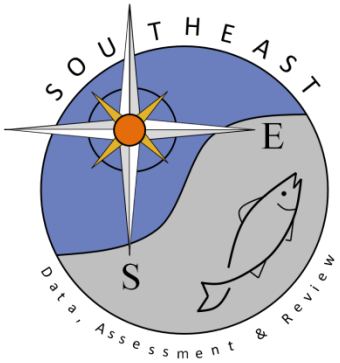
Proxy Discard Estimates of Red Grouper (*Epinephelus morio*) from the US Gulf of Mexico Headboat Fishery

Matthew A. Nuttall

SEDAR88-WP-05

21 March 2024



Please cite this document as:

Nuttall, Matthew A. 2024. Proxy Discard Estimates of Red Grouper (*Epinephelus morio*) from the US Gulf of Mexico Headboat Fishery. SEDAR88-WP-05. SEDAR, North Charleston, SC. 10 pp.

SEDAR 88-WP-05

Proxy Discard Estimates of Red Grouper (*Epinephelus morio*) from the US Gulf of Mexico Headboat Fishery

NOAA Fisheries
Southeast Fisheries Science Center
Sustainable Fisheries Division
Data Analysis and Assessment Support Branch
75 Virginia Beach Drive
Miami FL 33149

Matthew A. Nuttall

03-21-2024

Abstract

Discard data were not routinely collected as part of the Southeast Region Headboat Survey (SRHS) until 2004, prior to which SRHS discard estimates are not available. These data are self-reported and not currently validated within the SRHS program. As a form of validation, SRHS discard rates were compared to those from the Headboat At-Sea Observer Program to determine those years for which SRHS discard estimates should be used (SEDAR 42-DW-17), from which the decision was to retain SRHS discard estimates between 2008-2022. For those years prior (1986-2007), proxy discard estimates were calculated using the superratio approach, with annual calculations conducted at the region level.

Introduction

The Southeast Region Headboat Survey (SRHS) logbook form was modified in 2004 to standardize collection of discard data for each reported trip (Fitzpatrick et al. 2017, SEDAR 79-DW-06). Between 2004-2012, discard information was collected from logbook forms as the number of fish (by species) released alive and released dead. Port agents instructed each captain on criteria for determining the condition of discarded fish. A fish was considered "released alive" if it was able to swim away on its own and "released dead" if it was unable to swim, floated off, or was obviously dead. As of Jan 1, 2013, the SRHS began collecting logbook data electronically. Changes to the required reporting were also made at this time, one of which was the removal of the condition category for discards. Current forms only require information on the total number of fish released, regardless of condition. Due to the subjectivity in determining the condition of released fish, live and dead releases for 2004 to 2012 are typically combined as total discards for consistency with SRHS data collection in later years.

Underreporting of discard information on SRHS logbooks was a concern in the initial years of data collection (e.g., 2004-2007) (SEDAR PW-07) as many headboat captains expressed confusion with the new data fields. Because logbook data are self-reported, discard data are not currently validated within the SRHS program. To assess the validity of annual SRHS discard estimates, discard rates from SRHS logbooks can be compared to those from the Headboat At-Sea Observer Programs. These programs were implemented to collect more detailed information on headboat catch, particularly for discarded fish. In the Gulf of Mexico, headboat observers operate mainly in western Florida (beginning in 2005), with limited coverage in Alabama in certain years (beginning in 2004) (SEDAR 61-WP-13) and Texas in 2011 (Donaldson et al. 2013). Inconsistent funding and natural phenomenon (e.g., 2020 COVID-19 pandemic) have led to short breaks in the sampling for some of these surveys (e.g., no observer coverage of Gulf of Mexico headboats in 2008). Within these programs, headboat vessels are randomly selected throughout the year in each state, with the west coast of Florida further stratified into three sample regions (i.e., panhandle, western peninsula, and the FL Keys). Biologists board selected vessels with permission from the captain and observe a subset of anglers as they fish on the recreational trip. Data collected include the number of fish landed and discarded by species.

Because discards were not added to the SRHS logbook form until 2004, a proxy method is needed to provide headboat discard estimates for prior years (e.g., 1986-2003) and/or for any years for which catch rates from the At-Sea Observer Programs suggest SRHS discard estimates may be inaccurate (e.g., 2004-2007). This working paper identifies how SRHS proxy discards were estimated in SEDAR 88 and the associated justifications for any required decisions (e.g., selection of method and years to include in the estimation).

