478
2002							
2003	0.05051	99	0.26946	0.48736	0.6019	0.16029	1.48185
2004	0.03297	91	0.19648	0.35537	0.76263	0.09174	1.37651
2005	0.025	40	0.25488	0.461	1.20602	0.06929	3.06732
2006	0.04082	49	0.13124	0.23737	0.91451	0.04992	1.12869
2007	0.04762	42	0.31705	0.57343	0.92316	0.11927	2.75683
2008							
2009	0.07273	55	0.30228	0.54672	0.63778	0.16995	1.75872
2010	0.17188	64	0.41138	0.74404	0.43779	0.32202	1.71917
2011	0.16822	107	0.67594	1.22254	0.32647	0.64691	2.31038
2012	0.23214	56	1.77574	3.21171	0.38249	1.53384	6.72501
2013	0.2037	54	1.02467	1.85328	0.42939	0.81403	4.21931
2014	0.35821	67	1.108	2.004	0.32222	1.06881	3.75746
2015	0.2973	74	0.70806	1.28063	0.32566	0.67867	2.4165
2016	0.37097	62	1.27683	2.30935	0.32129	1.23379	4.32252
2017	0.24638	69	0.31098	0.56247	0.37328	0.27314	1.15826
2018	0.21429	56	0.47011	0.85027	0.42584	0.37582	1.92368
2019	0.23729	59	0.39587	0.71599	0.40699	0.32723	1.5666
2020	0.14583	48	0.28896	0.52263	0.55496	0.18541	1.47318

Table 2. Index of red snapper abundance developed using the delta-lognormal (DL) model for 2001-2020 for the NMFS Bottom Longline and DISL Bottom Longline surveys in the Gulf of Mexico. 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	0.11245	249	0.21905	0.24589	0.26385	0.14635	0.41311
2002	0.23333	150	0.21494	0.24128	0.24452	0.14901	0.39068
2003	0.09843	254	0.20983	0.23554	0.27526	0.13719	0.40438
2004	0.09005	211	0.24363	0.27348	0.31514	0.14779	0.50606
2005							
2006	0.11719	128	0.19527	0.21919	0.35484	0.11008	0.43646
2007	0.11364	132	0.22585	0.25352	0.35453	0.12739	0.50452
2008							
2009	0.18293	164	0.43377	0.48691	0.25132	0.29682	0.79875
2010	0.16901	142	0.48835	0.54818	0.28112	0.31577	0.95163
2011	0.21600	250	0.85395	0.95857	0.18348	0.66615	1.37936
2012	0.26316	133	1.51779	1.70375	0.22407	1.09436	2.65246
2013	0.23226	155	0.94397	1.05962	0.22934	0.67375	1.66650
2014	0.32090	134	1.46822	1.64811	0.20572	1.09685	2.47640
2015	0.32934	166	1.64898	1.85102	0.17844	1.29907	2.63746
2016	0.38235	136	2.12526	2.38565	0.18065	1.66706	3.41399
2017	0.40385	156	1.71839	1.92892	0.16455	1.39104	2.67479
2018	0.29167	144	1.18060	1.32525	0.20750	0.87894	1.99818
2019	0.33065	124	1.60287	1.79925	0.20830	1.19147	2.71706
2020	0.14286	49	0.74465	0.83589	0.49416	0.32820	2.12888

Table 3. Index of red snapper abundance developed using the delta-lognormal (DL) model for 2001-2019 for the NMFS Bottom Longline and DISL Bottom Longline surveys in the Gulf of Mexico. 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	0.11245	249	0.21775	0.24270	0.26576	0.14393	0.40924
2002	0.23333	150	0.21377	0.23827	0.24624	0.14666	0.38709
2003	0.09843	254	0.20904	0.23300	0.27724	0.13520	0.40152
2004	0.09005	211	0.24290	0.27073	0.31735	0.14571	0.50304
2005							
2006	0.11719	128	0.19428	0.21653	0.35720	0.10828	0.43303
2007	0.11364	132	0.22480	0.25056	0.35693	0.12535	0.50083
2008							
2009	0.18293	164	0.43332	0.48296	0.25333	0.29328	0.79533
2010	0.16901	142	0.48724	0.54306	0.28344	0.31146	0.94689
2011	0.21600	250	0.85688	0.95505	0.18520	0.66149	1.37891
2012	0.26316	133	1.51683	1.69061	0.22601	1.08186	2.64191
2013	0.23226	155	0.93722	1.04460	0.23146	0.66149	1.64961
2014	0.32090	134	1.45975	1.62699	0.20787	1.07831	2.45487
2015	0.32934	166	1.64408	1.83244	0.18029	1.28140	2.62045
2016	0.38235	136	2.12316	2.36641	0.18253	1.64756	3.39891
2017	0.40385	156	1.71753	1.91431	0.16623	1.37597	2.66327
2018	0.29167	144	1.17669	1.31150	0.20947	0.86651	1.98501
2019	0.33065	124	1.59726	1.78026	0.21037	1.17418	2.69919

