Synthesis of Management Histories for Gulf of America Reef Fishes through 2024

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U.S. Department of Commerce
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Executive Summary

Fisheries resources are monitored using stock assessments and other quantitative analyses and managed for sustainability using regulations. Historically, compilation of management histories for stock assessments in the Gulf of America (formerly the Gulf of Mexico) has been a collaborative process involving the Gulf Council (formerly the Gulf of Mexico Fishery Management Council), the Southeast Regional Office, and the Southeast Fisheries Science Center (SEFSC). Efforts to document these management actions have traditionally been expended for one species at a time at the onset of a stock assessment. The objective of this document was to provide a comprehensive review of management regulations for all Gulf of America Reef Fish (Gulf Reef Fish) that fall within the Fishery Management Plan for Reef Fish Resources in the Gulf of Mexico (Reef Fish FMP). Time series of regulations were developed using data from the SEFSC's Management History database, which were obtained from final rules published in the Federal Register that were associated with fishery management actions affecting federally managed species throughout the Gulf of America, as well as the Atlantic and U.S. Caribbean regions. Regulations focused on herein include size limits (both minimum and maximum), trip limits (commercial only), species and aggregate bag limits (recreational only), crew limits (recreational only), the implementation of Individual Fishing Quota programs (commercial), and open federal season duration (i.e., number of days fishing is allowed per year). Since 1984, the number and frequency of changing commercial and recreational minimum size limits has varied across species, with the largest changes evident for target species such as Red Snapper. Maximum size limits, in addition to minimum size limits, are implemented solely for Lesser Amberjack and Banded Rudderfish. Prior to the establishment of the Individual Fishing Quota (IFQ) program for Red Snapper in 2007 and for Grouper-Tilefish in 2010, commercial trip limits were initially implemented for Red Snapper in 1992 and for Deep-Water and Shallow-Water Groupers in 2005. Commercial open season lengths were highly variable for reef fish, especially for IFQ species prior to the implementation of their respective IFQ programs. Recreational bag limits were first implemented for aggregate snappers and groupers starting in 1990, and then in 1997 for an aggregate Gulf reef fish group. Individual bag limits were first implemented for Red Snapper and Greater Amberjack in 1990, have been implemented for many species, and have varied considerably over time for target species such as Red Snapper and Red Grouper. Crew bag limits have generally limited crew members from retaining Red Snapper since 1999, Greater Amberjack since 2008, and groupers since 2006. Highly variable open federal recreational season lengths were evident for many species across the time series, with considerable reductions in recent years. A segmented regression and breakpoint analysis conducted on the number of open days per year identified significant shifts in recreational season length for target species. These management histories will greatly increase the ability of fisheries analysts and managers to consider the multispecies nature of fisheries throughout the stock assessment process. For example, exploring how regulations change for other species, especially red snapper, could help explain trends observed in data inputs or stock assessment model fits (e.g., residual patterns in compositions).

Acknowledgements

We thank all the data managers including SEFSC and SERO staff, University of Miami Cooperative Institute for Marine and Atmospheric Studies (CIMAS) research associates, and students who combed through the Federal Register and helped with data entry during this project. We are also grateful to database managers and programmers who built the Online Dataset Manager application and data entry system. This project was funded by NOAA Fisheries' Fisheries Information System Program and the Southeast Fisheries Science Center. This work was carried out under the framework of the Cooperative Institute for Marine and Atmospheric Studies (CIMAS), a Cooperative Institute of the University of Miami and the National Oceanic and Atmospheric Administration, cooperative agreement #NA20OAR4320472.

Abbreviations and Acronyms

CPUE	catch-per-unit-effort
DWG	Deep-Water Grouper
FMP	Fishery Management Plan
FL	Fork Length
Gulf Reef Fish	Gulf of America Reef Fish
GW	Gutted Weight
IFQ	Individual Fishing Quota
ITIS	Integrated Taxonomic Information System
NOAA	National Oceanic and Atmospheric Administration
NMFS	National Marine Fisheries Service
Reef Fish FMP	Fishery Management Plan for Reef Fish Resources in the Gulf of Mexico*
SWG	Shallow-Water Grouper
SEDAR	Southeast Data Assessment and Review
SEFSC	Southeast Fisheries Science Center
TL	Total Length
WW	Whole Weight

*The Gulf of Mexico was renamed the Gulf of America pursuant to Executive Order 14172, and Secretary of the Interior Order No. 3423. All geographical references to the Gulf of America in this document refer to the same body of water referred to as the Gulf of Mexico in the regulations at 50 CFR part 622. However, previous documentation (cited herein) may have referred to this water body as the "Gulf of Mexico", in particular the title of the Reef Fish FMP as designated in Amendment 1.

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Introduction

Fisheries resources are monitored using stock assessments and other quantitative analyses and managed for sustainability using regulations. Stock assessment models are traditionally developed for a single species at a time and can cover a spectrum of complexity, ranging from data-limited approaches to complex statistical catch-at-age models (see Dichmont et al. 2016 for a review). Application of each assessment approach comes with its own inherent assumptions, whether through construction of data inputs (e.g., assuming standardized indices of abundance are proportional to stock abundance; Maunder et al. 2006, Hoyle et al. 2024) or configuring model structure (e.g., assumed selectivity of fisheries or surveys; Cope 2024). Stock assessment models attempt to determine stock status related to the health of the fish stock along with catch advice recommendations for implementation by fishery managers. Following independent peer review of stock assessments (Brown et al. 2006, 2020), fisheries managers implement regulations to ensure that catch levels do not exceed those recommended by the stock assessment model and that the stock remains sustainable. Common regulations implemented to reduce harvest include size limits, trip limits, and closures (seasonal or spatial), among other management measures (see Dowling et al. 2022 for a thorough review of regulations as included in FishPath (*https://fishpath.org/*)).

Stock assessment models rely on the assumption that trends in input data streams accurately reflect changes in the population being modeled. Ideally, stock assessment models would be populated by fishery-independent data streams where data collection methods are consistent over time and the spatial range of the stock (Lynch et al. 2018). In the Southeast United States (U.S.), fishery-dependent indices of relative abundance and composition data are foundational to developing stock assessments because they exhibit the longest time series compared to more recent fishery-independent surveys (Grüss et al. 2018). Given the reliance on fishery-dependent data sources in many Southeast U.S. stock assessments, it is crucial that data inputs are reflective of trends in the population being modeled and not a function of an external driver such as changes in management regulations.

Compilation of management histories for operational stock assessments in the Gulf of America (formerly the Gulf of Mexico) has been a collaborative process involving the Gulf Council (formerly the Gulf of Mexico Fishery Management Council), the Southeast Regional Office, and the Southeast Fisheries Science Center (SEFSC). However, efforts have primarily been expended for one species at a time. The objective of this document was to provide a comprehensive review of management regulations for Gulf of America Reef Fish (hereafter referred to as "Gulf Reef Fish") in the Fishery Management Plan (FMP) for Reef Fish Resources in the Gulf of Mexico (hereafter referred to "Reef Fish FMP"). We focused our synthesis on commercial and recreational size limits, commercial trip limits, recreational bag limits, and open season duration for recreational fisheries because of the potential impacts on developing data inputs or informing fisheries behavior in the stock assessment process. As the first comprehensive picture of regulations since their implementation for all managed Gulf reef fish, this document will serve as an important reference in exploring whether regulations for other species may be driving trends observed in data inputs or stock assessment model fits (e.g., residual patterns in compositions).

Methods

Study Region

The Gulf of America large marine ecosystem (**Figure 1**) holds some of the most diverse fauna (Fautin et al. 2010) and fisheries in the United States. Thirty-one reef fish species are currently managed under the Reef Fish FMP (**Table 1**). The status of assessed stocks has greatly improved in recent years compared to the late 1990s (Karnauskas et al. 2019), with only four stocks undergoing overfishing as of 2023 (NOAA Fisheries 2024). The commercial reef fish fishery in the Gulf of America primarily uses vertical line and longline gears (Scott-Denton et al. 2011) and targets a range of species including snappers (Lutjanidae), groupers (Serranidae), triggerfish (Balistidae), amberjacks (*Seriola* spp.), hogfish (*Lachnolaimus maximus*), and tilefish (Malacanthidae) (**Figure 2**). Unique to the Southeast US, the recreational fishery in the Gulf of America is essential to the economy and can lead to landings rivaling or exceeding commercial landings for some fisheries stocks (Shertzer et al. 2019). The recreational reef fish fishery in the Gulf of America primarily uses handlines from private vessels, for-hire vessels (i.e., headboats and charterboats), or from shore. Red Snapper (*Lutjanus campechanus*) are a key target for recreational anglers among other reef fishes (**Figure 3**). As a result, fishery management in the region must account for competing interests of commercial and recreational sectors, as exemplified by the history of Red Snapper management (Simmons et al. 2019).

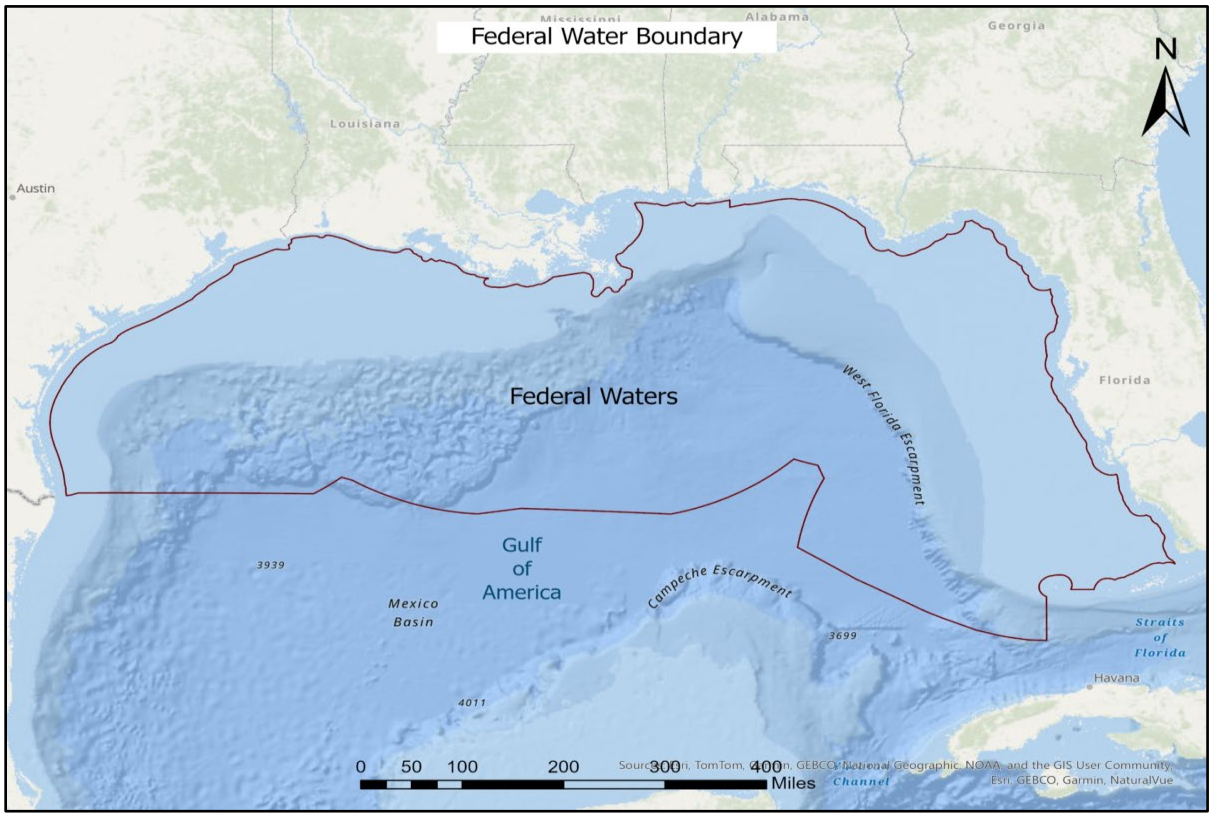

Figure 1. The Gulf of America waters that are managed by the Gulf Council. Image obtained from: *https://gulfcouncil.org/about/what-we-do/*.

Table 1. Thirty-one currently managed species in the Reef Fish FMP in the Gulf of America. – indicates no stock assessment exists for that species. Stock assessments conducted since 2002 can be found on the Southeast Data Assessment and Review website (SEDAR; www.sedarweb.org).

Family	Common Name	Scientific Name	Last Assessment
Balistidae	Gray Triggerfish	*Balistes capriscus*	SEDAR 43
Carangidae	Greater Amberjack	*Seriola dumerili*	SEDAR 70
	Lesser Amberjack	*Seriola fasciata*	SEDAR 49
	Banded Rudderfish	*Seriola zonata*	-
	Almaco Jack	*Seriola rivoliana*	SEDAR 49
Labridae	Hogfish	*Lachnolaimus maximus*	SEDAR 37
Malacanthidae	Golden Tilefish	*Lopholatilus chamaeleonticeps*	SEDAR 22
	Blueline Tilefish	*Caulolatilus microps*	-
	Goldface Tilefish	*Caulolatilus chrysops*	-
Serranidae	Red Grouper	*Epinephelus morio*	SEDAR 61
	Gag Grouper	*Mycteroperca microlepis*	SEDAR 72
	Atlantic Goliath Grouper	*Epinephelus itajara*	SEDAR 47
	Scamp Grouper	*Mycteroperca phenax*	SEDAR 68
	Black Grouper	*Mycteroperca bonaci*	SEDAR 19
	Yellowmouth Grouper	*Mycteroperca interstitialis*	SEDAR 49/68
	Yellowfin Grouper	*Mycteroperca venenosa*	-
	Yellowedge Grouper	*Hyporthodus flavolimbatus*	SEDAR 85
	Speckled Hind	*Epinephelus drummondhayi*	SEDAR 49
	Snowy Grouper	*Hyporthodus niveatus*	SEDAR 49
	Warsaw Grouper	*Hyporthodus nigritus*	-
Lutjanidae	Red Snapper	*Lutjanus campechanus*	SEDAR 74
	Vermilion Snapper	*Rhomboplites aurorubens*	SEDAR 67
	Mutton Snapper	*Lutjanus analis*	SEDAR 15A
	Gray Snapper	*Lutjanus griseus*	SEDAR 75
	Yellowtail Snapper	*Ocyurus chrysurus*	SEDAR 64
	Lane Snapper	*Lutjanus synagris*	SEDAR 49
	Wenchman	*Pristipomoides aquilonaris*	SEDAR 49
	Queen Snapper	*Etelis oculatus*	-
	Blackfin Snapper	*Lutjanus buccanella*	-
	Cubera Snapper	*Lutjanus cyanopterus*	-
	Silk Snapper	*Lutjanus vivanus*	-

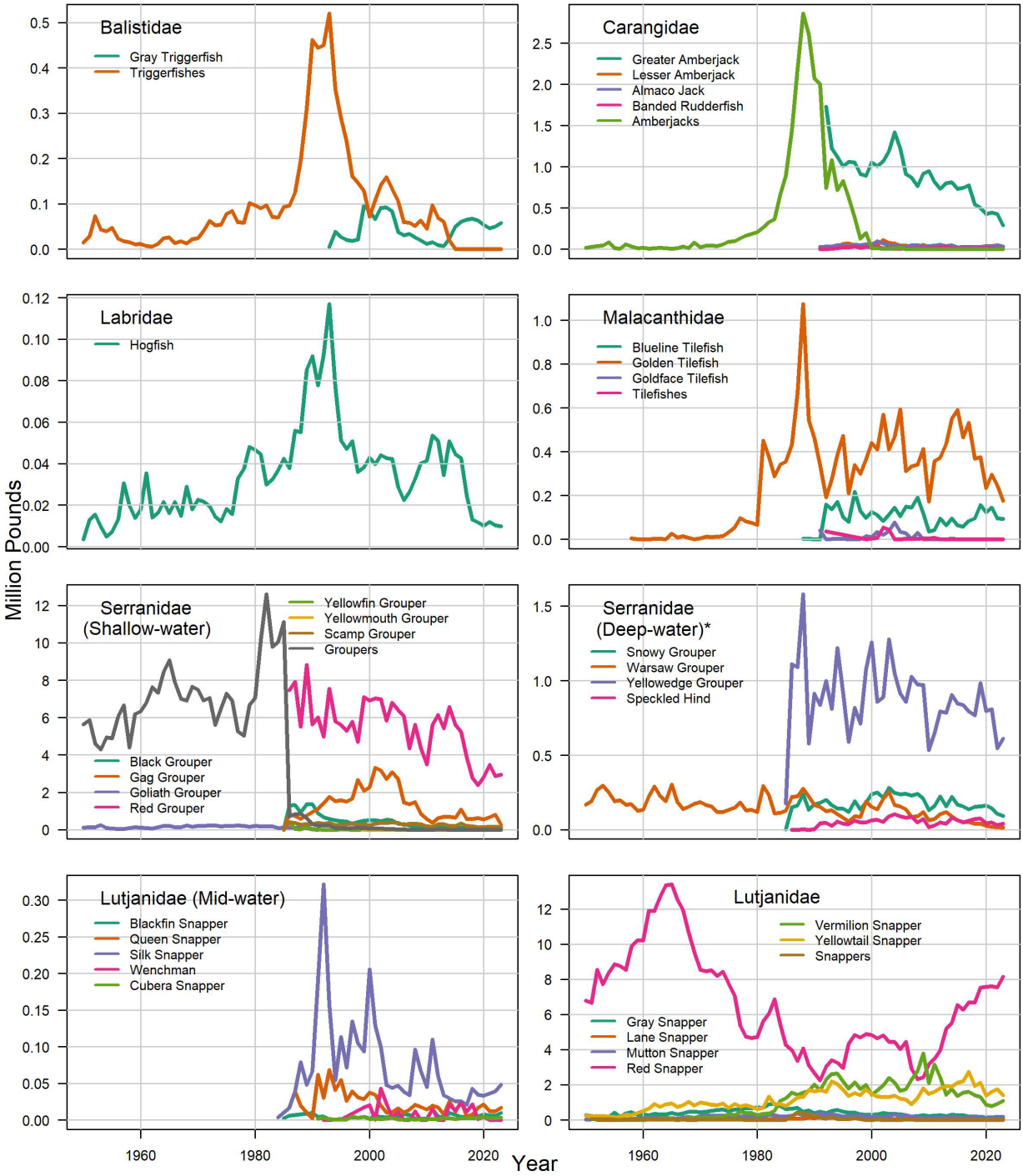

Figure 2. Commercial landings for reef fish in the Gulf of America from 1950 to 2023, including family-level landings where present (*Groupers landings shown in the Shallow-water plot also include Deep-water species). Note that y-axes differ between panels. Data obtained from the NOAA NMFS Fisheries Statistics Division (NMFS Fisheries Statistics Division; *https://www.fisheries.noaa.gov/national/commercial-fishing/commercial-landings/annual*; accessed March 11, 2025).

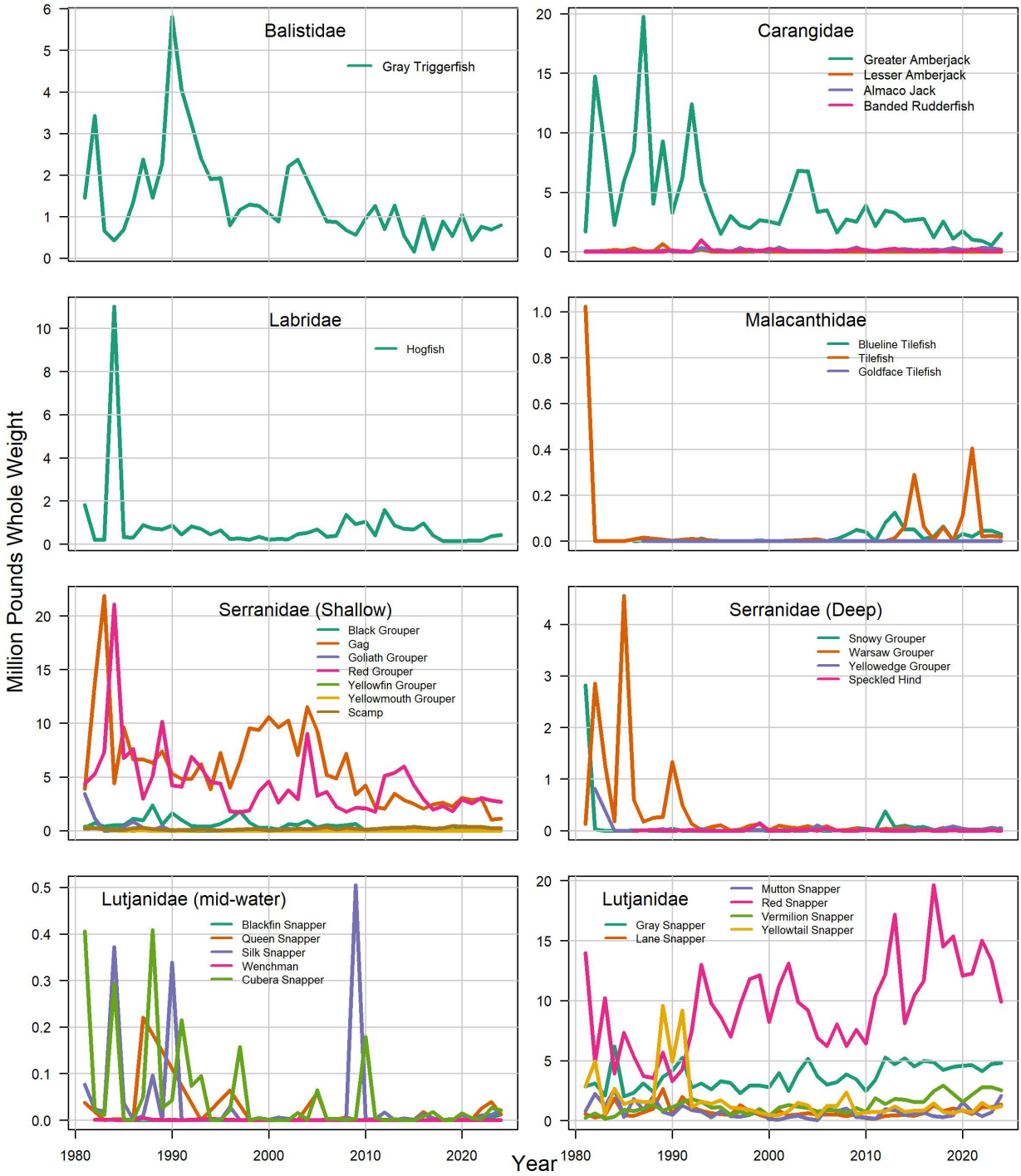

Figure 3. Recreational landings for reef fish in the Gulf of America from 1981 to 2024. Note that y-axes differ between panels. Obtained from the SEFSC annual catch limit monitoring dataset (accessed March 2025), which aggregates recreational landings from the NMFS Marine Recreational Information Program Fishing Effort Survey (Matter and Nuttall 2020), NMFS Southeast Region Headboat Survey (Fitzpatrick 2017), Texas Parks and Wildlife Department (Nuttall and Matter 2020), and Louisiana Creel Survey (LADWF 2022).

Management History Data

In 2019 the SEFSC and SERO began an effort to digitize federal regulations into a database that could be queried for customized management history summaries. The SEFSC Management History database is currently populated for 16 fishery management plans (FMP) throughout the Gulf of America, Atlantic, and U.S. Caribbean regions. The first step of this project was for data managers to identify final rules published in the Federal Register that were associated with management actions for each FMP. For each Federal Register reference, changes to the Code of Federal Regulations were extracted and entered independently by two data managers, with the data submitted to the database after all records entered matched between data managers (i.e., double blind data entry). Standardized records in the database included the FMP, species (or aggregate), jurisdiction (state vs federal), effective date, Federal Register reference (Volume number and Fed. Reg. page number), and fishing sector (commercial and recreational) to which each management action applied, among other recorded variables. The regulatory timeline for Gulf reef fish (**Figures 4-6**) underscores the breadth of information gathered on all federally managed species. We first highlight the various regulations implemented over time for a few key stocks such as Greater Amberjack, Red Snapper, and Red Grouper (**Figure 4)**. We then show this information simultaneously for all 31 stocks currently within the Reef fish FMP (**Figure 5**), with the intention of highlighting the frequency and complexity of regulations (but at the expense of interpretation). Lastly, regulations are shown over time for species which were previously managed within the Reef Fish FMP (**Figure 6**).

Example species

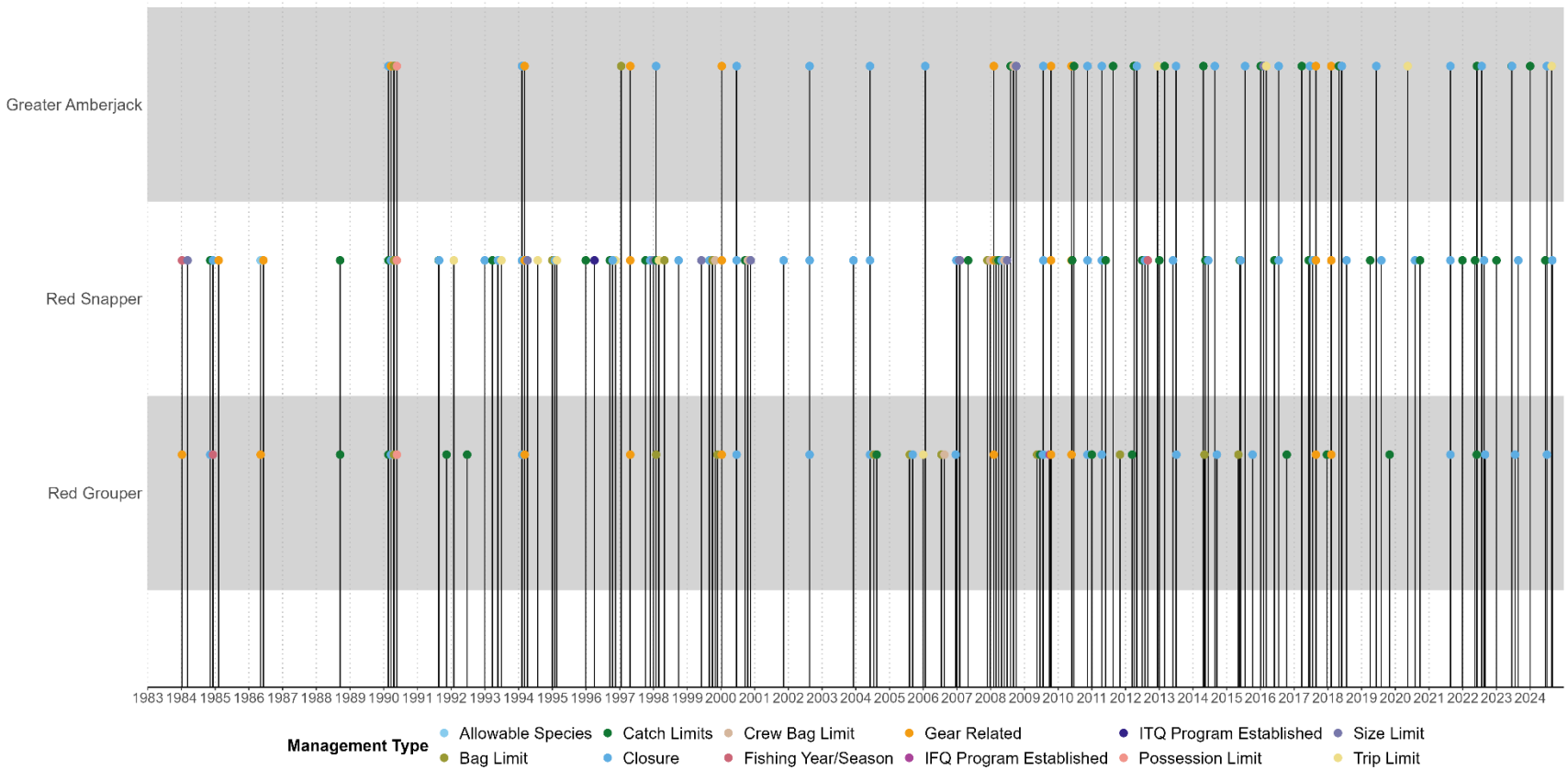

Figure 4. Timeline of management actions for Greater Amberjack, Red Snapper, and Red Grouper, which represent three of the most prominent and regulated species managed under the Reef Fish FMP in the Gulf of America. While the FMP manages 31 species overall, this timeline of regulatory actions for these three species provides a snapshot of the complexity of management. Due to the significant number of management actions published throughout the time series, management actions were summarized at the year level.