Methods

Validation of SRHS Catch Rates

Discard rates of Gulf of Mexico red grouper (ratio of discards to total catch) from SRHS logbooks were compared to those from the Headboat At-Sea Observer Programs to identify any years for which proxy estimates may be needed as a substitute for SRHS discard estimates. This analysis was done as part of SEDAR 42 (SEDAR 42-DW-17) and was not repeated for SEDAR 88. However, the associated decisions from this comparison were reevaluated for SEDAR 88. Note that the recommended start year for SRHS discards, for which proxies are required for all years prior, from SEDAR 42-DW-17 was also applied in the SEDAR 61 assessment for Gulf of Mexico red grouper.

Discard proxy

Several sources of proxy (SRHS) discard estimates have been considered in past SEDAR stock assessments, including the preferred superratio approach (SEDAR-PW-07). All of these methods are based on scaling historic SRHS landings estimates (e.g., 1986-2007) by some assumed discard rate(s), but what differs between the approaches is how these discard rate(s) are estimated, most being derived from some subset of MRIP catch data (described in SEDAR 88-WP-02). SRHS catch estimates for SEDAR 88 Gulf of Mexico red grouper are provided in SEDAR 88-WP-01.

For SEDAR 88 Gulf of Mexico red grouper, the preferred superratio approach was evaluated as a suitable proxy method for SRHS discards, which rescales past (e.g., 1986-2007) discard rates of the MRIP charterboat mode (discards:landings) by the ratio of mean discard rates between the MRIP charterboat mode and SRHS headboat mode from recent years (e.g., 2008-2022). This approach is the current “Best Practice” method for calculating discard proxies as it allows for changes in management and year class effects to be incorporated into the estimation (annual discard proxies estimated from SRHS landings and discard rates for the same year) and accounts for potential differences in the magnitude of MRIP vs. SRHS discards (i.e., rescaling with superratios) (SEDAR-PW-07, Issue #11). Additionally, the discard rates for this method are estimated from those of charterboat anglers, who are generally assumed to fish in areas and use fishing methods most similar to headboat anglers. Note that this was the same approach applied in the SEDAR 61 stock assessment for Gulf of Mexico red grouper.

As further evaluation of the chosen proxy method, the combined discard timeseries (i.e., proxies, 1986-2007, added to SRHS estimates, 2008-2022) is rescaled to that representative of dead discards using an assumed discard mortality rate (of 11.6%) from the previous stock assessment for Gulf of Mexico red grouper (see Figure 2), facilitating comparisons of actual removals from the population (i.e., landings vs. dead discards). A comparison of proxy discards estimated between SEDAR 88 and the previous stock assessment is also provided (Figure 3).

Uncertainty estimates for SRHS proxy discards are provided as coefficients of variation, with associated variances calculated using standard statistical equations. Variances of annual discard rates ($var\left(r_{\frac{B2}{AB1}}\right)$) are approximated using a Taylor Series expansion ignoring covariance terms (SEDAR 74-DW-10, Equation 2):

$$var\left(r_{\frac{B2}{AB1}}\right) = \frac{var(B2)}{AB1^2} + \frac{B2^2 * var(AB1)}{AB1^4}$$

SRHS estimates of catch and associated uncertainties are provided in SEDAR 88-WP-01. GenRec estimates of catch and associated uncertainties are provided in SEDAR 88-WP-02. For those methods that require an average discard rate (e.g., superratios), the associated variance is calculated as $\frac{\sum variance}{n^2}$. With variances available for discard rates ($r_{\frac{B2}{AB1}}$) and SRHS landings estimates ($AB1$), variances of the associated proxies ($var(\widehat{B2})$) are approximated using Goodman's Formula (SEDAR 74-DW-10, Equation 5):

$$var(\widehat{B2}) = \left(AB1^2 * var\left(r_{\frac{B2}{AB1}}\right)\right) + \left(r^2_{\frac{B2}{AB1}} * var(AB1)\right) - \left(var\left(r_{\frac{B2}{AB1}}\right) * var(AB1)\right)$$

Results

Validation of SRHS Catch Rates

Although the decision in previous SEDARs was to retain SRHS discard estimates starting in year 2007 (SEDAR 42-DW-17, SEDAR 61), the choice for SEDAR 88 is to retain SRHS discard estimates from 2008-2022 and impute proxy discard estimates for any years prior (1986-2007). As justification for this deviation, discard rates from the observer programs were more than double that from SRHS logbooks in 2007 (SEDAR 42-DW-17). Similarly, the corresponding discard estimate in 2007 was more similar to the relatively small estimates in 2004-2006, none of which are being retained in SEDAR 88. Taken together, these results suggest SRHS discard estimates of Gulf of Mexico red grouper were still being underreported by the logbooks in 2007, and so the decision for SEDAR 88 is to replace SRHS discard estimates from 2004-2007 with the associated proxy estimates.

