

Gulf of America Red Grouper commercial CPUE nominal index

SEFSC
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Background

At the request of the Gulf Fisheries Management Council, nominal CPUE was estimated for the commercial handline and commercial longline Red Grouper fleets from 2010 – 2025 using data from the Commercial Fisheries Logbook Program (Atkinson et al. 2021). This year range was selected to reflect the period of time during which the Individual Fishing Quota (IFQ) was active for Red Grouper.

The rationale for requesting these indices was that the most recent assessment resulted in a fairly optimistic outlook for the Gulf Red Grouper population, with the potential for increasing quota, despite the fishery being unable to catch the full quota for several years. Many experienced fishermen have reported a noticeable lack of Red Grouper, and as such, the council was interested to see whether that perceived lack of Red Grouper was reflected in the catch rates being reported in the logbook.

Data description and analytical steps

For each fishing trip, the CFLP records a unique trip identifier, the landing date, fishing gear deployed, areas fished, number of days at sea, number of crew, gear-specific fishing effort, species caught, and weight of the landings. Fishing effort data available for the handline gear (manual and electric) includes number of lines fished, hours fished, and number of hooks per line. For longline, fishing effort data available includes the number of sets, the total soak time, and the number of hooks per line. Catch per unit effort (CPUE) was calculated as follows:

Handline:

$$CPUE = \text{lbs of Red Grouper} / (\text{number of lines} * \text{number of hooks per line} * \text{hours fished})$$

Longline:

$$CPUE = \text{lbs of Red Grouper} / (\text{number of sets} * \text{number of hooks per set})$$

Hours fished for longline sets is considered unreliable in the coastal logbook program due to misreporting (McCarthy and Cass-Calay 2006), and was therefore not used in the CPUE calculation.

Data preparation

1. Outlier removal

Extreme values occur more frequently in self-reported data because there are limited opportunities to validate data. Recent SEDAR stock assessments have removed values at the extreme tail of the distribution for CPUE and associated fields in self-reported fishery-dependent data. Values falling outside the 99.5th percentile of the data were excluded from the analyses

conducted for number of lines/sets, effort (hooks per line/set), hours fished, days away, crew size and overall longline length (for longline only).

2. Data exclusions and assumptions (delayed reporting, multiple gears, area reported, closures)

Data were restricted to include only those trips with landings and effort data reported within 45 days of the completion of the trip to minimize the potential for recall bias (some reporting delays were longer than one year). Also excluded were trips that reported use of multiple gears fished, which prevents designating trip-level catch and effort records to specific gears. Therefore, only trips which reported one gear fished were included in these analyses. For trips that reported fishing in more than one area, the first area reported was used to determine the spatial zone associated with the trip.

3. Areas included in the model

Data were initially investigated for statistical zones 1-11, following data filtering used in the length and age compositions in SEDAR 88, however very few logbook trips were recorded in zones 1, 10, and 11 for longline and as such were excluded from the longline analyses. Handline had sufficient trips to include all zones 1 – 11.

4. Time period

As mentioned above, this nominal index is meant to reflect the IFQ time period which began in 2010, therefore data were restricted to trips from 2010 – 2025, the most recent year of complete logbook data.

Subsetting trips

Effective effort was based on those trips from areas where Red Grouper were available to be caught. Without fine-scale geographic information on fishing location, trips to be included in the analysis must be inferred, which was done here using the method of Stephens and MacCall (2004). The method uses multiple logistic regression to estimate a probability for each trip that the focal species was caught, given other species caught on that trip.

A backwards stepwise AIC procedure (Venables and Ripley 1997) was then used to perform further selection among possible species as predictor variables, where the most general model included all listed species as main effects. In this procedure, a generalized linear model with a binomial response was used to relate presence/absence of Red Grouper in each trip to presence/absence of other species. A trip was then included if its associated probability of catching Red Grouper was higher than a threshold probability. The threshold was designed to be that which resulted in the same number of predicted and observed positive trips, as suggested by Stephens and MacCall (2004). Given the potential differences in species assemblages by region we broke up the data into North (areas 6 – 11) and South (areas 1 – 5) for subsetting. The subsequent selected trips were then combined for the index.

Index calculation

After subsetting trips using the Stephens and MacCall procedure, trips are further filtered to remove CPUE outliers falling outside of the 99.5th percentile. This final dataset was then used to produce the nominal index by calculating the mean CPUE by year for each gear.

Results

For handline, the Stephens and MacCall procedure identified Gag grouper, Lane Snapper, Scamp, and Gray Snapper as being strongly positively associated with Red Grouper catch in the northern region. Greater Amberjack, Almaco Jack, and Red Snapper were most strongly negatively associated with Red Grouper catch in the northern region. In the southern region, Red Grouper catch was most strongly positively correlated with Gag Grouper, Lane Snapper, Red Snapper, Scamp, and Black Grouper, meanwhile, Yellowtail Snapper and Blue Runner were strongly negatively associated with Red Grouper (Figure 1).