Currently managed species

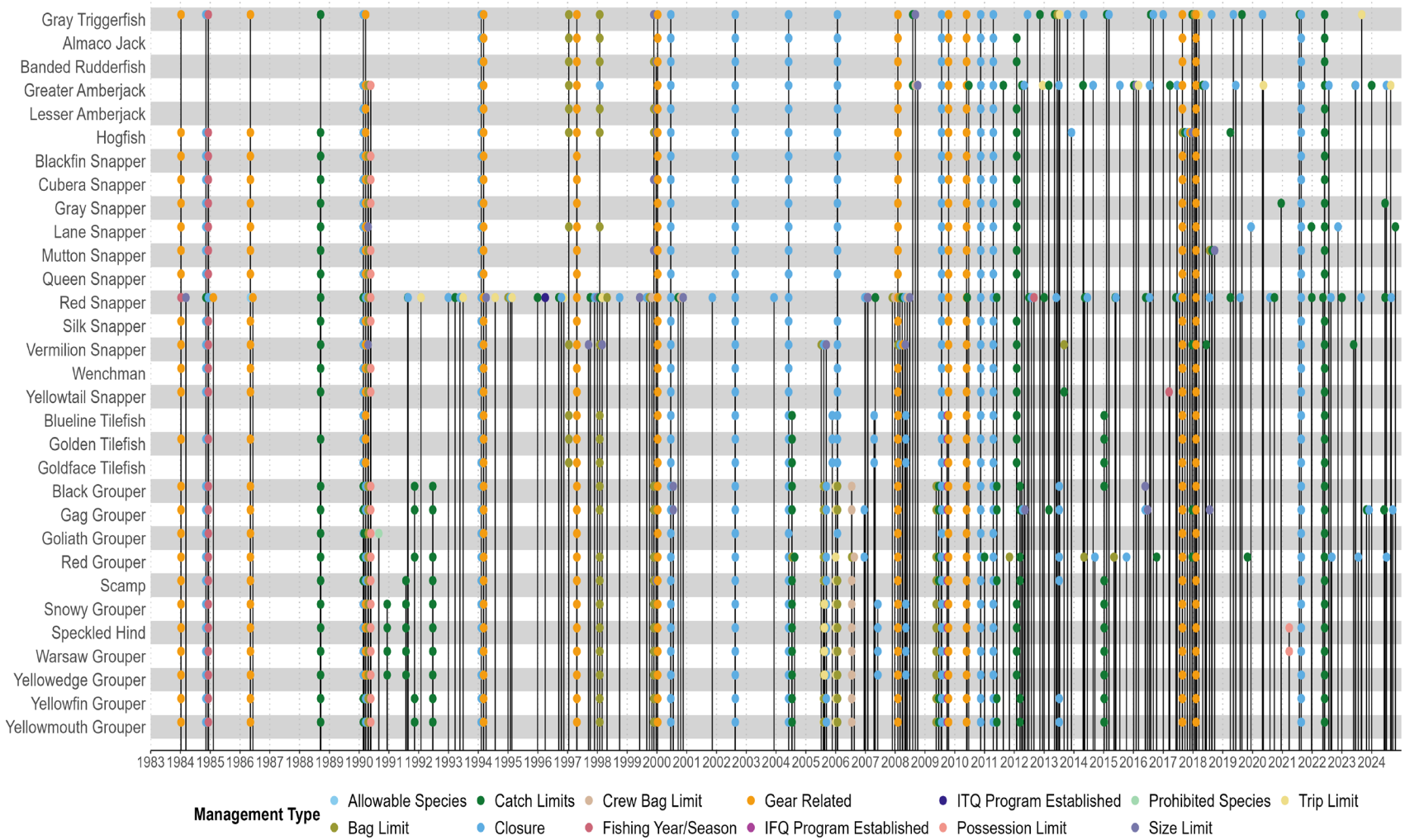

Figure 5. Timeline of management actions for reef fish managed under the Reef Fish FMP in the Gulf of America. Due to the significant number of management actions published throughout the time series, management actions were summarized at the year level. A list of federally managed species over time is provided in **Table 2**.

Previously managed species

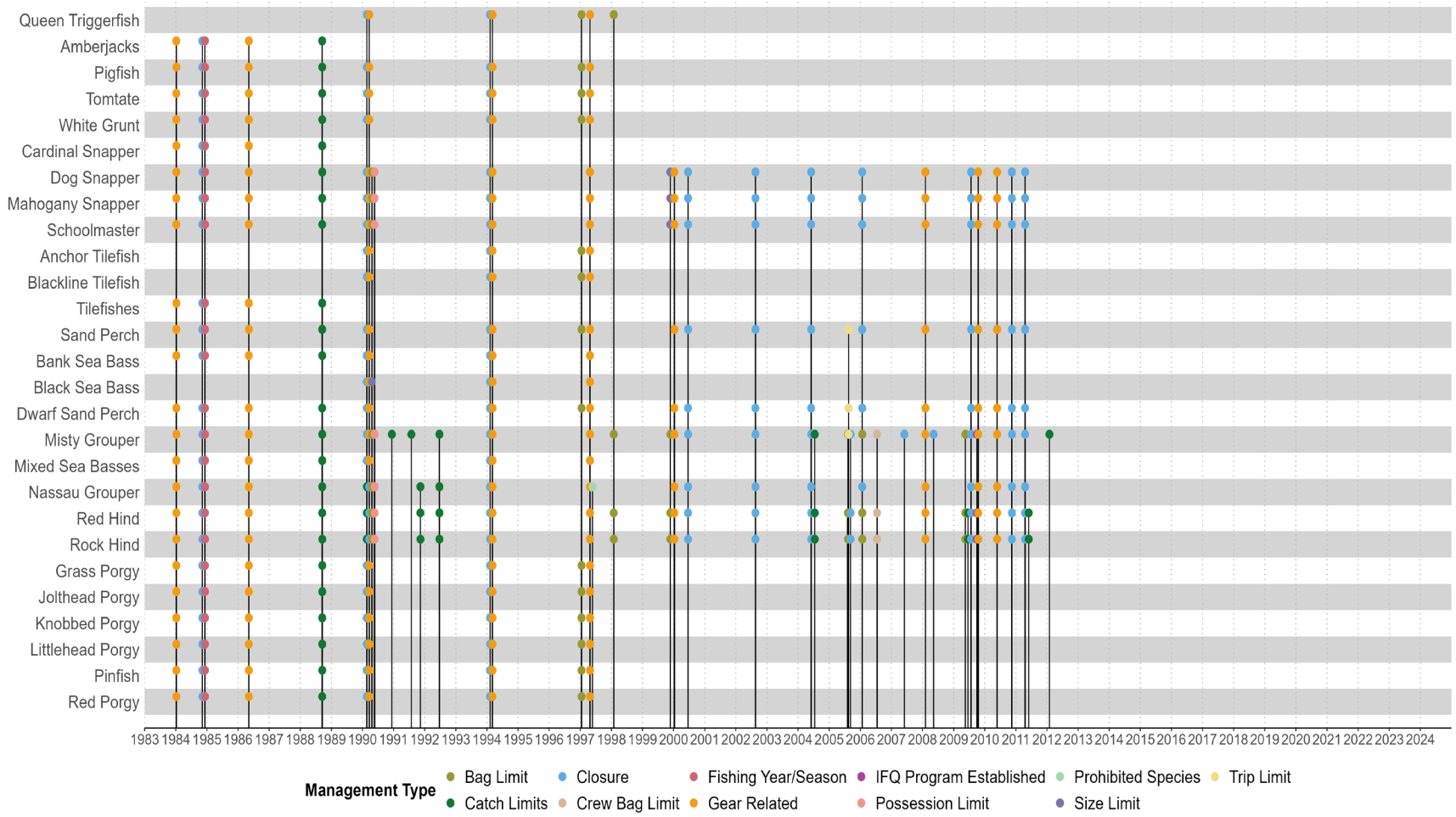

Figure 6. Timeline of management actions for reef fish managed under the Reef Fish FMP in the Gulf of America. Due to the significant number of management actions published throughout the time series, management actions were summarized at the year level. A list of federally managed species over time is provided in **Table 2**.

Table 2. Fifty-nine species included in the Reef Fish FMP in the Gulf of America, along with their respective dates of inclusion or removal if applicable.

ITIS Code	Common Name	Scientific Name	Date Added	Date Removed
173138	Gray Triggerfish	*Balistes capriscus*	1984-11-08	
173139	Queen Triggerfish	*Balistes vetula*	1990-02-21	1999-11-24
168688	Amberjacks	*Seriola*	1984-11-08	1990-02-21
168689	Greater Amberjack	*Seriola dumerili*	1990-02-21	
168690	Lesser Amberjack	*Seriola fasciata*	1990-02-21	
168693	Banded Rudderfish	*Seriola zonata*	1992-05-08	
168691	Almaco Jack	*Seriola rivoliana*	1992-05-08	
170566	Hogfish	*Lachnolaimus maximus*	1984-11-08	
168539	Caulolatilus	*Caulolatilus*	1984-11-08	1990-02-21
168546	Golden Tilefish	*Lopholatilus chamaeleonticeps*	1984-11-08	
168543	Blueline Tilefish	*Caulolatilus microps*	1990-02-21	
168544	Goldface Tilefish	*Caulolatilus chrysops*	1990-02-21	
168541	Blackline Tilefish	*Caulolatilus cyanops*	1990-02-21	1999-11-24
168542	Anchor Tilefish	*Caulolatilus intermedius*	1990-02-21	1999-11-24
167702	Red Grouper	*Epinephelus morio*	1984-11-08	
167759	Gag Grouper	*Mycteroperca microlepis*	1984-11-08	
167695	Goliath Grouper	*Epinephelus itajara*	1984-11-08	
167763	Scamp	*Mycteroperca phenax*	1984-11-08	
167760	Black Grouper	*Mycteroperca bonaci*	1984-11-08	
167762	Yellowmouth Grouper	*Mycteroperca interstitialis*	1984-11-08	
167764	Yellowfin Grouper	*Mycteroperca venenosa*	1984-11-08	
167699	Yellowedge Grouper	*Epinephelus flavolimbatus*	1984-11-08	
167698	Speckled Hind	*Epinephelus drummondhayi*	1984-11-08	
167705	Snowy Grouper	*Epinephelus niveatus*	1984-11-08	
167704	Warsaw Grouper	*Epinephelus nigritus*	1984-11-08	
167703	Misty Grouper	*Epinephelus mystacinus*	1984-11-08	2012-01-30
167700	Red Hind	*Epinephelus guttatus*	1984-11-08	2012-01-30
167696	Rock Hind	*Epinephelus adscensionis*	1984-11-08	2012-01-30
167706	Nassau Grouper	*Epinephelus striatus*	1984-11-08	2012-01-30

Table 2 Continued. Reef fish species included in the Reef Fish FMP in the Gulf of America, along with their dates of removal if applicable.

ITIS Code	Common Name	Scientific Name	Date Added	Date Removed
167796	Dwarf Sand Perch	*Diplectrum bivittatum*	1984-11-08	2012-01-30
167793	Sand Perch	*Diplectrum formosum*	1984-11-08	2012-01-30
167690	Bank Sea Bass	*Centropristis ocyurus*	1984-11-08	1998-01-29
167687	Black Sea Bass	*Centropristis striata*	1990-02-21	1998-01-29
167686	Mixed Sea Basses	*Centropristis*	1984-11-08	1998-01-29
167692	Centropristis Melana	*Centropristis melana*	1984-11-08	1990-02-21
168853	Red Snapper	*Lutjanus campechanus*	1984-11-08	
168909	Vermilion Snapper	*Rhomboplites aurorubens*	1984-11-08	
168849	Mutton Snapper	*Lutjanus analis*	1984-11-08	
168848	Gray Snapper	*Lutjanus griseus*	1984-11-08	
168907	Yellowtail Snapper	*Ocyurus chrysurus*	1984-11-08	
168860	Lane Snapper	*Lutjanus synagris*	1984-11-08	
168913	Wenchman	*Pristipomoides aquilonaris*	1984-11-08	
168902	Queen Snapper	*Etelis oculatus*	1984-11-08	
168852	Blackfin Snapper	*Lutjanus buccanella*	1984-11-08	
168847	Cubera Snapper	*Lutjanus cyanopterus*	1984-11-08	
168861	Silk Snapper	*Lutjanus vivanus*	1984-11-08	
168857	Dog Snapper	*Lutjanus jocu*	1984-11-08	2012-01-30
168858	Mahogany Snapper	*Lutjanus mahogoni*	1984-11-08	2012-01-30
643085	Cardinal Snapper	*Pristipomoides macrophthalmus*	1984-11-08	1990-02-21
168850	Schoolmaster	*Lutjanus apodus*	1984-11-08	2012-01-30
169187	Pinfish	*Lagodon rhomboides*	1984-11-08	1998-01-29
169196	Grass Porgy	*Calamus arctifrons*	1984-11-08	1998-01-29
169197	Jolthead Porgy	*Calamus bajonado*	1984-11-08	1998-01-29
169201	Knobbed Porgy	*Calamus nodosus*	1984-11-08	1998-01-29
169203	Littlehead Porgy	*Calamus proridens*	1984-11-08	1998-01-29
169207	Red Porgy	*Pagrus pagrus*	1984-11-08	1998-01-29
613026	White Grunt	*Haemulon plumieri*	1984-11-08	1998-01-29
169077	Pigfish	*Orthopristis chrysoptera*	1984-11-08	1998-01-29
169058	Tomtate	*Haemulon aurolineatum*	1984-11-08	1998-01-29

The purpose of the Management History database is to offer a vetted, searchable record of management actions published within an FMP over time. Given the complexities associated with fishery management (i.e., actions may amend, overwrite, or repeal prior actions either temporarily or permanently; measures are sometimes delayed or withdrawn before they become effective), the database enables users to gain a better understanding of fishery management throughout time by providing a means to visualize management actions in various ways (**Figures 7 & 8**).

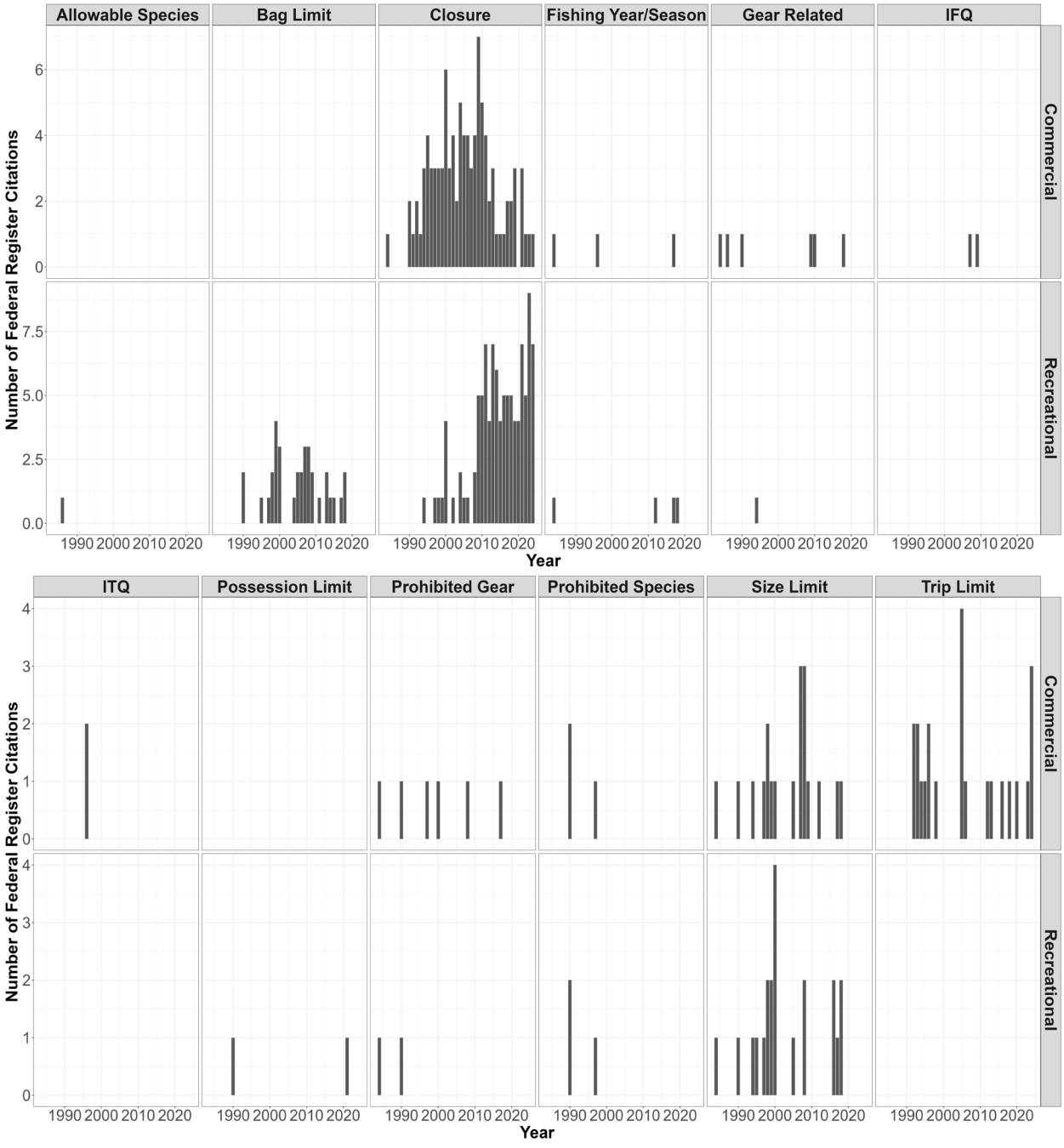

Figure 7. Number of Federal Register notices published for each management type by fishery sector and year in the Gulf of America.

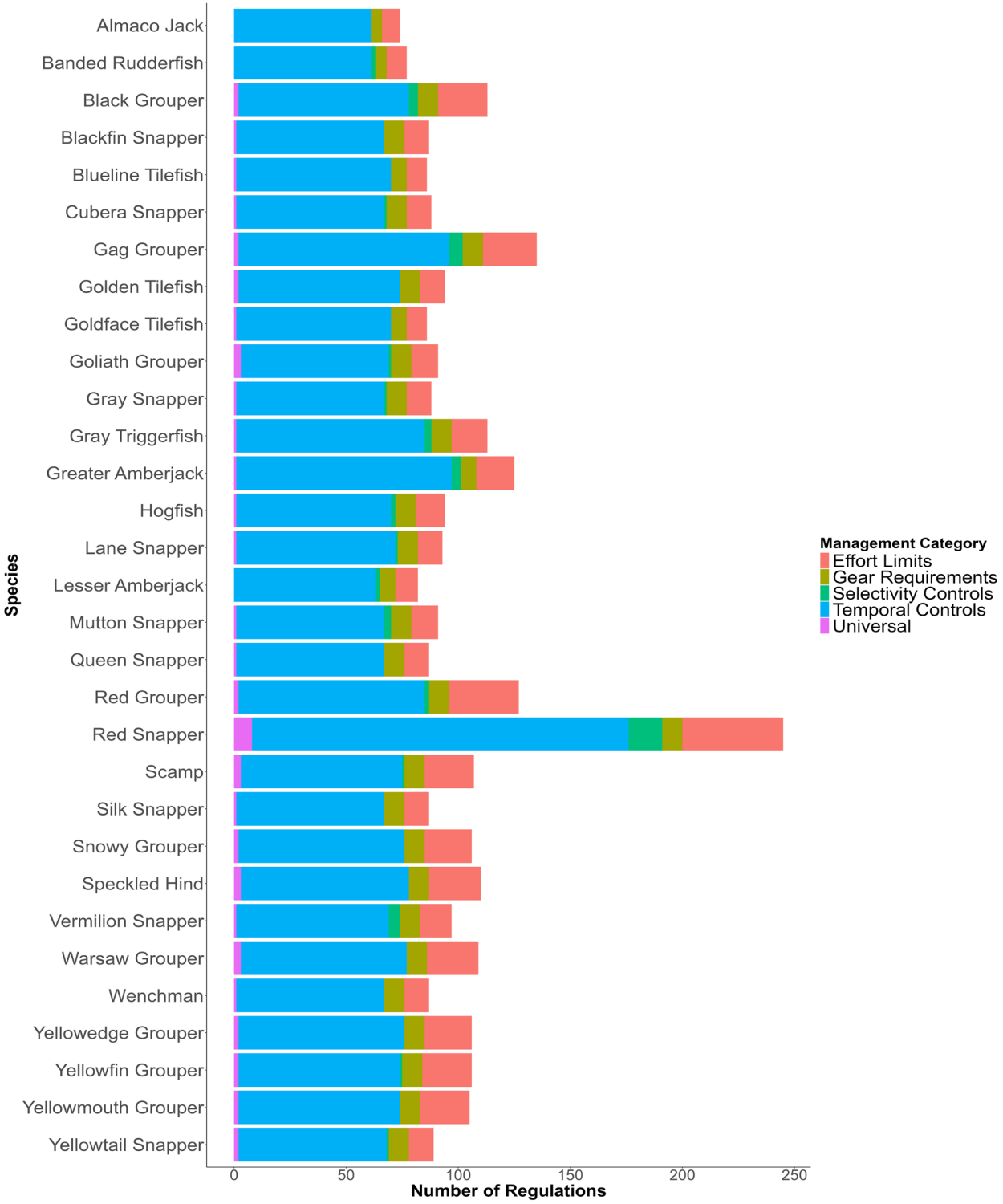

Figure 8. Number of regulations published by each management type for each species managed under the Reef Fish FMP in the Gulf of America.

Results

Commercial Size Limits

The first commercial size limit of any Gulf reef fish was implemented in 1984 for Red Snapper, with size limits first established for other species in 1990 (**Figure 9**). The number and frequency of changing commercial size limits has varied across species throughout the time series. Targeted species have undergone more changes in commercial size limits, with the most changes exhibited for Red Snapper (4 different limits), Gag Grouper (*Mycteroperca microlepis*) (3 limits), Mutton Snapper (*Lutjanus analis*) (3 limits), and Vermilion Snapper (*Rhomboplites aurorubens*) (3 limits). Size limits have generally remained static or increased over time for many species, with the exception of Red Grouper (*Epinephelus morio*), Red Snapper, and Vermilion Snapper. Lesser Amberjack (*Seriola fasciata*) and Banded Rudderfish (*Seriola zonata*) are the only two reef fish that possess both a minimum size limit and a maximum size limit.

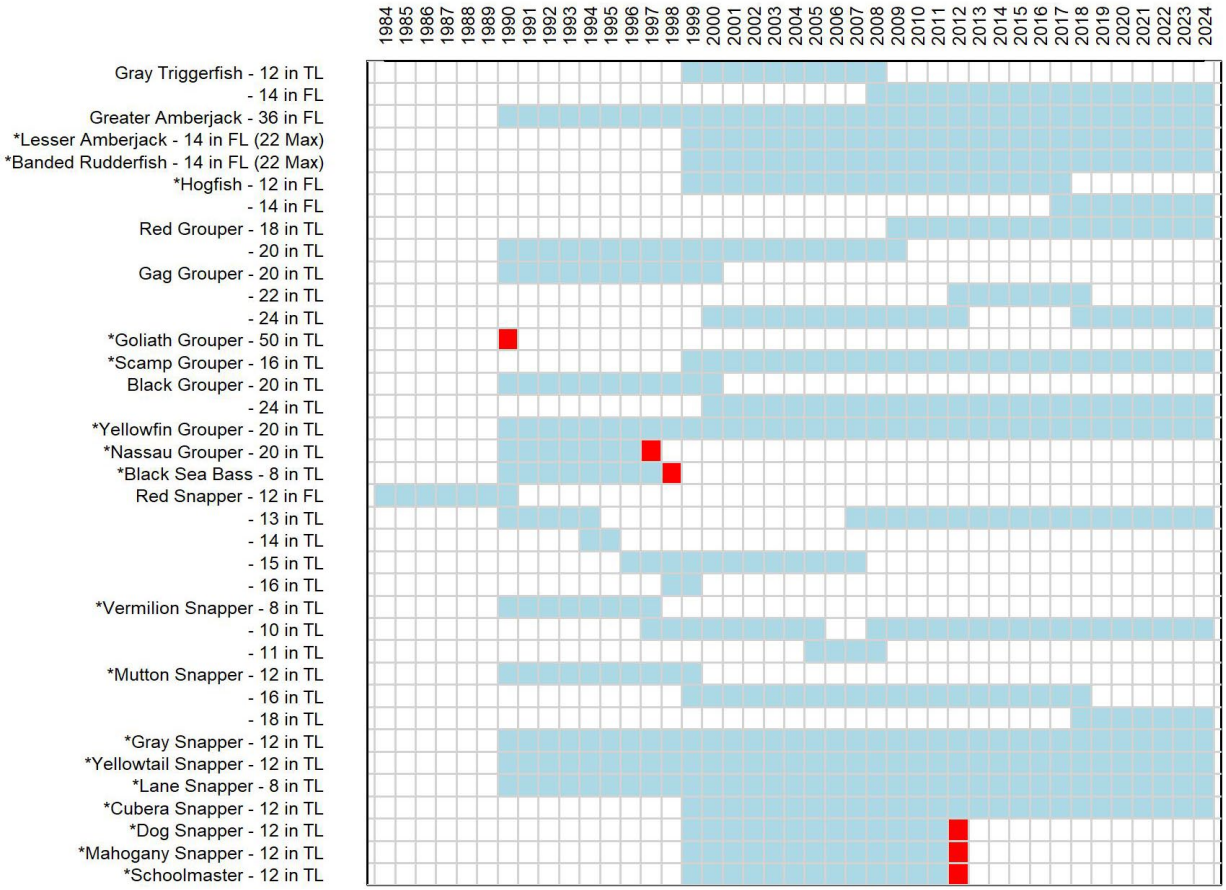

Figure 9. Commercial minimum size limits in fork length (FL) or total length (TL) for reef fish in the Gulf of America. Red boxes indicate where a species was removed from the Reef Fish FMP in the Gulf of America. Max (in parentheses) refers to a maximum size limit where present. An asterisk (*) identifies species where size limits are consistent between commercial and recreational fisheries.