Discussion

For SEDAR 88, the superratio approach is recommended to provide proxy SRHS discard estimates for years 1986-2007 (Table 1). The relative agreement between actual SRHS discard estimates and these proxies (2008-2022) provides support for their use in other

years (1986-2007) (Figure 1). This approach is the preferred proxy method according to SEDAR Best Practices (SEDAR-PW-07) because it applies historic (rescaled) discard rates of MRIP charterboat anglers, who are generally assumed to fish in areas and use fishing methods most similar to headboat anglers, while accounting for potential differences in magnitude between MRIP vs. SRHS discards and any year-specific effects of management regulations and/or year-class strength on angler behavior. This decision to apply the superratio method is in agreement with past SEDAR stock assessments for Gulf of Mexico red grouper (i.e., SEDAR 42 and 61). Although this approach produced relatively high discard estimates in 1989, the same spike in proxy discards is also seen in the corresponding SRHS landings timeseries (Figure 1) and GenRec estimates for this assessment (SEDAR 88-WP-02). These high estimates are therefore assumed to be representative of the true catch in that year.

References

Cheshire, RT, K Brennan, and ME Green. 2023. SEDAR 79-DW-06. Headboat Data for Mutton Snapper in the Southeast US Atlantic and Gulf of Mexico. SEDAR, North Charleston, SC. 55pp.

Donaldson, D, G Bray, B Sauls, S Freed, B Cermak, P Campbell, A Best, K Doyle, A Strelcheck, and K Brennan. 2013. Final Report: For-Hire Electronic Logbook Pilot Study in the Gulf of Mexico. Submitted to the Marine Recreational Information Program Operations Team. 284pp. Retrieved from: https://www.st.nmfs.noaa.gov/Assets/recreational/pdf/Charter_Boat_Logbook_Project_report.pdf

Fisheries Ecosystem Branch, NMFS, SEFSC, Beaufort Lab. 2014. Discards of red grouper (*Epinephelus morio*) for the headboat fishery in the US Gulf of Mexico. SEDAR 42-DW-17. SEDAR, North Charleston, SC. 10pp.

Fitzpatrick, EE, EH Williams, KW Shertzer, KI Siegfried, JK Craig, RT Cheshire, GT Kellison, KE Fitzpatrick, and K Brennan. 2017. The NMFS Southeast Region Headboat Survey: History, Methodology, and Data Integrity. Marine Fisheries Review 79(1): 1-27. Retrieved from: https://repository.library.noaa.gov/view/noaa/51771

Lazarre, D. 2018. SEDAR 61-WP-13. A Summary of Red Grouper Size Distribution Data from Recreational Fishery Surveys in the Gulf of Mexico. SEDAR, North Charleston, SC. 17pp.

NMFS Office of Science and Technology. 2022. SEDAR 74-DW-10. Methodology Description for a Calibration of Texas Private Boat Red Snapper Annual Landings Estimates. National Marine Fisheries Service (NMFS) Office of Science and Technology (OST) Fisheries Statistics Division. Silver Spring, MD.

Nuttall, MA and S Binion-Rock. 2024. SEDAR 88-WP-02. General Recreational Survey Data for Red Grouper in the Gulf of Mexico. National Marine Fisheries Service (NMFS) Southeast Fisheries Science Center (SEFSC) Sustainable Fisheries Division. Miami, FL.

SEDAR. 2015. SEDAR-PW-07. SEDAR Procedural Workshop 7: Data Best Practices. SEDAR, North Charleston SC. 151pp. Available online at: https://sedarweb.org/documents/sedar-pw-07-data-best-practices-final-report-sept-2015/

Table 1. Timeseries of SRHS Proxy Discard Estimates and associated Coefficients of Variation (1986-2007) for SEDAR 88 Gulf of Mexico red grouper. Proxy discards were calculated using the superratio approach, with annual calculations conducted at the region level.