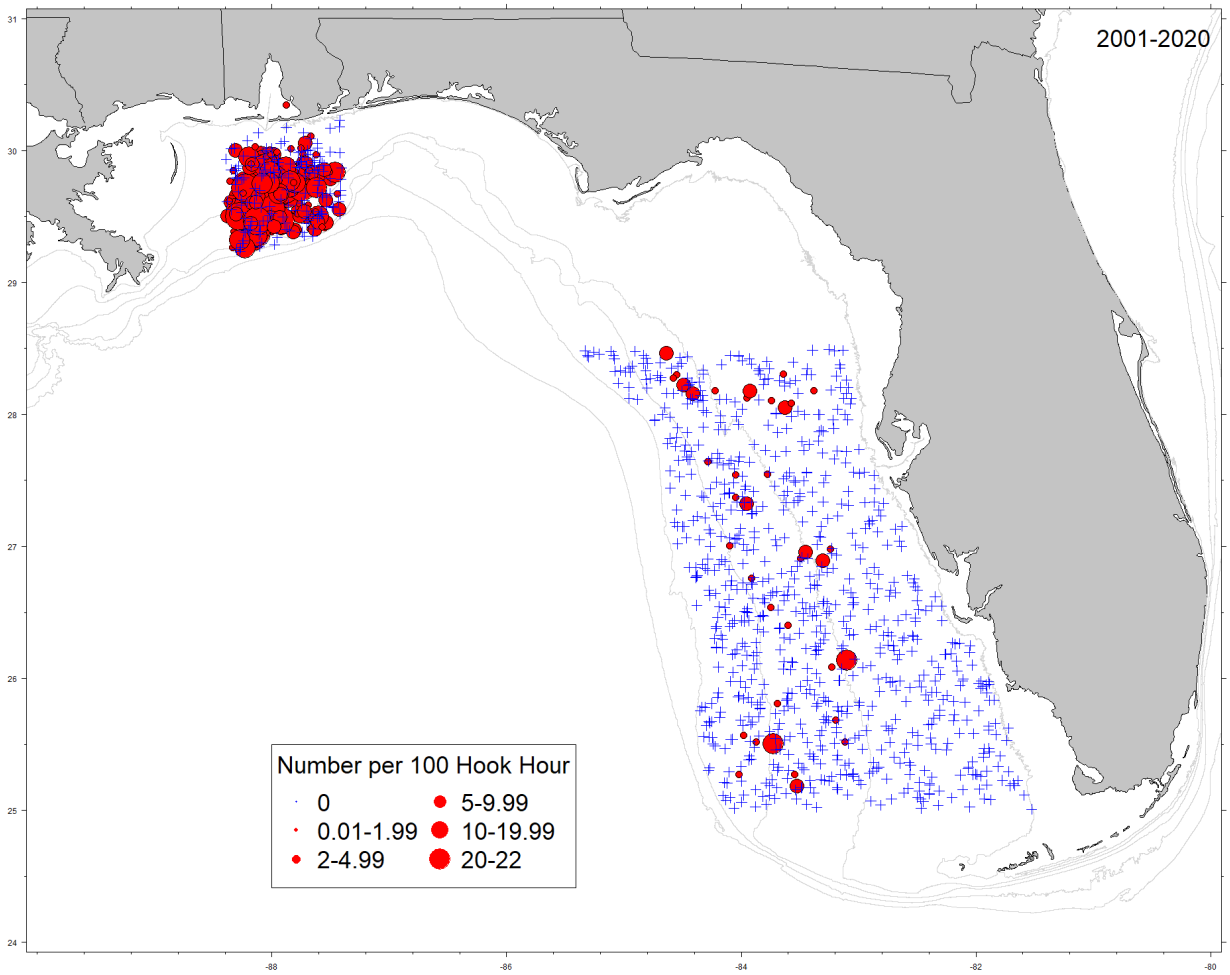


Figure 1. Stations sampled in the eastern Gulf of Mexico from 2001 to 2020 (limited to the area used for the index – reduced to match the sampling area covered in 2020) during the NMFS Bottom Longline and DISL Bottom Longline surveys with the CPUE for red snapper.