Commercial Trip Limits and IFQ

Prior to the implementation of the Individual Fishing Quota (IFQ) program for Red Snapper in 2007 (Agar et al. 2014) and for Grouper-Tilefish in 2010 (Agar et al. 2022), trip limits were implemented for Red Snapper, Deep-Water and Shallow-Water Groupers (**Figure 10**; **Tables 3-4**). The IFQ programs were implemented with the aims of reducing overcapacity of the fishing fleet, increasing harvesting efficiency, and eliminating the race to fish (GMFMC 2008). Additional information on the IFQ program can be found at the NMFS's Southeast Regional Office webpage at *https://secatchshares.fisheries.noaa.gov/*. Trip limits were established in 2012 for Greater Amberjack and in 2013 for Gray Triggerfish.

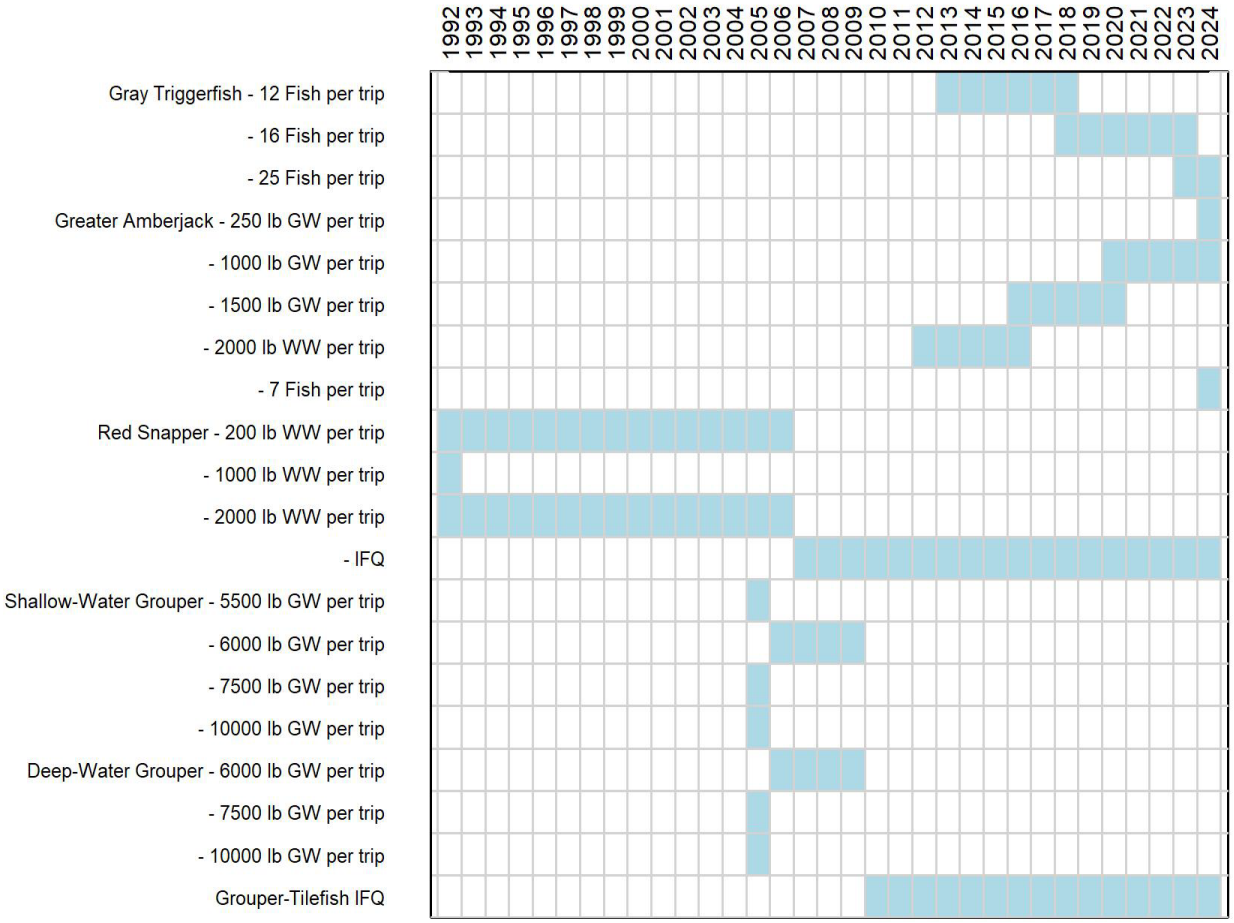

Figure 10. Commercial trip limits in gutted weight (GW), whole weight (WW), or number of fish per trip for reef fish in the Gulf of America. Also shown is the implementation of the Individual Fishing Quota Programs for Red Snapper and Grouper-Tilefish. Note that two trip limits existed for Red Snapper from 1992-2006 and differed based on endorsement (commercial reef fish vessels with a Red Snapper endorsement were allowed the higher limit).

Table 3. Aggregates pertaining to trip limits for the commercial fishery in the Gulf of America. SWG and DWG refer to Shallow-Water and Deep-Water Groupers, respectively. All trip limit aggregates were disbanded in 2010 at the start of Individual Fishing Quota Programs.

Common Name	Scientific Name	Date Added	Date Removed
DWG & SWG Trip Limit			
Red Grouper	*Epinephelus morio*	2005-03-03	
Gag Grouper	*Mycteroperca microlepis*	2005-03-03	
Scamp	*Mycteroperca phenax*	2005-03-03	
Black Grouper	*Mycteroperca bonaci*	2005-03-03	
Yellowmouth Grouper	*Mycteroperca interstitialis*	2005-03-03	
Yellowfin Grouper	*Mycteroperca venenosa*	2005-03-03	
Yellowedge Grouper	*Epinephelus flavolimbatus*	2005-03-03	
Speckled Hind	*Epinephelus drummondhayi*	2005-03-03	
Snowy Grouper	*Epinephelus niveatus*	2005-03-03	
Warsaw Grouper	*Epinephelus nigritus*	2005-03-03	
Misty Grouper	*Epinephelus mystacinus*	2005-03-03	
Rock Hind	*Epinephelus adscensionis*	2005-03-03	
Red Hind	*Epinephelus guttatus*	2005-03-03	
Dwarf Sand Perch	*Diplectrum bivittatum*	2005-03-03	2005-12-31
Sand Perch	*Diplectrum formosum*	2005-03-03	2005-12-31
SWG Trip Limit			
Red Grouper	*Epinephelus morio*	2005-08-04	2005-12-31
Gag Grouper	*Mycteroperca microlepis*	2005-08-04	2005-12-31
Scamp	*Mycteroperca phenax*	2005-08-04	2005-12-31
Black Grouper	*Mycteroperca bonaci*	2005-08-04	2005-12-31
Yellowmouth Grouper	*Mycteroperca interstitialis*	2005-08-04	2005-12-31
Yellowfin Grouper	*Mycteroperca venenosa*	2005-08-04	2005-12-31
Rock Hind	*Epinephelus adscensionis*	2005-08-04	2005-12-31
Red Hind	*Epinephelus guttatus*	2005-08-04	2005-12-31

Table 4. Aggregates pertaining to the Individual Fishing Quota Program (IFQ) for the commercial fishery in the Gulf of America. SWG and DWG refer to Shallow-Water and Deep-Water Groupers, respectively.

Common Name	Scientific Name	Date Added	Date Removed
DWG IFQ			
Scamp	*Mycteroperca phenax*	2009-09-30	
Yellowedge Grouper	*Epinephelus flavolimbatus*	2009-09-30	
Speckled Hind	*Epinephelus drummondhayi*	2009-09-30	
Snowy Grouper	*Epinephelus niveatus*	2009-09-30	
Warsaw Grouper	*Epinephelus nigritus*	2009-09-30	
Misty Grouper	*Epinephelus mystacinus*	2009-09-30	2012-01-30
Other SWG IFQ			
Scamp	*Mycteroperca phenax*	2009-09-30	
Black Grouper	*Mycteroperca bonaci*	2009-09-30	
Yellowmouth Grouper	*Mycteroperca interstitialis*	2009-09-30	
Yellowfin Grouper	*Mycteroperca venenosa*	2009-09-30	
Warsaw Grouper	*Epinephelus nigritus*	2009-09-30	
Speckled Hind	*Epinephelus drummondhayi*	2009-09-30	
Rock Hind	*Epinephelus adscensionis*	2009-09-30	2012-01-30
Red Hind	*Epinephelus guttatus*	2009-09-30	2012-01-30
Tilefishes IFQ			
Golden Tilefish	*Lopholatilus chamaeleonticeps*	2009-09-30	
Blueline Tilefish	*Caulolatilus microps*	2009-09-30	
Goldface Tilefish	*Caulolatilus chrysops*	2009-09-30	
Blackline Tilefish	*Caulolatilus cyanops*	2009-09-30	2012-01-30
Anchor Tilefish	*Caulolatilus intermedius*	2009-09-30	2012-01-30

Since the implementation of the IFQ programs, the percentage of quota landed has varied both across and within species (**Figure 11**). Nearly all of the quota has been consistently landed for Red Snapper in each year (98% on average, range of 96% in 2007 to 100% for 2017-2018). The quota attained for Deep-Water Grouper has been relatively constant (81% on average, range of 57% in 2022 to 97% in 2014). Approximately 75% of the quota was attained on average for both Tilefish (range of 54% in 2023 to 92% in 2015) and Red Grouper (range of 30% in 2018 to 100% in 2014), although the percentage varied considerably for Red Grouper. Declines in the proportion of quota landed in more recent years for Red Grouper were evident until the quota was reduced in 2019. The majority of years exhibited landings well below the quota for gag grouper (overall average of 69%, ranging from 35% in 2010 to 118% in 2023), and for all years for Shallow-Water Grouper (overall average of 41%, ranging from 27% in 2019 to 64% in 2016).

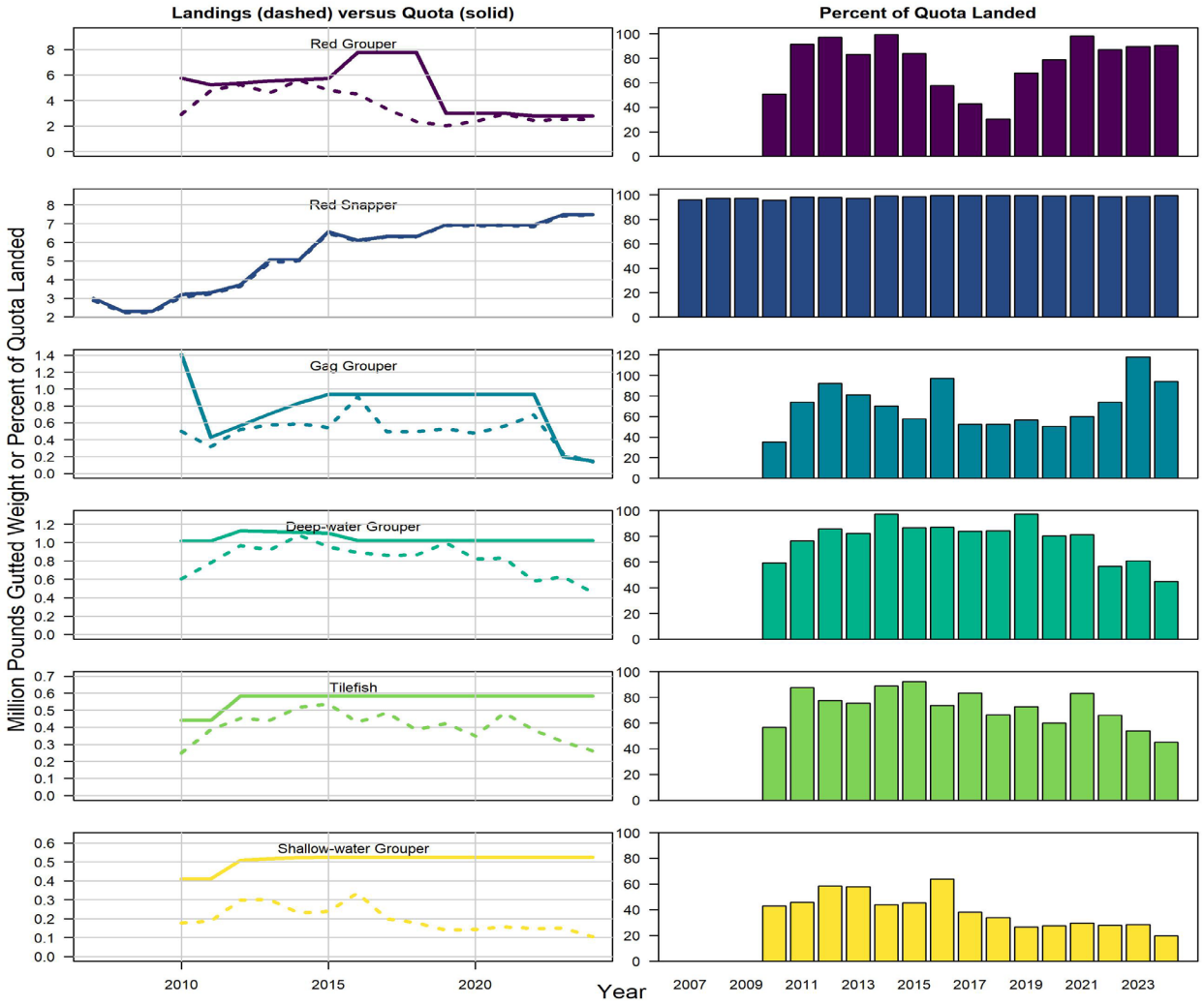

Figure 11. Comparison of commercial landings (dashed lines) and quotas (solid lines) through 2024 since the implementation of the Red Snapper and Grouper-Tilefish IFQ program in 2010. Shallow-Water and Deep-Water Groupers are identified in **Table 4**. Data were obtained from the Individual Fishing Quota (IFQ) portal database, accessed March 11 2025 (*https://secatchshares.fisheries.noaa.gov/getQuotasAndCatchAllowancesReport*).

Commercial Open Seasons

The reef fish examined revealed variable open season lengths across the time series before the implementation of the IFQ programs for Red Snapper and Grouper-Tilefish (**Figure 12**). Since the start of IFQ programs, Gray Triggerfish and Greater Amberjack are the two main species managed with fishery closures.

Commercial Fishery - Open Days Per Year

	Red Snapper	Vermilion	Lane Snapper	G. Triggerfish	G. Amberjack	Hogfish	Gag,Red,Black	Other SWG	S. Hind	DWG	Tilefish
1985	365	365	365	365		365	365	365	365	365	365
1986	365	365	365	365		365	365	365	365	365	365
1987	365	365	365	365		365	365	365	365	365	365
1988	366	366	366	366		366	366	366	366	366	366
1989	365	365	365	365		365	365	365	365	365	365
1990	365	365	365	365		365	311	311	331	365	365
1991	235	365	365	365	365	365	365	365	365	365	365
1992	52	366	366	366	366	366	366	366	366	366	366
1993	94	365	365	365	365	365	365	365	365	365	365
1994	77	365	365	365	365	365	365	365	365	365	365
1995	51.5	365	365	365	365	365	365	365	365	365	365
1996	86	366	366	366	366	366	366	366	366	366	366
1997	71	365	365	365	365	365	365	365	365	365	365
1998	67	365	365	365	273	365	365	365	365	365	365
1999	64	365	365	365	273	365	365	365	365	365	365
2000	68	366	366	366	274	366	366	366	366	366	366
2001	70	365	365	365	273	365	336	365	365	365	365
2002	81	365	365	365	273	365	336	365	365	365	365
2003	84	365	365	365	273	365	336	365	365	365	365
2004	90.5	366	366	366	274	366	289	319	196	196	366
2005	99	365	365	365	273	365	253	282	173	173	324
2006	99	325	365	365	273	365	336	365	177	177	202
2007	364.5	325	365	365	273	365	336	365	152	152	107
2008	366	366	366	366	274	366	336	366	140	140	140
2009	365	365	365	365	218	365	336	365	177	177	134
2010	365	365	365	365	208	365	365	365	365	365	365
2011	365	365	365	365	125	365	365	365	365	365	365
2012	366	366	366	182	60	366	366	366	366	366	366
2013	365	365	365	313	89	335	365	365	365	365	365
2014	365	365	365	304	144	365	365	365	365	365	365
2015	365	365	365	304	107	365	365	365	365	365	365
2016	366	366	366	305	106	366	366	366	366	366	366
2017	365	365	365	260	78	365	365	365	365	365	365
2018	365	365	365	217	59	365	365	365	365	365	365
2019	365	365	346	268	67	365	365	365	365	365	365
2020	366	366	366	305	274	366	366	366	366	366	366
2021	365	365	299	304	273	365	365	365	365	365	365
2022	365	365	318	304	273	365	365	365	365	365	365
2023	365	365	365	304	76	365	365	365	365	365	365
2024	366	366	366	305	89	366	366	366	366	366	366

Figure 12. Commercial season length (i.e., number of days open to fishing) for reef fish in federal waters of the Gulf of America. Red cells indicate a fishing season less than 365 days (or 366 days in leap years). Species defined as SWG, DWG, and Tilefishes are provided in **Table 5**. *Note that the 1992 data for Red Snapper in the Management History database did not include the reopening from April 4 through May 15 because it was not cited in the Federal Register.

Table 5. Aggregates pertaining to open seasons for the commercial fishery in the Gulf of America. Note that the seasons for Red Grouper, Gag Grouper, and Black Grouper are plotted separately in **Figure 12** to distinguish changes in season length from the "Other SWG" species (denoted with * below).

Common Name	Scientific Name	Date Added	Date Removed
SWG			
Red Grouper	*Epinephelus morio*	1990-11-08	
Gag Grouper	*Mycteroperca microlepis*	1990-11-08	
Black Grouper	*Mycteroperca bonaci*	1990-11-08	
Scamp*	*Mycteroperca phenax*	1990-11-08	
Yellowmouth Grouper*	*Mycteroperca interstitialis*	1990-11-08	
Yellowfin Grouper*	*Mycteroperca venenosa*	1990-11-08	
Rock Hind*	*Epinephelus adscensionis*	1990-11-08	2012-01-30
Red Hind*	*Epinephelus guttatus*	1990-11-08	2012-01-30
Nassau Grouper*	*Epinephelus striatus*	1990-11-08	1997-04-24
Speckled Hind	*Epinephelus drummondhayi*	1990-11-08	1990-12-11
DWG			
Yellowedge Grouper	*Epinephelus flavolimbatus*	2004-07-15	
Snowy Grouper	*Epinephelus niveatus*	2004-07-15	
Warsaw Grouper	*Epinephelus nigritus*	2004-07-15	
Speckled Hind	*Epinephelus drummondhayi*	2004-07-15	
Misty Grouper	*Epinephelus mystacinus*	2004-07-15	2012-01-30
Tilefishes			
Golden Tilefish	*Lopholatilus chamaeleonticeps*	2004-07-15	
Blueline Tilefish	*Caulolatilus microps*	2004-07-15	
Goldface Tilefish	*Caulolatilus chrysops*	2004-07-15	
Blackline Tilefish	*Caulolatilus cyanops*	2004-07-15	2012-01-30
Anchor Tilefish	*Caulolatilus intermedius*	2004-07-15	2012-01-30

Recreational Size Limits

As observed for the commercial fishery, the first recreational size limit of any Gulf reef fish was implemented in 1984 for Red Snapper and in 1990 for other reef fish (**Figure 13**). The most changes were evident for Red Snapper (6 different limits), Greater Amberjack (3 limits), Black Grouper (*Mycteroperca bonaci*) (3 limits), Gag Grouper (3 limits), Mutton Snapper (3 limits), Vermilion Snapper (3 limits), and Gray Triggerfish (*Balistes capriscus*) (3 limits). Most of these species showed shifts towards larger sized fish in more recent years, with the exception of Vermilion Snapper. The size limits for many Gulf reef fish are the same between the commercial and recreational fisheries (**Figures 9, 13**), including the slot limit (i.e., a minimum size limit and a maximum size limit) for Lesser Amberjack and Banded Rudderfish.

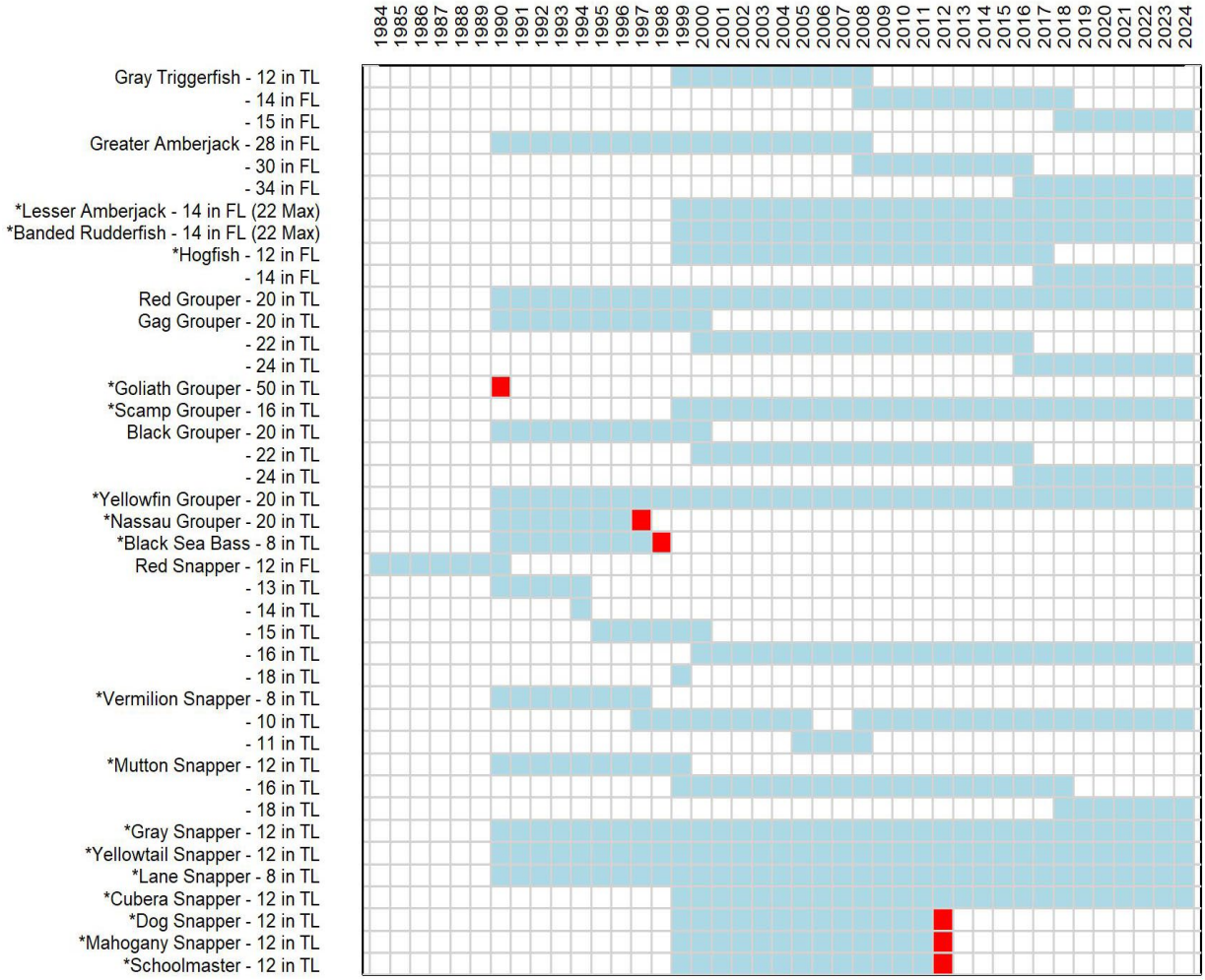

Figure 13. Recreational size limits in fork length (FL) or total length (TL) for reef fish in the Gulf of America. Red boxes indicate where a species was removed from the Reef Fish FMP in the Gulf of America. Max (in parentheses) refers to a maximum size limit where present. An asterisk (*) identifies species where size limits are consistent between commercial and recreational fisheries.

Recreational Bag Limits

Aggregate bag limits were first implemented for snappers (10 fish) and groupers (5 fish) starting in 1990, and then in 1997 for an aggregate Gulf reef fish group (see **Table 6** for species within each aggregate). While the aggregate snapper limit has remained constant through time, the grouper aggregate bag limit has varied from 3 to 5 fish, with the most recent aggregate limit set at 4 fish per person per day. Individual bag limits have been implemented for many species, first for Red Snapper and Greater Amberjack in 1990. Both the Red Snapper and Red Grouper bag limits varied considerably over time, with Red Snapper consistently declining while the Red Grouper bag limit has been more variable and smallest between 2005 and 2009 (**Figure 14**). Crew bag limits are shown in **Figure 15**, and have generally limited crew members from retaining any fish since their implementation for Red Snapper in 1999, for Greater Amberjack in 2008, and groupers in 2006.