For longline, the Stephens and MacCall procedure identified Gray Snapper, Scamp, Gag Grouper, Speckled Hind, Margate, Vermillion Snapper, Gray Triggerfish, and Red Snapper as being positively associated with Red Grouper in the northern region. Yellowedge Grouper and Golden Tilefish were identified as strongly negatively associated with Red Grouper in the northern region. In the southern region, Mutton Snapper, Lane Snapper, Red Snapper, Margate, Gray Snapper, Gag Grouper, and Scamp were all positively associated with Red Grouper catch. Several species were negatively associated with Red Grouper in the southern region, however, Yellowedge Grouper and Yellowtail Snapper showed the strongest negative correlation (Figure 2).

Positive catch trips were retained at a fairly high percentage across both regions for both handline and longline, however, zero trips were retained at a much higher rate for handline than for longline, with some years have no zero catch trips selected for longline (Figures 3 & 4 for handline and longline, respectively). For handline, the northern region showed a decreasing trend in the number of positive trips through time, while the number of zero catch trips was slightly more stable. For handline in the southern region, the number of positive trips was somewhat dome-shaped through time, while the number of zero catch trips decreased through time. For longline, both the number of positive trips and the number of zero trips was slightly more stable through time.

The retained positive and zero catch trips for each gear were used to compute the mean annual CPUE (Nominal Index), proportion positive trips, and the mean annual CPUE adjusted to the grand mean, the results of which are shown in Tables 1 & 2 for handline and longline, respectively. A comparison showing the standardized nominal index for each gear is shown in Figure 5. Additionally, nominal and weighted length and age compositions which were provided for the SEDAR88 Gulf Red Grouper assessment are shown for reference in Figures 6 – 9 (Pawluk 2024). Finally, a comparison of the nominal CPUE from this report compared to the standardized fishery independent indices presented in SEDAR 88 is shown in Figure 10.

Caveats

It is important to reiterate that this index should not be interpreted as reflecting population abundance, but rather reflecting the trends within the fishery. Disentangling the effects of fisher behavior, regulatory actions, and population abundance on observed catch per unit effort is beyond the scope of this analysis and would require considerable effort and allocation of resources beyond what the center is currently able to provide.

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144 **References**

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Tables

Table 1. Nominal and standardized catch per unit effort and associated number of trips and proportion positive trips for the Gulf Red Grouper commercial handline fleet.

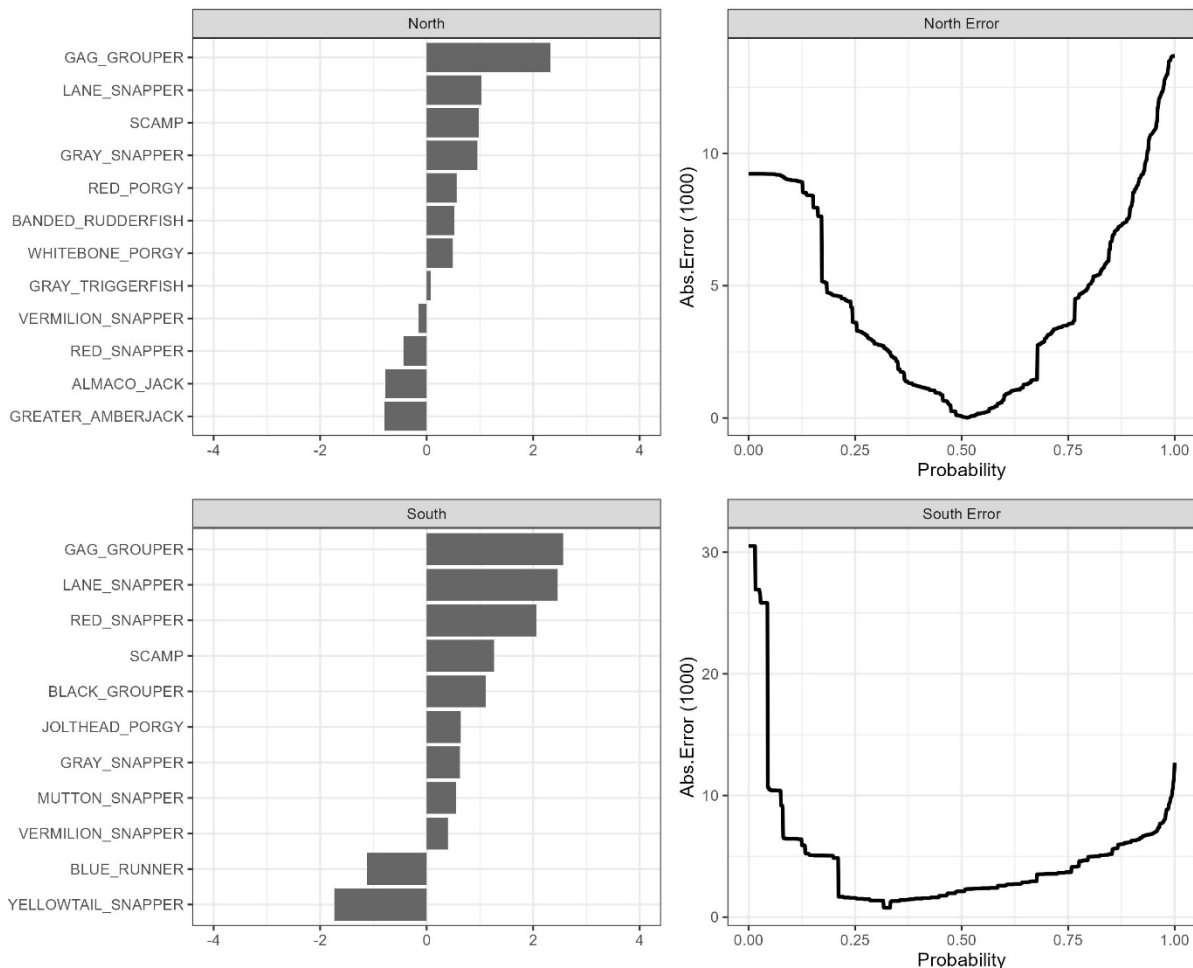
Year	# of Trips	Nominal CPUE	% Positive Trips	Standardized Nominal CPUE
2010	2134	3.1437	79.3814	0.9019
2011	1917	4.0645	84.1419	1.1661
2012	2166	4.3322	81.1173	1.2429
2013	1799	3.3465	83.9911	0.9601
2014	2181	3.9822	80.6052	1.1425
2015	2162	4.6133	81.0361	1.3235
2016	2201	3.1303	77.4648	0.8981
2017	2048	3.0574	76.6113	0.8772
2018	1725	2.5737	78.3188	0.7384
2019	1741	2.4406	77.5991	0.7002
2020	1354	3.2097	78.2127	0.9209
2021	1436	4.1715	80.1532	1.1968
2022	1214	3.4863	75.7002	1.0002
2023	1095	3.5331	79.3607	1.0136
2024	939	3.0858	79.4462	0.8853
2025	891	3.5980	79.0123	1.0323