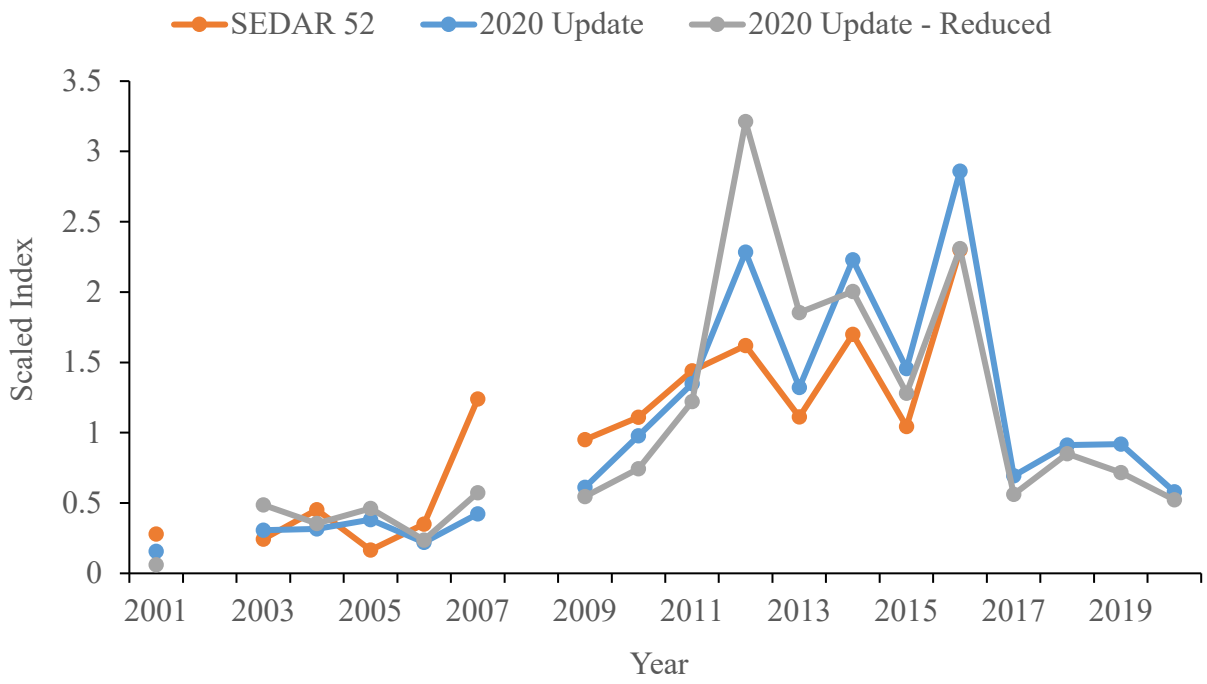


Figure 2. Annual index of abundance for eastern Gulf of Mexico red snapper from the NMFS Bottom Longline and DISL Bottom Longline surveys from 2001 – 2020 from the reduced area compared to the indices of abundance submitted for the 2020 Update and SEDAR 52.