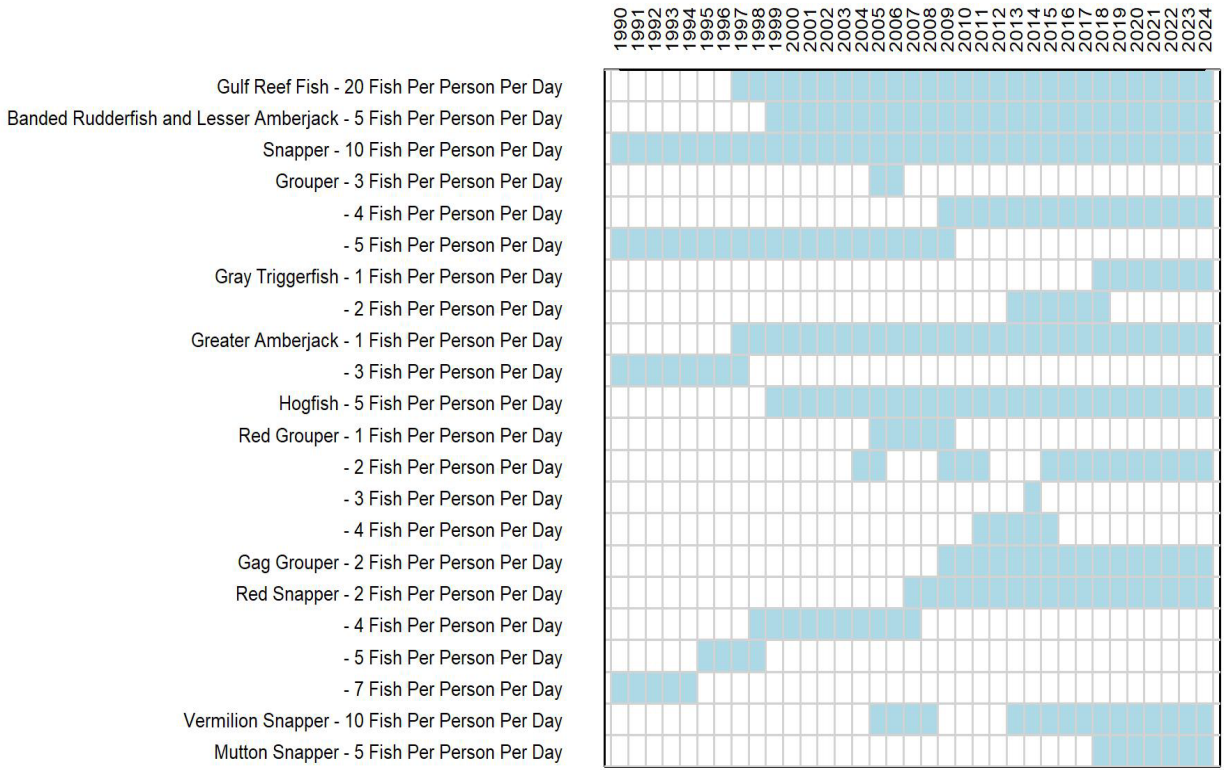

Figure 14. Recreational bag limits in number of fish per person per day for reef fish or aggregates in the Gulf of America.

Table 6. Aggregates pertaining to bag limits for the recreational fishery in the Gulf of America.

Common Name	Scientific Name	Date Added	Date Removed
Groupers			
Red Grouper	*Epinephelus morio*	1990-04-23	
Gag Grouper	*Mycteroperca microlepis*	1990-04-23	2011-01-01
Gag Grouper	*Mycteroperca microlepis*	2011-06-01	
Scamp	*Mycteroperca phenax*	1990-04-23	
Black Grouper	*Mycteroperca bonaci*	1990-04-23	
Yellowmouth Grouper	*Mycteroperca interstitialis*	1990-04-23	
Yellowfin Grouper	*Mycteroperca venenosa*	1990-04-23	
Yellowedge Grouper	*Epinephelus flavolimbatus*	1990-04-23	
Speckled Hind	*Epinephelus drummondhayi*	1990-04-23	
Snowy Grouper	*Epinephelus niveatus*	1990-04-23	
Warsaw Grouper	*Epinephelus nigritus*	1990-04-23	
Goliath Grouper	*Epinephelus itajara*	1990-04-23	1990-08-30
Nassau Grouper	*Epinephelus striatus*	1990-04-23	1997-04-24
Misty Grouper	*Epinephelus mystacinus*	1990-04-23	2012-01-30
Rock Hind	*Epinephelus adscensionis*	1990-04-23	2012-01-30
Red Hind	*Epinephelus guttatus*	1990-04-23	2012-01-30
Snappers			
Mutton Snapper	*Lutjanus analis*	1990-04-23	
Gray Snapper	*Lutjanus griseus*	1990-04-23	
Yellowtail Snapper	*Ocyurus chrysurus*	1990-04-23	
Wenchman	*Pristipomoides aquilonaris*	1990-04-23	
Queen Snapper	*Etelis oculatus*	1990-04-23	
Blackfin Snapper	*Lutjanus buccanella*	1990-04-23	
Cubera Snapper	*Lutjanus cyanopterus*	1990-04-23	
Silk Snapper	*Lutjanus vivanus*	1990-04-23	
Dog Snapper	*Lutjanus jocu*	1990-04-23	2012-01-30
Mahogany Snapper	*Lutjanus mahogoni*	1990-04-23	2012-01-30
Schoolmaster	*Lutjanus apodus*	1990-04-23	2012-01-30

Table 6 Continued. Aggregates pertaining to bag limits for the recreational fishery in the Gulf of America.

Common Name	Scientific Name	Date Added	Date Removed
Banded Rudderfish and			
Lesser Amberjack	*Seriola fasciata*	1999-11-24	
Banded Rudderfish	*Seriola zonata*	1999-11-24	
Gulf Reef Fish			
Gray Triggerfish	*Balistes capriscus*	1997-01-15	
Queen Triggerfish	*Balistes vetula*	1997-01-15	1999-11-24
Lesser Amberjack	*Seriola fasciata*	1997-01-15	1999-11-24
Banded Rudderfish	*Seriola zonata*	1997-01-15	1999-11-24
Almaco Jack	*Seriola rivoliana*	1997-01-15	
Hogfish	*Lachnolaimus maximus*	1997-01-15	1999-11-24
Golden Tilefish	*Lopholatilus chamaeleonticeps*	1997-01-15	
Blueline Tilefish	*Caulolatilus microps*	1997-01-15	
Goldface Tilefish	*Caulolatilus chrysops*	1997-01-15	
Blackline Tilefish	*Caulolatilus cyanops*	1997-01-15	2012-01-30
Anchor Tilefish	*Caulolatilus intermedius*	1997-01-15	2012-01-30
Dwarf Sand Perch	*Diplectrum bivittatum*	1997-01-15	1998-01-29
Sand Perch	*Diplectrum formosum*	1997-01-15	1998-01-29
Vermilion Snapper	*Rhomboplites aurorubens*	1997-01-15	
Lane Snapper	*Lutjanus synagris*	1997-01-15	
Pinfish	*Lagodon rhomboides*	1997-01-15	1998-01-29
Grass Porgy	*Calamus arctifrons*	1997-01-15	1998-01-29
Jolthead Porgy	*Calamus bajonado*	1997-01-15	1998-01-29
Knobbed Porgy	*Calamus nodosus*	1997-01-15	1998-01-29
Littlehead Porgy	*Calamus proridens*	1997-01-15	1998-01-29
Red Porgy	*Pagrus pagrus*	1997-01-15	1998-01-29
White Grunt	*Haemulon plumieri*	1997-01-15	1998-01-29
Pigfish	*Orthopristis chrysoptera*	1997-01-15	1998-01-29
Tomtate	*Haemulon aurolineatum*	1997-01-15	1998-01-29

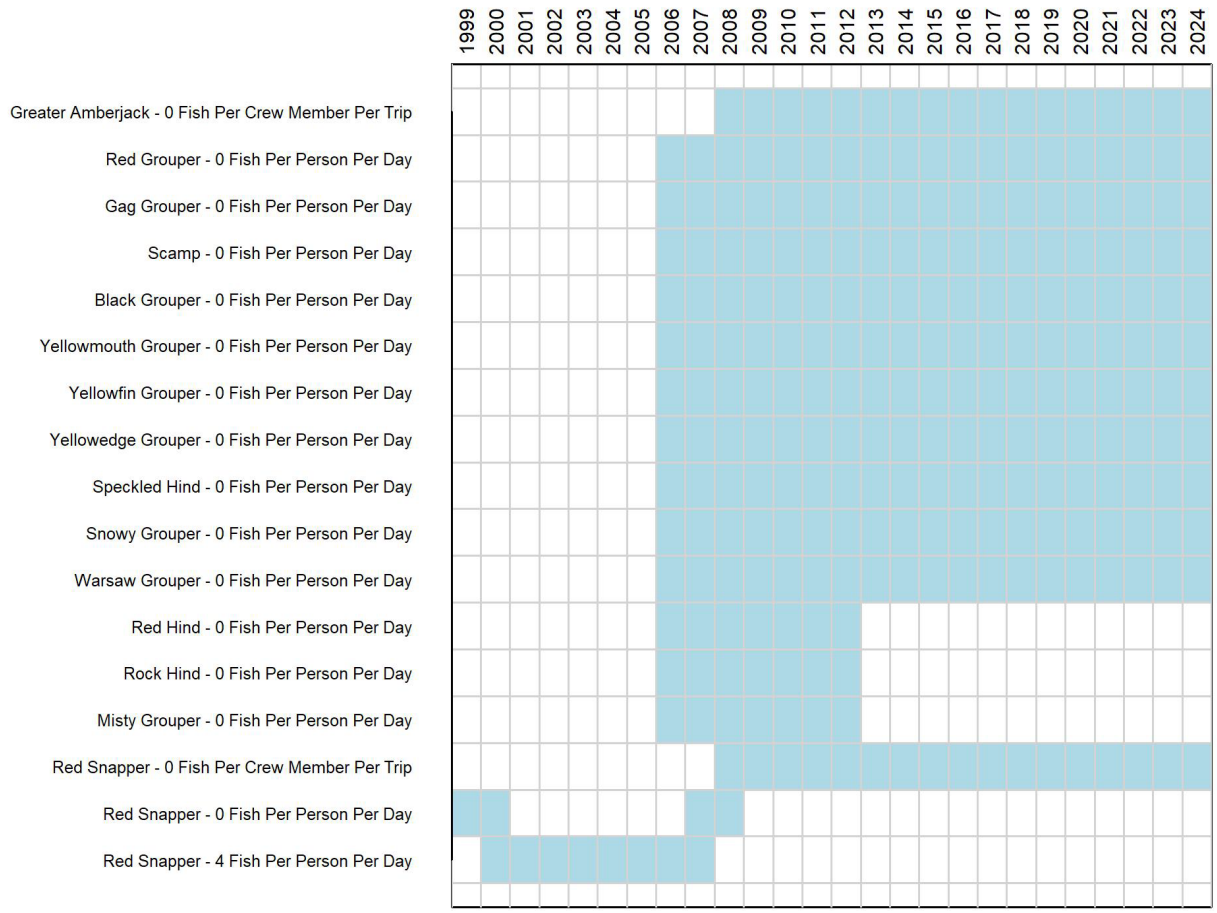

Figure 15. Recreational crew bag limits in number of fish per person per day for reef fish in the Gulf of America.

Recreational Federal Open Seasons

The reef fish examined revealed highly variable open season lengths across the time series, with considerable reductions in most recent years for some species (**Figure 16**).

Recreational Fishery - Open Days Per Year

	Red Snapper	G. Triggerfish	Red Grouper	G. Amberjack	Gag	Hogfish	Lane Snapper	DWG	SWG	Black Grouper
1985	365	365	365		365	365	365	365	365	365
1986	365	365	365		365	365	365	365	365	365
1987	365	365	365		365	365	365	365	365	365
1988	366	366	366		366	366	366	366	366	366
1989	365	365	365		365	365	365	365	365	365
1990	365	365	365		365	365	365	365	365	365
1991	365	365	365	365	365	365	365	365	365	365
1992	366	366	366	366	366	366	366	366	366	366
1993	365	365	365	365	365	365	365	365	365	365
1994	365	365	365	365	365	365	365	365	365	365
1995	365	365	365	365	365	365	365	365	365	365
1996	366	366	366	366	366	366	366	366	366	366
1997	330	365	365	365	365	365	365	365	365	365
1998	272	365	365	365	365	365	365	365	365	365
1999	240	365	365	365	365	365	365	365	365	365
2000	193	366	366	366	366	366	366	366	366	366
2001	194	365	365	365	365	365	365	365	365	365
2002	194	365	365	365	365	365	365	365	365	365
2003	194	365	365	365	365	365	365	365	365	365
2004	194	366	366	366	366	366	366	366	366	366
2005	194	365	304	365	304	365	365	304	304	304
2006	194	365	365	365	365	365	365	365	365	365
2007	194	365	336	365	336	365	365	365	365	336
2008	65	366	336	366	336	366	366	366	366	336
2009	75	365	336	296	306	365	365	365	365	336
2010	77	365	306	365	306	365	365	365	306	306
2011	140	365	306	304	61	365	365	365	306	306
2012	46	162	306	305	123	366	366	366	306	306
2013	42	235	306	304	155	335	365	365	306	306
2014	9	120	276	175	155	365	365	365	365	365
2015	44	37	279	209	155	365	365	365	365	365
2016	46	152	366	152	214	366	366	366	366	366
2017	49	0	365	82	214	365	365	365	365	365
2018	51	122	365	149	214	365	365	365	365	365
2019	62	70	365	92	214	365	346	365	365	365
2020	62	116	366	123	214	366	366	366	366	366
2021	63	136	257	123	214	365	299	365	365	365
2022	79	244	241	92	214	365	318	365	365	365
2023	85	244	201	24	48	365	365	365	365	365
2024	132	244	182	61	15	366	366	366	366	366

Figure 16. Recreational season length (i.e., number of days open to fishing) for reef fish in federal waters of the Gulf of America. Species defined as SWG and DWG are provided in **Table 7**. Note that since 2014 a seasonal closure has existed in the Gulf EEZ seaward of 20 fathoms for Black Grouper, Red Grouper, Scamp Grouper, Yellowfin Grouper, and Yellowmouth Grouper. Additionally, the 2024 data for Gag Grouper from the Management History database had to be manually adjusted because of a gap between the end of the temporary rule (5/2/2024) and the start of Amendment 56 (5/31/2024) where fishing was not allowed.

Table 7. Aggregates pertaining to open seasons for the recreational fishery in the Gulf of America. Note that the seasons for Red Grouper, Gag Grouper, and Black Grouper are plotted separately in **Figure 16** to distinguish changes in season length from the "Other SWG" species (denoted with * below).

Common Name	Scientific Name	Date Added	Date Removed
SWG			
Red Grouper	*Epinephelus morio*	2005-08-09	
Gag Grouper	*Mycteroperca microlepis*	2005-08-09	
Black Grouper	*Mycteroperca bonaci*	2005-08-09	
Scamp*	*Mycteroperca phenax*	2005-08-09	
Speckled Hind*	*Epinephelus drummondhayi*	2005-08-09	
Yellowmouth Grouper*	*Mycteroperca interstitialis*	2005-08-09	
Yellowfin Grouper*	*Mycteroperca venenosa*	2005-08-09	
Rock Hind*	*Epinephelus adscensionis*	2005-08-09	2012-01-30
Red Hind*	*Epinephelus guttatus*	2005-08-09	2012-01-30
DWG			
Yellowedge Grouper	*Epinephelus flavolimbatus*	2005-08-09	
Snowy Grouper	*Epinephelus niveatus*	2005-08-09	
Warsaw Grouper	*Epinephelus nigritus*	2005-08-09	
Misty Grouper	*Epinephelus mystacinus*	2005-08-09	2012-01-30
Dwarf Sand Perch	*Diplectrum bivittatum*	2005-08-09	2012-01-30
Sand Perch	*Diplectrum formosum*	2005-08-09	2012-01-30

To better elucidate temporal trends in the recreational season length for target species, the recreational season length (i.e., the number of days open per year) was analyzed using segmented regression and a breakpoint analysis in the 'strucchange' package in R (Zeileis et al. 2002). A series of linear regressions were fitted between breakpoints parsimoniously to maximize the overall fit of the segmented regression while penalizing the number of breakpoints in the series using the Bayesian Information Criterion. The breakpoint(s) were considered the point or points which separated two significantly differing linear regressions as derived from the data (number of days open per year).

Multiple shifts in recreational season length were detected for Red Snapper, where four significant breakpoints were detected at 1995, 2001, 2007, and 2013 (**Figure 17**). For Red Snapper, the season length was greatly reduced over time to the lowest number of open days (9 days) in 2014. The recreational open season for Red Grouper remained year-round until 2004, where season length declined until another significant breakpoint was identified in 2015 where the season length dropped sharply. The season length for Gag Grouper also declined

considerably after 2004, with a significant breakpoint identified in 2010 which identified a period of increasing season length until 2018 where the season length declined. Two breakpoints occurring in 2011 and 2017 were detected for Gray Triggerfish, with season length declining in the first period and increasing in recent years. Two breakpoints were also identified for Greater Amberjack in 2008 and 2013, both of which captured declining season lengths, with the latter being the most severe.

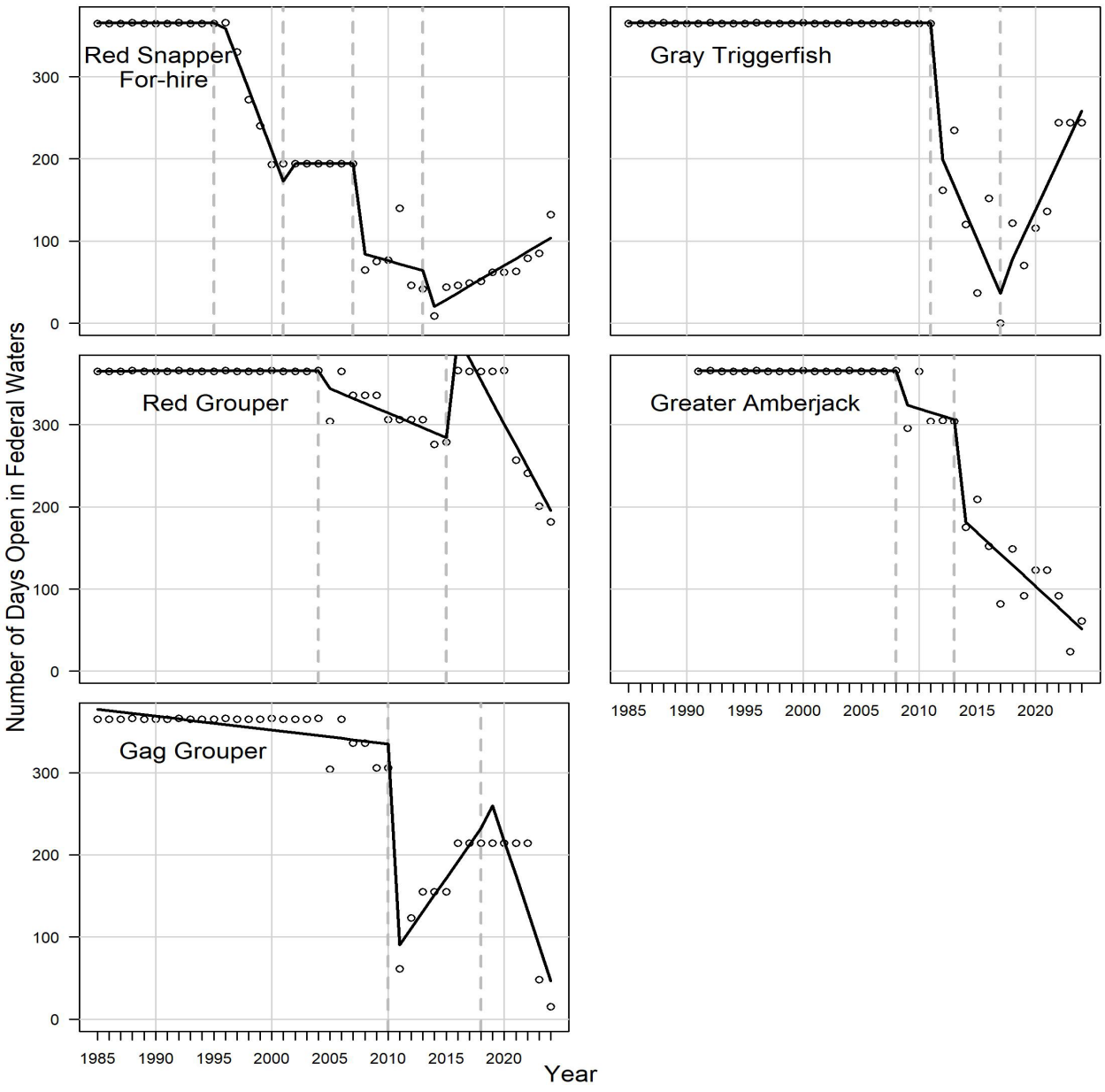

Figure 17. Breakpoint analysis of the recreational season length (i.e., number of days open to fishing) for key targeted species in federal waters of the Gulf of America with large recent reductions in season length. Dots reflect the number of days open, solid lines reflect fitted segmented regression lines, and dashed lines indicate significant breakpoints. Note that Red Snapper regulations refer to for-hire, which diverged from private regulations starting in 2015.

Discussion

The information compiled in the Management History database and presented herein provides a summary of major regulation changes across fifty-nine reef fish species over time, which can enable more consideration of the multispecies nature of fisheries when developing data inputs and conducting stock assessments. This has been difficult for past stock assessments in the Southeast because of the single-species focus and lack of understanding management regulations across reef fish in the Gulf of America. To our knowledge, this is the first analysis which provides a comprehensive review of management regulations over time for all reef fish species in the region. The Management History database greatly increases the available information, through a standardized and reliable process, which will ultimately enable the development of consistent and reliable data inputs for stock assessment. The comprehensive understanding of regulations for reef fish provided herein, possible only after processing data from the Management History database, may provide insight into explaining poor fits or trends in assessment fits (e.g., compositions). It is not uncommon for Gulf of America assessment models to reveal poor composition fits (e.g., residual patterns; e.g., SEDAR 2021), which may relate to regulation changes for other target species or shifts in the fishery.

One of the largest drivers of change in the commercial fishery was the implementation of the IFQ programs which were established with the goal of eliminating the "derby fishing" atmosphere characterized by an increased number of accidents and fatalities (Marvasti and Dakhlia 2016). With the IFQ, fishermen were allowed more flexibility in their fishing practices, and could shift their targeting seasonally or regionally depending upon species they have quota for or market prices. Implementation of the Red Snapper IFQ in 2007 coincides with an increase in landings of vermilion Snapper (**Figure 2**), likely due to a shift in targeting for fishermen that were not allocated Red Snapper. As a result, changes in fishing behavior could violate assumptions of fishery-dependent indices of abundance being proportional to stock abundance. Stock assessments have moved away from developing catch-per-unit-effort (CPUE) from logbook data because of the inability to account for potential changes due to the IFQ program (SEDAR 2021, 2024). Instead, indices developed using Reef Fish Observer Program data (Scott-Denton et al. 2011) were recommended for use because they included both landings and discards and therefore were deemed less influenced by management regulations than traditional indices developed with landings only from logbooks (Smith et al. 2021a). Additional fishery-dependent data sources such as Mote Marine Laboratory's Center for Fisheries Electronic Monitoring data (Neidig et al. 2020) could also be pursued for index development because they capture detailed information on fishing location and effort (i.e., set-level) which could be utilized during the index standardization process.

Given that Red Snapper is the most prized species in the Gulf of America, Red Snapper regulations may introduce bias into analytical processes or even into stock assessments for other Gulf of America reef fish. Changes to Red Snapper management regulations, particularly highly variable and frequent changes in recreational season lengths, likely affect the ability to track relative abundance within fishery-dependent indices not just for Red Snapper but for other reef fish. Changes in targeting or fishing behavior may be masked as perceived changes in relative abundance, which could introduce additional noise into a stock assessment model when trying to fit to indices of relative abundance. Development of CPUE indices for other reef fish has often included a variable of whether Red Snapper season was open or closed because of the potential

influence on fisher behavior. Red snapper recreational season (i.e., open and closed) was a significant predictive factor for the CPUE of Gray Triggerfish by headboats in the Western Gulf of America (Smith et al. 2015a; Sagarese and Isely 2019a), of Gray Triggerfish by private and charterboats in the Eastern Gulf of America (Smith et al. 2015b; Sagarese and Isely 2019b), and of Vermilion Snapper by headboats in the Western Gulf of America (Sagarese 2019).

One of the key questions faced by stock assessment analysts is how regulations may affect selectivity or retention. Selectivity represents the probability of capture by age or length for a given fishing fleet or survey and represents the net result of multiple interrelated factors (e.g., gear type, targeting, and availability of fish due to spatial and temporal constraints). For most Gulf of America reef fish, selectivity patterns are assumed to be constant over time for each fishery, with management regulations assumed to influence discard patterns and accounted for in the assessment model using time-varying retention and modeling discards explicitly. More commonly, time-varying retention is modeled to allow for varying discards at size due to the impacts of changing fishery minimum size limits and bag limits for the target species. Time blocks are usually specified based on changes in regulations, such as the implementation of size limits or reduced fishing seasons. Our breakpoint analysis identified different periods of recreational season length within species, which could help inform time blocks used to parameterize retention.

Size limits are often used as a management measure to protect younger individuals of a stock. For species that are prone to mis-identification, size limits for morphologically-similar species may also affect whether or not an individual fish is landed or discarded. For example, Amberjacks (*Seriola* spp.) exhibit very different size limits, and mis-characterizing a Lesser Amberjack above 22 inches total length as a Greater Amberjack would be a violation. Mis-identification of Amberjacks, even by trained scientists, was a key reason why the data-limited stock assessments for Lesser Amberjack and Almaco Jack (*Seriola rivoliana*) were not accepted for use by management (GMFMC SSC 2017). Differing size limits combined with mis-identification issues have complicated estimation of landings for Gag Grouper (Smith et al. 2021b). Size changes redefine the age/size composition of each Gag and Black Grouper population, which in turn changes the ratio of Gag to Black Grouper abundance (Smith et al. 2021b). Combining all management regulations with annual landings data for federally managed species in a single document makes it easier to identify these connections and provides a valuable resource for the region.

Disclaimer Regarding the Use of the Management History Database

While every effort has been made to obtain quality-assured quality-controlled data, it is possible that some federal regulations are not captured within the current database. It is our understanding that some ACL and quota allocations were established without formal publication in an FR notice. Since these allocations were not documented in a way that we could reference in the database, we have only recorded allocations that have been outlined in an FR notice. Therefore, we acknowledge that this database may contain an incomplete record of these allocations. We also acknowledge that this database does not currently include state regulations.

Code Availability

All code used to create plots and this report is available at: *https://github.com/SEFSC/SEFSC-ODM-MH-GulfReefFish/tree/main*. The SEFSC-ODM-MH-GulfReefFish repository is a scientific product and is not official communication of the National Oceanic and Atmospheric Administration, or the United States Department of Commerce. All NOAA GitHub project code is provided on an 'as is' basis and the user assumes responsibility for its use. Any claims against the Department of Commerce or Department of Commerce bureaus stemming from the use of this GitHub project will be governed by all applicable Federal law. Any reference to specific commercial products, processes, or services by service mark, trademark, manufacturer, or otherwise, does not constitute or imply their endorsement, recommendation or favoring by the Department of Commerce. The Department of Commerce seal and logo, or the seal and logo of a DOC bureau, shall not be used in any manner to imply endorsement of any commercial product or activity by DOC or the United States Government.

Data Availability

Management history data are available at the github repository cited above. Commercial landings data are publicly available at *https://www.fisheries.noaa.gov/national/commercial-fishing/commercial-landings/annual* and since the implementation of the IFQ program at *https://secatchshares.fisheries.noaa.gov/*. The recreational landings data from the SEFSC annual catch limit monitoring dataset are not publicly available due to confidentiality issues.