175 Table 2. Nominal and standardized catch per unit effort and associated number of trips and
 176 proportion positive trips for the Gulf Red Grouper commercial longline fleet.

Year	# of Trips	Nominal CPUE	% Positive Trips	Standardized Nominal CPUE
2010	203	0.2402	99.0148	1.0529
2011	362	0.3275	99.4475	1.4353
2012	286	0.3751	97.5524	1.6441
2013	272	0.3073	98.5294	1.3467
2014	323	0.2993	98.7616	1.3120
2015	312	0.2161	98.7179	0.9470
2016	419	0.2413	98.5680	1.0575
2017	443	0.1690	98.6456	0.7408
2018	400	0.1386	96.7500	0.6076
2019	355	0.1500	97.1831	0.6575
2020	358	0.1681	99.4413	0.7366
2021	377	0.2023	96.8170	0.8867
2022	335	0.2239	97.9104	0.9812
2023	349	0.1935	96.5616	0.8482
2024	318	0.2131	98.1132	0.9338
2025	354	0.1853	98.8701	0.8123

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192 Figures



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 194 Figure 1. Species-specific regression coefficients from the Stephens and MacCall procedure used
 195 for north and south Gulf to predict each trip's probability of catching Red Grouper for the
 196 **commercial handline** fleet (left panels). The absolute difference between observed and
 197 predicted number of positive trips across a range of probability cutoff values (right panels).