Year	Proxy	CV
1986	50,616	0.689
1987	46,793	0.749
1988	86,089	0.747
1989	587,205	0.647
1990	78,811	0.965
1991	113,714	1.125
1992	71,889	0.541
1993	85,626	0.804
1994	91,286	0.851
1995	116,385	0.669
1996	177,825	1.001
1997	85,302	0.720
1998	90,959	0.470
1999	195,738	0.471
2000	107,311	0.655
2001	79,197	0.542
2002	69,150	0.389
2003	148,723	0.413
2004	167,953	0.321
2005	100,332	0.315
2006	35,396	0.415
2007	55,532	0.488

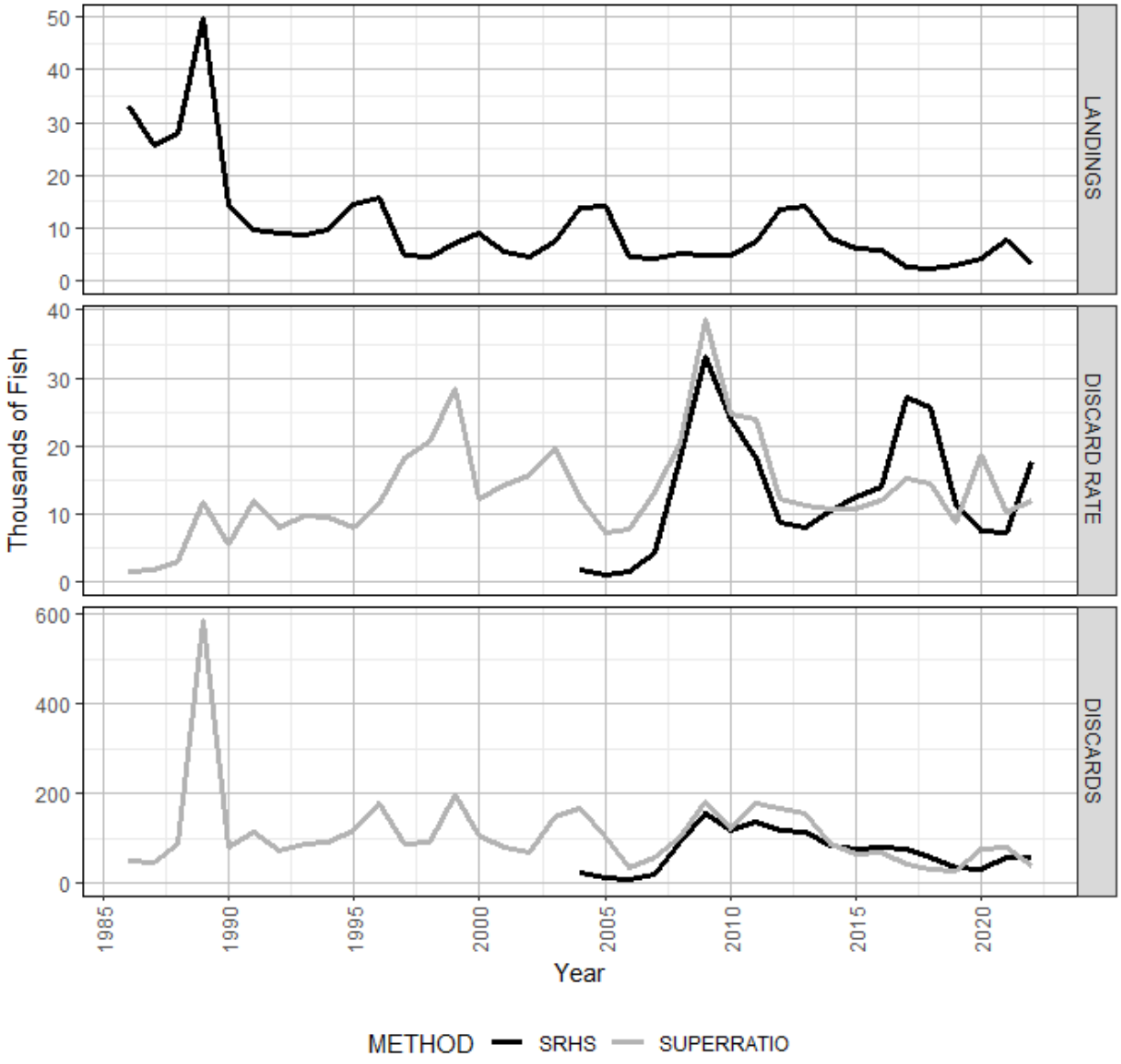


Figure 1. *Estimation of SRHS discard proxies for Gulf of Mexico red grouper from the superratio approach. Proxy estimates are needed for years 1986-2007 in SEDAR 88, but shown through 2022 to provide the overlap needed to compare proxies to actual SRHS estimates (black lines). Discard proxies (third row) are calculated as the product of annual SRHS landings estimates (first row) and discard rates from other surveys or years (second row).*