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Appendix: Regulations by Reef Fish Species

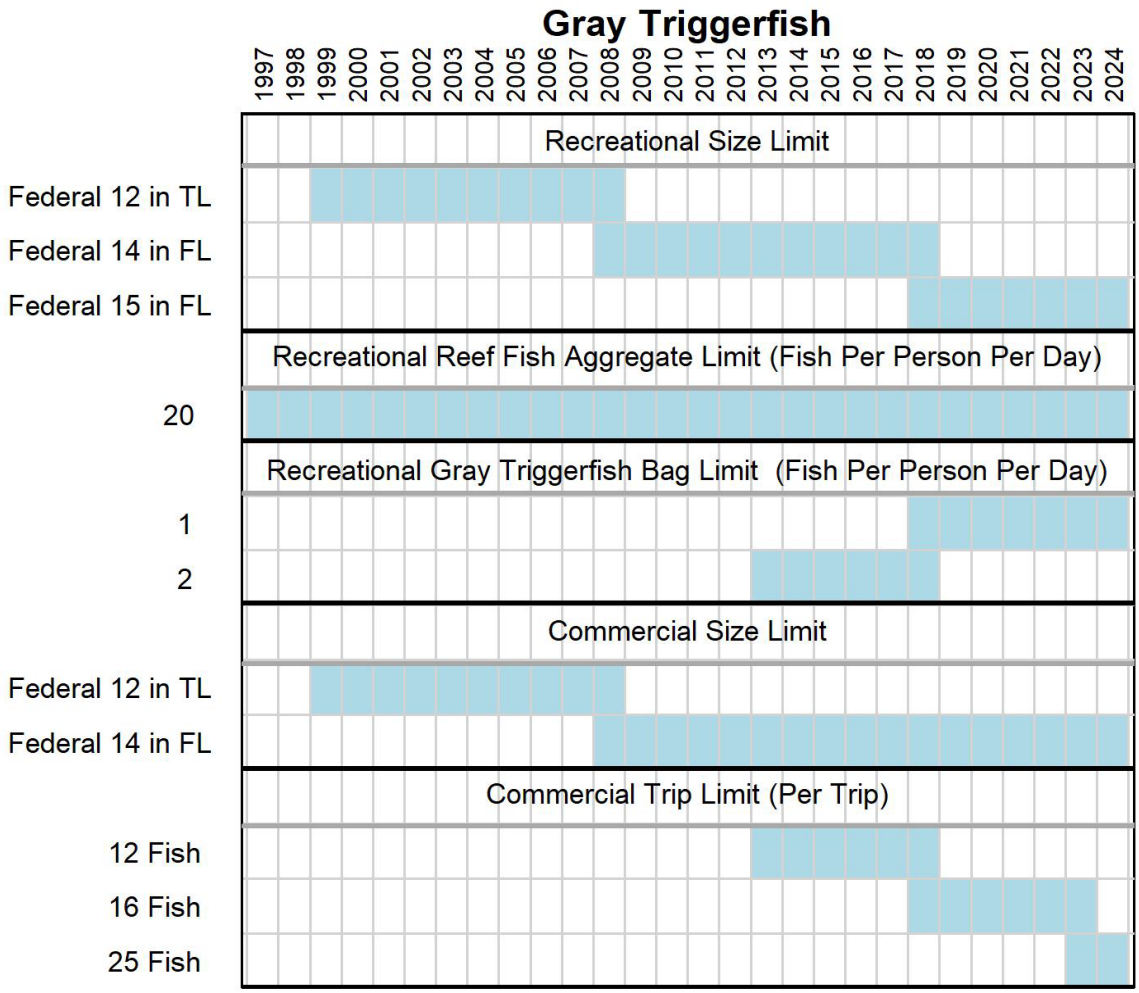

Figure A1. Summary of federal management regulations for Gulf of America Gray Triggerfish. Size limits shown are for inches fork length (in FL) or total length (in TL).

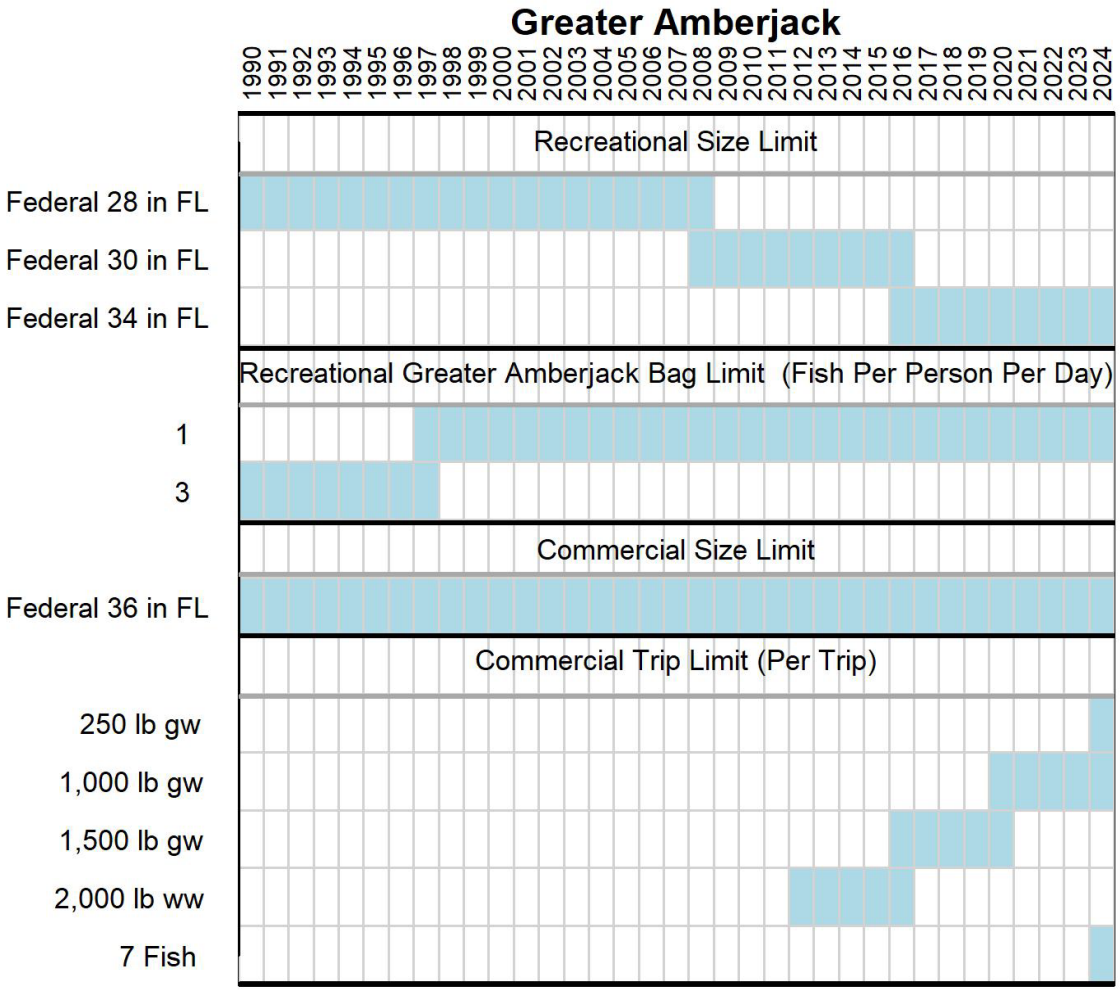

Figure A2. Summary of federal management regulations for Gulf of America Greater Amberjack. Size limits shown are for inches fork length (in FL) and trip limits in pounds gutted weight (lb gw) or whole weight (lb ww).

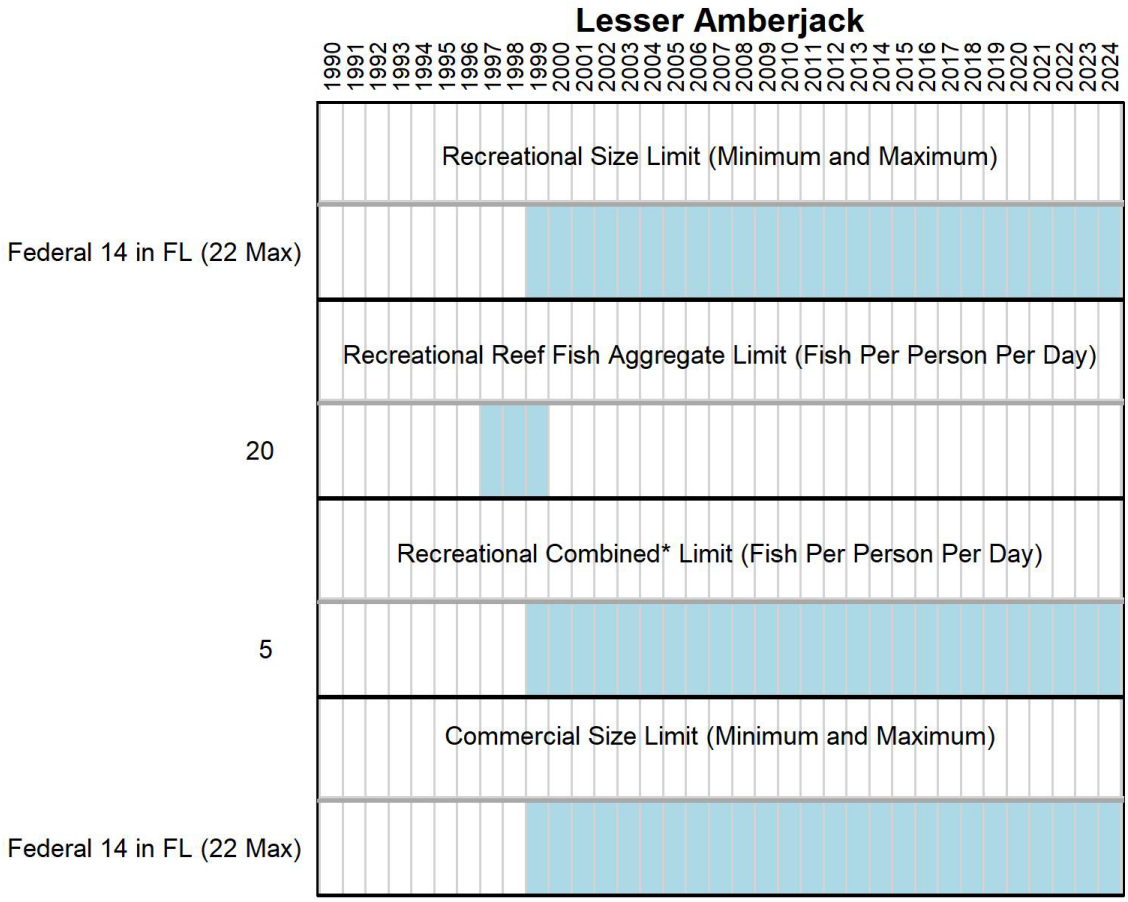

Figure A3. Summary of federal management regulations for Gulf of America Lesser Amberjack. Size limits shown are for inches fork length (in FL). *The combined bag limit consists of Banded Rudderfish and Lesser Amberjack.

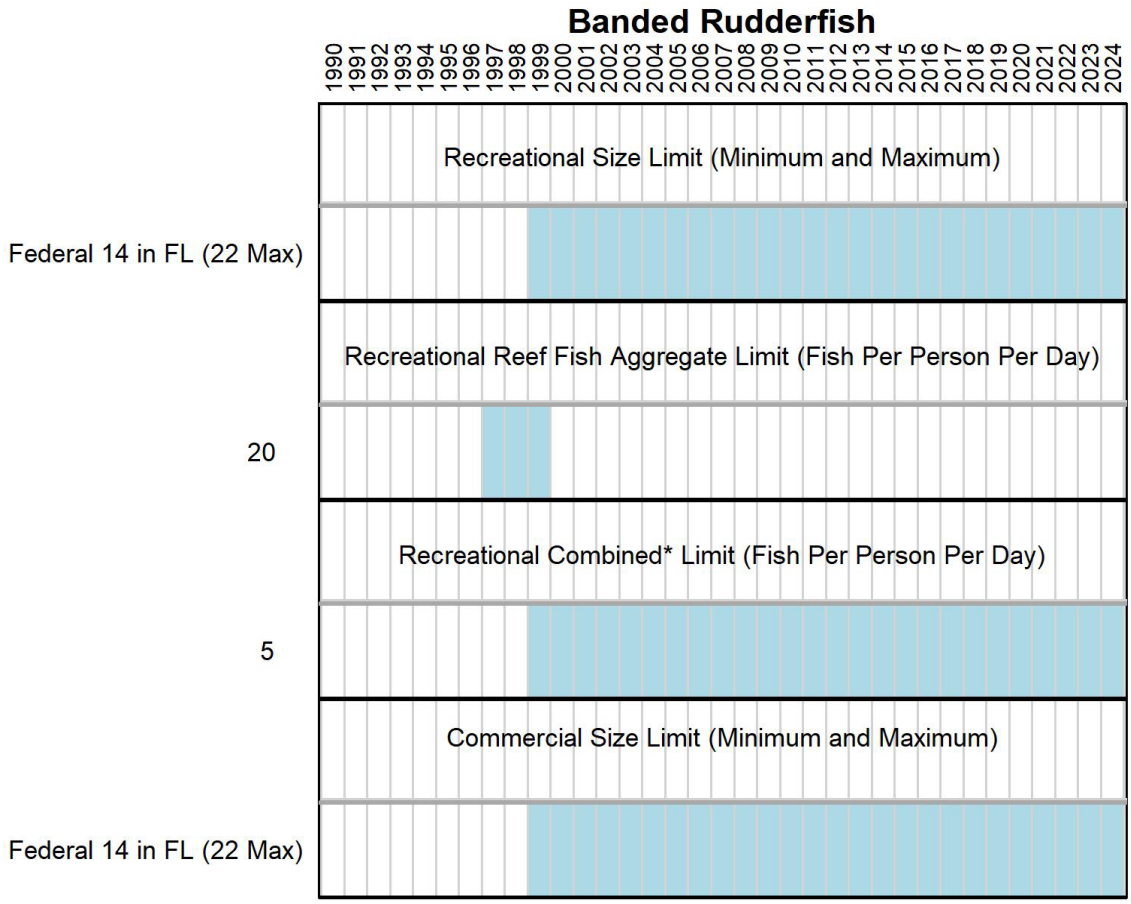

Figure A4. Summary of federal management regulations for Gulf of America Banded Rudderfish. Size limits shown are for inches fork length (in FL). *The combined bag limit consists of Banded Rudderfish and Lesser Amberjack.

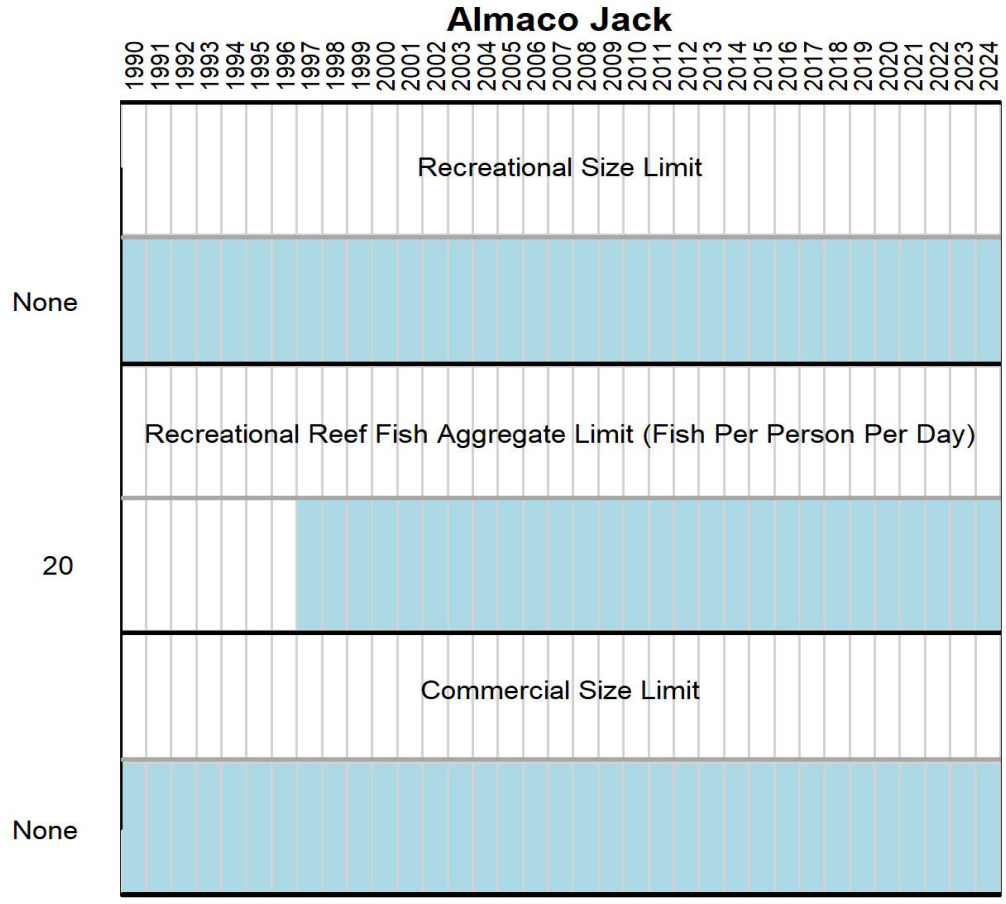

Figure A5. Summary of federal management regulations for Gulf of America Almaco Jack.

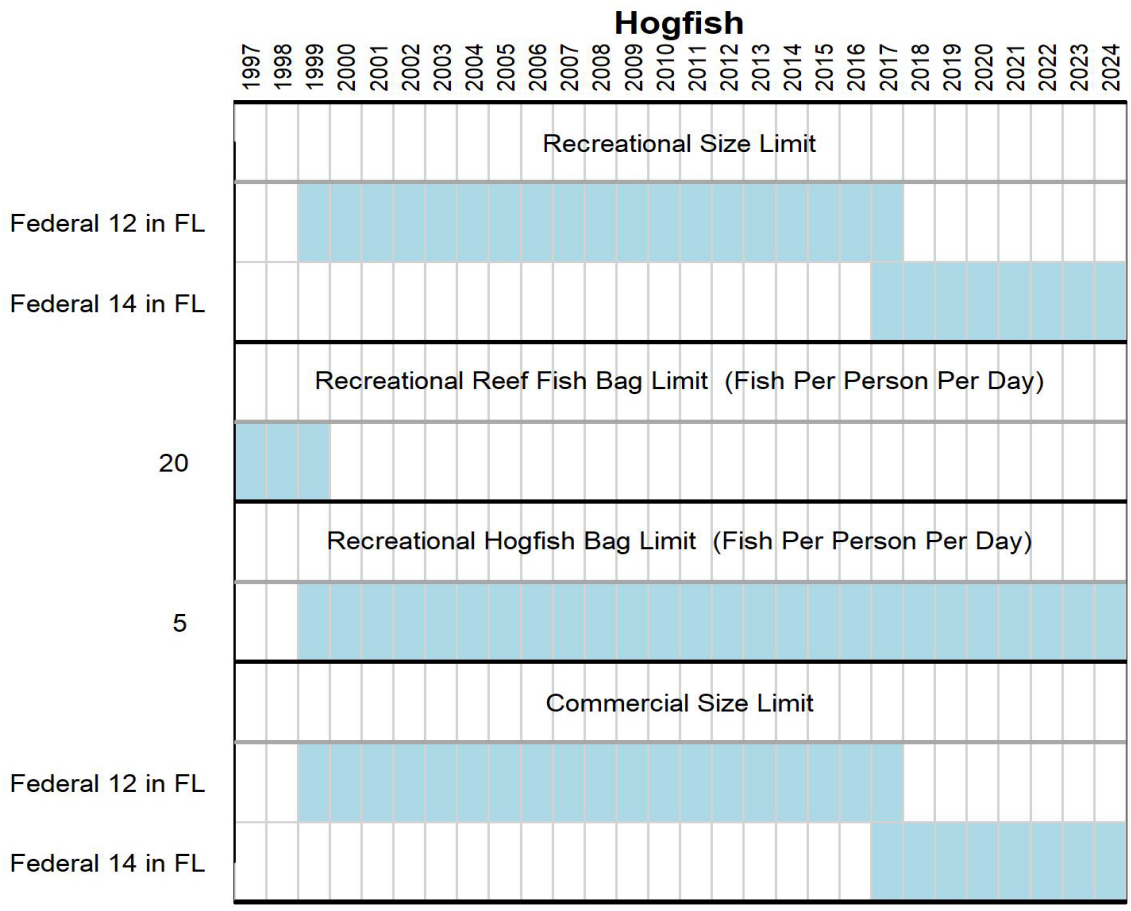

Figure A6. Summary of federal management regulations for Gulf of America Hogfish. Size limits shown are for inches fork length (in FL).

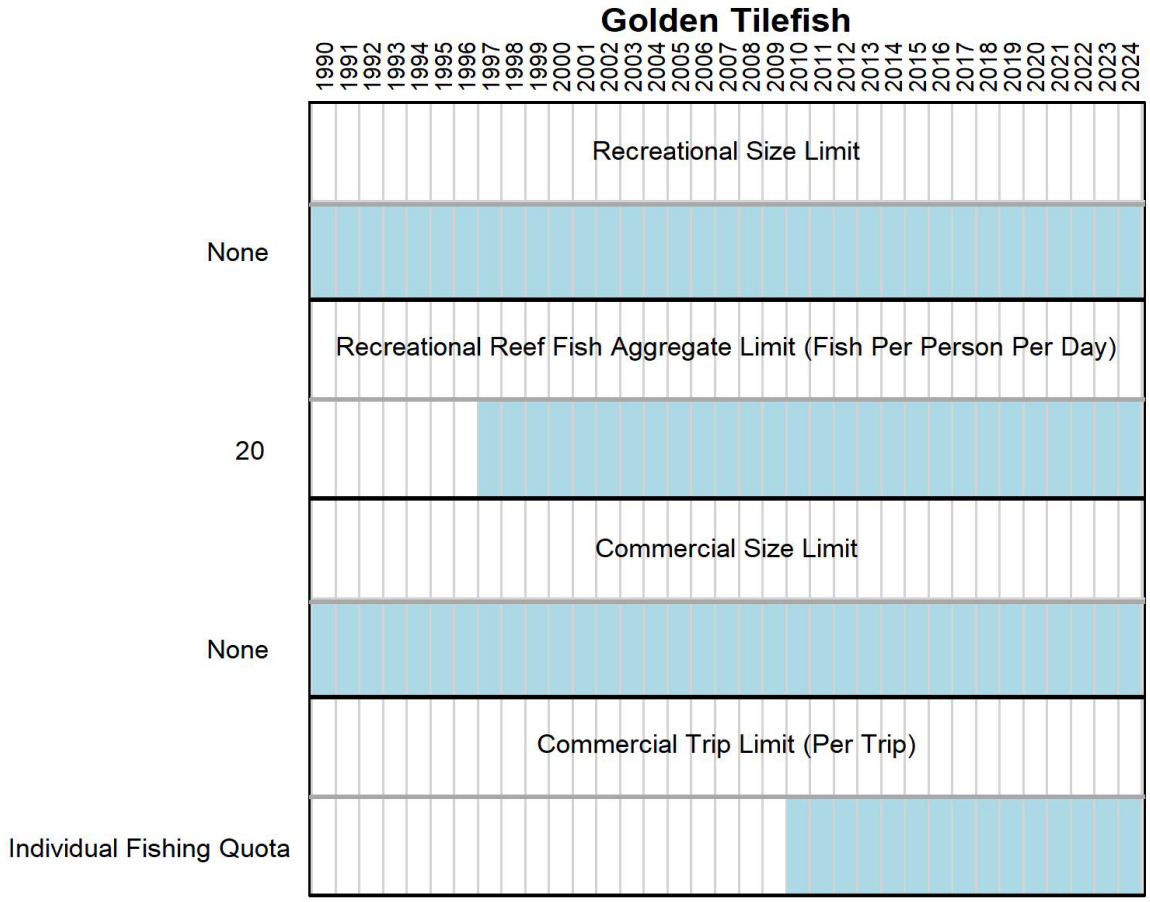

Figure A7. Summary of federal management regulations for Gulf of America Golden Tilefish. Also shown is the implementation of the Grouper-Tilefish Individual Fishing Quota program.

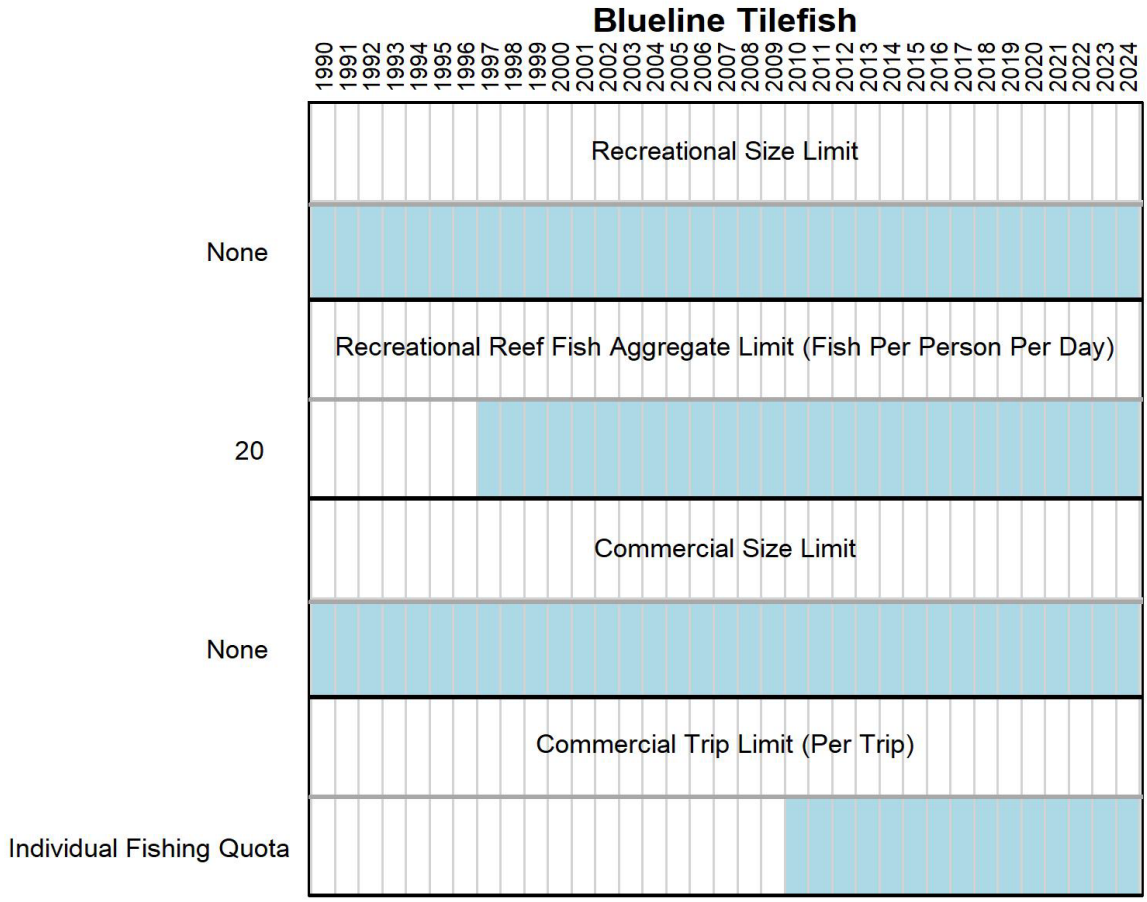

Figure A8. Summary of federal management regulations for Gulf of America Blueline Tilefish. Also shown is the implementation of the Grouper-Tilefish Individual Fishing Quota program.