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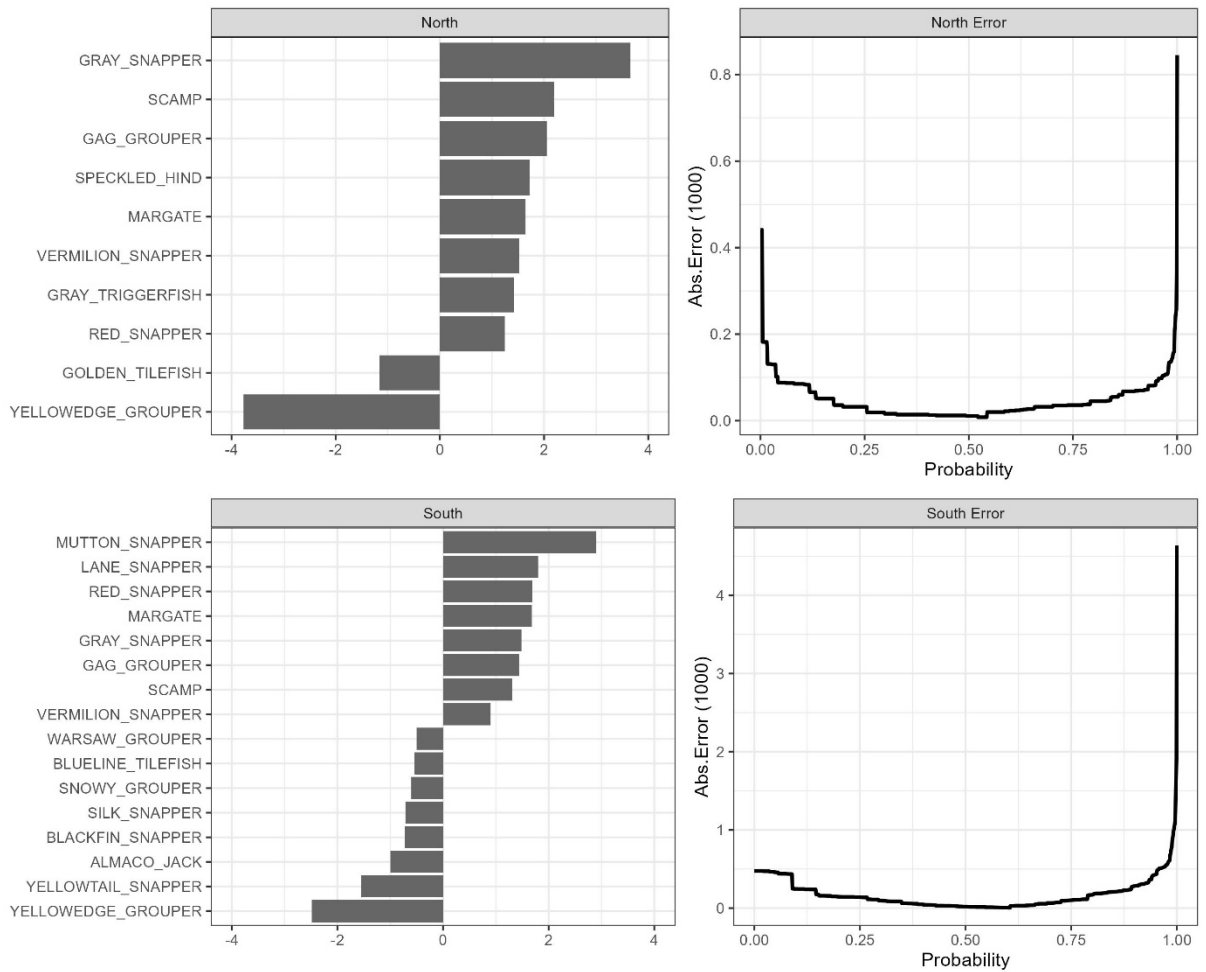