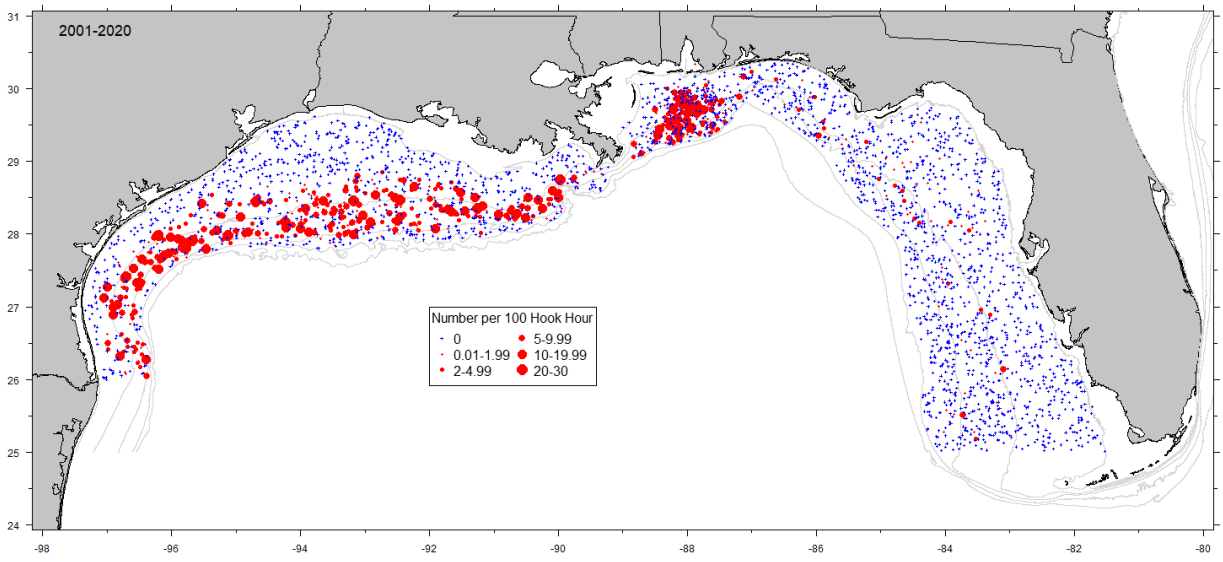


Figure 3. Stations sampled in the Gulf of Mexico from 2001 to 2020 (limited to the area used for the index) during the NMFS Bottom Longline and DISL Bottom Longline surveys with the CPUE for red snapper

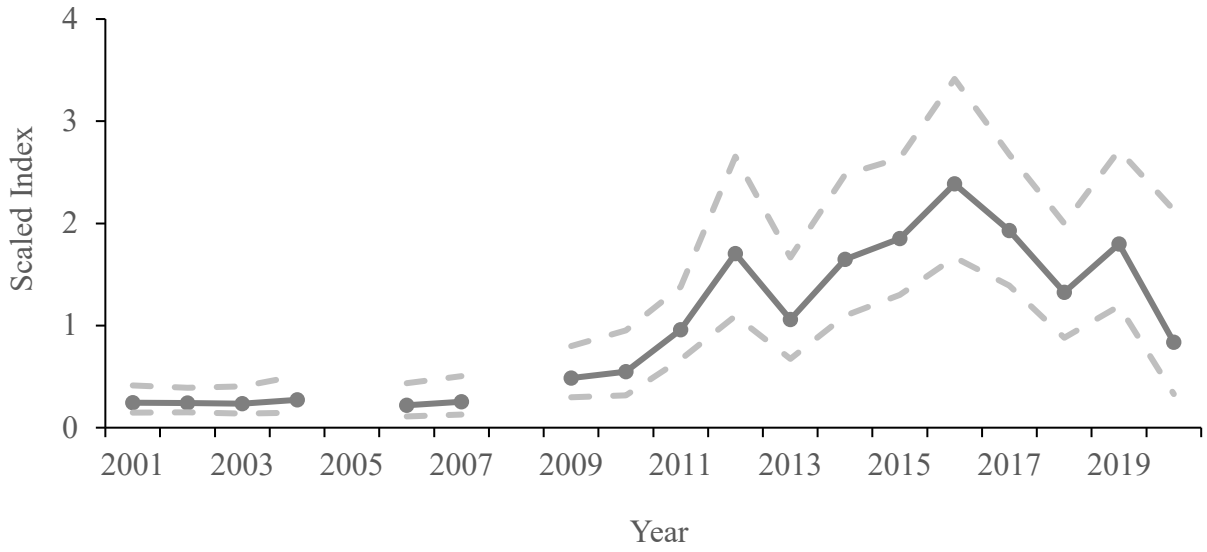


Figure 4. Annual index of abundance for Gulf of Mexico red snapper from the NMFS Bottom Longline and DISL Bottom Longline surveys from 2001 – 2020.