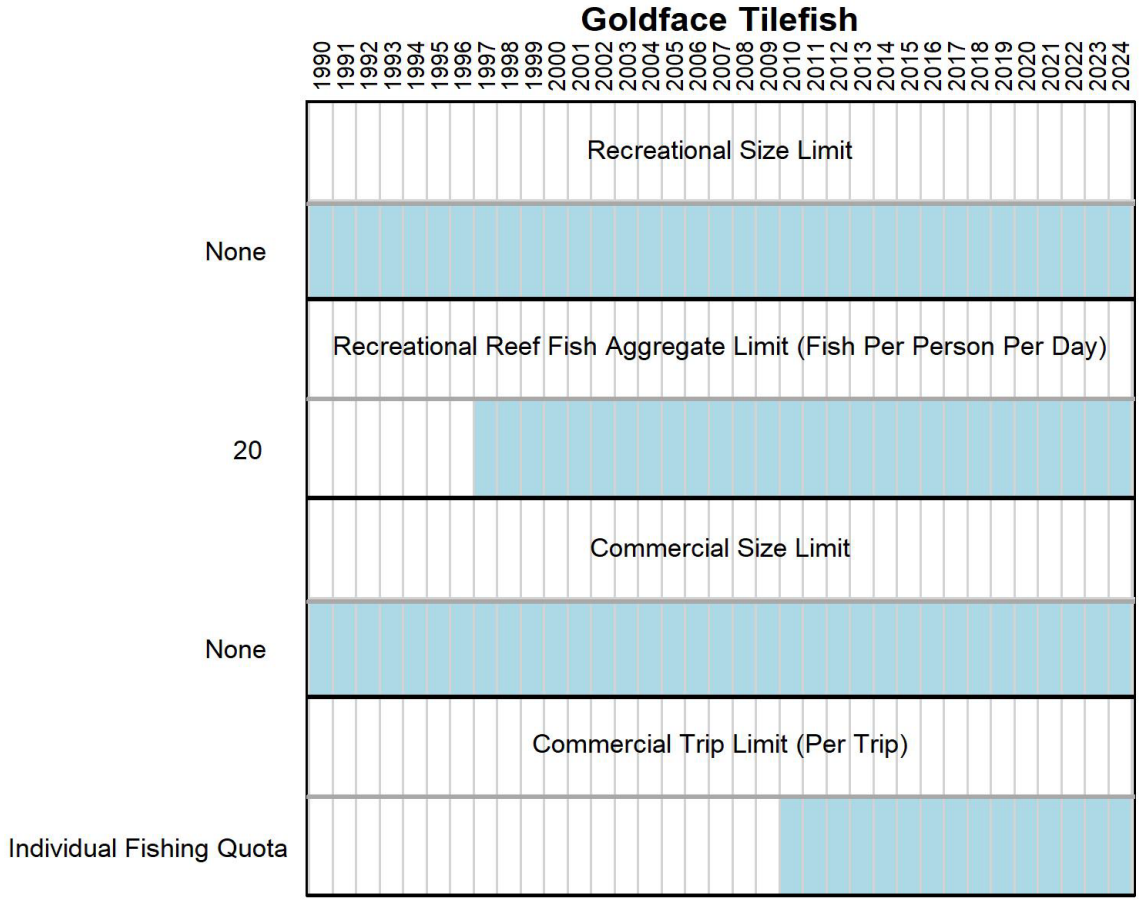

Figure A9. Summary of federal management regulations for Gulf of America Goldface Tilefish. Also shown is the implementation of the Grouper-Tilefish Individual Fishing Quota program.

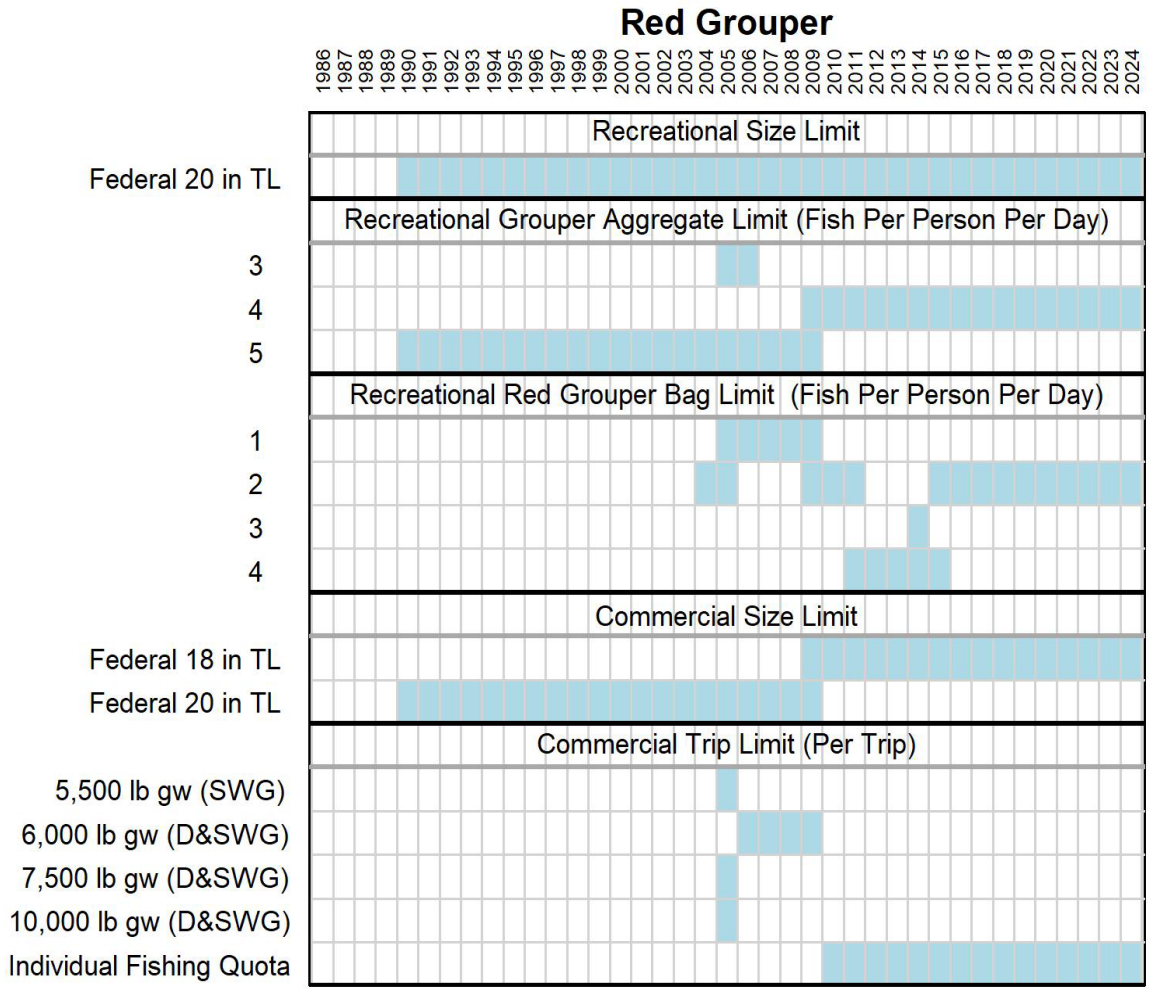

Figure A10. Summary of federal management regulations for Gulf of America Red Grouper. Size limits shown are for inches total length (in TL) and trip limits in pounds gutted weight (lb gw) are shown for either Shallow-Water Grouper (SWG) or Deep- and Shallow-Water Grouper (D&SWG). Also shown is the implementation of the Grouper-Tilefish Individual Fishing Quota program.

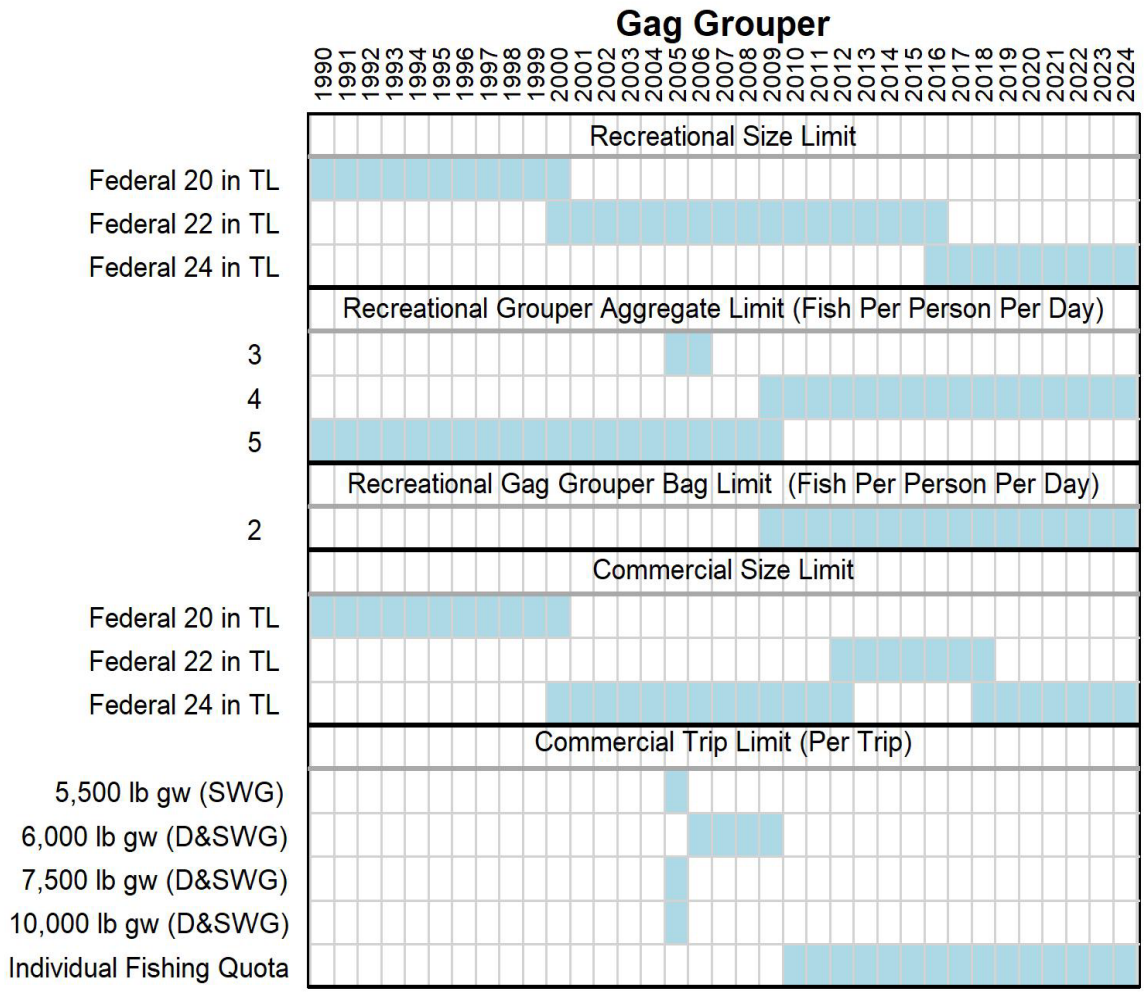

Figure A11. Summary of federal management regulations for Gulf of America Gag Grouper. Size limits shown are for inches total length (in TL) and trip limits in pounds gutted weight (lb gw) are shown for either Shallow-Water Grouper (SWG) or Deep- and Shallow-Water Grouper (D&SWG). Also shown is the implementation of the Grouper-Tilefish Individual Fishing Quota program.

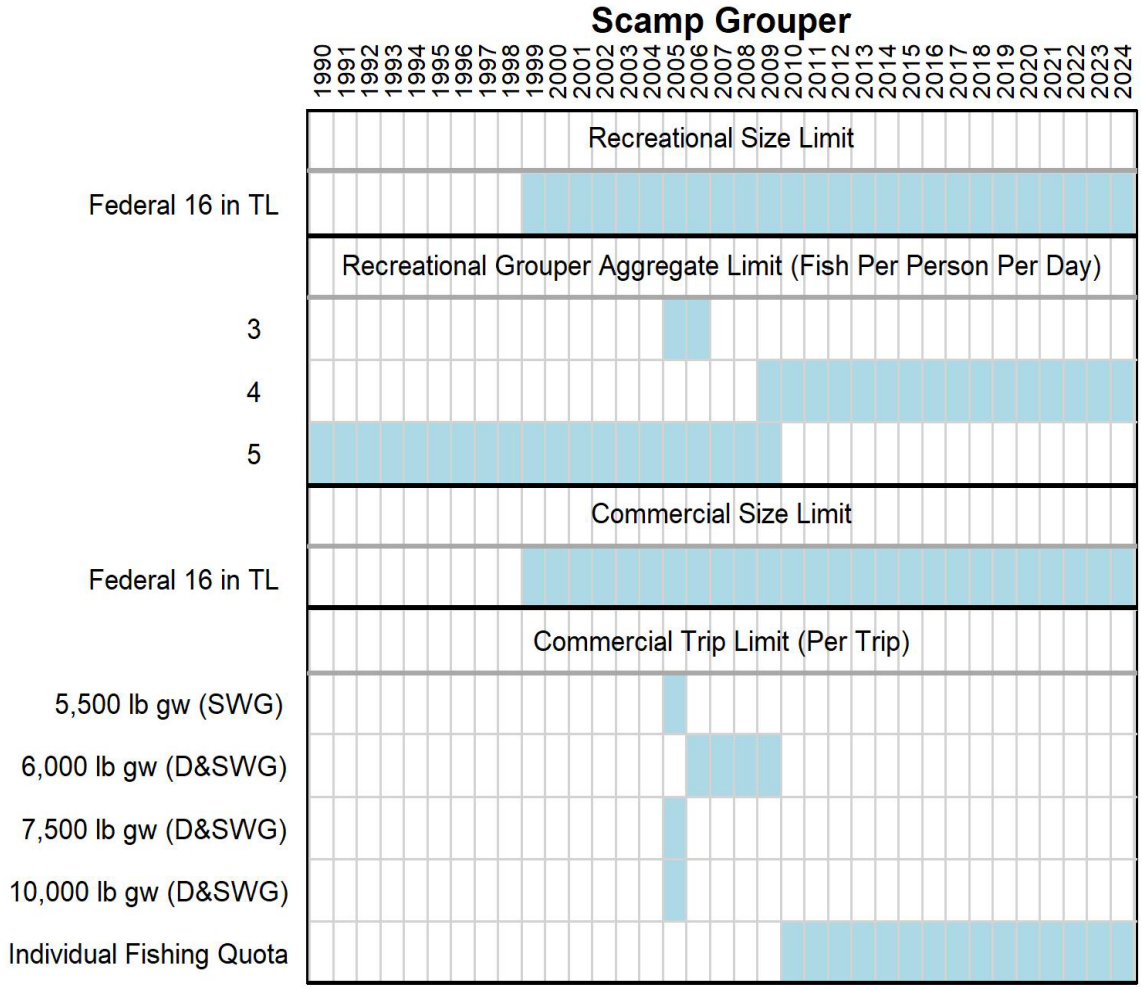

Figure A12. Summary of federal management regulations for Gulf of America Scamp Grouper. Size limits shown are for inches total length (in TL) and trip limits in pounds gutted weight (lb gw) are shown for either Shallow-Water Grouper (SWG) or Deep- and Shallow-Water Grouper (D&SWG). Also shown is the implementation of the Grouper-Tilefish Individual Fishing Quota program.

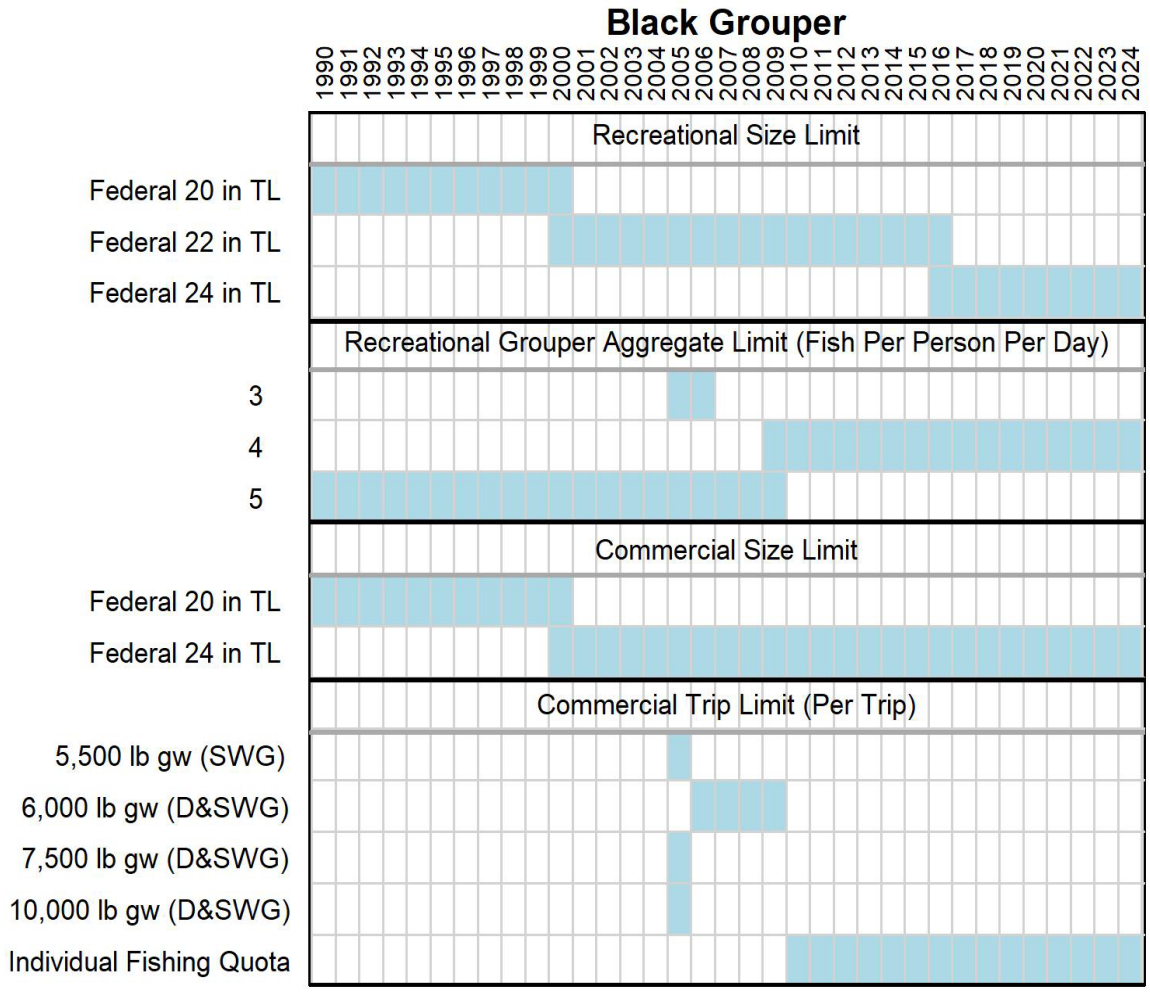

Figure A13. Summary of federal management regulations for Gulf of America Black Grouper. Size limits shown are for inches total length (in TL) and trip limits in pounds gutted weight (lb gw) are shown for either Shallow-Water Grouper (SWG) or Deep- and Shallow-Water Grouper (D&SWG). Also shown is the implementation of the Grouper-Tilefish Individual Fishing Quota program.

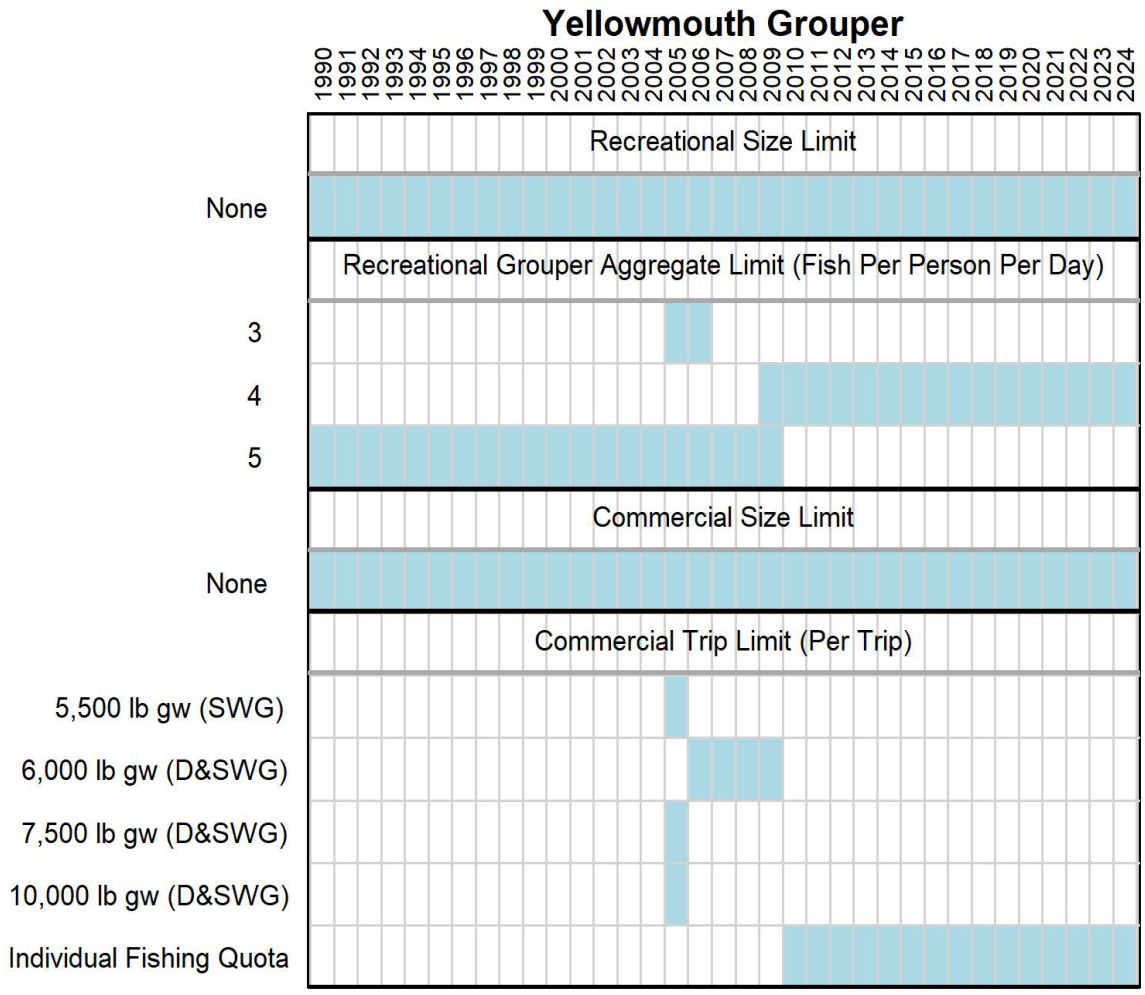

Figure A14. Summary of federal management regulations for Gulf of America Yellowmouth Grouper. Trip limits in pounds gutted weight (lb gw) are shown for either Shallow-Water Grouper (SWG) or Deep- and Shallow-Water Grouper (D&SWG). Also shown is the implementation of the Grouper-Tilefish Individual Fishing Quota program.

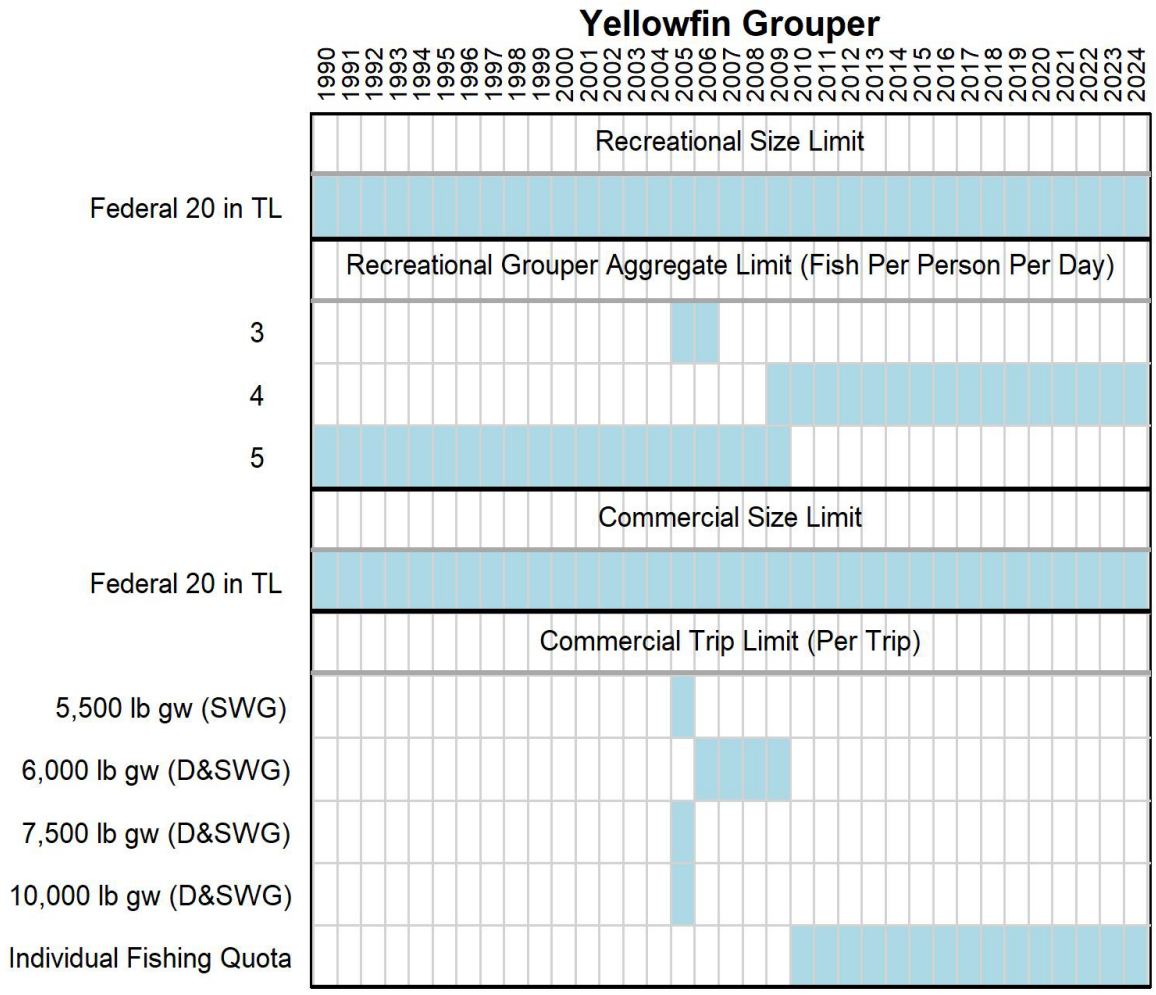

Figure A15. Summary of federal management regulations for Gulf of America Yellowfin Grouper. Size limits shown are for inches total length (in TL) and trip limits in pounds gutted weight (lb gw) are shown for either Shallow-Water Grouper (SWG) or Deep- and Shallow-Water Grouper (D&SWG). Also shown is the implementation of the Grouper-Tilefish Individual Fishing Quota program.