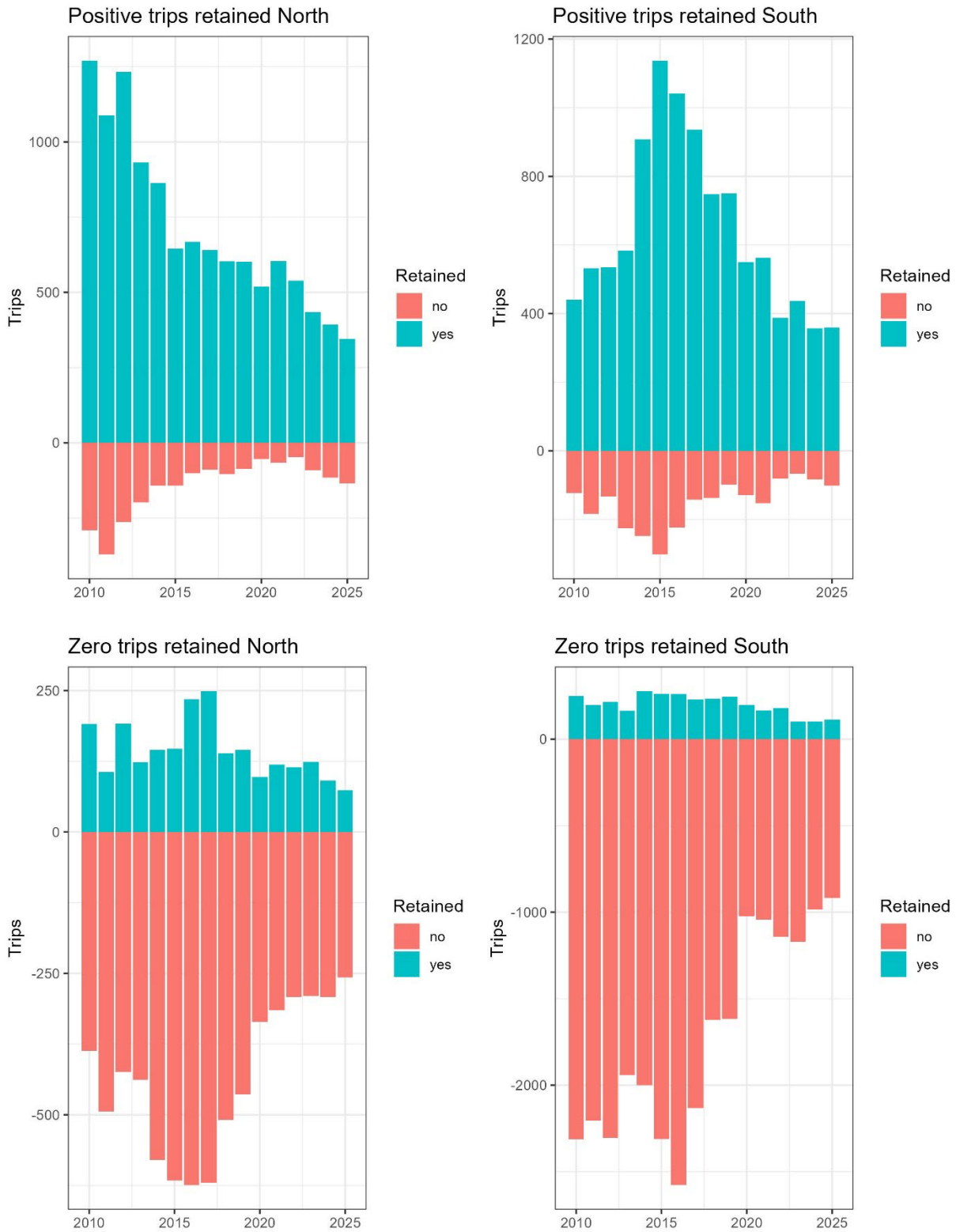
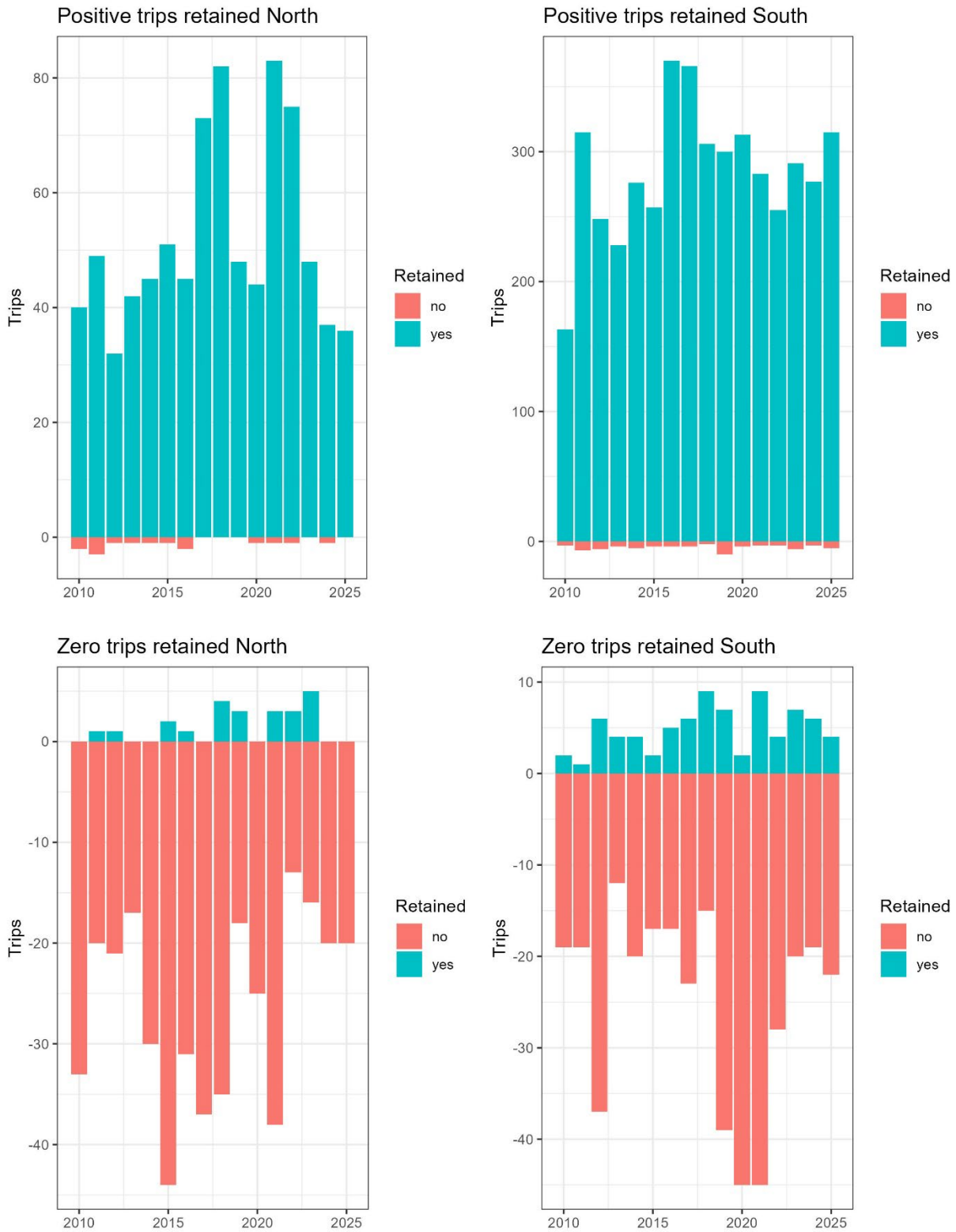