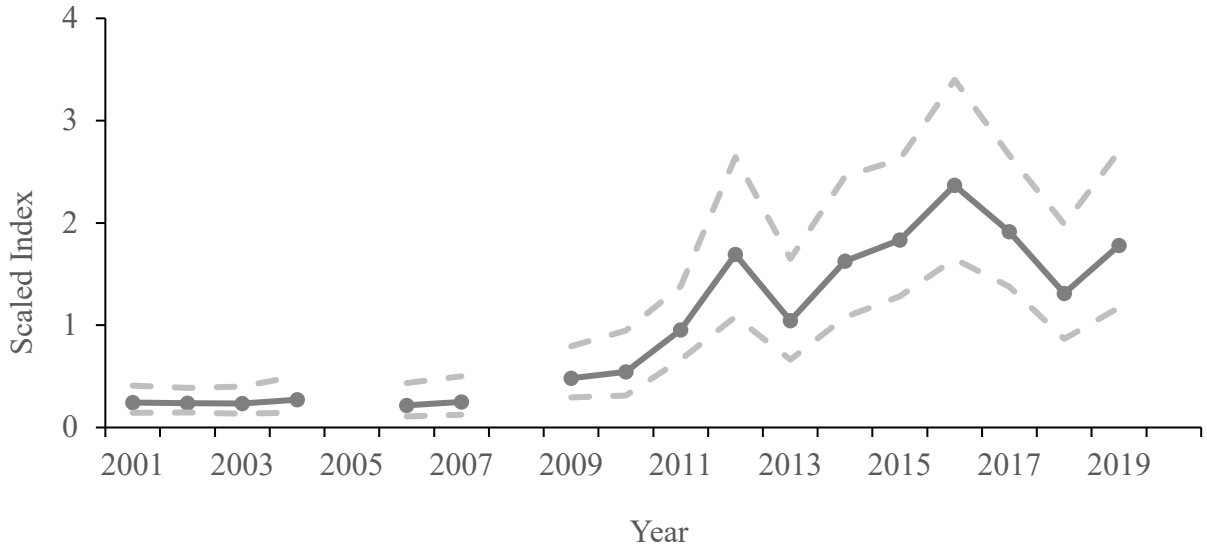
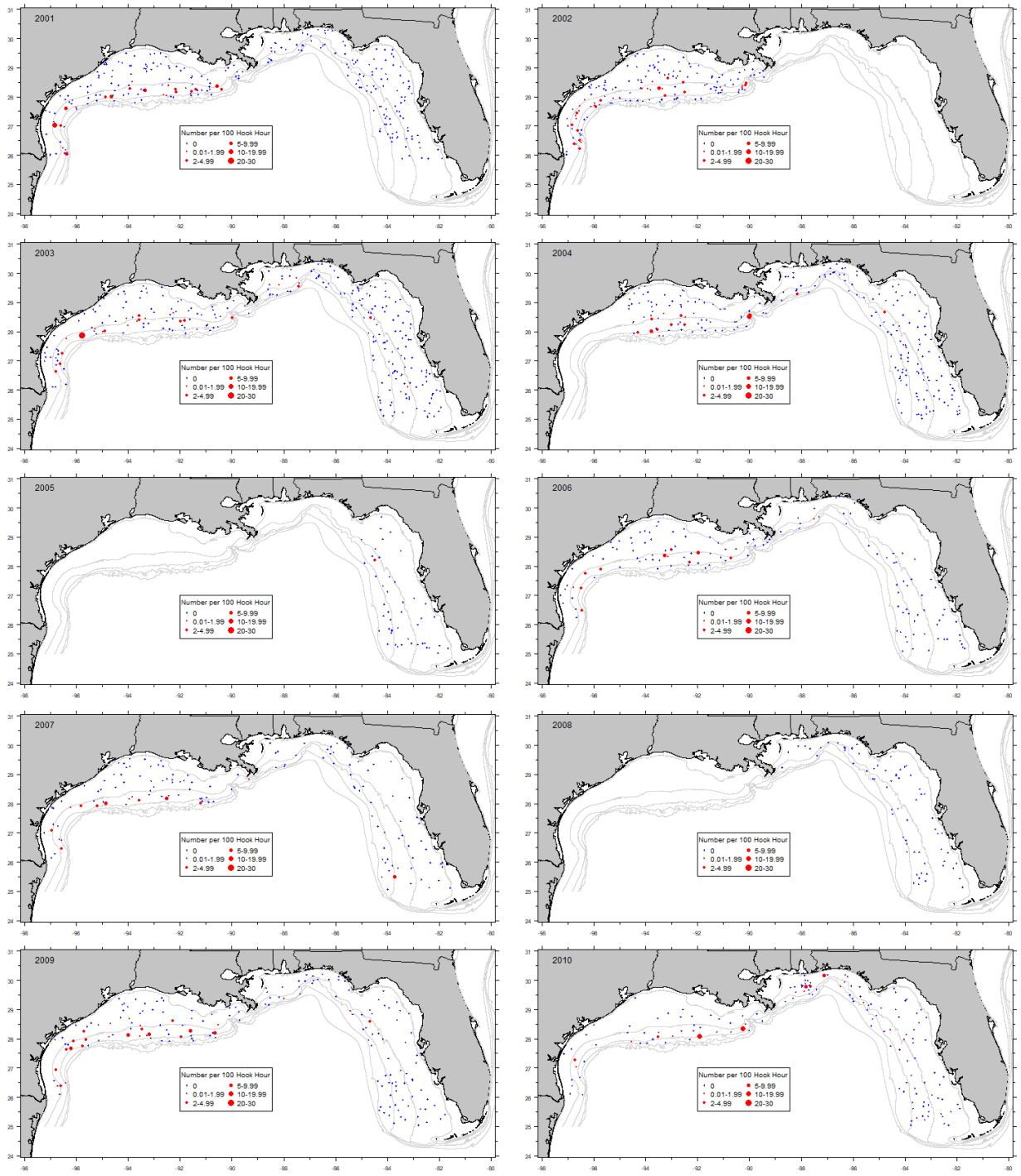
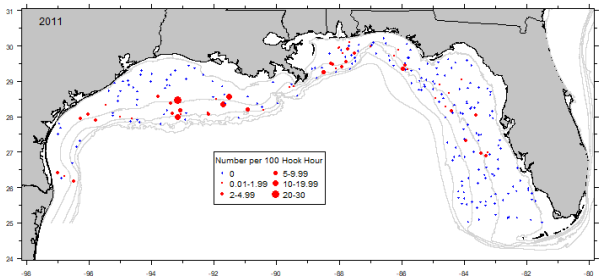