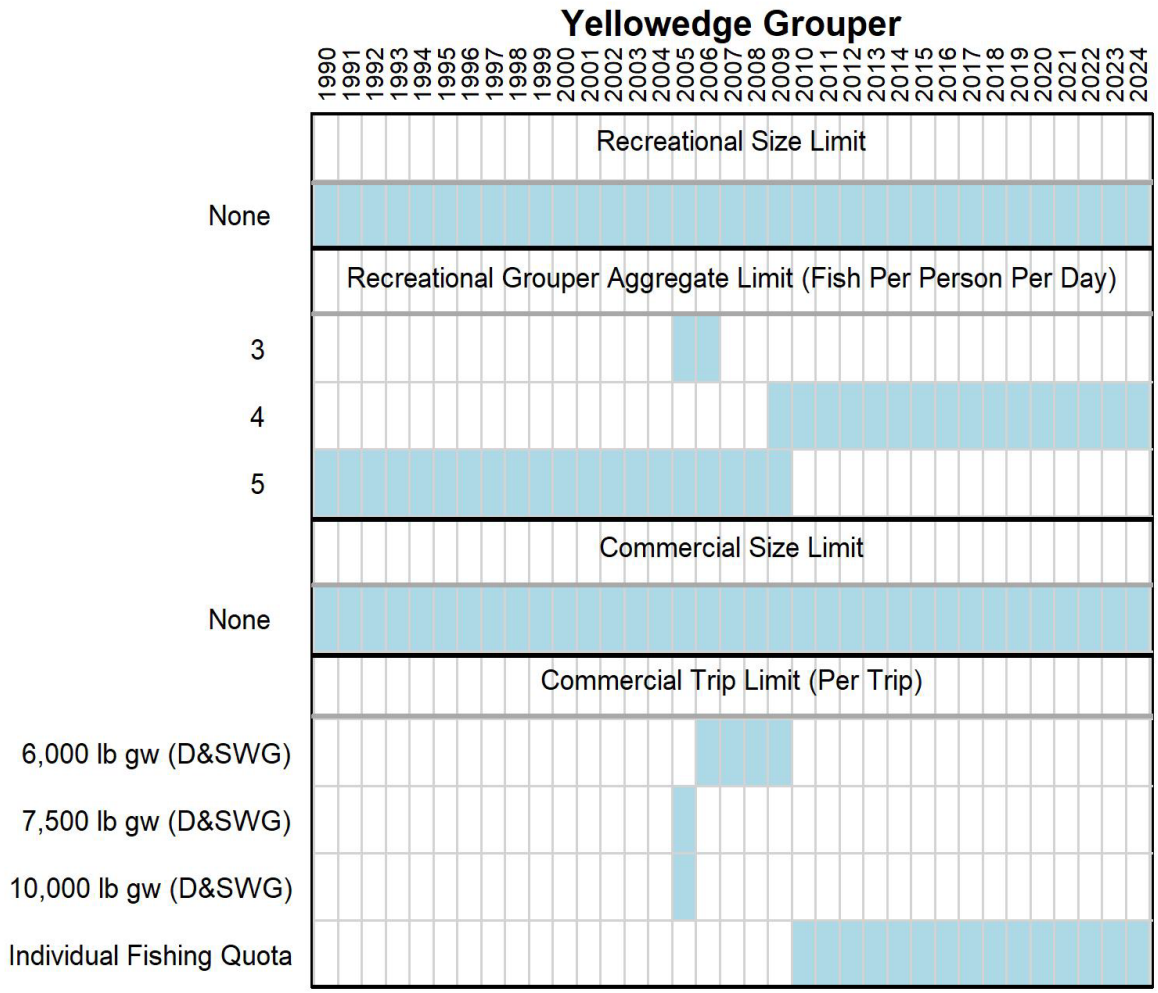

Figure A16. Summary of federal management regulations for Gulf of America Yellowedge Grouper. Trip limits in pounds gutted weight (lb gw) are shown for Deep- and Shallow-Water Grouper (D&SWG). Also shown is the implementation of the Grouper-Tilefish Individual Fishing Quota program.

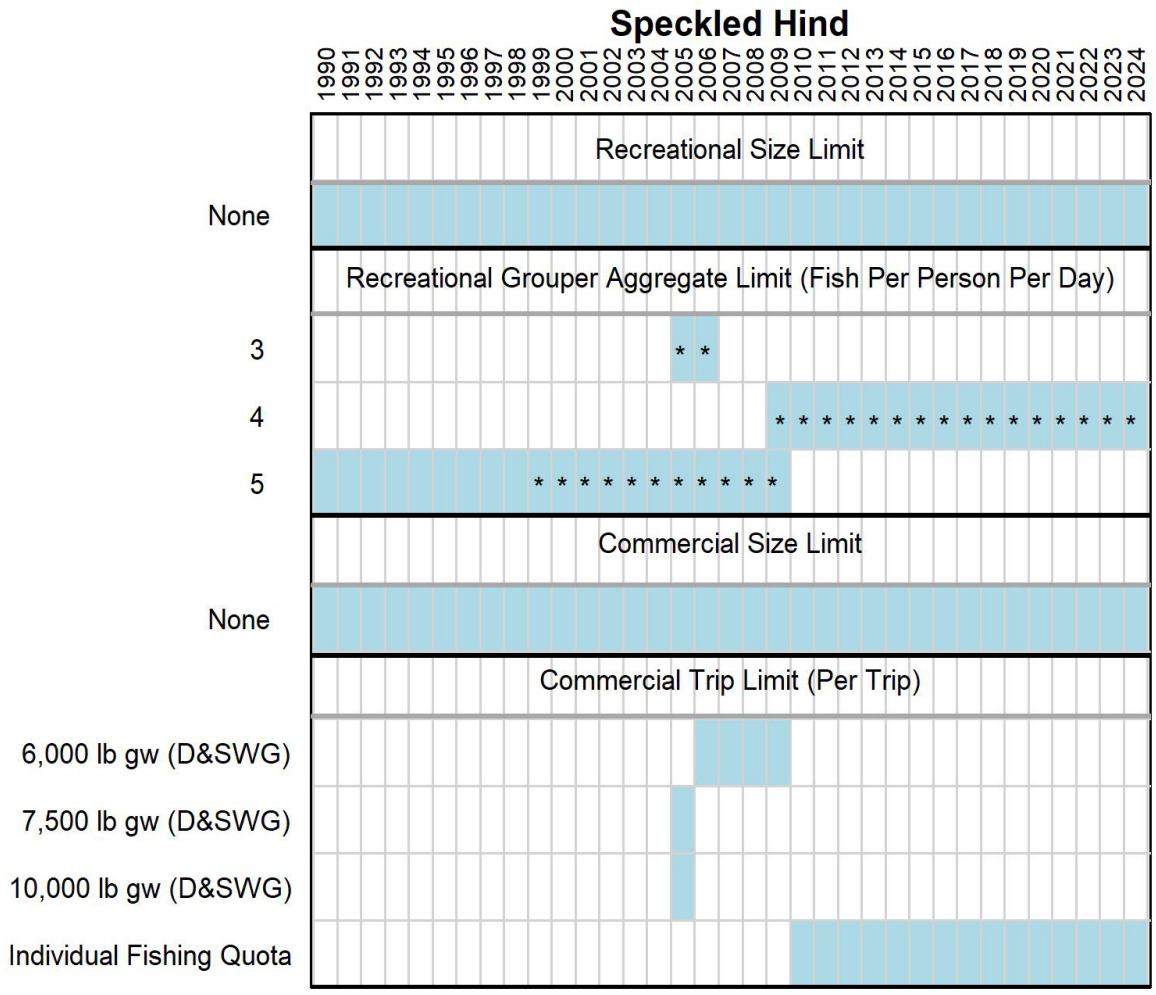

Figure A17. Summary of federal management regulations for Gulf of America Speckled Hind. Trip limits in pounds gutted weight (lb gw) are shown for Deep- and Shallow-Water Grouper (D&SWG). Also shown is the implementation of the Grouper-Tilefish Individual Fishing Quota program. *Note that starting in 1999, the recreational grouper aggregate limit includes a limit of 1 Speckled Hind per vessel per day (64 FR 57403).

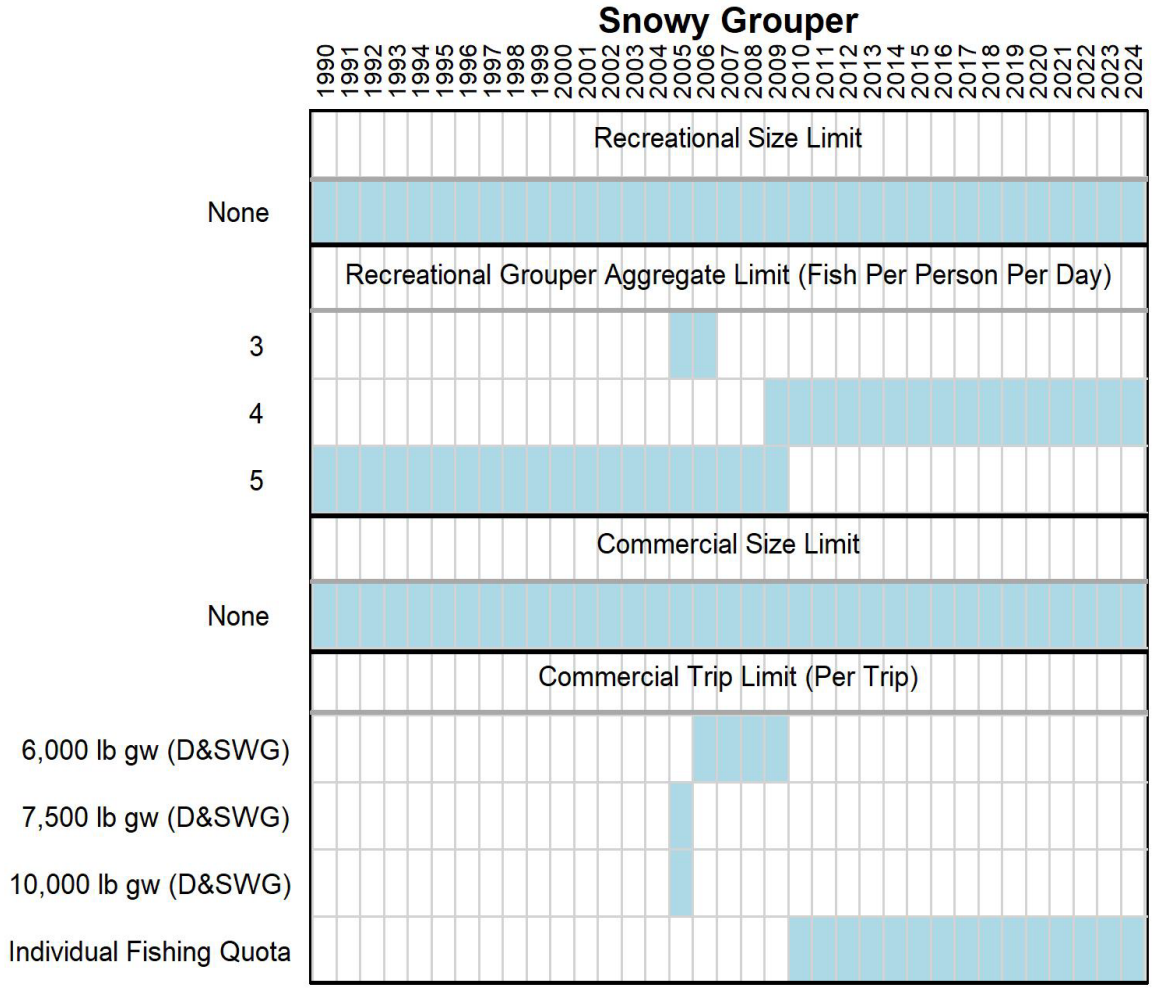

Figure A18. Summary of federal management regulations for Gulf of America Snowy Grouper. Trip limits in pounds gutted weight (lb gw) are shown for Deep- and Shallow-Water Grouper (D&SWG). Also shown is the implementation of the Grouper-Tilefish Individual Fishing Quota program.

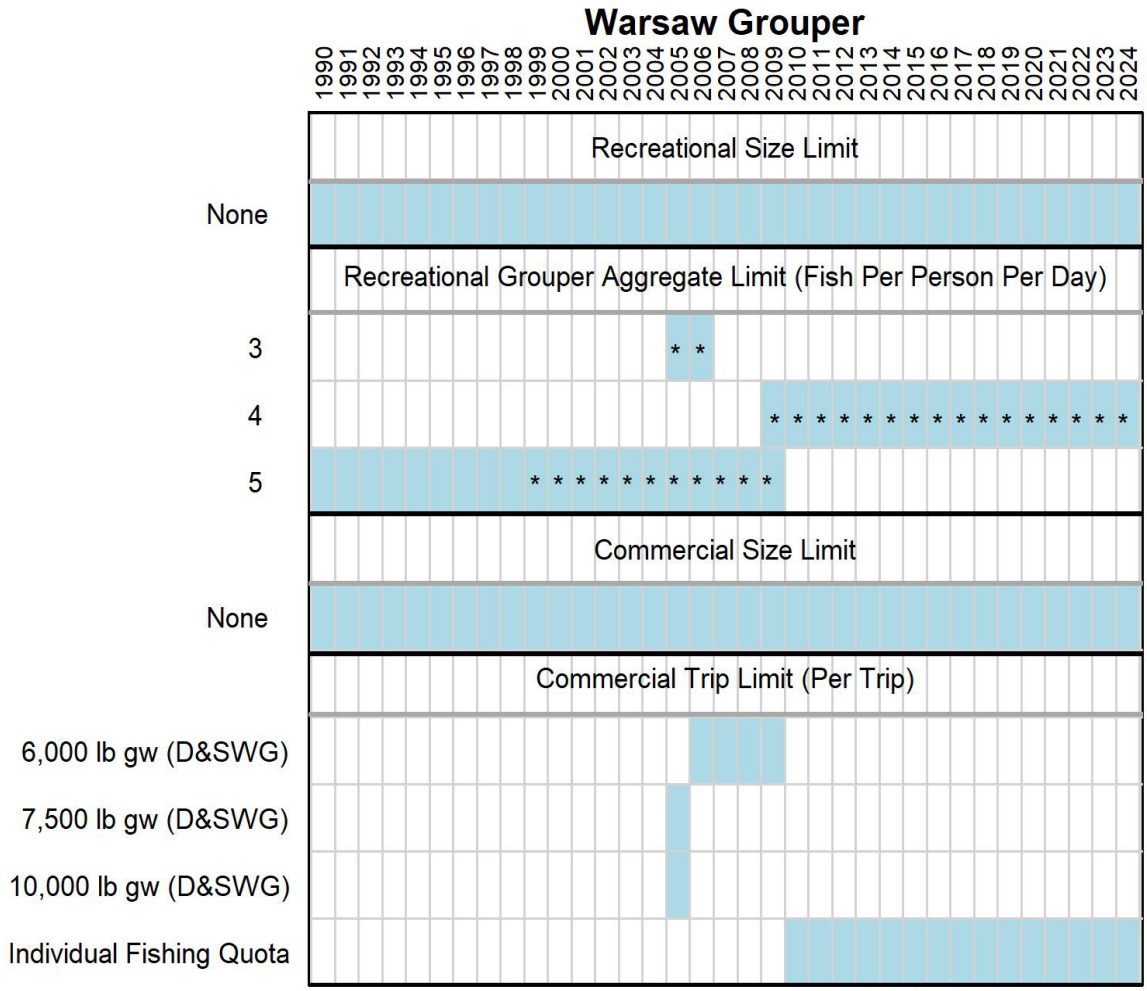

Figure A19. Summary of federal management regulations for Gulf of America Warsaw Grouper. Trip limits in pounds gutted weight (lb gw) are shown for Deep- and Shallow-Water Grouper (D&SWG). Also shown is the implementation of the Grouper-Tilefish Individual Fishing Quota program. *Note that starting in 1999, the recreational grouper aggregate limit includes a limit of 1 Warsaw Grouper per vessel per day (64 FR 57403).

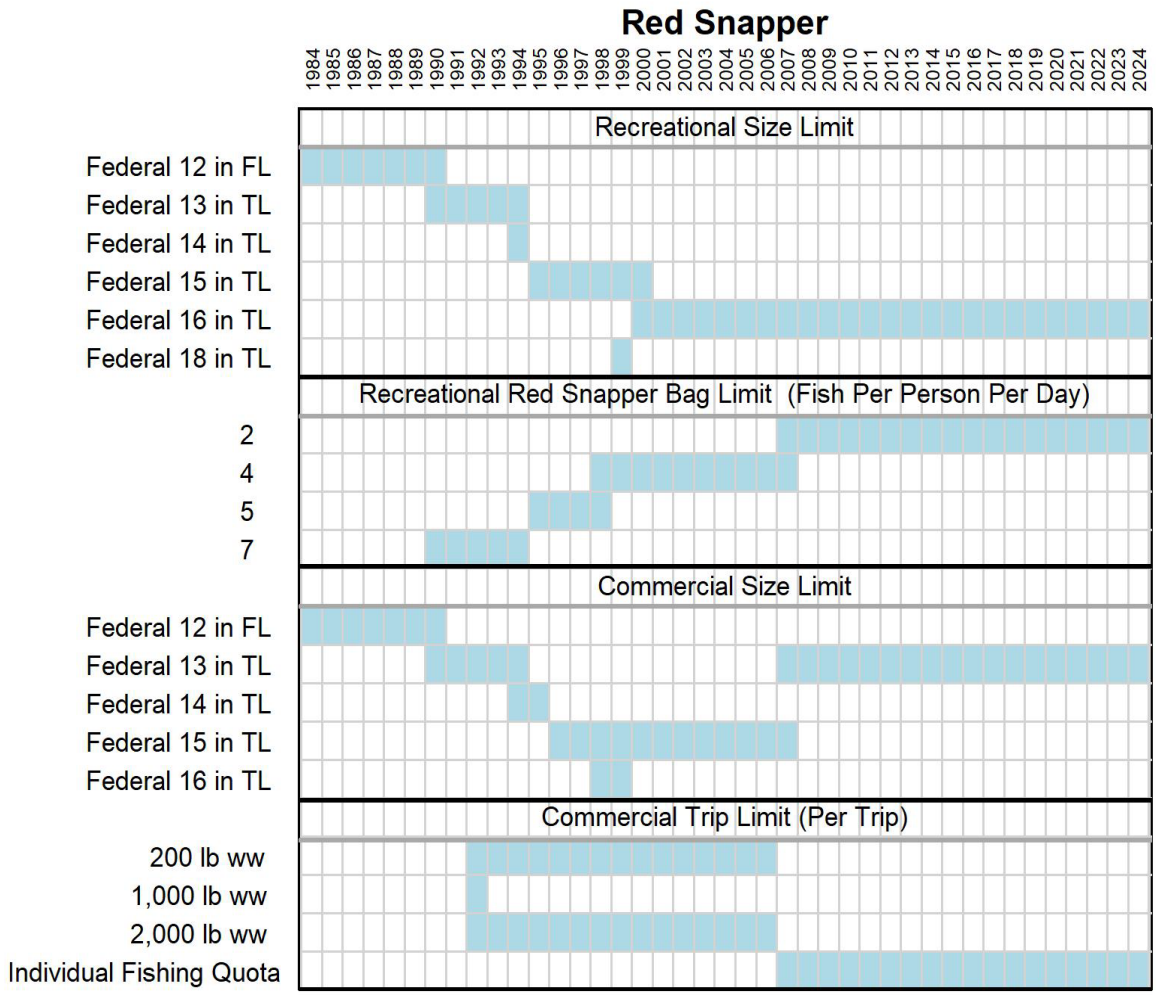

Figure A20. Summary of federal management regulations for Gulf of America Red Snapper. Size limits shown are for inches fork length (in FL) or total length (in TL) and trip limits are in pounds whole weight (lb ww). Also shown is the implementation of the Red Snapper Individual Fishing Quota program.

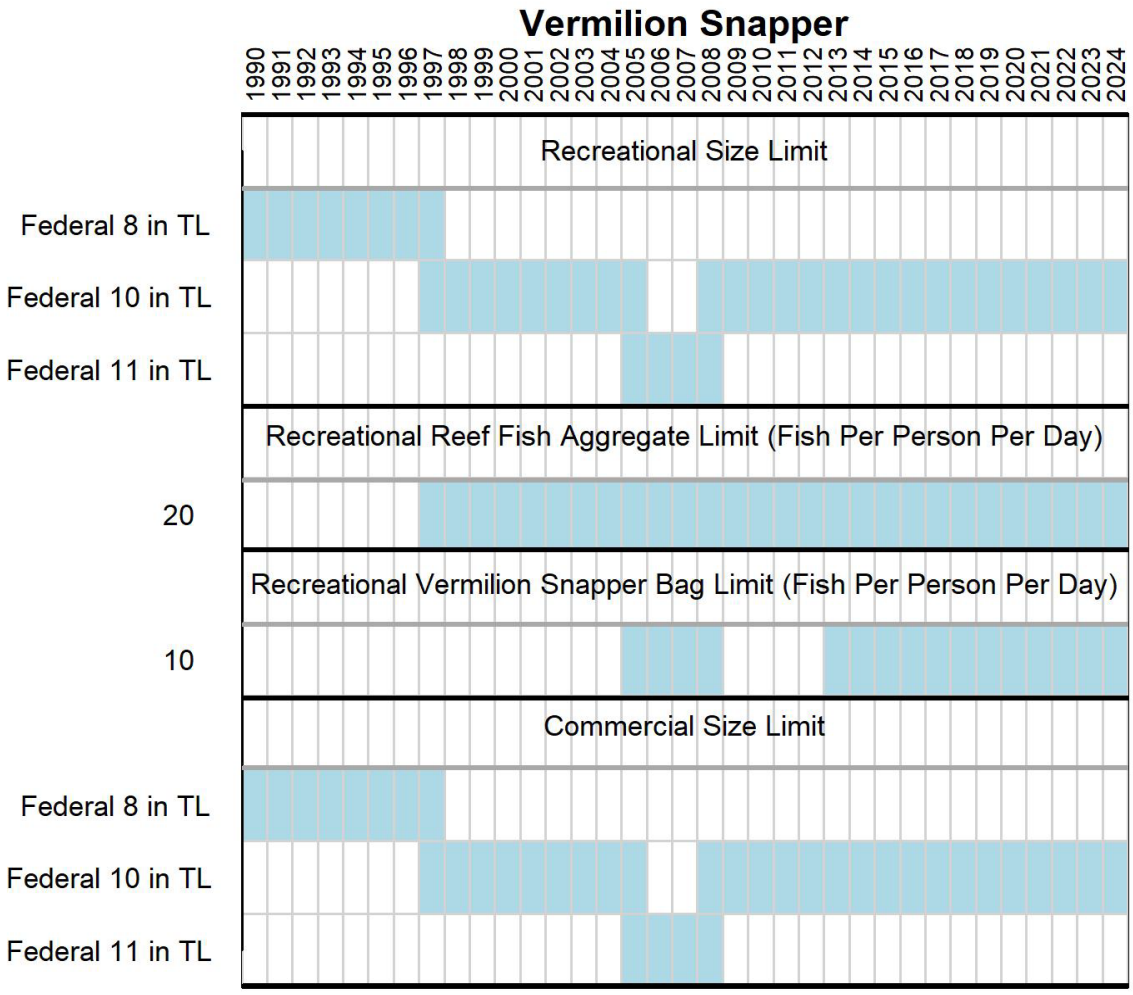

Figure A21. Summary of federal management regulations for Gulf of America Vermilion Snapper. Size limits shown are for inches total length (in TL).

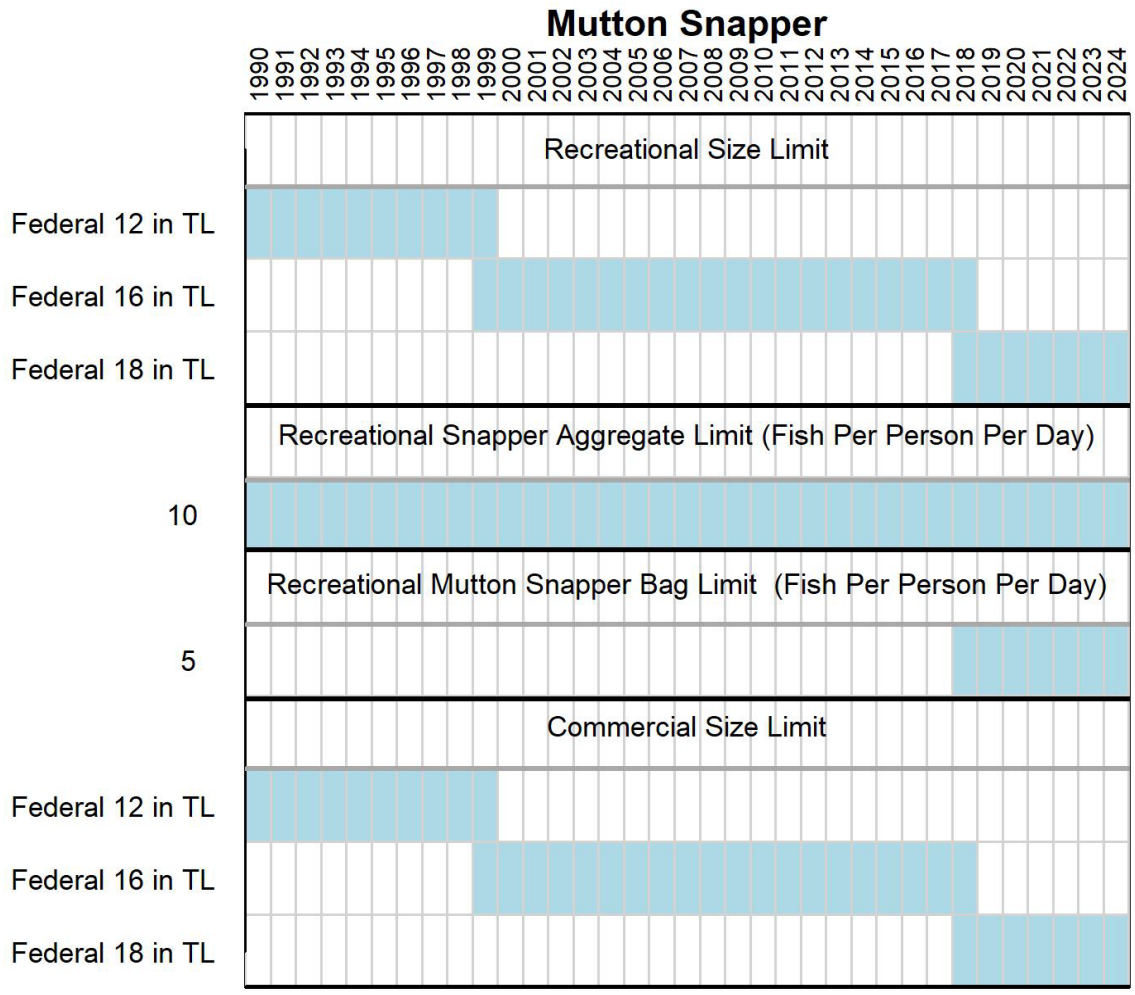

Figure A22. Summary of federal management regulations for Gulf of America Mutton Snapper. Size limits shown are for inches total length (in TL).