Figure 2. Species-specific regression coefficients from the Stephens and MacCall procedure used for north and south Gulf to predict each trip’s probability of catching Red Grouper for the **commercial longline** fleet (left panels). The absolute difference between observed and predicted number of positive trips across a range of probability cutoff values (right panels).



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207 Figure 3. **Commercial handline** positive and zero trips retained by year after subsetting using the
 208 Stephens and MacCall procedure for Gulf Red Grouper.



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210 Figure 4. **Commercial longline** positive and zero trips retained by year after subsetting using the
 211 Stephens and MacCall procedure for Gulf Red Grouper.

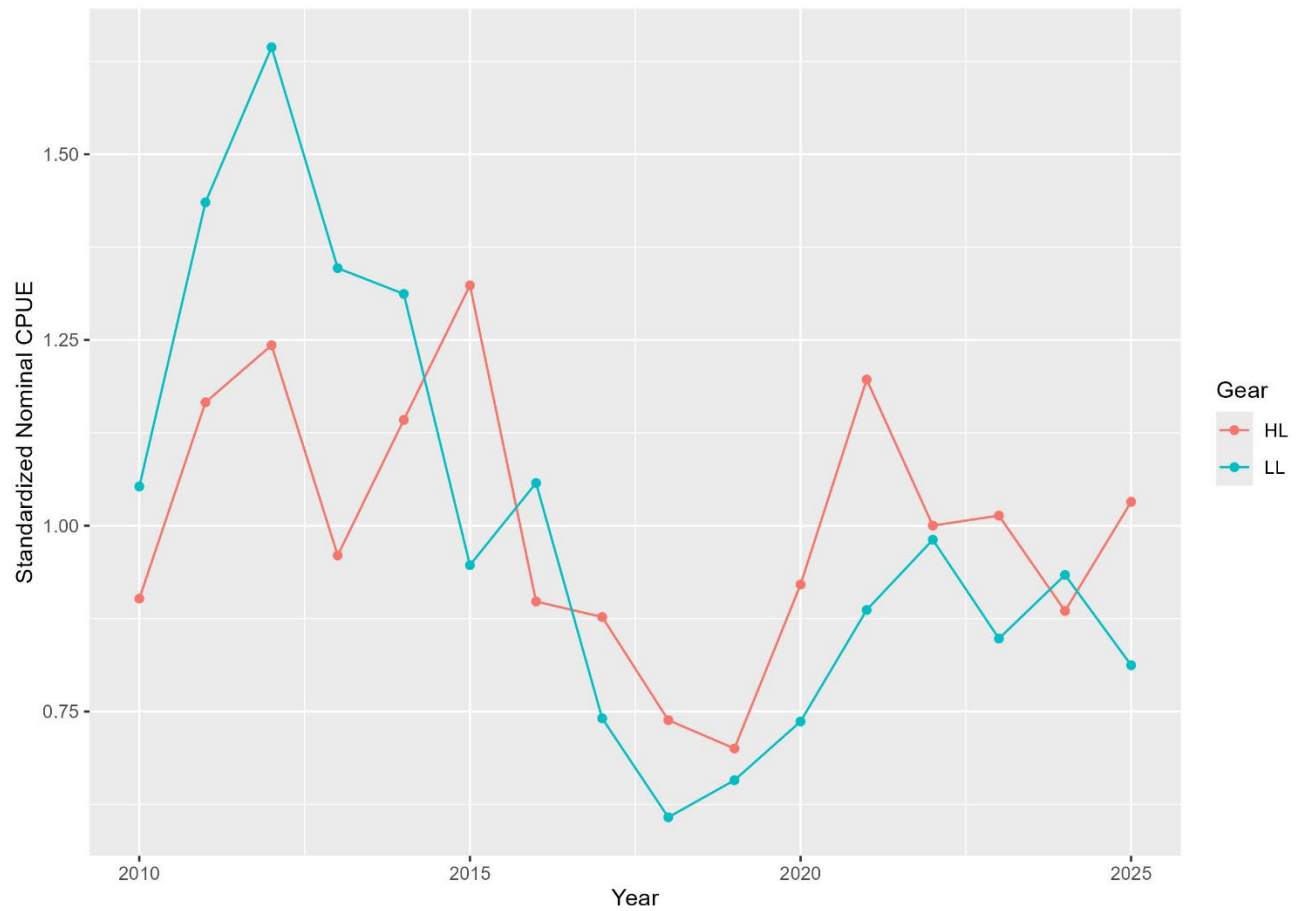
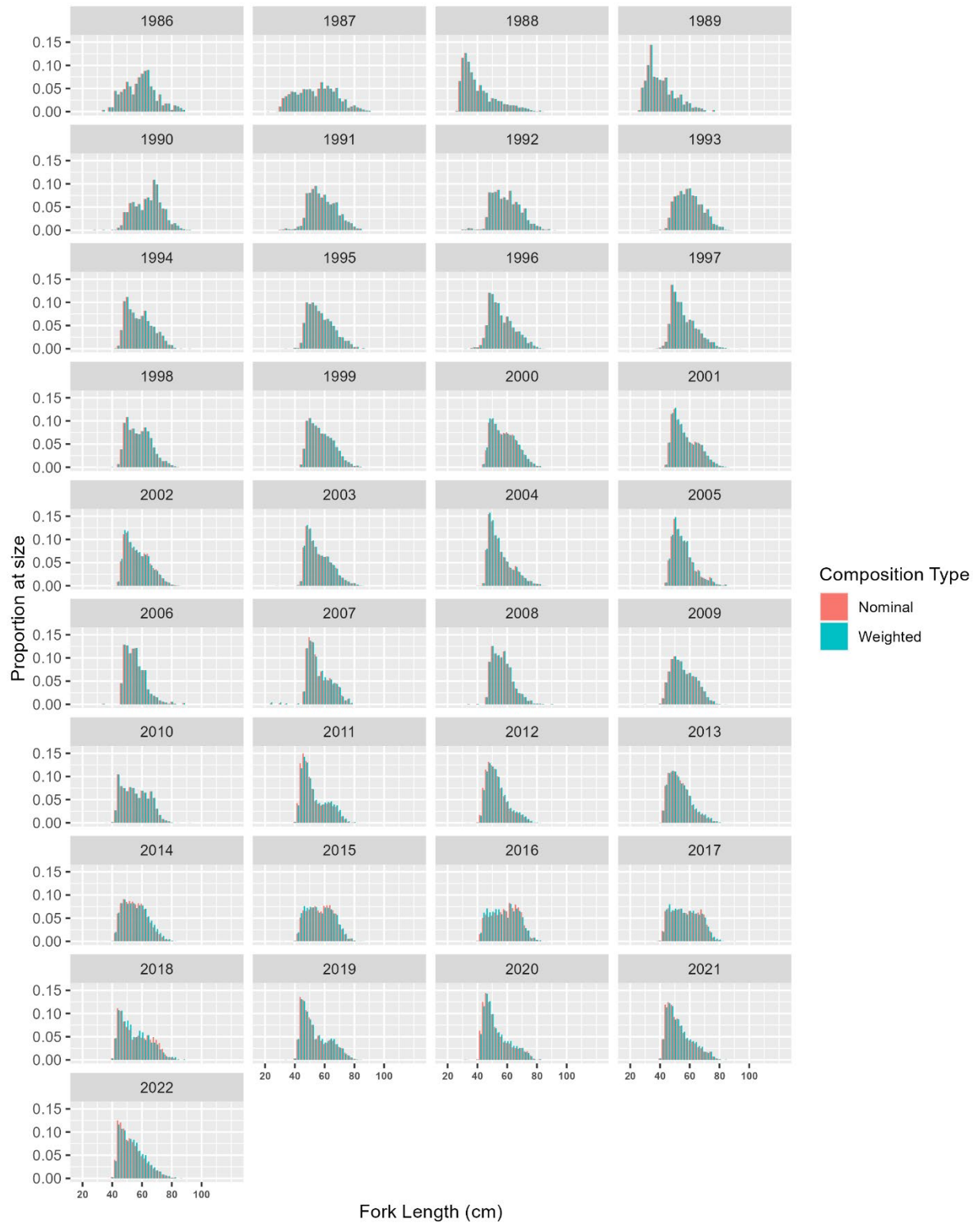