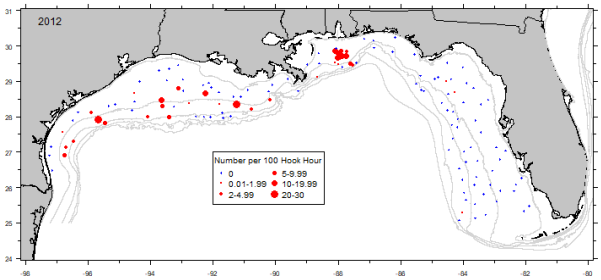
Figure 5. Annual index of abundance for Gulf of Mexico red snapper from the NMFS Bottom Longline and DISL Bottom Longline surveys from 2001 – 2019.

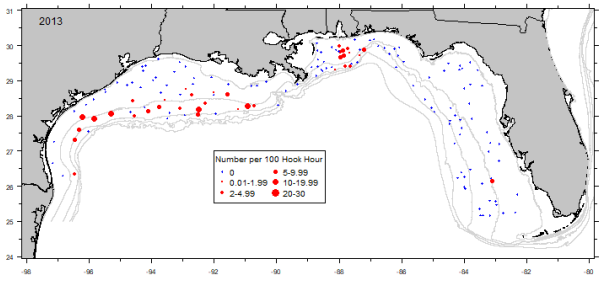
Appendix

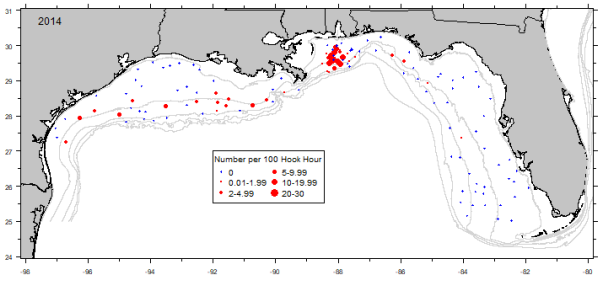
Appendix Figure 1. . Annual survey effort and catch of red snapper from the NMFS Bottom Longline and DISL Bottom Longline surveys (2001-2020) in the Gulf of Mexico.