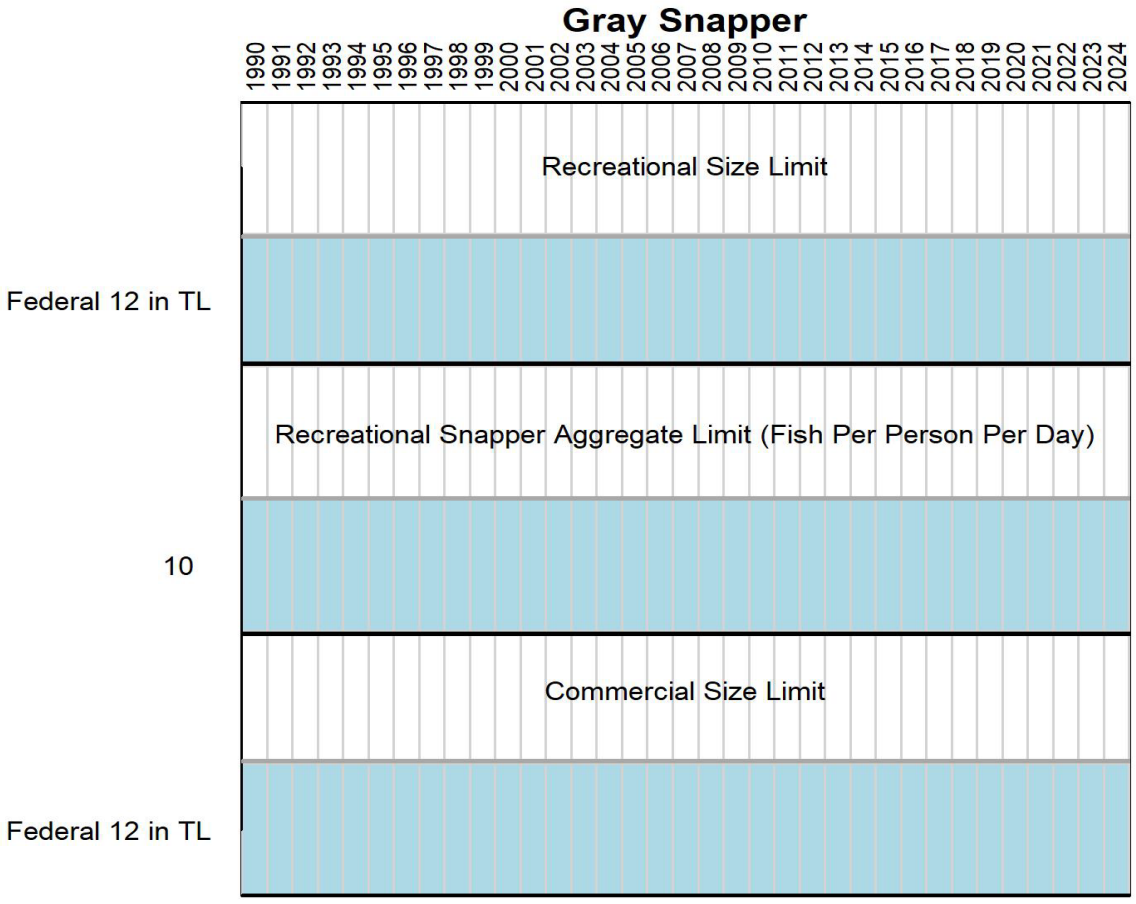

Figure A23. Summary of federal management regulations for Gulf of America Gray Snapper. Size limits shown are for inches total length (in TL).

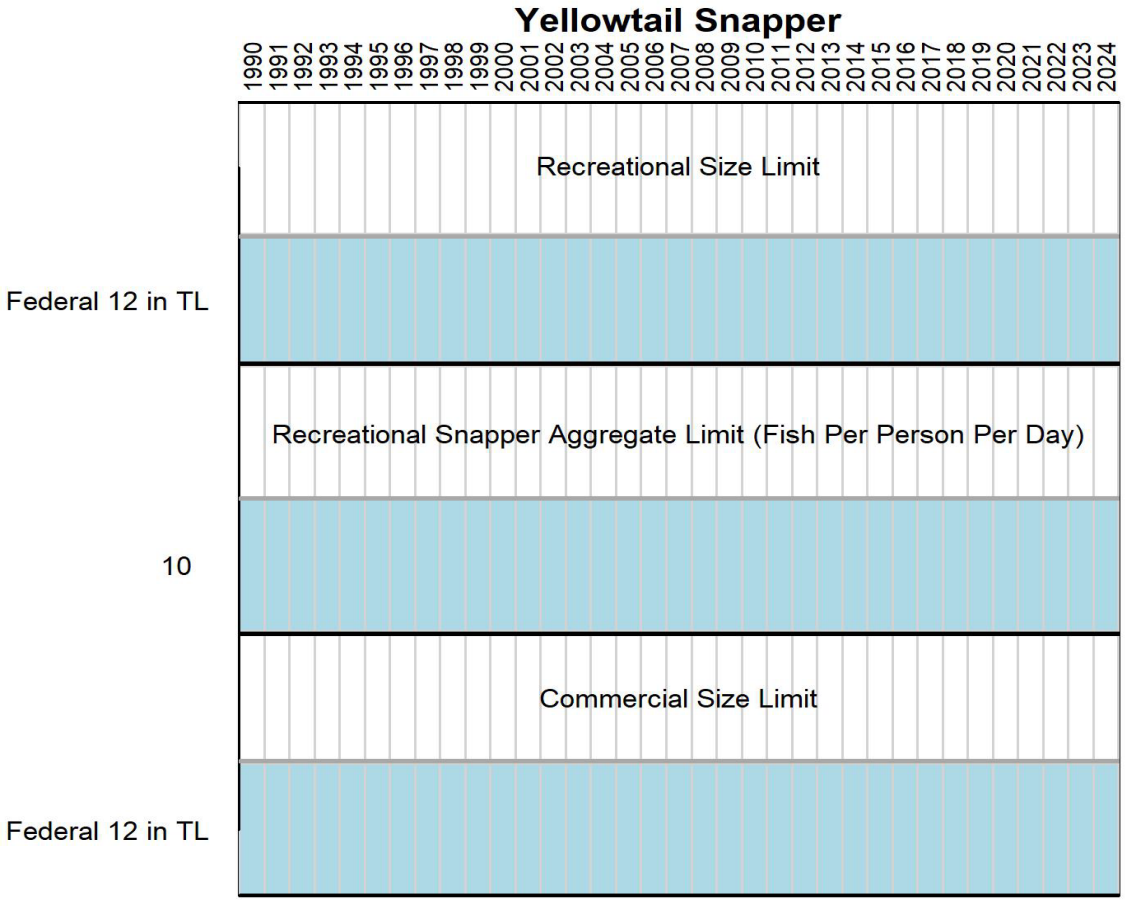

Figure A24. Summary of federal management regulations for Gulf of America Yellowtail Snapper. Size limits shown are for inches total length (TL).

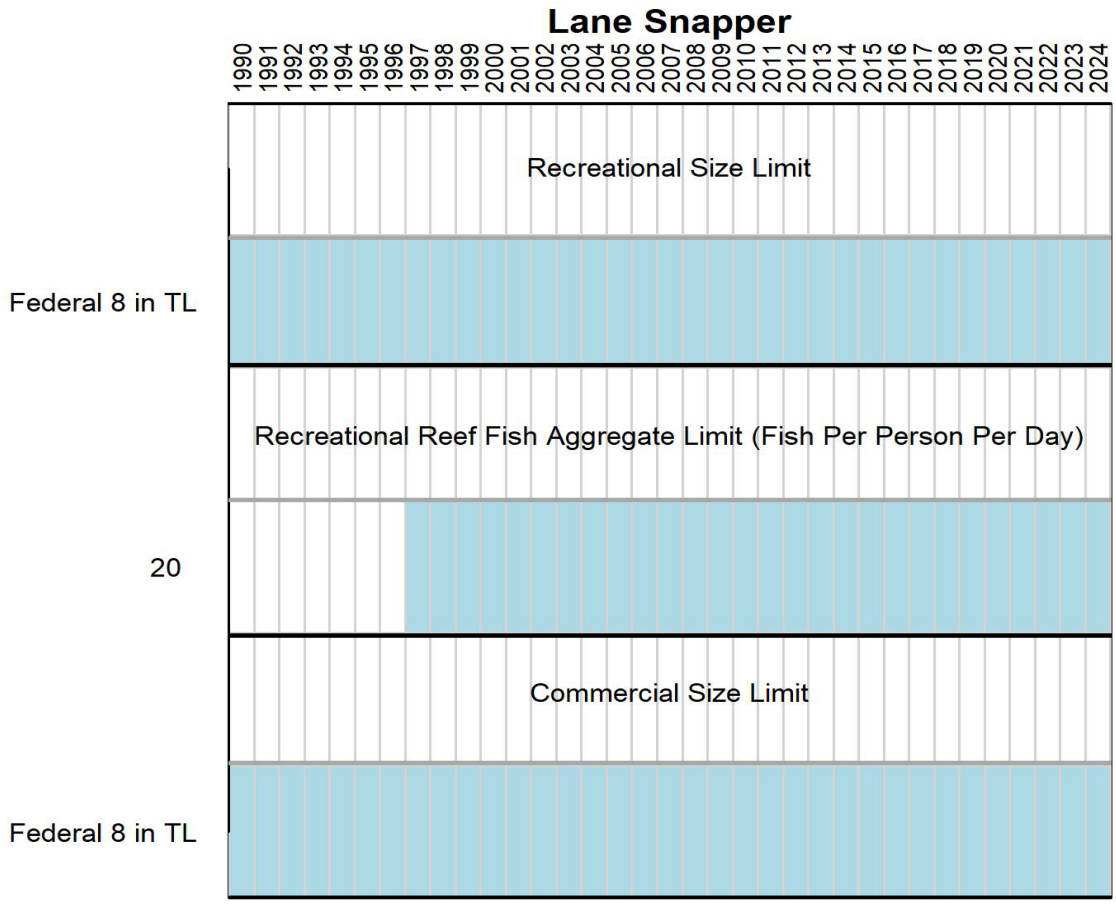

Figure A25. Summary of federal management regulations for Gulf of America Lane Snapper. Size limits shown are for inches total length (in TL).

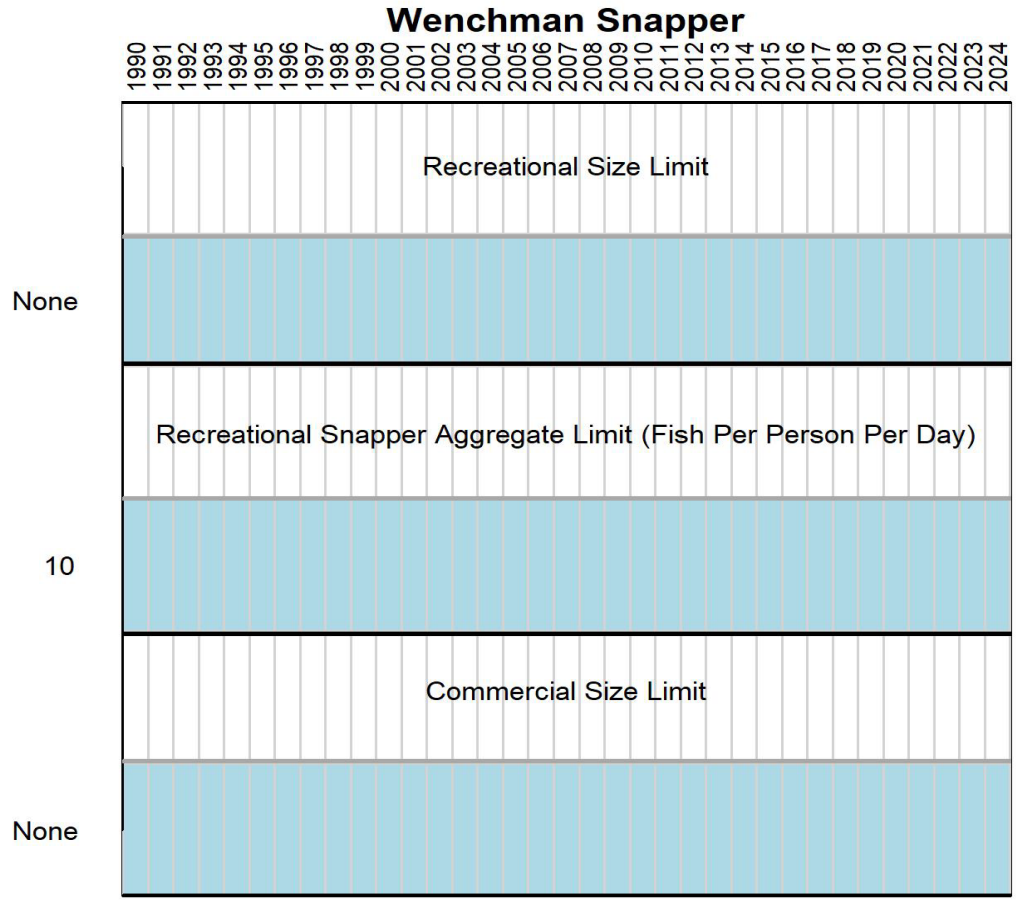

Figure A26. Summary of federal management regulations for Gulf of America Wenchman Snapper.

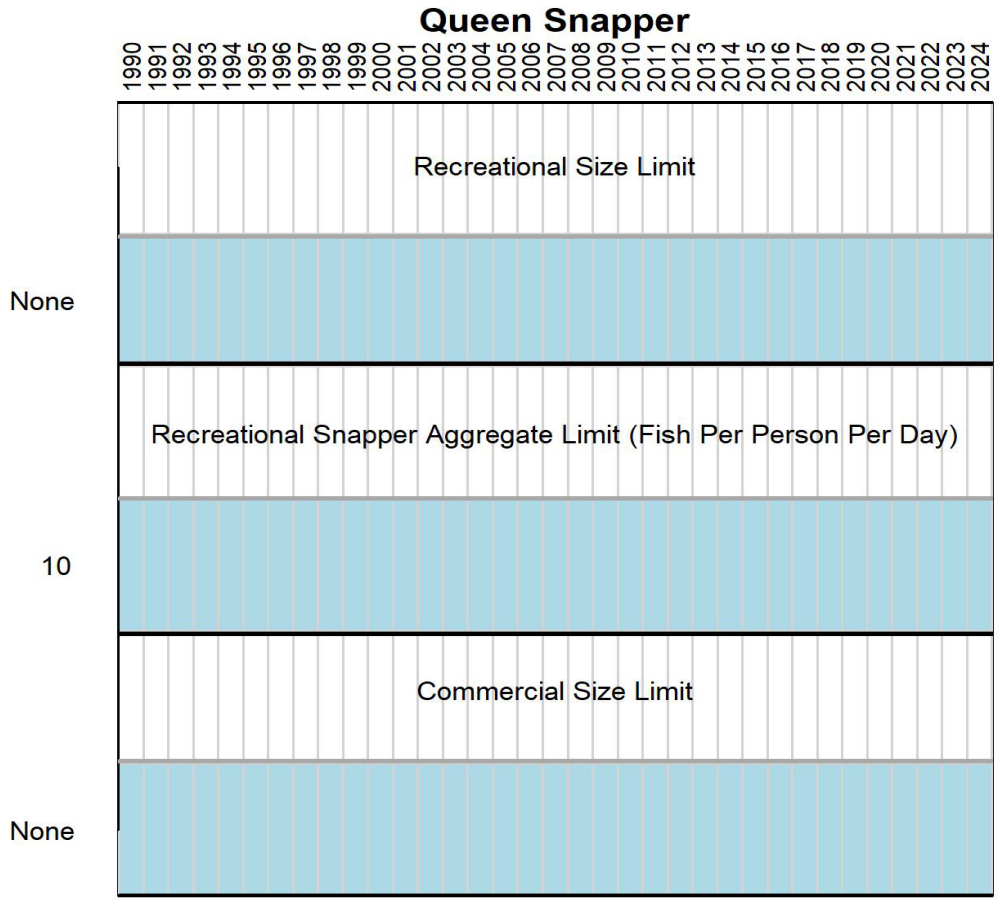

Figure A27. Summary of federal management regulations for Gulf of America Queen Snapper.

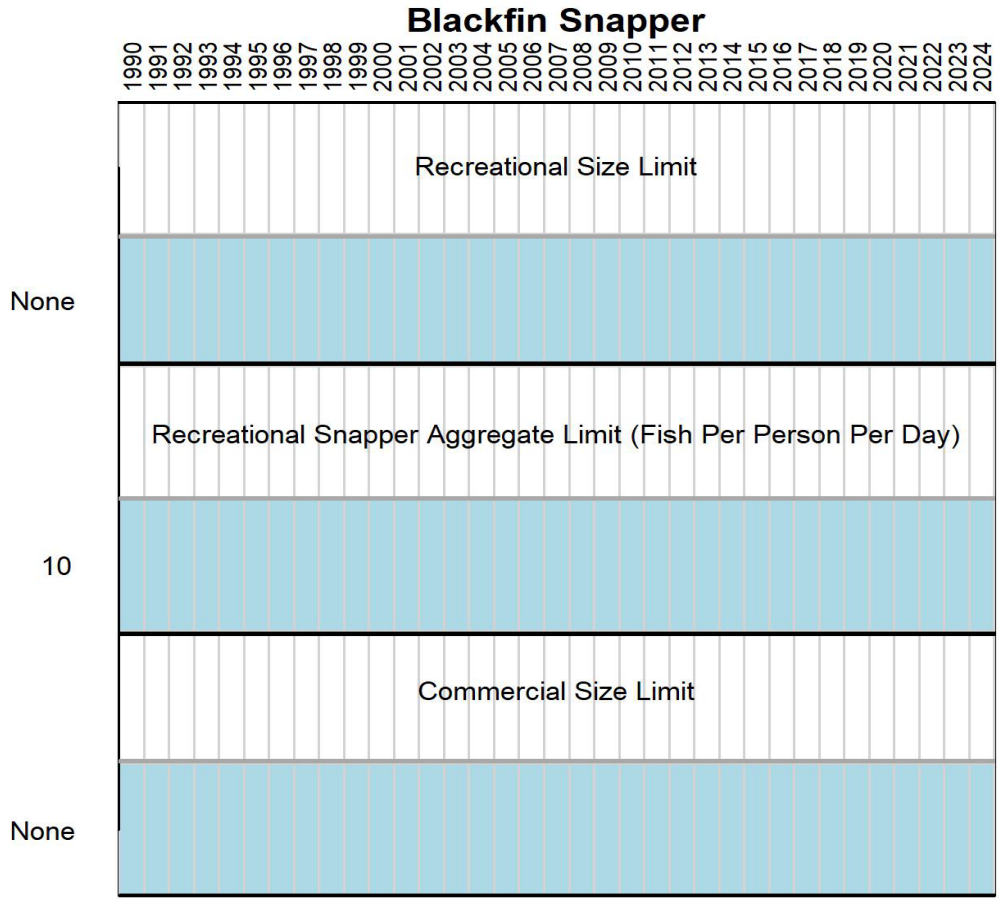

Figure A28. Summary of federal management regulations for Gulf of America Blackfin Snapper.

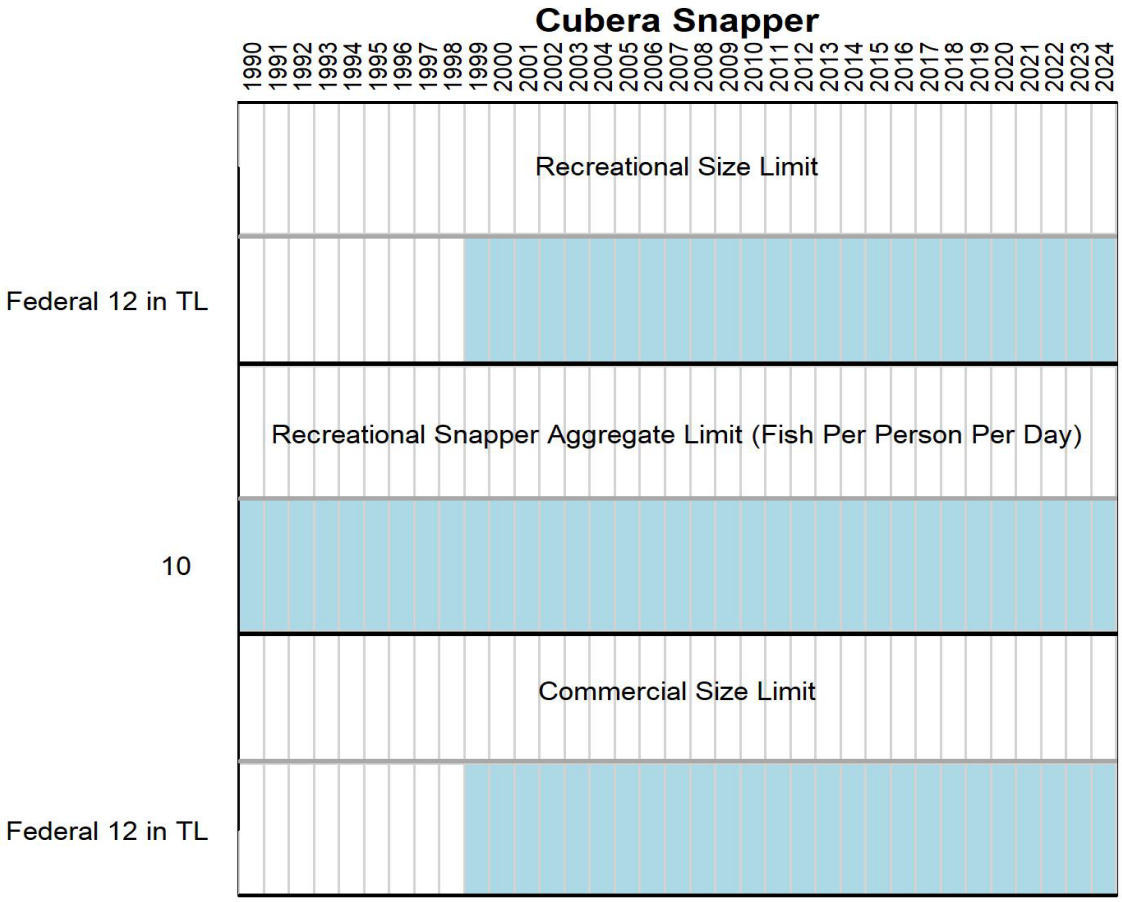

Figure A29. Summary of federal management regulations for Gulf of America Cubera Snapper. Size limits shown are for inches total length (in TL).

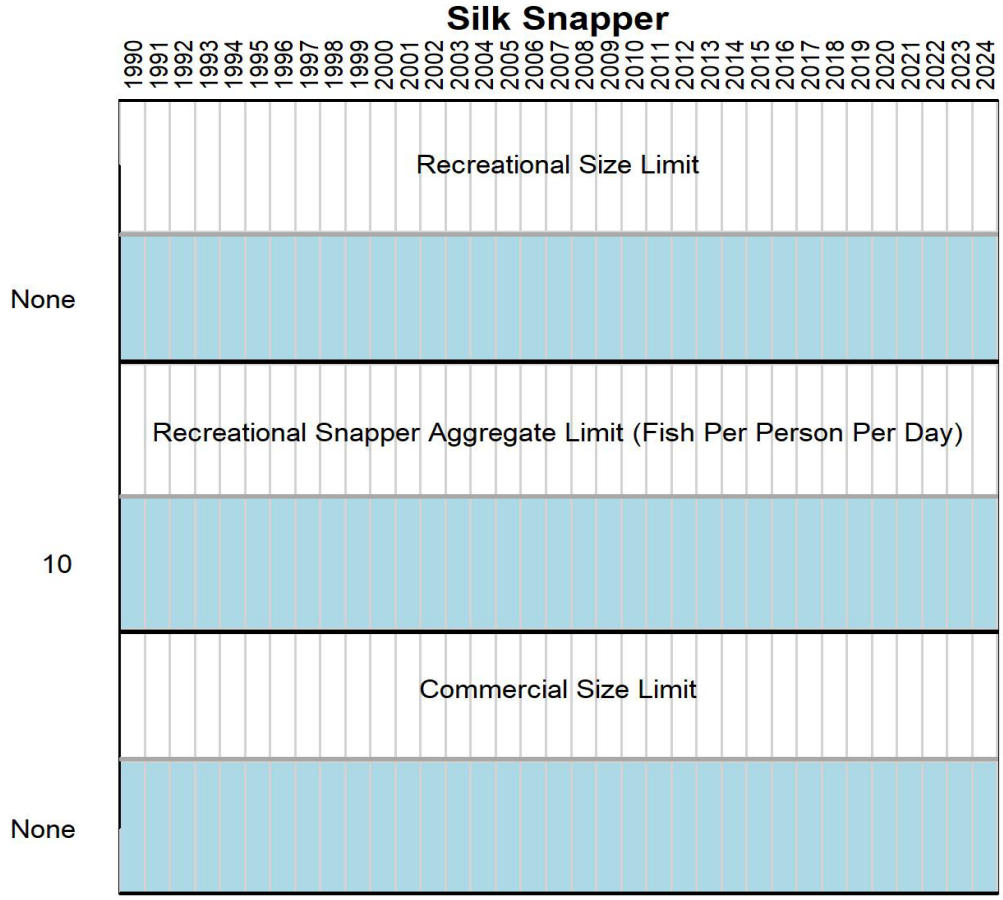

Figure A30. Summary of federal management regulations for Gulf of America Silk Snapper.

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