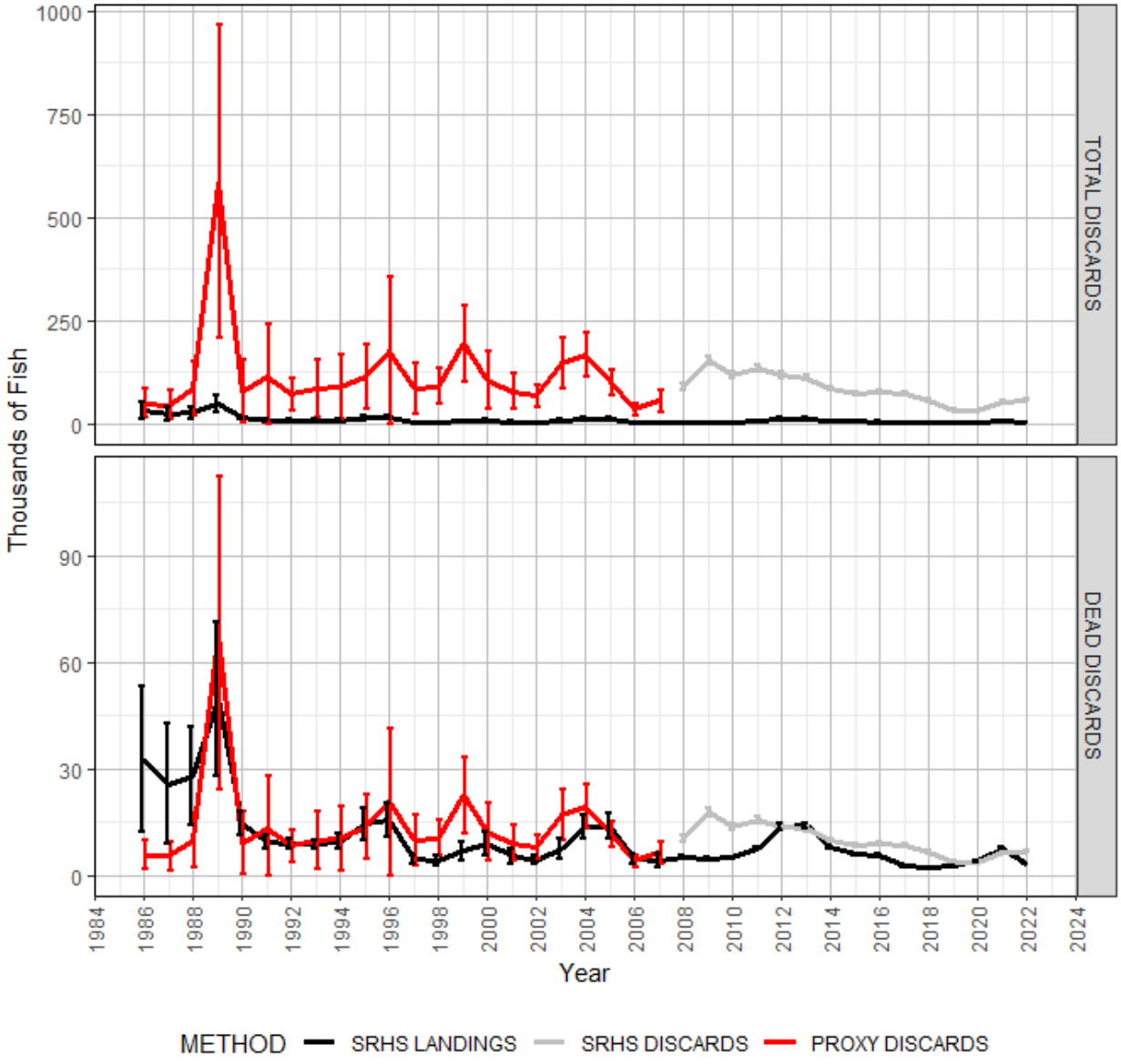


Figure 2. *Timeseries of SRHS landings (1986-2022), SRHS discards (2008-2022), and proxy discard estimates (1986-2007) for SEDAR 88 Gulf of Mexico red grouper with associated estimates of uncertainty. Proxy discard estimates were provided by the superratio approach, with annual calculations conducted at the region level. Dead discards (lower panel) were calculated by applying an assumed discard mortality rate of 11.6% from the previous assessment.*