Figure 5. Standardized nominal CPUE for the Gulf Red Grouper handline (HL) and longline (LL) fleets.



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227 Figure 6. Nominal and weighted length compositions for the Gulf Red Grouper commercial
 228 handline fleet.

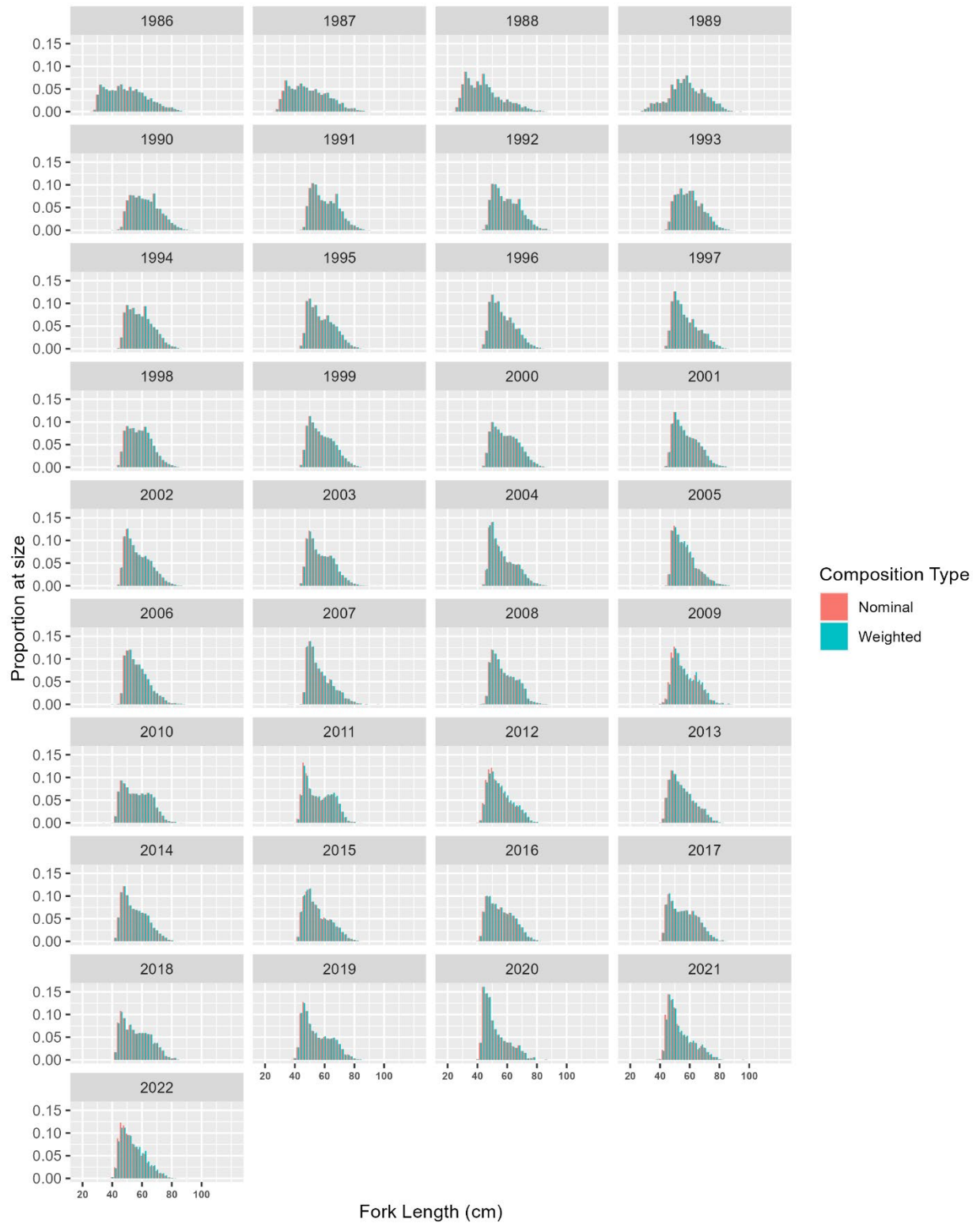


Figure 7. Nominal and weighted length compositions for the Gulf Red Grouper commercial longline fleet.

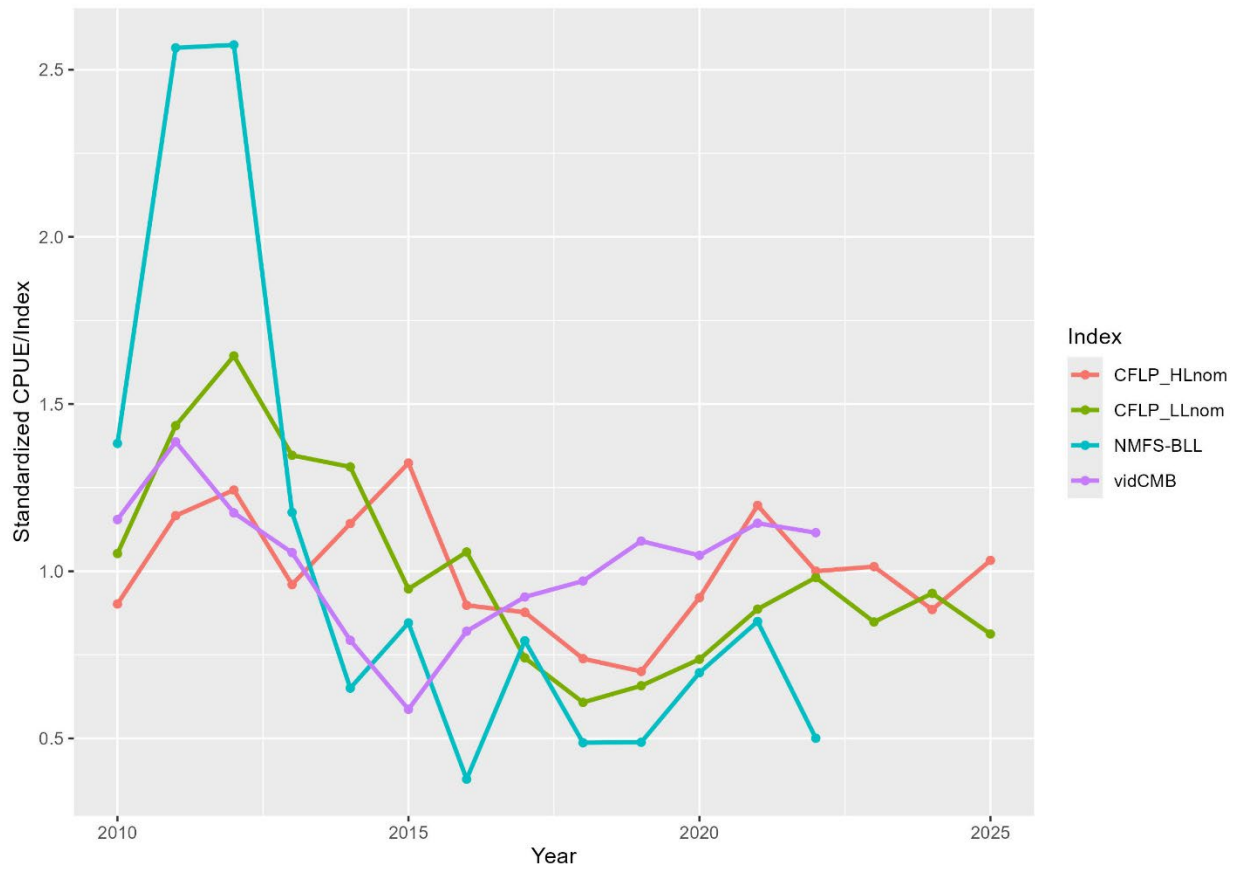


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234 Figure 8. Nominal and weighted age compositions for the Gulf Red Grouper commercial
 235 handline fleet.



Figure 9. Nominal and weighted age compositions for the Gulf Red Grouper commercial longline fleet.



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240 Figure 10. Comparison of the standardized nominal CPUE from the logbook (CFLP_HLnom –
 241 Handline, CFLP_LLnom – LL) to the fishery independent indices from SEDAR 88
 242 (NMFS_BLL – NMFS Bottom Longline Survey, vidCMB – combined video survey).