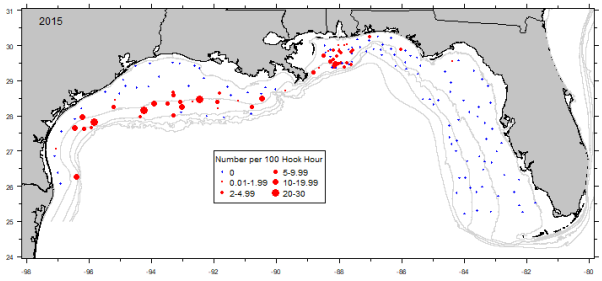


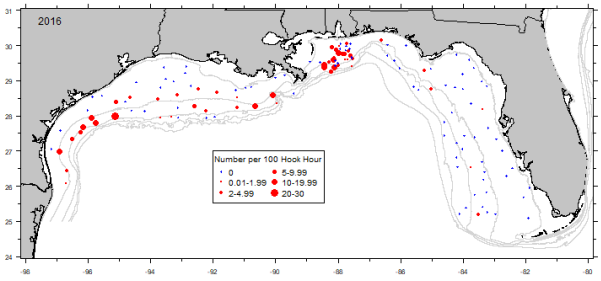

2011
Number per 100 Hook Hour
0
0.01-1.99
2-4.99
5-9.99
10-19.99
20-30

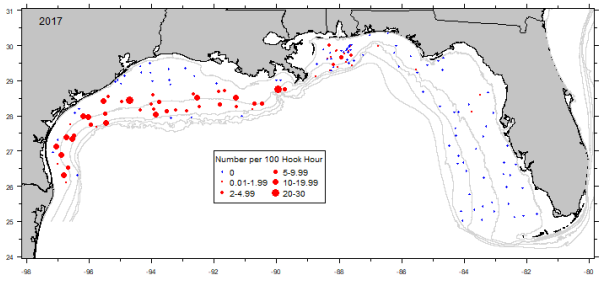

2012
Number per 100 Hook Hour
0
0.01-1.99
2-4.99
5-9.99
10-19.99
20-30

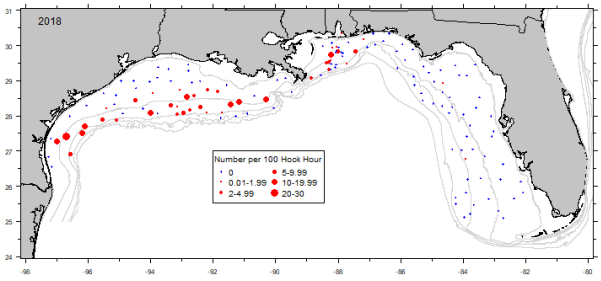

2013
Number per 100 Hook Hour
0
0.01-1.99
2-4.99
5-9.99
10-19.99
20-30

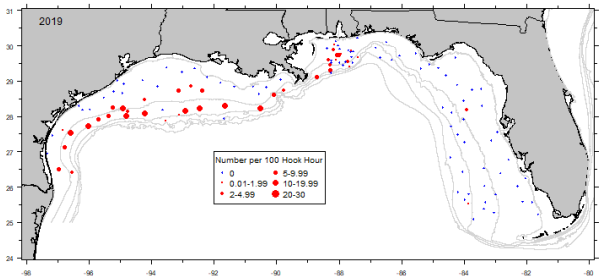

2014
Number per 100 Hook Hour
0
0.01-1.99
2-4.99
5-9.99
10-19.99
20-30

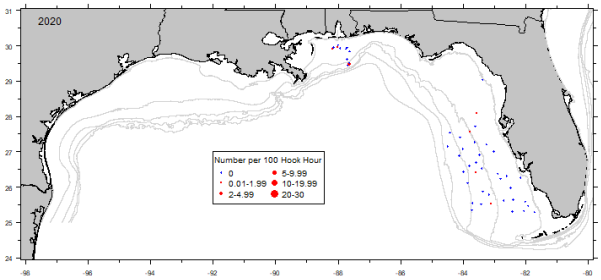

2015
Number per 100 Hook Hour
0
0.01-1.99
2-4.99
5-9.99
10-19.99
20-30


2016
Number per 100 Hook Hour
0
0.01-1.99
2-4.99
5-9.99
10-19.99
20-30


2017
Number per 100 Hook Hour
0
0.01-1.99
2-4.99
5-9.99
10-19.99
20-30


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


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


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