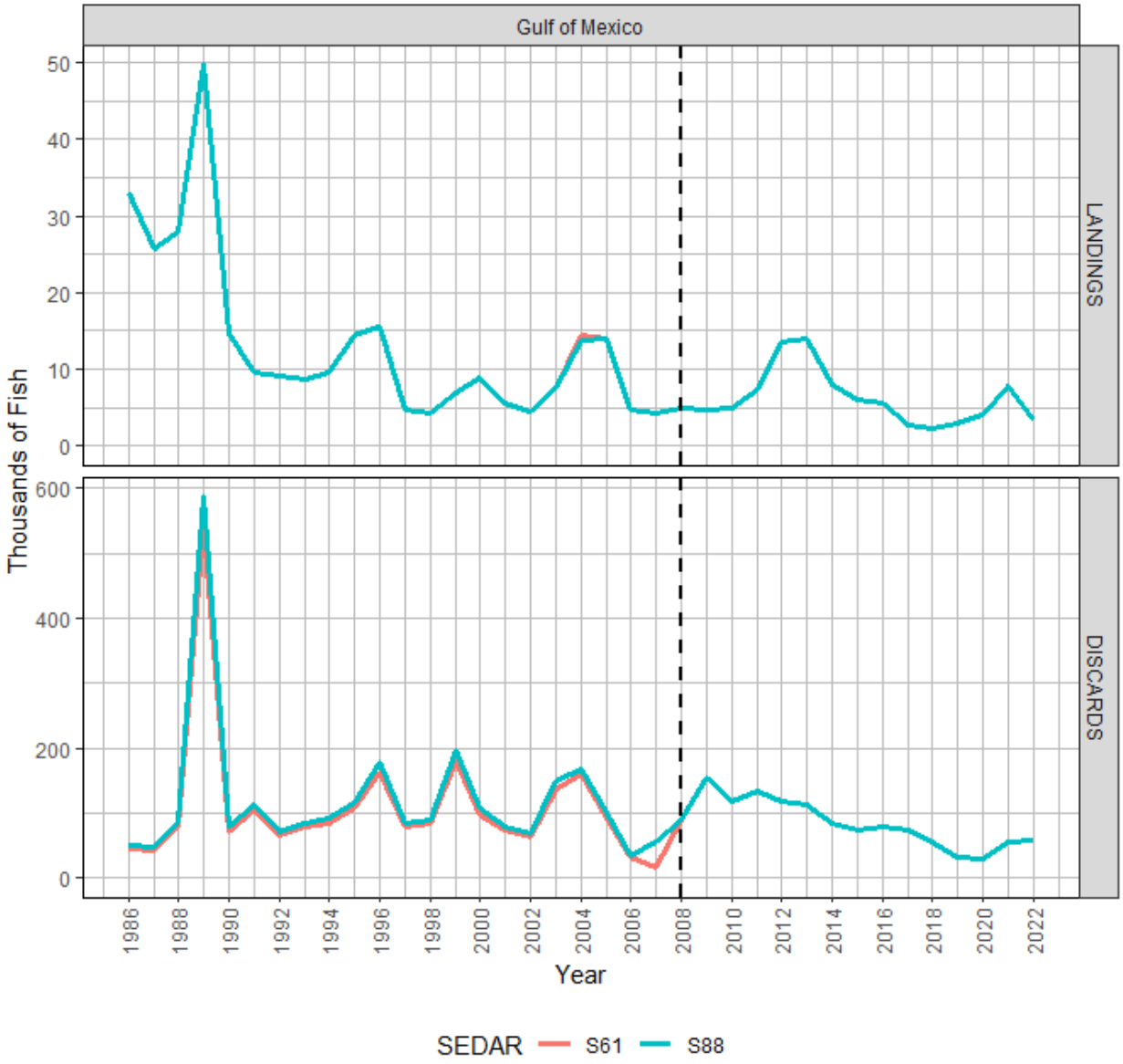


Figure 3. *Comparison of total SRHS landings and discard estimates provided for Gulf of Mexico red grouper between SEDAR 88 and SEDAR 61, the terminal years of which are 2022 and 2017 respectively. A dashed black line is drawn in 2008 to separate years where SRHS discard estimates were retained for use in SEDAR 88 (2008-2022) versus those where proxy discard estimates are needed (1986-2007).*